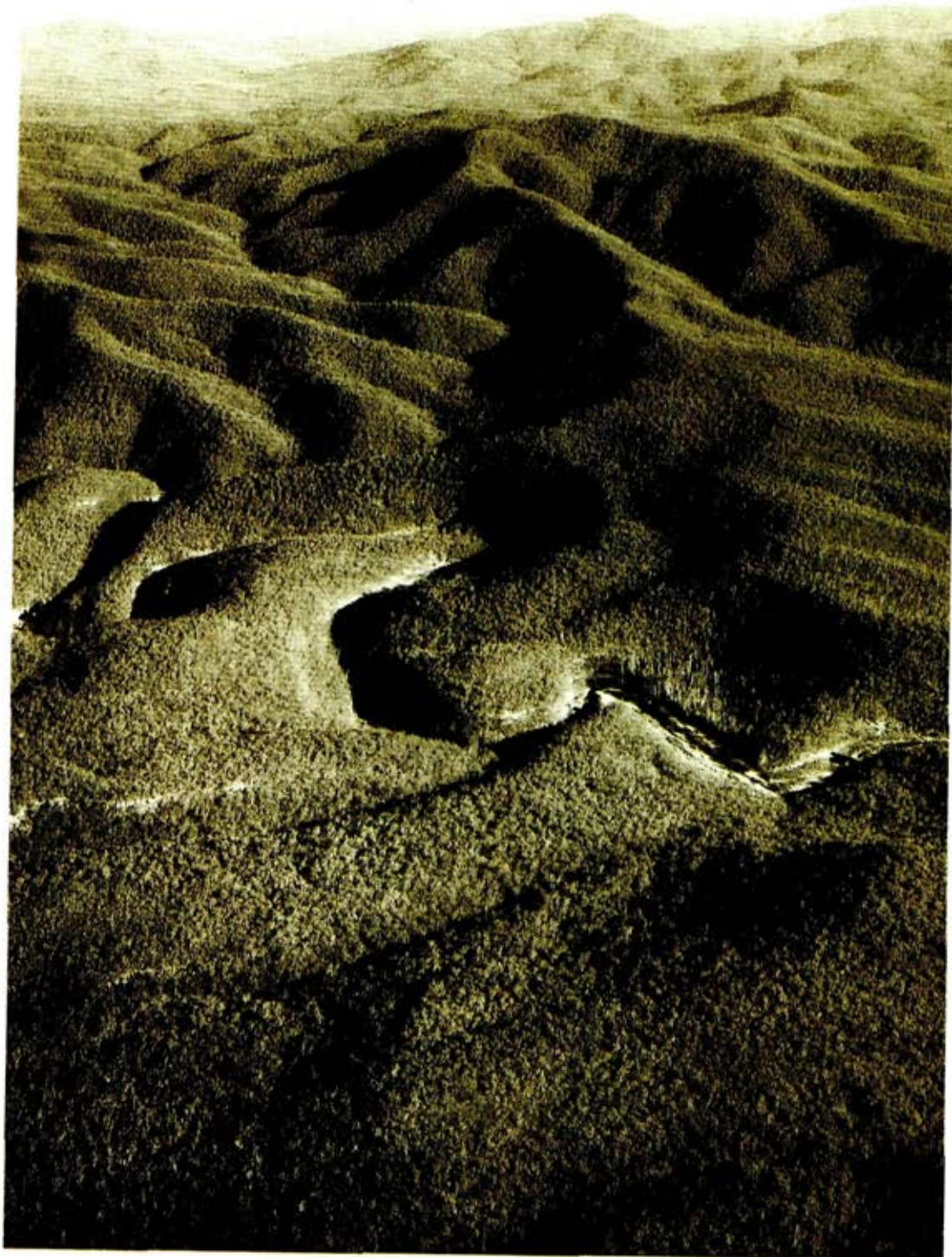


EAST GIPPSLAND AREA

REVIEW



LCC LAND CONSERVATION COUNCIL



LAND CONSERVATION COUNCIL

Government of Victoria

Fourth Floor, 464 St. Kilda Rd. Melbourne, Victoria 3004

Phone: (03) 267 1311

SUBMISSIONS AND ISSUES

This report is published to allow all who are interested in the use of public land the opportunity to comment by making written submissions to the Land Conservation Council.

All such submissions must reach the Secretary no later than Monday 28 October 1985. These submissions will be considered by the Council before proposed recommendations are made on the use of public land in the study area. It is suggested that persons wishing to make a confidential submission, should first contact the Chairman of the Land Conservation Council.

The Council anticipates that submissions will cover many aspects of public land use in East Gippsland and may include general issues as well as specific details of land use.

It is apparent that there are some issues that concern many Victorians while others are of greater interest to the local community. The following is simply a listing of issues without any attempt to identify differing views (see over). It does not purport to be complete but is offered merely to provide a focus on what appear to be major points of discussion. Comment on any other matter is of course encouraged and will be welcomed by the Council.

In addition to written submissions, David Scott, the Chairman of the Council, and other Council officers will be available for meetings in Mallacoota and Orbost as well as Melbourne. Any people wishing to arrange a meeting in Mallacoota on Monday or Tuesday 9 and 10 September 1985 or Orbost on Wednesday or Thursday 11 and 12 September 1985 should contact the Shire of Orbost (051) 54-1088.

G. Blackman
Acting Secretary
Land Conservation Council

(for listing of issues,
see over)

LISTING OF ISSUES

1. Operation of the timber industry in East Gippsland over the next 25 years.
2. Security of tenure for access to timber resources on public land.
3. Pulpwood harvesting in East Gippsland.
4. Integrated harvesting in East Gippsland.
5. Forest management prescriptions.
6. Clearfelling and other methods of harvesting and regenerating forests.
7. Regional sustained yield.
8. Location, nature and extent of parks and other reserves.
9. Protection of rare and/or endangered plants and animals and representation of plant communities and animal habitats in reserves.
10. Cinnamon fungus.
11. Cool temperate and warm temperate rainforest.
12. Wilderness.
13. Protection of rivers, streams and catchments and their associated biological communities.
14. Marine reserves.
15. Expansion of employment opportunities in East Gippsland associated with public land use.
16. The need for land to be made available for agricultural and township expansion.
17. The mineral potential of East Gippsland
18. Public land grazing.
19. Vermin and noxious weeds control.
20. Fire protection and prevention.
21. Potential for major tourist developments.
22. Development of visitor facilities in association with major parks.
23. Promotion of tourism in East Gippsland.
24. Coastal road.

REPORT ON THE
EAST GIPPSLAND AREA
REVIEW
AUGUST 1985



LAND CONSERVATION COUNCIL

Fourth Floor, 464 St. Kilda Rd. Melbourne, Victoria 3004

Phone: (03) 267 1311

Government of Victoria

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Front cover: *Genoa River valley,
Coopracambra State Park*

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FOREWORD

The *Land Conservation Act* 1970 established the Land Conservation Council, whose function is to carry out investigations and make recommendations to the Minister with respect to the use of public land in order to provide for the balanced use of public land in Victoria.

As with past reports, this report provides a factual basis for the preparation of submissions to the Council, by describing and assessing the natural resources of public land in the East Gippsland area. It ensures that all those persons and bodies who have an interest in the future use of public land in this area can obtain and study the basic information which the Council itself will study, and so make informed and constructive suggestions to the Council for its consideration.

Demands for land for various purposes are many and varied, some of which are compatible and some conflicting or competitive. It is therefore important that the decisions made are based on the best information available.

Submissions are now invited and should reach the Secretary of the Land Conservation Council within 60 days of the publication of this report, as notified in the *Victorian Government Gazette*. The Council will make its recommendations on the use of public land in the East Gippsland area only after due consideration of all these submissions.



DAVID SCOTT
Chairman

Land Conservation Council
464 St Kilda Road
MELBOURNE 3004

LAND CONSERVATION ACT 1970

EXTRACT

Public land

Section 2.

(1) "Public land" means -

- (a) land which is not within a city, town or borough and is -
 - (i) unalienated land of the Crown including land permanently or temporarily reserved under section 4 of the *Crown Land (Reserves) Act* 1978, State forest and parks within the meaning of the *National Parks Act* 1975;
 - (ii) vested in any public authority (other than a municipality or a sewerage authority within the meaning of the *Sewerage Districts Act* 1958); or
 - (iii) vested in the Melbourne and Metropolitan Board of Works; and
- (b) any other land which the Governor in Council declares under sub-section (2) to be public land for the purposes of this Act.

"Reserved forest" and "State forest" have the same meanings as in section 3 of the *Forests Act* 1958.

(2) The Governor in Council may on the recommendation of the Minister made after consultation with -

- (a) any Minister of the Crown in whom any land is vested; or
- (b) the Minister responsible for a public authority in which any land is vested -

by proclamation published in the *Government Gazette* declare any such land to be public land for the purposes of this Act.

Functions of the Council

Section 5.

(1) The Council shall -

- (a) carry out investigations and make recommendations to the Minister with respect to the use of public land in order to provide for the balanced use of land in Victoria;

- (b) make recommendations to the Governor in Council as to the constitution and definition of water supply catchment areas under the *Soil Conservation and Land Utilization Act* 1958; and
 - (c) advise the Soil Conservation Authority concerning policy on the use of land (whether public land or any other land however vested) in any water supply catchment area.
- (2) In making any recommendation the Council shall have regard to the present and future needs of the people of Victoria in relation to -
- (a) the preservation of areas which are ecologically significant;
 - (b) the conservation of areas of natural interest beauty or of historical interest;
 - (c) the creation and preservation of areas of reserved forest;
 - (d) the creation and preservation of areas for national parks;
 - (e) the creation and preservation of areas for leisure and recreation, and in particular of areas close to cities and towns for bushland recreation reserves;
 - (f) the creation and reservation of reserves for the conservation of fish and wildlife;
 - (g) the preservation of species of native plants; and
 - (h) land required by government departments and public authorities in order to carry out their functions.
- (3) Where the Council recommends the alienation of any land the recommendation shall include the Council's opinion as to the best method of alienating the land to ensure the most satisfactory use and management of the land in the public interest.
- (4) Any person or body may make submissions to the Council as to how any public land can be better used to meet the needs of the people of Victoria and the Council shall consider any such submissions before making any recommendation under paragraph (a) of sub-section (1).

Investigations, notices and reports

Section 9.

- (1) The Council shall not make any recommendation under this *Act* in relation to any district or area without a prior investigation of the district or area.

- (2) Before commencing any investigation under paragraph (a) of sub-section (1) of section 5 the Council shall publish a notice in the *Government Gazette*, in a newspaper circulating throughout the State and in a newspaper circulating particularly in or in the vicinity of the area or district to be investigated stating that an investigation of the district or area described in the notice is to be carried out for the purposes of this *Act*.
- (3) On completing an investigation of a district or area under paragraph (a) of sub-section (1) of section 5 the Council shall -
 - (a) publish a report of the investigation;
 - (b) give notice in the *Government Gazette* of the publication of the report, the address where copies of the report may be obtained or inspected and stating that any submissions to the Council in relation to such report will be considered by the Council if they are made within 60 days of such notice; and
 - (c) publish notice in a newspaper circulating throughout the State and in a newspaper circulating particularly in or in the vicinity of the area or district investigated of the publication of the report, the address where copies of the report may be obtained or inspected and stating that submissions may be made to the Council and the date before which they should be made.
- (4) The Council shall consider any submissions in relation to such report made by any person or body within 60 days of notice being given under paragraph (b) of sub-section (3).

**Notice to be given to public departments
and authorities in certain cases**

Section 10

- (1) Not earlier than 60 days after notice being given under paragraph (b) of sub-section (3) of section 9, the Council shall send a copy of its proposed recommendation to -
 - (a) the Council of any municipality in the municipal district of which any part of the area or district to which the recommendation relates is situated;
 - (b) any other public authority or government department that in the opinion of the Council has an interest in the area of the proposed recommendation, and
 - (c) any person or body who made a submission under section 9 -

and shall consider any submissions received within 60 days of the sending of such copy to the council, authority, department, person or body or in the case of a public authority or government department within such longer period as may be agreed upon between the Minister and the Minister administering that department or responsible for that authority.

- (2) Where any recommendation is made to the Minister under this *Act* it shall be accompanied by a copy of any submissions received from any person body department authority or council pursuant to the provisions of sub-section (4) of section 9 or sub-section (1) of this section.

**Government departments and authorities
to give effect to recommendations**

- (3) Where the Council has made a recommendation to the Minister under paragraph (a) of sub-section (1) of section 5 the Minister may, after he has given not less than fourteen days notice of his intention so to do to the Minister administering a government department or responsible for a public authority recommend to the Governor in Council that notice of the recommendation or that part of the recommendation that affects the government department or public authority be given to the government department or public authority concerned and where notice of that recommendation or part is so given by the Governor in Council it shall be the duty of the government department or public authority to use all diligence and dispatch to give effect to such recommendation so far as it affects any land vested in or controlled by it.

**Copy of every recommendation and of
proposals to be tabled in Parliament**

Section 11.

A copy of every recommendation of the Council made under sub-section (1) of section 5 and of the proposals of the Council submitted to the Minister pursuant to section 7 shall be laid before both Houses of Parliament within fourteen days of the making thereof if Parliament is then sitting and if Parliament is not then sitting within fourteen days after the meeting of Parliament.

A copy of the *Land Conservation Act* can be obtained from the Government Printer Sales Office, 41 St Andrews Place, East Melbourne 3002.

ACKNOWLEDGEMENTS

This report covers so wide a field that its compilation would not have been possible without the generous assistance and co-operation of a great many individuals and organizations.

Information for maps and chapters was supplied by: the Departments of Conservation, Forests and Lands, Agriculture, and Minerals and Energy; the Rural Water Commission, the Victoria Archaeological Survey, the National Herbarium, and the National Museum.

The following staff from these organizations were involved in the preparation or revision of chapters for the report: D. Hooley, K. Wareing, J. Taylor, F. Garden, P. Robertson, I. Mansergh, J. Duff, R. Paul, R. King, T. Cooney, T. Weight, J. Blyth, A. Yen, and D. Parkes.

Special studies were carried out for this area by the following consultants: Aboriginal associations - K. Thompson; European history - G. Butler; vegetation - A. Moorrees; fauna - survey team from Arthur Rylah Institute for Environmental Research.

The Council is indebted to the following individuals and organizations that made photographs available for use in the report:

Mr. N. Rosengren, Geography Department, University of Melbourne who kindly provided all the aerial photographs, including that used on the front cover of the report, and also some of the ground photographs; Mr. G. Butler; Mr. P. Robertson and Mr. J. Cooper of the Fisheries and Wildlife Service; Mr. A. Jackomos; the Victoria Archaeological Survey, and the National Parks Service.

Many others also readily gave information, checked drafts, or contributed valuable discussion and advice. They include other Victorian government bodies, local government agencies, representatives of various industries, outdoor recreation, and sporting organizations, and individuals with expert knowledge of specific disciplines or particular localities. Their assistance is gratefully acknowledged.

Part I
INTRODUCTION

1. INTRODUCTION

The Land Conservation Council commenced the first investigation of the East Gippsland area in 1973, and published a descriptive report in 1974. Final recommendations on the use of public land in the area were published in 1977.

All but two of the Council's recommendations have been accepted by the government and have been or are being implemented. The recommendations provided for the establishment of three major national parks and numerous wildlife and flora and fauna reserves. Just under half of the public land in the study area was set aside for timber production, while about one-quarter was recommended to remain uncommitted to any primary use for the time being. Two areas in particular - namely, the headwaters of the Goolengook River and Gelantipy Plateau--Bowen Range - were designated as a special form of uncommitted land, and Council stipulated that neither timber-harvesting nor the construction of logging access would be permitted until its review of the East Gippsland area.

The Council is aware that many changes in demand for the use of public land cannot be foreseen, and that the value of resources will change as exploration, research, and technology progress. For these reasons, the Council believes that periodic reviews of public land use in the State are desirable, and it must be expected that resources will be reallocated or adapted to meet changed demands.

Since the publication of the Council's final recommendations for this area in 1977, a considerable amount of new information about the natural resources of East Gippsland has been collected. Of particular note is the work conducted for the Environmental Studies Division of the former Ministry for Conservation on sites of zoological, botanical, and geological/geomorphological significance in East Gippsland and information arising out of the Victorian Timber Industry Inquiry.

The major impetus of the review is thus to assess the Council's land use decisions in the light of changed demands and the availability of new information.

Advertisements stating that the Council intended to review the East Gippsland area appeared in the Government Gazette and in local and Victorian newspapers on or about 18 July 1984.

Aims and Methods

This report briefly describes the physical and biological characteristics of the land, examines alternative forms of land use, and assesses the hazards and conflicts associated

with such uses. To give a proper perspective, the report considers the general regional characteristics of freehold land, as well as the specific nature of the public land.

It draws heavily on information contained in the original 'Report on the East Gippsland Study Area', published in 1974. Where necessary, information has been updated, and additional material that was not then available has been incorporated. For a more comprehensive description of the study area, however, readers are referred to the original report, copies of which are held in many libraries and by many government departments. A copy is also available for inspection at the offices of the Land Conservation Council.

The present report is the first stage in the decision-making process for the future use of public land in the study area. It does not contain recommendations - rather, it presents factual information on which land use decisions can be made.

It is divided into four main parts: Part I is an introduction, Part II describes the physical and biological nature of the land, Part III deals with the major forms of land use, and Part IV provides more detailed information. In Part IV the study area has been divided for convenience into six descriptive blocks, and a consistent format of headings is used so that the reader can readily find specific information for any block and compare one with another. Explanatory tables, maps, and a number of appendices complete the report.

Information has been supplied by government departments, public authorities, and interested individuals, and has also been obtained from published reports and other sources.

The Study Area

The study area lies in the far eastern corner of the State (see Map 1) and includes all land contained within the Shire of Orbost. It is bounded on the south by Bass Strait, on the north-east by the Victoria--New South Wales border, and on the west by the boundary between the Orbost and Tambo Shires, which, for most of its length, is marked by the Snowy River. The Orbost Shire is the third largest of the 211 Victorian municipalities, with the lowest proportion of rateable land.

Of the total area of 945,000 ha, public land occupies approximately 832,000 ha, or 88%. Freehold land is generally confined to relatively flat or undulating land along major streams in the area, especially the lower reaches of the Snowy River and Cann River or on the elevated tablelands in the north around Tubbut, Bonang, and Bendoc. The topography of the area ranges from elevated tablelands in the north, through deeply dissected mountainous terrain, undulating to hilly foothills, and broad coastal plains, to extensive dune systems behind broad sandy beaches interspersed with rocky headlands and coastal cliffs. The varied topography produces a range of climatic conditions. Those near the coast are mild, being moderated by proximity to the sea; the

LOCALITY MAP
East Gippsland Area – Review

Scale 1:4 000 000
20 0 20 40 60 80 100
Kilometres

Land Conservation Council
Victoria

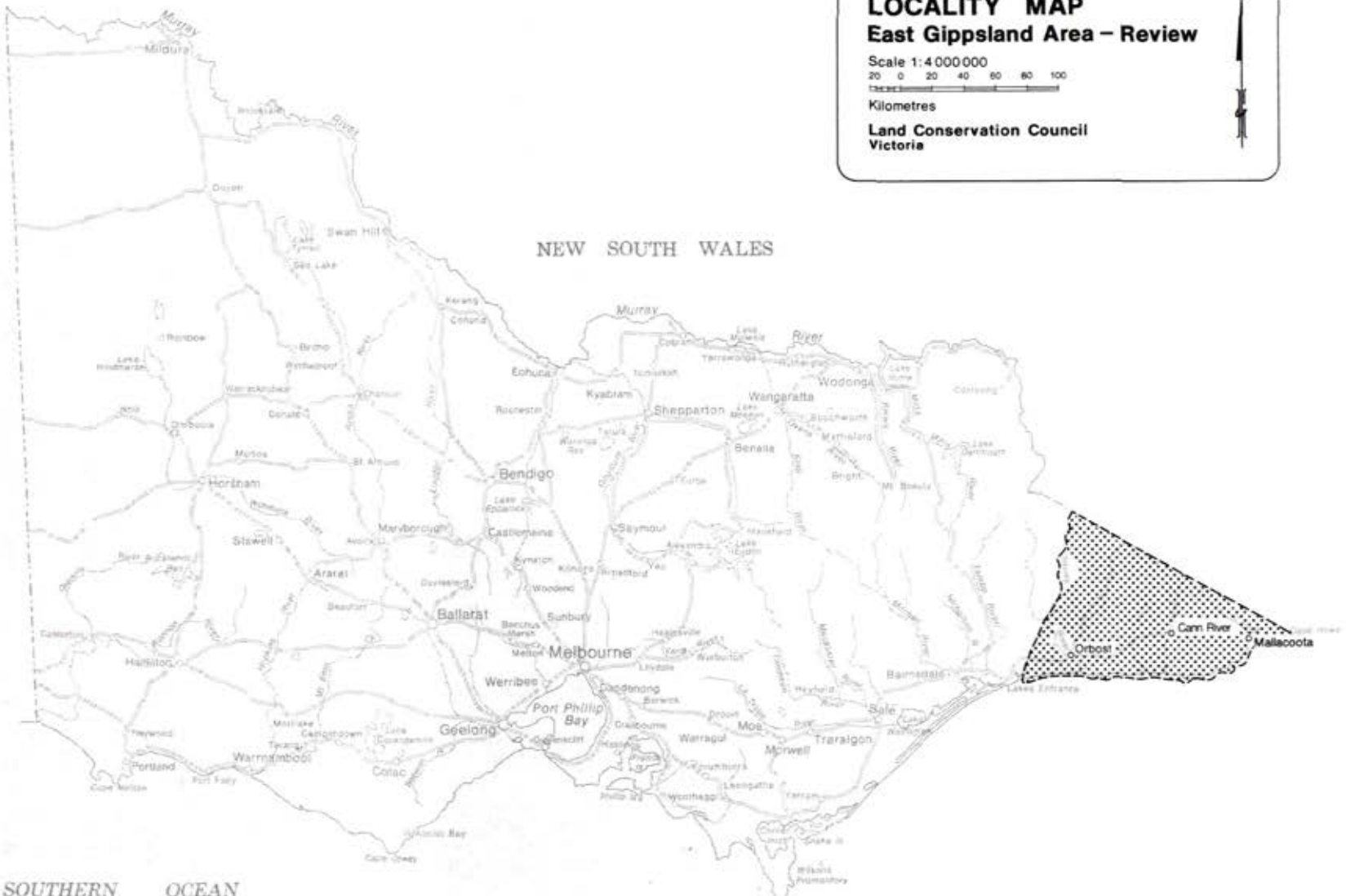


SOUTH AUSTRALIA

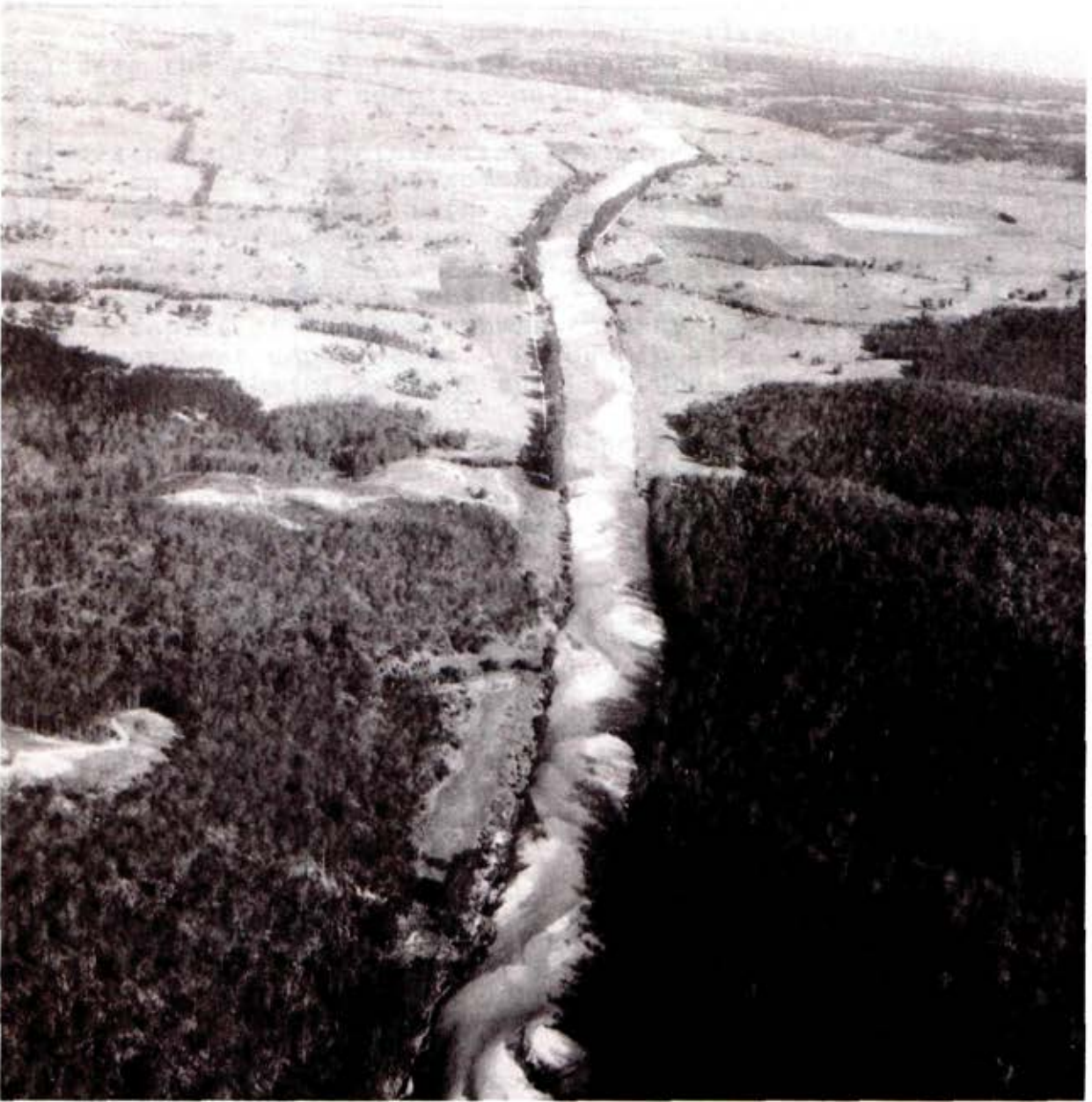
NEW SOUTH WALES

SOUTHERN OCEAN

BASS STRAIT



MAP No.1



The Snowy River flats at Bete Bolong

elevated tablelands, however, experience wider variations in temperature and are subject to severe frosts during winter. Average annual rainfall varies from below 700 mm in the upper Snowy River and Deddick River valleys to an estimated 2,000 mm on the Errinundra Plateau.

Vegetation on public land ranges from coastal heaths to tall mountain forests, with the most extensive vegetation type being lowland sclerophyll forest. Other less extensive, but nonetheless significant, vegetation types include the warm temperate and cool temperate rainforest communities scattered throughout the study area, the rainshadow woodlands found on dry rocky hillsides in the upper Snowy River area, and the bloodwood--angophora forests more characteristic of coastal New South Wales.

Soils range from undifferentiated dune sand and skeletal soils on rocky hills and ridges to deep friable gradational soils.

Population

From the 1981 census, the study area has an estimated population of 6,058, nearly half of whom live in the township of Orbost. It has an average population density of less than 2 people per square kilometre compared with the State average of 15.4 per square kilometre. The population appears to have peaked at around 6,500 during the late '60s but is now declining. This trend is obvious from the general shire statistics and is also reflected in the figures for the town of Orbost (see Table 1). By contrast however, the resort townships of Mallacoota and Marlo have experienced considerable growth in recent years.

Table 1

POPULATION

Year	Whole shire	Orbost township
1954	5,492	2,214
1961	6,179	2,213
1966	6,430	2,797
1971	6,301	2,938
1976	6,390	2,789
1981	6,058	2,586

Source: Australian Bureau of Statistics

Orbost is the only town in the study area with an extensive shopping centre and industries other than sawmilling. The remainder of the population (3,472 people) live in other townships or on individual properties scattered throughout the shire.

Employment

The Shire of Orbost has a narrow economic base and currently depends heavily on the timber industry and agriculture. About 25% of its work force are directly employed by the timber industry. In addition, an estimated 10--15% of the work force are employed in service and other industries that are largely dependent on the timber industry and the employment it provides. Some 15% are employed in the agricultural sector.

Services

Many community services, including education and health, are sensitive to population changes. Orbost High School has suffered a decline in student numbers in recent years, due in part to the decline in population in the shire caused by amalgamation of rural properties, factory closures, reduction in employment in the timber industry, drought, and

economic conditions in the agricultural sector. This lack of student numbers currently threatens maintenance of studies at year-12 level. Primary schools at Bendoc, Club Terrace, and Cabbage Tree are facing similar problems due to declining student numbers.

Health and other services may well be affected by population reduction. Medical and hospital services are based on Orbost and District Hospital, which has a number of mobile services visiting the more remote areas of the shire. As *per capita* funding supports these services, they depend on a stable and growing population for their maintenance or expansion.

Orbost Shire provides a wide range of services and facilities - such as roads, bridges, public buildings, and health and welfare services - which are available to the general public, not just the rate-payers within the shire.

All the main population centres are supplied with electricity from the State network, although Bendoc, Bonang, Tubbut, Deddick, Goongerah, and some properties in the Cann River Valley near the State border receive their power supply from the Monaro County Council in New South Wales.

Access

The Princes Highway, which passes through the area, connects Melbourne and the Latrobe Valley with Sydney via the south coast of New South Wales. The Cann Valley Highway leaves the Princes Highway at Cann River, and forms a link between East Gippsland and Cooma and Canberra. The Bonang Highway



The MacKillop Bridge, the only road crossing over the Snowy River between Orbost and the border

runs from Orbost to Cooma. Several lesser roads provide all-weather access to other parts of the area, but large blocks of country are accessible only by dry-weather roads or four-wheel-drive tracks.

In addition to the highway link with Melbourne, a railway line runs from Bairnsdale through Nowa Nowa to terminate at Orbost. At present this line only carries freight traffic, with one train each weekday; however, a bus service links with passenger trains from Bairnsdale and two companies run buses to Melbourne. There are no scheduled air services, but Mallacoota and Marlo have good aerodromes.

2. ABORIGINAL HISTORY AND ASSOCIATIONS WITH PUBLIC LAND

One of the difficulties in describing pre-contact Aboriginal culture, particularly for those closely settled areas such as Victoria, is the paucity of information. Much of the evidence of traditional concepts and culture has been lost - due to the dispersion of the Aborigines during settlement and the imposition of western culture.

This chapter uses, in the main, information from a report commissioned by the Land Conservation Council describing the past and present association of Aboriginal people with the study area. Research for and compilation of the report was carried out by Mr Kym Thompson. The full report, which gives Mr Thompson's interpretation of Aboriginal associations with the area, is available for inspection at the Council's offices.

The earliest known site of Aboriginal occupation occurring in the study area is located at Mallacoota Inlet, and material from this locality has been dated at 2,500 BP (before present). However, immediately to the west of the study area in the catchment of Tara Creek near Buchan, bone and stone tools have been located in Cloggs Cave and provide evidence that occupation of that area dates back to at least 17,000 BP. Very little archaeological work has been carried out in the area apart from a number of intensive surveys conducted around Mallacoota Inlet and adjacent coastal areas, and it is therefore likely that other undiscovered sites will eventually reveal that Aboriginal occupation in the study area began much earlier. At this stage, however, information about Aboriginal prehistory in the study area before 2,500 BP is somewhat speculative.

Social Organization

Traditional Aboriginal social organization in south-eastern Australia was complex and varied. Our present understanding is based partly on studies of contemporary Aboriginal societies in central and northern Australia, and partly on observations made after the massive disruption to Aboriginal society caused by the white invasion. It is not always clear to what extent this reflects the traditional culture of the study area.

In the past, it has been popularly considered that the 'tribe' was the primary unit of Aboriginal society, but it is now generally agreed that the tribe is not strictly a political, economic, social, land-owning, or land-using unit; rather, it is a linguistic and cultural unit, with boundaries that are indistinct and that may change through time.

A hierarchy of organizational levels or groups can be recog-

nized, however. The smallest group is the 'family': a man with one or more wives, their children, and often some of their parents. While a family in Gippsland might have acted as a discrete unit at various times, it usually formed part of a larger group of related families, often called a 'band'. The band seems to have been the primary group in Aboriginal society. Individuals of a band would carry out the day-to-day activities such as hunting and food collection. It might have consisted of an average of about 50 people, although numbers varied from area to area.

Larger groups, made up of a small number of bands, were also recognized. In the Gippsland region these groups were named, and were believed to be descended from a common ancestor. Howitt, who recorded a great deal of information about traditional Aboriginal culture in the region, called them 'divisions', but they could also be called 'clans'. These groups would have assembled together for ceremonies, or whenever food was particularly abundant in one area.

The 'tribe' or linguistic unit is larger again, while the maximal grouping recognized is that of a 'culture area', which some early writers inappropriately called a 'nation'. All of Gippsland was a culture area, occupied by five tribes who called themselves the Gunnai. Groups throughout a culture area shared common basic cultural and economic characteristics, spoke related languages, and often had the same initiation ceremonies.

Other groups came together temporarily for various reasons. Membership of these groups was determined by a range of criteria such as age, gender, the right to participate in secret ceremonies, or responsibilities towards specific sacred sites or totemic animals.

Aboriginal society therefore consisted of different groups that formed for various activities and then dispersed. The basic unit of everyday life, however, was the band, a loose and often changing group united by common descent, marriage, and shared participation in subsistence activities.

Aboriginal individuals did not 'own' land in a European sense. Land was 'owned' by groups, but this ownership was complex, non-transferable, and involved considerable responsibilities. In some Aboriginal societies the 'owners' - those with rights to hunt and collect in an area - would not be the same as the 'managers' - those responsible for the ceremonial maintenance of the same area.

Individuals had rights to or responsibilities for land as a result of their membership of various groups. In the past, anthropologists believed that patrilineal descent (that is, the inheritance of rights from the individual's father) was the main criterion determining membership of such groups, but it is now realized that matrilineal descent, place of conception or birth, and various other criteria are also valid justifications for claims to access to natural resources, ceremonial rights, and social status.

Intertribal relations

The available evidence indicates that most of the East Gippsland study area was occupied by bands belonging to the Krauatungalung tribe, which was one of the five tribes comprising the Gunnai of Gippsland. Bands from other tribes, some belonging to different culture areas, also occupied parts of it. The Ngarigo tribe occupied the northern third of the Snowy River valley and extended into New South Wales.

The coastally oriented Gunnai had little contact with the inland Ngarigo, and called them 'Brajerak', or 'wild men'. Bands occupying the Mallacoota area had contact with both the Gunnai and the Yuin tribes of the New South Wales southern coast. The rest of the study area was occupied by inland bands, who lived around the headwaters of the Cann, Bemm, and Genoa Rivers. These bands were at the junction of three culture areas, and shared cultural characteristics of all three: the Gunnai, the Yuin, and the tribes of the Monaro Tablelands. The Gunnai called these inland bands 'Bidawal', meaning 'scrub-dwellers'.

Within Gunnai society, interactions between individuals were determined by their kinship relationships. An individual's aunts and uncles were considered to be almost the same as parents and their children were treated as brothers and sisters, although they would be regarded as cousins in European society. Strong kinship relationships produced a close-knit group of individuals with strong family ties.

Once sufficient youths were considered old enough, groups from a number of tribes would assemble for an initiation ceremony. This would go on for many days, and many parts were secret and could not be witnessed by women or children. The Gunnai initiation ceremony was called the 'Jeraeil'.

In traditional society most marriages involved sister or cousin exchange; that is, a man would marry a woman from another group, and her brother or cousin would in turn marry a sister or cousin of the first man. Such marriages were usually arranged by the older men and women and they functioned to maintain bonds between groups within tribes, and also between tribes.

Religion

Aboriginal religious beliefs or mythology played an integral part in the daily lives of the people, and numerous features in the landscape were related to them. The best terms to describe the beliefs about the past are the 'dreamtime' or 'the dreaming'. These beliefs describe the forces, events, and characters that shaped Aboriginal culture.

As is typical for south-eastern Australia, very few specific details are known about the beliefs of the Aborigines in East Gippsland. Information from many parts of Australia, however, clearly shows that the basic idea of the dreaming was common to all Aboriginal societies. The characters

of the dreaming, who are simultaneously animal, human, and creative forces, are considered to be still present in various natural features. While their creative acts occurred in the past, they still play an important role in the maintenance of Aboriginal society and the natural world.

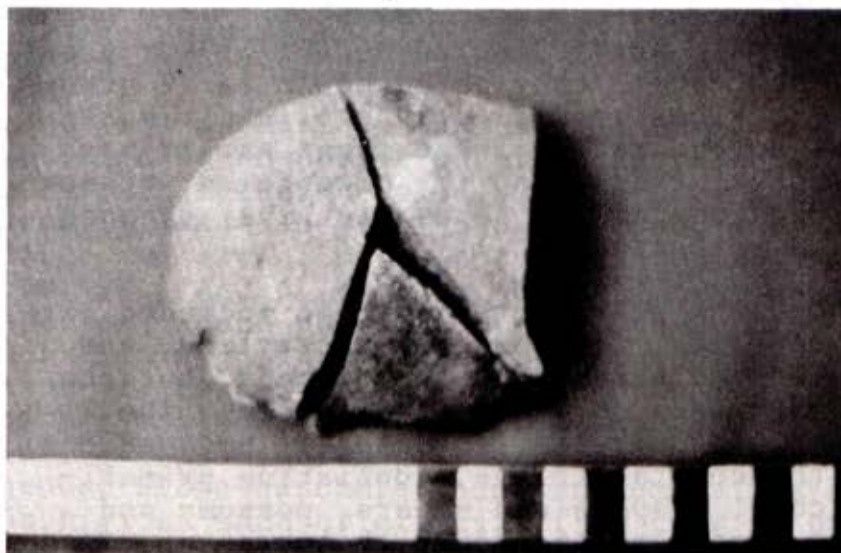
One recorded Gunnai creation myth, for example, provides an explanation for the origin of the landscape and animals, and that of Aboriginal society and culture. The myth also emphasizes that the existence of Nature, Aboriginal society, and Aboriginal culture depends on the continued observance of tradition. It is similar in basic form to other Aboriginal creation myths and indeed similar myths of many other cultures around the world.

Unfortunately, the vast majority of Gunnai beliefs about the dreaming perished along with the last traditional tribal elders.

The Gunnai also believed in sorcery and magic. They were very careful to ensure that strangers did not manage to obtain any of their hair or fingernail parings, as this would provide the strangers with power over them. Deaths were believed to be due to sorcery, and the sorcerer would have to be sought out and killed.

Traditional economy

Aborigines traditionally maintained a hunter--gatherer economy. However, variations in the terrain and climate in East Gippsland resulted in differences in this basic life style in different parts of the area. The Krauatungalong spent most of the spring and summer close to the coast, mainly near major inlets and wetlands, where they caught fish and wildfowl, and collected shellfish, vegetables, and fruit. Fish were an important part of the diet, as were larger land animals. Autumn was reported to be a time of large social gatherings and ceremonies. During this season land animals such as possums, koalas, kangaroos, and wallabies were important foods. In winter they also focused on inland game, and caught fish in the rivers.



*A stone hatchet
from the upper
Snowy River area*



The scar left when bark was cut to make a canoe

The Krauatunglung made a variety of tools for hunting and food-collecting. They made fish-hooks of bone and possibly shell, and lines from wattle bark. They also constructed a variety of grass nets to catch fish, and stretched the larger nets, with bark floats and stone sinkers, between two canoes. Fish and eels were also caught with spears, which had one or more polished bone or hard wooden points. Spears for hunting and fighting had barbs made of small jagged pieces of stone set along a groove, and were thrown using spear-throwers. Other weapons included clubs, boomerangs, and wooden shields.

Ground-edge stone hatchets were very important tools, being used to cut bark or wood from trees for canoes, shelters, containers, or wooden tools, and to cut toe-holes into trees when hunting for tree-dwelling animals. Flaked stone tools were used for other cutting purposes, as were

sharpened pieces of reed. Other items included bags, baskets, and wooden water containers.

The Ngarigo tribe occupied the upper Snowy River valley and the area northward across the Australian Alps, almost to Queanbeyan. They are thought to have practised seasonal transhumance - that is, a highly nomadic existence related to food supply and seasonal conditions. Winter was a time of harsh conditions and scarce food resources in the alpine country and the Ngarigo bands avoided these problems by sheltering in the major river valleys. From spring to autumn they roamed the high country, including the higher peaks such as Mount Kosciusko, where they gathered in large groups with bands from other tribes to collect one of their most important foods, the Bogong moth. These large gatherings were times of ceremonies, trade, and the arrangement of marriages. The Krauatunglung do not appear to have attended these moth-collecting gatherings.

Foods eaten throughout the year by the Ngarigo included larger mammals, emus, reptiles, fish and eels, crayfish, and shellfish. They collected a range of plant foods, but the daisy yam seems to have been the only staple item. The highly mobile Ngarigo had only limited material possessions in comparison with the coastal tribes, consisting primarily of the stone hatchet, weapons and spears, possum- and kangaroo-skin cloaks, and bark and bough shelters.

The coastal bands in the far east of the study area had an economy and technology similar to that of the Krauatungalung. While very little is known of the inland Bidawal bands, they probably had a similar way of life to that of the Ngarigo.

Archaeological evidence

The Victoria Archaeological Survey has carried out detailed investigations into much of the eastern half of the coastline in the study area. This work has generally confirmed 19th century observations that coastal occupation focused in the areas around inlets, estuaries, and wetlands. Surveys of the narrow coastal strip between Tamboon Inlet and the Betka River located 82 sites, almost all shell middens, containing chiefly the remains of rock-platform shellfish, even on sandy beaches lying several kilometres from the nearest rock platform. The sites contain few stone tools, and almost no bones of land animals. They appear to represent transitory camps made by small groups, either moving along the coast from one inlet to another or making brief visits to the coast from inland camps. Most of these sites are poorly preserved, having been damaged by severe erosion, especially in mobile dune fields.



A poorly preserved shell midden in coastal dunes

Land east of Mallacoota Inlet, between the coast and the wetlands of Howe Flat and Lake Barracoota, appears to have been much more intensively occupied. A survey of a small area of sand dunes located 25 sites, many of which contain large numbers of bones and stone tools as well as shellfish remains. Again, most of the shellfish were rock-platform species, which had been brought there from several kilometres away. It is clear from the size, contents, and location of these sites that the abundant plant and animal foods of the wetlands were an important food resource, and Aboriginal groups might have camped for weeks at a time. Edge-ground stone hatchets found in some sites suggest that the Aborigines made brief trips from them to exploit the resources of the nearby forested hills.

A further 20 sites, mainly shell middens, have been found on Gabo Island and are thought to represent seasonal visits in pursuit of mutton-birds, fish, seals, and rock-platform shellfish.

The greatest focus of archaeological research in the study area has been on Mallacoota Inlet. Virtually the entire shoreline of the inlet has been surveyed and 150 sites located, four of which have been excavated. Most of them are shell middens, ranging in size from little more than a metre across to large complex ones covering several hundred square metres, with up to a metre of material including shell, bone, and bone and stone tools. Although long linear sites sometimes extend 100 m or more along the shore, very few sites extend more than 10--20 m inland.

A number of different shellfish habitats occur in or near Mallacoota Inlet, including rock platforms along the ocean coast adjacent to the inlet, and mudflats, sandy beaches, and rock platforms inside the inlet. Smaller middens generally comprise almost entirely the shells of species available in the immediate vicinity, and represent the remains of single-purpose visits to a location to collect shellfish. Larger middens, however, especially those near the mouth of the inlet, generally contain a wider variety of materials, including shellfish collected from several kilometres away. They also contain more stone tools, and bones of fish and land animals, and it is clear that these sites represent more permanent camps, from which groups made daily trips to hunt and gather food in the surrounding region.

Plant foods probably provided a greater part of the diet than meat, but no information is available about the plants utilized. However, one of the excavated middens (at Captain Stevensons Point) provides some information about the relative importance of various sources of meat in the diet. At this locality mammals made up 60% of the meat eaten, fish comprised 30%, and shellfish the remainder, based on the calories provided by each of these food sources.



*An Aboriginal
midden*

In addition to almost 150 middens, a few stone artefact scatters were found. It is likely, however, that many more exist but have not been located due to the thick vegetation that obscures the ground surface away from the shores of the inlet, which is where these sites are found. The relation between the middens and the artefact scatters is unclear. They appear to represent different functionally specific 'components' of semi-permanent 'base camps' in particular areas, with the same group of people carrying out different activities, and leaving different remains, in the two sorts of sites. Other evidence, however, suggests that the artefact scatter sites are older than the middens, and major differences in the types of stone tools at the two types of sites, and even in the sort of stone from which they are made, argue against them being used by the same group of people at the same time. Further archaeological research will be necessary to resolve this problem.

On the basis of the archaeological surveys and excavations to date, the traditional Aboriginal occupation around Malla-coota Inlet can be outlined as follows.

The largest middens in both Top Lake and Bottom Lake, and especially those along the south-western shore of Bottom Lake, represent parts of semi-permanent camps that were occupied by groups, probably of several dozen Aborigines, for several days to perhaps a few weeks at a time. From these relatively central locations, people made daily trips to collect shellfish from both the shores and mudflats of the inlet and the rock platforms of the ocean coast. Because of their considerable weight, shellfish were often cooked and eaten at temporary camps near where they were collected. Small groups might spend a few hours at these camps, or perhaps stay overnight, before returning to the larger camp. Fish were caught from the shore and from canoes. Daily hunting and gathering trips, often extending several kilometres into the inland forests, provided larger quantities of plant and animal foods.

After a few weeks at any one location, plant foods, shellfish, small animals, and firewood would begin to become scarce in the immediate vicinity, prompting a move to another camp. This might be elsewhere on the inlet shore, or perhaps inland. A substantial amount of the year could well have been spent living away from the coast, at short-term camps most probably located along the various inland rivers and creeks. Other nearby areas would also have attracted large groups at certain times of the year. The wetlands of Howe Flat and Lake Barracoota would have provided abundant food, especially when water-birds were nesting, and large groups probably camped around the edge of the wetlands for lengthy periods. Gabo Island was another attraction, offering not only fish and shellfish but also mutton-birds, penguins, and perhaps seals in the right season. The evidence from excavated sites suggests that this pattern remained relatively unchanged over the last 2,500 years.

Archaeological survey work in the study area to date has been largely restricted to the coast, extending at most up

to 1.5 kilometres inland from the coast or inlets. As a result, only a few inland sites have so far been identified. These are on the Monaro Tablelands around Bendoc and in the Snowy River valley - for example at the confluence of the Deddick River and the Snowy. New South Wales site-density figures for similar environments suggest that several thousand inland sites, mostly small artefact scatters, could exist in the study area.

After a probable concentration of sites within 2--3 km of the coast, an area extending up to about 10 km inland would contain few sites, having been exploited by groups camped either near the coast or further inland. Next, inland sites will probably be situated on relatively flat areas or ridges, or at the foot of spurs, near creeks or rivers. These predictions from New South Wales, however, need to be tested by systematic archaeological surveys in the study area. Detailed surveys will then be required in order that sites can be identified and protected.

Population prior to 1788

Estimates of population prior to European settlement are based on various assumptions, owing to the lack of written data. Butlin (1983) has recently argued that the pre-1788 population of Victoria (previously accepted as perhaps 15,000) must have exceeded 50,000 and possibly risen as high as 100,000. He argues that two smallpox epidemics swept through Victoria before white settlers arrived there, and so the Aboriginal population observed in 1835 was only a fraction of that prior to 1788. It has been estimated that the pre-invasion population of East Gippsland was probably between 500 and 1,000, but this figure is based on several broad assumptions.

Colonial History

Initial contacts 1770--98

'The Endeavour' sailed along part of the East Gippsland coast in April 1770, but those on board saw only a few signs of the inhabitants.

'at noon a [smoak] was seen a little way inland
and in the evening several more...'
(from 'Endeavour' Journal of Joseph Banks, 1768--71)

The first whites to come into contact with the local Aborigines were the survivors of the shipwrecked 'Sydney Cove', whose longboat was wrecked on the Ninety Mile Beach in March 1797. They encountered three Aboriginal groups in East Gippsland while walking along the coast to Sydney. These contacts were friendly, but some later meetings with Aborigines on the New South Wales coast were hostile.

Bass, during his voyage in a whaleboat from Sydney to Western Port, noted many 'large smokes' behind the Ninety Mile Beach, and on his return journey to Sydney in February 1798 he landed on the north-eastern part of the beach.

'... some natives came to us with very little hesitation, the usual signs of friendship being offered and accepted on each side. By their manner we concluded that they had never seen white people before; or even heard of them.' (Bass, 1797)

Flinders experienced a similar meeting somewhere on the Ninety Mile Beach in 1801.

The initial invasion 1798--1838

Of the years separating the first visits of the whites by sea and their eventual arrival by land, very few historical records remain. During this period, however, the sealing industry in Bass Strait developed, and contact between the sealers and East Gippsland Aborigines led to drastic changes in relations. The first sealers, acting immediately following the return of Bass, arrived on the Victorian coast and Bass Strait islands in 1798. Their numbers increased rapidly to several hundred within a couple of years. Small groups of sealers were dropped at various points along the coast, where they remained for several months at a time. The long and isolated stays soon led to the acquisition of Aboriginal women as sexual partners and domestic servants, often several to each man. The effects on Aboriginal society were devastating.

Aboriginal men would have been killed when the women were initially taken and also in attempts to rescue them. The young women would probably have been the most productive collectors of food and the men killed were probably among the most active hunters, with disastrous effects upon those children and older people whom they were supporting. In the longer term, the kidnapping of Aboriginal women would have made it more difficult to arrange marriages, because of a shortage of eligible young women. This would have caused direct conflict between men within groups, and increased raids on other groups to steal women from them. It would also have disrupted long-standing relations between groups, which were cemented by the exchange of women. The shortage of women of child-bearing age would have had serious demographic effects, as well.

In addition, the sealers were responsible for the introduction and spread of many new diseases to the Aboriginal people. The most important in East Gippsland were probably measles, whooping cough, and influenza. These highly contagious diseases killed large numbers of Aborigines who had no immunity. Venereal disease was another significant problem, as it killed babies and rendered women sterile. The sealers thus produced a substantial fall in the Aboriginal birth rate, and at the same time increased the death rate. The Aborigines attributed deaths from disease to sorcery, and so neighbouring groups were set against each other with a previously unknown ferocity.

Fortunately, the sealing period was relatively short-lived in Bass Strait, with the seal population being almost wiped out by the early 1820s.

The next major thrust of the white invasion came from the north. In the late 1820s and early '30s cattle stations were established at Batemans Bay, Bega, and Twofold Bay in New South Wales. By the mid 1830s other stations were established on the border of East Gippsland. It has been suggested that these settlers, while immediately taking over the prime hunting lands of the river valleys for pasture, did not cause any major disturbance to traditional Aboriginal subsistence activities.

The first settlers, 1838--51

It was in the late 1830s that the real front of the pastoral invasion reached East Gippsland. Driven by drought in New South Wales, men seeking new pastures for their cattle advanced southward; and in 1838 the first black assaults on white intruders were reported. It is thought that resistance against the whites was stronger in Gippsland than in other parts of Victoria. This might have been due to the rugged and heavily forested land into which the Gippsland Aborigines could easily escape, and upon which they continued to support themselves. It was probably also due to the fact that Gippsland, by its isolation, escaped the devastation of the smallpox plagues. The white occupants of the eastern part of the area in the 19th century remembered their initial entry into the area as being characterized by fierce resistance from the Aborigines.

By the mid 1840s pastoral runs had been established along the Genoa River, at Mallacoota, and on the Snowy River. In the following few years considerable conflict arose between the settlers and the Aborigines. A number of massacres of Aborigines are known to have occurred, some of which involved the infamous native police. Two massacres, one in 1846 and the other in 1851, took place on the Brodribb River, just upstream from its junction with the Snowy River. The latter event can be considered to mark the completion of this phase of the white invasion, as there were no further reports of major clashes, and few subsequent reports of Aboriginal attacks on whites.

Destruction of traditional Aboriginal society, 1851--86

The main characteristics of this period were: the economic changes that forced most Aborigines to become dependent on government rations; the increasing government involvement in Aboriginal people's lives, which culminated in their segregation on missions and government stations; and the conflict between different tribal groups, which resulted from their being forced to live in close association. There was also initial violent conflict between the Gunnai and the Aboriginal men from the Monaro Tablelands brought to the area by the white settlers.

Slowly the Aborigines abandoned their old way of life and began to leave the mountains and swamps for the white settlements. They begged for food and clothing, prostituted themselves, and drank alcohol. Some got jobs as stockmen, shepherds, station hands, or servants, but most had little

choice but to wander and beg, taking casual seasonal work when available. Alcoholism and illness became serious problems, as living conditions on the fringe of white society were appalling. More than 40% of deaths were now caused by respiratory complaints such as tuberculosis, bronchitis, and pneumonia.

With depressed birth rates and soaring death rates, the Aboriginal population simply died away. By 1863 only about 1,900 Aborigines remained alive in Victoria, compared with the estimate of about 50,000 in 1788, and by 1877 the figure had declined to about 1,100. East Gippsland probably had several hundred left in the 1830s, but by 1863 the number had declined to only 42.

By the late 1850s both the government and churches, recognizing too late the plight of the Aborigines, stepped up their efforts to 'protect' the remaining population. Two mission stations (Lake Tyers and Ramahyuck) were established in Gippsland. In 1863 the government temporarily reserved 2,000 acres for the mission at Lake Tyers, which was extended to 4,000 acres in 1879. Although just outside the study area, this mission played a central role in the lives of East Gippsland Aborigines for the rest of the 19th century.

In its initial years the mission attracted only a small number of Aborigines, many choosing instead to continue living on the fringe of white society. A great deal of fighting between different Aboriginal tribal groups occurred on the mission station and alcohol was a major problem. However, legislation providing for the establishment of the infamous



An Aboriginal family at Lake Tyers station

Board for the Protection of Aborigines in 1869 led to severe restrictions being imposed upon the people, including determining where they could live. It also gave the Board power to define the terms of work contracts, control both the earning and expenditure of income, and determine whether children were in need of care, custody, and education. Even marriages were subject to Board approval. Board inspectors attempted to round up the Aborigines, and relocate those from East Gippsland at Lake Tyers.

John Bulmer, the missionary at Lake Tyers, eventually gained the trust of the Aborigines there. Frustrated by the Board's refusal to support positive initiatives to raise the standard of living at the station, in 1870 he purchased 200 sheep, five pigs and three milking cows for the mission, at an estimated personal expense equivalent to 2 years' salary. In the same year the Aborigines voluntarily surrendered their weapons to Bulmer, adopting his suggestion of a council of tribal elders to resolve disputes and judge offenders who had breached tribal law.



John Bulmer (centre) officiating at a double wedding

With various pressures forcing people towards Lake Tyers, and the development of a quieter and more orderly life there, the population of the mission rose from 23 in 1868 to 112 in 1880. In late 1876, 39 Aborigines from the Bendoc and Delegate area arrived at Lake Tyers, some of whom were thought to be the last of the Bidawal people. Apart from a small number who continued to work on the larger stations and a few older people who continued to find seasonal work, the Aboriginal depopulation of East Gippsland was essentially complete by the 1890s.

By 1886 the people at Lake Tyers had lost all economic independence. With virtually no access to income of any sort

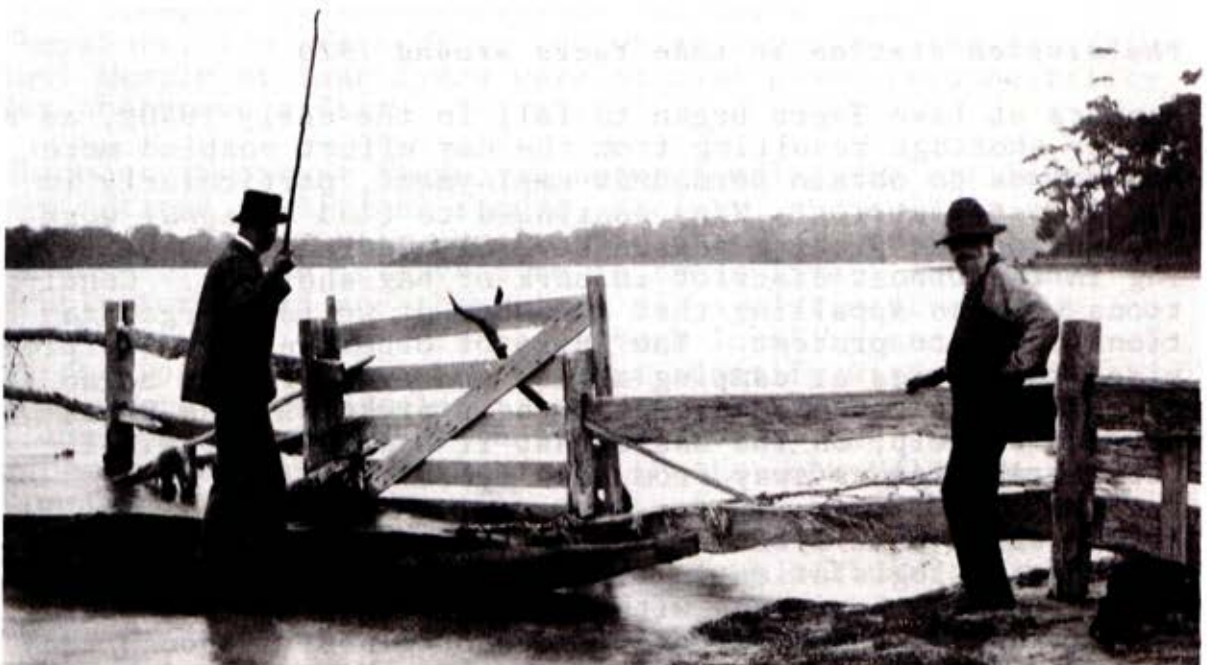
and with hunting restricted, they had to rely on the Board for food and shelter. This situation was in turn used to restrict personal freedom and self-determination. Standards of behaviour and dress, restrictions on movements on and off the mission, and attendance at daily church services were all enforced under the threat of withdrawal of rations.

The *Aborigines Protection Act* passed in 1886 was one of the most significant events in the history of Victorian Aborigines. It marked an about-face in policy from segregation to assimilation. Two of its central features were a change in the legal definition of an 'Aborigine' to exclude 'half-castes' under the age of 34, and the power to force these people off the stations. The Board for the Protection of Aborigines misused the Act, taking advantage of its disciplinary provisions to expel troublemakers from the stations. The Board was able to significantly reduce the number of Aborigines at Lake Tyers, which resulted in considerable financial advantages. The forced removal of half-castes had a drastic effect, however, and many extended families were broken up as a result.

By 1891 those who had to leave Lake Tyers had done so. The depression made work difficult to find and most Aborigines were unemployed or could only get seasonal work. Many of them, demoralized by years of mission life, followed by unemployment, spent long periods camped near the mission station. This situation persisted for many years, and poverty, unemployment, alcoholism, and homelessness became an integral part of the Aboriginal way of life.

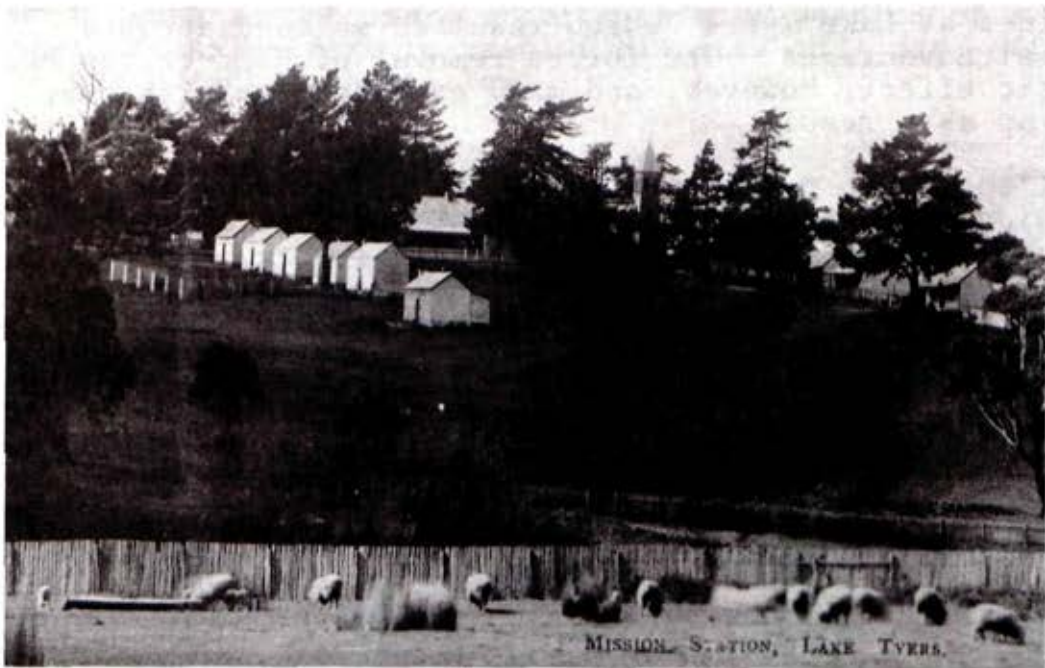
The 20th Century

The Lake Tyers station has continued as an important focus for the Aborigines up to the present time. Control of the station passed from the Anglican Church to the Board for the



A traditional bark canoe in use at Lake Tyers in the 1890s

Protection of Aborigines in 1908. By the 1920s the Board had completed its rationalization of Victorian Aboriginal stations and had closed down every one except Lake Tyers, to which it transferred the remaining occupants of the other stations. Life there was dominated by strict rules and regulations. The Board's broad policy was to eventually assimilate everyone and then close the station, but at no stage does any attempt appear to have been made to prepare the Aborigines for a new life in white society. Throughout a succession of white station managers - some good, some bad - life at the mission was characterized by ongoing conflict between residents and managers. Attempts by those at the mission to grow and sell vegetables were thwarted, and continual attempts were made to hamper the movement of people on and off the station in response to the availability of seasonal work.



The mission station at Lake Tyers around 1910

Numbers at Lake Tyers began to fall in the early 1940s, as a labour shortage resulting from the war effort enabled more Aborigines to obtain permanent employment, particularly in the Orbost district. Many continued to find seasonal work, and during the picking season several hundred would be living in the Orbost district in bark or bag shelters. Conditions were so appalling that a number of welfare organizations began to protest. The Shire of Orbost eventually provided facilities at camping areas, and crop-growers began to provide basic accommodation for their pickers. The Board refused to help, on the basis that it had no responsibilities to Aborigines away from Lake Tyers.

After nearly half a century of virtual neglect, the government passed legislation in 1957 replacing the Board for the Protection of Aborigines with the Aboriginal Welfare Board. Two of the ten Board members were Aborigines, although they were nominated by the government rather than elected by the Aboriginal community. The new Act altered the legal defini-

tion of an 'Aborigine' to include all people of Aboriginal descent. The Board made improvements at Lake Tyers, including the connection of electricity and water to the houses and the replacement of the communal washing and toilet block with individual facilities attached to each house. Government policy, however, remained one of assimilation, with the main difference being that the new Board pursued this goal far more actively than its predecessor had. The Board put pressure on families to leave Lake Tyers, and built houses for them in towns throughout Gippsland, including Orbost.

The initial success of the rehousing scheme led the Board to announce in 1962 that it intended to close Lake Tyers within 3 years. This proposal led to a storm of protest from many groups, both black and white, including demonstrations in Melbourne and petitions to parliament. Despite this, families continued to leave Lake Tyers, attracted by the prospect of new houses or jobs in the Latrobe Valley, or just resigned to the fact that the Board would win eventually anyway. Numbers on the station rapidly declined from 209 in 1957 to 34 in 1966. The rehousing scheme, however, was a disaster, mainly because the transition from mission life to white society was too great. The people were ill-prepared, had little support from the Board, and were not accepted by the communities in which they settled. Most importantly, they were separated from their relatives and friends, who play such an important role in Aboriginal society.

As a result of intense pressure from some groups, and after the failure of the rehousing scheme, the government altered its policy from assimilation to integration. The Lake Tyers reserve was given permanent status, an Aboriginal Council was elected, and plans were drawn up for the development of enterprises that would provide employment and job training. In 1971 the Lake Tyers Reserve was handed over to the newly formed Lake Tyers Aboriginal Trust, which included all those who had been resident at the station since 1968, or who had been accepted by the Aboriginal Council at Lake Tyers. Therefore, 130 years after the white invasion, the Aboriginal people at Lake Tyers were at last given responsibility for their own affairs.

The most important factor in understanding the attitudes, aspirations, political stance, society, and culture of Aborigines today is their sense of identity. Despite the long history of white intervention in their lives, Aboriginal people form, and see themselves as, a distinctive group, to which membership is defined by both locality and family relationships - Victorian Aborigines identify with a region that contains particular tribal territories, mission stations, and the homes of their relatives. One such region extends from Dandenong, through the Latrobe Valley and East Gippsland, to the far south coast of New South Wales. Within this region economic interdependence and interhousehold migration maintain a strong sense of group solidarity.

At present almost 140 Aborigines live in East Gippsland - about 120 in Orbost, and the rest at Cann River. They are represented by the Gippsland and East Gippsland Aboriginal

Co-operative established in 1974, which is based at Bairnsdale.

The Co-operative currently has an annual turnover of about \$1 million, of which approximately one-third is spent on housing. In late 1984 it employed a staff of 35, almost all Aborigines. It provides facilities including a medical clinic, day care centre, alcohol rehabilitation centre and hostel for secondary school students. It has recently established its own building program, sub-contracting work to white tradesmen who are prepared to take on Aboriginal apprentices. Unfortunately many of the employment opportunities currently provided by the Co-operative are funded by short-term training schemes or employment initiative programs, and so depend on ongoing government financial support.

Encouraging new initiatives have also commenced at Lake Tyers, including a building program, a brick-works, and agricultural developments. Unfortunately these programs are still reliant upon white tradesmen. The timber industry is an important source of employment for Aborigines in Orbost and Cann River. Unemployment, however, continued to be very high among Aborigines in the region. A survey in 1966 revealed an unemployment figure of 12% among East Gippsland Aboriginal men, compared with 0.7% for the entire male work force of Victoria. Current figures are not available, although figures collected for Bairnsdale and Lakes Entrance in February 1985 revealed an official unemployment rate, excluding hidden unemployed, estimated to be approximately 50%.

It is clear therefore that, despite recent developments, the long history of poverty, hardship, unemployment, and discrimination is still not over. Many positive initiatives will still be needed before the Aboriginal people of East Gippsland achieve equality of opportunity with the descendants of the white invaders.

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3. EXPLORATION AND SETTLEMENT

The history of exploration and settlement of the study area was discussed in some detail in the original report. The following brief summary identifies some of the historical events in the region. Readers are directed to the original report and to other publications, such as those cited below, for a more complete account. Much of the information in this chapter about particular sites comes from a report specially prepared for the Council by Mr G. Butler on 'The European History of East Gippsland'.

Exploration

The first European contact with the area was also the first sighting of the eastern coast of Australia by those on board Captain James Cook's vessel 'The Endeavour' in April 1770. Cook's First Lieutenant, Mr Hicks, sighted a rocky promontory - subsequently named Point Hicks.

Cook also named Rame Head, because of its resemblance to a point of that name at the entrance to Plymouth Sound, and Cape Howe.

Survivors of the shipwrecked 'Sydney Cove', which foundered in 1797, became the first Europeans to land on the coast. They set out for Sydney, but only three reached their final destination.

On December 21, 1797, George Bass and the crew of his whale-boat 'landed at a little beach about a mile north of the Rame Head' near Wingan Inlet. Bass explored the vicinity, and recorded quite detailed observations on the physiography, soils, and vegetation. Ten days later he continued his journey westward.



*The beach at
Wingan Inlet
where George
Bass is thought
to have landed
in 1797*

The pastoral industry and settlement

Although sealers were scattered along the coast between 1798 and 1838, permanent settlement did not occur until the 1830s, when pastoral runs were taken up in the Monaro, Bendoc, Mallacoota, and Genoa districts. Pastoralists on the Monaro Tablelands searching for new pastures for their stock were the impetus for much of the early exploration of the region.

In 1835 George MacKillop crossed the Snowy River near the present State border and headed south-west to Omeo. In 1835--36 Andrew Hutton and William Morris journeyed from Twofold Bay to the Snowy River. Four years later, Angus McMillan found his way down the Deddick River valley and crossed the Snowy, passing through what are now the settlements of Wulgulmerang and Gelantipy, and continued to Omeo.

The famous botanist Baron Sir Ferdinand von Mueller visited East Gippsland three times between 1854 and 1860. In the later stages of his first long journey, he followed the Tambo River downstream and reached the Snowy flats, where he was particularly fascinated by the cabbage fan-palms. He returned to this area in 1854--55, via the Snowy River from the Murray--Snowy divide. In 1860 he visited Cape Howe, Mallacoota, the Genoa River, and Nungatta Mountain (in New South Wales adjacent to what is now Cooperacambra State Park).

Land in East Gippsland was first legally held as pastoral holdings or runs. Tubbut was licensed in 1838 to T.M. Moore; John McLaughlin held Dellicknora from 1833 to 1867; and William Bradley occupied Kirkenong in 1841. Bendoc was first licensed in 1842 in the Bendoc district and Jingallala in 1854. However, permanent settlement did not take place in the Bendoc district until 1849, when Whittaker moved from the New South Wales tablelands to Tubbut.

The first grazing licence for a run in the extreme east of Gippsland was issued to John Stevenson in 1839 for Wangarabell. William Morris held Nungatta and Genoa about 1840, while in 1841 Robert Greig took up Maramingo. Around 1841, Stevenson and James Allan attempted to run cattle at Cann River but were forced away by Aborigines. In 1842 Peter Imlay tried to run cattle at Orbost but was also driven off by Aborigines. He later sold the Imlay brand to Norman and John Macleod, and they took out the first licences for Newmerella and Orbost respectively.

In 1850 the Ewing brothers took up a run between Lakes Entrance and the Snowy River and in 1857 Thomas Stirling took up the Corrangle run, extending from Lake Tyers to Bemm River. The Stirling family grave is still visible in the Marlo cemetery and it contains the first 'public' burials in the region. In 1868 Hamilton Reed and John Lock took up a grazing area of about 60,000 acres at Goongerah. Further agricultural development followed gradually, but was concentrated along the major river valleys and on the tablelands around Bendoc and Bonang.



The Stirling family grave, Marlo cemetery

From the late 19th century onwards, various families took up land in the upper Snowy River valley near Mountain Creek and Jacksons Crossing, on the Rodger River, and in the Murrungowar--Glen Arte area, but they were largely unsuccessful due to the rugged inhospitable nature of the country, its remoteness, and lack of finance to support the farming enterprises.

Mining

The discovery of gold also played a part in opening up the area for settlement, although finds were less valuable than those in other parts of the State.

In 1852 W.B. Clarke suggested that gold could occur in the Bendoc district, and in 1866 alluvial gold was discovered in payable quantities in all streams flowing north from the Coast Range.

Around 1862, many Chinese came to the Bendoc area in search of gold and, for a time, a thriving Chinese community existed at lower Bendoc. A number of gold-mines operated in the district between 1869 and 1910, and the Victoria Star Mine, the region's highest producer with 5,337 ounces of gold, was worked until about 1935. The relics at the mine site are a comprehensive collection of traditional processing equipment. The Rising Sun Reef Gold-mine at Bonang produced some 5,000 ounces between 1869 and 1897. The shafts, water race, and mine cage are still present and the Rising Sun Track follows the original tramline route from the mine to the reducing mills on the Bonang River.

A.W. Howitt visited the area in 1867 and again a year later. He reported on the first occasion that about 500 miners and squatters were living in the Bonang--Bendoc--Tubbut district. The following year he found that the township of Wag-
ra (now Bendoc) was beginning to take shape.



*The Rising Sun Reef
Gold-mine lift cage,
Bonang*

In 1889, between 60 and 70 people were living in Bendoc and mining was sporadic. Great excitement attended the discovery of gold at Clarkeville on the upper Bendoc River in 1889--1890, but the hectic activity did not last long and was but a memory by 1907. In that year, all mining had ceased around Bendoc and activity at Bonang was of little consequence. The Spotted Dog mine near Mallacoota (now in Croajingolong National Park) operated between 1894 and 1897 and was the fourth largest producer in the region (899 ounces). Some relics can still be seen at the site.



Alluvial workings on the Combienbar River were first recorded in 1873, and then in the 1890s. In the early part of this century a 9-ounce nugget was found at Golden Gully. In 1909 the Rozynski brothers, Oscar and Charlie, established a reef mine and brought a crusher from Combienbar to Golden Gully. The crusher was driven by a water-wheel that they constructed, and this in turn was fed by a diversion channel from a dam upstream. Ore from the mine was transferred to the crusher via an 80 m flying fox pulley system. However, only 32 ounces of gold was produced from 60 tons of ore. The water-wheel has since been restored to working order on site and provides a valuable example of traditional mining methods.

*The recently restored water-wheel and
crusher on the Combienbar River*



The lower Bendoc State School was established in 1896

The Club Terrace field was opened in 1895 and some good yields were obtained from the Ace of Clubs Mine and the Gippsland Boulder Reef Mine, which produced 1,886 ounces and more than 5,000 ounces respectively. The latter mine is still worked today. Gold was discovered at other localities also, but in minor quantities only. Many ex-miners remained in the area and selected land for grazing and agriculture.

Great optimism was felt about the silver-lead deposits found in the Mount Deddick area during the 1890s, but remoteness, the difficulty of working the lodes, and lack of skill in mining confounded these hopes, although prospectors continued to work the area on a small scale for many years. There is still much evidence of the workings to be seen - by following the Silver Mine walking track from near the camping area at MacKillop Bridge, within the Snowy River National Park.

Shipwrecks

The study area has a coastline more than 160 km long. The section between Cape Howe and Mallacoota Inlet is particularly treacherous and has resulted in numerous shipwrecks. One of the earliest recorded wrecks involved the steamship 'Monumental City', which foundered on Tullaberga Island in May 1853; 33 lives were lost. This tragedy led to the decision to build the Gabo Island lighthouse, which was completed in 1862. A telegraph line linking the Gabo lighthouse to the settlement at Twofold Bay was completed in the 1860s. Remnant poles and wires are still visible on Gabo Island and on the mainland. Some 16 ships were lost in the vicinity of Cape Howe and Gabo Island between 1852 and 1890, and another five up to 1930.

Further west, the coast is less treacherous and fewer wrecks occurred. Earlier this century, a group of graves marked by wooden crosses remained on the Cape Conran foreshore reserve. Little is known about them, but they might have been the graves of sailors who died in one or more of the shipping disasters along this stretch of coastline.

Border survey

Discoveries of gold along many tributaries of the Snowy River inspired the colonial governments of Victoria and New South Wales to clearly identify their common border from the source of the Murray River to Cape Howe. The geodetic survey was conducted by Alexander Black and Alexander Allan in 1870. A number of trigonometrical stations were established and were marked by stone cairns. Intermediate stations were also marked by stone cairns, but these were smaller. Most, if not all, of the principal station cairns have since been replaced by modern trigonometrical markers, as occurred recently on Mount Tingaringy. The intermediate cairns are now the only features remaining from that border survey.

Forestry

Pit-sawing took place at Bendoc when gold-mining was at its peak around 1855, and might well have been the earliest commercial forest utilization in the region.

Samuel Richardson cut the first timber in the Orbost area in a mill at Tabbara in 1822. All early buildings at Orbost were built with timber from there.

In 1875 Charles Petterson, from Copenhagen, took a gang of about 40 men to the Snowy River to strip wattle bark for export to Europe, where it was used as a source of tanning for the leather industry. Boats took the bark down to the river mouth, where it was loaded onto schooners.

Large-scale timber production from the area began with the extension of the railway to Nowa Nowa in 1914 and to Orbost in 1916. The newly accessible hardwood forests were eminently suitable for railway sleepers and also for hewn beams, which were in demand for heavy construction purposes such as wharves and bridges. By 1920, the East Gippsland area was producing some 60% of the State requirement of hewn beams and 25% of the sleepers. Between 1950 and 1960, East Gippsland supplied up to half the State's requirements for railway sleepers, but the demand for (and production of) poles and sleepers has since declined.

The destruction of the mature ash resource in the central highlands by the 1939 wildfires led to the acceleration of logging in East Gippsland.

In 1940, only three sawmills were operating in the area. By 1950, however, the number and size of mills had increased - mainly in response to the need for increased supplies of timber to meet the post-war housing boom. The area currently produces about 25% of the State's total hardwood output.

Transport

The earliest known routes in the study area are miners' tracks - for example, the Gelantipy Track from Gelantipy to Bonang via Campbells Knob. Traces of the original route are still visible as blazes on trees. A punt was operated on the Snowy River at MacKellar's Crossing, upstream from the present-day crossing at MacKillop Bridge.

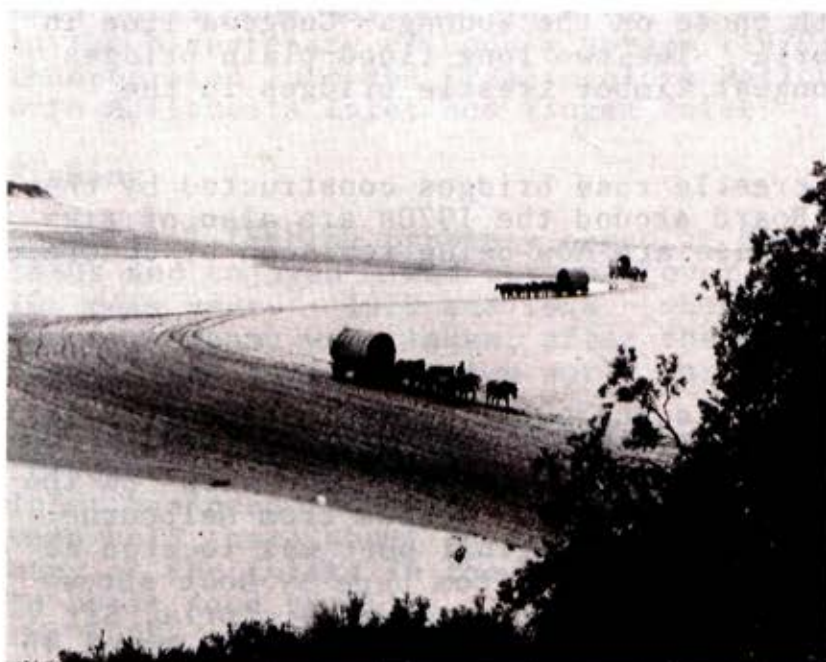
Lack of transport and limited access certainly restricted the early development of the region. In the early days, the only access to Orbost was via two very rough roads - one from Lakes Entrance via Ewing Marsh and the other from Bruthen via Nowa Nowa - and no roads ran north or east.

In 1878 Hamilton Reed and Nicholson blazed a trail from Goongerah to Orbost, but it was many years before it became trafficable to drays.

The Orbost Shipping Company was formed in 1880 and comprised two vessels - the schooner *Orbost* built at Paynesville and the ketch *Endeavour* built by Samuel Richardson at Tabbara. Both were designed to enable them to negotiate the sand-bar at the mouth of the Snowy River. The company transported bags of maize grown on the Snowy River flats as far upstream as Bete Bolong. The Shipping Company eventually ceased operation in 1915.

As mentioned earlier, the timber industry expanded rapidly with the extension of the railway to Orbost, but as wood within wagon-reach of the railway became scarce, the sleeper carters invested in motor lorries. By 1935 the Forests Commission was assisting in the establishment of access roads to suitable stands of timber.

The timber trestle railway bridges on the Orbost--Bairnsdale railway line built between 1914 and 1916 comprise an impressive series of bridges, which compare favourably in both



*Wagons crossing
the sealed mouth
of Lake Tyers
around the turn
of the century*



*The Stony Creek
Timber Trestle
Bridge is on the
Orbost--Bairnsdale
railway line (just
outside the study
area)*

number and size with those on the Wodonga--Cudgewa line in north-eastern Victoria. The two long flood-plain bridges are probably the longest timber trestle bridges in the State.

A number of timber trestle road bridges constructed by the then Country Roads Board around the 1920s are also of significance. Many of these are now being replaced by concrete bridges.

Tourism and recreation

The earliest use of hotels and guest houses by tourists in the region appears to have been in the Mallacoota area. In 1882, John Dorrin established a hotel at 'Lake View' on the eastern shore of Mallacoota Inlet. Access from Melbourne was by sea to the inlet. The original port was located at Gipsy Point and guests were taken from here by boat across the inlet to the hotel. A past Governor of Victoria, Sir James Carmichael, is reputed to have stayed at the hotel in

1910 as well as Sir Charles Barrett, 'father' of the Malla-coota Inlet National Park.

The introduction of motor transport and improvements to roads in the region meant that an increasing number of guests at the hotel arrived by car. However, the establishment of Malla-coota township and access road led to the development of a number of guest houses and hotels, which were able to compete favourably with 'Lake View'.

After transfer of the hotel licence to Malla-coota, Lake View was used as the Dorron family residence. The house and surrounding gardens, which are now within the Croajingolong National park, have recently been restored to near-original condition.

The Allans Head cemetery, also now within the Croajingolong National Park, contains the grave of John Dorron (owner of 'Lake View' hotel, who died in 1913), while the Gipsy Point cemetery includes the graves of Henry Bucknall (founder of the Gipsy Point settlement) and his family, E.H. Lees of Fairhaven (the government surveyor who marked out the township of Malla-coota), and other members of the Dorron family.

Since that time Malla-coota has continued to be a major focus for tourism and recreation in the region, although other areas, particularly along the coast, have also become popular.

The study area contains two of the State's long-established national parks, at Malla-coota and Wingan Inlet. Both were set aside in 1909, mainly in response to requests from conservation groups for the preservation of their natural features.

Alfred and Lind National Parks (named after prominent politicians of the day) were established in 1925 and 1926 respectively to protect significant botanical features. Captain James Cook National Park (at Point Hicks) was declared in the bicentenary of Cook's voyage (1970) and in 1979 was incorporated into the Croajingolong National Park, together with Malla-coota Inlet and Wingan Inlet.

Fishing

Commercial fishing probably began at Malla-coota Inlet in the 1880s and enjoyed mixed fortunes over the years, apart from two peak years - 1919 and 1948 - when record annual catches (mainly bream) were taken, after the fishing grounds had been rested during the two world wars.

Abalone-fishing may also date from the late 19th century; in those early years Chinese fishermen were prominent. Wingan Inlet has been fished from time to time, and oyster leases were held there about 70 years ago. During World War II, many of the inlets in the region were used for fish-farming to boost food supplies. Commercial abalone-fishing began in the 1960s and now supplies about one-third of Victoria's annual production.

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Part II
PHYSICAL AND BIOLOGICAL RESOURCES

4. LANDSCAPE EVOLUTION AND SOILS

In the previous descriptive resources report, the geology, physiography, and soils of the region were described in separate chapters. The following account attempts to integrate these and describe how contemporary land forms express geological processes, both past and present.

The account below briefly describes firstly, the geological history of the region and secondly, the four geomorphic units identified in the study area and their relationship to land use. The chapter is more readily understood by reference to Table 2 (Geological Time Scale), Map 3 (Land Systems and Land Zones), and the geological map sheets for the area (available from the Department of Industry, Technology and Resources). The East Gippsland region lies in the eastern portion of the Lachlan (or Tasman) Fold belt, a region with a complex Palaeozoic geological history. At least four main

Table 2

GEOLOGICAL TIME SCALE

Era	Period	Epoch	Age (million years)
Cainozoic	Quaternary	Recent	0.01
		Pleistocene	1.8
	Tertiary	Pliocene	5
		Miocene	24
		Oligocene	37
		Eocene	54
Palaeocene		65	
Mesozoic	Cretaceous		143
	Jurassic		212
	Triassic		247
Palaeozoic	Permian		289
	Carboniferous		367
	Devonian		416
	Silurian		446
	Ordovician		509
	Cambrian		575
Precambrian	Not outcropping in Victoria		

cycles of deposition and deformation are recognized, accompanied at times by igneous activity.

Palaeozoic

Ordovician

During the Ordovician, a thick sequence of marine sediments was deposited in a deep basin known as the Omeo Trough. Ordovician beds outcropping in the study area are several thousand metres thick and consist of marine siltstone and silty shale with feldspathic sandstone.

Fossils preserved in these sediments indicate a Middle to Upper Ordovician age, although no graptolites have been recorded east of Cape Conran.

The Ordovician sequence outcropping from Eden, N.S.W., south to Mallacoota Inlet - the Mallacoota Beds - is well exposed along the coast to the south-west of the Inlet. Much of the outcrop east of Cann River is masked by thin Tertiary cover, except where faulting has exposed several prominent wedges and larger blocks.

Tectonic activity in the Upper Devonian and Lower Silurian - the Benambran Deformation - resulted in the thick marine Ordovician sequence being tightly folded by strong compression, intruded by granite magmas, and partly metamorphosed in a high-temperature regime.

The strongest grade metamorphism caused complete recrystallization of the sediments to crystalline gneiss, while



Steeply dipping Ordovician sediments outcropping at the mouth of Shipwreck Creek

at lower strengths the original rocks were altered to low-grade phyllites and schists. On the eastern side of the Kuark metamorphic belt, Ordovician sediments merge laterally into metamorphic rocks. On the western side, a massive shear zone exists, separating high-grade gneisses from Ordovician sediments to the west.

Granitic rocks of various ages intrude the area of the metamorphic belt. Some granites have foliations parallel to those in the main belt, indicating intrusion before the effects of regional metamorphism had completely waned. Other younger granites are structureless, imposing their contact aureoles on the regionally metamorphosed rocks.

A strongly metamorphosed belt of Ordovician sediments extends south from the Ellery granodiorite through to Murrungowar (Kuark metamorphics).

These sediments are often steeply dipping, which accounts for much of the rugged terrain throughout the study area. Vegetation is generally sparse on the steep ridges where the bedrock outcrops, but is usually denser on the lower slopes where weathering has produced deeper soils.

Silurian

Outcrops of rocks formed during this period occur between Martins Creek and Sardine Creek, in the Buldah and Combienbar districts, an area to the west of Club Terrace and in the Genoa River catchment. They consist mainly of conglomerates, and sandstones with minor occurrences of limestone.

Devonian

Igneous massifs of Lower Devonian age intrude the Ordovician beds in the Genoa district, along the Mount Kaye--Mount Cann line, and in the Deddick River district. Outcrops of granite at Mount Raymond and Cape Conran are outliers of these intrusions. The Genoa Peak massif is considered to be of Lower Devonian age.

Upper Devonian intrusions also occur around Mount Ellery - the Ellery granodiorite - and in the far east of Gippsland, where the Gabo Island granite outcrops prominently and forms the Howe Range. Extensive tor fields with sparse tree cover have developed on a number of granitic intrusions such as the Mount Kaye Range and Mount Ellery. Weathering of the granitic rocks has, in some areas, produced extensive gravel deposits that are difficult to distinguish from Tertiary gravels, which often flank or cap the granitic rocks.

In about early to mid Devonian time, a further episode of crustal extension resulted in the last major deformation of eastern and central Victoria. This movement produced the Buchan Rift, a broad trough-like depression in which eruption of the acid Snowy River volcanics occurred. The volcanics are almost entirely sub-aerial rhyodacites, tuffs, rhyolites, and andesites, but contain some intercalated marine beds in their lower part - suggesting that much of



Exposure of Devonian granite, Cape Conran (foreground) and Ordovician sediments (top centre)

the region was at sea level. Thin sequences of Snowy River volcanics occur well outside the Buchan Rift, such as at Errinundra, suggesting also that the volcanics were originally extensive but quite thin outside the main rift.

Following the cessation of volcanic activity, further slight subsidence allowed the incursion of a shallow sea over much of the Buchan Rift, and probably extending well outside it. The essentially quiet-water shelf carbonate and mudstone sequence of the Buchan Group was deposited in this sea. At Errinundra a downfaulted remnant of the volcanics is interbedded with marine limestones.

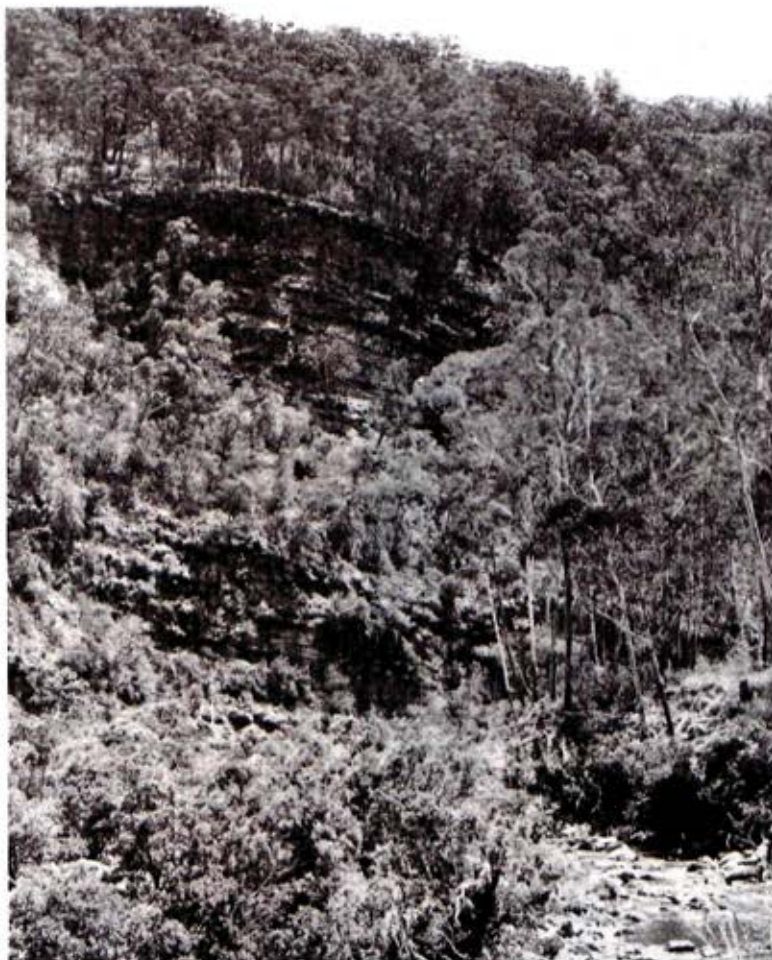
The Buchan Rift was deformed during the Middle Devonian Tabberabberan Orogeny, resulting in the development of broad folding in the Lower Devonian rocks and, possibly, producing second generation folding in the older rocks. Non-marine Upper Devonian beds occur in the Cann, Combiensbar, Bemm, and Genoa River valleys. Most have been preserved in downfaulted blocks and consist of essentially horizontal sandstones, shales, and some conglomerates.

Late Palaeozoic--Mesozoic

Broad regional uplift - probably in early Cretaceous time - set the first stage in the shaping of the Eastern Highlands, and initiated the period of erosion that continues to the present day.

Cainozoic

Remnants of the igneous activity known as the 'Older Basalts' occur east of Club Terrace and are of minor importance. Much more extensive are the Tertiary sands, gravels, semi-lateritic ironstones, and conglomerates.



*Horizontally bedded
Upper Devonian
sediments, Genoa
River Valley*

Fringing the coastal plain in the west, and extending to the highlands in the east, the Tertiary beds are often represented by little more than relic sandy soils, but also survive in pockets of well-bedded gravels and sand. Along the Princes Highway east of Genoa, and south of Wangarabell, the beds often contain fragments and logs of silicified wood. Marine beds are not known in this district, but limestones of Miocene age (Tambo River Formation, Gippsland limestone) form the cliffs on the western side of the Snowy River flats at Orbost and underlie the younger Tertiary sands and gravels to the west. The Tertiary sequence thickens rapidly to the south of this zone, which is a hinge-line or fault of major structural importance in the development of the Gippsland Basin.

Flights of alluvial and marine terraces, as well as sand barriers and coastal dune formations, reflect episodes of marine transgression and regression over the Pleistocene and Holocene periods. River mouths submerged during the Holocene marine transgression have been infilled to varying degrees by estuarine and deltaic sedimentation.

Geomorphic Units

Four major geomorphic units can be recognized in the study area and these correspond to the four land zones depicted on Map 3 (Land Zones and Land Systems). Sites of national or State geological and geomorphological significance in East Gippsland are listed in Appendix I.



The entrance to Mallacoota Inlet showing the delta islands and infilling of the estuary with Holocene sediment

Elevated tablelands

Extensive tablelands and plateaux occur in the north around Bendoc and Bonang and represent a continuation of the Monaro Tablelands, which occupy a large area of south-eastern New South Wales. The Errinundra Plateau forms part of the southern margin of these tableland areas. Isolated remnants of these tablelands occur around Mount Canterbury, the Bowen Ranges, and the Gelantipy Plateau, and have been isolated from the main body of the tablelands by stream dissection. The tablelands themselves are, in the main, gently undulating and are characterized by broad valleys and low divides - generally above 900 metres elevation. Some areas, for example Mount Delegate, exceed 1,200 metres and rise above the general level of the tablelands because of greater resistance to erosion than the surrounding terrain.

The rocks forming the tablelands consist mainly of folded Ordovician sandstones and mudstones with occasional outcrops of Devonian granites and granodiorites. The tablelands represent an ancient land surface that has subsequently been uplifted and subjected to stream dissection, resulting in the development of a steep escarpment on their southern margin. The escarpment is well developed in the headwaters of the Brodribb River and the Errinundra River.

The tablelands are gently back-tilted towards the north, with the result that streams flowing north off the tablelands have generally much lower gradients than those flowing south. On some of these - such as the Delegate River, Craigie Bog Creek, and Bonang River - extensive stream flats and bogs have developed; in contrast, the south-flowing streams have steep gradients and are characterized by numerous cascades and waterfalls.

Several features of local or regional geological and geomorphological significance occur in the area. For example, the Delegate River near Kirkenong Road displays the effect of differential erosion on broad landscape features. Here the river has eroded the softer granodiorite, but the more resistant Ordovician metamorphic rocks remain as a prominent ridge surrounding the basin.

Other significant features are located at Mount Delegate, Mount Bendoc, the Errinundra Plateau, and Mount Ellery. Both Mount Delegate and Mount Bendoc are associated with mining activity - for gold at Mount Delegate and bismuth and wolfram at Mount Bendoc. Mount Delegate also has regional significance, being a monadnock of resistant rock rising above the tablelands and displaying a radial drainage pattern. The Errinundra Plateau shows the range of geomorphic features typical of the Monaro Tablelands. Mount Ellery is significant because of the well developed granitic tor field at its summit.

Agriculture and hardwood timber production are the major land uses on the plateau and both depend on fertile soils, high rainfall, and relatively flat land.



The elevated tablelands surrounding Mount Delegate, near Bendoc

The tablelands on the Errinundra, Kirkenong, and Cabanandra land systems consist mainly of friable well-structured red and brown gradational soils, which are well suited to development for pasture land and, in some cases, for orchards or broad-area cropping. However, the short growing season associated with the higher elevations limits agricultural potential. The Moonkan land system supports similar but somewhat more stony gradational soils on slopes that are generally too steep for agriculture, but some areas are important for timber production.

Dissected highlands

Deeply dissected mountainous terrain characterizes much of the northern and central parts of the study area. Relief is greatest in the northern parts around the margins of the tablelands, where differences of 600 to 800 metres between the edge of the plateaux and valley floors are common. The highlands steadily decrease in elevation towards the coast and relief is more subdued.



*Dissected ranges
south of the
Errinundra
Plateau*

Having descended abruptly from the tablelands, most of the major streams flow in relatively broad valleys with quite extensive alluvial flats. Stands of warm temperate rain-forest occupy many of these stream flats, particularly along the Bemm, Brodribb, Thurra, and Wingan Rivers and also on many of the smaller creeks throughout the area, especially east of Mallacoota Inlet. The general pattern of dissection is complex and is related to variations in geology across the area. For example, the Ordovician sediments tend to be more deeply dissected than the Devonian igneous rocks.

Periodic elevation by tectonic forces and differential erosion of various rock types have been the most important factors in the geomorphic evolution of this region. A number of isolated intermontane basins occur throughout the dissected highland areas and their development is mainly the result of differential erosion, although the boundaries of some have been determined by faulting and their development is therefore structurally controlled. The Combienbar,

Buldah, and Goongerah basins are structurally controlled. Within these intermontane basins the topography is generally subdued, with broad valley floors and rounded hills.

The geology of the dissected highlands consists mainly of folded Ordovician sediments and granitic intrusions, the largest of which occur in the Cann River valley, the Genoa River valley, and the Wingan River catchment. Outcrops of horizontally bedded Silurian conglomerates and sandstones occur in the Buldah and Combiensbar districts, in the area west of Club Terrace, and in the Genoa River catchment. An outcrop of metamorphic rocks running south from Mount Ellery to just west of the township of Cabbage Tree has been protected from erosion by downfaulting.

The bulk of the dissected highland areas is still public land, mainly because the terrain is too rugged to be cleared for agriculture. Some of the intermontane basins and sections of the alluviated valleys along the major streams throughout the highlands have been alienated for agriculture, however, primarily because of gentler slopes and better soils. Much of the area supports mixed eucalypt forests which are suitable for timber production.

Numerous features of geological and geomorphological significance occur here. Examples include the course of the Snowy River between Campbell Knob and Lucas Point, which displays the variation in river valley morphology resulting from the range of rock types encountered in the area. The easternmost occurrence of Tertiary older volcanics in the State is located just to the west of Club Terrace township, while exposures of various Palaeozoic sediments in the Yalmy catchment, and the structural and lithological control of the drainage system, are of regional significance. Graptolite-bearing Ordovician sediments are rare in the study area. However, a site at McLaughlan Creek on the eastern edge of the Tingaringy National Park contains some fossils and further investigation of the area may provide important stratigraphical information. Mount Tingaringy is a site of regional significance, providing extensive outcrops of Ordovician sandstones, shales, and slates that are elsewhere poorly exposed.

The dissected ranges contain predominantly red and brown gradational soils, although some duplex soils occur in the Deddick valley on the Tubbut and Jingallala land systems. Agricultural potential is limited by steep slopes on most land systems, although the Tubbut land system in the drier north-west has some potential for further pasture development. This area is at best, however, marginal agricultural land. The gentler slopes on the Pinnak and Wurrin land systems could be considered marginally suitable for agriculture.

Piedmont downs

This geomorphic unit corresponds to the Bralak land zone on Map 3 and consists of a series of relatively low, gently undulating terraces with subdued topography. The piedmont

downs - located along the southern margins of the dissected highlands - have been uplifted and partially dissected, and form a continuous topographic feature across the whole of the study area. They correspond to a series of gravels and sands deposited in late Tertiary times and were derived as a result of tectonic uplift and subsequent deep dissection in the highlands to the north. These alluvial sediments form a capping over the older rocks along the highlands margin and increase in thickness towards the south. Continued erosion of such deposits adjacent to the highland front has exposed the underlying Palaeozoic rocks. Remnant cappings of Tertiary sediments are common throughout, however, particularly in the area north of Bete Bolong.

Towards the coast, the Tertiary sediments comprising these downs pass beneath a veneer of sand dunes and sheets of Pleistocene age. Much of this unit supports eucalypt forests which are used for timber production and represent ecological units found only in this part of the State. Features of geological and geomorphological significance include a site along the Yeerung River that clearly displays the relation between the Palaeozoic rocks and the overlying Tertiary sediments forming the piedmont downs. The area between Cape Conran and the Princes Highway shows the relation between the Tertiary sediments and the younger dune sands, which increase in thickness towards the coast.



Tertiary sediments exposed in a road cutting, Yeerung River catchment

A site at Maramingo provides one of the best exposures of the sediments comprising the piedmont downs. The outcrop, in a road cutting, consists of unconsolidated quartz gravels, grits, and sands that exhibit obvious current bedding. Two silicified tree trunks are embedded in the deposit.

Gradational and duplex soils dominate throughout this geomorphic unit. Earthy brown or yellowish brown gradational soils and occasionally brown loams are common on the Noorinbee land system, which is best developed in the Snowy and Cann valleys. This land system has a high agricultural productivity and most of it has already been cleared for agriculture. The reddish brown or yellowish brown duplex

soils of the Waygara land system are suitable for development as pasture but not for cropping. The areas of leached sands occurring within this land system have a high wind erosion hazard. The gradational soils occurring within the Wooyoot land system have marginal agricultural potential, while the areas of leached sands are considered unsuitable.

Coastal plains

The coastal plains in East Gippsland are relatively narrow and consist mainly of sandy deposits of Quaternary age. The oldest deposits - a series of dunes - form a veneer overlying Tertiary sands and gravels. They developed under the influence of dominant south-westerly winds. These dune ridges and intervening swales, which are clearly displayed along the Cape Conran--Cabbage Tree road, have been substantially modified by subsequent wind action, but the general trend of the ridges remains evident. Extensive swamps and wet heaths have developed in the swales while eucalypt forests and banksia woodlands dominate the sandy ridges. The dune complex extends from Point Ricardo near Marlo to Tamboon Inlet.

A sandy barrier capped by dunes stretches from Lake Tyers to Point Ricardo. Extensive swamps and lagoons have formed behind the barrier as a result of the blocking or diversion of streams in the area. A coastal bluff bordering the landward side of the lagoons and swamps marks the former position of the shoreline prior to the development of the sandy barrier enclosing Ewing Marsh. Remnants of an earlier barrier that developed immediately in front of the former sea cliff occur near the mouth of Simpson Creek south of Waygara.

The outer barrier often consists of several parallel ridges - for example, in the area between Marlo and Cape Conran.



Vegetated Quaternary dunes with intervening swamps and heathlands, Marlo Plains



*The outer barrier,
Ewing Marsh,
remnant inner
barrier and coastal
bluff, south of
Waygara*



*Extensive dune-
fields, Lake
Barracoota and Howe
Flat, east of
Mallacoota Inlet*

Where a large supply of sediment persists, however, extensive dune-fields have developed like those at Point Hicks, Sandpatch Point, and east of Mallacoota Inlet. The mouths of most streams flowing towards the coast have been blocked or diverted by the development of the outer barrier or extensive dune-fields, which display either parabolic or transverse dune forms.

Between Lake Tyers and Marlo the streams have been completely defeated, resulting in the formation of Ewing Marsh. Along other parts of the coast, streams with greater dis-

charges have an outlet to the sea through the outer barrier, but many such outlets are periodically closed. Numerous coastal lagoons and estuaries have developed along the coast in response to the blockage of stream outlets.

Many sites of geological and geomorphological significance occur within this unit. Sites along the coast that display the regional geology and geomorphic history of the area include the Howe Flat--Mallacoota Inlet complex, the dune-fields at Point Hicks and Cape Howe, and the outcrops of Ordovician sediments between Mallacoota Inlet and Sandpatch Point. A number of the sites are of State significance and they often show a clear relation between coastal processes (both past and present) and the land forms occurring today.

The coastal plains have significant nature conservation value, and a considerable proportion is included in the Croajingolong National Park.

Uniform soils, mainly in the form of leached sands or undifferentiated sands, dominate the coastal plains unit. They are considered unsuitable for agriculture because of low inherent fertility, susceptibility to periodic flooding, and the saline nature of some of the soils.

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5. CLIMATE

The climate of East Gippsland differs in many ways from that of the rest of the State; it is more characteristic of climatic conditions along the southern New South Wales coast, being influenced by vigorous depressions off the coast and an inflow of warm, moist subtropical air from the Tasman sea. Most rainfall originates from these atmospheric depressions and their occurrence has no seasonal trend. Rainfall is thus distributed fairly evenly throughout the year and is relatively plentiful, except in the north-west of the area. Winters are generally mild near the coast, often more so than other parts of the State, while summers are hot. Temperature ranges are more extreme, in both winter and summer, in the more elevated northern parts of the study area. Snowfalls occur on country above 600 metres. Droughts are relatively common on the tablelands and in rainshadow country, although severe droughts (such as occurred in 1982/83) can affect the whole area.

Detailed climatic information for the study area is lacking due to the small number of meteorological recording stations. Only two stations, Orbost and Gabo Island, have long-term temperature records. Rainfall records have been taken at a greater number of places, but such places are usually restricted to the major valleys and lowland areas. As a result, climatic information for the East Gippsland area is far from complete.

Precipitation

Precipitation mainly takes the form of rain, although snow falls on the higher peaks and plateaux in winter. Rainfall is fairly evenly distributed month by month in most areas (see Table 3) and is reasonably plentiful although somewhat unreliable. Its general pattern in the study area is reflected in the different mean annual rainfall statistics



*Snow on the
Errinundra Plateau*

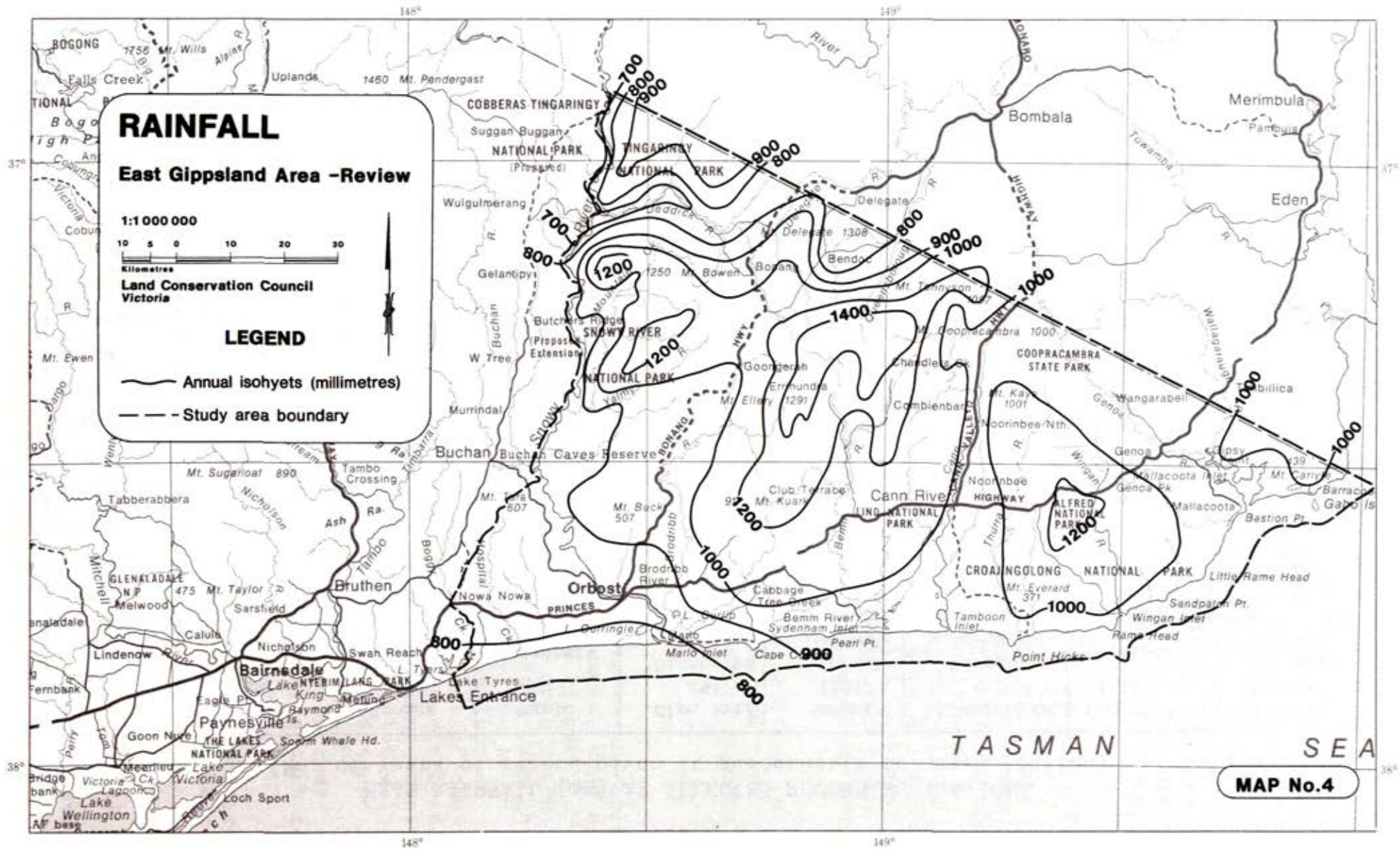


Table 3

MEAN RAINFALL (mm) AT SELECTED RECORDING STATIONS
(No. of years of record given in parenthesis for each station)

Month	Tubbut (26) North-west rainshadow	Bonang (83) Plateau	Marlo (45) Coastal	Glen Arte (9) Dissected ranges	Genoa (53) Coastal lowlands	Combienbar (13) Dissected ranges	Gabo I (111) Coastal	Orbost (89) Coastal lowlands
January	69	71	64	98	76	57	70	70
February	55	68	58	88	68	69	69	66
March	52	67	69	96	77	65	72	68
April	48	72	68	75	68	58	79	71
May	50	81	76	139	86	108	102	72
June	50	103	68	91	104	141	109	82
July	47	90	62	95	73	120	85	66
August	54	74	55	134	78	94	75	59
September	51	78	65	114	70	113	72	69
October	59	85	73	119	79	102	75	78
November	68	78	61	114	73	106	69	68
December	75	79	61	155	74	106	68	77
YEAR	678	946	780	1,318	926	1,139	945	846

shown in Table 3 and also on Map 4. The coastal and adjacent lowland areas generally receive between 800 and 1,000 mm per annum. The dissected ranges further inland receive between 1,000 and 1,400 mm, while rainfall in the north-west - in the Deddick catchment and the Upper Snowy River area - is generally less than 900 mm due to a rainshadow effect. Rainfall on the elevated plateau centred on the Gunmark Range and Coast Range generally exceeds 1,000 mm. Unfortunately, no reliable rainfall records exist for this plateau area, but it has been suggested that certain parts may receive up to 2,000 mm per annum.

Most precipitation in East Gippsland originates from depressions centred off the east coast of Australia. These may have passed through Bass Strait and intensified near Gabo Island, but more commonly depressions develop off the New South Wales coast and move southwards. When the centre of such a depression lies just south-east of Gabo Island, a vigorous southerly airstream flows across East Gippsland. This air, which is relatively warm, picks up moisture during its passage across the Tasman Sea, which results in heavy rainfall over most of the study area but particularly between Orbost and Cann River. Such coastal depressions can originate throughout the year.

Total 24-hour falls that exceed 76 mm occur more often in East Gippsland than in other parts of the State and frequently result in rapid rises in the short coastal streams such as the Brodribb, Bemm, and Cann Rivers.

Effective rainfall

In addition to rainfall, the amount of moisture in the soil available to plants depends on a number of factors, such as evaporation, slope of the ground, and the type of soil. Variations in the length of growing season are most often climatic in origin - with distribution of rainfall throughout the year being a prime determinant. 'Effective rainfall' - a widely accepted measure of the availability of moisture to plants - is often used as an indicator of the length of growing season. It is based on both rainfall and evaporation figures, and is defined as the amount necessary to start germination and to maintain growth above the wilting point of plants. The growing season is deemed to be the period during which rainfall has a better than 50% chance of exceeding the effective amount, plus a further period when water stored in the soil allows plant growth to continue.

Effective rainfall estimates provide a useful guide for crop and pasture growth, but are not ideal indicators of conditions affecting other plant species, particularly deep-rooted perennials.

As Table 3 indicates, the study area has a long potential growing season throughout - even in the rainshadow areas. Length of growing season is also influenced by temperature, however, and this is a limiting factor in some areas, particularly in the winter months.

Table 4

MEAN TEMPERATURES ($^{\circ}\text{C}$)
(No. of years of record given in parenthesis for most stations)

Station		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Gabo I (82)	Max	21.1	21.4	20.9	19.1	16.8	13.2	14.0	14.6	15.8	17.1	18.3	19.8	17.7
	Min	15.5	16.0	15.3	13.3	10.9	7.8	8.0	8.4	9.6	11.0	12.5	14.2	11.9
	Mean	18.3	18.7	13.1	16.2	13.9	10.5	11.0	11.5	12.7	14.1	15.4	17.0	14.8
Orbost (31)	Max	25.1	24.9	23.6	20.5	17.3	14.0	14.4	15.5	17.5	19.4	21.2	23.3	19.8
	Min	12.6	13.1	11.7	9.0	6.7	4.9	3.9	4.5	5.9	8.0	9.8	11.4	8.5
	Mean	18.9	19.0	17.7	14.8	12.0	9.9	9.2	10.0	11.7	13.7	15.5	17.4	14.2
Nowa Nowa (7)	Max	25.4	24.7	24.1	20.5	17.3	14.5	14.8	15.8	18.6	20.3	21.4	24.4	20.1
	Min	11.3	12.4	11.1	7.8	5.9	3.8	2.0	2.6	4.2	6.9	8.5	10.3	7.2
	Mean	18.4	18.6	17.6	14.2	11.6	9.2	8.4	9.2	11.4	13.6	15.0	17.3	13.7
Cann River (5)	Max	25.9	24.5	24.5	20.1	16.3	13.7	13.5	14.4	17.9	19.6	20.0	24.3	19.6
	Min	12.1	12.8	11.4	7.8	5.7	4.3	2.3	2.9	4.9	7.5	8.8	10.8	7.6
	Mean	19.0	18.7	18.0	14.0	11.0	9.0	7.9	8.7	11.4	13.6	14.9	17.6	13.6
Bendoc	Max	22.6	24.2	21.5	17.0	13.7	10.8	9.1	10.4	13.9	17.2	19.2	23.3	16.9
	Min	7.3	8.4	5.3	2.6	0.0	-1.5	-2.8	-1.0	0.9	3.8	3.5	7.8	2.9
	Mean	14.9	16.3	13.4	9.8	6.8	4.6	6.7	4.7	6.5	6.7	11.3	15.5	9.9
Point Hicks	Max	23.4	24.1	21.6	20.4	16.3	14.3	13.9	14.5	16.0	18.2	19.1	21.5	18.6
	Min	15.6	16.0	14.7	13.2	10.2	8.2	7.7	7.7	8.6	10.6	11.9	13.6	11.5
	Mean	19.5	20.0	18.1	16.8	13.2	11.2	10.8	11.1	12.3	14.4	15.5	17.5	15.0

Temperature

The very few temperature-recording stations that do exist within the study area are concentrated along the coast or the nearby lowlands. Table 4 does, however, provide information for Bendoc, the only recording station on the elevated tablelands.

Temperatures along the coast are generally moderate, mainly due to the influence of the sea. Further inland, temperature ranges increase, with the greatest range recorded at Bendoc - nearly twice the range of Gabo Island. Maximum temperatures are generally greatest in the coastal lowlands such as at Nowa Nowa, Orbost, and Cann River. Winter temperatures in the lowlands rise when northerly or north-westerly winds become warmer as they descend from the ranges. This is known as the Fohn effect, and sometimes results in East Gippsland being the warmest part of the State.

If 10°C is taken as the mean monthly temperature below which plant growth is severely restricted, it becomes clear from Table 4 that the months of June, July, and August would be considered too cold for plant growth in the lowland areas, while on the tablelands this period extends between April and September exclusively.

Frosts at Orbost generally occur only between April and September, with an average of 30 per year, while at Bendoc they can occur at almost any time of the year. Snowfalls are rare over the lowland country, but are common in winter at elevations above 600 metres.

Prevailing winds

Along much of the coast extensive dune fields (both active and stabilized) have developed throughout the Quaternary in response to prevailing winds from the south-west. The past dune systems display a similar orientation to those of today, indicating that processes involved in the development of the dunes have remained relatively constant for a considerable period of time. In the summer months, however, from about November through to March, strong easterly winds are common along the East Gippsland coast, and these can produce considerable modification of dune crests.

Many of the large dune systems such as those at Point Hicks and Cape Howe are moving rapidly north-eastwards under the influence of the onshore south-westerlies. Movement of sediment along the coast by current action is also influenced by the dominant south-westerly winds and this accounts for the deflection of many stream outlets toward the east, such as occurs at Wingan Inlet, Sydenham Inlet, Tamboon Inlet, and the mouth of the Snowy River.

The influence of climate

The pattern of rainfall across the study area has a profound influence on the distribution of vegetation, as a comparison of Maps 4 and 5 reveals. The wetter forests are gener-



Extensive dune fields developed under the influence of dominant south-westerly winds, Point Hicks

ally confined to the dissected range and higher peaks that receive high rainfall, while the dry sclerophyll forests and woodlands occur mainly in the north-west in the rainshadow country around the Deddick and Snowy River valleys. The coastal forests and woodlands are confined to a relatively narrow belt on the coastal plain, which seldom extends more than 25 km inland, where coastal influences moderate the climate.

Droughts produce extremely dry forest fuel conditions and increase the intensity and difficulty of controlling forest fires. The Cann River fires in February and March 1983, which were the most extensive for more than 40 years, followed 5 years of generally reduced rainfall and a period of substantially below-average falls from April 1982 to March 1983. The marked departure from normal rainfall in the months preceding the fires, shown in Table 5, was a major factor in the extreme fire behaviour and the difficulty experienced in bringing the fires under control.

Drought can also have a severe impact on agricultural production in the area, which can often lead to increased demands on public land for cattle and sheep grazing. Production on the Snowy River and Cann River flats is less susceptible than elsewhere, owing to the availability of irrigation water. However, in the last 12 years the whole shire has been declared a drought area on four separate occasions; in 1972/73, 1976, 1980 and 1982/83.

The prolonged drought in 1981/82 and 1982/83 severely reduced the number of people using the Snowy River and Tingaringy National Parks due to a lack of water in the Snowy River for water-based recreation. Other popular recreation areas, particularly those away from the coast, probably suffered in the same way.

Table 5

AVERAGE DISTRICT RAINFALL MARCH 1982 TO APRIL 1983

Month	Actual (mm)	Normal (mm)	Departure from normal (%)
March 1982	134	63	+ 113
April 1982	27	61	- 56
May 1982	25	66	- 62
June 1982	55	69	- 20
July 1982	61	58	+ 5
August 1982	11	59	- 81
September 1982	52	61	- 15
October 1982	46	74	- 38
November 1982	10	73	- 86
December 1982	49	71	- 31
January 1983	40	64	- 37
February 1983	16	55	- 71
March 1983	85	63	+ 35
April 1983	102	60	+ 70

Climate also determines to a certain extent the suitability of various areas for particular agricultural pursuits. For example, dairying and beef production predominates in the wetter parts while sheep are more important in the rain-shadow country in the north-west.

Crop production is generally confined to the lowland areas, which have a longer growing season and fewer frosts.

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6. WATER RESOURCES AND UTILIZATION

Character of the catchments

Apart from those of the largest rivers here, such as the Snowy, Cann, Genoa, and Wallagaraugh, the catchments of most streams occur entirely within the study area.

The largest river in East Gippsland is the Snowy, which is almost 500 km long, from its source in New South Wales to its mouth at Marlo. Its major tributaries within the study area are the Deddick River, Mountain Creek, Rodger River, Yalmy River, and Serpentine Creek. Several streams - such as the Delegate River, Bendoc River, Queensborough River, and Craigie Bog Creek - rise on the Errinundra Plateau and flow north into New South Wales, where they join with the Snowy via the Bombala River. Brodribb River also rises on the Errinundra Plateau, but flows south to join the Snowy near the coast at Marlo.

Bemm River, which flows into Sydenham Inlet, is formed by the confluence of Combienbar and Errinundra Rivers.

While the east branch of the Cann River rises in New South Wales, the west branch originates on the south side of the Coast Range. The two branches join at Weeragua and flow south toward to the coast and into Tamboon Inlet. Genoa River also rises in New South Wales and flows through a spectacular gorge before entering Mallacoota Inlet.

Numerous other streams of variable size - such as the Wingan, Thurra, Mueller, Little, Red, and Bendedore Rivers - occur in the area. Irrespective of discharge, all East Gippsland streams enter coastal lagoons or inlets, the mouths of which may at times be blocked by sandy barriers.

Most catchments within the study area are short and steep and these factors, in combination with heavy general rains, often result in considerable flooding. Owing to the generally steep gradient of the streams, the floods travel rapidly and, because the rivers often flow in deep valleys or gorges for much of their length, no appreciable ponding of floodwaters takes place over stream-flats; thus, very high peak flows can develop.

Serious flooding has occurred only in the lower reaches of the Snowy, Cann, and Genoa Rivers and, although they recede fairly rapidly, the flood-waters may cause considerable damage.

Significance of the streams and catchments

A report recently produced by the Standing Consultative Committee on River Improvement, entitled 'The State of the



The essentially undisturbed catchment of the Snowy River

Rivers', states that 'the hydraulic and environmental characteristics of most Victorian Rivers have changed dramatically since settlement. Moreover, the present condition of many of the rivers and their frontages is unsatisfactory and is becoming steadily worse with each flood'.

Many catchments throughout the State have been substantially modified from their original condition, primarily to meet the needs of the growing population.

By contrast, however, many catchments in East Gippsland are still predominantly forested and, although many have been subjected to various forms of human disturbance, some remain in an essentially natural condition. They therefore constitute an invaluable resource as reference catchments against which to judge the state of many other streams in south-eastern Australia.

Of the 36 species of native 'fresh-water' fish listed by McDowall (1980) as occurring in streams draining southern New South Wales and Victoria, 25 have been recorded in East Gippsland. Furthermore, only three exotic species have been recorded and their distributions are limited. The introduced brown trout and rainbow trout are widespread in south-eastern Australia, thus increasing the significance of those East Gippsland streams in which they do not occur.

Information about the fresh-water invertebrate fauna is very limited, but what little work has been done suggests that many undescribed species will be identified. Its range of climate and habitat types and its geographical position also

suggest that the East Gippsland region is an important transition area between different climatic zones, and harbours several different groups of species at the limit of their ranges.

Deterioration of the State's rivers has stemmed from a lack of understanding about stream-flow characteristics and the effects of various activities on both the channel and the catchment as a whole. Human interference to natural aquatic systems has created imbalances that result in drastic changes to stream flow, sediment yield, habitat, and other environmental values. River Improvement Trusts have been established since the 1950s to attempt to remedy these problems and to try to re-establish stable stream regimes, but limited finance has meant that expenditure on rivers has been directed not towards prevention but rather towards patching up and repairs after the damage has been done. Maintenance of river improvement works has also been neglected, with the result that they deteriorate or become totally ineffective.

Another major problem that has arisen is that often river improvement works are carried out in one part of a catchment without adequate knowledge of the hydraulic characteristics of the catchment as a whole. In many cases erosion or siltation problems in a particular area result from poor management practices further upstream in the catchment. Carrying out improvement works in that area, although essential in the short term, does nothing to alleviate the source of the problem in the longer term. It is therefore essential that any works carried out in a catchment be co-ordinated, in order to make sufficient knowledge available to implement a systematic river management strategy for each catchment in the State.

A task force appointed by the Minister for Water Resources is currently considering the Public Bodies Review Committee's 8th Report, which recommends the rationalization of water board boundaries to include entire catchments within the boundary of a single board to ensure such co-ordination of planning for river improvement, drainage, and flood-plain management. With regard to East Gippsland, the report proposes that the Snowy River Catchment Board manage the whole of that catchment within Victoria, while the East Gippsland Catchment Board would control the remaining catchments east of the Snowy. These bodies are in the final stages of completing Management Strategy Plans. The plans will take into account the characteristics of each catchment and the stream management problems throughout it, and aim at developing a co-ordinated plan for future stream management.

Stream-flow records

Table 6 shows stream-flow data for selected gauging stations, including two long-term records for the Snowy River - at Jarrahmond and MacKillop Bridge. These records do not accurately reflect present catchment conditions, as they contain data collected prior to establishment of the Snowy Mountains Hydro-Electric Scheme, which stores and diverts

water from the upper Snowy River. That scheme affects only 14% of the total Snowy River catchment of 1.4 million ha above Orbost, but it has been estimated that about half of the annual flow of the river came from this area. Water yield from the remainder of the catchment, which is partly in a rainshadow, is rather poor except when general rains occur.

Due to the great variability of stream flow, short-term records are usually unreliable indicators of normal or average conditions. Even the relatively long-term records may be significantly changed by later information. The data in Table 6 should therefore be viewed in this light and be seen as indicative only.

In addition to those listed in Table 6, stream-gauging stations are in operation on the Errinundra, Cann (east branch and downstream of Cann River township), Wingan, Goolengook, and Rodger Rivers.

Water quality

A range of criteria can be used to characterize water quality, including levels of suspended sediment, turbidity, bacterial indicator organisms, dissolved ions, organic matter, dissolved oxygen, acidity, and colour. The criteria selected for measurement depend on the use of the water and the perceived quality problems.

Water used for an untreated domestic supply, for example, should meet certain health standards for bacterial levels, as well as acceptability standards including turbidity, dissolved ion, and colour levels. Water used for irrigated agriculture must have a dissolved ion (or total dissolved solids - T.D.S.) level less than the tolerable limit for the particular crop under irrigation.

The specific dissolved ions present can also be important, as well as the total concentrations. Increased levels of dissolved nitrogen and phosphorus can stimulate excessive algal growth in streams and in stored water; too much iron in domestic supply can cause colour, deposits, taste, and discolouration of fabrics.

In the East Gippsland area, T.D.S. level is the most commonly recorded indicator of chemical water quality. Regular T.D.S. observations are carried out on the more important streams in the area and records are available for the Snowy, Brodribb, Rocky, Deddick, Bemm, Cann, Errinundra, Genoa, Thurra, and Betka Rivers. The average amounts of total dissolved solids in these rivers range from 65 to 170 mg per litre; these amounts increase slightly during the seawards passage of the rivers. Water with T.D.S. levels less than 1,000 mg per litre is suitable for domestic, industrial, livestock, and irrigation uses.

In March 1968, during a drought, salinity of all flowing streams in the area and of pools originating from these streams was tested, and even at those very low stages the

Table 6

STREAM-FLOW DATA FOR SELECTED GAUGING STATIONS TO DECEMBER 1983

Stream	Gauging point	Years recorded	Catchment area (sq.km)	Annual discharge (ML)			Minimum monthly discharge (ML)	Peak flow (ML/day)
				Maximum	Minimum	Mean		
Cann River (west branch)	Weeragua	62	311	178,000	8,260	59,700	28	53,800
Genoa River	The Gorge	11	837	475,000	19,000	173,000	1	98,800
Bemm River	Princes Highway	9	725	453,000	65,000	170,000	1,120	31,100
Snowy River	Jarrahmond	61	13,421	5,930,000	159,000	1,750,000	1,050	648,000
Brodribb River	Sardine Creek	61	658	356,000	38,400	134,000	775	52,200
Snowy River	MacKillop Bridge	42	10,619	2,560,000	106,000	93,000	1,240	661,000
Deddick River	Deddick (Casey's)	19	857	227,000	9,330	79,900	119	36,600
Snowy River	downstream of Basin Creek	5	11,964	373,000	129,000	263,000	2,170	161,000

highest salinity observed was only 365 p.p.m. Quality of the streams used for domestic supply is generally good.

In addition to the above criteria for water quality for a particular use, the in-stream quality of water is important for the stream biota. In natural streams the biota depend on the stream organic matter budget and inputs of sunlight, nutrients, and inorganic sediment. The most effective way of measuring water quality for stream biota is to quantify the biota by biological monitoring, rather than to measure individual water quality criteria.

In East Gippsland streams, very little biological monitoring has been carried out. Some preliminary work, however, indicates that large-scale disturbance of natural catchments has an impact on the stream biota by increasing sediment, nutrient, and incident sunlight levels. These effects may be short-lived, and further work is necessary before any firm conclusions are reached.

Groundwater

Because there has been little need to exploit underground water, little exploratory work has been done. Geological considerations make it probable, however, that reserves of groundwater lie beneath many of the Tertiary and Quaternary alluvial deposits.

Water Utilization

Domestic supplies

A number of towns within the study area have a reticulated water supply. These are:

- Orbost
- Newmerella
- Marlo
- Bemm River
- Cann River
- Mallacoota

Supplies for the first three towns listed come from a diversion weir located on the Rocky River. Water gravitates through a 20-km pipeline to a 53-ML service basin. The system is controlled by the Orbost Water Board and may be augmented by water pumped from the Brodribb River at Orbost. Investigations are currently under way to improve the Orbost water supply, either by duplicating the existing gravity main from the diversion weir, or by constructing a storage on Rocky River. At Bemm River water is pumped from the Bemm River to a 6.8-ML service basin, from where it is reticulated to the town.

The water supply for Cann River township comes from Cann River and is pumped to a 2.3-ML service basin. It is then reticulated throughout the town. Supply is controlled by the Cann Valley Water Board, which is currently experiencing problems in obtaining sufficient water in the summer months.

Several options such as the use of groundwater, or alternative stream offtakes on Back Creek or Deep Creek, are currently being considered to improve the supply to the township.

Mallacoota Water Board controls a pumping station on the Betka River, which supplies water to two service basins (23 and 41 ML capacity respectively) for use in the township of Mallacoota. The Board can be augmented this from two groundwater bores, and is currently investigating a proposal for increased service storage. None of these supplies requires chlorination at the present time.

The Rocky River, Betka River, and Cann River catchments have been proclaimed, and investigation of the Bemm and Brodrigg catchments is in progress.

Irrigation

East Gippsland generally has relatively plentiful rain, and conditions are usually satisfactory for crop or pasture growth. In addition, much of the agricultural land is on hilly country, and thus has limited potential for irrigation development. It can be beneficial, however, as dry periods may occur at any time of the year.

In 1982/83, 803 ha of land was irrigated (committing 4,850 megalitres of water per annum). The area under irrigated pasture, and consequently the volume of water utilized, has more than doubled in the last 10 years. At least part of the increase can be attributed to the severe drought conditions in 1982/83. Most of the irrigated pasture is located on the Snowy River floodplain around Orbost and along the Cann River flats.

In addition, there are 35 stream diversion permits for domestic, dairy, and industrial purposes. Of these, 34 draw water from the Snowy while the majority of the rest extract



Irrigated pasture on the Cann River Flats

from the Cann or Genoa Rivers. The total volume available under all permits is about 5,360 ML annually. An additional but rather insignificant amount is removed under riparian rights, which are entitlements available to properties alienated prior to 1881. Water requirements for irrigation are likely to increase further as cultivation of the Snowy River flats is extended.

On-farm storage of run-off in dams is an important source of water for stock. Currently, the area does not contain any licensed bores or major water storages.

It will be important to ensure that the quantity and quality of all water supplies are maintained at adequate levels. As mentioned above, this may involve providing for further catchment and/or storage capacity in some cases, and certain activities may need to be controlled in the water supply catchments. A close watch will also need to be kept on water table and salinity levels as the area under irrigation expands.

7. VEGETATION

The vegetation of the East Gippsland area is remarkably varied. The combination of topography and climate, which is more typical of the coast of New South Wales than of the rest of Victoria, results in a complex pattern of vegetation types (or plant communities). Although the East Gippsland study area comprises only about 4% of the State, more than one-third of the plant species recorded in Victoria occur there. Many have their only Victorian occurrence in East Gippsland. The fact that some 88% of the study area is public land probably accounts for the high number of species present.

The Council's original descriptive report for the study area described the vegetation on public land in detail. In that report, vegetation was classified and mapped by a number of structural forms based on the height and form of the tallest stratum and on the percentage of projected foliage cover. That classification, shown in Table 7, is a modification of the one developed by Specht. Maps 5a and 5b depict the distribution of vegetation on public land by the major species comprising the tallest stratum.

While the previous report gave a brief list of the understorey species occurring in association with each structural form, it did not group the vegetation into communities.

More recently, however, the National Herbarium has completed a vegetation survey of the Gippsland area east of the Omeo Highway, which described some 21 separate plant communities (Forbes *et al.* 1981). Subsequent work by the Herbarium enabled the production of a map (described below), which shows the distribution of each community in East Gippsland. In contrast to Maps 5a and 5b, which depict structural vegetation units only, the communities described by the National Herbarium comprise both structurally and floristically distinct types of vegetation that reflect a broad set of environmental conditions.

Identification of each community relies on the frequency of occurrence of both overstorey and understorey species, not just the major species in the tallest stratum. The map in the back pocket of this report titled 'A Floristic Vegetation Map of East Gippsland' shows the distribution of each of the 21 communities and lists the character species that define them. In some cases, these communities have been further subdivided into a number of sub-communities that reflect more subtle changes in the vegetation composition. The list of character species in each is shown on the Herbarium map and each is depicted by a number; for example, coastal heathland has four sub-communities, while snow gum woodland has only two. However, the sub-communities have not been mapped due to limitations of map scale.

Table 7

STRUCTURAL FORMS OF VEGETATION
[Modified from Specht (1970)]

Form and height of tallest stratum*	Projective foliage cover of tallest stratum			
	Dense (70--100%)	Mid dense (30--70%)	Sparse (10--30%)	Very sparse (<10%)
Trees**				
>40 m		Open forest IV		
28--40 m		Open forest III	Woodland III	Open woodland III
15--28 m	Closed forest	Open forest II	Woodland II	Open woodland II
5--15 m	Closed forest	Open forest I	Woodland I	Open woodland I
Shrubs**				
2--8 m	Closed scrub	Open scrub	Tall scrubland	Tall open shrubland
0--2 m	Closed heath	Open heath	Low scrubland	Low open shrubland
Herbs, including grasses, moss, ferns, lichens	Closed herbland, including: closed tussock grassland; herbfield; sedgeland	Herbland, including: tussock grassland; herbfield; sedgeland		

* Isolated trees (emergents) may project from the canopy of some communities. Heights are of mature communities.

** A tree is defined as a woody plant more than 5 m tall, usually with a single stem. A shrub is a woody plant less than 8 m tall, frequently with many stems arising at or near the base.

The National Herbarium map makes reference in the key to descriptions of communities on the reverse side. It should be noted, however, that only the map has been reproduced for this report as the community descriptions are included in the text below. It should also be noted that the map covers a larger region than the Council's East Gippsland study area, but the community descriptions below refer specifically to the land under review by Council - that is, broadly the area east of the Snowy River and Lake Tyers.

It is not intended in this report to give detailed descriptions of each of the structural forms occurring in the East Gippsland area, which appeared in the Council's original report. However, reference to them will be made in the appropriate community descriptions below and Table 8 shows the broad relation between the structural forms shown on Maps 5a

and 5b and the vegetation communities identified by the National Herbarium. Information about the most representative examples of each community and their conservation status is based on a report specially prepared for the Land Conservation Council (Moorrees 1984).

This chapter also includes an assessment of the sites of botanical significance identified by the National Herbarium, as well as information about the conservation status of the vegetation communities represented in each of these sites.

Vegetation Communities

1. Alpine wet heathland

This community occurs as closed heath or low woodlands of both sheltered and open sub-alpine plains, often on peaty poorly drained soils. It is confined to the Delegate River, Bidwell Creek, and Craigie Bog Creek catchments, generally above 900 m, and corresponds to part of the heathland structural form (see Table 8).

Although the tree layer is neither tall nor dense, black sallee (*Eucalyptus stellulata*) and mountain swamp gum (*E. camphora*) are common, the latter being most abundant near water. Common water-milfoil (*Myriophyllum propinquum*) and small river buttercup (*Ranunculus rivularis*) are the common aquatic species found in this community.

Of the two sub-communities present in East Gippsland, alpine wet heathland I occurs on the more open plains, where the shrub layer may be absent and disturbance through cattle grazing is reflected in the consistent occurrence of weedy species - for example Yorkshire fog (*Holcus lanatus*), white clover (*Trifolium repens*), and spear thistle (*Cirsium vulgare*).

Alpine wet heathland II occupies gully heads and drainage lines, and usually supports a closed shrub layer featuring small-fruit hakea (*Hakea microcarpa*) and alpine bottlebrush (*Callistemon sieberi*), coral heath (*Epacris microphylla*), and drumstick heath (*E. breviflora*). *Sphagnum* moss often forms a carpeting ground layer. The community occupies less than 1% of the area in East Gippsland and about 12% of this lies within existing reserves, namely the Delegate River Flora Reserve and the Bidwell Education Area. It is, however, fairly common in the scheduled Cobberas National Park and other reserves to the west of the study area. Grazing is permitted in these.

2. Montane riparian forest

Characteristically, this closed scrub of mountain tea-tree (*Leptospermum grandifolium*) is confined to gullies and stream margins of sub-alpine and montane valleys. It occurs most commonly on the Nunniong Plateau, near Mount Misery and the Cobberas (900--1500 m) to the west of the study area, but is uncommon in East Gippsland. It is known to occur in the headwaters of Swede Creek in the Coast Range and also in

the headwaters of the Errinundra River. A shrub layer of wax berry (*Gaultheria appressa*), mountain beard heath (*Leucopogon suaveolens*), mountain pepper (*Tasmannia lanceolata*), and prickly bush pea (*Pultenaea juniperina*) is also usually present.

Although no eucalypts are characteristic of montane riparian forest, individuals of alpine ash (*Eucalyptus delegatensis*), candlebark gum (*E. rubida*), or snow gum (*E. pauciflora*) are often present or nearby. The herb layer includes a range of ferns (*Blechnum* spp., *Polystichum*) and sedges such as tall sedge (*Carex appressa*) and club rush (*Isolepis subtilissima*), which are typical of a moist environment.

3. Montane forest

Tall open forest grows in moist sheltered valleys and protected slopes in montane and sub-alpine areas. The bulk of this environment occurs above 1,000 m elevation in the vicinity of Mount Gelantipy, the Bowen Range, the headwaters of the Rodger River, Mount Tingaringy, and Mount Ellery and on the Errinundra Plateau, with other scattered occurrences further east.

The tall straight trunks of alpine ash (or woollybutt) over a shrubby understorey give this community an attractive appearance. Montane forest generally has a sparse shrub layer, but fire or windfalls may encourage dense growth in some areas of either prickly bush-pea or gorse bitter-pea (*Daviesia ulicifolia*). The herb layer usually approaches complete cover, with tussock grass (*Poa labillardieri*) and mother shield-fern (*Polystichum proliferum*) prominent. The community corresponds to open forest IV (2c) structural form that is dominated by alpine ash, usually in pure stands. The most representative example in the East Gippsland area is located on the Gelantipy Plateau, although similar stands of mature and regrowth alpine ash occur in the Alpine study area to the west; some of these are within the proposed Alpine National Park. Although it comprises less than 1% of the area, 24% of montane forest that does



A stand of alpine ash on the Gelantipy Plateau

occur in East Gippsland lies within existing reserves, including the Errinundra Flora Reserve, Mount Delegate and Mount Ellery Scenic Reserves, and the Gelantipy Plateau Reference Area.

4. Snow gum woodland

This woodland or open forest is the predominant vegetation of sub-alpine regions, and is found on well-drained soils of ridges and adjacent slopes above 1,100 m. It occurs near the summits of Mount Tingaringy, Mount Bowen, Mount Tower, and Mount Delegate, and as a fringe around the alpine wet heathland community along the upper Delegate River.

It contains two visually distinctive sub-communities: snow gum woodland I, a low woodland of snow gum capping exposed ridges; and snow gum woodland II, an open forest of snow gum--candlebark gum on more protected slopes and plateaux. The sparse, low shrub layer is often dominated by a member of the pea family - for example, gorse bitter-pea, alpine oxlyobium (*Oxylobium alpestre*), or handsome flat-pea (*Platylobium formosum*) - but mountain beard heath is more consistently present. The dominant ground cover is tussock grass, which has been able to survive and capitalize on repeated burning and grazing.

The community occupies less than 1% of the East Gippsland area, and of this, 15% occurs in existing reserves, including the Tingaringy National Park, Mount Delegate Scenic Reserve, and the Delegate River Flora Reserve. Extensive areas also occur in the scheduled Cobberas National Park to the west. This community corresponds to open forest I structural form.



Snow gum woodland at Mount Tingaringy

5. Montane sclerophyll woodland

A woodland or low forest developed on skeletal soils that generally grows on northern aspects characterized by low effective rainfall. The major occurrences are on slopes above 800 m on Mount Tingaringy, Mount Bowen, Mount Tower, and Mount Delegate and on the tablelands around Bendoc. It corresponds to structural forms open forest I and II (4a and 5).

This mixed-species woodland or forest is characterized by candlebark gum, broad-leaf peppermint (*E. dives*), snow gum, and occasionally messmate (*E. obliqua*), and merges with snow gum woodland at higher altitudes and dry sclerophyll forest at lower altitudes. Accordingly it comprises a mixture of typical highland species - such as snow gum, moth daisy-bush (*Olearia erubescens*), and heath pink-bells (*Tetrathecabauerifolia*) - and foothill and lowland species such as messmate, common heath (*Epacris impressa*), and austral bracken (*Pteridium esculentum*).

As in snow gum woodland, the dominant species in the shrub layer are members of the pea family (for example, gorse bitter-pea and prickly bush-pea) and dense stands of these may reflect a high frequency of fire. This community comprises just over 1% of the total area of East Gippsland and 24% is included in conservation reserves such as the Tingaringy National Park and the Mount Delegate Scenic Reserve.

6. Sub-alpine rocky outcrop scrubland

The community is confined to the summit of Mount Tingaringy. It occurs on exposed cliffs and rocky ledges and is characterized by mallee forms of Tingaringy gum (*Eucalyptus glaucescens*) and snow gum in association with a closed scrub of royal grevillea (*Grevillea victoriae*), phebalium (*Phebalium ozothamnoides*), and mountain hickory wattle (*Acacia*



Montane sclerophyll woodland on the slopes of Mount Tingaringy



*Sub-alpine
rocky out-
crop scrub-
land, Mount
Tingaringy*

obliquinervia). Ground cover species include prickly starwort (*Stellaria pungens*), diggers speedwell (*Parahebe perfoliata*), Tasman flax-lily (*Dianella tasmanica*), and tussock grass.

All recorded occurrences of this community are within the Tingaringy National Park.

7. Cool temperate rainforest

This comprises a closed forest (with a very dense canopy) that is generally confined to moist gullies and sheltered slopes between 600 and 1,200 m. In East Gippsland, the community occurs predominantly on and around the margins of the Errinundra Plateau, the Coast Range and in the Rodger River catchment. It usually forms a narrow strip adjacent to streams, but on the Errinundra Plateau it also occurs in larger stands on slopes away from drainage lines.

Apart from Tasmania, cool temperate rainforest is found only in Victoria in East Gippsland, the Central and South Gippsland Highlands, and the Otway Ranges. The last three localities support rainforest dominated by myrtle beech (*Nothofagus cunninghamii*), but this species is absent from East Gippsland, where southern sassafras (*Atherosperma moschatum*) is dominant with black olive-berry (*Elaeocarpus holopetalus*) forming a subsidiary canopy element. Other common trees or shrubs associated with this community include forest wattle (*Acacia frigescens*), Gippsland waratah (*Telopea oreades*) and mountain pepper, privet mock-olive (*Notelaea ligustrina*), and banyalla (*Pittosporum bicolor*). Ferns - in particular, soft tree-fern (*Dicksonia antarctica*), mother shield-fern, and *Blechnum* spp. - dominate the understorey and species such as veined bristle-fern (*Polyphlebium venosum*), mother spleenwort (*Asplenium bulbiferum*), and common finger-fern (*Grammitis billardieri*) are epiphytes commonly associated with this community.

Cool temperate rainforest represents a climax community developing in response to the prolonged absence of severe

fire. Its very wet nature assists in reducing the incidence of fire and it is thus, to a certain extent, self-perpetuating. However, the species occurring in the community are very susceptible to desiccation through exposure, which may be caused either by fire or timber-harvesting activities in the adjoining eucalypt forest, which normally acts as a buffer.

The largest single stand of cool temperate rainforest in Victoria (covering 150 ha) occurs on the Coast Range, straddling the divide between the north-flowing Queensborough River and the south-flowing Errinundra River. It lies within the Errinundra Flora Reserve and contains many veteran sassafras festooned with mosses and epiphytic ferns. Many stands form a dense canopy along small tributary creeks and streams and are scenically very attractive.

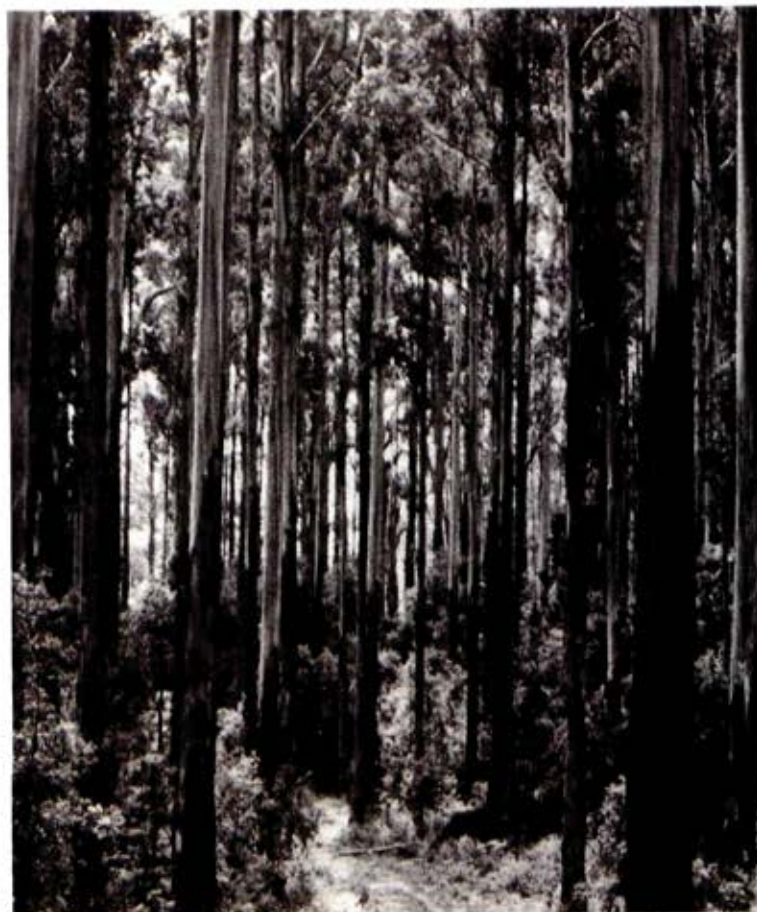
On some streams, such as the Goolengook River and Errinundra River, cool temperate rainforest elements appear to intergrade with warm temperate rainforest (Community 12) at about 600 m elevation. In such areas southern sassafras and blackwood (*Acacia melanoxylon*) are co-dominant overstorey trees.

Less than 1% of East Gippsland is occupied by this community and some 8% is contained in existing conservation reserves including the Errinundra Flora Reserve, Mount Ellery Scenic Reserve and the Kanuka Creek Scenic Reserve. However, it is a very significant vegetation type both in scientific terms and aesthetically. This community corresponds to the 'closed forest II' (1a) structural form.

8. Wet sclerophyll forest

Distribution of these tall open forests in the study area is generally limited to areas of high rainfall, deep soils, and protected slopes throughout the dissected ranges between 200 and 1,200 m elevation. The community contains extensive stands of mature and regrowth shining gum (*Eucalyptus nitens*), mountain ash (*E. regnans*), brown-barrel (*E. fastigata*), blue gum (*E. globulus*), messmate, and mountain grey gum (*E. cypellocarpa*) and all are important commercial timber species. In the western part of the study area (for example, in the Rodger, Yalmy, and Mountain Creek catchments) wet sclerophyll forest is dominated by mountain grey gum and messmate with isolated stands dominated by manna gum (*E. viminalis*), mountain ash, and blue gum. On the Errinundra Plateau shining gum and brown-barrel are dominant, while further east brown-barrel often forms pure stands. The community corresponds generally with open forest IV and some open forest III structural forms.

Of the four sub-communities defined within it, the most widespread is sub-community II, which is comparable in general terms to the tall open forests elsewhere in Victoria. The understorey has a strong visual similarity to other forests of this type in the State having a well-developed tall shrub layer including blanket leaf (*Bedfordia arborescens*), hazel pomaderris (*Pomaderris aspera*), and musk



Stand of even-aged mountain ash in the Rodger River catchment

daisy-bush (*Olearia argophylla*), tree ferns such as soft tree-fern and rough tree-fern (*Cyathea australis*), and a ground fern layer including mother shield fern and *Blechnum* spp. The sub-community does, however, contain three East Gippsland endemics, namely brown-barrel, austral sarsparilla (*Smilax australis*), and bearded tylophora (*Tylophora barbata*) and - in contrast to similar forests to the west - mountain ash is relatively uncommon and reaches the eastern limit of its distribution here.

Favourable growth conditions coupled with the absence of severe fires have allowed the development of a very old forest in sheltered areas, such as parts of the Rodger River catchment. In these areas specimens of mountain ash may reach 80 m in height, and could be as much as 350 years old.

Extensive stands of even-aged wet sclerophyll forests occur in the Central Highlands of Victoria, resulting mainly from regrowth following the disastrous 1939 fires, but only limited areas of mature forest remain in the State. One lies in the Rodger River catchment; others occur in the O'Shannassy and Wallaby Creek catchments near Melbourne.

Recent studies by Chesterfield *et al.* (1983) indicate that, in addition to their maturity, stands of wet sclerophyll forest dominated by mountain ash near the Rodger River display an unusual multi-aged structure; that is, within one stand, trees representing several age classes are interspersed with one another. Each age class appears to represent a particular event that resulted in a period of regeneration.



*Wet sclerophyll
forest dominated by
mature mountain ash,
Rodger River*

Fire has most probably been responsible for initiating these periods of regeneration. Unlike the severe fires of 1939 that killed most trees and thus resulted in an even-aged regeneration, however, some might have been relatively cool fires, restricted essentially to the understorey vegetation and so enabling the older trees to survive. It has been shown that mountain ash beyond 100 years of age can tolerate understorey burns provided 'crowning' does not occur, and the resistance to fire increases with increasing age. Thus, the probability of a multi-aged structure following a fire in these forests increases with increasing age.

In contrast to previous data about mountain ash regeneration, these results revealing the presence of a multi-aged structure indicate that such forests can perpetuate themselves under wildfire conditions that are not severe enough to kill the parent trees. They might therefore have been more common before the severe fires between 1850 and 1939, which destroyed most of the mature wet sclerophyll forests in the State - now replaced by young even-aged forests.

This suggests that for some areas of the State the even-aged stands may represent a stage in the long-term development of multi-aged mature mountain ash forest. Such multi-aged forests, being uncommon in Victoria, have not yet been adequately studied by ecologists, who may be able to shed new light on the life cycle of wet sclerophyll forests. The available evidence suggests that any prolonged absence of fire in this community results in a shift towards cool temperate rainforest and a consequent decrease in the density of overstorey eucalypts.

Wet sclerophyll forest sub-community I occurs almost exclusively on the Errinundra Plateau and the Coast Range. It is considered to be transitional between wet sclerophyll forest sub-community II and cool temperate rainforest (described below) and occurs on deep friable soils in high-rainfall areas, usually on slopes with southerly or easterly aspects.

The dominant tree species - shining gum - forms an overstorey to a secondary tree layer of typical cool temperate rainforest species such as southern sassafras, black olive-berry, silver wattle (*Acacia dealbata*), and a well-developed shrub layer including Gippsland waratah, mountain pepper, and privet mock-olive.

The crown cover provided by the eucalypt overstorey varies greatly across the plateau, but is generally between 10% and 80%. Areas with a crown cover of less than 10% and a well-developed rainforest understorey are considered by the Department of Conservation, Forests and Lands to be a form of cool temperate rainforest. Areas with a crown cover of between 10% and 50% but with a well-developed rainforest understorey have been termed 'mixed forest', while those with a crown cover between 30% and 80% are considered to be true eucalypt forests.

Recent exploratory studies conducted by the Department in the mixed forests of the Errinundra Plateau suggest that the eucalypt overstorey is generally between 200 and 250 years old while in all but one case the rainforest trees in the understorey are slightly younger. One of the sites, however, carried understorey rainforest older than a mature shining gum. The results point to the need for more detailed work to be carried out in order to determine whether



*Wet sclerophyll forest dominated by shining gum,
Errinundra Plateau*

these forests are multi-aged and if in fact some of the age classes of overstorey eucalypts are younger than the rainforest understorey. Such research has far-reaching implications. If it establishes that the forest is multi-aged, then perhaps shining gum can perpetuate itself in the absence of severe wildfire, which produces even-aged regeneration. Some researchers believe that a number of less intense fires, which have probably had a patchy distribution across the plateau, could have burnt the understorey but left most of the overstorey trees intact, and led to some regeneration of eucalypts. A second implication is that if some of the mature eucalypts are younger than the rainforest understorey a mechanism exists whereby eucalypts can regenerate to some extent in an area containing a rainforest understorey. This may involve some disturbance to the rainforest canopy (perhaps as a result of a relatively cool fire) in order to produce gaps in which the eucalypts can regenerate, but not enough to kill the surrounding rainforest.

The Department of Conservation, Forests and Lands has recently compiled a vegetation map of the Errinundra Plateau, which is contained in the back pocket of this report. The map shows the distribution of mixed forest, cool temperate rainforest, and eucalypt forest on the plateau, as well as other vegetation types occurring in the area, including the closed scrub or low closed forest of mountain plum pine (*Podocarpus lawrencei*) that occurs in association with the rainforest understorey along the crest of the Gunmark Range between Cobb Hill and the headwaters of Yandown Creek. At Goonmirk Rocks the podocarp grows in tree form and reaches a height of more than 10 m. Usually it is a sub-alpine prostrate shrub, no more than about 1.5 m in height. The map also shows the distribution of the major eucalypt species, and areas of fire and logging regrowth on the plateau.

Wet sclerophyll forest sub-community III is a somewhat drier forest occurring on more exposed north-facing slopes bordering the Errinundra Plateau. Narrow-leaf peppermint (*Eucalyptus radiata*) is the common overstorey species, along with messmate and blackwood. Understorey species include soft tree-fern, dogwood (*Cassinia aculeata*), mother shield-fern, mountain beard-heath, dusty daisy-bush (*Olearia phlogopappa*), gorse bitter-pea, and narrow-leaf wattle (*Acacia mucronata*).

Sub-community IV - a riparian form of wet sclerophyll forest - occurs adjacent to permanent streams in higher-elevation areas. It is often dominated by manna gum, narrow-leaf peppermint, blackwood, and silver wattle and is interspersed with the other sub-communities.

Some 9% of the wet sclerophyll forest in the study area is included in existing conservation reserves such as the Gelantipy Plateau Reference Area, Mountain Creek Reference Area, Mount Ellery Scenic Reserve, Errinundra Flora Reserve, Mount Kaye Flora Reserve and the Musket Creek Reference Area. The community represents about 20% of the vegetated area in East Gippsland.

9. Dry sclerophyll forest

This community is widespread throughout the foothills of the study area between 200 m and 900 m elevation, usually on the drier northerly slopes and often in association with stony skeletal soils. It comprises a diverse range of foothill forests, and so no single eucalypt species is dominant in all four of its sub-communities.

Depending upon the sub-community, red stringybark (*Eucalyptus macrorhyncha*), broad-leaf peppermint, silvertop (*E. sieberi*), white stringybark (*E. globoidea*), or mountain grey gum may predominate, while apple box (*E. bridgesiana*), brittle gum (*E. mannifera*), narrow-leaf peppermint, blue gum, or red box (*E. polyanthemos*) may occur as associate species.



Dry sclerophyll forest of red stringybark and brittle gum in the Tingaringy National Park

The usually sparse understorey is dominated by opportunistic species, commonly long-leaf dogwood (*Cassinia longifolia*) and prickly bush-pea, while the ground layer consists of semi-shrubs such as common heath, honey pots (*Acrotriche serrulata*), cranberry heath (*Astroloma humifusum*), grey guinea-flower (*Hibbertia obtusifolia*), and herbs including three species of flax-lillies (*Dianella* spp.). Grasses include tussock grass, silvertop wallaby-grass (*Danthonia pallida*), and forest wire-grass (*Tetrarrhena juncea*). Other species such as gorse bitter-pea, narrow-leaf geebung (*Persoonia linearis*), narrow-leaf wattle, and lance beard-heath (*Leucopogon lanceolatus*) are common components of at least one of the sub-communities.

Dry sclerophyll forest corresponds broadly to a number of structural forms - including some types of open forest III, open forest II, and woodland I and II - and covers some 21%

of the East Gippsland study area. Of that total, about 19% is included within existing reserves such as the Snowy River National Park, Tingaringy National Park, Mountain Creek Reference Area, Mount Kaye Flora Reserve, Sardine Creek Education Area, and Coopracambra State Park.

Good examples of the community occur along the Bonang Highway, the Cann Valley north of Mount Kaye, and the area surrounding the lower Snowy Valley north of Bete Bolong. Perhaps the most representative example of dry sclerophyll forest occurs in the catchment of Back Creek near Mount Kaye; this contains a very diverse flora including a number of rare species. Victoria's only known natural occurrence of spotted gum (*Eucalyptus maculata*) is located in dry sclerophyll forest to the west of Stringer Knob within the Mottle Range Flora Reserve.

10. Box--ironbark woodland

Box--ironbark woodland is generally confined to the foothills north and west of Orbost on skeletal soils associated with rocky ridges and slopes. The dominant overstorey trees are red ironbark (*Eucalyptus sideroxylon*), red box, and white stringybark, in association with cherry ballart (*Exocarpus cupressiformis*), pale hickory wattle (*Acacia falci-formis*), long-leaf dogwood, black wattle (*A. mearnsii*), large mock-olive (*Notelaea venosa*), and common correa (*Correa reflexa*). Tussock grass and weeping grass (*Microlaena stipoides*) are common in the ground cover. The community has a generally very sparse shrub and ground flora, indicating the poor soils upon which it grows. In the early 1900s, it supplied ironbark timber - used extensively for railway sleepers and large beams - but suitable trees are now in relatively short supply. It has also been heavily utilized for firewood in the past, as both ironbark and red box make excellent sources of fuel. The most representative examples occur along the Rocky River road east of its crossing of the Brodribb River and in the vicinity of Stringer Knob. This community has close affinities with open forest II and woodland I and II structural forms. It covers a very



Box--ironbark
woodland near
Stringer Knob

small area in East Gippsland, but some 10% lies within existing conservation reserves, namely the Brodribb River and Mottle Range Flora Reserves.

11. Rocky outcrop open scrubland

This community occurs either as closed scrub or a tall shrubland with scattered trees, and is confined to rocky escarpments or exposed slopes in the upper Snowy and Deddick valleys between 600 m and 900 m elevation. The closed scrub lacking eucalypts, known locally as 'blackthorn scrub', is characterized by rock wax-flower (*Eriostemon trachyphyllus*) or red wattle (*Acacia silvestris*). Where eucalypts occur, they are mallee-like in habit and often low-branching. Species such as Suggan Buggan mallee (*Eucalyptus saxatilis*), gully gum (*E. smithii*), manna gum, and Tingaringy gum predominate. Vegetation density may vary from very low for all strata to very high in the shrub layer.

Such scrubland is known to occur on rocky escarpments on the margins of the Gelantipy Plateau and Bowen Ranges, and on cliffs overlooking New Country Creek upstream of its junction with Mountain Creek. It occupies a very small proportion of East Gippsland, but some 75% is contained in two existing conservation reserves - the Snowy River National Park and Tingaringy National Park. Its significance is enhanced by the rare or significant species associated with it. These include Suggan Buggan mallee, shrubby everlasting (*Haloragodendron bauerlenii*), shiny phebalium (*Phebalium lamprophyllum*), tall acrotriche (*Acrotriche divaricata*), showy boronia (*Boronia ledifolia*), mountain dampiera (*Dampiera purpurea*), and goodenia (*Goodenia heterophylla*).

12. Warm temperate rainforest

Also known as 'closed forest' or 'jungle', this community forms a southern extension of subtropical rainforest. It is confined to sheltered gullies, on alluvial flats along major streams, and on some steep south-facing slopes across the study area. It is scattered throughout the lowland and foothill country from sea level about 700 m elevation.

Warm temperate rainforest is one of the few Victorian forest types not dominated by eucalypts. Lilly pilly (*Eugenia smithii*) predominates and may reach a height of 30 m. It commonly forms a closed canopy, usually with a variety of woody vines or lianes (for example, jungle grape (*Cissus hypoglauca*), milk-vine (*Marsdenia rostrata*), and austral sarsparilla. In all, 17 species of epiphytic lianes are known to occur here. Associated trees include kanooka (*Tristania laurina*) and blackwood along streams, and mutton-wood (*Rapaeneae howittiana*), yellow wood (*Acronychia oblongfolia*), and blue olive-berry (*Elaeocarpus reticulatus*).

Ferns are prominent beneath the overstorey canopy and may be arborescent or ground-dwelling. Any of Victoria's five species of tree-fern may be present as well as a variety of other ground ferns - such as hard water-fern (*Blechnum watsonii*), gristle fern (*B. cartilagineum*), and shining shield-



Warm temperate rainforest along a small tributary stream

fern (*Lastreopsis acuminata*) - and epiphytes, including fragrant fern (*Microsorium scandens*), kangaroo fern (*M. diversifolium*), and veined bristle-fern (*Polyphlebium venosum*).

A feature of these rainforests in New South Wales and Queensland is the large number of tree species (often more than 100 per acre). Those in East Gippsland are very depauperate by comparison, but at the same time represent part of the rainforest continuum on the eastern coast of Australia. Even within the study area, the species composition shows considerable variation. For example, some species occur only in rainforest stands east of Mallacoota Inlet, while others are known only in stands near Orbost.

On Cabbage Tree Creek and the Brodribb River, a few small patches contain individuals of cabbage fan-palm (*Livistona australis*), which is separated from the southern limit of its main distribution in New South Wales by some 300 km.

The largest stand of warm temperate rainforest in Victoria, in the upper reaches of Jones Creek near Genoa, was severely burnt by wildfire in early 1983. Regeneration of this area is likely to take a considerable time and whether complete recovery will occur remains unknown. Experimental plots have been established here to monitor the situation. One of the best examples of this rainforest grows on the southern slopes of Mount Drummer where the Princes Highway travels through Alfred National Park. This area was also

burnt in 1983. Relatively easy access to other stands is possible on Martins Creek along the Bonang Highway and on the Bemm River along the Combienbar road.

Although comprising less than 1% of the total area of East Gippsland, warm temperate rainforest is a very significant community as it contains many species of plants and animals that are uncommon or rare in the State. The linear nature of most stands makes them difficult to protect from potential hazards such as fire and weed invasion.

About 18% of the community is contained within existing conservation reserves, including the Croajingolong National Park, Alfred National Park, Jones Creek Reference Area, Martins Creek and Bemm River Scenic Reserves, and Wood Point and Cabbage Tree Creek Flora Reserves. Other stands in State forests are protected by management prescriptions.

Warm temperate rainforest community corresponds to the lowland closed forest structural type.

13. Riparian forest

This is an open forest of wet slopes and riversides of nearly all the major lowland watercourses in the area. Various forms of it occur from the coast up to 700 m altitude, depending upon whether the site is exposed or protected.

Overstorey species commonly found within this community include mountain grey gum, manna gum, river peppermint (*E. elata*), messmate, and yellow stringybark (*E. muelleriana*). Occasionally kanooka attains a sufficient height to form part of the canopy. Associated species include hazel pomaderris, blue olive-berry, blackwood, silver wattle, and a host of other shrubs and small trees. Many herbs, grasses, ferns, sedges, and rushes may also be present.

High species diversity is a feature of riparian communities, which thus form a significant component of the natural environment. They provide corridors linking a range of habitats, making them important for migratory animals. Streams are important in the dispersal and transport of seeds, including those of weeds, and for this reason riparian vegetation is rarely weed-free. Blackberry (*Rubus fruticosus* sp. agg.) is now widespread throughout the study area due to seed dispersal by water.

The community varies both between and within river systems - and has three recognized sub-communities. Riparian forest I represents a true intermediate (or ecotone) between the common form (riparian forest II) and warm temperate rainforest. Riparian forest III is typical of drier, more open country - for example, along the lower Snowy and Genoa Rivers, where seasonal flooding may form banks of alluvial sand, and granite or sandstone boulders are features. In some areas, where the invasion of exotic species from adjoining freehold land has modified much of the riparian environment, Yorkshire fog, white clover, and blackberry are common understorey components.



Riparian forest along the Deddick River dominated by manna gum

Easily accessible examples occur on the Brodrigg River along the Bonang Highway and on the Deddick River along the Deddick River Road.

Riparian forest covers about 2% of the study area, and about 25% of the community is contained in existing conservation reserves such as the Coopracambra State Park, Snowy River National Park, Tingaringy National Park, and the Brodrigg River Flora Reserve. Many others are protected to some extent by management prescriptions in State forest.

14. Rainshadow woodland

This community is essentially confined to the rainshadow area in the north-western part of the study area where rainfall is generally less than 700 mm per annum. It occurs mainly in the Upper Snowy and Deddick valleys with isolated patches along the central Snowy valley and corresponds to woodland I and II (6a and 6b) structural forms.

The dry, often steep slopes and associated gravelly soils carry woodlands of white box (*Eucalyptus albens*) and white cypress-pine (*Callitris columellaris*). These species may either be co-dominant or dominant depending upon local environmental factors, with cypress-pine being most tolerant of harsh conditions. Other species common to this woodland are lightwood (*Acacia implexa*), kurrajong (*Brachycton populneus*), slender hop-bush (*Dodonaea angustissima*), yellow box (*Eucalyptus melliodora*), and a glaucous form of long-leaf box (*E. nortonii*).



*Rainshadow
woodland of
white cy-
press pine
near MacKil-
lop Bridge*

A number of character species possess adaptations to the dry environment. These include species with small sclerophyllous foliage - for example, peach heath (*Lissanthe strigosa*) and urn heath (*Melichrus urceolatus*) - or an ability to dry out and then rapidly respond to sporadic rains, such as the resurrection fern (*Cheilanthes tenuifolia*).

A riparian form of the community occurs on coarse alluvial sands beside the Deddick and upper Snowy Rivers. Short-lived species, many of them weeds capable of completing their life cycle between flood periods, are common. Other species including burgan (*Leptospermum phyllicoides*), common fringe-myrtle (*Calytrix tetragona*), Snowy River wattle (*Acacia boormanii*), white sallow wattle (*A. floribunda*), and Blakely's red gum (*Eucalyptus blakelyi*) are often contorted by successive floods.

Sensitivity to fire and past utilization, particularly in the early days of settlement, has meant that few very old individuals of cypress-pine remain, and seedling regeneration is threatened by grazing pressure where dense rabbit populations occur. The dramatic visual change observed when entering this woodland is best experienced when travelling towards MacKillop Bridge on the upper Snowy River along the Deddick River road.

Rainshadow woodland covers about 4% of the East Gippsland area and some 28% is included in the Tingaringy and Snowy River National Parks. Many species that occur nowhere else in the study area are found here and, for many, these occurrences represent a significant disjunction from their normal distribution.

15. **Banksia woodland**

Banksia woodland occurs on deep, coarse sands throughout the coastal lowlands from the Snowy River to the Victorian--New South Wales border and rarely occurs far from the coast. It corresponds to open forest III (3e) and woodland I--II (6d and 6e) structural forms.



Banksia
woodland
near Sand-
patch Point

It has saw banksia (*Banksia serrata*) as the dominant tree and, although no single one is considered a character species, usually contains one or more eucalypts. The most common of these are white stringybark, red bloodwood (*E. gum-mifera*) (which occurs only east of Wingan Inlet), silvertop, yertchuk (*E. consideniiana*), yellow stringybark, and southern mahogany (*E. botryoides*). On some exposed headlands, contorted saw banksia and mallee-like red bloodwood and/or yellow stringybark form a stunted woodland generally 3 to 4 m in height. Rough-barked apple (*Angophora floribunda*) is a common overstorey component around Mallacoota Inlet.

The understorey contains many species that also occur in lowland sclerophyll forest (described below): a diverse shrub layer of small-leaved sclerophyllous species includes common heath, prickly tea-tree, sweet wattle (*Acacia suave-olens*), fringed beard-heath (*Leucopogon collinus*), common correa, sunshine wattle (*A. terminalis*), and common aotus (*Aotus ericoides*). A ground layer consists of species such as sand-hill saw-sedge (*Lepidosperma concavum*), oat spear-grass (*Anisopogon avenaceus*), and semi-shrubs including blue dampiera (*Dampiera stricta*) and broom spurge (*Amperea xiphoclada*).

Several species display their best development in this community, including wedding bush (*Ricinocarpos pinifolius*), paperbark tea-tree (*Leptospermum attenuatum*), and smooth parrot-pea (*Dillwynia glaberrima*), although they also occur in lowland sclerophyll forest sub-community I. Two species - swamp selaginella (*Selaginella uliginosa*) and scented paperbark (*Melaleuca squarrosa*) - indicate areas of restricted drainage in banksia woodland.

The most representative examples occur near the Betka River, Benedore River, Shipwreck Creek, and north of Tamboon Inlet, all within the Croajingolong National Park. Other significant stands are found on the coastal reserve east of Point Ricardo - containing the rare sword bossiaea (*Bossiaea ensata*) - and north-east of Pearl Point. The most accessible examples occur along the Cape Conran--Marlo and the

Mallacoota--Genoa roads. More than 69% of the banksia woodland is included in existing conservation reserves - in particular, the Croajingolong National Park. It accounts for some 2% of the total area of East Gippsland.

16. Lowland sclerophyll forest

This community is the most abundant vegetation association in the study area; it is widespread across the region and extends from near the coast to the foothills up to about 400 m elevation.

It corresponds to the open forest III and woodland structural forms; it is dominated by silvertop and white stringybark, but six sub-communities have been identified and these usually reflect differences in aspect, drainage, soil type, and altitude.

Sub-community I is regarded as a floristic intermediate between banksia woodland and sub-community II. It is dominated by saw banksia, silvertop, white stringybark, and yertchuk.

Sub-community II is the most common form of lowland sclerophyll forest between the Cann and Genoa Rivers. The major eucalypts - silvertop and white stringybark - dominate in association with saw banksia. Common understorey species include bushy hakea (*Hakea sericea*), hairpin banksia (*Banksia spinulosa*), and smooth geebung (*Persoonia levis*), which are indicative of this sub-community, with narrow-leaf geebung (*Persoonia linearis*) and holly lomatia (*Lomatia ilicifolia*), which are common components of lowland sclerophyll forests.

Sub-community III is generally associated with clay-loam soils occurring near Cabbage Tree Creek and north-east of Mallacoota. Yellow stringybark, although occurring in other



Lowland sclerophyll forest dominated by silvertop and white stringybark west of Mallacoota

sub-communities, is common enough here to be regarded as a character species; it occurs in association with silvertop and white stringybark.

Sub-community IV is regarded as the typical lowland sclerophyll forest, although it contains no species that clearly distinguishes it from other sub-communities. Some examples of it are probably the result of disturbance.

Sub-community V grows in the foothill areas and is indicative of somewhat wetter conditions, as shown by the presence of messmate in association with silvertop and white stringybark in the overstorey. Rough tree-fern occurs in the understorey, along with long-leaf dogwood, long-leaf wattle, and large-leaf bush-pea (*Pultenaea daphnoides*).

Sub-community VI is restricted to the area west of Orbost, where it dominates, and is characterized by an unusual combination of eucalypts in the overstorey: silvertop, white stringybark, mountain grey gum, and red ironbark.

Other patterns are also discernible within this community. For example, opportunistic species such as forest wiregrass, austral bracken, flat peas, cane holy grass (*Hierochloa rariflora*), saw-sedge, and wattles produce very dense stands at times, implying disturbance by fire and/or forestry operations. Drainage lines within it are not identified as a distinct sub-community, but may be characterized by species not found on adjacent slopes, such as scented paperbark and tall saw-sedge (*Gahnia clarkei*).

Distribution of some species commonly found here is determined by an east--west gradient rather than being related to particular sub-communities. For example, red bloodwood, rough-barked apple, and black she-oak (*Casuarina littoralis*) are confined to the eastern portion of the study area.

This community occupies about 42% of the study area, making it the most common vegetation association. However, only 17% of it occurs in existing conservation reserves. Some of the most representative examples are included in the Croajingolong National Park, although several sub-communities are not well represented.

17. Coastal heathland

The ridge and swale topography common throughout the coastal plains of East Gippsland has resulted in the development of numerous linear-shaped heathlands in the depressions between intervening dunes. Such depressions are subject to seasonal waterlogging and this is reflected in the vegetation, which consists of heaths or low woodlands dominated by a range of sedges, rope-rushes, and sclerophyllous shrubs. The community is well developed on the Marlo plains between Cape Conran and Sydenham Inlet, between Tamboon Inlet and the Thurra River, and from Sandpatch Point to Shipwreck Creek. Heathlands of similar floristic composition have also developed in areas of restricted drainage along many lowland streams and on exposed headlands.



*Coastal heathland
(sub-community I)
near the mouth of
the Mueller River*



*Coastal heathland
near Wangarabell
with silver-leaf
stringybark*

Most of these heathlands are treeless, although silver-leaf stringybark (*Eucalyptus cephalocarpa*) may form small patches of woodland; however, it is not developed consistently enough for the species to be regarded as characteristic of the community. Four sub-communities have been identified.

Sub-community I is a species-rich heath restricted to sandy soils on coastal cliff-top plateaux between Point Hicks and Mallacoota. It is dominated by scrub she-oak (*Casuarina paludosa*), prickly tea-tree (*Leptospermum juniperinum*), silver banksia (*Banksia marginata*), and myrtle wattle (*Acacia myrtifolia*) with a ground layer of grasses, sedges, and lillies.

Sub-community II is visually distinctive and is widely known as 'grass-tree plain'. It is dominated by spear grass-tree (*Xanthorrhoea resinosa*), along with scented paperbark, prickly tea-tree, and less commonly saw banksia, and a ground layer of heathy plants including smooth parrot-pea, common aotus, and blunt-leaf heath (*Epacris obtusifolia*).

Sub-community III occupies somewhat wetter areas than the previous form, and both scrub she-oak and spear grass-tree constitute the major species. Species that reflect the wetter environment also include tall yellow-eye (*Xyris operculata*), short purple-flag (*Patersonia fragilis*), pink swamp-heath (*Sprengelia incarnata*), flat cord-rush (*Restio complanatus*), and slender twine-rush (*Leptocarpus tenax*).

Sub-community IV replaces the grass-tree plain vegetation on deeper sandy soils, and tends to be floristically similar to the surrounding lowland sclerophyll forests. It is dominated by prickly tea-tree and scrub she-oak, but crimson bottle-brush (*Callistemon citrinus*) and dagger hakea (*Hakea teretifolia*) are the most distinctive character species.

The coastal lowland environment is associated with frequent fires, and heathlands, as part of this environment, are well adapted to recovery after wildfire. Regeneration is often rapid and impressive. Some species sprout from intact root-stocks, while many ephemerals (including orchids, lillies, and carnivorous species) occur in profusion.

Many of the most representative examples of this community occur in the Croajingolong National Park - on the cliff-tops near the mouth of Shipwreck Creek and on O'Meara Lagoon 14 km south-west of Cann River township. Interesting occurrences of heathland--woodland dominated by silver-leaf stringybark are located in the Jones Creek Flora Reserve and along Moresford road, south of Raymond Creek.

Coastal heathland occupies about 3% of the total area and some 28% of the community is contained in existing reserves - in particular, the Croajingolong National Park and the Cabbage Tree Creek, Maramingo Creek, and Jones Creek Flora Reserves. It corresponds to the heathland structural form (see Table 8).

18. Coastal sclerophyll forest

An essentially riparian association of the coastal lowlands, coastal sclerophyll forest occupies mainly sandy alluvial soils; it is fairly common between Lake Tyers and Orbost, but occurs only sporadically further east. Southern mahogany dominates, while the understorey contains a mixture of riparian, lowland forest, and coastal species. Species that distinguish the community from the surrounding forests include black wattle, snow daisy-bush (*Olearia lirata*), and common hedgehog-grass (*Echinopogon ovatus*). Good examples occur where forest tracks cross Hospital Creek, Simpson Creek, and the Hartland River between Orbost and Nowa Nowa.

Although occupying less than 2% of the East Gippsland area, some 42% of the community occurs within the Croajingolong National Park and the Ewing Marsh Wildlife Reserve.

19. Coastal banksia woodland

Low-lying areas surrounding the larger estuaries - such as those at Sydenham Inlet and Mallacoota Inlet and at the



Coastal sclerophyll forest on the landward side of Ewing Marsh

mouth of the Snowy and Betka Rivers - carry coastal banksia woodland.

Coast banksia (*Banksia integrifolia*), saw banksia, and southern mahogany dominate the overstorey, while the understorey may be characterized by thickets of tall saw-sedge, swamp paperbark (*Melaleuca ericifolia*), or scented paperbark. Other common understorey species include tree broom-heath (*Monotoca elliptica*), blue olive-berry, sallow wattle (*Acacia longifolia*), and large-leaf bush-pea.

The community has some affinities with woodland I--II(6e) and heathland structural forms; it has limited occurrence throughout the region, but about 70% is included in the Croajingolong National Park and the Ewing Marsh Wildlife Reserve. The most representative example occurs around the shores of Tamboon Inlet, although it is relatively small.



Coastal banksia woodland around the margin of Sydenham Inlet

20. Primary dune scrub

This scrub occupies the foredunes or sea cliffs throughout the study area, and indeed the remainder of the Victorian coast. It has remarkably similar species composition throughout its range and consists of several grasses that assist in the accumulation and stabilization of sand, as well as numerous herbs and low shrubs. The extensive root systems of most species in the community and the rhizome development in some are important factors in dune stabilization, which in turn protects other communities further inland from the effects of strong winds and salt spray.

Common trees and shrubs include coast banksia, coast tea-tree (*Leptospermum laevigatum*), common boobialla (*Myoporum insulare*), sallow wattle, coast everlasting (*Helychrysum paraliium*), and cushion-bush (*Calocephalus brownii*). Ground layer species such as hairy spinifex (*Spinifex hirsutus*) and karkalla (*Carpobrotus rossii*) are commonly present. The introduced species, marram grass (*Ammophila arenaria*) is a particularly good stabilizer of sands. It has been planted in some areas to check dune erosion, but is now widespread along much of the coast.

The most representative examples of this community occur near the mouth of Shipwreck Creek, and along the coast between Point Hicks and Petrel Point, all of which are in Croajingolong National Park.

Much of this community occurs within the Croajingolong National Park and the Ewing Marsh Wildlife Reserve.

21. Saltmarsh

Muds and silts fringing most brackish estuaries from Lake Tyers to Mallacoota carry saltmarsh. It is generally



Primary dune scrub

dominated by sea rush (*Juncus kraussii*) in association with creeping brookweed (*Samolus repens*), selliera (*Selliera radicans*), beaded glasswort (*Sarcocornia quinqueflora*), and austral seablite (*Suaeda australis*). Elsewhere in Victoria, saltmarsh communities are often dominated by shrubby plants (particularly shrubby glasswort), but these are absent from the East Gippsland form. Good examples occur within the Croajingolong National Park, which also includes more than half the total area occupied by this community.

Unusual or isolated communities

Throughout the East Gippsland region a number of unusual and isolated communities occur, usually associated with unique environmental features. They are often very restricted and have not been defined in the map or legend. Examples include:

- * swamps and some creek margins; for example, Ewing Marsh, Karlo Creek, and Lake Barracoota, often dominated by reed beds of common reed (*Phragmites australis*) or soft twig-rush (*Baumea rubiginosa*) or thickets of swamp paperbark, and any of a number of aquatic or semi-aquatic herbs
- * rocky cliffs on the Snowy and Genoa River gorges; species such as river beard-heath (*Leucopogon riparius*) and Snowy River westringia (*Westringia cremnophylla*) are endemic to the Snowy River
- * tall open forest of white ash (*Eucalyptus fraxinoides*) on the Howe Range
- * heathland dominated by stunted she-oak (*Casuarina nana*) on sandstone in the upper Genoa River region

Sites of Botanical Significance

The National Herbarium, in its botanical survey of the East Gippsland region, delineated 15 major sites of botanical significance within the study area. An evaluation of these sites conducted by Mr A. Moorrees for the Land Conservation Council indicates that eight of the sites contain significant examples of vegetation communities that are currently only poorly or moderately represented in existing conservation reserves. These are shown in Table 9.

A number of the poorly or moderately conserved communities also have their best representations in some of these sites - for example, areas of wet sclerophyll forest on the Errinundra Plateau, in the Rodger River catchment (Central Snowy River), in the Gelantipy Plateau--Bowen Range area (upper Snowy River), and at Waldron Mountain north of Cann River township.

The remaining seven sites are essentially included within existing conservation reserves, although some small areas are excluded. In each of these cases, however, the excluded portions are not known to contain any significant vegetation.

Table 8

RELATIONSHIP BETWEEN VEGETATION COMMUNITIES AND
STRUCTURAL FORMS IN EAST GIPPSLAND

Map Symbol	Structural Forms	Major Species of Tallest Stratum	Associated Tree Species	National Herbarium Communities (see notes below for Communities marked *)																						
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21		
				Alpine Wet Heathland	Montane Riparian Forest*	Montane Forest	Snow Gum Woodland	Montane Sclerophyll Woodland	Sub-Alpine Rocky Outcrop Scrubland	Cool Temperate Rainforest	Wet Sclerophyll Forest	Dry Sclerophyll Forest	Box Ironbark Woodland	Rocky Outcrop Open Scrubland*	Warm Temperate Rainforest	Riparian Forest*	Rainshadow Woodland	Banksia Woodland	Lowland Sclerophyll Forest	Coastal Heathland	Coastal Sclerophyll Forest	Coastal Banksia Woodland	Primary Dune Scrub*	Seitmarah*		
1a	CLOSED FOREST II (not mapped)	sassafras	black olive-berry																							
1b		lilly-pilly, kanooka	blackwood, blue olive-berry																							
2a	OPEN FOREST IV taller than 40 metres	shining gum	alpine ash, brown-barrel																							
2b		mountain ash																								
2c		alpine ash	shining gum, mountain grey gum																							
2d		brown barrel	mountain grey gum, messmate, shining gum																							
2e		messmate, mountain grey gum	Gippsland blue gum, brown-barrel																							
3a	OPEN FOREST III 28-40 metres	messmate, mountain grey gum	Gippsland blue gum, yellow stringybark, river peppermint, narrow-leaf peppermint																							
3b		narrow-leaf peppermint, broad-leaf peppermint, mountain grey gum	candlebark, messmate																							
3c		silvertop																								
3d		silvertop, white stringybark	brown stringybark, yellow stringybark, mountain grey gum																							
3e		red bloodwood, silvertop	yertchuk, white stringybark, brown stringybark																							
3f		coast grey box	but-but																							
4a	OPEN FOREST II 15-28 metres (may also be woodland)	broad-leaf peppermint, red stringybark	brittle gum, candlebark																							
4b		red stringybark, red box, silvertop	white stringybark																							
4c		red bloodwood, rough-barked apple	white stringybark, brown stringybark, yertchuk																							
5	OPEN FOREST I less than 15 metres	white sallee	spinning gum, candlebark, broad-leaf peppermint																							
6a	WOODLAND I-II less than 28 metres (may also be open forest)	white cypress pine	white box black cypress pine																							
6b		white box	white cypress pine bundy																							
6c		yertchuk, red stringybark	red ironbark, red box, brittle gum, white stringybark																							
6d		yertchuk, southern mahogany, red bloodwood	brown stringybark, white stringybark, rough-barked apple																							
6e		southern mahogany, brown stringybark	white stringybark, red bloodwood, silvertop																							
7	HEATH	scrub she-oak, prickly tea-tree																								
		prickly tea-tree, slender twine-rush																								
		swamp paperbark, zig-zag bog-rush																								
		scented paperbark																								
		coast tea-tree	saw banksia, coast banksia																							
		giant honey-myrtle																								
		tall sedge, swamp club-rush																								
		woolly tea-tree, coral heath	mountain swamp gum																							

Notes relating to Herbarium Communities

- * 2 - Scattered in Montane forests
- * 6 - Restricted to the summit of Mount Tingaringy
- * 11 - Isolated occurrences on rocky outcrops in Deddick and Snowy valleys

- * 13 - Confined to streamsides but common throughout except in the dry north-west
- * 20 - Common along foredunes and seacliffs
- * 21 - Restricted to the estuaries of the Bemm, Cann, Mueller, Wingan and Genoa Rivers

Table 9

SITES OF SIGNIFICANCE CONTAINING POORLY OR MODERATELY
RESERVED COMMUNITIES

Site of significance	Communities	Representation in existing reserves
Upper Snowy River	Wet sclerophyll forest Snow gum woodland Montane forest Montane sclerophyll woodland	Poor Poor Moderate Moderate
Central Snowy River	Wet sclerophyll forest Riparian forest	Poor Moderate
Lower Snowy River	Warm temperate rainforest	Poor
Errinundra Plateau	Wet sclerophyll forest Cool temperate rainforest Montane sclerophyll woodland	Poor Poor Moderate
Waldron Mountain	Wet sclerophyll forest	Poor
Coastal I	Warm temperate rainforest	Poor
Coastal III	Lowland sclerophyll forest Coastal heathland Warm temperate rainforest	Poor Moderate Poor
Mount Kaye	Dry sclerophyll forest Wet sclerophyll forest Riparian forest	Poor Poor Moderate

Significant Plant Species

Appendix II lists those species that, for various reasons, are considered to be significant components of the East Gippsland vegetation.

Those species in lists 1 and 2 are afforded a coding established by Leigh *et al.* that denotes their degree of vulnerability and representation in existing conservation reserves in Australia. The reserve status of each species listed in the appendix is also shown. Further reference to these species is made in Part IV of this report (Block Descriptions).

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8. FAUNA

Introduction

Information about the fauna in East Gippsland provided in the Council's initial descriptive resources report was based on data from a very limited survey conducted by the Zoology Department, Monash University, and the then Fisheries and Wildlife Division. The National Museum of Victoria supplied supplementary data on specimens lodged in the museum. Since that time, numerous studies have covered the wildlife of the region. They include surveys that have determined: sites of zoological significance; areas of conservation significance in new logging areas; studies on individual species; wildlife surveys of the lesser-known areas; and surveys of wet lands and river systems.

These studies have greatly increased our knowledge of the fauna and, together with an extensive literature survey, provide the data base for this review. The following account provides a brief description of the vertebrate fauna of each habitat type, together with information concerning sites of zoological significance, rare and threatened fauna and invertebrate fauna known to occur within the region.

Vertebrate Fauna and Habitats

East Gippsland contains a diverse range of vegetation communities and other environments that together support a large number of vertebrates. At least 492 species of vertebrates have been recorded in this region, comprising 61 mammal, 319 bird, 36 reptile, 20 amphibian, and 55 fish species. Many of these have their Victorian range limited to the East Gippsland region, or are more common here than elsewhere in the State. One, the long-footed potoroo, is endemic to the area.

Approximately 60% of the extant mammal species, 60% of the bird species, more than 20% of the reptile, 60% of the amphibian, and 50% of the fish species recorded in Victoria have been recorded in East Gippsland. Lists of the species showing their occurrence within major habitat types and known distributions within the six descriptive blocks are provided in Appendices IV and V.

Examination of subfossil deposits in East Gippsland has revealed the former occurrence of a number of mammal species that have not been recorded in this region since settlement. These are listed in Appendix VII.

The occurrence of native fauna depends on the availability of suitable habitat, each species having unique habitat requirements. In this chapter the vegetation communities

identified by Forbes *et al.* (1982) are used to describe the range of habitats utilized by the terrestrial vertebrate species (Table 10). Chapter 7 provides a full description of these vegetation communities.

Other environments of importance to many species are also included: these are oceanic islands, riverine environments, estuarine environments, marine environments, wetlands, and agricultural land.

Table 10
FAUNA HABITATS IN EAST GIPPSLAND

Habitat type	Representative area
Alpine--sub-alpine	
Alpine wet heathland	Northern Errinundra Plateau
Snow gum woodland	Mount Tingaringy
Forests, woodlands and scrublands	
Montane forest	Southern Bowen Ranges
Montane sclerophyll woodland	Bendoc Upper
Cool temperate rainforest	Errinundra Plateau
Wet sclerophyll forest	Coast Range
Dry sclerophyll forest	Buldah
Box--ironbark woodland	Near Orbost
Rocky outcrop open scrubland	Upper Snowy River
Warm temperate rainforest	Howe Range
Riparian forest	Howe Range
Rainshadow woodland	MacKillop Bridge
Banksia woodland	East of Marlo
Lowland sclerophyll forest	Cann River
Coastal and other environments	
Coastal heathland	Marlo
Coastal sclerophyll forest	South of Genoa
Primary dune scrub	Throughout coast
Saltmarsh	Bemm River estuary
Beaches and oceanic islands	Gabo Island
Riverine	Bemm River
Estuary	Tamboon Inlet
Marine	Throughout coast
Wetlands and swamps	Ewing Marsh
Agricultural land	Orbost

Alpine wet heathland

This vegetation community occurs in several small and disjunct areas within the region, generally above 1,300 m altitude but it may also occur below 1,000 m. More than 15% of the non-marine vertebrate fauna occurring in the region are found in alpine heathlands, but no species are restricted to this community. Native mammals here include brown and dusky antechinus, bush rat, common wombat, and dingo.

Introduced mammals include the fox, European rabbit, and, in the north-west of the study area, brumbies. Records during the spring--autumn period cover more than 50 species of birds. Some, such as the flame robin, are altitudinal migrants, while others that utilize this habitat seasonally migrate from further afield (for example, the fan-tailed cuckoo). Common birds include the crimson rosella, grey fantail, and white-browed scrubwren, while Richard's pipit, Australian magpie, and Australian kestrel are common in adjacent grassland. The damper areas support the southern bullfrog, and the highland form of the copperhead snake is the most frequently encountered reptile in this community.

Snow gum woodland

The mammalian fauna is similar to that occurring in alpine wet heathlands, but the eastern pygmy-possum is also present. More than 50 species of birds have been recorded in this habitat, of which the gang-gang cockatoo, crimson rosella, flame robin, and Australian raven are typical inhabitants. At least seven species of honeyeater utilize this habitat during the non-winter period.

Montane forest

The common wombat, bush rat and brown antechinus are common mammal species recorded here, with the long-nosed bandicoot encountered less frequently. The long-footed potoroo has been recorded in a stand of alpine ash along Greens Road, on the Errinundra Plateau. Arboreal mammals include the yellow-bellied glider, sugar glider, and greater glider. More than 80 species of birds are known to occur in this habitat. Mature montane forests contain birds such as the powerful owl, rose robin, pink robin, and olive whistler. In damper areas the common eastern froglet and brown tree frog are common residents. More than ten species of reptiles occur, the most notable of which is Spencer's skink.

Montane sclerophyll woodland

This woodland community is typical of montane skeletal soils with low effective rainfall. It supports a high diversity



The rare long-footed potoroo has been recorded in a range of habitats including montane forest

of arboreal mammals, including the mountain brushtail possum, common ringtail possum, eastern pygmy-possum, greater glider, and yellow-bellied glider. Three species of large macropods - the eastern grey kangaroo, red-necked wallaby, and swamp wallaby - have been recorded. Typical bat species include the great pipistrelle, large forest eptesicus, and lesser long-eared bat. The wide range of bird species includes common species such as the spotted pardalote, grey shrike-thrush, white-throated treecreeper, and rufous whistler.

Cool temperate rainforest

Typically, cool temperate rainforest occurs at higher altitudes (>500 m) along sheltered gullies and slopes having a high rainfall. Mammals inhabiting this restricted habitat are cosmopolitan species such as the bush rat and common wombat. This is the favoured habitat of the pink robin and many other common birds, such as the olive whistler, golden whistler, and pilotbird. Common reptiles include McCoy's skink, Coventry's skink, and southern water skink (cool-temperate form).

Wet sclerophyll forest

This habitat is notable for the high density and diversity of arboreal mammals (for example, greater glider, yellow-bellied glider, and mountain brushtail possum) and other hollow-dependent forest species (such as owls and cockatoos) that it supports. Bat species such as the great pipistrelle, King River eptesicus, and chocolate wattled bat are typical representatives. The large-billed scrubwren, a species more common in the study area than elsewhere in Victoria, occurs in the gullies of this habitat as do the black-faced monarch, pink robin, and rose robin. The Jervis Bay tree frog, an uncommon amphibian in East Gippsland, is found where permanent or semi-permanent water is available.

Dry sclerophyll forest

Small mammals recorded are similar to those in the wetter communities, with the addition of the white-footed dunnart. Tiger quolls have been recorded at several localities. A high diversity of bats comprises 13 recorded species, including the uncommon little mastiff-bat, eastern broad-nosed bat, and eastern horseshoe-bat. Most of the sites where the rare long-footed potoroo has been recorded are in this habitat, especially around Bellbird Creek. More than 80 species of birds utilize this community, including the laughing kookaburra, eastern yellow robin, spotted pardalote, and 12 honeyeater species. The garden skink is a common reptile in these forests, and the lace monitor is also frequently observed.

Box--ironbark woodland

Although uncommon and sporadic in occurrence, box--ironbark woodland typically occurs on dry slopes and ridges with skeletal soils. It has a similar faunal complement to other



Eastern horseshoe-bat



Brush-tailed rock-wallaby

dry foothill woodlands, but the presence of the winter-flowering red ironbark makes it important for species such as the musk and rainbow lorikeet, and a number of honey-eaters.

Rocky outcrop open scrubland

The unusual and diverse scrubland primarily occurs in the upper Snowy River area. The brush-tailed rock-wallaby inhabits rocky cliffs and crags along and to the west of the Snowy River, and the peregrine falcon may use these sites for nesting. Feral goats may pose a problem in some of these areas. The three species of cave-dwelling bats found in East Gippsland - the common bent-wing bat, eastern horseshoe-bat, and large-footed myotis - are all known to utilize rock crevices as roost sites.

Warm temperate rainforest

At lower altitudes (below 500 m), warm temperate rainforest occurs on the foothills, usually in sheltered gullies or along streams. Several faunal species that are rare and/or restricted elsewhere in Victoria appear common in this environment (for example, brown gerygone, black-faced monarch, and large-billed scrubwren). At Dowell Creek near Mallacoota Inlet, up to 20,000 grey-headed flying-foxes in one camp occupy a patch of the rainforest. These bats migrate to Victoria from further north and spend the autumn here feeding on fruits and eucalyptus blossom (Menkhorst and Dixon, 1985). Amphibians and reptiles common in this habitat include the water skink (warm-temperate form), Lesueur's tree frog, and leaf-green tree frog. The rare great barred frog also occurs here.

Riparian forest

Dusky antechinus and bush rat are typical small mammals in this environment, occurring at relatively high densities. Two introduced mammal species, the black rat and house mouse, may invade following disturbance. Most arboreal mammals and bats present in the study area may be found here. Of more than 90 bird species recorded in this habitat, Lewin's honeyeater, red-browed firetail, eastern whipbird, and black-faced monarch are typical East Gippsland inhabitants. At least 10 species of amphibian utilize the riparian forest, as do at least 16 species of reptile, including the Gippsland form of the eastern water dragon.

Rainshadow woodland

In eastern Victoria, this unique community is restricted to the upper Snowy River area. In some areas grazing by sheep and rabbits has affected its floristic integrity. The habitat supports a number of species, usually associated with drier inland areas, that are rare or absent from the rest of Gippsland. Examples include the common wallaroo, rainbow bee-eater, rufous songlark, weebill, speckled warbler, fuscous honeyeater, common brown snake, and the three-toed skink. Adverse environmental conditions further north may also produce periodic influxes of species such as the white-browed woodswallow. A population of the tiger quoll is known to occupy this habitat in the upper Snowy River area - one of the few areas in the State where tiger quolls are regularly reported. Brumbies are common throughout, and create well-worn tracks that other species such as tiger quolls use. The introduced black rat has become established, possibly due to disturbance caused by the introduced herbivores.

Banksia woodland

This community supports a rich and diverse vertebrate fauna. Small mammals present include the smoky mouse, brown antechinus, dusky antechinus, long-nosed bandicoot, southern brown bandicoot, and long-nosed potoroo. Disturbed areas may contain the introduced black rat and house mouse.



Tiger quoll

The habitat is also favoured by the eastern pygmy-possum and, where bloodwoods are present, the yellow-bellied glider. More than 100 species of bird have been recorded in this community, including typical residents such as the New Holland honeyeater, crescent honeyeater, and eastern spinebill and rarer migrants such as the scarlet honeyeater. In swampy areas the southern emu-wren, green and golden bell frog, and swamp skink may be found.

Lowland sclerophyll forest

The fauna occurring in this community resembles that present in the dry sclerophyll forest of higher altitudes. However, it also includes several species restricted to, or more common at, lower altitudes (such as the southern brown bandicoot, long-nosed potoroo, and rainbow lorikeet). Because of the range of understorey plant species present, some of the sub-communities provide a year-round source of food for nectivorous animals - some honeyeaters and eastern pygmy-possum, for example. The introduced house mouse becomes abundant following disturbance such as fire. This vegetation type also supports a high diversity of bat species, and relatively high densities of less-common species such as the white-footed dunnart and the eastern pygmy-possum.

Coastal heathland

Faunal species characteristic in this vegetation type include the swamp rat, white-footed dunnart, eastern pygmy-possum, southern brown bandicoot, ground parrot, beautiful firetail, eastern bristlebird, tawny-crowned honeyeater, southern emu-wren, chestnut-rumped hylacola, and she-oak skink.

Coastal sclerophyll forest

Mixed-eucalypt open forest is distributed throughout the lowland regions, and is particularly well developed in the Mallacoota and Orbost regions. Several common mammal



Smoky mouse

species have been recorded in it, including the tiger quoll, white-footed dunnart, long-nosed bandicoot, long-nosed pot-oro, and smoky mouse. Birds recorded in this community include the little wattlebird and rainbow lorikeet.

Primary dune scrub

The brown antechinus, bush rat, and swamp rat occur, and where the vegetation has been disturbed the introduced black rat and house mouse may become abundant. The New Holland honeyeater and little wattlebird are typical bird species here. Reptiles present include the garden skink.

Saltmarsh

Small mammals recorded in saltmarsh include the brown antechinus, bush rat, and swamp rat. The marsh harrier and whistling kite forage over this community, which is also utilized by cosmopolitan bird species such as the brown thornbill.

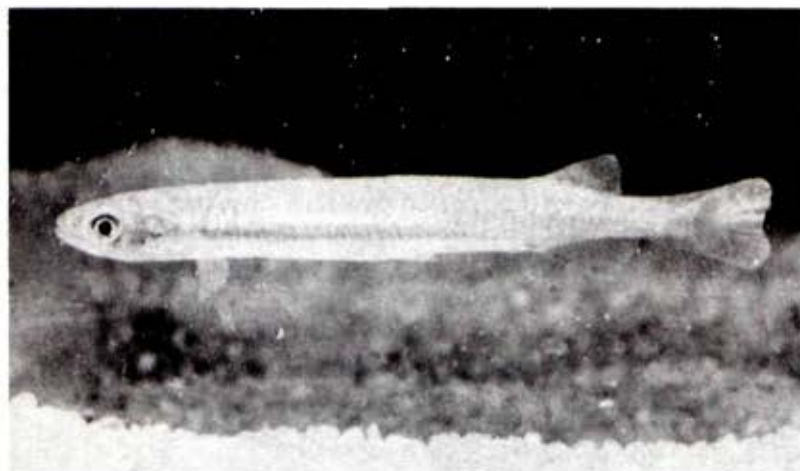
Beaches and oceanic islands

The range of coastal environments that beaches and oceanic islands provide are of particular importance to components of the bird fauna of East Gippsland. Birds such as the little tern and hooded plover require undisturbed sandy beaches for breeding, while the shore-line is an important feeding area for wading birds such as herons, egrets, sandpipers, dotterels, and plovers. Oceanic islands provide relatively undisturbed breeding areas for a number of species. Tullaberga, Gabo Island and The Skerries support significant breeding populations of the white-faced storm-petrel, little penguin, short-tailed shearwater, and Australian fur-seal. Other less significant breeding populations include the silver gull and crested tern. Predation by feral cats is a management problem on some islands, such as Gabo Island.

Riverine

The platypus and water-rat are two mammal species for which the riverine environment is the primary habitat. In addition, many species of bats forage over water, including the uncommon large-footed myotis whose major known foraging area is over water bodies. Birds that utilize riverine areas include pacific black duck, white-faced heron, azure kingfisher, and black-fronted plover. The environment is particularly important for many amphibians, such as the Blue Mountains tree frog and Peron's tree frog. The eastern water dragon is a semi-aquatic species commonly observed in riverine environments.

Of Victoria's 43 described freshwater native fish species, 25 are found in the rivers of East Gippsland (see Appendix IX). These include the Australian grayling, a species whose conservation status is 'vulnerable', and five other species that have a restricted distribution or are rare within Victoria.



Common galaxias

Seven of the eight major rivers (Snowy, Bemm, Cann, Thurra, Wangan, Genoa, and Betka) have been assigned a conservation status based on the occurrence of native fish species.

Assessments of freshwater fish communities within the Croajingolong National Park place them as close to the original fish populations as it is possible to find in Victoria, with relatively low numbers of introduced fish species compared with other Victorian waters. These rivers and their catchments therefore have very high conservation value.

Australian bass, estuary perch, and freshwater blackfish are also noted angling species in these streams.

Estuary

In East Gippsland, several estuaries provide spawning, nursery, feeding, and living areas for a wide range of fish species (see Appendix IX). Fish populations present include large numbers of popular angling species such as bream, mullet, flathead, tailor, estuary perch, and luderick and support a large sport fishery. An extensive survey of estuaries recently carried out assigned high ratings to all of

the major rivers as priorities for research. Table 11 shows these priorities, which reflect their importance in terms of fish stocks present, suitability for sport fishery, and ability to provide scientific information.

Table 11
RESEARCH PRIORITY RATINGS OF STREAMS

River	Rating
Snowy	A
Brodribb	A
Bemm	A
Cann	A
Thurra	B
Wingan	A
Genoa	A
Betka	B

A - high priority B - moderate priority

The estuarine environment is also an important foraging habitat for birds such as the silver gull, little pied cormorant, little black cormorant, and Australian pelican. Aquatic mammals (water-rat and platypus) may venture into the estuaries from adjacent rivers, and bats, particularly the large-footed myotis, forage over estuarine water bodies.



Red River estuary (Croajingolong National Park) supports good populations of native fish

Marine

Very little is known about the marine fauna of East Gippsland. Some information is available on those species that are harvested commercially or are sought after by recreational fishermen.

Much of the coastline and adjacent offshore areas consist of substrates that are regarded as generally unsuitable for a wide range of marine invertebrate species. The extensive sandy beaches and exposures of granitic bedrock are particularly unsuitable as invertebrate habitat, and these occupy a large proportion of the coastline. As a result, the study area has a lower diversity of marine invertebrates than the western and central parts of the State, where more extensive areas of suitable habitat include the sheltered waters of Port Phillip Bay and Westernport Bay.

A number of marine molluscs and crustaceans are known to have their Victorian distribution confined to the study area; although they are also known to be found in New South Wales.



Rock platform and sandy beach environments at the mouth of the Mueller River

Wetlands and swamps

Wetlands vary greatly in size and form, ranging from swampy marshes in low-lying areas, through open shallow bodies of water, to small fire dams constructed within forests. Wetland habitats are particularly important for many amphibian species such as the brown tree frog, common eastern froglet, spotted grass frog and green and golden bell frog. Reptiles such as the red-bellied black snake, tiger snake, and copperhead also frequent swamps and marshy wetland habitats. The white-faced heron and masked lapwing are among the birds utilizing this habitat. Dams and open bodies of water are also commonly used by bats for drinking and foraging.

Agricultural land

In the East Gippsland study area cleared land mainly occupies river valleys that have relatively flat terrain with fertile soils. As a result of agricultural clearing, most of the vertebrate fauna occupying the former forest habitats have been displaced and have been replaced by species tolerant of this altered environment, including common brush-tail possum, white-striped mastiff-bat, Australian magpie, willie wagtail, Jacky winter, welcome swallow, wedge-tailed eagle, and garden skink. Other species, such as the eastern grey kangaroo, can utilize the habitat for feeding if there are forested areas nearby to provide shelter. In these modified areas introduced species such as the common starling, blackbird, house sparrow, European rabbit, and brown hare can invade and thrive. The largest known population of the cattle egret in East Gippsland utilizes this environment near Orbost.

Sites of Zoological Significance

Distributional data for vertebrate fauna, derived from both faunal surveys and literature surveys, have been used to assess and describe sites of zoological significance in East Gippsland.

Two basic criteria were used to identify sites of regional to global significance: that every species occurs in at least one site of significance; and the number of sites is minimized. In summary, the sites selected represent areas in which rare species are known to occur, as well as being areas of relatively high faunal diversity. Twelve sites were identified as having global to regional significance, with a further 11 sites classified as being of local and scientific interest.

Since the publication of the original report further wildlife survey work has increased the number of records and extended the known range of some of the rarer vertebrate species. For example, the long-footed potoroo has been recorded at several new localities, but, although a minor extension of known range has resulted, this species remains endemic to East Gippsland. Similarly, the number of records of the eastern broad-nosed bat has greatly increased since it was first recorded in Gippsland at Link Camp Creek in

1981. As a consequence, the status of the site of significance nominated for this locality may need to be reviewed. It therefore appears advisable to undertake a review of all the sites, utilizing recent data, which may result in changes to the areas presently recognized.

Some of the areas presently designated as sites of zoological significance are well represented in the current reserve system. In general, near-coastal vegetation communities and those communities occurring in rainshadow areas are relatively well reserved, but the converse appears to be true for the mountain and foothill forest habitats - in particular wet sclerophyll forest, lowland sclerophyll forest, snow gum woodland, alpine wet heathland, cool temperate rainforest, and warm temperate rainforest.

Significant and Notable Species

Fifteen species of vertebrates are considered 'significant' species within the East Gippsland study area on the basis that the area is of particular importance for their conservation and/or scientific investigation. A further 35 species are regarded as 'notable' due to their rarity, restricted distribution, or important conservation status here. Species in both categories are listed in Appendix VI, together with their Australian and Victorian status, distribution, and population trend.

Significant species

Tiger quoll (*Dasyurus maculatus*)

Although distributed throughout the Great Dividing Range from northern Queensland to southern Victoria and Tasmania, in Victoria the tiger quoll is considered rare. However, it is still widespread, occurring sparsely throughout much of the eastern highlands and foothills. Its range has been reduced by approximately half during the last 140 years, and records have been concentrated in only three small, widely separated areas: south-western Victoria; the Otway Ranges; and in East Gippsland, in the upper Snowy River valley north of Tulloch Ard Gorge. In the Snowy River area the dry rainshadow woodlands appear to be favoured habitat, but records have also come from wetter forest habitats in other parts of East Gippsland. Little is known of the population ecology, habitat utilization, and precise distribution of this species because of its rarity and elusiveness. Many records have been obtained from incidental observations such as captures in dog traps. Sightings in the upper Snowy River were primarily recorded in Tingaringy National Park, but others have been scattered throughout the hardwood production zones - for example, in the Rodger River area. East Gippsland remains important for the conservation of this species in Victoria.

Common wallaroo (*Macropus robustus*)

In Victoria this species is rare, and restricted to the upper Snowy River area north of MacKillop Bridge. Within

the study area the only records are of two animals found dead near Deddick in 1969. All known extant populations are within national parks or a proposed one (Cobberas). The species is common elsewhere in Australia.

Brush-tailed rock-wallaby (*Petrogale penicillata*)

The brush-tailed rock-wallaby is common in suitable habitat throughout the Great Dividing Range in New South Wales and southern Queensland. It was once widespread throughout eastern Victoria, but its range has been severely reduced and it is now considered an endangered species in this State. Since 1910 it has been recorded only around the Snowy River gorge and in a small area in the Grampians. Known colonies in the Snowy River gorge area declined drastically early this century, possibly due to shooting and predation. If still extant in the study area, populations would be limited to the vicinity of inaccessible rocky cliffs on the Snowy River, such as Tulloch Ard Gorge.

Long-footed potoroo (*Potorous longipes*)

The long-footed potoroo was only recently described (1980) as a new species. It has been recorded at only a small number of sites, all of which are in East Gippsland. Only 16 confirmed specimens have been recorded to date, with some additional sightings and records from predator scat analysis. Of these 16 specimens, 12 were collected within or adjacent to the Bellbird Creek catchment, two at Yalmy Road 46 km north-west of Bellbird, one at Sardine Creek 29 km northwest of Bellbird, and one in the Ellery Creek catchment 28 km north-north-west of Bellbird. At least 14 of the specimens have come from hardwood production zones, and another from the Sardine Creek Education area, which is surrounded by land designated for hardwood production.

Localities of sightings and results from scat analysis all fall outside existing reserves. These records encompass a range of forest types, but most have come from stringybark forests with a dense understorey of dry sclerophyllous shrubs and wire-grass.

The animal is classified as an endangered species in Victoria.

White-faced storm-petrel (*Pelagodroma marina*)

The only storm-petrel to breed in Australia, the white-faced storm-petrel is a migratory species that in summer forms breeding colonies on islands off southern Australia.

Victoria contains three breeding colonies - on Mud Islands and South Channel Island in Port Phillip Bay, and Tullaberga Island in the study area. Mud Islands are currently experiencing a dramatic population explosion of silver gulls, which could threaten the nesting habits of white-faced storm-petrels. The South Channel Island colony may be affected by plans to develop this tiny island for tourism purposes. Tullaberga Island, which contains more than 60%

of Victorian nesting burrows, is therefore the most secure breeding colony in the State.

Little tern (*Sterna albifrons*)

The little tern lives along the coastal margin, feeding mainly on fish taken in a dive from above the surface of the water. The birds nest in small colonies on sand islands or sandy beaches, where they make a shallow scrape to serve as a nest. Disturbance to breeding - from predation, encroachment of vegetation, and particularly from human recreational activities - has led to a decline in the breeding population in New South Wales and Victoria. Due to concern at the declining status of this species in Victoria, the little tern has become the subject of a management program aimed at protecting breeding sites and increasing reproductive success.

Glossy black-cockatoo (*Calyptorhynchus lathami*)

The primary distribution of the glossy black-cockatoo is along the Great Dividing Range of eastern Australia, from south-eastern Queensland to eastern Victoria. The East Gippsland study area forms the southern limit of this population. These cockatoos live in eucalypt forest and woodland where they feed almost exclusively on casuarina fruit, ripping and crushing the cones with their powerful bills to extract the seeds.

Ground parrot (*Pezoporus wallicus*)

This is one of only three species of parrot in the world that is specialized to a ground-dwelling existence. It is a rare coastal species, which is now extinct in South Australia and has seriously declined in Western Australia. In Victoria it now breeds in only four areas - Long Swamp, Carlisle River--Blanket Bay heaths, northern Wilson's Promontory heaths, and East Gippsland. The last-named contains 75% of the ground parrot's Victorian habitat. The bird has three preferred habitats in this State:

- * sedgeland, in which it can survive indefinitely in the absence of fire
- * *Casuarina*-dominated heathlands
- * *Xanthorrhoea*-dominated heathlands

The two heathlands need to be burnt every 20 to 25 years to ensure an adequate supply of seeds, the parrot's main food item. (This species feeds on a wide variety of small seeds and fruits, the most important of which are the seeds of sedges in the families Cyperaceae and Restionaceae.) *Xanthorrhoea* heaths that have been burnt with a frequency of less than 6--8 years rapidly degrade and will no longer support ground parrots.

Turquoise parrot (*Neophema pulchella*)

The turquoise parrot has a discontinuous distribution from south-eastern Queensland, through eastern New South Wales,

to north-central and far eastern Victoria. It was formerly common in south-eastern Australia before suffering a severe decline that resulted in it being believed to be almost extinct. Since 1920 it has progressively recovered and expanded its range.

It is rare in Victoria, breeding regularly only in the Warby Ranges, Chiltern, and nearby dry forested foothills. In East Gippsland it occurs in the Mallacoota--Genoa district and is now known to breed in that area.

It feeds on or near the ground on seeds of grasses or herbaceous plants. Nests are generally less than a metre above the ground in hollows of small trees, dead eucalypts, holes in stumps, fence posts, or even logs on the ground.

The range and abundance of this parrot have fluctuated in the past and consequently current populations, although apparently relatively stable at present, should still be monitored.

Masked owl (*Tyto novaehollandiae*)

Although believed to have a wide distribution on the Australian mainland, the masked owl is very rarely observed. It is more common in Tasmania. In Victoria, East Gippsland is the region where the limited sightings of this owl are most concentrated. The bird lives in eucalypt forest and woodland and preys upon a range of small vertebrates, including rodents, marsupials, and birds. In south-eastern Australia each pair is believed to occupy a territory of about 500--1,000 ha.

Eastern bristlebird (*Dasyornis brachypterus*)

The limited geographical distribution of the eastern bristlebird encompasses eastern New South Wales and coastal East Gippsland in Victoria. This species lives in dense low vegetation such as coastal scrublands and wet heathlands, where it feeds on the ground, scratching mainly for insects in the litter. Populations of the eastern bristlebird are isolated, scattered, and sedentary, and the species is considered rare.

Regent honeyeater (*Xanthomyza phrygia*)

A nomadic species occurring in the forests and woodlands of south-eastern Australia, the regent honeyeater is now rare and endangered, having seriously declined in numbers throughout its range.

In the study area it has been recorded at Wangarabell, Shipwreck Creek, Wallagaraugh River, and west of Mallacoota aerodrome.

It is a very active, brightly plumaged honeyeater whose nomadic wanderings are associated with its search for suitable flowering trees and shrubs, chiefly eucalypts, banksia, and grevillea.



Diamond python

Diamond python (*Morelia spilota spilota*)

This snake is restricted to the eastern side of the Great Dividing Range between Coffs Harbour in New South Wales and the Mallacoota area in Victoria. It is nocturnal, feeding on mammals and birds largely at night, but is also seen basking during the day. It is very rare in Victoria, being restricted to the Mallacoota area of East Gippsland, where it is regarded as possibly threatened due to habitat disturbance, fires, and illegal collection by reptile fanciers.

Great barred frog (*Mixophyes balbus*)

This species inhabits only warm temperate rainforest, and is known in Victoria in just three localities. The occurrence of this species determined a site of zoological significance (upper Cann River valley). Other isolated areas of potential rainforest habitat occur at sites as little as 10 ha in total extent. It is regarded as threatened throughout its range.

Notable species

Grey-headed flying-fox (*Pteropus poliocephalus*)

The large nectar- and fruit-eating grey headed flying-fox, is common in coastal areas of New South Wales and Queensland, congregating in large camps. At the end of summer when food becomes scarce, adults disperse and become nomadic, and some congregate in areas of Victoria, where they feed on flowering or fruiting trees in gardens and orchards.

They do not remain throughout the winter and usually depart in late May or June.

In Victoria, the bats' only traditional regularly used roosting site is in a patch of warm temperate rainforest on Dowell Creek near Mallacoota Inlet. Up to 20,000 flying-foxes have been present during March and April of each year for at least the last 20 years. However, although virtually surrounded by national park, the colony is mostly on private land.

Eastern horseshoe-bat (*Rhinolophus megaphyllus*)

This bat is also a cave-roosting species, but it requires particular roost sites having a microclimate of high temperature and relative humidity. These special roosts are so critical that they are a limiting factor in the distribution of the species.

The eastern horseshoe-bat is less common in Victoria than further north, due to the lack of suitable roost sites. Like the common bent-wing bat, this species congregates at specific maternity sites and hence is vulnerable to disturbance. In East Gippsland it has been located in only a few roost sites, and has been caught at night away from roosts in several other localities.

Common bent-wing bat (*Miniopterus oceanensis*)

In addition to caves, the common bent-wing bat roosts in old mines and tunnels. Non-breeding animals use a number of sites, often moving large distances according to changing seasonal needs. For example, in south-eastern Australia they seek cold roosts during winter to allow hibernation at a time when insect food is scarce. However, with the onset of spring adult females move from these widely scattered roosts to congregate, often in their thousands, at specific traditional maternity sites that provide high temperature and humidity. Although this species is common in Victoria, its reliance on a very small number of maternity sites makes it vulnerable.

Large-footed myotis (*Myotis adversus*)

The large-footed myotis is distributed along coastal eastern and northern Australia. Colonies never occur far from water bodies. The bats' diet consists predominantly of aquatic insects obtained while foraging above the surface of the water, and they have also been recorded catching small fish. They usually roost in small colonies in caves, mines, under bridges, and at times even in dense foliage.

They are rare throughout their range, and in Victoria are considered vulnerable due to their reliance on specific roost sites. In East Gippsland this species has only been recorded along a few of the major rivers and inlets - for example, the Genoa and Errinundra Rivers and Wingan and Tamboon Inlets - and to date no major roost sites have been located.

Smoky mouse (*Pseudomys fumeus*)

This small grey native rodent now occurs only within Victoria, although it was formerly present also in New South Wales. Extant populations are known in the Otway Ranges, the Grampians, the highlands north-east of Melbourne, and East Gippsland. Although occupying a wide range of habitats in Victoria, in East Gippsland the smoky mouse is only known to inhabit coastal heath and woodland sites having diverse understories and all occurring on Quaternary dunes. These are restricted to the coastal strip between Marlo and Cape Everard.

An important habitat feature is the presence of a diverse array of leguminous and heathy shrubs to contribute towards the year-round supply of food resources - namely, seeds, berries, flowers, underground fungi and certain invertebrates - that the mouse requires. It appears that the availability and quality of suitable habitat may be linked with post-fire vegetation succession.

Introduced species

Twelve species of introduced mammals have been recorded in the East Gippsland study area (see Appendix IV). Some, such as the feral dog, feral cat, and rabbit, are widespread, whereas others such as the brumby are only found in localized populations. Currently, population levels of house mice are high, especially throughout areas burnt by wild-fires over the last 5 years, probably in response to successional changes in the vegetation. Eleven species of introduced birds have been recorded, such as the mallard, skylark, European goldfinch, and common starling (see Appendix IV). Information about the effect of these animals on native species can be found in the section on pest animals in Chapter 16 (Hazards).

Invertebrate Fauna

Information about the local invertebrate fauna is limited, owing to the dearth of studies carried out in East Gippsland to date. As yet, no systematic survey of invertebrates has been undertaken and most of the available information is based on data collected during studies of specific localities within the area.

However, a number of general statements about the significance of the East Gippsland invertebrate fauna can be made from the available information.

- * East Gippsland invertebrates exhibit a high level of endemism.
- * East Gippsland supports many species, normally associated with warm temperate communities further north, at the extreme end of their range.
- * Species with two other distinct distribution patterns also occur at the extreme ends of their range - those

along the southern coast of Australia and those mainly occurring on the drier western inland slopes of the Great Dividing Range.

- * As a result of East Gippsland being a meeting place for several distinct climatic and ecological zones, and of its own great diversity in physical and climatic factors, it can be expected to have an unusually high diversity of invertebrate species.
- * The area probably supports many undescribed species of invertebrates, as most of it is still relatively undisturbed forested public land and very few areas in the region have been studied in detail.

Invertebrates play an extremely important role in forest ecology. Because of their relatively short life histories, their limited tolerances to environmental changes, and their diversity and abundance, they have great potential for use as indicators of environmental changes. Invertebrates, including insects, move a significant proportion of energy through the ecosystem, recycle dead material, and regulate animal and plant populations on which they feed, or with which they compete.

As terrestrial and aquatic invertebrates comprise two distinct groups, they are discussed separately here.

Terrestrial invertebrates

Terrestrial invertebrates are commonly associated with three interacting habitats in the forest ecosystem. These are:

- * the soil
- * the forest floor and litter
- * the vegetation

Some groups of invertebrates are totally dependent for their survival on the maintenance of one or more of these habitats, while others utilize them for at least part of their life cycle.

Very little information is available regarding the terrestrial invertebrate fauna of East Gippsland, but the data available show that the fauna is particularly unusual. It has close affinities with the Australian east coast and subtropical faunas, which are absent from the rest of Victoria, as well as a high level of endemism.

The best known group is the butterflies (Lepidoptera) (see Appendix VIII). About 70 species have been recorded in East Gippsland - 15 of these are east coast and subtropical species whose only Victorian occurrence is in East Gippsland. Two northern species of moths have also been recorded in the area.

Eight species of native bees have been described, including three new ones. Two others were northern species recorded

for the first time in Victoria. Some 22 ants have been identified, including two new species. The fly *Scaptodrosophila* sp. is restricted to damp gullies around Mallacoota.

Terrestrial molluscs assist litter breakdown by consuming plant matter, algae, and fungi. They show a high degree of habitat specificity; of the 20 species recorded in East Gippsland, two are confined to rainforests there, and 10 occur in the litter and logs of fern gullies.

Other invertebrates reported in East Gippsland include the Onychophoran (*Peripatus* sp.), nine species of flatworms, and a funnel-web spider.

Aquatic invertebrates

The aquatic habitats of East Gippsland are extremely varied, and little altered by human activities. Their relatively undisturbed condition makes them important for scientific reference, against which the other aquatic habitats in south-eastern Australia can be compared.

Very little research, even of an exploratory nature, has been published, but the fauna appears to be very diverse. More than 2,000 species of aquatic insects have so far been identified for Australia, while two studies in East Gippsland have reported around 250 species. One researcher collected about 50 species of bottom-dwelling and littoral insects from three coastal freshwater lakes, and zooplankton from eleven such lakes. This study also recorded about 30 species of Crustacea (out of a total of about 500 species described for Australia). In a study using artificial substrata in lower and middle sections of five main streams, at least 225 taxa of invertebrates were recognized, including about 200 larval insects and 15 aquatic mites.

Some 23 freshwater molluscs have been recorded in Gippsland east of the Mitchell River, most of which occur east of the Snowy River.

A study of littoral invertebrates in coastal lakes yielded at least two new species: an ostracod; and an isopod from an essentially marine group. Data from a study of Lake Barracoota showed that three out of a total of 14 bottom-dwelling organisms found were undescribed, and all three (two isopods and a polychaete worm) have marine affinities, suggesting that salinity in the lake has probably been higher in the past.

Other species of interest found in East Gippsland include the gyrid beetle (*Gyrinus convexiusculus*), mainly distributed along the more northerly east coast, and the amphipod *Austrochiltonia subtenuis*, widely distributed in western Victoria and extending to Western Australia.

The caddis-flies (Trichoptera) are among the most abundant and diverse groups of insects in most Australian streams, and East Gippsland appears to have a particularly rich fauna, comprising five components.

- * Species widespread throughout temperate Australia, particularly in the south-east, include several species specifically associated with solid substrata and fast-flowing streams.
- * Some east coast forms reach the southerly and westerly limits of their distribution in East Gippsland. This group includes: a species collected in Lake Barracoota, and elsewhere only from Fraser and North Stradbroke Islands in Queensland; a recently described species collected in the Genoa River, occasionally in other forested catchments in East Gippsland and coastal New South Wales, and the Carnarvon Gorge in Queensland; and finally an undescribed species that has been recorded only in the Cann River at Noorinbee and Barrington Tops in New South Wales.
- * Widespread, mainly inland forms penetrate into East Gippsland along the warmer and drier valleys of the Snowy and Deddick Rivers.
- * Some species so far collected only in East Gippsland are probably endemic to the region, with limited northward extension into coastal New South Wales. Eight such undescribed species have so far been collected.
- * A fifth small group includes species or genera occurring mainly in mountain streams along Victoria's south coast. For instance, one species is found west of Mallacoota but belongs to an otherwise northerly genus. Another is rare and represents a new genus in the family Hydroptilidae. It is described from a specimen found in the Genoa River at Wangarabell, and collected elsewhere only from the Gellibrand River in the Otway Ranges and from forested areas near Imbil in south-eastern Queensland.

The importance of northern species reaching their southern limit in East Gippsland is also apparent in the stoneflies (Plecoptera). Several other groups, both terrestrial and aquatic, can be expected to show the same pattern.

Recent, as-yet unpublished, work on the taxonomy and distribution of freshwater crayfish (Parastacidae) has identified a number of new species, several of them endemic to East Gippsland. Of four species of spiny crayfish (*Euastacus*) occurring in the area, two are yet to be described, and two are found only in East Gippsland and small adjacent parts of New South Wales. The widespread and common genus of land crayfish (*Engaeus*) is also represented in East Gippsland by four species, of which three are endemic and two yet to be described.

Although little is known about the ecology of particular members of the invertebrate fauna of East Gippsland streams, a number of generalizations can be made.

Most lotic species are adapted to solid substrata. This applies even in streams with naturally sandy beds. The relatively unstable, sandy portions of stream-beds harbour

few specialist species. Many species normally associated with stony substrata still occur in sandy streams but are found mainly along the banks or on snags, logs, and submerged plants.

Partly as a result of that, and partly because of greater microhabitat diversity, the fauna of cobble-bed streams is usually more diverse than that of sandy streams.

The fauna of a natural stream alters gradually, from the source of a stream to the mouth, along with the gradients of various physical and chemical factors. However, many species are commonly found in particular stream stretches. For instance, a number of stoneflies are restricted to cool stony mountain streams, while some dragonflies and damselflies (Odonata) are more common in warmer and more sluggish lowland streams.

Many montane species of caddis flies are restricted to first- and second-order streams, and are known to be particularly susceptible to increased sediment loads.

Cool, stony upland streams of intermediate size generally support a more diverse fauna than either very small headwater streams or larger lowland streams.

Potential threats to invertebrate populations

It is likely that environmental disturbance created by activities such as roading, mining, and timber harvesting could affect invertebrate fauna. However, the net effect would vary depending upon a variety of factors, such as the timing, frequency, and extent of the disturbance.

Very little work has been done to determine any such effects, but some activities would probably result in loss of habitat, exposure to environmental extremes, and reductions in the availability of food, at least in the short term. The subsequent decrease in invertebrate populations may also affect species higher up the food chain, which rely on invertebrates as a source of food. However, many of those effects may be localized and short-lived.

Preliminary studies conducted by the National Museum of Victoria on the Errinundra Plateau indicate that there were generally more groups of invertebrates represented in the litter and soil of mature forests than in regrowth forests up to 12 years of age. Several of the groups present in mature forests such as snails and worms were absent from the areas of regrowth sampled. More detailed research is required to test these preliminary findings and to determine whether the differences are of a short term or long term nature.

Considerable evidence shows that increases in sediment yields from catchments, resulting in the blanketing of cobble substrates with sand and silt, is a major factor in reducing the diversity of invertebrate fauna and their habitats. Altering the bed structure by the deep penetration

of fine-grained sediment, and the coating of solid surfaces with silt and/or algal mats, can reduce invertebrate species richness and invertebrate biomass by 50% or more. It is now known that some invertebrates live deep within the stream bed, and it is possible that filling of spaces in the river bed may have a critical effect upon seasonal movement and life cycle patterns, such that, in the longer term, a reduction in diversity and abundance of stream-bed fauna results. The effect of these changes on species higher up the food chain is unknown.

References

References used in the preparation of this chapter are listed in Appendix III.

9. LAND SYSTEMS

The preceding chapters have discussed individually the various environmental factors - climate, geology, physiography, soils, vegetation, and fauna. However, no one factor alone determines land use; it is their combined effect that controls the uses to which the land may be put. The mapping of land systems is an attempt to consider the different environmental factors in combination.

The fundamental land unit (or component) may be regarded as an area in which the environmental factors do not vary enough to significantly influence any of the likely forms of use such as agriculture or forestry. Such a component may be, for example, a section of a ridgetop. Because these components are frequently small (say 5--20 ha), it is practical to define land units as combinations of components - for management and mapping purposes. In any land unit, such as a shallow basin of the order of 100 ha or more, the fundamental components show a predictable pattern.

As an aid to mapping and general description, these land units may be further grouped into mapping units, termed land systems. Similar land systems may be combined into land zones.

The land systems and land zones of the study area have been described and mapped by B.M. Nicholson (see Map 3). Land systems are recognized on geomorphic grounds and thus have characteristic patterns of land forms. These patterns were delineated on 1:80,000 aerial photographs and transferred to a 1:250,000 base map. Field inspections of land systems allowed compilation of notes on climate, geology, topography, vegetation, soils, land use, and their interrelations.

In the mountains, land system boundaries are generally sharp; but on the plains the subdued relief and occurrence of similar leached sands in adjacent land systems makes some boundaries - particularly those between the Wooyoot, Waygara, and Barga Land Systems - more difficult to map.

Table 11 lists the characteristics of the land systems. The four land zones shown on Map 3 correspond to the four geomorphic units described in Chapter 4.

Table 11
LAND SYSTEMS OF THE EAST GIPPSLAND STUDY AREA

Land system	Map symbol	Area ha	% of total	Mean annual rainfall (mm)	Parent material	Land forms
Errinundra	E	58,300	7%	900-->1,300	Ordovician sandstones and clay-stones (mainly) and Devonian granodiorite	High plateaux with rolling landscape
Kirkenong	Kg	14,600	2%	700--900	Ordovician sandstones and clay-stones (mainly) Devonian granodiorite	Undulating, gently sloping high plateaux
Cabanandra	C	9,600	1%	750--1,000	Ordovician sandstones and Devonian granodiorite	Low hills with rounded ridges
Moonkan	M	15,200	2%	900-->1,300	Palaeozoic quartzites, clay-stones, and sandstones	High rounded ridges and peaks with deep dissection
Tubbut	T	15,400	2%	650--900	Devonian granodiorite	Moderately steep, deeply dissected valleys
Jingallala	J	17,900	2%	600--900	Devonian granodiorite and minor Devonian Snowy River volcanics	Steep hills with long narrow ridges and v-shaped valleys
Wyangil	Wl	27,900	3%	600--900	Ordovician sandstones and clay-stones	Long narrow ridges and deep v-shaped valleys; slopes greater than 15°
Bullamalk	Bk	109,200	13%	1,000--1,300	Ordovician sandstones and clay-stones and minor Devonian Snowy River volcanics	Long narrow ridges and deep v-shaped valleys; slopes greater than 20°
Weeragua	We	67,200	7%	900--1,000	Ordovician sandstones and clay-stones	Moderately long, narrow ridges and deep v-shaped valleys; slopes greater than 20°
Wat Wat	Wt	36,700	4%	1,000-->1,300	Devonian granodiorite	Long, broad, steep ridges; rectangular drainage pattern
Kowat	Kt	50,500	6%	850--1,000	Devonian granodiorite and minor Devonian Snowy River volcanics	Moderately steep, broad ridges, wide valleys, rectangular drainage pattern

Soils	Native vegetation	Land use capabilities
Friable red and brown gradational soils	Open forest of shining gum, brown-barrel, and alpine ash above 900 m; broad-leaf peppermint, narrow-leaf peppermint, and candlebark below 900 m	Water conservation of prime importance because of high precipitation and absorptive soils; hardwood production very valuable and nature conservation important. Some areas are cleared for grazing, which has further potential in forested land below about 1,000 m elevation.
Friable brown gradational soils	Open forest of white sallee, broad-leaf peppermint, and narrow-leaf peppermint	Important for water conservation and nature conservation. Most of the area is used for grazing (improved pasture), but some potential for timber production.
Friable red and brown gradational soils	Open forest of white sallee, candlebark, and broad-leaf peppermint	Water conservation is important, as is timber production in the taller forests. The limited gentler slopes and deeper soils can support high-quality improved pastures.
Friable red and brown stony gradational soils	Open forest of candlebark, broad-leaf peppermint, messmate, and alpine ash above 1,100 m	Soils of this land system are prone to erosion if disturbed. Important for water conservation, hardwood production, and (because it is rich botanically and has spectacular scenery) nature conservation and recreation. Too steep for agriculture.
Yellowish-brown duplex soils	White box woodland west of Tubbut; red stringybark open forest to the east	Erosion hazard is fairly high. About one-fifth of the area is under pasture for beef cattle and wool, and these have further potential. There is limited scope for hardwood production and nature conservation.
Brown gravelly loams with reddish-brown duplex soils on gentler footslopes	Red stringybark open forest above 600 m; woodland of white box or white cypress pine below 600 m	Erosion hazard is high. Low potential for agriculture because of the short growing season, steep slopes, and poor access. Timber is generally of poor quality and stands are of low density and relatively inaccessible. The rugged landscape favours nature conservation and recreation
Friable red and brown gradational soils, and (lower elevations) red and brown gradational soils	Mainly open forest of red stringybark with woodlands of white sallee on exposed ridges above 1,100 m; open forest of candlebark and broad-leaf peppermint in wetter areas between 750 and 1,400 m altitude	Erosion hazard is high, and damage to the native plant cover should be minimized to protect the Deddick and Snowy Rivers. Hardwood production is important in the taller forest. Spectacular scenery and interesting vegetation make this land system valuable for nature conservation and recreation.
Friable red and brown gradational soils above 700 m; red and brown gradational soils below 700 m	Open forest of messmate, mountain grey gum, and broad-leaf peppermint above 700 m; silvertop below 700 m	Important for water conservation, hardwood production, nature conservation, and recreation.
Red and brown gradational soils	Open forest of silvertop (mainly), with red stringybark open forest on northerly aspects	As for Bullamalk land system.
Friable red and brown gradational soils above 750 m; yellowish-brown gradational soils below 750 m	At altitudes greater than 750 m, open forest of candlebark, brown-barrel, alpine ash (above 1,100 m), shining gum (above 900 m), mountain grey gum, and messmate; at elevations below 750 m, silvertop open forest	As for Bullamalk land system.
Stony friable red and brown gradational soils above 850 m; yellowish-brown gradational soils below 850 m	Open forest of messmate, brown-barrel, and mountain grey gum above 850 m; silvertop below 850 m	Erosion hazard is high. Important for water conservation, timber production, and (mainly because of its precipitous peaks) nature conservation and recreation.

Table 11 (continued...)

Land system	Map symbol	Area ha	% of total	Mean annual rainfall (mm)	Parent material	Land forms
Yalmy	Y	11,100	1%	750--900	Ordovician sandstones and clay-stones; Devonian Snowy River volcanics and Devonian granodiorite	Broad steep ridges, often with gorge-like valleys
Koola	Ka	10,300	1%	850--1,150	Devonian sandstones, silt-stones and conglomerate	Dissected land form with moderately steep, rounded ridges and narrow, often gorge-like valleys
Pinnak	P	93,300	10%	800--1,150	Ordovician sandstones and clay-stones	Hilly with short narrow ridges and valleys
Murrin	Wn	72,200	8%	800--1,000	Devonian granodiorite	Hilly to undulating; short, broad, rounded ridges; rectangular drainage pattern
Wooyoot	Wo	170,500	19%	900-1,000	Devonian granodiorite and Tertiary deposits	Dissected plains, scarps, and depressions
Waygara	Wa	56,200	6%	750--900	Tertiary fluvialite deposits	Dissected plains
Noorinbee	N	21,300	2%	750--1,000	Quaternary fluvialite deposits	Riverine terraces
Wau Wauka	WW	3,800	1%	800--1,000	Recent estuarine deposits	Low terraces
Barga	Ba	16,800	2%	750--1,000	Quaternary marine and aeolian sand	Longitudinal dunes
Boole Poole	Bp	7,500	1%	750--1,000	Recent marine and aeolian sand	Longitudinal dunes

Soils	Native vegetation	Land use capabilities
Red and brown gradational soils	Open forest of silvertop above 500 m altitude; open forest of white stringybark below 500 m	Potential for hardwood limited and for agriculture very limited. The gorges, with grand scenery and (often) unique flora, are valuable for nature conservation and recreation.
Red and brown gradational soils	Open forest of silvertop, or where mean annual rainfall is less than about 1,000 mm and aspect dry, red stringybark	Erosion hazard is very high where rainfall is less than 1,000 mm annually. Important for water conservation, timber production (in the taller forest), and nature conservation and recreation (especially in the gorges).
North of Princes Hwy stony red and brown gradational soils; south of Princes Hwy yellowish-brown gradational soils	Open forest of silvertop and (lower slopes) white stringybark, with red stringybark on drier sites	Most of the land is used for hardwood production with some bush grazing. There is potential for improved pastures on the gentler slopes, water supply catchments, and nature conservation.
Yellowish-brown gradational soils	On moist well-drained sites, open forest of silvertop (upper slopes) or white stringybark (lower slopes); white stringybark open forest on drier aspects and steeper slopes	Used mainly for hardwood production, with some bush grazing. May have potential for further agricultural development. Limited value for nature conservation and recreation.
Friable yellow or red gradational soils; leached sands	Open forest of silvertop and (lower slopes) white stringybark; and heaths of scrub she-oak and spear grass-tree	Hardwood production is important. The Betka River catchment supplies Murrumbidgee and an increasing extra demand for conservation of water for town supply is likely. Hardly any land has been cleared although the gradational soils have agricultural value. There is potential for extensive nature conservation reserves.
Reddish-brown or yellowish-brown duplex soils; leached sands	Open forest or woodland of silvertop; woodland of white stringybark	Hardwood production is important. The duplex soils have agricultural potential, although costs of development are high. There are valuable (but limited) areas for nature conservation and recreation.
Earthy brown or yellowish-brown gradational soils; brown loams	Open forest of coast grey box; heath of scrub she-oak or spear grass-tree; closed forest of lilly-pilly, vines, ferns, and epiphytes	Most of the land has been cleared for agriculture. The public land is particularly important for the conservation of closed forest.
Leached sands; saline soils	Woodland of swamp gum (<i>Eucalyptus ovata</i>) on leached sands, scrubs of swamp paper-bark and giant honey-myrtle, and various heath associations	Limited potential for agriculture. Much of the land has been periodically grazed after burning. Most of the land system is important for nature conservation and recreation, providing feed and shelter for wildlife.
Leached sands	Woodland of yellow stringybark, southern mahogany, brown stringybark, and white stringybark; heaths of spear grass-tree and scented paper-bark	Low potential for timber production and agriculture. Some land, particularly adjacent to the ocean or inlets, is valuable for nature conservation and recreation.
Weakly differentiated calcareous sands; weakly differentiated acid sands	Heath of coast wattle or coast tea-tree; woodland of coast banksia (east of Sydenham Inlet); woodland of southern mahogany and coast banksia (west of Sydenham Inlet)	Very prone to wind erosion following disturbance. Damaged by tourists and cattle (and associated burning). Valuable for nature conservation and recreation.



Mount Tingaringy surrounded by forested country on the Wyangil land system, and cleared land (background) on the Tubbut land system

Part III
CURRENT LAND USE

10. PUBLIC LAND USE

The total area of public land within each major category of land use is indicated in Table 13. In all, public land, as defined under the *Land Conservation Act* 1970, occupies some 830,000 ha or 88% of the study area.

The following chapters and Part IV (on the descriptive blocks) provide details on much of the public land in the various land use categories. Their locations are shown on Map 2.

Table 13
PUBLIC LAND USE

Major land use category	Area (ha)
National parks*	128,796
State parks	15,470
Regional parks	800
Reference areas	9,860
Flora, flora and fauna reserves**	8,011
Wildlife reserves	9,100
Coastal reserves	8,320
Bushland reserves	205
Scenic reserves	3,120
Education areas	1,500
Recreation reserves	113
Highway park	40
Hardwood production	433,000
Uncommitted land	203,000
Agriculture	8,194
Utilities	713
Township land	135

Notes:

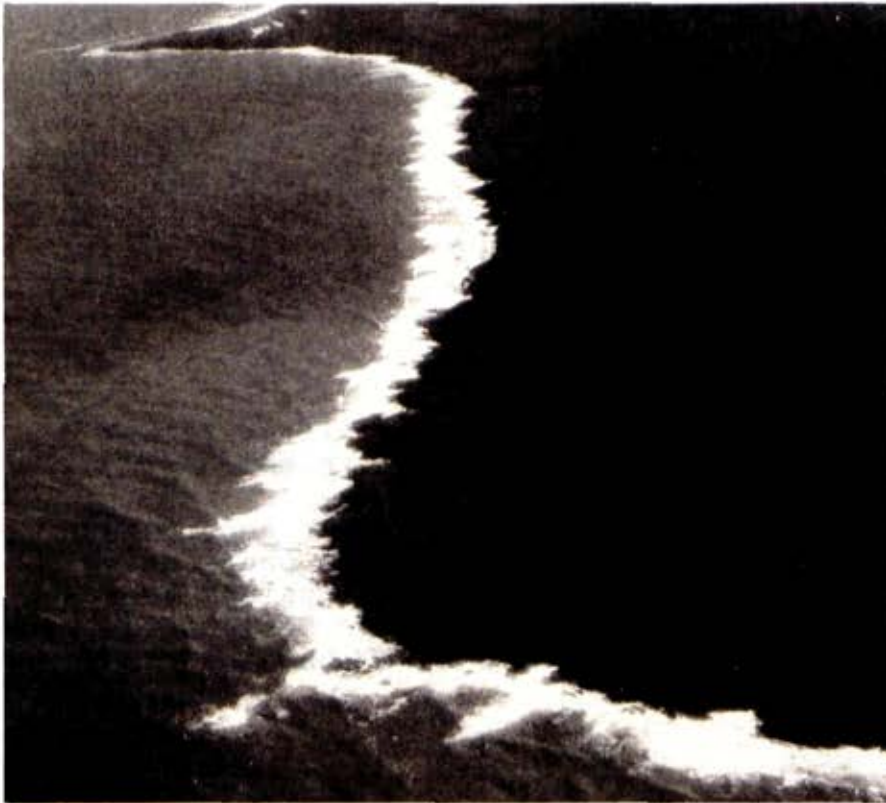
- * Included in this category are Lind and Alfred Parks scheduled prior to the Council's final recommendations.
- ** A number of areas have been reserved under section 50 of the *Forests Act* 1958 subsequent to the publication of final recommendations for the East Gippsland area and are included in this category. They are Errinundra, Beehive Creek, and Brodrigg, and are also shown on Map 2.

11. NATURE CONSERVATION

This chapter deals with nature conservation, which includes the protection of native species, natural features, and landscapes. Protection of these attributes is important for a number of land uses, including reference, conservation of species, recreation, and education. None of them necessarily monopolizes the land; often conservation needs are compatible with each other or with commercially productive uses.

In its final recommendations for the East Gippsland area, published in 1977, the Land Conservation Council recommended the establishment of various types of nature conservation reserves. These reserves were subsequently approved by the government in 1978 and 1979, with the exception of the Mount Drummer Flora Reserve, which remained as the Alfred National Park and the Euchre Creek Scenic Reserve, which, together with a small area designated for hardwood production, remained as the Lind National Park.

The large tracts of public land throughout the region comprise some of the least disturbed areas in the State and this, together with the variety of habitats represented, makes East Gippsland an area of major conservation significance.



Undisturbed coastal landscape between Sandpatch Point and Little Rame head (Croajingolong National Park)

Existing Conservation Reserves

Parks

The study area contains eight parks covering some 145,000 ha of public land. Their locations are shown on Map 2 (Public Land Use). The parks fall into three categories - national, State, and regional (see Table 14).

Table 14
EXISTING PARKS

Name	Category	Area (ha)
Croajingolong	National	82,130
Alfred*	National	2,300
Lind*	National	1,166
Tingaringy	National	17,600
Snowy River	National	25,600
Coopracambra	State	13,470
Lake Tyers (part)**	State	2,000
Mount Raymond**	Regional	800
Total		145,066

* These parks were scheduled prior to the Council's final recommendations. The Council recommended that the Alfred Park become a flora reserve with some boundary modifications, while Lind Park was recommended for hardwood production, with a scenic reserve along Euchre Creek. These recommendations were not accepted by government.

** These parks have yet to be reserved under section 4 of the *Crown Land (Reserves) Act* 1978 as approved by the government.

National parks

A national park is an 'extensive area of public land of nation-wide significance because of its outstanding natural features and diverse land types, set aside primarily to provide public enjoyment, education, and inspiration in natural environments'.

The area contains five national parks. The Croajingolong park, extending from Sydenham Inlet in the west to Cape Howe in the east, incorporates excellent representations of the coastal and adjacent lowland environments typical of the East Gippsland area. It contains a diverse range of habitats, vegetation, fauna, land forms, and landscapes, and numerous rare and interesting plants and animals are known to occur there. It is extremely valuable for recreation, situated as it is about half way between Sydney and Melbourne. Major features include inlets, extensive ocean beaches, dune systems, cliff-backed coves, and rocky promontories.

Several peaks form excellent lookout points while the varied vegetation - of forest, woodland, rainforest, and heath, with spectacular wildflower displays - provides a diverse range of wildlife habitats.

The Snowy River National Park and the Tingaringy National Park together encompass the eastern side of the Snowy River valley, and contain some of the most spectacular scenery in the State. In addition to their scenic grandeur, the parks contain a range of environments from rainshadow woodland and scrub on rocky outcrops to alpine ash and snow gum woodland at Mount Tingaringy. A few plant species, such as the Snowy River wattle (*Acacia boormanii*), are endemic to the Snowy River valley and a number of others are considered rare. Populations of the rare brush-tailed rock wallaby are thought to exist here, as are the tiger quoll and the common wallaroo (also rare in Victoria). The parks provide excellent opportunities for bushwalking and white-water canoeing; the Tingaringy Park adjoins the Kosciusko Park (in New South Wales) along the Victoria--New South Wales border. Both parks are contiguous with national parks on the western bank of the Snowy River.



The Snowy River valley near MacKillop Bridge

The remaining two national parks (Alfred and Lind) are relatively small, but are particularly important as they contain some excellent examples of warm temperate rainforest, otherwise known as lowland closed forest or jungle. Alfred Park is noted for its diverse array of fern species including occurrences of all five of Victoria's tree fern species. These warm temperate rainforests are biogeographically significant and contain a variety of plant groups such as lianes, epiphytes, ground ferns, and a closed canopy of kanooka, lilly pilly, blackwood, and pittosporum. They also support a number of animals that are rare or restricted elsewhere in Victoria, including the brown gerygone, black-faced monarch, large-billed scrubwren, and great barred frog.

State parks

A State park is 'an area of public land containing one or more land types, set aside primarily to provide public enjoyment, education, and inspiration in natural environments'. It is intended that such parks would include samples of land types not represented in national parks and would complement the latter, so that together the two types form a State-wide system. The study area contains two State parks: the Coopracambra and Lake Tyers parks. The main feature of Coopracambra State Park is the spectacular Genoa River gorge, with its steep sandstone escarpments and virtually undisturbed vegetation. The Upper Devonian sediments support diverse vegetation associations, and several species found in the park are not recorded elsewhere in Victoria. The park also supports a diverse assemblage of fauna, including the recent discovery of the common scaly-foot in dry rocky habitat beside the Genoa River. This is the first record of a legless lizard in eastern Victoria. The park adjoins the Nungatta National Park in New South Wales.

Only portion of the Lake Tyers State Park is located in the East Gippsland area, the bulk of it being included in the Gippsland Lakes Hinterland area. It contains fine stands of silvertop--stringybark forest and localized but very attractive stands of Gippsland grey box, particularly around the lake shore. The lake is a significant recreational resource and provides a range of water-based activities including boating, fishing, water-skiing, and swimming.

Regional parks

A regional park is 'an area of public land, readily accessible from urban centres or a major tourist route, set aside primarily to provide recreation for large numbers of people in natural or semi-natural surroundings'. Mount Raymond Park is the only one in the area and is located some 12 km



The common scaly-foot

from Orbost, the main centre of population in East Gippsland. It offers panoramic views over Orbost township, the Snowy River flood-plain, and the coastal lowlands around Marlo.

Reference areas

Finding a solution to problems arising from use of a particular land type is often helped by reference to an undisturbed example of the land type. Here the soils, vegetation, and fauna can be studied under natural conditions and the knowledge gained about the basic relations operating between these components can help solve land use problems.

Reference areas therefore act as standards against which the progress and effect of human alterations and utilization of the land can be measured. They also provide a valuable gene pool of some plant and animal species.

The Council's previous recommendations set aside 14 parcels of land totalling 9,860 ha as reference areas. They contain representatives of the major land types found in the study area.

As far as possible natural processes should be allowed to continue undisturbed within them: access is restricted and experimental manipulation is not permitted. Four of these - namely, Musket Creek (B7), Jones Creek (B11), Benedore River (B13), and Seal Creek (B14) - have so far been proclaimed under the *Reference Areas Act* 1978.

Wildlife reserves

Conservation of fauna depends on conservation of habitat, and by far the largest remaining areas of natural habitat are on public land. Although many forms of land use do not have marked detrimental effects on habitat, some areas have been set aside specifically for wildlife conservation and for developing wildlife conservation techniques.

Three such areas were recommended by the Council - Ewing Marsh, Lake Corringale--Lake Wat Wat, and Lake Curlip - and are important wetland areas for water-birds and duck-hunting. The woodlands and forests adjoining Ewing Marsh also provide important habitat for native mammals and birds.

Flora reserves and flora and fauna reserves

Flora reserves are managed to preserve plant species that may be rare or endangered or to protect associations of native species that are poorly represented on public land. Flora and fauna reserves are significant because they provide valuable habitat for populations of native fauna and contain examples of native vegetation with considerable floristic value in a natural or semi-natural state.

Included here is the 1,600-ha Errinundra Flora Reserve, which incorporates significant plant communities such as the largest stand of cool temperate rainforest in the State,



*Cabbage fan-palms in riparian forest along
Cabbage Tree Creek*

stands of the tree form of mountain plum pine, found only on the Errinundra Plateau, and stands of mature shining gum and mountain ash (which is near the eastern limit of its range). The Delegate River Flora Reserve contains significant sub-alpine heathland and bog communities as well as other vegetation types characteristic of the tablelands around Bendoc. The Cabbage Tree Creek Flora Reserve contains valuable examples of riparian communities, warm temperate rainforest (which includes the only Victorian occurrences of the cabbage fan-palm), and coastal heathland. Several other flora reserves near Mount Kaye, Maramingo Creek, Kanuka Creek, Mottle Range, Wood Point (lower Snowy River), and Jones Creek near Wangarabell include some important components of the East Gippsland flora.

The Brodribb Flora and Fauna Reserve preserves a remnant of vegetation and fauna typical of the Snowy River--Brodribb River flood-plain environment, most of which has been cleared for agriculture.

Scenic reserves

Scenic reserves are set aside to preserve the environs of major lookouts or areas of particular scenic value. Mount Delegate is a prominent peak located on the Monaro Tablelands to the north of Bendoc. It provides excellent views of the surrounding tablelands and is an important landscape feature in the region. Mount Ellery, situated on the southern margin of the Errinundra Plateau, is a prominent landscape feature and provides extensive views of the country to the north and south. The scenic reserves at Martins Creek on the Bonang Highway, along the Bemm River adjacent to the Princes Highway, and at Murrungowar along the Arte River contain attractive stands of warm temperate rainforest that are easily accessible and provide a pleasant roadside environment. Similarly, The Gap Scenic Reserve, south of Bonang,

protects attractive roadside vegetation including mature wet sclerophyll forest and cool temperate rainforest.

Coastal reserves and scenic coasts

Coastal reserves are set aside primarily for public recreation, education, and inspiration, but much of their value for these purposes depends on the maintenance of coastal landscapes, and the protection of natural ecosystems and features of geomorphological, archaeological, and historical significance.

The coastal reserves established in the study area have significant natural attributes such as the mouth of the Snowy River, the rocky headlands at Cape Conran, Pearl Point, and Bastion Point, and the broad sandy beaches east of Lake Tyers, at Marlo, and near Mallacoota Inlet and Sydenham Inlet. These areas are also important for the conservation of several rare plants and animals.

Three areas have been designated as scenic coasts where management emphasis is to be given to the protection of coastal landscapes that have outstanding values and that remain in a relatively unspoiled state.

Other conservation reserves

The study area also contains a number of other conservation reserves.

Bushland reserves are set aside to protect remnants of native vegetation on small areas of public land situated in predominantly cleared agricultural land. Their major use is to provide diversity in the landscape and to maintain the distinctive Australian character of the countryside. Three bushland reserves occur in the study area - at Mount Bendoc, Mallacoota, and Cann River.

Education is an important use of land in a natural or semi-natural state. Forests, rivers, and other natural landscapes have many applications in education - from primary to postgraduate levels - giving students opportunities to see natural land forms, to observe, interpret, and monitor biological processes, and collect specimens. In some cases this may involve long-term studies or alterations to the environment for experimental purposes. The Council's previous recommendations set aside four parcels of land, covering 1,500 ha, as education areas to be developed specifically for outdoor recreation purposes. The Bidwell Education Area is representative of plateau and higher-elevation environments, Sardine Creek is typical of foothill and associated riparian areas, while Bemm River and Serpentine Creek provide examples of coastal and near-coastal environments.

Other public land

Substantial areas of uncommitted land remain in the study area and, together with the areas designated for hardwood production, are of major significance for flora and fauna.

conservation. The range of vegetation communities supports a diverse assemblage of flora and fauna, and particular values occurring in such areas are described in the appropriate block descriptions later in this report.

The Council's previous recommendations for these areas require the land managers to conserve native plants and animals, to provide opportunities for the development of wildlife conservation techniques in consultation with the Fisheries and Wildlife Service, and to protect particular values listed in the recommendations.

Two areas of uncommitted land, one in the headwaters of the Goolengook River and the other in the Gelantipy Plateau--Bowen Range area, have been withheld from logging or new roading pending a review by Council. Both these areas contain appreciable quantities of mature timber and also have high nature conservation values.

Further small areas of public land include road reserves and stream frontages, but are of limited extent.

12. RECREATION

Outdoor recreation of various kinds is an important use of public land and is thus a major reason for the retention of natural areas.

The diversity of natural features within the study area - including the impressive forests of the ranges and plateaux, spectacular coastal scenery, the scenic grandeur of many areas such as the Snowy River valley, the Genoa River valley, and Mallacoota Inlet, and the remoteness and relatively undisturbed nature of many areas of East Gippsland - make it one of the most interesting and unspoilt places in Victoria for outdoor recreation.

Because relatively few people live in the area, most of those involved in recreational activities are visitors. East Gippsland is distant from major population centres such as Melbourne, Canberra, and Sydney, and as a consequence many areas closer to these cities are more heavily used for recreation. However, with improved roads and access together with an increase in leisure time, reduced travel costs, and promotion, recreational use of East Gippsland is likely to increase in the future.

East Gippsland is too far from major cities to be important for weekend trips for much of the population. The average length of stay in the area is more than a week, although there is potential for encouraging more people using the Princes Highway as a route to Canberra and Sydney to stop over in East Gippsland for a day or two.

Recreational levels vary throughout the area due to lack of promotion, problems of access, and availability of facilities. The most heavily used areas are those that have developed facilities that can be reached by car. This is re-



The Cape Conran area is popular for swimming and other beach activities

flected in the figures given in Tables 15 and 16, which show that Croajingolong National Park and the adjoining coastal reserve receive by far the highest use of any area in East Gippsland, although most use is by day visitors. The Ben Kurnai Coastal Reserve between Marlo and Cape Conran and the foreshore reserve at Mallacoota also receive heavy use. Both Lind and Alfred National Parks adjoin the Princes Highway and as such receive relatively high usage also.

Facilities at many of the parks in the area are not fully developed, as reflected in the present low levels of usage. In addition, the 1983 bushfires had a dramatic effect on total visitor levels to the area for many months after the fires. Facilities at some locations, such as at Wingan Inlet and Alfred National Park, were destroyed and some camping areas were temporarily closed to allow repairs to be

Table 15

VISITOR STATISTICS FOR PARKS IN EAST GIPPSLAND

Park	1980/81	81/82	82/83	83/84	84/85
Croajingolong National Park					
Day visitors	111,300	106,000	102,200a	177,200	140,000
Camper nights	19,800	19,000	7,300a	11,400a	18,000
Lind National Park					
Day visitors	38,000	50,000	50,000	50,000	50,000
Alfred National Park					
Day visitors	18,000	50,000	25,000a	25,000a	25,000
Snowy River National Park					
Day visitors	3,500	1,700b	1,650b	6,000	6,000
Camper nights	7,000	2,500b	2,700b	6,000	6,000
Tingaringy National Park					
Day visitors	700	100b	100b	400	400
Camper nights	600	nr	300b	400	400
Coopracambra State Park					
Day visitors	50a	400	600	600	600
Camper nights	50a	50a	300	300	300

Notes:

- a Figures reflect visitor decrease and loss of facilities in fires.
 b Figures reflect visitor decrease during periods of low river levels.
 nr No records

Most of the above figures are estimates of visitor use, as detailed recording methods are difficult to establish and maintain. It is extremely difficult to measure day visitors to all areas.

Table 16

VISITOR STATISTICS FOR 'OTHER CROWN LAND' IN EAST GIPPSLAND

Location	1984/85
Ben Kurnai Coastal Reserve (Corringle Creek - Sydenham Inlet)	
Day visitors	141,000
Camper nights	46,780
Mallacoota Foreshore and Recreation Reserve	
Day visitors	150,000
Camper nights	132,000
Marlo (Shire Park)	
Camper nights	25--30,000
Bemm River (Shire Park)	
Camper nights	15,000

made. The prolonged drought in 1981/82 and 1982/83 also had a pronounced effect on usage levels in the Snowy River and Tingaringy National Parks due to a lack of water in the Snowy River for water-based recreation.

Camping is probably the most popular recreational activity in the East Gippsland area and car-based facilities are provided at a number of locations such as the Mallacoota foreshore and recreation reserve, the Ben Kurnai coastal reserve between Marlo and Cape Conran, at Wingan Inlet, Point Hicks, and Shipwreck Creek in the Croajingolong National Park, and at MacKillop Bridge in the Snowy River National Park. A camp-site in the southern portion of the Snowy River park is also being developed.

The Department of Conservation, Forests and Lands is currently upgrading camping facilities at Cape Conran and it is also proposed to establish a number of holiday cabins in this area.

The Shire of Orbost controls six caravan and camping parks located at Orbost, Marlo, Mallacoota, Genoa, Bemm River, and Cann River, while privately owned caravan and camping parks are located at Marlo and Mallacoota.

Bush camping is also permitted in the Croajingolong National Park, Snowy River National Park, Tingaringy National Park, and Coopracambra State Park, but no facilities have been provided.

Bushwalking is popular in the more remote parts of the Croajingolong National Park, particularly along the coast, parts of the Snowy River valley, and through the Genoa River gorge within the Coopracambra State Park. Several nature trails



A party of bushwalkers at Red River, Croajingolong National Park

and longer walks have been established throughout the Croajingolong National Park, particularly around Mallacoota Inlet, Wingan Inlet, and Point Hicks, as well as in the Alfred National Park and the Snowy River National Park. A nature drive has also been developed in the Lind National Park.

The Department of Conservation, Forests and Lands has established a number of walking tracks, nature trails, and scenic drives to points of interest within State forests. It has been estimated that about 100,000 visitor days were spent in State forest in East Gippsland in 1982/83, including visits to two wayside stops on the Princes Highway at Murrungowar and Newmerella (see Table 17).

Some parts of the study area have been identified in a Statewide inventory as having potential for wilderness-type recreation. These are: the area around the upper Snowy River north of MacKillop Bridge and across to Mount Tingaringy, the central Snowy River area including the Gelantipy Plateau, Bowen Range, and the Rodger River catchment; an area incorporating the Genoa River gorge between the Cann Valley Highway, W.B. Line, Wangarabell, and the Victoria--New South Wales border; and the area east of Mallacoota Inlet, which is part of a larger area in New South Wales.

Table 17

ESTIMATED VISITOR NUMBERS FOR RECREATION SITES
IN STATE FOREST IN EAST GIPPSLAND

Location	1981/82 estimated recreation use (visitor days)	Main activities
Murrungowar checking station	15,000	Wayside stop, picnicking
Newmerella checking station	37,000	Wayside stop, picnicking
Mottle Range--Stringer Knob	13,000	Pleasure driving, sight-seeing, nature study
Mount Raymond	1,600	Sightseeing, nature studies
Young Creek Falls	1,600	Walking, sightseeing, picnicking

Most of these occur within existing parks except for the Gelantipy--Bowen Range--Rodger River area.

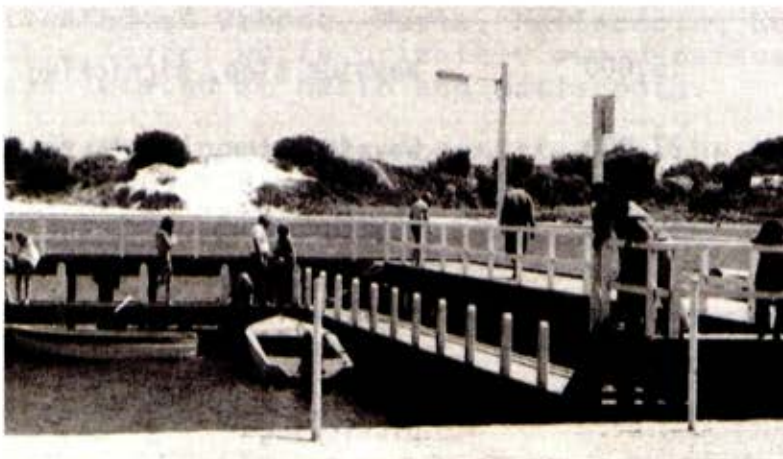
Increasing numbers of people are using the Snowy River for extended canoeing or rafting trips of several days duration. Trips usually begin at Willis (on the Victoria--New South Wales border) or at MacKillop Bridge, and end at the confluence of the Buchan River and the Snowy or sometimes at Orbost. The Snowy is one of the few streams in the State that can provide this type of recreation experience.

That part of the Snowy between the Victoria--New South Wales border and its confluence with the Buchan River has been designated as a 'wild and scenic river', which is defined as being 'a river or section of a river together with its corridor, representing select parts of the environment', that has significant value for nature conservation, recreation, aesthetic, historical or other special values. It may be that a number of streams in the State have similar values, but to date no assessment of other rivers has been made.

Fishing is a popular activity in most of the accessible coastal inlets and ocean beaches. The most productive angling water is Mallacoota Inlet, although Sydenham, Tamboon, and Wingan Inlet and the lower reaches of the Snowy River also provide good fishing. The main species caught include bream, luderick, estuary perch, flathead, mullet, whiting, mulloway, tailor, garfish, and trevally.



Tulloch Ard Gorge, Snowy River National Park



Marlo jetty

A number of streams throughout the study area contain populations of brown and rainbow trout, in addition to native species such as bass and blackfish. However, access to these streams is generally poor. The best streams appear to be the Bonang, Brodribb, Delegate, and Snowy Rivers.

There is likely to be increased potential in the future for deer-hunting. Hog deer occur in small groups along the coast from Lake Tyers to near Mallacoota. At present most hunters concentrate on the major hog deer populations further west around the Gippsland Lakes, but this may change if the East Gippsland populations increase in size.

Sambar deer are known to occur in the Orbost district, along the length of the Snowy River, and around the Brodribb River and Bemm River north of the Princes Highway. Colonization is continuing and it is likely that breeding populations will occupy much of the study area in the future. The East Gippsland population therefore offers potential for hunting but at this stage is not heavily exploited. Major hunting areas at present are located in central Gippsland.

Lake Corringale, Lake Curlip, Ewing Marsh, and surrounding wetlands are popular for duck-hunting. Elsewhere in the study area opportunities for duck-hunting are limited although local duck-hunters use the river flats at Genoa and Wangarabell and parts of the Betka River catchment in the far east of the study area.

The network of forest roads and tracks both in parks and State forests are becoming increasingly popular with people interested in visiting the more remote parts of East Gippsland. The main activities include sightseeing, pleasure driving, nature study, picnicking, four-wheel-drive touring, fishing, camping, and trail-bike riding.

13. PRIMARY PRODUCTION

Present Land Use

The study area covers a total of 945,000 ha, of which only about 113,000 ha or 12% is held as freehold. A little over half of the freehold (59,000 ha) is under pasture or crop for agricultural production, with the remainder of freehold being forested. Some parcels of public land within the study area, particularly in the eastern and northern parts, are leased for cattle grazing.

At March 1983, the study area contained 302 rural holdings - a drop of 30% from the 437 rural holdings present in 1971. The most extensively developed agricultural area lies within a 25-km radius of Orbost township in the south-western corner, and comprises the flats of the Snowy and Brodribb Rivers, the adjoining undulating country, and the flat land near the coast. It mainly supports dairying, beef cattle production, and maize- and vegetable-growing.

Another developed region in the north includes the settlements of Deddick, Tubbut, Cabanandra, Dellicknora, Delegate River, Bonang, and the larger Bendoc settlement. These are not all continuous, but stretch more than 60--80 km from west to east. Wool, fat lamb, and beef production are the main agricultural industries here.

Other settled parts of the study area include the productive Cann River valley, Combienbar, Cabbage Tree, Genoa, and Mal-lacoota. Further small areas of freehold, some cleared, some still forested, are scattered throughout most parts of East Gippsland.

Beef cattle production, despite showing a marked decline in numbers since 1975, still remains the most important live-stock industry here. Table 18 shows the trends in livestock numbers over the last 13 years.

Beef industry

Since the beef slump of 1974/75, the number of beef cattle in the study area has steadily declined. This trend has been general throughout Victoria, and has reflected the declining terms of trade of beef-producers. However, despite a 47% decline in numbers since 1975, beef cattle still represent more than 60% of the total stock units for the study area (see Table 18).

The vast majority of the beef cattle in the study area are Herefords (80--85%). Virtually all of these are situated in the river valleys or the coastal regions, although a few herds remain in the higher-rainfall mountain areas in the north.

Table 18

LIVESTOCK NUMBERS ('000) AND WOOL PRODUCTION IN ORBOST SHIRE

Year	Dairy cattle	Beef cattle	Total cattle	Sheep	Wool production (tonnes)
1970/71	18.3	34.5	52.8	67.4	280
71/72	17.9	40.3	58.2	55.0	231
72/73	16.0	34.5	50.5	41.4	207
73/74	15.7	37.9	53.7	46.7	176
74/75	15.0	45.9	60.9	49.2	225
75/76	12.5	44.7	57.2	48.2	196
76/77	11.9	40.6	52.5	40.9	163
77/78	11.9	38.1	50.0	41.1	181
78/79	11.2	30.7	41.9	52.8	220
79/80	8.9	33.4	42.3	46.4	222
80/81	8.7	29.1	37.8	42.4	205
81/82	8.9	28.3	37.2	42.6	208
82/83	8.7	24.3	33.0	56.0	239
Orbost as % of Victoria	82/83 (0.6%)	(1.3%)	(1.0%)	(0.2%)	(0.2%)
Total, Victoria	82/83 1,477.8	1,920.6	3,408.2	22,748.0	109,262

The major product from the beef properties is fat cattle that have been bred on the property. The herds consist mainly of breeding cows; the calves are sold off as vealers if fat, or else held over to produce fat steers. There is also some store calf production and some fattening of bought-in steers.

Calving time for beef herds varies depending upon the climate and more importantly the pasture growth pattern. The undulating and coastal areas tend to have March--April calving, while the more productive river flat and irrigated areas have later calving in June--July. Calving times vary considerably within any area, depending on management systems and personal preferences.

Little if any supplementary feeding of beef cattle is required in average years, particularly in the milder coastal regions; however, some winter feeding may be necessary in the colder mountain areas. Stocking rates vary according to location, with the undulating and coastal areas stocked at around a cow and calf to 1.2 ha, while the Snowy River flats occasionally carry up to a cow and calf to 0.4 ha.



*Prime grazing land
along the Snowy
river near Orbost*

The cost-price squeeze experienced by all beef-producers over recent years is accentuated in this study area as a result of the great distances to markets and from sources of inputs. This helps to account for the large decline in cattle numbers in the study area.

Dairy industry

At present, about 60 dairy farmers remain in the study area. This is a marked decline from 1973, when about 110 dairy farmers were operating here, and that figure itself reflected a decline from the 180 dairy farmers operating in the study area in 1963.

Dairy cattle numbers have also declined, but not at the same rate as the number of farmers. As can be seen from Table 18, the decline in numbers has steadied over the last 4 years, reflecting the slightly better returns from dairying during that period. The present decline in milk prices may lead to a further reduction in both farmer and cattle numbers in the near future.

The vast majority of dairy farms are located on the Snowy River and Brodribb River flats and surrounding districts. Five farms remain in the Cann River valley - three at Combienbar and two at Cabbage Tree. All but six of the dairy farms in the study area supply the Murray Goulburn factory at Maffra. The pick-up therefore involves a rather large cartage cost being docked from their price.

Major sidelines for dairy farmers in the study area include beef cattle, vegetable-growing, maize-production, and fattening store lambs.

Sheep industry

Most of the sheep in the study area can be found in the lower-rainfall areas in the north-west. Freehold land in this part of East Gippsland supports good pastures of lucerne, which have great value for fattening stock, growing out young stock, and wool production.

The Tubbut--Deddick area can suffer from extensive dry spells and is therefore considered more suitable for Merino sheep, although some Merino crossbreds are also present. Further to the east around Bonang and Bendoc, farmers more commonly run crossbred sheep suited to prime-lamb production. Livestock are usually marketed to the north of the district in Delegate, Bombala, and Cooma. Wool, however, is usually sent to Melbourne for auction.

Sheep numbers in the study area have shown wide fluctuations since the high figures of the late 1960s (see Table 18). During that period, the wetter southern parts of the study area carried many large flocks of crossbred sheep.

One factor that contributes to the fluctuations in sheep numbers is that many farmers in the southern part of the study area will buy in store lambs when these are inexpensive, for growing out and fattening on the green summer pastures that result from the relatively high summer rainfall here.

Declining prices, health problems associated with running sheep in wet areas, and an increase in the number of wild dogs have drastically reduced sheep numbers here.

Climate in the north of the study area - around Deddick, Tubbut, and Bonang - is more suitable for sheep production. As a consequence, quite large flocks of both Merino and crossbred sheep can be found in this region. In recent years, however, the viability of these sheep properties has been threatened by a prolonged drought, poor product prices, and wild dog attacks.

It is now evident that the single most important problem facing these sheep-producers is the increasing incidence of wild dog attacks. The farmers point out that the financial loss from such attacks is not restricted to those sheep actually killed. They also cite such factors as stress on their remaining sheep, not to mention on themselves and their families and their inability to use some paddocks that are prone to dog attacks, as major threats to the viability of the sheep enterprises.

Vegetable industry

Vegetable production in the study area is concentrated on stream flats, particularly those associated with the Snowy River near Orbost.

Moderate summer temperatures, good summer rainfall, and relatively high humidity make the region particularly suited to summer-growing vegetables. The areas under different crops vary markedly from year to year depending on market price, grower interest, and the relative profitability of other enterprises such as beef cattle, dairying, and lamb fattening.

The Orbost flats once produced large quantities of beans for processing under contract. These contracts were lost in the



Bean and sweet corn crops on the Snowy River flats

early 1980s, and so very few fresh beans are grown today. The loss of processing contracts caused a decline in the vegetable industry, although alternative crops are now appearing in larger quantities.

In the 1983/84 season, the main crops in the study area were dry edible beans (90 ha), sweetcorn (160 ha seed and market), popping corn (60 ha), pumpkins (10 ha), cabbages (10 ha), capsicums (10 ha), broccoli (5 ha), and cauliflowers (3 ha).

Maize-growing is still prevalent on the Orbost flats, although much reduced from its level in 1963/64 when 700 ha were planted. It declined heavily after that year, but has increased lately with the introduction of waxy maize contracts in the early 1980s. In the 1983/84 season approximately 170 ha of maize were planted.

Production of fresh market vegetables is increasing, but further expansion is limited by the stagnant prices and the distances from markets. Some recent innovations in vegetable-marketing occurring in East Gippsland may be of benefit to vegetable-growers in the study area. These include specialized fresh-vegetable packaging for specific markets, and the possibility of vegetable-processing in East Gippsland.

Forest grazing

At present, 49 current grazing licences throughout the study area cover almost 100,000 ha. Most of the licences and agistment sites are located between Club Terrace and Genoa and along the Cann Valley. Other licences apply in the Tingaringy National Park and the Snowy River National

Park although those in the latter park are to be phased out. Most grazing takes place for 2 to 4 months during the winter, but some summer grazing occurs in the north. Certain licensed areas are only grazed in abnormally dry years and this may hinder regeneration there, depending on the rate of stocking. While the value of agricultural production from the licensed areas is insignificant on both district and State-wide bases, the loss of these areas would probably mean that some graziers would need to reduce their total stock numbers, which in turn would reduce the viability of their farms, particularly those in isolated districts. Without access to fodder on the licensed areas, the cost of providing additional feed would certainly be much greater.

The existence of many small rural communities within the study area depends upon the continued viability of farms in outlying districts. The survival of many properties is already threatened by reduced terms of trade that Australian agriculture faces today, particularly in relation to the extra costs associated with distance from markets. Thus, any additional costs, such as those arising from the loss of forest grazing land, could significantly affect farm viability.

Demand for agistment rights at the present time is very small although it may increase substantially during periods of drought. Agistment sites are usually areas that have been recently burnt and therefore have suitable feed, but other areas may be used to graze stock when floodwaters inundate low-lying agricultural land. Some 31,000 ha adjoining the Cann valley has been available for agistment since 1981.

Apiculture

Apiculture is a relatively small primary industry producing honey and beeswax. Honey is used for table consumption, confectionery manufacture, and stock feeds, and in the preparation of meat, vinegar, some types of tobacco, and some pharmaceutical and cosmetic products. Beeswax has many uses, including candle, cosmetic, and polish manufacture. Pollen is sought after as a protein health food. Other primary industries also benefit directly from apiculture through the pollination of flowers, and crops such as apples, cherries, plums, pears, pumpkins, cabbages, rape, sunflower, clover, and lucerne benefit from this process.

Level of production

In 1984, Victoria produced 3,602 tonnes of honey and 64.7 tonnes of beeswax. Considerable quantities of both these products are exported to countries such as Britain and Japan. Production levels can fluctuate considerably from year to year because of climatic variation. High production was achieved in 1979/80 (4,605 tonnes) and 1980/81 (5,160 tonnes), compared with only 1,713 tonnes in the 1976/77 drought season. In 1984, Victoria had 381 registered apiarists with 40 or more hives, despite a steady decline in numbers over the last few years.

The principal supply of nectar in this State comes from eucalypts and a few other native trees and shrubs. The native ground flora, although important in other countries, has relatively little importance as a source of nectar in most parts of Victoria. For maximum production of honey, hives are moved from district to district, following the flowering of the eucalypts.

Outlook

World demand for honey has increased noticeably in recent times. One reason for this is that people in many countries now regard honey as a health food. It is expected that this trend in consumption will continue.

The trend to larger transport vehicles and mechanical means of loading and unloading hives has led to a heavier concentration of hives per apiary that is likely to continue also.

Beekeeping in the region

Although very few commercial apiarists live within the study area, large quantities of honey have been produced throughout the region. This is because apiarists travel widely to harvest honey from different areas as different honey producing species flower, and many of them visit East Gippsland when conditions are favourable. As access is improved throughout, it is expected that honey production could increase, especially from the northern parts of the study area. Table 19 lists the most important honey-producing eucalypts.

Numerous shrubs in the study area, such as hop bush, coast banksia, sunshine wattle, sea box, and coast tea-tree yield good quantities of nectar and pollen in spring, which stimulates brood-rearing, thus providing beekeepers with strong healthy hives in time for the eucalypt honey flows.



Lowland sclerophyll forest north of Ewing Marsh containing important honey-producing eucalypts such as blue box, red box, white stringybark, southern mahogany, and mountain grey gum

Table 19
 MOST IMPORTANT HONEY-PRODUCING EUCALYPTS

Species	Distribution within the study area
Blue box	A valuable species around Hartland--Waygara
Red box	Main areas worked are north and east of Nowa Nowa and at Sardine Creek
Southern mahogany	Common throughout near-coastal areas, but heavily worked for honey between Lake Tyers and the Thurra River.
White stringybark	Worked extensively along the coastal strip throughout
Red stringybark	A very important species in the rainshadow area near Deddick and Tubbut, and to a lesser extent near Waygara
Mountain grey gum	Widespread throughout
White box	A common species in the rainshadow country, but access restricts its use to the far east
Red bloodwood	A very important species, but it flowers spasmodically and is restricted to the far east
Brown-barrel	The main stands worked for honey occur around Bonang--Goongerah--Errinundra

Hazards

Both wildfire and the clearing of native vegetation pose major threats to apiculture. Bushfires may destroy whole apiaries and can seriously damage prime sites, making them unproductive for many years. Widespread clearing of native vegetation, although not a major problem in East Gippsland, can seriously reduce the availability of high-quality honey-producing species and coastal plants that are valuable for breeding and building up hives.

Fishing

Based on 1983-84 estimates provided by the Commercial Fisheries Branch of the Department of Agriculture and Rural Affairs, the commercial fishing industry in the study area contributes some 5% of the total Victorian fisheries production. The 1982 census showed that about 6% of the work force in the Shire of Orbost were employed in the industry. The largest employer is the Abalone Fishermen's Co-operative at Mallacoota, which currently employs some 30 people.



*A fishing trawler
off Cape Conran*

The fishing fleet is based at Mallacoota and Marlo and the most important commodity produced is abalone. Currently, a total of 26 abalone fishermen working from either Mallacoota or Marlo produce approximately one-third of the total Victorian catch. Most reefs along the coast from Cape Conran to Cape Howe are harvested. Rock lobster and shark are also caught around these reefs and from Starbank Reef some 20 km offshore from Mallacoota, but on State-wide basis the study area contributes less than 1% of the total catch for both these species.

Trawlers from Eden and Lakes Entrance also fish the area although mainly further offshore, and concentrate on species such as flathead and morwong. Some exploratory work is being conducted by fishermen from Lakes Entrance on the feasibility of scallop-fishing in the study area.

There are currently seven licensed fishermen working the bottom lake section of Mallacoota Inlet and another four licensees at Tamboon Inlet. The main target species they catch are bream and luderick, although they also take whiting, garfish, trevally, mullet, and tailor. Some 3% of the State's fish production from major bays and inlets is supplied from East Gippsland.

The offshore fishing industry has some potential for expansion, but this is limited to a large extent by a lack of good access to suitable port facilities, as many of the inlets in the study area, such as Mallacoota, have only shallow entrances.

Reference

Australian Bureau of Statistics (1984). 'Livestock and Livestock Products. Season 1983/84'. (A.G.P.S.: Melbourne.)

14. TIMBER PRODUCTION

Hardwood forests cover most of the public land in the study area. Their utilization commenced in the 1850s near Bendoc, and continued at a fairly low level elsewhere in East Gippsland for the next 100 years. Sawlog production increased rapidly from the 1950s, and since then, the area has become very important for the maintenance of Victoria's supplies of sawn timber.

The area mainly produces logs for sawn timber, with a less important amount of other forms of forest produce, although it has supplied significant quantities of beams and railway sleepers since about 1916. It still provides about 20% of the State's requirements for railway sleepers with about half originating from the forests of the Murray Valley.

Between 1850 and 1950, sawlog production was largely associated with gold-mining and agricultural development. However, Victorian demand for structural timber increased substantially after World War II and this resulted in a rapid expansion of the area's sawmilling capacity in order to meet the demand. The post-war expansion of the sawmilling industry has been particularly important to the economic and social welfare of the Orbost Shire residents. The continuing existence of settlements such as Club Terrace and Bendoc depend essentially on the timber industry, which has also added a major industrial component to the previously mainly agricultural base of the largest town, Orbost (see Table 20).



Sawmill near the Brodribb River, east of Orbost

Table 20

SAWMILL LOCATION, EMPLOYMENT, AND SAWLOG ALLOCATIONS

Sawmill location	Number of sawmills*	Number of employees**	Sawlog allocations from public land (cu.m)***
Bemm River	2	33	18,000
Bendoc	2	43	31,500
Brodribb River	2	120	93,000
Cann River	5	65	50,250
Club Terrace	3	64	54,000
Combienbar	1	12	12,000
Maramingo	1	3	1,200
Newmerella	1	17	9,000
Noorinbee North	1	7	2,250
Waygara	2	77	54,000
Outside study area (Nowa Nowa & Eden)	3	53	45,750
Sub-total	23	494	370,950
Other timber industry employment:			
Department of Conservation, Forests and Lands (Forestry)		70	
Sawn-timber cartage		27	
Sleeper and pole-cutters		20	
Total		611	

* Six other sawmills, one at Cabbage Tree, Maramingo, and Bendoc and three at Newmerella do not have allocations from public land but obtain supplies from freehold land.

** Includes bush workers, truck drivers, and further processing where this is done at the sawmilling centre and shows average employment at the peak of the logging season.

*** Sawlog entitlements are the annual allocated volumes that may be obtained by the mills at the centres listed.

Forest Types and Silvicultural Systems

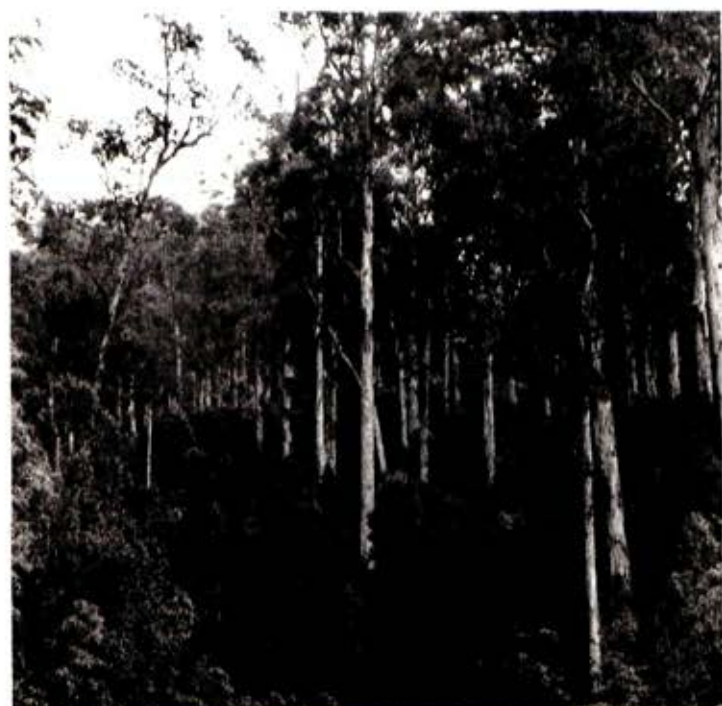
About 87% of the land within the study area is forested. A broad classification of forest types is described below along with the silvicultural systems applied to each.

Plateau forests

As the name suggests, these forests generally occur above 800 metres elevation and are found in three main areas - Errinundra Plateau, Rodger--Yalmy Basins and the Deddick

Plateau - where rainfall is high, and deep fertile gradational soils predominate. Stand heights are rarely less than 40 m and commonly exceed 70 m. The main commercial species are shining gum, alpine ash, mountain ash, brown-barrel, mountain grey gum, and messmate stringybark, which usually occur in wet sclerophyll forest and montane forest. Fast growth rates, high volumes (both per hectare and per tree), and long bole length make these forests important for feature timbers, structural timbers, furniture, and joinery.

Conditions required for the regeneration of a heavily stocked productive forest of plateau species are exposed soil or ash bed, no overhead shade, and a supply of seed. Such conditions occur naturally following intense wildfire, but can be created artificially by clear-felling, controlled firing, and seeding. However, the presence of a number of



Plateau forest of shining gum



Portion of a clear-felled logging coupe on the Errinundra Plateau, following controlled firing, and hand-planting of shining gum

distinct age classes in parts of these forests indicates that it is possible for these species to regenerate in the absence of intense fire and total removal of the overstorey. The difficulty of collecting sufficient seed from shining gum has often made it necessary to hand-plant after utilization in order to re-establish this species.

Mountain forests

The mountain forests occur at elevations between 450 metres and 800 metres and also comprise highly productive forests on deep friable soil. The principal species are brown-barrel, messmate stringybark, and mountain grey gum. The predominant vegetation community utilized is wet sclerophyll forest. Most species are suitable for sawlogs and for other types of produce including poles, pulpwood, and occasionally sleepers. Stand heights usually exceed 40 m although lesser heights occur on the more exposed northerly slopes. The requirements for regeneration are similar to those of the plateau forests, but seed from the mountain forest species is more readily collected, thus eliminating the need for hand-planting following utilization.

Coastal and foothill forests

These forest types occupy a wide belt of moderately to gently undulating country across the southern portion of the study area. The most important commercial species is silvertop, which occurs extensively - often in pure stands, but white stringybark, yellow stringybark, mountain grey gum, red ironbark, and Gippsland grey box are also harvested. These species commonly occur in the lowland sclerophyll forest community. Stand height is normally greater than 30 metres and often exceeds 40 m. Forest produce includes structural and framing timbers, sleepers, and fencing timbers. Silvertop is very versatile: it is highly sought after for house framing and, when free of defect, can be seasoned and used for joinery and other specialized purposes. This species attains its best development in East Gippsland. Further west, however, it usually occurs as a stunted tree on dry stony ridges.



A typical coastal--foothill forest dominated by silvertop and a variety of stringybarks

Because the forest type has been subjected to repeated burning, the combined effects of utilization and fire have resulted in a complex forest structure ranging from regenerating stands of various ages to mature stands with a high degree of defect.

Regeneration to produce commercially productive forests can be achieved by clear-felling, or by selective harvesting that aims at reducing the stocking rate of the site to a basal area of about 10 sq.m per ha, while retaining seed trees. Reduction to such a level can seldom be achieved in a sawlog-only operation because of the cost of felling unproductive trees. Thus, regeneration in these areas is sometimes inadequate due to the amount of overwood (unfelled trees) left on a site.

Significance of Timber Production from East Gippsland Forests

About 60% of the annual sawn timber consumption in Victoria is produced from public land and private forests within the State. The remaining 40% is imported. About one-third of these imports come from overseas (mainly North America), and about two-thirds from South Australia (softwoods) and Tasmania (hardwoods).

Sawn timber produced in Victoria comprises about 70% hardwood, of which more than 95% comes from public land, and about 30% is softwood (predominantly radiata pine), of which approximately one-third comes from public land. State forests in the East Gippsland study area supply about 25% of the total production of sawn hardwood timber in Victoria. This material, depending on the quality and species involved, is suited to a variety of uses including furniture manufacture, joinery, house framing, heavy construction, and urban fencing.

At present consumers are showing a strong preference for timber-frame houses, and approximately 90% of the new houses



*Shining gum
sawlogs*

erected in Victoria use timber for structural framing. Despite competition from softwood, hardwood maintained a relatively constant share of the framing market during the period 1975--83 and is the preferred material, particularly on the Melbourne market, because of its intrinsic properties such as higher strength and lower cost. Most of the timber produced in East Gippsland is used for house framing, with the Melbourne metropolitan area being the main market. It is of good quality and is in high demand, particularly for specialist uses such as roof frames where long lengths with few defects are required.

In addition to sawn timber, the East Gippsland forests supply railway sleepers, poles, fencing timbers, flitches for sliced veneers, and chips. The demand for railway sleepers and transmission poles has continued to decline and although the study area still provides about 20% of the State's production of railway sleepers the output declined to some 17,400 units in 1983/84 compared with 70,000 in 1974. Some selected flitches from sawlogs are sold for the production of sliced veneer. The veneer is used for facing panelboards, such as particleboard, which are used for furniture and interior fittings.

Most sawmills in the study area have installed chippers to convert the residues associated with sawn timber production to chips. About 100,000 tonnes of chips per annum are produced from sawmill residues for export from Eden.

In financial terms the value of the output of the East Gippsland hardwood timber industry is estimated to be about \$30 million per annum at the point of sale, or about 30% of the value of log sawmilling in the State, while royalties paid to the government in 1983/84 amounted to \$4.4 million or about 30% of the royalties paid on hardwood sawlogs. The industry is thus currently important to the economy of the State and is a most significant factor in the economy of East Gippsland. Harvesting of timber provides commodities that are widely used by the community and also provides employment - not only in the study area but in places such as Melbourne, where the timber is marketed, further manufacturing is undertaken, and the headquarters of some of the sawmilling companies are located.

About 25% of the work force in the Orbost Shire is directly employed by the industry, while an estimated 10--15% work in service and other industries that depend to a large extent on the timber industry and the employment it provides.

As timber is by far the most important freight item, the industry also has a major influence on the maintenance of rail freight services between Bairnsdale and Orbost.

However, changes in the location and extent of timber activity have been a characteristic of the industry. Although sawmilling has been an integral part of the Victorian economy since the early days of settlement, it has a history of locational instability. The effects of the disastrous bushfires of 1939, which forced the relocation of many mills,



*Snigging logs
on the Errin-
undra Plateau*

still influence Victorian forestry activities. The forests do not yet contain a satisfactory series of age classes in local areas to provide for sustained timber production at all milling locations without reduction of quotas at some.

Areas available for wood production

Table 21 gives the actual area available for timber production in East Gippsland. Although this table shows that 63% of the forest in the study area is available for harvesting, it is important to note that 205,670 ha or 53% of that total cannot be economically operated for sawlog-only harvesting because of low sawlog volumes, leaving some 180,000 ha of net productive forest.

The current standing sawlog volumes on areas available for sawlog harvesting together with areas of fire and logging regrowth are fully described in Forest Inventory Report No. 68 (1984) and are summarized in Table 22.

The mature forests in this area are the most extensive in the State. Most of the ash species forest of 757,000 cu.m

Table 21

AREA AVAILABLE FOR TIMBER PRODUCTION

	Area (ha)	Proportion (%)
Gross area available for hardwood production	612,600	100
- unsuitable for hardwood production (steep slopes etc.)	141,290	23
- excluded by prescription	85,410	14
Net area available for hardwood	385,900	63

Table 22

SAWLOG RESOURCES BY FOREST TYPE FOR
THE EAST GIPPSLAND AREA*

Forest type	Mature/overmature forest		Regrowth
	Standing volume (cu.m)*	Net area (ha)	Net area (ha)
Ash species** (incl. shining gum)	756,900	5,660	4,210
Mountain mixed species	4,630,100	62,830	20,380
Foothill mixed species	1,367,900	24,880	36,310
Coastal mixed species	113,500	2,280	23,620
All types	6,868,400	95,200	84,520

* Volumes available for harvesting under current management prescriptions for sawlog-only operations.

** Includes shining gum in pure stands only. Shining gum also occurs in mixture with the mountain mixed-species forest type.

is in the Rodger--Yalmy basin (41%) and on the Errinunda Plateau (43%). Also, approximately 70,000 cu.m of alpine ash is growing on uncommitted land on the Gelantipy Plateau, where logging is not permitted pending a review of land use by the Council.

Based on the current resource estimates for sawlog-only operations and the present utilization rate of 370,950 cu.m per annum, the mature timber resource will be cut out in about 19 years time. However, as Table 23 shows, the age structure of the regrowth resource here will make it impossible to maintain a constant flow of timber after the mature resource is exhausted. This will have important social and commercial consequences for the people employed in sawmilling, the firms they work for, and the communities in which they live.

Of the regrowth available for harvesting in the study area, 90% is less than 35 years of age and 49% less than 15 years, and it will therefore be about 35 to 45 years before this resource is sufficiently mature to yield sawlogs.

The regrowth in the ash-type and mountain mixed-species forests can be regarded as adequately stocked, but regrowth in foothill and coastal mixed-species forests (71% of the total regrowth area) varies considerably in density and quality depending on the degree of competition from the overwood trees.

In its 1984 submission to the Timber Industry Inquiry, the Department of Conservation, Forests and Lands suggested a number of options that may be adopted in the future with regard to the utilization of timber from the study area.



Heavily stocked stands of shining gum regrowth

The ultimate aim of each option would be to harvest the forest on a sustained-yield basis, but, depending upon when the level of cutting was reduced to that required to achieve a sustained yield, and whether or not integrated harvesting was permitted, the effect on the resource base over the next 10 years would vary considerably. Immediate introduction of harvesting on a sustained-yield basis, together with integrated harvesting, would result in least disruption to employment. The other options referred to would have more severe effects on employment in the timber industry, which would affect other sectors in the economy.

Table 23

REGROWTH FOREST BY SPECIES AND AGE CLASS FOR THE
EAST GIPPSLAND AREA

Forest type	Net area of regrowth by age class (ha)			Total
	1--15 yrs	16--35 yrs	>35 yrs	
Ash species	1,640	880	1,700	4,220
Mountain mixed species	12,330	4,080	3,970	20,380
Foothill mixed species	18,200	16,920	1,180	36,300
Coastal mixed species	9,130	13,250	1,240	23,620
All types	41,300	35,130	8,090	84,520

Note:

At the time of publication, figures were not available to allow the data to be updated to take account of fire damage that occurred in 1983.

The Council has commissioned a firm of consultants to carry out a three-part socio-economic study in the region. Part one of the study will describe the socio-economic framework of the region and provide a base against which the implications of future land use decisions can be made. Parts two and three will provide an assessment of the implications of the Council's proposed and final recommendations on local, regional, and State economies using the socio-economic base established in part one. It is expected that the first part of the study will be completed later this year.

Pre-logging surveys

In August 1982, the Minister for Conservation, Forests and Lands instituted a new procedure for forest blocks to be opened up for logging. The procedure aims at ensuring that due consideration is given to all forest values, that rare or endangered plants and animals are not put at risk, and that the public has the opportunity to comment on proposed logging in new areas prior to commencement.

New areas to be opened up for logging are defined as forest management blocks that are substantially unlogged - that is, from which less than 50% of the timber has been removed. Forest management blocks are the primary unit of subdivision for operational planning, referencing, and mapping within a forest district. They vary in size, but are generally about 10,000 ha.

Logging and regeneration in State forest are planned in accordance with standard procedures, which involve the preparation of a plan and cutting schedules, and require that the operations conform with forest prescriptions. The procedure to apply to 'new areas' involves the standard procedures plus the following additional steps.

- * Undertake a fauna and flora survey of the forest management block or blocks, to identify species or sites of significance that should be taken into consideration in the utilization and management of the area.
- * Prepare maps of natural features, topography, vegetation, and soil types.
- * Prepare a draft plan giving details of areas to be harvested in the immediate future, the longer-term strategy for cutting, details of methods, prescriptions, etc. to show those areas that will not be utilized.
- * Make the fauna and flora survey report, maps, and draft plan available for public comment.
- * Review the draft plan in the light of submissions received, and finalize the plan.

To date, sawlog harvesting proposals and their corresponding flora and fauna survey reports have been published for three forest management blocks in East Gippsland: the Rodger, Yalmy, and Ellery blocks. The surveys have provided valuable

new information on the distribution, status, and significance of flora and fauna in the area. Details of some of this survey work are discussed elsewhere in this report.

Integrated harvesting

At the present time, timber operations in East Gippsland are primarily aimed at producing sawlogs. It is planned to manage the regrowth forests established following harvesting operations, to produce sawlogs on a rotation of about 80 years.

However, in areas such as East Gippsland where sawlogs only are harvested, substantial quantities of wood that is inferior to sawlog quality is not utilized. This residual resource comprises parts of felled trees that are too small or too defective to be economically harvested for sawlogs, and trees that are unsuitable because of defect and are not required as seed or habitat trees. The volume of the residual resource in a particular logging coupe varies according to factors such as age of the forest, past damage by fire, and logging history, but it generally exceeds the volume of sawlogs harvested.

In some parts of Victoria this residual resource is harvested in conjunction with sawlogs and is used for pulpwood and occasionally firewood. This combined operation is known as integrated harvesting. Apart from some trial pulpwood harvesting operations in 1975/76 and 1981/82, pulpwood is not utilized in conjunction with sawlogs on public land in East Gippsland. However, the residue associated with the milling of sawlogs there is chipped and transported to Eden, and this amounts to about 100,000 tonnes per annum. Current estimates of the volume of pulpwood in the areas available for timber harvesting over an 80-year rotation totals about 580,000 cu.m per annum.

As indicated earlier, some 200,000 ha of land available for timber production in East Gippsland cannot be utilized economically on a sawlog-only basis because of low sawlog volumes. However, utilization of pulpwood in conjunction with sawlogs from an integrated operation in this area would be economic and would assist in the regeneration of many stands currently containing a high proportion of defective trees.

To ensure that all potential sawlogs are harvested from a logging coupe, the Department of Conservation, Forests and Lands may compensate licensees for felling trees that prove to be too defective for sawlogs. In addition, some inferior logs are made available at reduced royalty rates, but this timber has only a limited market. In October 1984 the Department advertised for tenders to harvest these inferior logs or billets from two previously logged areas in the Orbost Forest District, but obtained no response.

The introduction of integrated harvesting in East Gippsland forests would also mean that an additional estimated 3.5 million cu.m of sawlogs would be available to the sawmilling industry. This volume represents a further 10 years' supply

of mature timber at the current level of utilization, and would come mainly from areas that are currently uneconomic to harvest in a sawlog-only operation because of the high proportion of defective trees.

In the long term, therefore, not only would a greater area be available for timber production but many sites would become more productive for sawlogs. Furthermore, the development of integrated harvesting would provide additional jobs in the timber industry in both the short and long terms.

Pulpwood harvesting is not without its environmental implications, however. Trees now left because they are uneconomic or unsuitable for harvesting for sawlogs would be felled for pulpwood and, as larger quantities of timber would be harvested, greater nutrient loss, increased soil disturbance on harvested areas, increased compaction of log landings, and increased road use would occur.

There is some evidence that the area of a coupe disturbed in an integrated operation is about 20% higher than for a sawlog-only operation. This may lead to an increase in the potential for erosion following harvesting, particularly on granitic parent materials. Rooding is recognized as a major contributor to increased sediment loads in streams, and can have a detrimental affect on water quality and stream biota.

A major environmental effect of integrated harvesting would result from the expansion of logging operations over a much larger area of the region, not currently subject to harvesting, thus increasing the area exposed to the associated environmental hazards. In addition, these forests that are unproductive on a sawlog-only basis contain many trees that provide habitat for hollow-nesting birds and mammals. Some areas, especially those interspersed with the productive forest areas, therefore provide important habitat refuges.

Concern has also been expressed that, once a pulpwood industry is established, pressure to increase the volume of residue supplied to the industry will follow with the result that environmental considerations would be compromised.

The environmental impact of pulpwood harvesting and the export of pulpwood in the form of woodchips has been the subject of considerable debate. Between 1975 and 1977, the Senate Standing Committee on Science and the Environment conducted an extensive inquiry into 'the impact on the Australian environment of the current woodchip industry program' and concluded that schemes to make economic use of sawmill waste and silvicultural residues, including thinnings, from existing sawlog operations have obvious economic benefits, but approval of any such schemes should incorporate safeguards to ensure that the material chipped is restricted to genuine wastes and residues, and that additional trees are not felled merely to maintain or increase chip supplies.

The Victorian Timber Industry Inquiry, under its terms of reference, is to investigate and report on the 'economic and

environmental effects of current and proposed pulpwood harvesting schemes' (see Appendix X).

Softwood

No softwood plantations have been established within the study area, but certain areas within the coastal and mountain forests are suitable for softwood growth. A number of experimental plots in the Nowa Nowa, Orbost, and Genoa localities are providing data on the potential for growth at various sites.

Much of the peppermint-type forest in the Bendoc area is highly suitable. The New South Wales Forestry Department has established the Bondi plantation, a major area of softwood development in that State, immediately across the border to the east of Bendoc.

15. MINERALS AND STONE

It is intended that this chapter will summarize and update the information contained in the Council's original report on East Gippsland, as well as providing a summary of mineral exploration activity over the last 10 years or so.

Mining

No major exploitation of minerals has taken place in East Gippsland, but small to moderate quantities of gold, silver, lead, molybdenum, iron, and manganese have been mined. The last recorded mineral production in the study area was of copper at Deddick in 1970, and gold in the Bendoc area in 1952. Current mining activity is being conducted on eight Miner's Right claims, which are generally about one hectare in size. As there is no requirement for production figures to be supplied from claims, no record exists to show how much gold is being produced from these areas.

No current mineral production is taking place from the two existing mining leases in the study area. The Department of Minerals and Energy has received two additional lease applications, however.

Development leases are tenements mid-way between an exploration licence and an actual mining lease, and are issued for the purpose of detailed investigations to determine the feasibility of putting a mineral deposit into production. A development lease application in the Parish of Derndang near Genoa is current. Table 24 lists the tenements under the *Mines Act* 1958 as at June 1984.

Gold

In the past, prospecting for gold was most intensive in the Bendoc--Clarkeville--Bonang--Delegate River district.



Remains of a steam engine which powered the Aspen battery near Clarkeville

Quartz reefs were mined to depths of about 100 m and the stream flats in the area were worked for alluvial gold. The small Tara goldfield, in the west of the study area, produced substantial quantities. Smaller gold-mining activities took place near Club Terrace, Poddy's Creek, Com-bienbar, Mallacoota, Mount Ellery, Goolengook, Chandler's Creek, Bemm River, Cabbage Tree, and on the Genoa River.

Iron

An iron ore deposit occurs north of Nowa Nowa, but has not been exploited because of its limited size and scattered occurrence.

Silver--lead

Granodiorite rocks at Deddick contain silver--lead mines, and assays have revealed values as high as 11% for silver and 47% for lead. These mines have no current production. A small quantity of silver--lead ore was also obtained from Boulder Flat, south of Errinundra.



*Accommodation
Creek copper mine*

Copper

Although copper has been mined at Accommodation Creek, near Deddick, the last recorded production was just over 1.5 tonnes of copper concentrate in 1970. Small copper lodes have also been worked at Sardine and Wallaby Creeks and on the Snowy River about 26 km north-west of Orbost.

Other small ore bodies have been located at various places throughout the study area, but none has proved to be of any economic value.

Mineral exploration

Exploration for minerals is an ongoing activity in East Gippsland. A number of mineralized geological environments

have been identified in the area, but the rugged terrain has hindered exploration. Thus a great deal of scope remains for future mineral discoveries. New concepts of ore genesis, improved exploration techniques, changes in economic conditions of price or demand, or development of new uses for mineral products will in time affect the 'prospectivity' of a given land area. Such changes lead to constant re-evaluation of areas, and this is particularly noticeable in the mineralized zones such as Boulder Flat.

Mineral exploration is a high-cost and high-risk activity. The Victorian experience shows that since 1965 about 1,500 exploration licences have been issued in the State and, although a few significant mineral deposits have been located under these programs, to date only one of them (at Stawell in western Victoria) has come into production.

Even though high risks are involved in finding a substantial ore body, the economic return can be great, and it is this prospect that encourages mineral exploration. Since 1970 about \$5,000,000 has been spent in association with exploration licences in the East Gippsland area, with current annual expenditure being around \$500,000. Both these figures exclude expenditure incurred under a number of mining leases and mineral search licences that have operated from time to time in parts of the area. Table 25 details expenditure by company and area since 1970.

A variety of geological environments hosting different mineral associations have been recognized here, and these are summarized in Table 26. All of these environments have received attention in recent years, with the exploration effort ranging from broad-scale activities, largely on public land, to detailed exploration of specific prospects, either known (a past mine) or newly discovered. Prospects identified to date have all occurred on public land. Exploration techniques have included geological mapping and a range of geochemical and geophysical methods, as well as drilling in certain places. Map 6 shows the areas explored between 1970 and 1982, and those currently being investigated.

Past mineral exploration

Since 1970 approximately \$2,500,000 (in 1984 values) has been expended under exploration licences that are no longer current, and about 70% of the East Gippsland area has been investigated under these exploration programs. A number of geological environments not currently under investigation were explored then and are likely to attract attention again in the future.

Recently, the gold potential of Ordovician sedimentary bedrock there has been investigated. Freeport of Australia Inc. undertook geochemical exploration in a large area between Bonang in the north-west and the Wingan River in the east. Around Bendoc and Bonang, gold was mined last century from numerous small high-grade quartz veins. The primary target in Freeport's exploration program was a large-tonnage

Table 25

MINERAL EXPLORATION ACTIVITY 1970--84

Exploration group	E.L. number(s)	Years	Area	Expenditure*
Rio de Janeiro Mines Pickands Mather Australian Geophysical Gippsland Minerals	50, 86, 115 92	1967--71 1969--71	Sunday Creek Prospect Double Bull Creek Prospect Campbell Knob Prospect Deddick mineral field	\$ 550,000 \$ 830,000
Pickands Mather Commstock Minerals	159 326	1970--71 1971	Parish of Wibenduck Parishes of Toonyarak to Kowat	\$ 14,000 \$ 15,000
Industrial and Mining W.Y.P. Development Jennings Mining	333 455	1971--72 1974--77	Murrungowar Errinundra Prospect	\$ 22,000 \$ 650,000
AMOCO Minerals AMOCO Minerals Freeport	460 480 839, 845--7	1973--74 1981--82	Mount Buck and Stringer Knob Prospects Bendoc--Wingan River	\$ 168,000 \$ 8,000 \$ 260,000
B.H.P. WMC--BP	988 1240, 1241	1981--82 1977--	Tostaree--Bemm River North-west part of area	\$ 50,000 \$ 940,000
Samedan of Australia	1254	1978--	Crabhole Creek--Combienbar area	\$1,260,000
			Total	<u>\$4,757,000</u>

* Expenditures are approximate figures given in 1984 dollars. Pre-1970 expenditures are not included.

Table 26

CLASSIFICATION OF MINERAL OCCURRENCES

Category	Genetic type	Host stratigraphy	Host lithology	Metal associations
Mineralization associated with acid-intermediate volcanic and sedimentary rocks	Volcanogenic partly re-mobilized	Snowy River volcanics	Acid lavas, pyroclastics, intercalated intermediate volcanics and sediments	Iron, manganese, barium, copper, silver, lead, zinc, gold
Mineralization associated with carbonate rocks	Possibly volcanogenic volcano-genic	Errinundra beds	Dolomitic limestones with interbedded calastic sediments overlying acid volcanics and sediments	Barium, lead, zinc, silver
Copper associated with quartz monzonite - granodiorite intrusives	Porphyry copper	Bete Bolong granodiorite, Mt Ellery granodiorite and associated stocks	Peripheral zone of granitic rocks and adjacent metamorphic aureoles	Iron, copper, molybdenum
	Porphyry copper	Campbell Knob granodiorite	Alteration zone in granodiorite	Lead, zinc, copper, silver
	Porphyry copper	Deddick granite, Mt Ellery and Norrinbee granodiorites	Contact zone between granodiorite and Ordovician sediments	Copper, molybdenum
Mineralization in fissures, quartz veins and acid dykes	Vein along shear	Ordovician sediments	Quartz veined and mineralized shear through sediments	Copper, lead, silver, gold
	Vein	Ordovician sediments	Mineralized quartz reefs through sediments	Gold, tungsten, bismuth
	Vein	Snowy River volcanics	Quartz reefs intersecting acid volcanics and sediments	Iron, copper, lead, gold, silver, barium
	Vein	Deddick and various other plutons	Quartz reefs intersecting granite and granodiorite	Lead, zinc, silver, barium, iron, arsenic, copper, tin, molybdenum

148°00' 149°00' 150°00'

MAP No. 6

MINERALS AND STONE

East Gippsland Area - Review

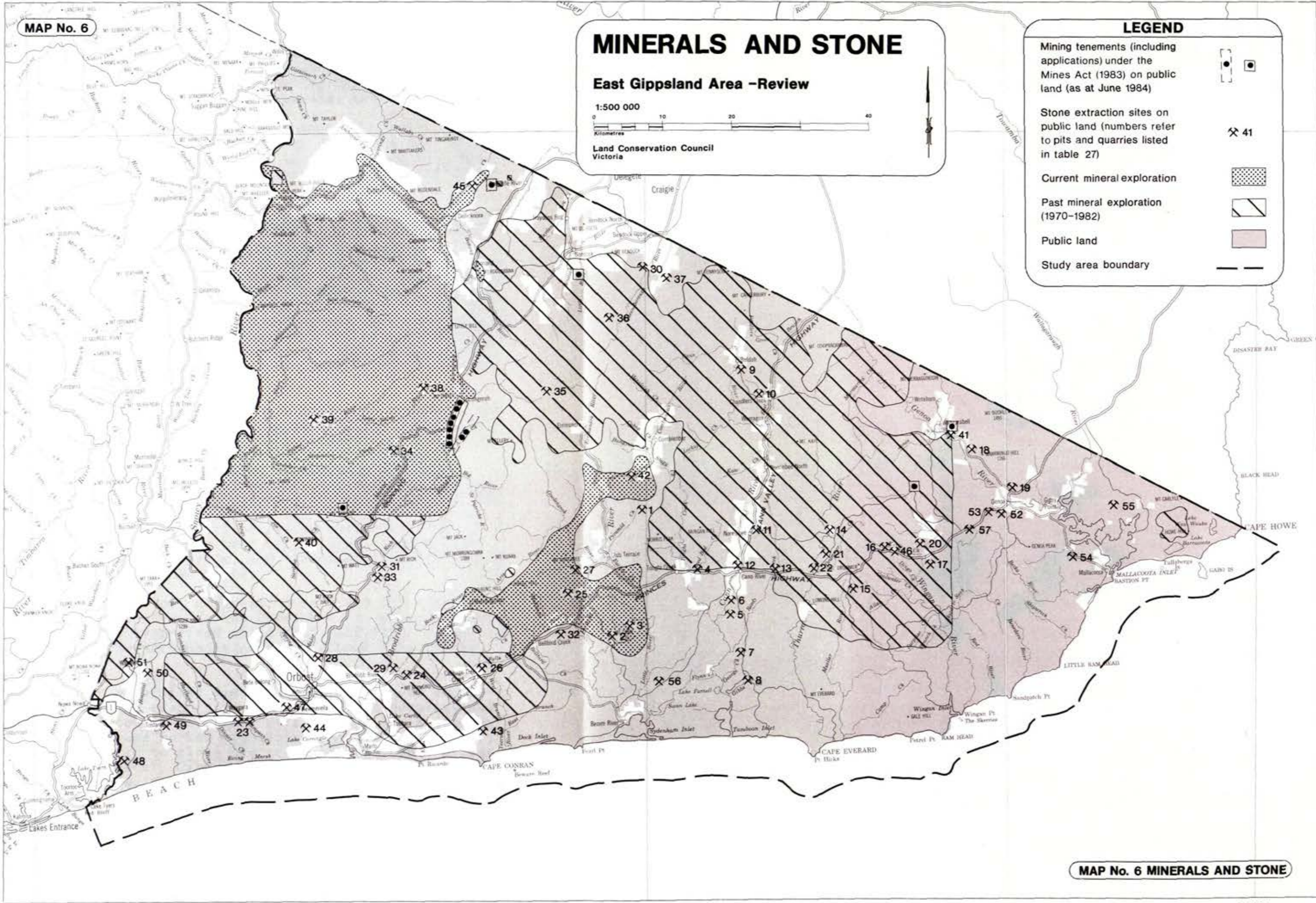
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0 10 20 40
Kilometres

Land Conservation Council
Victoria

LEGEND

- Mining tenements (including applications) under the Mines Act (1983) on public land (as at June 1984)
- Stone extraction sites on public land (numbers refer to pits and quarries listed in table 27)
- Current mineral exploration
- Past mineral exploration (1970-1982)
- Public land
- Study area boundary



MAP No. 6 MINERALS AND STONE

148°00' 149°00' 150°00'

disseminated gold deposit in fine-grained, carbonaceous sediments. A secondary target was a quartz vein-stockwork gold deposit, but other possibilities such as tin and base metal mineralization hosted by intrusives were also investigated in the course of exploration (Apthorpe and Rosenhain, 1982). A number of geochemical anomalies were delineated and more intensive work was carried out on these, as well as five abandoned gold-mines in the Bonang--Bendoc area. None of the prospects was considered large enough to host an ore deposit of the size that Freeport were searching for, but considerable scope remains for future exploration of this geological environment.

In the mid 1970s, Jennings Mining undertook a comprehensive exploration program of the Lower Devonian Errinundra beds (Cochrane, 1982). These rocks had been prospected in the past with minor discoveries of silver and barite mineralization. Jennings' exploration, however, proved the existence of persistent lead--zinc (--silver) mineralization within limestone. Detailed investigations, including a total of 10 diamond drillholes, encountered widespread but low grades of mineralization. Jennings relinquished the area in 1977, but shortly afterwards Samedan obtained the exploration rights over the Errinundra beds, and investigations on this prospective area are continuing.

In the late 1960s and early 1970s a number of companies undertook exploration in the western part of the area, principally for base metal mineralization associated with acid intrusive rocks, and defined a total of six prospects (Cochrane, 1982). More detailed examination of these prospects (including considerable diamond drilling) showed that the mineralization has porphyry copper affinities, but the grades that were established were too low to be economic. There has been little detailed exploration of granitic intrusions in the east of the area, even though copper, molybdenum, tungsten, and tin mineralization have been reported from these rocks.

During the same period, Gippsland Minerals N.L. undertook geochemical exploration in the Deddick area, concentrating on the Deddick silver--lead field near MacKillop Bridge, and in particular the Accommodation Creek copper mine to the east.

Mineralization of similar age occurs at both these localities, although the respective lodes vary in mineralogy and have been emplaced in different host rocks. The Accommodation Creek mine was worked regularly from 1959 until 1971, when it was forced to close due to a fall in copper prices and a rise in costs. Gippsland Minerals controlled the mine from 1969 onwards, and undertook extensive diamond drilling to try to upgrade the deposit. They established that the pattern of mineralization continued at depth; however, due to the narrow widths and relatively low average grades, it is unlikely that a profitable mining operation could be sustained in the future. Nevertheless, the mine may be of interest to small prospecting groups in times of high copper prices.

Recent exploration for non-metallic minerals in the East Gippsland area has been confined to the search for brown coal in the Orbost region. In 1981/82, B.H.P. carried out a drilling program between Tostaree and Bemm River but concluded that there was little prospect of finding an economic coal-field in the area (B.H.P., 1982).

Current mineral exploration activity

As at August 1984, six exploration licences and applications for a further 10 were current in the East Gippsland area. Two exploration groups - Western Mining Corporation Ltd-- British Petroleum Mining Development Australia Pty Ltd (WMC--BP), and Samedan of Australia - have extensive ongoing mineral exploration programs there and have committed more than \$2,000,000 to those programs during the last 7 years.

The WMC--BP joint venture has undertaken exploration near Yalmy since 1977. The targets are base metal (copper, lead, zinc, etc.) and precious metal (gold and silver) environments within Devonian volcanics, Ordovician sediments, and metamorphic rocks. Exploration has included geochemical stream sediment surveys over most of the tenement, from the Deddick River in the north to Mount Sardine to the south.

Soil-sampling traverses have also been undertaken over a large part of licensed area as part of the exploration program. This work has delineated many anomalous zones throughout the area. To date six prospects have advanced to the stage of gridding and detailed exploration. One of these prospects has had an initial phase of diamond drilling. Many other anomalies are still to be followed up in the exploration program and the companies regard the whole of their licensed area as highly prospective for base and precious metal mineralization.

Samedan of Australia has, since 1978, been exploring for base metal deposits in a roughly triangular area between Murrungowar, Mount Cann, and Combiobar. Large-scale geochemical stream sediment surveys and geophysical surveys have delineated numerous anomalies within Ordovician sediments and a sequence of Devonian volcanics, limestones, and clastic sedimentary rocks (Errinundra beds). A number of prospects have been gridded and explored in more detail, leading to diamond drilling in a few cases.

One such prospect occurs near Crabhole Creek, where Samedan has delineated base metal mineralization in a steeply dipping succession of fine-grained carbonaceous sedimentary rocks of Ordovician age. Throughout the world, many large base metal deposits are hosted by rocks similar to those at Crabhole Creek.

Samedan has many more anomalies to follow up and regards not only its existing exploration licence area as highly prospective, but also surrounding areas of Ordovician bedrock. For this reason the company has applied for a further five exploration licences covering 1,700 sq.km of predominantly Ordovician sediments in adjacent areas.

A joint venture between Preussag Australia and CRA is also involved in a long-term exploration program for base and precious metals in part of East Gippsland around the Rodger River. Most of this exploration, however, is being undertaken west of the Snowy River, and outside the area under review. The joint venture partners have applied for two small exploration licence areas to cover prospects around the lower Rodger River. Other companies with exploration licences in East Gippsland have only recently obtained these tenements, and work is at a preliminary stage (as of August 1984).

Stone Production

Most stone extracted in East Gippsland comes from public land, largely due to the scarcity of freehold land in the area. The majority of pits and quarries operate under provisions of the *Forests Act* 1958 or the *Land Act* 1958, although one quarry on public land south of Cann River operates under the *Extractive Industries Act* 1966. The principal use of stone in the area is for maintenance and improvement of the road network. It is estimated that, for the year ending 30 June 1984, about 120,000 cu.m of stone (including sand and gravel) was extracted from public land in East Gippsland.

At present the major user of stone in the area is the Road Construction Authority with its Commonwealth-funded bicentennial construction program upgrading the Princes Highway, and to a lesser extent the Cann Valley Highway. The Road Construction Authority expects to use some 100,000 cu.m of stone annually for the next 4 years. When funding is reduced after 1988, stone requirements are likely to fall by about half. Some good-quality crushed stone is brought into the study area or supplied from private land for use as sealing aggregate, but the vast bulk of road gravel is extracted locally from public land. Ordovician sandstone is widely used for road-making, but to date there has been little attempt to exploit the best-quality metamorphosed Ordovician beds, as the low density of traffic on minor roads does not warrant the use of high-grade material.

The State Forests and Lands Service is a large user of stone here (see Table 27), with maintenance and construction of an extensive network of forest roads and tracks. Most of the pits in East Gippsland are controlled by this Service, which also operates the largest hardrock quarry in the area at Mount Raymond, east of Orbost.

Another major user of stone here, the Shire of Orbost, takes most of its road gravel requirements from public land except for small amounts extracted from private land in the Bendoc--Bonang area.

Table 28 lists the pits that are in current use or are drawn upon from time to time. Their locations are mapped on Map 6. The location of many pits is largely determined by proximity to a particular road project or to a major road, as transport costs are a major factor in what is otherwise a

Table 27

STONE PRODUCTION FROM PUBLIC LAND IN EAST GIPPSLAND
[for the year ending 30 June 1984]

User	Approximate quantity (cu.m)
Road Construction Authority	95,000
Shire of Orbost	13,300
State Forests) Nowa Nowa	300
and Lands) Orbost	7,000
Service) Cann River	1,000

generally low-cost operation at the actual pit or quarry site. Commercial operators in Gippsland/East Gippsland quote a transport cost of 12--20 cents per cu.m per km (August 1984), which indicates the economic constraint of pit and quarry locations with respect to road construction programs.

A number of the pits, such as some associated with the Princes Highway reconstruction, are once-off pits. Others, such as the Corringale, Simpson Creek, Dynamite, and the Carlip Pits, are longer-term. Table 28 indicates those pits that are seen as providing a long-term source of road construction material. Many of the remainder are utilized intermittently on a small but continuing basis. Close liaison is maintained between the extracting authorities and those vested with the control and management of the area.

References

Apthorpe, K.A. and Rosenhain, P.B. (1982). E.L.s 839, 845, 846, 847, East Gippsland, Victoria - final report from Freeport Australia Inc. *Open file, exploration licence 839, 845--7; Victorian Department of Minerals and Energy.*

B.H.P. (1982). E.L. 988, Orbost, Victoria - final report. *Open file, exploration licence 988; Victorian Department of Minerals and Energy.*

Cochrane, G.W. (1982). Copper, lead, zinc, and barium deposits of Victoria. *Bulletin of the Geological Survey of Victoria*, 61.

Table 28

QUARRIES AND GRAVEL PITS IN THE EAST GIPPSLAND AREA

Name	1983/84 production (cu.m)	LCC recommendation (1977)
1 Pyramid Creek Pit	200	E1
2 Poddys Creek Road Pit	I	E1
3 Mount Bemm Road Pit	I	E1
4 Reedbed Pit	20	R1
5 Brass Track Pit ⁺	I	R1
6 River Trust Pit ⁺ (E.I. Lease 266)	I	R1
7 Tamboon Road Pit	I	E1
8 Gibbs Creek Pit	I	E1
9 Buldah Road 1 Pit	I	E1
10 Buldah Road 2 Pit	I	R1
11 Magazine Track Pit	100	E1
12 Cann River Pit	300	R1
13 Reedy Creek Pit	300	R1
14 Browns Track Pit	100	E1
15 Soda Creek Pit	250	E1
16 Dingo Creek Pit	200	E1
17 East Wigan Pit	400	E1
18 Wangarabell Pit	I	E1
19 Genoa Pit	800	R1? P5?
20)		
21) RCA Bi-Centennial Construction Program	55,000 (total)	E1
22)		
23 Simpson Creek Pit ⁺	6,110	R1
24 Mt Raymond Quarry	20,000	E1
25 Boulder Creek ⁺	1,160	E1
26 Enfields Track Pit	I	E1
27 Goolengook Quarry	I	E1
28 Major Creek Pit (Orbost Tip)	100	R1
29 Knockup Pit	I	E1
30 Crawfords Road Pit	I	R1
31 Carlip Pits ⁺	5,000	E1
32 Patrol Road Pit	I	E1
33 Dynamite Creek Pit ⁺	15,000	E1

Table 28 (continued...)

Name	1983/84 production (cu.m)	LCC recommendation (1977)
34 Malinns Gravel Pit ⁺	I	E1
35 Brunt Pit ⁺	2,000	E1
36 Back Creek Quarry	I	E1
37 Hepburns Pit	I	E1
38 Little Yalmy Pit	1,000	E1
39 Yalmy Sidecut Pit	I	E1
40 Pinnak Pit	500	R1
41 Wangarabell (Jones)	I	R1
42 Combienbar Road Pit	I	E1
43 Cabbage Tree/Conran Road Pit	I	R1
44 Corringale Pit, Newmerella ⁺	5,530	P3
45 Hobbs Road Pit	I	R1
46 Rankins Pit	I	E1
47 Newmerella Pits	I	N1
48 Morgans Pit	50	A5
49 Old Orbost Pit ⁺	10	R1
50 Carl Smith Pit ⁺	200	R1
51 Lemon Hill Pit ⁺	50	R1
52 Genoa Peak Track Pit	I	A1
53 Falls Creek Pit (RCA)	(large)	A1
54 Miners Track Pit	I	A1
55 Fairhaven Road Pit	I	A1
56 Old Coast Road Pit	I	A1
57 Tobins Hill Pit	I	R1

Notes:

+ Large, long-term resource.

I Production not known, often small intermittent use.

16. HAZARDS

A hazard in the use of land is anything that threatens to reduce its ability to serve chosen purposes.

Because of interdependence of the various environmental factors, a change in one usually produces changes in others until a new stable relation, which may be more or less productive, is attained. Complete understanding of the interrelations between environmental variables would enable us to predict those changes that are likely to cause a decline in productivity. However, much of our present knowledge of land use hazards comes only from experience. Consequently a knowledge of the present condition of the land in relation to the way it is used has great value.

Soil Deterioration

In East Gippsland soil loss is generally an important potential hazard rather than a problem, apart from the limited areas already suffering water erosion and the wind-eroded stretches of the coastal dunes. Erosion resulting from soil disturbance by man's activities (such as clearing, burning, cultivating, grazing, timber extraction, earth moving, track construction, or trampling) is generally mitigated by a long growing season and rapid regrowth of vegetation - although, once the native vegetation is removed, severe water erosion can occur quickly because of the high and often intensive rainfall. The water erosion hazard is greatest in the largely uncleared mountainous two-thirds of the area because of the steep slopes. It is also severe on the higher country, in the drier north-west, where the growing season is shorter.

Water erosion affects not only the productivity and aesthetic appeal of the land but also the flow rates of the streams and the quality of the water used for urban and farm supplies. In addition, it causes increased siltation, which leads to a reduction in the capacity of the stream channel to carry water, thereby increasing the damage caused by floods. It can also lead to the destruction of sensitive aquatic habitats. Stream-bank erosion and siltation is a significant problem on the Cann and Snowy Rivers, but also occurs on the Genoa, Brodribb, and Combienbar Rivers and many smaller streams. Such erosion is usually of most concern on adjoining freehold land, where it is often aggravated by the removal of streamside vegetation and trampling by stock.

The most extensive water erosion in the study area originates from gravel roads and earthen tracks. The problem is worst where roads are constructed on grades that are too steep or where inadequate provision has been made for run-offs, or both.



A badly eroded track on unconsolidated coastal sands

Gully and sheet erosion is limited mainly to where the mean annual rainfall is about 750 mm or less, on dry aspects where the steep slopes have been over-grazed by stock and rabbits. Examples may be seen in the north-west on Devonian granodiorite (Tubbut and Jingallala Land Systems), in the west on Snowy River volcanics (Yalmy Land System), and in the south-west on Tertiary fluvial deposits (Waygara Land System). In the mountains the better-structured, porous soils of higher elevations, particularly those on Ordovician sediments, are usually less prone to these hazards.

During the summer of 1981/82 the Soil Conservation Authority, in conjunction with the Forests Commission, carried out a pilot erosion hazard assessment and mapping program in the Cann Valley State forest between the New South Wales border and the Princes Highway. The method is being evaluated to assess its suitability for use in planning the utilization of timber resources in East Gippsland.

Wind erosion problems are confined to coastal areas and, although widespread, are seldom serious.

Movement of sand leading to the development of extensive dune-fields is a natural phenomenon and occurred long before the area was settled, as evidenced by the now stabilized dunes along many parts of the East Gippsland coast and adjacent hinterland. The enormous quantities of sand moved towards the coast during the last marine transgression are being incorporated into large dune-fields at Point Hicks and Cape Howe under the influence of westerly and south-westerly

winds. Unconsolidated sandy deposits are continually exposed to wind action as major rivers (such as the Snowy) shift their entrances to the ocean and this can result in the initiation of blowouts and subsequent wind erosion. Sand movement in some areas can be a hazard to man-made structures such as buildings and roads.

A considerable amount of erosion-control work has been carried out to stabilize dunes threatening to inundate the small township of Tamboon South. The area is not yet completely stabilized and a small amount of marram grass planting is carried out annually.

Wind erosion can be aggravated by increased visitor use and uncontrolled access to vegetated foredunes. Serious erosion problems can arise, as evidenced along the coast between Pearl Point and Sydenham Inlet, on the western side of the Snowy River mouth, and between Marlo and Cape Conran. These problems are now being checked by reducing the number of access points to the beaches and fencing out areas to allow revegetation to take place.



Mobile dunes at the mouth of Tamboon Inlet

Wildfire

Australian mixed-eucalypt forests are probably the most fire-prone and most fire-resistant forests anywhere in the world. High concentrations of highly flammable fuel, periodic droughts, and dangerous weather conditions (such as high temperatures, low humidity, and high winds) combine to provide a favourable environment for the development of catastrophic wildfires. The eucalypt forests having evolved in a fire-prone environment are extremely fire-resistant and have adapted to survive in an area renowned for its severity and frequency of fires. Most species can survive even intense fires and, although damaged, recover by the development of epicormic crowns, while others such as the ash species produce dense stands of regrowth following wildfire.

Because of the length of the fire season, the very high concentration of flammable fuel, and the extensive tracts of forest, the East Gippsland study area is one of the most hazardous in Victoria. Table 29 outlines the number and

Table 29

FIRE STATISTICS FOR THE FIRE-PROTECTED AREA
OF THE EAST GIPPSLAND STUDY AREA

Year	Major fires (ha)	Total area major fires (ha)	No. fires	Size distribution of fires (%)			
				<5 ha	5-50 ha	50-250 ha	>250 ha
1978/79	23,147 6,800 1,000	30,947	56	79	9	6	6
1979/80	1,295 1,120* 550	4,065	105	80	9	7	4
1980/81	32,666 28,000 24,180 2,506 2,300* 1,045*	92,787	170	50	26	12	12
1981/82	-	-	53	64	30	4	2
1982/83	126,100 102,200 3,400* 538	233,850	89	72	16	5	7
1983/84	-	-	19	84	16	-	-

* These figures are derived from averaging the area burnt in three to four other fires.

extent of wildfires that have occurred between 1978/79 and 1983/84 and Table 30 shows the sources of fires during the same period. Forest fires in 1982/83 were the most extensive and damaging in Victoria since 1939 and followed one of the most severe and widespread droughts recorded in the State. The East Gippsland study area suffered 89 recorded fires during that season, with the two largest burning 102,200 ha and 126,100 ha respectively. Tables 31 and 32 classify the area burnt according to forest type, land classification, and causes of fires in the 1982/83, while the extent of the major fires is shown on Map 8.

On the basis of fire hazard, three broad forest types are recognizable in East Gippsland: mountain and plateau; coastal and foothill; and rainshadow.

Mountain and plateau areas have a high rainfall that is reasonably well distributed throughout the year; soils are deep and conducive to fast-growing vegetation. Here the fire hazard is much lower than for other types of forest because the moist sheltered gullies only rarely dry out during summer.

Coastal and foothill country is flat and undulating, with a dense accumulation of fuels that dry out quickly and uniformly over the entire zone. Since these areas remain dry for 6--7 months each year, the fire hazard is considerable.

Table 30

SOURCES OF FIRES FOR THE FIRE PROTECTED AREA
OF THE EAST GIPPSLAND STUDY AREA

Source (percentage of total)	Year					
	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84
Lightning	26	57	40	26	57	44
Deliberate	16	15	17	33	15	5
Camping, BBQ	5	3	15	2	3	5
Escapes from other fires	5	8	8	13	8	2
Burning off	5	5	8	13	9	14
Waste disposal	11	5	4	1	4	4
Other	32	7	8	7	4	14
Unknown	-	-	-	5	-	12
Total number of fires	56	105	170	53	89	19

Table 31

AREAS BURNT BY MAJOR FIRES IN THE EAST GIPPSLAND STUDY AREA - 1982/83

Location	Date	Area burnt by forest type (% public land)					Area burnt by land classification (% total)					Total	
		Mixed species II	III	IV	V	Heath	Total	RF	PF	NP	PP		Total
Cann River # 12*	31/1/83	5	56	3	1	3	100	89	3	2	6	100	102,200
Cann River # 16	4/3/83	1	77	18	1	3	100	45	12	42	1	100	126,200
Nowa Nowa # 10	6/11/83	5	80	10	5		100	10	89		1	100	3,400

Height classes are:

40-52 m = Class II
 27-40 m = Class III
 15-27 m = Class IV
 < 15 m = Class V

Land classes are:

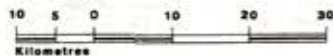
RF = Reserved forest
 PF = Protected forest
 NP = National parks
 PP = Private property

* Note: This fire burnt an additional 25,000 ha across the State border in New South Wales.

OCCURENCE OF MAJOR WILDFIRES 1982 / 83 SEASON



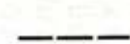

East Gippsland Area - Review

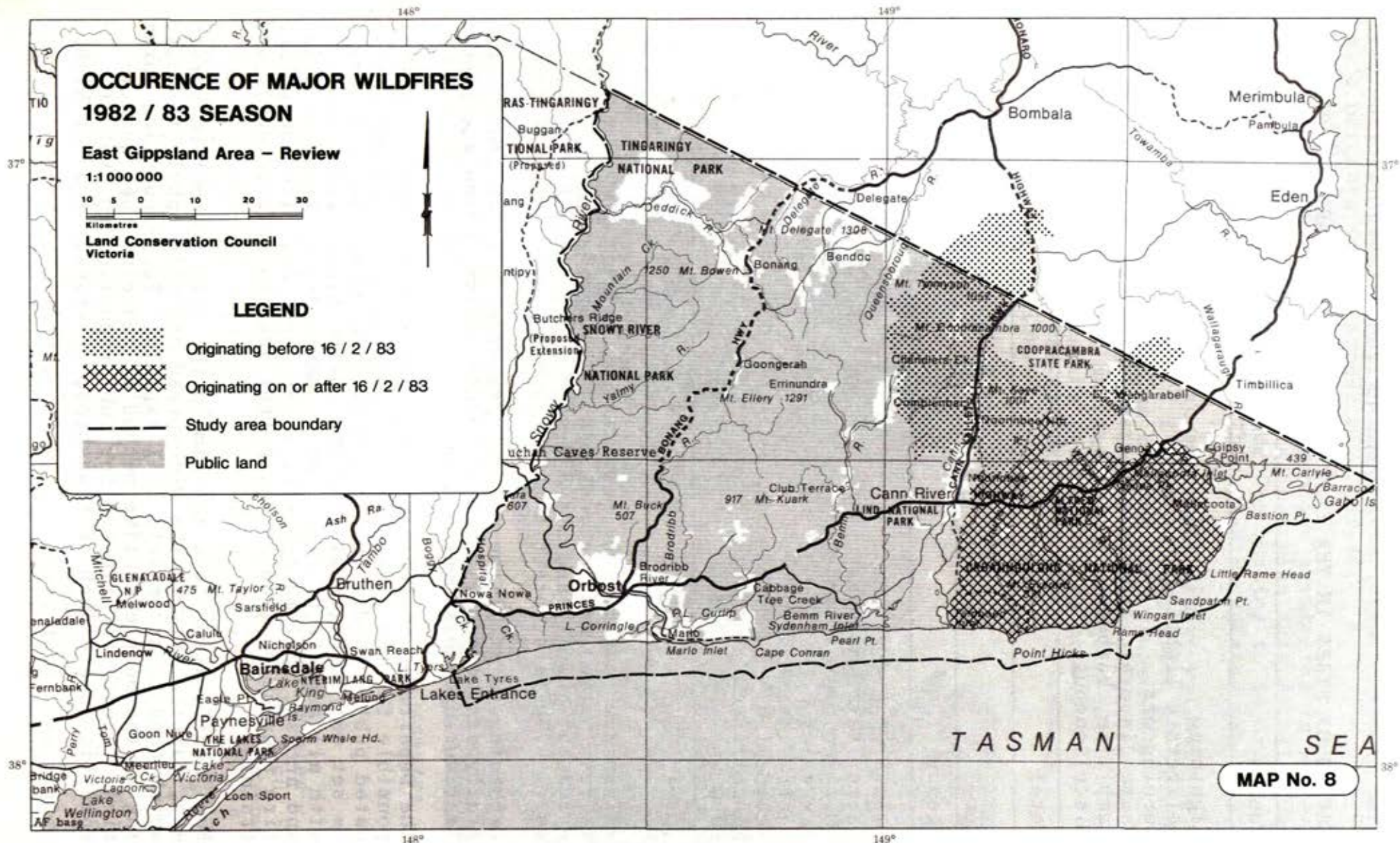
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Land Conservation Council
Victoria

LEGEND

-  Originating before 16 / 2 / 83
-  Originating on or after 16 / 2 / 83
-  Study area boundary
-  Public land



MAP No. 8

Table 32

CAUSES OF FIRES IN THE EAST GIPPSLAND STUDY AREA - 1982/83

Source	% of total
Lightning	57
Deliberate lighting	15
Burning off	9
Waste disposal, industrial, sawmill, tip	4
Camp fire, barbeque	3
Miscellaneous	12
Total	100%

Agency	% of total
Lightning	57
Farmer/farm employee	12
Employee, forest industry	9
Traveller	3
Recreationist	3
Resident	3
Miscellaneous	8
Unknown	5
Total	100%

Rainshadow country receives little rainfall and the terrain is very rugged and inaccessible. The sparse vegetation dries out quickly and stays dry for long periods of the year. The fire hazard in this type of forest is moderate.

Lightning is still the major cause of most fires and is generally associated with 'dry' thunderstorms, which are prevalent during the summer months.

The Department of Conservation, Forests and Lands is responsible for the prevention and suppression of fires in forested public land. The long-term fire-prevention strategy is set out in Regional Fire Prevention Plans, which deal with all aspects of detection, communication, transportation and access, fuel management, water supplies, fire equipment, fire prevention (education, patrol and law enforcement), and training.

Fuel modification is a key aim in the fire-prevention strategy, particularly in the widespread dry sclerophyll forests, which tend to accumulate fuel rapidly. Fuel-reduction burning is the most effective method of reducing fuel quantities. Areas are selected for fuel reduction to protect specific assets such as townships, reserves, areas of high

recreational use, recently regenerated forests, and to provide barriers to the spread of wildfire.

Implementation of the fire-prevention strategies is carried out in accordance with an operations plan that details fire-prevention works and fuel-reduction burning to be carried out over the next 3 years. This plan is updated annually.

While uncontrolled fires can seriously damage wildlife habitat, plant communities, and timber values, there is increasing recognition of the value of fire as a management tool. Fire is used in the regeneration of forests after logging and is important in the maintenance of suitable habitat for flora and fauna such as the ground parrot, provided its frequency and intensity are matched with the requirements of each particular species.



Lowland sclerophyll forest severely burnt by the 1982/83 wildfires

Floods

Most catchments in East Gippsland retain their forested cover over the bulk of their area, but much of the land presently developed for agriculture is situated on the low-lying but extremely productive river flats and as such is particularly vulnerable to flooding. Under natural conditions, large areas of these flats were subject to flooding and were poorly drained. However, accelerated erosion in the Snowy and Cann catchments has added to the flooding problem, because the consequent deposition of large quantities of sand and gravel in the lower reaches has reduced the water-carrying capacity of these streams. The most serious flooding occurs on the Snowy River flats near Orbost



Extensive flooding occurred on the Snowy River flats in February 1971

where the flood-plain is extensive. Other streams in the study area, in particular the Cann River, experience floods resulting in damage to property and stock losses.

The steep and often rocky nature of the catchments, coupled with the tendency for particularly intensive rainfall, often leads to rapid rises in river levels throughout the study area. Serious flooding can therefore result as the streams have only minimal flood-plain development (in relation to catchment size) and thus a limited capacity for retention of floodwaters.

Some flood-control works have been carried out on the Snowy, Brodribb, and Cann Rivers, including the removal of snags and obstructions, protection of eroded banks, and construction of levees. These works have had little effect, except on a very localized scale. Dams constructed as part of the Snowy Mountains Hydro-electric Scheme in the headwaters of the Snowy River provide only minimal control over flooding. Vegetation plays an important part in mitigating the effects of flooding and if further land clearing takes place it can be expected that the severity of floods will also increase.

Biological Hazards

Pest animals

The majority of problems associated with pest animals in the area occur on or near privately owned land.

Wombats cause some damage to fencing, but this is only a minor problem. Rabbits occur mainly on freehold properties and on the margins of Crown land. They rarely penetrate more than about a kilometre into undisturbed native forest

or heathland. Numbers generally remain low, but with favourable seasonal and breeding conditions, numbers can build up to the point where local eradication campaigns are required.

Feral species often compete with the native fauna for resources such as food and nest sites. For example, the common starling uses tree hollows and, where it is common, close to urban areas, this species may displace native hollow-nesting birds such as treecreepers. Other feral species, particularly the dog, fox, and cat prey extensively on native fauna. In an analysis of predator scats collected in the Bowen Ranges and the forests south of Bendoc, approximately 70% of the identifiable scats were from feral dogs. As dog scats are often more obvious and hence easier to locate, this figure may indicate a higher population than true levels, as foxes and feral cats are also known to be common and widespread. Of 26 mammal species recorded as prey species, 18 were native. Commonly recorded prey included the swamp wallaby, wombat, common ringtail possum, mountain brushtail possum, greater glider, bush rat, and rabbit. Evidence of the endangered long-footed potoroo was recorded in a dog scat, and other rarely recorded species including the platypus, echidna, feathertail glider, eastern pygmy-possum, and sugar glider. Birds and reptiles are also taken and in this study 16% of scats contained bird remains and 2% reptiles.

Dingoes and feral dogs are fairly prevalent in undisturbed Crown land, on grazing leases, and in some uncleared freehold land. Under the present system of trapping and poisoning, wild dogs are under reasonable control, but they still cause sheep losses particularly in the Deddick valley. Constant control work is required to keep stock losses from dog attack to a minimum. They also carry hydatids, which could present a problem if the population was not kept under control.

Noxious weeds

In Victoria, 103 plants have been proclaimed as noxious weeds under the provisions of the *Vermin and Noxious Weeds Act* 1958, and 22 of these are found within the study area. In general, their distribution is limited to semi-improved agricultural land, undeveloped land, or land that has been disturbed. However, only four of these 22 weeds, namely blackberry, great mullein, saffron thistle, and thorn apple, cause significant problems. Blackberry grows along the banks of many streams throughout the study area where it can form impenetrable thickets, completely replacing native riparian plants. Many blackberry infestations occur in inaccessible areas, making control difficult. Consequently, control programs are essentially confined to public land adjoining private property. A major proportion of the time and money allocated to noxious weed control is spent on blackberry infestations throughout the study area.

Blackberry rust (*Phragmidium violaceum*) is a fungus that attacks six of the eight species of blackberry naturalized

in Victoria. It was first discovered in Victoria 1984 and it appears to have been deliberately introduced.

The rust spread quickly during the summer and autumn of 1984, mainly from South Gippsland, and is now apparently affecting blackberries in East Gippsland. A field study of its effect on blackberry has commenced. Assuming that the rust has no adverse side-effects, it could prove to be a major weapon in biological control of blackberry. It is estimated that the cost of controlling blackberry infestations across the State exceeds \$13 million annually.



An infestation of great mullein on pastoral land in the Deddick River valley

Great mullein is a significant noxious weed in the Bonang district and in the Deddick valley, where it occurs mainly on freehold land. It grows best on areas of low fertility, including rocky outcrops and unimproved native pasture. The rosette covers a fairly large area and, as stock do not eat it, reduces pasture production. Great mullein survives well in heavily grazed pastures as competing plants are removed.

The major infestation of saffron thistle again occurs in the Bonang district and the Deddick valley. Heavy grazing pressure also encourages this weed because sheep and cattle have difficulty in grazing the flat rosettes; they therefore tend to eat out the other plants first. It thus reduces pasture production and, because it is spiny, tends to get caught in wool, thus reducing its value at market.

Thorn apple is a weed of high-rainfall or irrigated areas such as the Snowy River flats and in the Cann valley. Infestations in summer-growing crops can be very dense and can

deprive the crop of moisture and nutrients, and also of light, because of the large broad leaves. Thorn apples establish readily in disturbed soil.

Other weeds occurring in the study area are of minor importance and their spread is restricted by existing control measures. New infestations appear frequently near streams after floods, and these require close attention to prevent their spread onto adjacent land.

Cinnamon fungus

The root rot disease that cinnamon fungus (*Phytophthora cinnamomi*) causes has been detected in a number of widely dispersed locations, including some rainforests in Queensland, mixed-eucalypt forests of south-eastern Australia, and jarrah forests in Western Australia. Following some debate over its origin, it is now generally accepted that the disease is a newly introduced pathogen that has spread rapidly.

About 1,000 ha of dieback and tree decline were observed in the coastal forests of East Gippsland in the 1950s, but this problem was not associated with cinnamon fungus until 1968. Soon afterwards (1970--71), acute dieback of both overstorey and understorey vegetation was found over extensive areas of these coastal forests and had severely affected about 5,000 ha, with the largest individual patches covering about 50 ha. The type of injury sustained by trees and other plants varied considerably, and it became evident that disease expression depended on species, soil type, elevation, and general climatic conditions.

The fungus seems to be most prevalent in relatively flat poorly drained coastal forest extending to about 25 km inland, especially those areas with an impervious hard-pan layer near the soil surface. It appears to be widely scattered in the foothill forests but less commonly located in mountain forests, where it was found only in machine-made clearings, drains, and log storage areas.

Initial research suggested that cinnamon fungus only attacked those areas of the root system that did not contain a protective layer of suberin (generally found on the older parts of the root network) and that it resulted in severe root pruning. It eventually killed plants, especially during subsequent drought periods, because it reduced their ability to take up water. Susceptibility to fungal attack varied widely, but in general terms the stringybark and ash species were severely affected (sub-genus *Monocalyptus*), while the boxes, gums, and ironbarks were more resistant. In addition many understorey plants, particularly those of heathlands, were severely affected. Banksias were found to be susceptible, but the wattles seemed to be unaffected. The fungus has a wide range of host plants and is therefore potentially very hazardous to Australia's native flora.

Although studies showed that the fungus was present in soils over relatively large tracts of land throughout the State, damage to the overstorey trees continued to be confined to

fairly distinct areas. The reasons for this remained unknown until about 1978.

From the initial studies, it became apparent that soil factors such as moisture and temperature status and microbiological properties were highly correlated with the pathogenicity of the fungus. The importance of soil type was demonstrated by inoculation of a fertile, well-drained mountain forest soil with the fungus. Population levels of the original inoculum declined rapidly over a 3-year period, suggesting that the fungus would have very little significance as a soil pathogen in such environments. The reasons for this apparent immunity have not been positively identified, but it is likely that the combination of a cool climate, well-drained soils, and a rich soil microflora containing organisms antagonistic to cinnamon fungus are major contributing factors. It also appears that these antagonistic micro-organisms were able to slow down the rate of fungal spread within the root tissue.

The importance of soil type in disease expression was confirmed in studies of the East Gippsland coastal forests in the 1970s. A strong relation was found between dieback and topography, soil, and rock type. Dieback was most intensive and extensive on soils derived from Tertiary sediments, but was not recorded on reddish soils or on deep freely draining sands developed on other rock types.

Dieback-susceptible soils on the Tertiary sediments were generally characterized by slopes of less than 0.5° and a shallow (20 to 55 cm) depth to an impeding clay-rich layer. This was particularly the case in the Waygara Land System, where severe and extensive dieback has occurred. This work confirmed the role of soil type and topography in the destructive potential of cinnamon fungus.



Dieback caused by cinnamon fungus

Climatic conditions appear to be strongly related to disease expression. All dieback epidemics so far recorded in Gippsland have occurred during years in which 3--4 months of high rainfall in the warmest months was immediately followed by a similar period of low rainfall. It should be noted that wet warm soil provides optimum conditions for the propagation of the fungus and the subsequent dry period results in stress within the host plant.

Finally, there is strong evidence of substantial genetic variation in disease resistance among a range of eucalypt species. It has been shown that sweet wattle (*Acacia suaveolens*), a common wattle in East Gippsland, can protect silvertop ash from infection and scientists are testing a number of wattle species from eastern Victoria to see whether they also have this protective effect. They plan to examine whether establishing protective acacias with susceptible eucalypts on dieback sites would reduce the risk of further dieback.

The effects on the spread of dieback in a clear-felling operation have been much discussed recently. The risk of dieback in the forest around an area being cleared may rise because of the possibility that run-off or the use of machinery may spread the fungus and because the soil around the cleared areas would probably become warmer and wetter. On the other hand, it is suggested that vigorous regenerating forest on the cleared area may keep the soil drier and cooler than it had been under the removed mixed-age forest, and as a result reduce the dieback risk in the adjacent areas.

A strategy now being evaluated for susceptible sites in East Gippsland relies heavily on several assumptions: that disease expression is reduced by decreasing the amount of available water in the surface soil horizons; that some plant species are far more resistant to the disease than others; and that significant genetic variation in disease resistance occurs within a species. The strategy incorporates both conservation and regeneration components. The former consists of a moratorium on felling disease-resistant eucalypt species to conserve these as seed sources, and a ban on so-called selective cutting. The regeneration component requires knowledge of the original species distribution (prior to selective cutting), and estimates of the disease hazard of the site and the amount of disease present before the site is clear-felled and the slash burnt. The site is then sown, with a seed mixture approximating the original eucalypt species composition, at heavy rates to ensure dense regeneration that will maximize water use and help selection for resistance among susceptible species in the mix.

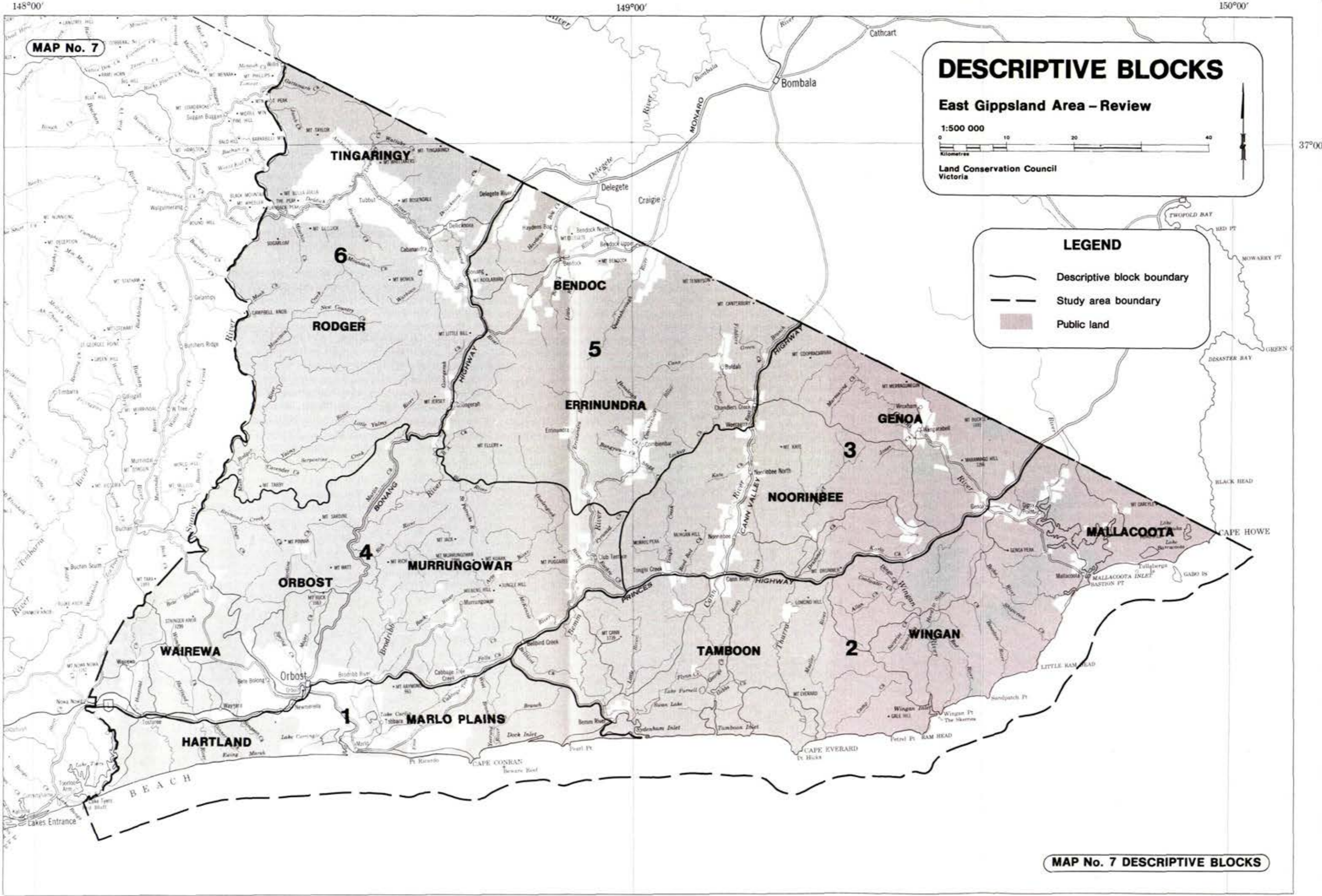
It will be several years before the effectiveness of this strategy can be fully evaluated. In the interim, its important elements are being incorporated into existing silvicultural systems for East Gippsland. Development of a strategy for the regeneration of the understorey vegetation on affected sites has also been suggested.

References

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Part IV
BLOCK DESCRIPTIONS



DESCRIPTIVE BLOCKS

East Gippsland Area – Review

1:500 000

0 10 20 40
Kilometres

Land Conservation Council
Victoria

LEGEND

- Descriptive block boundary
- Study area boundary
- Public land

MAP No. 7 DESCRIPTIVE BLOCKS

BLOCK DESCRIPTIONS

The original descriptive report by the Land Conservation Council covering East Gippsland divided the area into 14 blocks to facilitate detailed description and assessment of natural resources. In this review the blocks have been amalgamated into six groups that have broadly similar climate, soils, topography, and vegetation. The block names used in the original report have been retained for continuity.

Map 7 shows the location of the 14 descriptive blocks and the boundaries of the six groups into which they have been amalgamated.

The present tenure, nature of the land, capability for various uses, and likely land use hazards are described for each group. A consistent format of headings and subheadings has been used to enable the reader to compare specific data for various blocks. The information on land uses in this section of the report refers to the public land except where explicit reference is made to private land. Within each block the discussion is concentrated on the resources and potential uses of the uncommitted land.

Capability

This term refers to the value of the land for the particular use to which it may be put. Present values of use are described, where possible, to give some indication of capability. Capability for some uses, such as nature conservation, is based primarily on the land's inherent characteristics. For others, it also depends on inputs (such as fertilizer application) that raise the productivity.

Capabilities are assessed in general terms only, because the amount of information available varies from block to block and because some values are difficult to quantify. In assessing capabilities, comparisons have been made with other blocks and with other parts of the State.

1. HARTLAND--MARLO PLAINS

A. Tenure and Nature of the Land

1. Present tenure

The public land totals about 53,000 ha, and is consolidated into substantial parcels. An area totalling about 6,400 ha is incorporated in three wildlife reserves - Ewing Marsh (4,450 ha), Lake Corringale--Lake Wat Wat (840 ha), and Lake Curlip (790 ha). Some 2,000 ha are included in the Lake Tyers State Park (part only) and another 800 ha in the Mount Raymond Regional Park. The Cabbage Tree Creek Flora Reserve covers an area of 1,700 ha, while a further 8,100 ha are included in coastal reserves. Some 650 ha have been set aside for education purposes at Sydenham Inlet. The Orbost areodrome occupies a 450-ha site to the east of Marlo township. The remaining 33,700 ha or so are predominantly uncommitted land. Freehold land totalling about 18,000 ha occurs mainly on the Snowy River flats around Orbost and on the Marlo Plains.

2. Climate

Average annual rainfall ranges from about 750 mm in the south-west around Lake Tyers to more than 1,000 around Cabbage Tree Creek township in the north-east and is fairly evenly distributed throughout the year. Temperatures are moderated by proximity to the sea, producing cooler summers and milder winters in comparison with areas further inland.

3. Geology and geomorphology

Isolated outcrops of Ordovician bedrock and granite rocks occur at Mount Raymond, Cape Conran, and along the Yeerung River valley and at Pearl Point. The surface material of most of this block is a sequence of Tertiary non-marine sediments. Vegetated dune systems of Pleistocene age occur east of Marlo and extend to Sydenham Inlet. Extensive deposits of Recent alluvium occur in the Snowy River valley, and around the lower reaches of the Brodribb River and Cabbage Tree Creek.

Most of the land on the Tertiary sediments is undulating while that on the alluvium is generally flat. The Marlo Plains country consists of a generally east--west trending system of dune ridges and intervening swales that are subject to seasonal waterlogging. Ewing Marsh was formed by the infilling of a coastal lagoon behind a sandy barrier. Both Lake Tyers and the lower reaches of the Snowy River are estuaries, closed off periodically by sand accumulations at their mouths. They are both drowned valleys, submerged by the world-wide rise in sea level during the Holocene epoch. Other small inlets such as Dock Inlet and the one at the

mouth of the Yeerung River have similar geological histories.

4. Soils

On the Tertiary parent material, soils are generally friable yellow or red gradational or duplex. Alluvial soils, particularly on the Snowy flood-plain, are predominantly sandy loams to clay loams. They are generally deep and particularly rich in nutrients.

The Marlo Plains carry strongly acidic dark grey or brown sands with much organic matter and a pronounced hardpan layer at a depth of (usually) 60--120 cm. These soils have naturally low fertility.

In waterlogged areas, the surface horizon is often peat or peaty sand over yellow-brown sand - with a peat layer, often at water table level, overlying coffee rock. In Ewing Marsh black peaty sands or sandy loams overly impermeable clays that rest on a sandy substrate.

5. Vegetation

The predominant community is lowland sclerophyll forest. To the west of Orbost the overstorey includes several eucalypts such as white stringybark, silvertop, red ironbark, mountain grey gum, and blue box (which is restricted to a relatively small area centred on Nowa Nowa). Elsewhere in the block silvertop and white stringybark dominate. Coastal sclerophyll forest occurs along the landward side of Ewing Marsh and extends up the small creeks draining the hinterland. Southern mahogany is an indicative overstorey component of this community.

Extensive coastal heathlands and banksia woodlands occur between Marlo and Sydenham Inlet, the heathlands being essentially confined to the seasonally wet depressions with the



Lowland sclerophyll forest in the Yeerung River catchment

woodlands on the adjacent ridges. The woodlands are dominated by saw banksia although the coastal form of manna gum (*Eucalyptus viminalis* var. *racemosa*) is often present, especially in the Marlo--Cape Conran area. The rare sword bossiaea occurs in banksia woodland east of Point Ricardo and a small flora reserve has been established near the Marlo recreation reserve to protect two rare orchids, the leafless tongue-orchid (*Cryptostylis hunteriana*) and tartan tongue-orchid (*C. erecta*). The primary dune scrub community is well developed along the coast.

6. Fauna

This block - comprising a narrow, essentially, coastal strip south of the Princes Highway between Nowa Nowa and Bemm River - has high significance for vertebrate fauna utilizing habitats such as ocean beaches, foredunes, coastal scrub, banksia woodland, and lowland sclerophyll forest.

Undisturbed ocean beaches, which occur along parts of the coastline here, are important as breeding sites for birds, such as the little tern and hooded plover, that nest in shallow scrapes in the sand. Increasing human disturbance to sandy beaches, particularly from recreational use, is reducing the availability of breeding areas for these species.

Coastal scrub occurring along the coastal dunes supports relatively few faunal species, but adjacent coastal heaths and banksia woodlands are utilized by many animals. Small mammals present include the brown antechinus, bush rat, swamp rat, southern brown bandicoot, long-nosed potoroo, white-footed dunnart, eastern pygmy-possum, and smoky mouse. Honeyeaters and lorikeets - which, in season, utilize nectar that the flowering banksias and other heathland plants produce - are a conspicuous component of the avifauna. Other birds present include those feeding on invertebrates, (including the grey shrike-thrush, dusky woodswallow, southern emu-wren, and rufous whistler) and predators such as whistling kite, marsh harrier, and brown goshawk. The rare ground parrot was formerly widespread in this coastal heath vegetation, but now occurs only sporadically - during post-breeding dispersal, etc.

The wetlands here (for example, Ewing Marsh) provide valuable feeding areas for such birds as the white-faced heron, masked lapwing, and purple swamphen, and are used as habitat by snakes (copperhead, tiger snake) and amphibians (common eastern froglet, spotted grass frog, and green and golden bell frog).

B. Present Use and Capabilities

1. Nature conservation

This block has considerable significance for nature conservation. Important wetland habitats are protected in the Ewing Marsh, Lake Corringale--Lake Wat Wat, and Lake Curlip Wildlife Reserves, while Cabbage Tree Creek Flora Reserve

contains good examples of coastal heathland, lowland sclerophyll forest, and warm temperate rainforest, in which the rare cabbage fan-palm is present. Lake Tyers State Park contains significant examples of lowland sclerophyll forest and coastal sclerophyll forest communities. The presence of Gippsland grey box makes these forests and the surrounding lake environs particularly attractive. Mount Raymond Regional Park is noted for its population of terrestrial orchids.

The coastal reserve between Marlo and Sydenham Inlet is particularly important for the conservation of woodland, heathland, and dune scrub vegetation and its associated fauna. The uncommitted land between Cape Conran and Sydenham Inlet south of the old coast road contains populations of the rare smoky mouse and ground parrot.

2. Recreation

Capability for recreation is high along the coast between Marlo and Yeerung River and at Sydenham Inlet. Boating, swimming, fishing, and camping are popular activities there, and the township of Marlo relies heavily on the tourist industry. The quiet estuary waters in the lower Snowy are ideal for many water sports, as is Sydenham Inlet, while the ocean coast is suitable for surf and rock fishing, swimming, and boating.

Boat ramps are located at Marlo, Cape Conran, and Bemm River, with camping and caravan areas at Orbost, Marlo, Cape Conran, and Bemm River. A major upgrading of facilities at Cape Conran is being carried out by the Department of Conservation, Forests and Lands. These areas have good road access.

Mount Raymond provides excellent views over Orbost and the Snowy River flood-plain, southwards to the coast, and east towards Sydenham Inlet.

Sightseeing, picnicking, nature study, and bushwalking are also popular in the area, but most activity is centred on or close to the coast. Duck-shooting is confined to the wetlands and swamps around the mouth of the Snowy River and at Ewing Marsh.

3. Agriculture and apiculture

Most of the block is situated on the Waygara and Wooyoot Land Systems, which have generally moderate slopes; and, although fertilizer and clearing costs are high, good rainfall, moderate temperatures, and excellent access give these areas a high capability for agriculture. The coastal strip, however, has a low capability.

The leached sands of the Barga Land System have a high fertilizer requirement and are poorly drained, but clearing costs are low and proximity to intensively farmed areas indicate a moderate capability for further agricultural development.



*Leached
sands,
Marlo Plains*

Flats and terraces along Cabbage Tree Creek have a high capability, as evidenced by the fact that similar areas on the Snowy flood-plain are intensively developed for agriculture.

The block has moderate capability for forest grazing, and the forests west of Orbost are highly regarded by apiarists for honey production. The areas of red box and blue box in particular have high value, and understorey species are useful for building up hives.

4. Timber production

Hardwood forests here have been used to supply sawlogs and sleepers for many years. Regeneration is rapid, and re-growth from harvesting operations will provide future supplies of timber.

Proximity to sawmills and towns increases the value of these forests for timber production, and their accessibility makes them particularly suited for sleeper production.

5. Mining and quarrying

No known commercial mineral deposits exist here. Sands containing heavy minerals occur on the coast near the mouth of the Snowy River, but are currently not considered economic. The goldfield around Cabbage Tree Creek township has been worked in the past. Marine limestones underlying the Tertiary non-marine sediments in the Snowy valley may have some commercial value. Useful deposits of gravel and sand suitable for road-making purposes also occur throughout the block.

6. Water production

The Snowy and Brodribb Rivers and Cabbage Tree Creek, which flow through the block, provide water for irrigation, but (apart from farm dams) catchments here have no importance for water production. Capability for production from underground sources is high, should the need arise.

7. Historical associations

The early settlement and development of the Orbost district is reflected in a number of historical sites and their associated artefacts. These include possibly the first white burial site in the region - that of Dan 'The Cook' Demsey, who was speared by a party of Aborigines in the 1850s. The Orbost cemetery has headstones dating back to the 1850s, although records date only from 1891. The Marlo cemetery was gazetted in 1873 and pre-dates all others in the region. The graves of the Stirling family were sites of the first public burials in the region.

At Cape Conran a small number of graves are known to have been located in the coastal reserve and were marked by small wooden crosses. They were probably the graves of sailors who perished in one or more of the early shipping disasters along this part of the coast.

Other features include the Tabbara Township and mill site, established in 1890, the Snowy River boat-landing site used by the Snowy River Shipping Company, the Brodribb Public Hall built in 1920, the pumphouse for the former Orbost Butter Factory, in use around the 1890s, and Robert's Glass Factory on the eastern shore of Lake Tyers, which was established in 1908.

8. Hazards and conflicts

Slopes are seldom steep except along deeply incised drainage lines, where a moderate erosion hazard exists. The coastal dunes are very prone to wind erosion if vegetation is disturbed by fire, trampling by animals or humans, or wave erosion of the foredune areas. The fire risk is very high because the vegetation is reasonably dense and dries out in the summer; it is a constant threat to agricultural settlements nearby. The risk is aggravated by the large number of tourists using the area in the summer months.

The Snowy--Brodribb River flats are prone to flooding. This affects freehold land in the main, although adjoining public land may be used temporarily to graze stock moved off the flooded areas. Ewing Marsh and the wetlands on the Snowy flood-plain are frequently inundated, but this is advantageous for wildlife conservation.

Cinnamon fungus is a hazard to native vegetation, particularly on the Waygara Land System.

Conflicts are likely to arise between different possible uses for the land. Clearing for agriculture diminishes wildlife, flora, and apiculture values, and ends timber production. Clear-felling and regenerating the forest for timber production may be economically possible, but would have some impact on scenic, wildlife, flora, and apiculture values.

2. TAMBOON--WINGAN--MALLACOOTA

A. Tenure and Nature of the Land

1. Present tenure

This block is largely public land (approximately 200,000 ha), with small areas of freehold at Bemm River, Cann River, Genoa, and Mallacoota totalling about 7,000 ha. It lies between the Princes Highway and the coast, from Sydenham Inlet to the New South Wales border. The block contains virtually the whole of the Croajingolong National Park (including Tulalberga Island and the Skerries), and the Commonwealth-owned Gabo Island. The park abuts the Nadgee Nature Reserve in New South Wales.

Large areas of the public land are used for hardwood production, and as uncommitted land.

As well as the 82,130-ha Croajingolong National Park, the block contains part (1,280 ha) of the Alfred National Park. An area similar to the Alfred Park was recommended by Council in 1977 to become the Mount Drummer Flora Reserve, but the government decided to retain the existing national park. Other reserves here include reference areas at Camp Creek (1,000 ha), Baawang (670 ha), Benedore River (1,200 ha), and Seal Creek (1,000 ha), the Serpentine Creek Education Area (500 ha), and the Mallacoota Coastal Reserve. In addition, the coastal strip has been largely designated as the Cape Howe and Tamboon Inlet to Mallacoota Scenic Coasts.

2. Climate

Climate is mild near the coast, but temperatures tend to be more variable inland and lower in the more elevated areas. Mean annual rainfall is 900 mm--1,000 mm, but may exceed 1,000 mm in elevated areas, such as the Howe Range, and on southerly aspects.

3. Geology and geomorphology

This block has a wide range of surface geology. It contains substantial areas of Ordovician marine sediments, particularly east of Genoa and south of Lomond Hill. Extensive areas of lower Devonian granites occur between Mount Cann and Cann River, between Wingan Inlet and Genoa, and at Mount Everard. Large areas of Tertiary non-marine sediments occur north of Sydenham Inlet, north of Point Hicks to the Princes the way, as far east as Genoa, and around Mallacoota Inlet. In addition to broad stretches of Quaternary aeolian sands behind Tamboon Inlet, east of Mallacoota Inlet, and at Point Hicks, Quaternary alluvial deposits occur along some of the valleys - such as parts of the Cann, Mueller, and Wingan Rivers - and on flats around Sydenham and Mallacoota Inlets.



Tightly-folded Ordovician sediments near the mouth of Shipwreck Creek

Most of the land here has an elevation of less than 150 m. However, some areas rise to 300 m on the granite and Ordovician sediments - the prominent granitic peaks of Mount Cann, Mount Everard, and Genoa Peak exceed 300 m elevation. These areas are undulating to hilly, with a complex pattern of ridges and valleys. Slopes are often steepest on the Ordovician sediments. Topography in the Tertiary areas is flatter, with some streams having deeply incised valleys. The Quaternary alluvial deposits are almost flat, while the Quaternary sands form generally parallel dunes aligned with the coast, reflecting the east--west direction of the prevailing winds. In the west these dunes are mostly low and vegetated, but north of Point Hicks, for example, and further east, they are largely bare and over 100 m high.

Inlets take up a considerable area here. Sydenham Inlet is a large estuarine lagoon, often sealed off from the sea. The sand barrier has frequently been opened artificially. As a result, the water of the inlet is now more often brackish than it was naturally. The lagoon is generally up to 2 m deep, with a smooth floor developed by sedimentation, but towards the outlet a deeper channel develops with depths up to 10 m.

Tamboon Inlet had a similar origin, but differs in being fringed largely by beaches, with only limited sectors of bordering swamp. The eastern shoreline is backed by steep granite slopes, once the western shoreline of a major coastal promontory. Much of Tamboon Inlet is about 6 m deep, with a smooth floor, but some parts are up to 12 m deep.

Wingan Inlet is estuarine and formed in a similar way to Sydenham and Tamboon Inlets, although it is smaller and is permanently open. Easby Creek (formerly Little River), Red River, Benedore River, and Betka River all have small estuarine lagoons.

Mallacoota Inlet was formed by the submergence of the valleys of the lower Genoa River and its tributaries. The islands near the mouth are deltaic deposits and, with the Goodwin Sands, are formed by the deposition of silt.

Two freshwater dune lakes - Barracoota and Wau Wauka - lie in the sandy strip in the far east. Lake Barracoota formed as a result of the silting up of a previous arm of

*Lake Elusive*

Mallacoota Inlet, and this origin gives it great scientific interest. Lake Elusive (near Wingan Inlet) and Lake Wau Wauka are typical marginal dune lakes, where small drainage systems have been blocked by dune encroachment.

Other geomorphic features of interest include contacts between Devonian granite and Ordovician sediments at Point Hicks and Sandpatch Point and sea cliffs up to 30 m high between Sandpatch Point and Mallacoota; these consist of strongly folded slates, schists, and sandstones.

The coastal plateau behind the cliffs comprises an uplifted wave-cut platform deeply incised along its seaward side.

4. Soils

Sandy uniform soils are found mainly on Quaternary sandy parent materials in a broad strip along the coast. These can be divided into three - the undifferentiated aeolian sands, occurring on bare frontal dunes; the weakly differentiated aeolian sands, which have some surface organic darkening and are found on stable Recent dunes; and the leached sands, with dark iron or organic matter accumulation, occurring on older dunes and swamps and in some of the Tertiary deposits.

Inland, the block carries a range of soil types, but most are gradational. Some uniform brown loams, and undifferentiated sands, silts, and gravels occur on deposits of river alluvium.

5. Vegetation

The primary dune scrub community is well developed here, except where the plateau capped by Tertiary sediments reaches



*Warm temperate
rainforest,
Harrison Creek*

*Below: Banksia woodland
and coastal heathland*



the coast between the mouth of the Betka River and Little Rame Head.

Banksia woodland dominates on the near-coastal sandy terrain, with heathlands in the intervening depressions, and on areas of impeded drainage along many of the streams.

Most of the block supports lowland sclerophyll forest dominated by silvertop and white stringybark, but bloodwood and southern mahogany are also present. Red bloodwood - Victoria's only representative of the bloodwood group of eucalypts - is restricted to the eastern part of the study area beyond Wingan Inlet. Rough-barked apple is restricted to the area east of Genoa; its presence in this community - in association with red bloodwood, white stringybark, and silvertop - gives an attractive appearance to these forests, particularly around Mallacoota Inlet. White ash (*Eucalyptus fraxinoides*) is more common in New South Wales, but has a restricted occurrence in the Howe Range.

Warm temperate rainforest is well developed along the lower reaches of the Bemm river, Wingan River, Benedore River, and a number of small catchments east of Mallacoota Inlet, namely, Teal, Dowell, David, Stockyard, and Harrison Creeks. However, the best stands occur in the Alfred National Park. This community contains many rare plants, particularly those localities east of Mallacoota Inlet, where species such as sandpaper fig (*Ficus coronata*) and eastern leatherwood (*Eucryphia moorei*) reach the southern limit of their range.

Riparian forest occurs along many of the streams and is dominated by mountain grey gum, yellow stringybark, and river peppermint.

6. Fauna

The main vegetation communities that provide habitat for the vertebrate fauna here are lowland sclerophyll forests, banksia woodlands, and coastal heaths. These lowland communities support a rich and diverse vertebrate fauna, probably due to the diversity and seasonal availability of food sources in these habitats. As well as widespread species (for example, swamp wallaby, bush rat, yellow-faced honey-eater, and garden skink), many species are characteristically present in these lowland habitats that are absent, or in lower abundance, at higher altitudes. These include the long-nosed potoroo, southern brown bandicoot, smoky mouse, eastern pygmy-possum, rainbow lorikeet, little wattlebird, southern emu-wren, chestnut-rumped hylacola, swamp skink, and she-oak skink.

Coastal beaches and off-shore islands provide important habitats for animals such as the hooded plover, little penguin, white-faced storm-petrel, and Australian fur seal, all of which require relatively undisturbed areas for breeding.

The turquoise parrot, a significant species within this study area, was first recorded in East Gippsland at Shipwreck Creek.

Coastal heathland vegetation is the primary habitat for two significant bird species, the ground parrot and eastern bristle-bird. The ground parrot, which has a fragmented distribution, has its most substantial Victorian population in Croajingolong National Park. The eastern bristle-bird has a very restricted distribution, in eastern Victoria and south-eastern New South Wales, with habitats in this block providing the bulk of the Victorian range.

The eastern part of the block forms the southernmost tip of the geographic range of several significant species, such as the glossy black cockatoo and the diamond python. This is the only locality where these species have been regularly recorded in Victoria. Several other species very rarely recorded elsewhere in Victoria also occur here, at the southern limit of their Australian range - for example, black bittern, striated heron, eastern reef egret, and scarlet honeyeater. The grey-headed flying-fox, an irregular seasonal visitor to southern Victoria, has regularly

occupied a roost-site in a warm temperate rainforest gully east of Genoa.

The leathery turtle and the yellow-bellied sea-snake, both marine inhabitants from more northern regions of Australia, have been recorded as vagrants.

B. Present Uses and Capabilities

1. Nature conservation

Croajingolong National Park, which occupies a large portion of the block, has been declared a biosphere reserve under the U.N.E.S.C.O. 'Man and the Biosphere Programme'. The park contains very good examples of all vegetation communities represented in the block, and is a significant reserve in terms of fauna conservation. Many of the small coastal streams are relatively undisturbed and therefore have the potential to provide valuable information about natural systems. The coastline and adjacent inlets have significant and diverse geological, geomorphic, and landscape values.

The riparian and warm temperate rainforest stands have important conservation values, and many are incorporated in existing reserves such as the Croajingolong and Alfred National Parks. Numerous areas of coastal heathland occur throughout the uncommitted land and the hardwood production areas; one of them, St Georges Plain, is possibly the largest grass-tree plain in East Gippsland. The rare green-midge orchid (*Prasophyllum viride*) has been recorded here.

Other stands of warm temperate rainforest in the uncommitted land east of Mallacoota Inlet contain some unique assemblages of rainforest species found nowhere else in the State.

All the streams are significant, as many contain no introduced fish species and support good populations of native fish.

2. Recreation

The block has considerable potential for recreation and some areas are already heavily used. Mallacoota Inlet is a popular destination for many holiday-makers, and visitor numbers are on the increase. Sydenham, Tamboon, and Wingan Inlet and the mouth of the Thurra River are also popular, and are suitable for camping, boating, fishing, and swimming. All the smaller coastal inlets provide excellent recreational fishing.

Ocean beaches, rocky cliffs, and headlands or picturesque inlets offer spectacular scenery, and are important for several forms of recreation, including fishing, swimming, camping, sightseeing, and nature study. Some parts of the coast - for example, between the mouth of the Thurra River and Mallacoota Inlet - can provide more remote types of recreation, and bushwalking in this area is increasing in popularity. The area east of Mallacoota Inlet has high wilderness values.

The Princes Highway and major linking roads provide good access to most of the heavily used areas, while the extensive network of forest tracks enables access into some of the more remote parts.

3. Agriculture and apiculture

The most widespread land systems in this block are Wooyoot, Pinnak, and Wurrin, parts of which have a moderate capability for agricultural use, particularly on gentler slopes. The Barga and Boole Poole Land Systems, on Quaternary sands, have a low capability.

Capability for forest grazing is moderate over most of the block, but higher around Mallacoota Inlet and Lake Barra-coota.

The white stringybark and silvertop forests are useful for apiculture. Red bloodwood, which is restricted to the east, is also a valued species for honey production.

4. Timber production

Most of the forests here have moderate to high capability for sawlog production. Valuable species such as silvertop, white stringybark, yellow stringybark, messmate, and mountain grey gum are abundant. Where logging has been intensive, regeneration following proper silvicultural treatment has been prolific.

Logging has been carried out over most of the area where it is permitted. The 1982/83 fires severely damaged both mature forests and logging regeneration.

5. Mining and quarrying

Several mineral deposits occur in this block, although they are not currently exploited commercially. Mineral-bearing sands have been found at some sites, including Mallacoota; copper ore occurs between Hard to Seek Creek and the Princes Highway; molybdenum ore has been found near Genoa Peak, Gipsy Point, and Fairhaven; tungsten has been recorded near Genoa; and gold has been worked north of Sydenham Inlet and around the shores of Mallacoota Inlet.

Quarries for roading material, and materials suitable for gravel and stone extraction, are found in scattered localities throughout.

6. Water production

This block has a moderate capability for water production although the headwaters of the major streams flowing through it, such as the Bemm, Cann, Thurra, Genoa, and Wallagaraugh Rivers, lie outside it.

It contains the proclaimed Betka River catchment, which supplies water to Mallacoota township. The maintenance of a continued supply of good-quality water, in sufficient

quantity, is vital for Mallacoota. This is of some concern, as the period of greatest demand for water, during the summer tourist season at Mallacoota, coincides with the period of minimum run-off.

A reticulated water system is being developed for the township of Bemm River. Water is supplied by pumping from the Bemm River just upstream of the rapids north of the township.

The major streams mentioned above are possible future sources for water supply to other coastal villages, and to camping areas.

7. Historical associations

Many features associated with the early settlement and development of the block are still obvious today, particularly around Mallacoota Inlet. In the early 1900s the Lake View property functioned as a hotel. People were transported to Gipsy Point, where they were ferried across the lake to the hotel. It was a popular destination for tourists even in those days, until the township of Mallacoota was established around 1918. The Gipsy Point--Maramingo Cemetery contains the burial place of several local identities, including Henry Bucknall, the founder of Gipsy Point settlement, Mr E.H. Lees, who surveyed the site for Mallacoota township and members of the Dorron family, who owned the Lake View property.

The wreck of the steamship 'Monumental City' on Tullaberga Island in 1853 and fears of attack during the Crimean War prompted the building of the Gabo Island lighthouse in 1860 and the subsequent establishment of a telegraph line between the lighthouse and the Twofold Bay settlement in 1862. Remnant poles and wires exist along the route, although many have been buried by the large sand drifts along this part of the coast.

Evidence of early gold-mining activity may be found around the shores of Mallacoota Inlet and at Poddy Creek.

The Tonghi Creek Primary School built between 1913 and 1920 stands adjacent to the Princes Highway at Tonghi Creek. The school was closed in 1950.

8. Hazards and conflicts

Soil erosion seldom poses a serious problem, except on steep slopes in the hilly areas, and on sand dunes.

The dunes are particularly susceptible to wind erosion when their vegetation cover is removed, although some of the presently unstable dunes may never have been fully vegetated in their natural condition. Erosion control work has been carried out on several large dunes that threatened to inundate the small township of Tamboon South. Even minor erosion can still be significant, particularly in catchments supplying an untreated domestic supply such as the Betka River.



Large dunes spilling into the Thurra River near Point Hicks

Streambank erosion, and sand deposition on stream flats, can adversely affect agricultural production, as has occurred along the Genoa River.

Fire is a serious hazard, as environmental conditions favour a build-up of highly flammable fuel, mainly as dense undergrowth. Combined with a long dry period, the hazard becomes extreme. Over the 1982/83 summer, large wildfires burnt through most of the block and areas to the north, destroying several houses at Mallacoota and threatening the town of Genoa.

Flooding is an occasional hazard on the Bemm, Cann, Thurra, Genoa, and Wallagaraugh River flats.

Cinnamon fungus is potentially a serious hazard to the forests in areas subject to waterlogging. Several of the main timber-producing tree species and many understorey species are susceptible. The fungus may be aggravated by road construction and other machinery operation.

The continued expansion of Mallacoota township may exacerbate problems of town water supply, and disposal of effluent and garbage.

Conflict may arise between timber production and aspects of nature conservation and recreation, although roading associated with timber production can improve access to forested areas and may thus benefit some forms of recreation.

3. GENOA--NOORINBEE

A. Tenure and Nature of the Land

1. Present tenure

This block contains 125,000 ha of public land, most of which is used for hardwood production. The 13,470-ha Coopracambra State Park lies in the north, abutting the Nungatta National Park in New South Wales. Some uncommitted land remains around Genoa and along the Cann valley.

The Mount Drummer Flora Reserve that Council recommended in 1977 was not accepted by the government, which retained the area as the Alfred National Park, of which some 1,020 ha occurs in this block. Other conservation reserves include three reference areas - Yambulla (380 ha) and Merragunegin (650 ha), within the Coopracambra State Park, and Jones Creek (430 ha) - and flora reserves at Mount Kaye (300 ha), Beehive Creek (200 ha), Jones Creek (80 ha), and Maramingo Creek (320 ha).

Freehold land, totalling some 10,500 ha, occurs mainly along the Cann valley north of Cann River, with some around Wangarabell and Genoa, as well as in several isolated parcels.

2. Climate

Summers are mild and winters are cool. It is estimated that mean monthly temperatures are below 10°C for 3 months each year. Average annual rainfall ranges from 900 to 1,000 mm along the Cann and Genoa valleys, with higher totals up to 1,250 mm west of the Cann River and in the area between Mount Kaye and Mount Drummer.

3. Geology and geomorphology

Ordovician sediments occur in broad areas between the extensive tracts of granite. Both Mount Merragunegin and Morris Peak consist of Ordovician bedrock.

Lower Devonian granites comprise the main basement and surface rock type in this block. They occur in wide bands, which include the Cann and Genoa valleys. These granites form several prominent peaks, including Mount Coopracambra, Mount Kaye, Mount Drummer, Maramingo Hill, and the Noorinbee Ridge.

Upper Devonian non-marine sediments, known as the 'red beds', occur in the upper reaches of the Genoa valley, west of Mount Merragunegin. Ancient fossil tetrapod footprints, found in these sediments beside the Genoa River, aroused great scientific interest. These are believed to be the oldest fossil records of a land-dwelling vertebrate.



Upper Devonian non-marine sediments outcropping in the Genoa River

Tertiary non-marine sediments occur as a shallow capping over bedrock, in areas between the Thurra River and Drummer Creek, and between the Wingan River and Genoa. The Princes Highway, marking the southern boundary of the block, is located on a semi-continuous strip of these Tertiary sediments.

Quaternary alluvial deposits occur along the larger rivers, in particular on the Cann River, and also on the Thurra, Wingan, and Genoa Rivers. Most of the freehold land is located on this material.

Broadly, the landscape consists of dissected hills with an elevation of 150--600 m. The valley bottoms of the Cann and Genoa Rivers are less than 150 m in elevation, however, while the peaks of Mounts Kaye and Coopracambra exceed 900 m.

Land on the Ordovician and Devonian sediments is strongly dissected, with rugged, steep slopes, narrow ridges, and incised stream systems. Where the Genoa River crosses the Devonian sediments it has cut a winding gorge, with discontinuous walls up to 20 m high.

The granitic country and areas with Tertiary sediments on the other hand are less strongly dissected, and are characterized by generally undulating to hilly terrain.

4. Soils

The hilly country mainly carries yellow-brown gradational soils, with red-brown gradational soils predominating in Werugua and Pinnak Land Systems. In addition, friable red and brown gradational soils occur above 850 m in Kowat Land System, and undifferentiated stony loams are found on the steepest, most exposed sites.

The soils of the stream flats, on Quaternary alluvium, are brown loams on the youngest terraces and yellowish brown gradational soils on older ones.

5. Vegetation

The most common community in Genoa--Noorinbee block is lowland sclerophyll forest, except in the north around the Genoa River, where dry sclerophyll forest predominates. Patches of wet sclerophyll forest occupy sheltered southerly aspects in the headwaters of the Wingan River, Cann River, and Jones Creek and on the south-eastern slopes of Mount Coopracambra and Mount Kaye. Coastal heathland communities occur on Maramingo Creek, Genoa Creek, Karlo Creek, the Wingan River, and two areas near the confluence of Jones Creek and the Genoa River.



*Dry
sclerophyll
forest*

Three main areas of warm temperate rainforest occur here: one lies within the Alfred National Park, another in the 'Tonghi Jungle' in the headwaters of Tonghi Creek, and the third - the largest stand in the State - in the headwaters of Jones Creek. This large stand is included in the Jones Creek Reference Area and was severely burnt in the 1983 wildfires, as was most of the block. Riparian forest is present along most of the larger streams.

A number of areas have particular floral values. The coastal heathland community in Maramingo Creek, protected in the Maramingo Flora Reserve, contains a relatively undisturbed swamp community boasting several rare species, including lanky fescue (*Festuca eriopoda*), scale-rush (*Lepyrodia anarthria*), tiny logania (*Logania pusilla*), bog clugmoss (*Lycopodium serpentinum*), sun-orchid (*Thelymitra cyanea*), and dwarf yellow-eye (*Xyris juncea*).

Coopracambra State Park, incorporating the upper reaches of the Genoa River and the spectacular Genoa River gorge, contains several rare species such as stunted she-oak (*Casuarina nana*), dwarf purple-flag (*Patersonia longifolia*), and

several species of *Pomaderris*, all of which are restricted to the upper Genoa River environs.

The area around Mount Kaye is also recognized as being botanically significant and supports a number of rare species. These include: Tasmanian wax-flower (*Eriostemon virgatus*) and club-rush (*Scirpus gunnii*), both of which are regarded as essentially Tasmanian species; a number of species more commonly found in New South Wales, including finger hakea (*Hakea dactyloides*); long-leaf bitter-pea (*Daviesia wyattiana*), dainty wedge-pea (*Gompholobium glabratum*), and slender mat-rush (*Lomandra confertifolia* ssp. *leptosachya*); and other rare plants such as long clubmoss (*Lycopodium varium*) and monkey mint-bush (*Prostanthera walteri*). Not all these species are present in the existing flora reserve and it is possible that the 1983 wildfires have resulted in a drastic reduction or even a loss of some of these plants. It may be that other sites in East Gippsland have suffered in a similar way as a result of the fires.

The forests around Waldron Mountain contain some particularly good examples of mature wet sclerophyll forest dominated by brown-barrel.

Several interesting eucalypts recorded here include stands of Gippsland grey box in lowland sclerophyll forest near Wangarabell and along the Cann valley north of Cann River, and blue-leaf box (*Eucalyptus agglomerata*) in dry sclerophyll forest in the northern sector.

6. Fauna

Faunal species present include a large number that have widespread distribution, such as the common wombat, long-nosed potoroo, sugar glider, chocolate wattled bat, crimson rosella, white-throated treecreeper, white-naped honeyeater, brown goshawk, water skink, red-bellied black snake, and eastern water dragon. In addition, a number of animals that are rare, or have specialized habitat requirements, have also been recorded. The rare masked owl has been sighted on a number of occasions in the lowland sclerophyll forests here, indicating that a localized population is present. The turquoise parrot, rare in Victoria, and only breeding regularly in north-eastern Victoria, is now known to breed in the Genoa area.

Warm temperate rainforest, present along sheltered moist gullies and creeks in the lowlands, is the only habitat in which the rare great barred frog has been recorded. This frog has been collected in only three Victorian localities, all of them within or close to the margins of this block.

Small areas of coastal heathland vegetation extend into the south-eastern sector, providing habitat for species such as the chestnut rumped hylacola, southern emu-wren, king quail, swamp rat, and southern brown bandicoot. The rare she-oak skink also occurs in this habitat, while the swamp skink, another notable reptile species, has been recorded in wet swampy heath and swampy drainage lines.

*She-oak skink*

The block is notable for the high diversity of bats recorded. A total of 14 species occur here, including common species such as the lesser long-eared bat, small forest epetescus, and chocolate wattled bat as well as rare ones like the large-footed myotis, eastern horseshoe-bat, and eastern broad-nosed bat.

The recent discovery of the common scaly-foot in dry rocky habitat beside the upper Genoa River is particularly noteworthy, as it is the first record of this legless lizard in eastern Victoria.

Wildfires throughout much of the block within the last 5 years have resulted in the destruction and consequent regeneration of the forest vegetation. The abundance of seed-eating birds such as the brown quail, painted button-quail, turquoise parrot, peaceful dove, and diamond firetail may be linked with the predominance of grasses in the regenerating vegetation. The introduced house mouse is abundant within the first 3 years of regeneration, and the occurrence of the white-footed dunnart in numerous localities may also reflect its utilization of post-fire regrowth vegetation.

B. Present Use and Capabilities

1. Nature conservation

Capability for nature conservation is high and many of the outstanding natural features are already included in existing conservation reserves. The Coopracambra State Park incorporates the geologically and geomorphologically significant Genoa River gorge as well as excellent examples of dry sclerophyll, wet sclerophyll, and riparian forests. Fossils of great scientific interest, including the footprints mentioned in Chapter 4, occur here. Several rare plants, and East Gippsland's first record of the legless lizard (common scaly-foot) also occur within the park. Other significant plant communities are contained in the Alfred National Park and the Mount Kaye, Jones Creek, and Maramingo Creek Flora Reserves. The Mount Kaye range - a significant landscape feature - contains several rare plant populations. Significant fauna habitats are associated with lowland sclerophyll forest, dry sclerophyll forest, and warm temperate rainforests.

2. Recreation

Although not heavily used for recreation at present, the block has relatively high capability, particularly in the upper Genoa River area, which is ideally suited to bushwalking and associated bush camping. Spectacular scenery, permanent water, a range of environments, and limited vehicular access are features that make the area suitable for these forms of recreation. The number of groups walking down the Genoa valley through the gorge is gradually increasing.

Although the Princes Highway passes through the centre of the Alfred National Park, few people are aware of the outstanding example of warm temperate rainforest occurring there. Its location on the main tourist route through the area makes this one of the most accessible areas of such rainforest in the region.

3. Agriculture and apiculture

Most parts of the block are generally too rugged and steep for agriculture. However, the more gentle slopes - particularly in the Genoa--Wangarabell area, along the Cann valley, and the Princes Highway - have a moderate to high capability.

In the Cann valley public land suitable for agriculture adjoins existing freehold land and substantial areas were made available for alienation in the Council's final recommendations for the area, published in 1977. Moderate temperatures, good rainfall, and proximity to extensively developed and productive freehold land indicate a high capability for agriculture in the south.

Forest grazing is an important activity here, particularly in the south where slopes are more gentle. Use of grazing leases is not intensive, but the ability to use public land for grazing in droughts and at other times when feed is in short supply offers considerable benefits to local graziers.



Agricultural land in the Cann valley

Capability for apiculture is moderate, the most important species being white stringybark, which is widespread throughout the lowland sclerophyll forest community, and red bloodwood, which in this block is restricted to the area around the Princes Highway near Genoa.

4. Timber production

Capability for timber production is high in the south, but is generally moderate in the north due to the more rugged terrain and the lower potential of the forests for sawlog production.

The most important species are silvertop, white stringybark, mountain grey gum, yellow stringybark, brown-barrel, and messmate stringybark. Proximity to sawmills at Cann River increases the value of this block for timber production.

5. Mining and quarrying

Economic mineral deposits found here so far are limited to a small goldfield near Mount Merragunegin. Currently uneconomic deposits of bismuth occur north of Mount Drummer, while molbydenum ore is present at Wangarabell.

Material suitable for road construction occurs in various areas, and the block contains several quarries that have been used in the past. Current extraction is carried out along roadsides.

6. Water production

This block has a moderate capability for water production, although the two main rivers, the Cann and Genoa, have much of their upper reaches outside the block.

An offtake on the Cann River, which supplies the township of Cann River, is located on this block, along with the lower part of its catchment. This has been proclaimed as a water supply catchment. A water supply may be required for Genoa in future, from either the Genoa River or Genoa Creek. The Cann River and Tonghi Creek provide water for irrigation use on freehold land adjacent to these streams.

7. Historical associations

The only aspect of known significance in the block is that the first grazing licence for a run in far East Gippsland was issued for the Wangarabell run, to John Stevenson in 1839.

8. Hazards and conflicts

A moderate to severe water erosion hazard applies on the steeper slopes. It is probably greatest in that part of the Genoa River valley on the Upper Devonian sediments, particularly on northern aspects where rainfall is relatively low, slopes are steep to very steep, soils are poorly structured, and ground cover is incomplete.

Slumping of road batters and table drain erosion occurs on granitic material, particularly on steeper country around Mount Coopracambra and Mount Kaye.

Fire is a serious hazard; over the 1982/83 summer, large wildfires burnt through most of this block and areas to the south, threatening Cann River and Genoa townships. The inaccessibility of some areas hampers control of wildfires, emphasizing the need for preventative measures.

Flooding is an occasional hazard in the Cann valley. Most of the agricultural land is low-lying, on the river floodplain, and stock must be moved to high ground during floods. This sometimes involves public land, as many graziers do not own sufficient elevated land for the purpose. Increased sediment loads in the Cann have reduced the carrying capacity of the stream, thereby exacerbating the flooding problem.

Flooding also affects the Genoa River, in the gorge tracts as well as the freehold land on the open flats.

Cinnamon fungus is likely to be a serious problem only on low-lying areas in the south. Many of the eucalypt and understorey species are susceptible.

Conflict may arise between timber production and aspects of nature conservation and recreation, although roading associated with timber production can improve access to forested areas and may thus benefit some forms of recreation.

4. WAIREWA--ORBOST--MURRUNGOWAR

A. Tenure and Nature of the Land

1. Present tenure

One of the few substantial areas of freehold land in East Gippsland is located in this block, around Orbost. Other freehold land here - in the Nowa Nowa--Wairewa, Lucas Point--Sandy Point, Murrungowar and Club Terrace areas and in several other parcels - totals some 21,000 ha.

In the 1977 final recommendations, about 1,400 ha were set aside for alienation for agriculture, adjacent to other freehold land and near Orbost. In addition, Council recommended that a contiguous area of some 3,500 ha (N2) be held for land exchange purposes, specifically for exchange with isolated plots of freehold land surrounded by public land. This recommendation amounted to a resettlement proposal for the owners of such plots, in order to reduce the costs of servicing outlying land, while at the same time, consolidating parcels of public land. To date, no exchanges have taken place.

Public land, totalling about 175,000 ha, is divided mainly between use for hardwood production and uncommitted land. Several areas have been set aside as conservation reserves. Some 3,300 ha in the north-western corner comprise the southern extremity of the Snowy River National Park. This incorporates the 600-ha Zig Zag Creek Reference Area. In the far east of the block, Council recommended in 1977 that a scenic reserve be set up along Euchre Creek. The government did not accept this recommendation, and retained the existing 1,166-ha Lind National Park.

The valley of the Brodribb River contains 'jungle' vegetation and some 2,800 ha of it have been reserved under section 50 of the *Forests Act* 1958. This protected area is shown on the public land use map as a flora reserve.

Other reserves include flora reserves in the Mottle Range and at Wood Point (120 ha and 40 ha respectively) and the Sardine Creek Education Area, of 200 ha.

2. Climate

Temperatures here are influenced both by distance from the sea and by altitude. In general, the block has a mild climate but is cooler in the north. Mean monthly temperatures would be expected to be less than 10°C for June, July, and August, and possibly longer in the north.

Average annual rainfall is 800--900 mm in the west and 900--1,000 mm in the Brodribb River catchment, and increases

steeply further east to more than 1,200 mm in the Arte and Goolengook River catchments.

3. Geology and geomorphology

This block has a very diverse geology. The major rock type found - Ordovician marine sediments - covers some 70% of the total area and forms the basement rock for much of the block. The Arte and Little Arte River catchments contain an outcrop of Ordovician metamorphic rock.

Four rock types from the Devonian period are represented. Upper Devonian non-marine sediments ('red beds') occur in a narrow band along the Bemm River. Middle Devonian extrusives - the Snowy River volcanics - occur in the west. Devonian granites and granodiorites are found in small areas at Murrungowar and south of Mount Ellery. Lower Devonian hornblende diorite occurs as small outcrops near the Snowy River at Sandy Point.

Non-marine Tertiary sediments are widespread in the south, from McKenzie River to the western boundary. Two small capings of Tertiary basalt overlie older sediments near the Bonang Highway in the north, and west of Club Terrace. Small areas of Quaternary alluvium occur in the Snowy River and Hospital Creek valleys.

The Ordovician sediments in particular develop a complex topography, with many deeply incised streams. Prominent peaks include Mount Pinnak, Mount Buck, Mount Sardine, and Mount Jack on Ordovician sediments, and Mount Murrungowar and Mount Kuark on the Ordovician metamorphic rocks.

Land forms are flat to undulating on the Quaternary and Tertiary sediments, but are steeply dissected and hilly to mountainous elsewhere.

4. Soils

The soils vary greatly, according to parent material, topography, climate, and elevation. Above 700 mm, the commonest are red and brown gradational soils, with undifferentiated stony loams on the steepest most exposed sites. At lower elevations, red-brown gradational soils predominate on the Ordovician parent material, and yellow-brown gradational soils are found on hilly to undulating land on granitic parent material. In the south, on the dissected Tertiary plain, friable yellow or red gradational soils are found in wetter areas, while red-brown or yellow-brown duplex soils occur on similar material in drier areas in the west. Small areas of leached sands also occur on the Tertiary material. The alluvial flats commonly carry brown or yellow-brown gradational soils.

5. Vegetation

Vegetation communities represented here include lowland sclerophyll forest (most commonly found in the southern sector), dry sclerophyll forest (widespread in the lower-

rainfall areas in the west but also present on the drier north-facing slopes throughout), and wet sclerophyll forest (more common to the east of the Bonang Highway). Warm temperate rainforest is well developed on the Bemm River and its tributaries, as well as Martins Creek and Cabbage Tree Creek. Small patches of box--ironbark woodland occur along the Bonang Highway north of Orbost, and a little further east on the dry ridges bordering the Brodribb River. Other small stands are located near Stringer Knob in the western part of the block.

Both silvertop and white stringybark are the dominant overstorey trees in lowland sclerophyll forest, although west of Orbost mountain grey gum and red ironbark are common also. On sandy soils yertchuk is also present.

Areas of dry sclerophyll forest contain silvertop, white stringybark, red stringybark, broad-leaf peppermint, and red box. A stand of spotted gum in the Mottle Range Flora Reserve is particularly interesting, as it is the only known occurrence of this species within Victoria, and is several hundred kilometres from the nearest New South Wales stand.



*Spotted gum,
Mottle Range
Flora Reserve*

Much of the wet sclerophyll forest in the block is dominated by brown-barrel, messmate, blue gum, and mountain grey gum.

The well-developed warm temperate rainforest along Martins Creek adjacent to the Bonang Highway is easily accessible, and this also applies on the Bemm River, both along the Com-bienbar road north of Club Terrace and where the Princes Highway crosses the Bemm. Stands along the Arte River contain a mixture of lilly pilly and southern sassafras as co-dominants in the overstorey. Isolated occurrences of warm temperate rainforest in sheltered gullies along the Snowy River north of Bete Bolong contain some rare species, including the only record of hazelwood (*Symplocos cochinchinensis*) in Victoria and yellow milk-vine (*Marsdenia flavescens*). Both species occur in the Wood Point Flora Reserve.

6. Fauna

Vertebrate fauna occurring in this block principally include species associated with wet sclerophyll, dry sclerophyll, riparian, and lowland sclerophyll forests. Warm temperate rainforest occurs in narrow strips along streams in the north, while other habitats present include riverine areas and wetlands.

Wet forests in the north, on sheltered southern slopes adjoining the Errinundra Plateau area, support species such as the rare sooty owl, large-billed scrub-wren, crescent honey-eater, pink robin, black-faced monarch, olive whistler, dusky antechinus, mountain brushtail possum, McCoy's skink, and Spencer's skink. The brown gerygone is present in rainforest gullies.

Drier forests at lower altitudes in the south of the block provide habitat for a wide range of forest-dependent mammals, birds, reptiles, and amphibians.

The most notable species is the long-footed potoroo, only recently described as a new species and regarded as endangered in Victoria. It is endemic to East Gippsland. To date, very few individuals of this species have been trapped or collected, but a high proportion of the records so far come from this block. Most long-footed potoroos have been captured along Bellbird Creek, on the southern edge, mainly in stringybark forests with a dense understorey of sclerophyllous shrubs and forest wire-grass.

Other significant or notable species recorded include the masked owl, grey goshawk, peregrine falcon, Latham's snipe, beautiful firetail, swamp skink, and tiger quoll.

B. Present Use and Capabilities

1. Nature conservation

The block contains a wide range of vegetation communities and most of it is forested public land. Capability for nature conservation is therefore high, except in the south around the freehold land in the vicinity of Orbost.

The Snowy River between Lucas Point and Bete Bolong is scenically attractive and also supports interesting stands of warm temperate rainforest, which contain the only Victorian occurrence of hazelwood and yellow milk-vine.

Well-developed warm temperate rainforests at Martins Creek, on the Brodribb River, and on the Arte River, are important for nature conservation. Lind National Park contains an area of lowland sclerophyll forest and warm temperate rainforest typical of the south-eastern part of the block.

The stand of spotted gum in the Mottle Range, occurrences of box--ironbark woodland north of Orbost, and the mealy-leaf stringybark woodland on Moresford Road south of Raymond Creek are also of interest.

2. Recreation

The major focus of recreation here is the Snowy River, which is very popular for canoeing and rafting. However, it receives less use below the junction of the Buchan River and Snowy River, where most canoeing or rafting trips terminate. The gorge above Lucas Point has impressive scenery and a high capability for bushwalking.

Good access to the southern end of the Snowy River National park is obtained from Orbost via the Yalmy Road.

A number of forest drives have been established in close proximity to Orbost and scenic driving and picnicking in the area is actively promoted. Popular destinations include Raymond Creek Falls, Young Creek Falls, the Mottle Range, and the historically significant Stringer Knob fire-tower. A nature drive and picnic area has also been established in the Lind National Park. In 1977, the Council recommended that a highway park be established where the Princes Highway crosses the McKenzie River, but it is yet to be developed.

The warm temperate rainforest along the Bemm and Brodribb Rivers adjoining the Princes Highway, and along Martins Creek adjacent to the Bonang Highway, are scenically attractive and enhance values for pleasure driving and picnicking. The network of forest roads throughout the block provides further opportunities for picnicking, sightseeing, and pleasure driving.

3. Agriculture and apiculture

Land in the Wooyoot and Waygara Land Systems in the south have moderate to high capability for agriculture because of moderate temperatures, adequate rainfall, reasonable soils, good access, and proximity to Orbost. The gentler slopes in parts of the Pinnak Land System also have moderate capability, as does land adjoining the smaller settlements of Club Terrace and Murrungowar.

Capability for forest grazing is moderate to high in most parts of the block, as is the value of the forests for apiculture, the most important species being white stringybark, red box, and red stringybark.

4. Timber production

The capability of the forests for sawlog production generally declines from being very high in the east to moderate to low in the west. The principal commercial species are messmate, mountain grey gum, silvertop, white stringybark, and yellow stringybark.

These forests have been used to supply sawlogs to sawmills at Cabbage Tree Creek, Orbost, and Waygara for many years and contain extensive areas of regrowth. The roading systems developed in association with log extraction have made them accessible, facilitating the protection of the regrowth and its management for future timber production.

5. Mining and quarrying

Minor deposits of several minerals have been discovered here. Goldfields were located at Cabbage Tree Creek, Club Terrace, and near the Goolengook River. Iron ore occurs near Mount Nowa Nowa, and copper ore at Raymond Creek and north of Mount Buck. Copper also occurs with manganese ore near Mount Tara and at Long Point. These deposits are not currently considered commercially exploitable.

Several quarries produce material suitable for road-making, and one is situated in a limestone deposit. An area of public land near Newmerella has been extensively quarried for road-making material.

6. Water production

Capability for surface water production is high in the east, along the middle reaches of the Bemm River, and in the central portion, where the Brodribb River catchment is located. Capability is low in the west, except for the Snowy River, which crosses the block.

Groundwater is available in the Tertiary deposits in the south-west.

Water supply for Orbost, Newmerella, and Marlo is provided from the Rocky and Brodribb Rivers. The Rocky River catchment has been proclaimed, and a land use determination has been made in order to protect the quality and quantity of water supply from this catchment.

7. Historical associations

Numerous features and sites of historical significance here cover a range of historical themes. They include a number of impressive road and rail timber-trestle bridges, such as those on the Orbost to Bairnsdale railway line, alluvial and reef gold workings at Club Terrace, and a number of sites associated with early forestry activities - for example, the Stringer Knob fire-tower, and the Young Creek sawmill site.



Remains of a steam engine wheel at the Young Creek sawmill site

8. Hazards and conflicts

Erosion hazard is moderate on the steeper slopes in the north, particularly on dry northerly and westerly aspects. Most existing erosion has occurred on unsurfaced or inadequately drained tracks. The greatest potential erosion hazard here exists on the long, steep slopes on Ordovician parent material in the north-east.

Fire hazard is high, particularly near settled areas around Orbost, Murrungowar, Cabbage Tree Creek, and Club Terrace, and in regrowth forests. A lower fire hazard exists in the wetter areas in the north-east.

Dieback from cinnamon fungus has occurred on wet sites in the south-west, but is unlikely to be a major problem elsewhere.

Flooding can be a serious problem on the Snowy River below Bete Bolong, and extensive areas of freehold land can be affected.

Conflict may arise between timber production and aspects of nature conservation and recreation, although roading associated with timber production can improve access to forested areas and may thus benefit some forms of recreation.

5. ERRINUNDRA--BENDOC

A. Tenure and Nature of the Land

1. Present tenure

Public land in the block totals about 132,000 ha; most of it has been set aside for hardwood production, although substantial areas of uncommitted land adjoin the large blocks of freehold property in the north around Bendoc.

The Errinundra Plateau contains conservation reserves of considerable biological significance: the Errinundra Flora Reserve (1,650 ha), Delegate River Flora Reserve (600 ha), Kanuka Creek Flora Reserve (200 ha), and a scenic reserve at Mount Ellery (1,400 ha).

Other conservation reserves in the block include two reference areas, Big River (370 ha) and Musket Creek (450 ha), an education area at Bidwell Creek (300 ha), The Gap Scenic Reserve (along the Bendoc--Bonang road), the Mount Delegate Scenic Reserve, and a bushland reserve at Mount Bendoc.

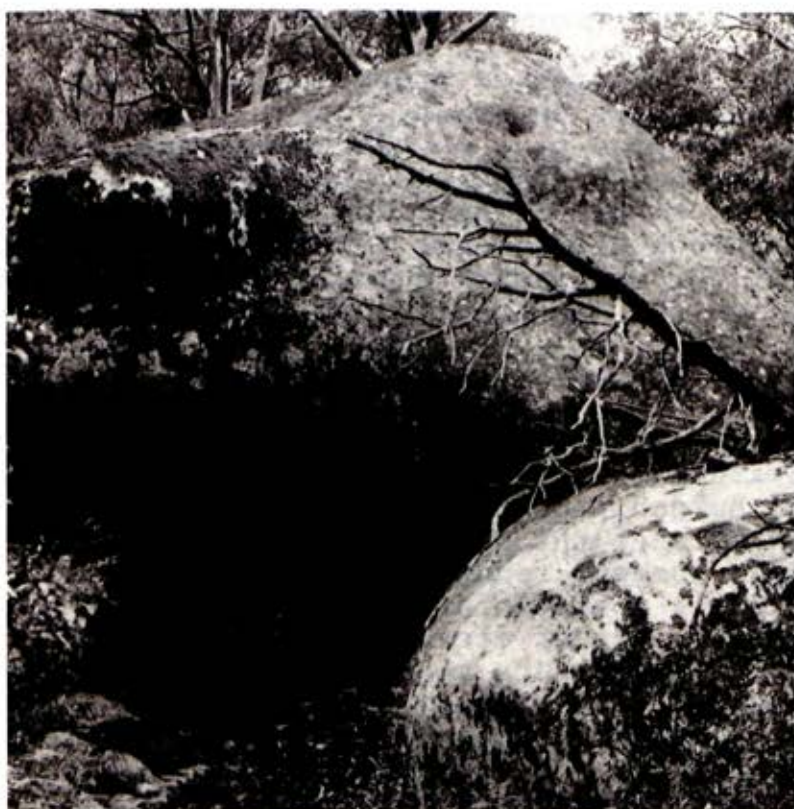
An area of 2,900 ha in the headwaters of the Goolengook River contains appreciable quantities of mature timber and also has high nature conservation values. The Council recommended in 1977 that this area be withheld from logging or new roading, other than that required for fire protection, until a subsequent review of public land in East Gippsland.

2. Climate

Summers are mild, but winters are cold. Snow commonly falls in winter on the tablelands around Bendoc and on the Errinundra Plateau, and may also occur in the southern portion of



Montane sclerophyll woodland, Delegate River Flora Reserve



*Granite tors near
the summit of
Mount Ellery*

the block, although less frequently. Frosts may occur at any time of the year on the tablelands and can be severe.

Rainfall is only about 750 mm in the north, but increases rapidly towards the south. For example, at Goongerah and Buldah it reaches 1,000 mm, and on sheltered southerly aspects at high elevations may exceed 2,000 mm.

3. Geology and geomorphology

Ordovician sedimentary rocks underlie most of this country, although outcrops of younger granitic rocks occur around Mount Ellery, Goongerah, Goonmirk Rocks, west of Bonang and Bendoc, and along the Cann Valley in the east.

Upper Devonian non-marine sediments are preserved in two down-faulted blocks around Combiénbar and Buldah. An outlier of Snowy River volcanics is also preserved in a down-thrown block near the confluence of the Errinundra and Combiénbar Rivers.

The northern part comprises the elevated plateaux that form the southern extension of the Monaro Tablelands. The country is gently undulating but rises gradually towards the south. The southern part is dominated by rugged mountainous terrain on the southern edge of the tablelands. A number of intermontane basins have developed as a result of differential erosion. Examples occur at Buldah and Combiénbar. The valley of the Brodribb River at Goongerah follows the alignment of a major wrench fault, and this is probably due to the fact that the bedrock has been crushed and sheared close to the fault and is therefore less resistant to erosion than the surrounding rocks.

4. Soils

Most of the soils are friable red or brown gradationals, although stony loams predominate on steep, rocky, and exposed sites. Some of the sub-alpine bogs on the tablelands contain areas of peat. At lower elevations, reddish-brown gradational soils occur on the Weeragua and Koola Land Systems, while yellowish-brown gradational soils predominate on the Kowat Land System. Brown loams are indicative of Recent alluvium.

5. Vegetation

The most common community here is wet sclerophyll forest, although substantial areas of dry sclerophyll forest occur around Combiobar and Buldah, Goongerah, and Bendoc, and on the drier north-facing slopes throughout the block. Montane sclerophyll woodland is common around the margins of freehold land at Bendoc, while montane forest dominated by alpine ash is scattered at higher elevations. An interesting zonation of communities occurs along the Delegate River near Bendoc. Alpine wet heathland growing along the stream margins is fringed by snow gum woodland and montane sclerophyll woodland. Cool temperate rainforest, common on the Errinundra Plateau, also occurs along most streams flowing off the plateau, both to the north and south. Its largest stand is found on the Coast Range, within the Errinundra Flora Reserve. Warm temperate rainforest occurs along the upper reaches of the Combiobar River and Bemm River.

On the eastern slopes of Mount Ellery, species typical of warm temperate and cool temperate rainforest occur together. Some of the cool temperate stands on the Errinundra Plateau are very old, as evidenced by the size and age of many of the rainforest trees. At Goonmirk Rocks, individuals of mountain plum-pine are more than 10 m high and are probably about 500 years old. This species normally grows to about 1.5 m in height.



Wet sclerophyll forest, Bonang River

A number of rare plants recorded in the block include Japanese lady-fern (*Athyrium japonicum*) and bent grass (*Deyeuxia microseta*) at Combienbar, monkey mint-bush on Mount Ellery, and rare-veined sun-orchid (*Thelymitra cyanea*), sun-orchid (*T. resecta*), and saw-sedge (*Gahnia subaequiglumis*) in areas of alpine wet heathland.

6. Fauna

Faunal species are predominantly those taxa associated with a variety of wet sclerophyll forest types, montane forests, and both cool temperate and warm temperate rainforest. Wet sclerophyll forests contain species such as the dusky antechinus, greater glider, yellow-bellied glider, great pipistrelle, swamp wallaby, eastern whipbird, superb lyrebird, crescent honeyeater, rose robin, McCoy's skink, and Coventry's skink. At least six species of arboreal marsupials live in the wet sclerophyll forests, most of which are relatively common in this habitat.

A number of uncommon or rare birds utilize the wet forest environment. The large-billed scrubwren, pink robin, and Lewin's honeyeater favour wet gullies, cool temperate rainforests, and forests with wet rainforest understorey. The Errinundra Plateau is one of the few areas of Victoria where the pink robin is frequently observed. The rare sooty owl occupies the wet forest environments, particularly in riparian forests along streams and gullies. This species and other wet sclerophyll forest inhabitants - such as the red-browed treecreeper, powerful owl, southern boobook, yellow-bellied glider, and mountain brushtail possum - are sensitive to the loss of mature trees containing hollows, which they require as nest or den sites.

At lower altitudes on southern slopes, warm temperate rainforest and moist riparian forests are present along streams such as the Errinundra River and Combienbar River. These vegetation communities form the primary habitat for the brown gerygone and the black-faced monarch, both regarded as notable in East Gippsland, as this region forms the bulk of their Victorian distribution. The black-faced monarch migrates northwards during the winter.

Bats are well represented in this block (at least 11 species recorded) and include the cave-dwelling species, the eastern horseshoe-bat, and common bent-wing bat. The rare long-footed potoroo has been captured in the Ellery forest in the south-western corner.

B. Present Use and Capabilities

1. Nature conservation

Capability for nature conservation is high. Most of the block is forested and includes a range of environments from warm temperate rainforest to sub-alpine heath. The remaining public land adjoining the large area of freehold at Bendoc is particularly significant, being virtually the only remnant of the Monaro Tablelands environments left in

Victoria. The occurrences of mountain plum-pine on the Gunmark Range, the cool temperate rainforest stands, areas of mature shining gum, and examples of 'mixed forest' on the Errinundra Plateau have great scientific and scenic value. Mountain ash reaches the eastern limit of its range in this block. The areas of cool temperate rainforest differ from others in the State in that southern sassafras and black olive-berry dominate. Elsewhere in Victoria, cool temperate rainforests are dominated by myrtle beech, with southern sassafras as a subdominant canopy species. The plateau probably supports the oldest examples in the State, evidenced by the occurrence of veteran individuals of a number of species commonly associated with rainforest or wet sclerophyll forest, including mountain plum-pine, privet mock-olive, and forest geebung.

Several of the catchments are of note, being among the few in Victoria remaining relatively undisturbed by humans. They are of particular scientific and conservation value for studies of the riverine faunal communities, especially fish and invertebrate species.

Mount Ellery has a high capability for nature conservation because of its range of habitats and the mixture of cool temperate and warm temperate rainforest elements.

The northern sector has significant landscape values. The southern escarpment of the plateau affords magnificent views of the deep forested valleys of the Brodribb and Errinundra River. A number of picturesque waterfalls and rocky cascades occur on the Errinundra River and Queensborough River tributaries. The cool temperate rainforest surrounding many of these adds greatly to their aesthetic value. Mount Ellery is a prominent peak from which extensive views can be obtained.



Cool temperate rainforest, Errinundra Plateau

A number of sightings of the rare long-footed potoroo have been made in this block, which may therefore be very important for the protection of this species.

2. Recreation

Capability for recreation in this block is moderate. The area is not extensively used, but bushwalking, nature study, pleasure driving, and fishing are the most popular pursuits. Improved access and provision of facilities would increase the value for recreation, particularly in the montane and plateau forests, which have outstanding scenic qualities.

3. Agriculture and apiculture

The Kirkenong Land System and the more gently sloping parts of the Errinundra Land System have moderate potential for agriculture. The fertile soils, reasonable rainfall, and proximity to freehold land enhance grazing value, but winters are cold, severely reducing pasture growth. The remainder of the block is generally too steep for agriculture.

Capability for forest grazing is limited by dense understorey and steepness over much of the block, although some areas have moderate capability.

Capability for apiculture is generally low, but is moderate where white stringybark, red stringybark, and red box occur.

4. Timber production

Extensive stands of high- to very high-quality timber are capable of supplying wood suitable for most purposes. Many of the forests have not been harvested and they are therefore potentially important to the supply of mature sawlogs for mills in Bendoc, Orbost, and Club Terrace.

The main timber-producing species are brown-barrel, alpine ash, shining gum, mountain grey gum, and messmate.



Shining gum sawlogs, Errinundra Plateau

Wet conditions restrict access to the elevated parts during winter.

5. Mining and quarrying

The first and most important discoveries of gold within the study area were made around Bendoc, and the goldfields were worked until the early 1950s. A number of Miners' Right claims have recently been pegged at Goongerah, and other mining tenements are scattered throughout the block. Bismuth and tungsten ores occur near Mount Bendoc, but the deposits are not currently economic.

Other minerals found here include baryte, limestone, platinum, lead, and silver, none of which occur in commercial quantities.

Quarries for road-making materials have been excavated, and further quarries for new roading may be needed in the future.

6. Water production

The block has a high capability for water production as it includes substantial areas that receive the highest rainfall of any land in the study area. While streams flowing north generally have small catchments, the south-flowing streams are usually larger. These include the headwaters of the Bemm River and most of the upper catchments of the Brodribb and Cann Rivers. The block includes part of the Cann River catchment, which has been proclaimed as a water supply catchment. In the future, a water supply may be required for Bendoc, and for use in irrigation on the tablelands.

7. Historical associations

Numerous sites associated with gold-mining occur in the Bendoc area, the most important of which is the site and relics associated with the Victoria Star Mine, and reef mining in the Clarkeville area.

Other features of significance include the Gippsland Boulder Creek Mine on Bola Creek north of Club Terrace, and the Stagg and Olsen Baby Endeavour Reef Gold Mine on Little Tiger Snake Creek, just north of Combiobar.

8. Hazards and conflicts

Erosion is mainly limited to a little sheet erosion and track rilling with resultant stream turbidity, particularly on steeper slopes. The long, steep, wet slopes of the Bullamalk and Wat Wat Land Systems are potentially the most hazardous.

Fire is a hazard in the drier parts and poses a threat to the settled areas of Combiobar, Buldah, and the Cann Valley. However, the wet forests rarely become sufficiently dry to create a fire hazard.

Dingoes and wild dogs sometimes attack sheep in the Tubbut--Bendoc district.



Wind damage to alpine ash regrowth

Conflict may arise between timber production and aspects of nature conservation and recreation, although roading associated with timber production can improve access to forested areas and may thus benefit some forms of recreation.

6. TINGARINGY--RODGER

A. Tenure and Nature of the Land

1. Present tenure

Two of the three national parks in East Gippsland established following the 1977 final recommendations (Tingaringy National Park and the Snowy River National Park), are located here. The block also contains the Rodger and Yalmy River catchments, which have significant timber production value, along with some 46,000 ha of uncommitted land. The public land totals about 145,000 ha.

The Tingaringy National Park, of 17,600 ha, follows the northern (New South Wales border) and western (Snowy River) boundaries of the block. It abuts the Kosciusko National Park to the north. Council's final recommendations for the Alpine area, published in 1983, provided for the establishment of a single Alpine park incorporating both the Tingaringy and Snowy River National Parks and other areas further west, some of which are yet to be proclaimed.



The northern face of Mount Tingaringy

Also on the Snowy River, but further south, lies the 25,600-ha Snowy River National Park, most of which is in this block. This adjoins complementary parks recommended in both the Alpine and Gippsland Lakes Hinterland areas, producing a total Snowy River National Park of 43,550 ha. The two adjacent sections have not yet been proclaimed.

Other conservation reserves include the following reference areas: Gattamurh Creek (400 ha) incorporated within Tingaringy National Park; Gelantipy Plateau (550 ha); Mountain Creek (1,400 ha); and Concordia Gully (760 ha).

About 53,000 ha set aside for hardwood production in the 1977 final recommendations included the Rodger and Yalmy forest blocks.

In accordance with the procedure for new areas being opened up for logging (see page ..), pre-logging flora and fauna surveys were carried out in early 1983, and the reports of these studies were published with the Rodger block sawlog-harvesting proposal in July 1983. Timber harvesting was to have commenced in the Rodger block in the 1983/84 summer; however, as a result of the flora and fauna surveys, the government placed a moratorium on logging here until the end of 1985.

A similar procedure, involving pre-logging surveys, has been followed for part of the Yalmy block and the Ellery block, which were also 'new areas'.

Within the uncommitted land, Council specified in the 1977 final recommendations that certain special features be protected, including the Gelantipy Plateau--Bowen Range area, of 23,000 ha. Council recommended that 'the whole of the land in this area be withheld from logging or new roading, other than that required for fire protection, until reviewed by the Council. This area contains appreciable quantities of mature timber and also has high recreation and nature conservation values.'

2. Climate

The block has mild summers and cool winters. It is estimated that May to September have mean temperatures below 10°C, and snow lies on the higher ground occasionally in the north of the block. Annual average rainfall ranges from less than 700 mm in the Snowy River--Deddick River rain-shadow to more than 1,200 mm in the elevated areas.

3. Geology and geomorphology

Ordovician marine sediments are the most extensive rock type. Lower Devonian granites are also extensive. In the south-east Upper Devonian granites outcrop as well as a small area of Lower Devonian hornblende diorite that occurs near Mount Taylor.

Exposures of Snowy River volcanics (of mid--Lower Devonian age), occur in down-faulted blocks in the west, and a small capping of Tertiary (Oligocene) basalt is found near Bonang.

Much of the land on the Ordovician sediments slopes steeply, with high ridges and peaks forming a complex pattern. Mount Tingaringy (1,448 m) - the highest mountain in the East Gippsland study area - is bounded by extensive cliffs on the west.

Land on the granitic rocks tends also to be steep, but is generally less strongly dissected. The Dellicknora valley in the north-east is also granitic, but slopes more gently.

Land is noticeably less steep and dissected on the Snowy River volcanics than on the other rock types, except where the Snowy River has cut a deep gorge, producing very steep, and often cliffed, sides.

4. Soils

Friable red or brown gradational soils, often shallow and stony are the most common. On steep exposed sites, undifferentiated stony loams are found. Brown gravelly loams occur on steep colluvium, particularly along the Snowy River.

At higher altitudes, deeper friable red and brown gradational soils predominate.

In the freehold areas along the Deddick River, yellow-brown duplex soils are common, reflecting the lower rainfall in that part of the block.

5. Vegetation

Dry sclerophyll forest occupies a large proportion of the block, with significant areas of wet sclerophyll forest in the Rodger and Yalmy catchments, in the Bowen Range, and on the margins of the Gelantipy Plateau. Patches of montane forest dominated by alpine ash occur around Mount Tingaringy, Mount Bowen, and the headwaters of the Rodger River, and on the Gelantipy Plateau. Rainshadow woodland predominates in the Deddick and upper Snowy River valleys. Isolated occurrences of cool temperate rainforest are found in the Rodger catchment and on the southern slopes of the Gelantipy Plateau. Montane sclerophyll woodland is commonly found on drier slopes bordering more sheltered sites, which support montane forest: examples occur at Mount Tingaringy and in the Bowen Range. Small, but significant stands of rocky outcrop open scrubland occur on the dry slopes into New Country Creek and the Deddick River. Snow gum woodland grows on the summits of Mount Tingaringy and Mount Bowen.



Dry sclerophyll forest containing blue gum on the Gelantipy Plateau

Impressive riparian forests border the Rodger, Yalmy, and Snowy Rivers.

Stands of mountain ash are largely confined to wet sclerophyll forest in the Rodger catchment. They have particular significance, given their maturity and multi-aged structure.

The dry sclerophyll forests north of the plateau contain blue gum, in association with the eucalypts common in this community. Blue gum is usually confined to much wetter environments than those on the dry north-facing slopes.

A number of rare plants have been recorded in the block, including spinning gum on the summits of Mount Bowen and Mount Tower, Tingaringy gum on the summit of Mount Tingaringy, and monkey mint-bush in montane forest on the slopes of Monkey Top.

6. Fauna

The wide range of vegetation communities present - from rainshadow woodland and scrub on rocky outcrops in the north to tall wet sclerophyll forests in the Rodger River catchment - provide habitat for a variety of fauna. Dry woodland vegetation is utilized by species such as the common brushtail possum, eastern grey kangaroo, Gould's wattled bat, buff-rumped thornbill, fuscous honeyeater, olive-backed oriole, tree dragon, and red-throated skink. Three lizards, the copper-tailed skink, Cunningham's skink, and red-throated skink, occur here at the eastern limit of their distribution in Victoria. Rainshadow woodland in the upper Snowy River area is particularly important for the tiger quoll. It is one of the few localities in Victoria where this rare carnivorous marsupial is consistently reported, and provides one of the most suitable localities to study this threatened animal.

The brush-tailed rock-wallaby, formerly common in East Gippsland, but now rare and endangered in Victoria follow-

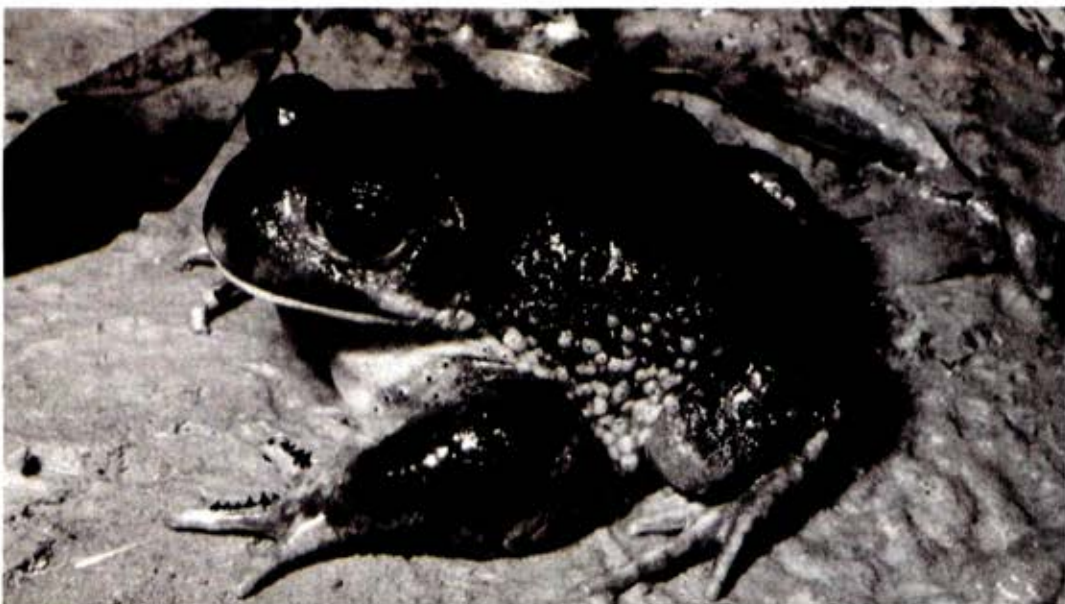


*Tingaringy
gum*

ing a drastic decline early this century, is believed to be still present in the Snowy River gorge area, where it utilizes the inaccessible rocky outcrops and cliffs. Another macropod, the common wallaroo, is common elsewhere in Australia but rare in Victoria, where it is known only in the upper Snowy River area.

With increasing rainfall in the south, the rainshadow woodlands give way to dry sclerophyll forests, montane woodlands, and alpine heaths at higher altitudes, and a variety of wet sclerophyll forest sub-communities. Many faunal species are widespread throughout these forest communities; these include the common wombat, brown antechinus, bush rat, little forest eptesicus, yellow-faced honeyeater, striated thornbill, eastern yellow robin, golden whistler, and garden skink. However, each habitat also contains species characteristically associated with it. Alpine heathland and snow gum woodland at the higher altitudes support fewer vertebrate species than most other vegetation types, probably due to the harsher climatic conditions. The alpine copperhead and water skink (cool temperate form) are characteristic inhabitants, while other species such as the flame robin, pied currawong, and white-eared honeyeater make seasonal migrations to these higher-altitude habitats.

Dry sclerophyll forest vegetation on slopes and ridges is utilized by many forest species, but characteristic species include the white-footed dunnart, eastern pygmy-possum, rufous whistler, cicada-bird, spotted quail-thrush, tree goanna, and red-bellied black snake. Typical inhabitants of wet sclerophyll forests, such as those around Rodger River and Yalmy River, include the mountain brushtail possum, yellow-bellied glider, King River eptesicus, satin bowerbird, rose robin, sooty owl, large-billed scrubwren, olive whistler, Jervis Bay tree frog, and Spencer's skink. Significant species recorded in the Rodger catchment include two rare animals, the tiger quoll and long-footed potoroo.



The giant burrowing frog is a rare amphibian recorded from this block

B. Present Use and Capabilities

1. Nature conservation

Capability for nature conservation is high, because of the diversity of vegetation and habitats and the essentially undisturbed nature of much of the land. The rugged terrain has restricted access to the more remote areas, and timber harvesting has been limited to the margins of the block.

Spectacular scenery is a feature, particularly along the Snowy River with its rocky cliffs and deep gorges. This area also has great geological and geomorphological significance. Outstanding views can be obtained from the summit of Mount Tingaringy and from various points in the Bowen Range.

The mature forests on the Gelantipy Plateau and in the Rodger River catchment have significant nature conservation values and are scenically very attractive, and those of the Rodger River are known to support populations of the rare tiger quoll and long-footed potoroo.

The Snowy River area is important for the conservation of a number of rare animals, including the brush-tailed rock-wallaby, common wallaroo, and tiger quoll.

2. Recreation

Capability for wilderness-based recreation and bushwalking is high in parts of the Tingaringy and Snowy River National Parks and Gelantipy--Bowen Range area. Part of the Tingaringy Park has been zoned as wilderness, to complement the Byadbo wilderness within the Kosciusko National Park in New South Wales.

The Snowy River also has a high capability for canoeing and rafting but a generally low one for most other forms of recreation because of poor access, although some of the forest tracks would be suitable for recreational four-wheel driving.

Basic camping facilities have been established at MacKillop Bridge in the northern part of the Snowy River National Park. This area has good access along the Deddick River valley or via Buchan, and it is a popular starting point for canoeing trips down the Snowy.

3. Agriculture and apiculture

Most of the agricultural land occurs on the Tubbut, Jingallala, and Cabanandra Land Systems. Gentler slopes within these land systems have moderate potential for agriculture, mainly for sheep and cattle grazing. Elsewhere, capability is low because of steepness.

The Errinundra Land System has good soils and rainfall, but restricted access, severe winters, and high clearing costs reduce its capability.



The affect of grazing on understorey vegetation in rainshadow woodland

Capability for forest grazing varies widely throughout, but is usually only moderate.

Capability for apiculture is moderate where red stringybark, white box, or red box occur, but poor access in most of the block is a limiting factor.

4. Timber production

Except for the area to the north of the Deddick River, most of this block contains extensive timber stands with high to very high production values. These are estimated to contain about 20% of the remaining mature sawlog resource within the study area. This resource is concentrated mainly on the Gelantipy Plateau (south of Mount Sugarloaf) and in the catchments of the Rodger and Yalmy Rivers.

Limited sawlog procurement has been carried out in the past, but its location makes the timber resource important for the sawmilling industry based in Nowa Nowa and Orbost.

The major species are alpine ash, brown-barrel, mountain ash, messmate, and mountain grey gum.

5. Mining and quarrying

Mineralized zones bearing silver, lead, zinc, and copper occur near Mount Deddick, around Accommodation Creek (south of Tubbut), and in the Snowy River gorge near Campbell Knob. Mining of these deposits has produced commercial quantities of ore, and further exploration may increase the known reserves. Recent exploration activity has centred on the Snowy River volcanics.

A non-commercial deposit of thorium ore (monazite) has been identified near Dellicknora.

Gold has been found south-west of Cabanandra, and between Dellicknora and Mount Tingaringy.

Material suitable for road-making occurs at several sites.

6. Water production

The centre and south of the block receive high rainfall, and run-off from most of the catchments in the area - such as those of the Rodger, Yalmy, and Deddick Rivers and Mountain Creek - flows into the Snowy River.

In the rainshadow area in the north, run-off is necessarily limited, and the capability for harvesting water here is low.

7. Historical associations

Evidence of early gold-mining activity occurs around Bonang, both on public land and freehold land. The Rising Sun Gold Mine was probably the most important mine in the district and the second-highest-yielding reef in the region, having produced 5,337 ounces. Another small goldfield is located at Cabanandra.

Relics of a silver--lead mining area occur on the Snowy River south of MacKillop Bridge and at the junction of Accommodation Creek and Hell Hole Creek south of Deddick.

The crossing at MacKillop Bridge has historical associations, in that it dates back to the early exploration and settlement of the area in the 1840s.

8. Hazards and conflicts

Erosion hazard is moderate over most of this block, and severe on dry westerly and northerly aspects. In the



Alpine ash, Gelantipy Plateau

rainshadow area it is potentially serious, as slopes are generally steep and the low rainfall inhibits revegetation.

Fire is a serious hazard. Lightning strikes occur frequently in the drier northern and western parts, and the rugged terrain and limited access reduce the effectiveness of fire-fighting efforts. In these areas fires can quickly reach a large size, and threaten settled areas - in the Tubbut and Bonang valleys, for example; they can also threaten other values on public land such as important stands of timber.

Use of the block for timber production or mining may conflict with nature conservation and wilderness-based recreation, but improved access may enhance capability for other land uses such as apiculture and some forms of recreation.

APPENDICES

LIST OF APPENDICES TO PART I

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Appendix I

SITES OF NATIONAL AND STATE GEOLOGICAL AND GEOMORPHOLOGICAL SIGNIFICANCE

Map sheet and name of site	Significance	Land tenure	Comment
Murrindal Sheet			
Campbell Knob/Tulloch Ard gorge	National	Snowy River National Park	Variation in river valley morphology resulting from different lithologies exposed along the course of the Snowy River
Snowy River gorge	National	Snowy River National Park	Exposures of Snowy River volcanics and Buchan limestones in the gorge, together with cave systems in the limestone
Murrungowar Sheet			
Dock Inlet	State	Uncommitted	Excellent example of a fresh-water lagoon displaying many geomorphological features
Cape Conran	State	Coastal Reserve	The contact between the granitic and sedimentary rocks is one of the best, and most accessible, igneous contacts along the East Gippsland coast
Marlo Plains	State	Uncommitted	Contributes a great deal to the understanding of Pleistocene environments in southern Victoria; it is the least disturbed area of such terrain in eastern Victoria

Appendix I (continued...)

Snowy River entrance	State	Coastal Reserve	A major opportunity to study short-term changes associated with floods and longer-term patterns of entrance migration and sedimentation
Cann Sheet			
Lake Elusive	State	Croajingolong National Park	The deepest dune-blocked coastal lake in Victoria
Wingan Inlet	State	Croajingolong National Park	A classic estuary, essentially unmodified; constitutes a major site for research and teaching on estuarine geomorphology and hydrology
Point Hicks and the Thurra River	State	Croajingolong National Park (portion only)	Provides an excellent opportunity for the study of past and present processes of dune development
Tamboon Inlet	State	Croajingolong National Park	One of the largest and relatively unmodified inlets in East Gippsland; a major site for estuarine hydrology and geomorphology
Sydenham Inlet	State	Coastal Reserve	Contains some significant geomorphological features, notably active and abandoned river deltas, extensive wetlands, and tidal channels

Appendix I (continued...)

Map sheet and name of site	Significance	Land tenure	Comment
Mallacoota Sheet			
Iron Prince Reef-- Cape Howe	State	Croajingolong National Park	Outcrops of sedimentary rock are the only exposures of Merimbula Group on the Victorian coast; the sand dunes constitute major examples of an active transverse ridge sequence undergoing rapid change
Lake Wau Wauka	State	Croajingolong National Park	A rare example of a stream blocked by coastal dunes to form a lake with subsequent shallowing and swamp encroachment
Telegraph Point	National	Croajingolong National Park	One of the largest sandy forelands in south-eastern Australia; displays a variety of aeolian accumulation forms
Howe Flat--Lake Barracoota	State	Croajingolong National Park	A large continuous coastal wetland with a complex geomorphological history related to Mallacoota Inlet
Tidal delta--Mallacoota Inlet	State	Croajingolong National Park	The largest estuarine tidal delta on the Victorian coast, the stratigraphy of which contrasts with similar features in New South Wales

Appendix I (continued...)

Bastion Point to Little Rame Head	State	Croajingolong National Park	The most extensive coastal exposure of Palaeozoic sedimentary rocks in Victoria, providing opportunities to study depositional and deformational history of the rocks and coastal land forms in the area
Sandpatch Point	State	Croajingolong National Park	The site displays a clear contact zone between granite and sedimentary rocks and the development of different shoreline morphology on the two rock types; the point is also capped by dunes, most of which are stabilized by vegetation

Appendix II

VEGETATION SPECIES OF SIGNIFICANCE

* Coding according to Leigh, Briggs, and Hartley (1981):

- 2 - maximum species range < 100 km
 3 - species range > 100 km, but small populations restricted to highly specific habitats
 E - endangered
 V - vulnerable
 R - rare
 K - poorly known species, distribution uncertain
 C - species represented within a national park or other proclaimed reserve

** Codes relating to reserve categories

- EGSA - East Gippsland Study Area
 NP - National Park
 SP - State Park
 FR - Flora Reserve
 RA - Reference Area
 SR - Scenic Reserve
 WR - Wildlife Reserve

LIST 1: Rare, endangered, or possibly extinct species

Species	Common name	Family	Code*	Reserves	Notes**
<i>Acacia maidenii</i>	Maiden's wattle	Mimosaceae		none	Small tree with isolated southern occurrences on sand near Orbost.
<i>Acacia subtilinervis</i>	Wattle	"	3V	1 A3	A shrub known in Victoria only in the Snowy River Gorge area.
<i>Athyrium japonicum</i>	Japanese lady-fern	Athyriaceae			Rare ground fern known in alluvial jungle flats: Upper Combiobar River
<i>Cryptostylis hunteriana</i>	Leafless tongue-orchid	Orchidaceae	3EC	1 A1	Confined to damp heathland in East Gippsland in the vicinity of Marlo, Cape Conran, Bellbird Creek, and near Cann River.
<i>Degeuxia microseta</i>	Bent grass	Gramineae	3V	none	The only Victorian collection of this grass is from Combiobar.
<i>Discaria pubescens</i>	Australian anchor plant	Rhamnaceae	3VC	none	Generally leafless spiny shrub with doubtful records in the Bendoc-Delegate districts.
<i>Dodonaea rhombifolia</i>	Broad-leaf hopbush	Sapindaceae	3RC	1 A3	Shrub collected from the Snowy River gorge area.
<i>Eucalyptus kybeanensis</i>	Ash mallee	Myrtaceae	3RC	1 A2	Thin-stemmed shrub of sub-alpine rocky ridges, found near Mt Tingaringy summit.
<i>Eucalyptus saxatilis</i>	Suggan Buggan mallee	"	3R	1 A2	Mallee-like tree described in 1977: endemic in the upper Snowy River rain-shadow area.
<i>Eucryphia moorei</i>	Eastern leatherwood	Eucryphiaceae	3VC	1 A1	Rainforest tree of far eastern areas, in the vicinity of Howe Range.
<i>Hibbertia spathulata</i>	Rock guinea-flower	Dilleniaceae	2RC	2 A3 B3	Shrub localized to and endemic in the Snowy River gorge area and recorded in the Mountain Creek reference area.
<i>Isopogon prostratus</i>	Prostrate cone-bush	Proteaceae	3VC	1 A1	Trailing shrub with sporadic southern-most occurrences including Howe Hill region.

<i>Leucopogon riparius</i>	River beard-heath	Epacridaceae	2RC	1 A3	Shrub of granite rocks along Snowy River downstream of Buchan River junction, where endemic.
<i>Olearia allenderae</i>	Promontory daisy-bush	Compositae	3RC	1 A1	Known along Cicada Trail between Mueller and Wingan Rivers, and on Wilson's Promontory.
<i>Persoonia myrtilloides</i>	Myrtle geebung	Proteaceae		1 A4	Small tree known in Victoria only on sandstone on upper Genoa River.
<i>Pomaderris cotoneaster</i>	Cotoneaster pomaderris	Rhamnaceae	3V	1 A4	Very rare shrub of upper Genoa River.
<i>Pomaderris sericea</i>	Bent pomaderris	"	3V	1 A4	Silky-leaved shrub with apetalous flowers collected from upper Genoa River.
<i>Frasophyllum appendiculatum</i>	Eastern leek orchid	Orchidaceae	2KC	1 A1	On damp sandy ground in far east of the study area, Tonghi Plain, and Genoa Creek.
<i>Prostanthera walteri</i>	Monkey mint-bush	Labiatae	2R	2 F7 M4	Stout sub-alpine shrub from Mts Ellery and Kaye, and the Monkey Top area.
<i>Pterostylis alveata</i>	Jug greenhood	Orchidaceae		none	On black coastal sand among bracken in stringybark forest near Genoa.
<i>Scirpus forsythii</i>	Club rush	Cyperaceae		none	On wet soil among granite rocks along Genoa River about 5 km upstream from Genoa.
<i>Scirpus gunnii</i>	Club rush	"		1 F7	Known only on Mt Kaye in the study area, otherwise on Bogong High Plains and Tasmania.
<i>Solanum violaceum</i>	Violet nightshade	Solanaceae			Medium to tall shrub of warm temperate rainforest around Mt Drummer.
<i>Spyridium cinereum</i>	Tiny spyridium	Rhamnaceae	3RC	1 A1	Endemic tridentate-leaved shrub known only in coastal heaths near Mallecoota and the Grampians.
<i>Taraxacum aristum</i>	Austral dandelion	Compositae		none	Rare herb recently collected by D. Cheal near Tubbut, otherwise found in Brisbane Ranges and Bogong High Plains.
<i>Thelymitra matthewsii</i>	Spiral sun-orchid	Orchidaceae	3V	none	Usually on sandy or gravelly ground in light forest in the Cann River and Genoa districts.
<i>Thesium australe</i>	Austral toad-flax	Santalaceae	3EC	none	One doubtful record from Lower Bendoc.
<i>Westringia crennophila</i>	Snowy River westringia	Labiatae	2RC	2 A3 A4	Endemic shrub of cliffs along Snowy River gorge.

Appendix II (continued...)

LIST 2: Species rare in Victoria, but possibly common elsewhere

Species	Common name	Family	Code*	Reserves	Notes**
<i>Acacia subporosa</i>	Bower wattle	Mimosaceae		1	Small tree discovered in Victoria in 1969 in the Howe Range; otherwise a southern NSW species.
<i>Adiantum formosum</i>	Giant maiden-hair	Adiantaceae		2	Fern restricted to lowland river flats and rainforest: Wood Point, Pipeclay Creek, Snowy and Brodribb River Flats, Cann River near Noorinbee, Cooracambra SP.
<i>Alectryon subcinereus</i>	Smooth ramboutan	Sapindaceae		-	Pinnate-leaved shrub occurring on or near the Genoa River gorge.
<i>Amphibromus archeri</i>	Pointed swamp wallaby-grass	Gramineae		2	Grass of swampy places, recorded in EGSA Mallacoota aerodrome, Maramingo Creek FR, Croajingolong NP, near Wingan River.
<i>Amphipogon strictus</i>	Grey beard-grass	Gramineae		2	Generally confined to sandy plains in western Victoria, but several records near Mt Raymond, in Croajingolong NP, in Cooracambra SP, and near Chandlers Creek.
<i>Asperula ambleia</i>	Stiff woodruff	Rubiaceae		-	Small shrub known in Victoria only at lower Snowy River at Bete Bolong.
<i>Asplenium falcatum</i>	Willow spleenwort	Aspleniaceae		1	Fern collected in 1941 near Genoa Peak, otherwise from 3 sites outside EGSA.
<i>Asplenium obtusatum</i>	Shore spleenwort	Aspleniaceae		1	Fern of rocky crevices on the shore near Rame Head and cliffs south-west of Mallacoota.
<i>Bertya cunninghamii</i>	Sticky bertya	Euphorbiaceae		1	Rare shrub of rocky areas, restricted in Victoria to the Upper Snowy River rain-shadow in Tingaringy NP.
<i>Boronia ledifolia</i>	Showy boronia	Rutaceae		1	Tall showy shrub of dry foothills near the Snowy River gorge.
<i>Bossiaea ensata</i>	Sword bossiaea	Papilionaceae		1	Leafless shrub of coastal heaths from Point Ricardo to near Seal Creek RA, the southern limit of its distribution.
<i>Botrychium australe</i>	Austral moonwort	Ophioglossaceae		-	Small fern scattered but rare throughout eastern Victoria, recorded near Lake Corringale, Noorinbee, and Genoa.
<i>Brachycome petrophila</i>	Rock daisy	Compositae	2RC	1	Herb of rocky montane sites, more widespread than previously considered, especially on dry cliff faces near the Snowy River.
<i>Brachycome riparia</i>	Snowy River daisy	Compositae	3RC	2	Riparian herb found among rocks in the gorges of the Snowy and Genoa Rivers.

<i>Brunoniella pumilio</i>	Dwarf brunoniella	Acanthaceae	1	Sprawling semi-shrub with an isolated southern-most occurrence south of Genoa.
<i>Casuarina nana</i>	Stunted she-oak	Casuarinaceae	1	Compact shrub known in Victoria only on sandstone outcrops near Genoa River and Yambulla Creek junction.
<i>Chiloglottis pescottiana</i>	Bronzy bird-orchid	Orchidaceae	-	Normally alpine orchid with an unusual occurrence south of Teal Creek in far east of study area.
<i>Chorizandra sphaerocephala</i>	Brittle-rush	Cyperaceae	1	Sedge of lowland swamps, known in Victoria only in Croajingolong NP and a site 11 km west of Genoa.
<i>Commersonia fraseri</i>	Blackfellows's hemp	Sterculiaceae	-	Large-leaved showy shrub with southern occurrences in the Errinundra, Combiobar, and Genoa River areas.
<i>Conospermum taxifolium</i>	Variable smoke-bush	Proteaceae	1	Restricted to heathlands near Howe Hill and near Little Rame Head.
<i>Corybas fordhamii</i>	Fordham's helmit-orchid	Orchidaceae	2	Orchid of coastal heathlands near Mallecoota Inlet, north of Cabbage Tree Creek town, Maramingo Creek FR, Wingan River area.
<i>Croton verreauxii</i>	Native cascarilla	Euphorbiaceae	-	NSW rainforest tree recorded at Back Creek near Mt Kaye.
<i>Cryptostylis erecta</i>	Tartan tongue-orchid	Orchidaceae	-	Localized to a few grass-tree plains near Marlo, Cape Conran, and along the Wingan River.
<i>Cyathea cunninghamii</i>	Slender tree-fern	Cyatheaceae	1	Tree fern of deep rainforest gullies, eg. Young's Creek at Orbost and Mt Drummer jungle.
<i>Cyathea leichardtiana</i>	Prickly tree-fern	Cyatheaceae	3	Tree fern of warm temperate rainforest on Howe Range, at Mt Drummer, lower Wingan River, Jones Creek.
<i>Cyathochaeta diandra</i>	Sheath-rush	Cyperaceae	1	Sedge restricted to coastal forest between Mallecoota and Seal Creek.
<i>Cyperus concinnus</i>	Flat sedge	Cyperaceae	-	Sedge from the rainshadow area near Snowy Deddick Rivers.
<i>Danthonia paradoxa</i>	Wiry wallaby-grass	Gramineae	1	Confined to forest swamps along Maramingo Creek.
<i>Darwinia camptosylis</i>	Darwinia	Myrtaceae	1	Small shrub of coastal heathland between Benedore River and Little Rame Head, and near Howe Range.
<i>Daviesia wyattiana</i>	Long-leaf bitter-pea	Papilionaceae	1	Tall, narrow-leaved shrub known only on Mt Kaye and Wangarabell.
<i>Desmodium brachypodum</i>	Large tick-trefoil	Papilionaceae	2	In East Gippsland Study Area - known only at Tubbut, Mt Deddick and Snowy River near MacKillop Bridge.

Appendix II (continued...)

LIST 2: Species rare in Victoria, but possibly common elsewhere (continued..)

Species	Common name	Family	Code*	Reserves	Notes**
<i>Deyeuxia contracta</i>	Bent-grass	Gramineae		-	Grass recorded in forest north-east of Orbost and near Big Murrumbidgee Creek near Dellicknora.
<i>Dipodium hamiltonianum</i>	Yellow hyacinth orchid	Orchidaceae		-	Orchid of dry, rocky areas in the vicinity of Deddick and Snowy Rivers.
<i>Erigeron conyzoides</i>	Fleabane	Compositae		-	An unlikely record, near the Snowy River mouth, of a normally alpine composite.
<i>Eriostemon virgatus</i>	Tasmanian waxflower	Rutaceae		1	Tall shrub discovered near Mt Kaye in 1971; otherwise a Tasmanian species.
<i>Eucalyptus fraxinoides</i>	White ash	Myrtaceae		1	Tall tree restricted in Victoria to well drained slopes in the Howe Range.
<i>Eucalyptus glaucescens</i>	Tingaringy gum	Myrtaceae		1	Mallee-like eucalypt of sub-alpine rocky outcrops, particularly on Mt Tingaringy.
<i>Eucalyptus maculata</i>	Spotted gum	Myrtaceae		1	Typically found on the NSW south coast this elegant tree has a disjunct population on Mottle Range south of Buchan.
<i>Festuca eriopoda</i>	Lanky fescue	Gramineae		1	Typically a montane grass with an unusual occurrence at Maramingo Creek.
<i>Ficus coronata</i>	Sandpaper fig	Moraceae		1	Native fig with scabrid leaves, confined in Victoria to the Howe Range area, e.g. Dowell Creek.
<i>Gahnia subaequiglumis</i>	Saw-sedge	Cyperaceae		1	Sedge of montane bogs, recorded from Nelson and Bidwell Creeks.
<i>Gompholobium glabratum</i>	Dainty wedge-pea	Papilionaceae		2	The southern limit of this small, pinnate-leaved shrub is Mt Kaye and Coopracambra SP.
<i>Goodenia grandiflora</i>	Pinnate goodenia	Goodeniaceae		2	Semi-shrub localized in dry rocky habitats in the Upper Snowy River area.
<i>Hakea dactyloides</i>	Finger hakea	Proteaceae		2	Large-leaved shrub known in Victoria only from Mt Kaye and Coopracambra
<i>Haloragodendron baeuerlenii</i>	Shrubby everlasting	Haloragaceae	3RC	2	A shrub of dry, rocky outcrops in Tingaringy NP and nearby rainshadow areas, including Snowy River NP.
<i>Helichrysum argophyllum</i>	Spicy everlasting	Compositae		1	A sweetly spicy shrub to 2m of coastal areas near Petrel Point and Wingan Point.
<i>Korthalsella japonica</i>	Jointed mistletoe	Visacaceae		1	Leafless mistletoe found on <i>Eugenia smithii</i> in rainforests along lower Snowy and Cann Rivers.
<i>Lasiopetalum ferrugineum</i>	Rusty velvet-bush	Sterculiaceae		2	Restricted in Victoria to Mt Kaye and the Genoa River gorge.

<i>Lastreopsis decomposita</i>	Trim shield-fern	Aspidiaceae	1	Ground fern of rainforests and their margin on Dowell Creek and near Gipsy Point, and within Croajingolong NP.
<i>Lepyrodia anarthria</i>	Scale-rush	Restionaceae	2	Occasionally on damp heaths along upper Genoa River and at Maramingo Creek.
<i>Leucopogon esquamatus</i>	Swamp beard-heath	Epacridaceae	1	Small shrub of coastal heaths from Marlo east to the Howe Range.
<i>Lindsaya microphylla</i>	Lacy wedge-fern	Linsaeaceae	1	Delicate fern of disturbed clay embankments on Karlo Creek, upper Cann River and Pheasant Creek.
<i>Livistona australis</i>	Cabbage fan-palm	Palmae	2	Tall palm tree found on Cabbage Tree Creek, Caley's Creek, and lower Brodribb.
<i>Logania pusilla</i>	Tiny logania	Loganiaceae	1	Small shrub with axillary flowers, known near Betka River and Maramingo Creek.
<i>Lomandra micrantha</i>	Small-flower mat-rush	Liliaceae	1	Var. <i>sorozia</i> , a montane form collected from Mt Tingaringy.
<i>Lomandra obliqua</i>		Liliaceae	-	Only Victorian record in catchment of Back Creek, near Mt Kaye.
<i>Lycopodium serpentinum</i>	Bog clubmoss	Lycopodiaceae	1	Known in peaty bogs near Jones and Maramingo Creeks.
<i>Lycopodium varium</i>	Long clubmoss	Lycopodiaceae	1	This species is scattered but rare throughout Victoria. In EGSA, known at Mt Kaye and Genoa Peak.
<i>Macroglena caudata</i>	Jungle bristle-fern	Hymenophyllaceae	2	An epiphytic fern of <i>Cyathea cunninghamii</i> and <i>C. leichardtiana</i> in rainforest Mt Drummer and Howe Range.
<i>Marsdenia flavescens</i>	Yellow milk-vine	Asclepiadaceae	2	A robust liane of lowland rainforests at Wood Point, Pipeclay Creek, and in lake Tyers SP.
<i>Mirbelia rubiifolia</i>	Mirbelia	Papilionaceae	1	Small shrub only recently collected from heathlands near Mallacoota.
<i>Muehlenbeckia gracillima</i>	Slender lignum	Polygonaceae	-	Small triangular-leaved climber with an isolated occurrence near Tongi Creek.
<i>Myoporum floribundum</i>	Slender myoporum	Myoporaceae	-	Showy, narrow-leaved shrub known in Victoria only in rainshadow area of the Upper Snowy River.
<i>Notothixos subaureus</i>	Golden mistletoe	Viscaceae	2	A parasite of other mistletoes occurring in the region of Mallacoota Inlet.
<i>Olax stricta</i>	Olax	Olacaceae	1	Woodland south of Cann River is the southern limit of this parasitic shrub.
<i>Pittosporum revolutum</i>	Rough-fruit pittosporum	Pittosporaceae	2	Large-leaved shrub recorded from Maramingo Creek, Harrison Creek, and Genoa River.
<i>Plectorrhiza tridentata</i>	Tangle orchid	Orchidaceae	2	An epiphytic orchid of warm temperate rainforest east of the Snowy River to Howe Range.

Appendix II (continued...)

LIST 2: Species rare in Victoria, but possibly common elsewhere (continued...)

Species	Common name	Family	Code*	Reserves	Notes**
<i>Poa menioneetes</i>	Tussock grass	Gramineae		1	Grass collected last century from Cann River and Genoa districts.
<i>Polystichum formosum</i>	Broad shield-fern	Aspidiaceae		1	Fern of shaded, riverine sites: Yambulla Creek near Genoa River.
<i>Pomaderris costata</i>	Veined pomaderris	Rhamnaceae		2	White-flowered shrub endemic in East Gippsland collected from Yambulla Creek, Howe Hill, Brodribb River.
* <i>ledifolia</i>	New South Wales pomaderris	Rhamnaceae		1	Narrow-leaved shrub of southern NSW; only Victorian record at Mt Kaye.
* <i>pauciflora</i>	Mountain pomaderris	Rhamnaceae	3RC	1	Another NSW species, recorded near Mt Coopracambra.
<i>Prasophyllum rogersii</i>	Marsh leek-orchid	Orchidaceae		-	Only Victorian record from Mallacoota dated 1930.
* <i>viride</i>	Green midge-orchid	Orchidaceae		1	A species of heathlands, recorded at St George Plain (east of Mt Bemm) and along the upper Cann River, also Benedore River, and near Lake Barracoota.
<i>Prostanthera decussata</i>	Dense mint-bush	Labiatae	3RC	1	This mint bush has been recorded in the Tingaringy NP.
<i>Prostanthera</i> sp. aff. <i>melissifolia</i>	Mint-bush	Labiatae		1	An undescribed shrub known only in the Howe Range area.
<i>Pseudoraphis paradoxa</i>	Slender mud-grass	Gramineae		1	Known only in Ewing Marsh WR and the Snowy River flats near Orbost.
<i>Pterostylis aestiva</i>	Long-tongue summer greenhood	Orchidaceae		-	Recently described (1982) near the Snowy River gorge.
* <i>baptistii</i>	King greenhood	Orchidaceae		1	On moist flats beside or near the Princes Highway near Cann River, Genoa Creek, Scrubby Creek, Maramingo Creek.
* <i>laxa</i>	Antelope greenhood	Orchidaceae		2	Rare greenhood of the Upper Snowy rain-shadow area, Tingaringy NP and Mt Delegate SR.
* <i>pedoglossa</i>	Prawn greenhood	Orchidaceae		1	On damp shaded sand under thickets or dense bracken in Mallacoota district.
<i>Pultenaea altissima</i>	Tall bush-pea	Papilionaceae		1	This shrub is known in Victoria only in Yambulla Creek and Genoa River area.
* <i>paludosa</i>	Bush-pea	Papilionaceae		-	A semi-shrub of lowland swamps in the Bemm River, Cape Conran, Cabbage Tree Creek areas.

<i>Pultenaea subspicata</i>	Low bush-pea	Papilionaceae	-	Procumbent shrub of montane areas in Wulgulmerang and Dellicknora districts.
<i>Ripogonum album</i>	White supplejack	Liliaceae	1	A liane of warm temperate rainforests from Orbost to Howe Range.
<i>Salvia plebeia</i>	Austral sage	Labiatae	-	Riparian herb of Snowy and Deddick Rivers.
<i>Sambucus australasica</i>	Yellow elderberry	Caprifoliaceae	-	Rare shrub of rainforests near Orbost and at Dowell Creek near Howe Range.
<i>Santalum obtusifolium</i>	Sandalwood	Santalaceae	-	Small sandalwood restricted to the Maramingo Hill/Genoa River area.
<i>Sarcochilus falcatus</i>	Orange-blossom orchid	Orchidaceae	1	An epiphytic orchid found in Victoria only in a few rainforest pockets near Mt Carlyle and Noorinbee.
* <i>hillii</i>		Orchidaceae	1	This epiphyte has only recently been discovered in Victoria in the Howe Range.
<i>Schoenus fluitans</i>	Floating bog-rush	Cyperaceae	1	Aquatic sedge collected only from Lake Barracoota within the EGSA.
* <i>turbinatus</i>	Bog-rush	Cyperaceae	1	Tufted sedge restricted to Lake Wau Wauka region and some localities in western Victoria.
<i>Sparganium erectum</i>	Branching burr-reed	Sparganiaceae	1	Riparian reed recorded at Ewing Marsh and near Orbost.
<i>Sticherus flabellatus</i>	Shiny fan-fern	Gleicheniaceae	1	Restricted in Victoria to lowland sites along Harrisons Creek, Cann River, and near Combianbar and Genoa Peak.
<i>Stylidium laricifolium</i>	Giant trigger-plant	Stylidiaceae	1	Occurs on moist siliceous sands near the western shore of Wingan Inlet.
<i>Symplocos cochinchinensis</i>	Hazelwood	Symplocaceae	1	A large-leaved rainforest tree discovered at Wood Point on the Snowy River in 1975.
<i>Thelymitra cyanea</i>	Sun-orchid	Orchidaceae	2	Known in subalpine heath fringing a <i>Sphagnum</i> bog on the upper Delegate River, at Bidwell, and from Maramingo Creek.
* <i>retecta</i>	Bog sun-orchid	Orchidaceae	1	Another species from subalpine bog on the Upper Delegate River at Bidwell
<i>Tieghemopanax murrayi</i>	Large-leaved panax	Araliaceae	1	Palm-like tree found on the margins of lowland rainforests along Dowell Creek and Harrisons Creek.
<i>Tmesipteris ovata</i>	Oval fork-fern	Psilotaceae	1	An epiphytic fern of warm temperate rainforest throughout the EGSA
<i>Trema aspera</i>	Peach-leaf poison-bush	Ulmaceae	-	Small tree of rainforest margins occurring near Mallacoota, its southern limit

Appendix II (continued...)

LIST 2: Species rare in Victoria, but possibly common elsewhere (continued...)

Species	Common name	Family	Code*	Reserves	Notes**
<i>Uncinia riparia</i>	River hook-sedge	Cyperaceae		3	Riparian sedge collected on the Errinundra Plateau, Kanuka Creek FR, near Murrungowar, and near Bemm River, Alfred NP.
<i>Viola caleyana</i>	Swamp violet	Violaceae		-	Herb with white flowers found along water-courses near Dellicknora; east of Orbost; and east of Buldah.
<i>Xyris juncea</i>	Dwarf yellow-eye	Xyridaceae		1	Known only in Maramingo Creek FR.

LIST 3: Species rare in the study area

Species	Common name	Family	Reserves	Notes**
<i>Boerhavia diffusa</i>	Tah-vine	Nyctaginaceae	1	Prostrate vine of western Victoria, occurring occasionally in rainshadow area of upper Snowy River.
<i>Burnettia cuneata</i>	Burnettia	Orchidaceae	-	Occasional on wet, peaty heaths under <i>Melaleuca squarrosa</i> , recorded at Reedy Creek near Cann River township.
<i>Cryptandra propinqua</i>	Silky cryptandra	Rhamnaceae	1	Disjunct record near Willis of this terete-leaved shrub of Mallee sandhills.
<i>Danthonia geniculata</i>	Kneed wallaby-grass	Gramineae	-	Frequent along the coast of western Victoria; recently collected near Goongerah.
<i>Eragrostis parviflora</i>	Weeping love-grass	Gramineae	2	This grass of northern Victoria has been recorded in the MacKillop Bridge area.
<i>Lepidosperma viscidum</i>	Sticky sword-sedge	Cyperaceae	1	Sedge of western Victoria occurring also near Genoa Peak.
<i>Phebalium glandulosum</i>	Phebalium	Rutaceae	1	Normally a shrub of the Mallee, but found in the Upper Snowy River area.
<i>Phebalium squameum</i> ssp. <i>squameum</i>	Satinwood	Rutaceae	-	Small tree with a scattered distribution including a population near Mt Buck, north-west of Orbost.
<i>Podocarpus lawrencei</i>	Mountain plum-pine	Podocarpaceae	1	Rare and restricted conifer found in a small area the Errinundra Plateau, near Goonmirk Rocks.
<i>Prasophyllum morrisii</i>	Bearded midge-orchid	Orchidaceae	2	Isolated records of this orchid come from the Harrisons Creek area and the Upper Genoa River.
<i>Ptilotus macrocephalus</i>	Feather-heads	Amaranthaceae	1	A western Victoria herb with isolated occurrences near Point Hicks and Wingan Inlet.

LIST 4: Species of restricted distribution in the study area

Species	Common name	Family	Reserves	Notes**
<i>Caladenia tessellata</i>	Thick lip spider-orchid	Orchidaceae	-	Widespread in lowlands elsewhere in Victoria, but restricted to Snowy River mouth in EGSA.
<i>Callitris columellaris</i>	White cypress-pine	Cupressaceae	1	A pine widespread in northern Victoria but restricted to the Upper Snowy River rainshadow area.
* <i>endlicheri</i>	Black cypress-pine	"	1	This native pine is scattered throughout north-eastern Victoria, but once again restricted to the rainshadow regions of EGSA.
* <i>rhomboidea</i>	Oyster Bay-pine	"	1	Native pine of near-coastal sites, common in western Victoria, with isolated occurrences along Croajingolong coast.
<i>Cassia nemophila</i>	Cassia	Caesalpiniaceae	1	Another species common in western Victoria with an isolated occurrence in the Upper Snowy River rainshadow.
<i>Cassinia uncata</i>	Sticky cassinia	Compositae	1	Slender shrub of semi-arid areas, occurring also in valleys in the EGSA.
<i>Dichanthum sericeum</i>	Silky blue-grass	Gramineae	1	A widespread grass, restricted to and uncommon in the rainshadow areas of EGSA.
<i>Enneapogon nigricans</i>	Niggerheads	"	2	Typically a grass of western Victoria, collected also in the rainshadow areas of EGSA.
<i>Eucalyptus perriniana</i>	Spinning gum	Myrtaceae	-	Occurs on Mts Tower and Bowen, where locally common; otherwise in alpine area to the west of EGSA.
* <i>regnans</i>	Mountain ash	"	1	Common west of the Snowy River, this majestic tree occurs in the Rodger and Yalmy catchments, and in the Errinundra FR.
<i>Gnaphalium indutum</i>	Tiny cudweed	Compositae	1	Small herb of deep sands, common in western Victoria, restricted in EGSA to a few localities west of Mallacoota.
<i>Pultenaea largiflorens</i>	Bush-pea	Papilionaceae	1	A low wiry shrub of western goldfields with disjunct records from Mueller River area.
* <i>subumbellata</i>	Wiry bush-pea	"	-	An uncommon shrub of montane swamps, recorded from Bonang and Chandler's Creek areas.
* <i>tenuifolia</i>	Slender bush-pea	"	1	Procumbent shrub of coastal and mallee areas, found in a few near-coastal localities in the EGSA.
<i>Senecio squarrosus</i>	Leafy fireweed	Compositae	1	A widespread herb, common in grassy areas of western Victoria, found near Mallacoota and near the Deddick River.
<i>Stylidium beagleholei</i>	Beaglehole's trigger-plant	Stylidiaceae	1	Recorded at Howe Creek, 700 km from the nearest occurrence in western Victoria.

Appendix II (*continued...*)LIST 4: Species of restricted distribution in the study area (*continued..*)

Species	Common name	Family	Reserves	Notes**
<i>Styphelia adscendens</i>	Golden heath	Epacridaceae	1	A low mottled shrub of western Victoria with an isolated record in the Howe Ranges.
<i>Swainsona lessertiifolia</i>	Coast swainson-pea	Papilionaceae		This shrub has isolated occurrences near Mallacoota and Wingan Inlets, but otherwise found in western Victoria.
* <i>oroboides</i>	Variable swainson-pea	"	-	Another species of the rainshadow areas of EGSA, widely distributed in drier areas of the State.

LIST 5: Species displaying significant disjunction or being noteworthy

Species	Common name	Family	Reserves	Notes**
<i>Agrostis rudis</i>	Bent	Gramineae	-	Uncommon in western Victoria, this grass has recently been collected in the Wingan River catchment.
<i>Baeckea linifolia</i>	Swamp baeckea	Myrtaceae	1	An uncommon shrub of swampy ground near Lower Cann River and Genoa River.
<i>Brachycome cardiocarpa</i>	Swamp daisy	Compositae	1	Grass-leaved herb, occasionally in lowland swamps including examples in Orbost area and in Croajingolong NP.
<i>Calotis lappulacea</i>	Yellow burr-daisy	"	1	Burr-seeded herb, with disjunct occurrences near Tubbut and Gattamurh Creek.
<i>Calystegia soldanella</i>	Sea bindweed	Convolvulaceae	1	An uncommon trailer, restricted to the coastal dunes; for example, Wingan Point and Benedore River mouth.
<i>Chenopodium carinatum</i>	Keeled goosefoot	Chenopodiaceae	1	Small annual of dry localities, uncommon in EGSA, restricted to the Snowy River rainshadow area.
<i>Dendrobium speciosum</i>	Rock orchid	Orchidaceae	2	Locally abundant on a few rocky outcrops and cliff-faces; for example, upper Genoa River, upper Cann River, Howe Ranges, Wingan Inlet.
<i>Dendrophthoe vitellina</i>	Long-flower mistletoe	Loranthaceae	2	Mistletoe with attractive flowers, uncommon in EGSA but common further north, recorded near Mallacoota.
<i>Dodonaea boroniifolia</i>	Hairy hop bush	Sapindaceae	-	Scattered on the western highlands, usually on granite hills, collected near the Genoa River.
<i>Epilobium curtisiae</i>	Bald-seeded willow-herb	Onagraceae	-	Small herb of sub-alpine swamps recently collected near Mt Koolabbra.
<i>Eucalyptus agglomerata</i>	Stringybark	Myrtaceae	1	This stringybark occurs at Jones Creek, near Wangarabell, and at Mt Kaye at the southern limit of its distribution.

"	<i>aromaphloia</i>	Scentbark	Myrtaceae	-	Isolated occurrences of this western and central Victorian species are found south of Cann River township.
"	<i>blakelyi</i>	Blakely's red gum	Myrtaceae	2	Found on stony slopes in the upper Snowy River region.
	<i>Goodenia heterophylla</i>	Goodenia	Goodeniaceae	1	A procumbent herb of dry stony ground, recently recorded in the Snowy River NP.
	<i>Helichrysum elatum</i>	Tall everlasting	Compositae	-	An uncommon semi-shrub restricted in Victoria to a few lowland sites in far East Gippsland.
"	<i>obtusifolium</i>	Blunt everlasting	Compositae	1	A showy herb, widespread in lowland heaths of western Victoria, but rarely recorded in EGSA, in the Howe Range.
	<i>Hibbertia rufa</i>	Brown guinea-flower	Dilleniaceae	2	Uncommon shrub of riparian sites at Jones Creek, Reedy Creek, Genoa Peak area.
	<i>Lespedeza juncea</i>	Chinese lespedeza	Papilionaceae	2	Occasional herb scattered in EGSA, recorded at Bete Bolong, Snowy River NP, and Tingaringy NP.
	<i>Marsilea hirsuta</i>	Short-fruit nardoo	Marsileaceae	1	Clover-like fern of swampy ground in western Victoria, recorded near the confluence of the Snowy and Deddick Rivers.
	<i>Myriophyllum amphibium</i>	Broad-water milfoil	Haloragaceae	1	Prostrate herb of the lowland swamps, common in western Victoria, recorded in Seal Creek RA and nearby areas.
	<i>Olearia tomentosus</i>	Toothed daisybush	Compositae	1	An uncommon shrub restricted to coastal forests of the Howe Range.
	<i>Persoonia rigida</i>	Hairy geebung	Proteaceae	1	Uncommon spatulate-leaved shrub of dry forests recorded near Dellicknora and in Tingaringy NP.
	<i>Poa hookeri</i>	Tussock grass	Gramineae	1	A grass of sub-alpine rocky areas, recorded from Tingaringy NP.
	<i>Pratia purpurascens</i>	Purplish pratia	Lobeliaceae	3	A mottled herb known in Victoria only in coastal East Gippsland, where uncommon.
	<i>Pseudanthus divaricatissimus</i>	Tangled Pseudanthus	Euphorbiaceae	1	Divaricate shrub with scattered distribution in rocky areas, recorded from Maramingo Hill area and Croajingolong NP.
	<i>Pultenaea benthamii</i>	Bentham's bush-pea	Papilionaceae	2	A shrub with disjunct distribution, occurring in the Grampians and East Gippsland, recorded in Croajingolong NP and Mt Kaye area.
"	<i>capitellata</i>	Hard-head bush-pea	"	1	An uncommon shrub of mountain areas recorded at the upper Delegate River and near Bendoc.
"	<i>cunninghamii</i>	Grey bush-pea	"	2	Showy shrub with large flowers occurring in the Eastern Highlands and recorded in the Snowy River/Mt Tingaringy area.
"	<i>polifolia</i>	Dusky bush-pea	"	-	An uncommon bush-pea from north of Orbost, Bonang, and Dellicknora areas.
	<i>Scaevola albidia</i>	Small fan-flower	Goodeniaceae	1	Procumbent coastal shrub occurring sporadically along the coast (e.g. Point Hicks) of the EGSA.

Appendix II (*continued...*)LIST 5: Species displaying significant disjunction or being noteworthy (*continued...*)

Species	Common name	Family	Reserves	Notes**
<i>Selaginella gracillima</i>	Tiny selaginella	Selaginellaceae	2	An uncommon small annual club moss of coastal areas such as Ewing Marsh, Marlo, and Lake Corringale.
<i>Senecio orarius</i>	Groundsel	Compositae		Uncommon small shrub scattered along the coast.
<i>Sicyos angulata</i>	Star cucumber	Cucurbitaceae	2	Weak climber of lowlands (e.g. Lake Corringale - Lake Wat Wat, Croajingolong NP), where uncommon
<i>Stackhousia intermedia</i>	Wiry stackhousia	Stackhousiaceae	-	Uncommon leafless semi-shrub known in Victoria only in coastal areas east of Cape Conran.
<i>Tmesipteris parva</i>	Small fork-fern	Psilotaceae	2	An epiphytic fern with curved fronds found at Mt Drummer and Howe Range on tree ferns.
<i>Westringia eremicola</i>	Slender westringia	Labiatae	2	Widespread but uncommon shrub with narrow leaves, with occurrences in Croajingolong NP, Coopracambra SP, Cann River, and Genoa River.
* <i>glabra</i>	Violet westringia	"	2	Uncommon in the EGSA: recorded in Mountain Creek RA, Mt Ellery SR, south-east of Nowa Nowa, and near Combiobar.

Appendix III

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Appendix IV (continued...)

Species	Alpine heathland	Snow gum woodland	Montane forest	Wet sclerophyll forest	Dry sclerophyll forest	Lowland sclerophyll forest	Riparian forest	Rainforest	Coastal sclerophyll forest	Montane sclerophyll woodland	Rocky outcrop open scrub	Rainshadow woodland	Box--ironbark woodland	Banksia woodland	Coastal heathland	Primary dune scrub	Saltmarsh	Beaches and oceanic islands	Riverine	Estuary	Wetlands and swamps	Agricultural land
Magpie goose																						x
Plumed whistling-duck																						x
Black swan																x		x		x	x	x
Cape Barren goose																		x				
Australian shelduck																	x	x		x	x	x
Pacific black duck																	x	x		x	x	x
Mallard (I)																						x
Grey teal																	x			x	x	x
Chestnut teal																		x		x	x	x
Australasian shoveler																						x
Pink-eared duck																						x
Hardhead																						x
Maned duck																						x
Blue-billed duck																						x
Musk duck																					x	x
Osprey																		x		x		
Black-shouldered kite															x	x	x	x	x	x		x
Letter-winged kite																						x
Black kite																						x
Square-tailed kite				x						x												x
Whistling kite					x	x	x								x	x	x	x	x	x	x	x
Brown goshawk		x	x	x		x	x			x		x	x				x		x	x		x
Collared sparrowhawk								x				x					x		x	x		x
Grey goshawk								x														x
White-bellied sea-eagle									x						x	x	x	x	x	x	x	x
Wedge-tailed eagle	x		x	x	x		x		x	x	x	x			x				x	x	x	x
Little eagle		x							x													x
Spotted harrier																						x
Marsh harrier									x						x	x	x	x		x	x	x
Black falcon																						x
Peregrine falcon		x					x		x	x										x	x	x
Australian hobby		x	x				x		x		x					x		x	x	x	x	x
Grey falcon																						
Brown falcon	x								x		x									x	x	x
Australian kestrel	x	x													x	x		x	x	x	x	x
Stubble quail															x							x
Brown quail															x							x
King quail																						x
Painted button-quail					x	x			x			x	x	x	x							
Buff-banded rail																						x
Lewin's rail																						x
Baillon's crake																						x
Australian crake																						x
Dusky moorhen																			x		x	x
Purple swamphen																			x		x	x

Appendix IV (continued...)

Species	Alpine heathland	Snow gum woodland	Montane forest	Wet sclerophyll forest	Dry sclerophyll forest	Lowland sclerophyll forest	Riparian forest	Rainforest	Coastal sclerophyll forest	Montane sclerophyll woodland	Rocky outcrop open scrub	Rainshadow woodland	Box--ironbark woodland	Banksia woodland	Coastal heathland	Primary dune scrub	Saltmarsh	Beaches and oceanic islands	Riverine	Estuary	Wetlands and swamps	Agricultural land
Eurasian coot																				x	x	x
Beach thick-knee																		x		x		
Pied oystercatcher																x		x		x		
Sooty oystercatcher																		x		x		
Masked lapwing	x														x	x		x	x	x	x	x
Banded lapwing																						x
Grey plover																				x		
Lesser golden plover																		x		x		
Black-fronted plover																		x	x	x	x	x
Hooded plover																		x		x		
Mongolian plover																		x		x		
Double-banded plover																		x		x		
Large sand plover																		x		x		
Red-capped plover																x		x		x	x	
Black-winged stilt																				x	x	
Ruddy turnstone																		x		x		
Eastern curlew																		x		x		
Whimbrel																		x		x		
Little curlew																		x		x		
Grey-tailed tattler																		x		x		
Common sandpiper																		x		x		
Greenshank																	x		x		x	
Marsh sandpiper																					x	
Latham's snipe		x																	x		x	x
Black-tailed godwit																				x		
Bar-tailed godwit																				x		
Red knot																				x		
Great knot																				x		
Sharp-tailed sandpiper																				x	x	
Red-necked stint																				x	x	
Curlew sandpiper																				x	x	
Sanderling																		x				
Broad-billed sandpiper																				x		
Great skua																		x				
Arctic jaeger																		x				
Pomarine jaeger																		x				
Silver gull								x						x	x	x		x		x	x	x
Pacific gull																		x		x		
Kelp gull																		x		x		
Whiskered tern																					x	
Gull-billed tern																				x		
Caspian tern																		x		x		
Common tern																		x		x		
Arctic tern																		x				
White-fronted tern																		x		x		

Appendix IV (continued...)

Species	Alpine heathland	Snow gum woodland	Montane forest	Wet sclerophyll forest	Dry sclerophyll forest	Lowland sclerophyll forest	Riparian forest	Rainforest	Coastal sclerophyll forest	Montane sclerophyll woodland	Rocky outcrop open scrub	Rainshadow woodland	Box--ironbark woodland	Banksia woodland	Coastal heathland	Primary dune scrub	Saltmarsh	Beaches and oceanic islands	Riverine	Estuary	Wetlands and swamps	Agricultural land
Rufous whistler	x	x	x	x	x	x	x	x	x	x		x			x							
Grey shrike-thrush	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x						x
Black-faced monarch				x			x	x		x												
Leaden flycatcher			x		x																	
Satin flycatcher	x	x	x	x	x		x			x												
Restless flycatcher						x			x			x										x
Rufous fantail	x	x	x	x		x	x	x		x												
Grey fantail	x	x	x	x	x	x	x	x	x	x		x	x		x	x						x
Willie wagtail		x		x								x							x			x
Eastern whipbird	x		x	x	x	x	x	x	x	x	x				x							
Spotted quail-thrush		x	x	x	x	x			x	x	x	x										
Clamorous reed-warbler																			x		x	x
Little grassbird																	x				x	
Golden-headed cisticola																				x	x	
Rufous songlark						x						x										x
Brown songlark																						x
Superb fairy-wren	x		x	x	x	x	x	x	x	x		x			x	x	x				x	x
Southern emu-wren						x	x		x						x							x
Eastern bristlebird															x	x						
Pilotbird	x	x	x	x		x	x	x		x	x											
Large-billed scrubwren				x				x														
White-browed scrubwren	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x					x	
Chestnut-rumped hylacola						x	x			x					x							
Calamanthus																		x				
Speckled warbler												x										
Weebill				x	x	x						x										
Brown gerygone			x	x			x	x														
White-throated gerygone									x			x										
Brown thornbill	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x					
Buff-rumped thornbill						x				x		x										x
Yellow-rumped thornbill												x										x
Yellow thornbill																						
Striated thornbill	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x						
Southern whiteface																						
Varied sittella				x	x	x	x	x	x	x		x										
White-throated treecreeper	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x					
Red-browed treecreeper	x	x	x	x	x	x	x	x		x												
Brown treecreeper												x										x
Red wattlebird	x	x	x	x	x	x	x	x	x	x	x	x	x	x								x
Little wattlebird						x	x	x	x				x	x	x	x						
Spiny-cheeked honey-eater																						
Noisy friarbird			x		x		x					x										x

Appendix V

OCCURRENCE OF TERRESTRIAL VERTEBRATE FAUNA IN DESCRIPTIVE BLOCKS

Key to Appendix V

- I - Introduced
E - Extinct
X - Recorded

Records include: FWD - sites of zoological significance in East Gippsland
FWD - wildlife survey team
FCV - pre-logging surveys
- Rodger Block - Chesterfield *et al.* (1983)
- Yalmy Block - Opie *et al.* (1984)
- Ellery Block - Horrocks *et al.* (1984)
- RAOU Atlas
- Birds of Mallacoota (1979)
- Atlas of Frogs of Victoria, Brook (1982)

Common name	Species Scientific name	Blocks					
		1	2	3	4	5	6
MAMMALS							
Short-beaked echidna	<i>Tachyglossus aculeatus</i>	X	X	X	X	X	X
Platypus	<i>Ornithorhynchus anatinus</i>	X	X	X	X	X	X
Brown antechinus	<i>Antechinus stuartii</i>	X	X	X	X	X	X
Dusky antechinus	<i>Antechinus swainsonii</i>	X	X	X	X	X	X
Tiger quoll	<i>Dasyurus maculatus</i>		X	X	X	X	X
Eastern quoll (E)	<i>Dasyurus viverrinus</i>						
Brush-tailed phascogale	<i>Phascogale tapoatafa</i>						X
White-footed dunnart	<i>Sminthopsis leucopus</i>	X	X	X			
Southern brown bandicoot	<i>Isoodon obesulus</i>	X	X	X	X		
Long-nosed bandicoot	<i>Perameles nasuta</i>	X	X	X	X	X	X
Mountain brushtail possum	<i>Trichosurus caninus</i>			X	X	X	X
Common brushtail possum	<i>Trichosurus vulpecula</i>	X	X	X	X	X	X
Feathertail glider	<i>Acrobates pygmaeus</i>		X	X	X	X	X
Eastern pygmy-possum	<i>Cercartetus nanus</i>	X	X	X	X	X	X
Greater glider	<i>Petauroides volans</i>		X	X	X	X	X
Yellow-bellied glider	<i>Petaurus australis</i>	X	X	X	X	X	X
Sugar glider	<i>Petaurus breviceps</i>	X	X	X	X	X	X
Common ringtail possum	<i>Pseudocheirus peregrinus</i>	X	X	X	X	X	X
Eastern grey kangaroo	<i>Macropus giganteus</i>	X	X	X	X	X	X
Common wallaroo	<i>Macropus robustus</i>						X
Red-necked wallaby	<i>Macropus rufogriseus</i>		X	X	X	X	X
Brush-tailed rock-wallaby	<i>Petrogale pencillata</i>						X
Long-footed potoroo	<i>Potorous longipes</i>	X	X		X	X	X
Long-nosed potoroo	<i>Potorous tridactylus</i>	X	X	X	X		
Red-bellied pademelon(E)	<i>Thylogale billardierii</i>		X				
Swamp wallaby	<i>Wallabia bicolor</i>	X	X	X	X	X	X

Appendix V (continued...)

Common name	Species	Scientific name	Blocks						
			1	2	3	4	5	6	
Koala		<i>Phascolarctos cinereus</i>		X		X		X	
Common wombat		<i>Vombatus ursinus</i>	X	X	X	X	X	X	X
Grey-headed flying-fox		<i>Pteropus poliocephalus</i>	X	X		X	X	X	
Eastern horseshoe-bat		<i>Rhinolophus megaphyllus</i>			X	X			X
Little mastiff-bat		<i>Mormopterus</i> sp.		X	X				
White-striped mastiff-bat		<i>Tadarida australis</i>	X	X	X	X	X	X	X
Gould's wattled bat		<i>Chalinolobus gouldii</i>		X	X			X	X
Chocolate wattled bat		<i>Chalinolobus morio</i>		X	X	X	X	X	X
King River eptesicus		<i>Eptesicus regulus</i>		X	X	X	X	X	X
Large forest eptesicus		<i>Eptesicus sagittula</i>		X	X	X	X	X	X
Little forest eptesicus		<i>Eptesicus vulturinus</i>		X	X	X	X	X	X
Common bent-wing bat		<i>Minopterus oceanensis</i>		X	X	X			X
Large-footed myotis		<i>Myotis adversus</i>		X	X	X			
Eastern broad-nosed bat		<i>Scotorepens orion</i>		X	X				X
Lesser long-eared bat		<i>Nyctophilus geoffroyi</i>		X	X	X	X	X	X
Gould's long-eared bat		<i>Nyctophilus gouldi</i>		X	X	X	X	X	X
Great pipistrelle		<i>Pipistrellus tasmaniensis</i>		X	X	X	X	X	X
Water-rat		<i>Hydromys chrysogaster</i>		X	X			X	X
House mouse (I)		<i>Mus musculus</i>	X	X		X	X	X	X
Smoky mouse		<i>Pseudomys fumeus</i>	X	X					
Bush rat		<i>Rattus fuscipes</i>	X	X	X	X	X	X	X
Swamp rat		<i>Rattus lutreolus</i>	X	X	X	X	X		
Black rat (I)		<i>Rattus rattus</i>						X	X
Dingo, feral dog (I)		<i>Canis familiaris</i>	X	X	X	X	X	X	X
Fox (I)		<i>Vulpes vulpes</i>	X	X	X	X	X	X	X
Cat (I)		<i>Felis catus</i>	X	X		X	X	X	
Horse (brumby) (I)		<i>Equus caballus</i>							X
European cattle (I)		<i>Bos taurus</i>		X		X			X
Goat (I)		<i>Capra hircus</i>							
Hog deer (I)		<i>Axis porcinus</i>	X	X					
Sambar (I)		<i>Cervus unicolor</i>						X	X
Brown hare (I)		<i>Lepus capensis</i>						X	X
European rabbit (I)		<i>Oryctolagus cuniculus</i>	X	X	X	X	X	X	X
Australian fur-seal		<i>Arctocephalus pusillus</i>		X					
Leopard seal		<i>Hydrurga leptonyx</i>		X					
Elephant seal		<i>Mirounga leonina</i>		X					

AMPHIBIANS

Green and golden bell frog	<i>Litoria aurea</i>	X	X	X	X	X	X	X
Green and golden bell frog	<i>Litoria raniformis</i>	X			X	X		
Blue Mountains tree frog	<i>Litoria citropa</i>	X	X	X	X	X		
Brown tree frog	<i>Litoria ewingii</i>	X	X	X	X	X	X	X
Verreaux's tree frog	<i>Litoria verreauxii</i>	X			X	X	X	
Jervis Bay tree frog	<i>Litoria jervisiensis</i>	X	X	X	X	X	X	X
Lesueur's frog	<i>Litoria lesueuri</i>	X	X	X	X	X	X	X
Peron's tree frog	<i>Litoria peronii</i>	X	X	X	X	X	X	X
Leaf green tree frog	<i>Litoria phyllochroa</i>	X	X	X	X	X	X	X
	<i>Geocrinia victoriana</i>	X	X	X	X	X	X	X

Appendix V (continued...)

Common name	Species Scientific name	Blocks					
		1	2	3	4	5	6
Giant burrowing frog	<i>Heleioporus australiacus</i>			X			X
Southern bullfrog	<i>Limnodynastes dumerilii</i>	X	X	X	X	X	X
Striped marsh frog	<i>Limnodynastes peronii</i>	X	X	X	X	X	X
Spotted grass frog	<i>Limnodynastes tasmaniensis</i>		X	X	X	X	X
Great barred frog	<i>Mixophyes balbus</i>			X		X	
Haswell's frog	<i>Paracrinia haswelli</i>	X	X	X	X	X	
Southern toadlet	<i>Pseudophryne dendyi</i>		X	X	X	X	X
Southern toadlet	<i>Pseudophryne semimarmorata</i>	X			X		
Common eastern froglet	<i>Ranidella signifera</i>	X	X	X	X	X	X
Yellow-spotted toadlet	<i>Uperoleia laevigata</i>		X	X	X		
REPTILES							
Long-necked tortoise	<i>Chelodina longicollis</i>	X			X		
Leathery turtle	<i>Dermochelys coriacea</i>		X				
Common scaly-foot	<i>Pygopus lepidopodus</i>			X			
Mountain dragon	<i>Amphibolurus diemensis</i>						X
Jacky lizard	<i>Amphibolurus muricatus</i>	X	X	X	X		X
Eastern water dragon	<i>Physignathus lesueurii</i>	X	X	X	X	X	X
Lace monitor/tree goanna	<i>Varanus varius</i>	X	X	X	X	X	X
Copper-tailed skink	<i>Ctenotus taeniolatus</i>						X
Swamp skink	<i>Egernia coventryi</i>		X	X	X		
Cunningham's skink	<i>Egernia cunninghami</i>						X
Black rock skink	<i>Egernia saxatilis</i>	X	X	X	X	X	X
White's skink	<i>Egernia whitii</i>	X	X	X	X	X	X
Three-toed skink	<i>Hemiergis decresiensis</i>	X			X		X
McCoy's skink	<i>Hemiergis maccoyi</i>	X	X	X	X	X	X
Delicate skink	<i>Lampropholis delicata</i>	X	X	X	X	X	X
Garden skink	<i>Lampropholis guichenoti</i>	X	X	X	X	X	X
Weasel skink	<i>Lampropholis mustelina</i>	X	X	X	X	X	X
Coventry's skink	<i>Leiopisma coventryi</i>			X	X	X	X
Grass skink	<i>Leiopisma entrecasteauxii</i>	X	X			X	X
Red-throated skink	<i>Leiopisma platynotum</i>						X
Three-lined skink	<i>Leiopisma trilineata</i>	X	X				
Spencer's skink	<i>Pseudemoia spenceri</i>				X	X	X
Southern water skink (warm temperate form)	<i>Sphenomorphus tympanum</i>	X	X	X	X	X	X
Southern water skink (cool temperate form)	<i>Sphenomorphus tympanum</i>		X	X	X		
She-oak skink	<i>Tiliqua casuarinae</i>		X	X			
Blotched blue-tongued lizard	<i>Tiliqua nigrolutea</i>					X	X
Eastern blue-tongued lizard	<i>Tiliqua scincoides</i>	X	X		X		
Diamond python	<i>Morelia spilota spilota</i>		X				
Copperhead (highland form)	<i>Austrelaps surperbus</i>				X	X	X
Copperhead (lowland form)	<i>Austrelaps surperbus</i>		X	X	X	X	
Eastern small-eyed snake	<i>Cryptophis nigrescens</i>	X		X	X		
White-lipped snake	<i>Drysdalia coronoides</i>	X	X	X	X	X	X

Appendix V: (continued...)

Common name	Species	Scientific name	Blocks					
			1	2	3	4	5	6
Mainland tiger snake		<i>Notechis scutatus</i>	x	x	x	x	x	x
Red-bellied black snake		<i>Pseudechis porphyriacus</i>	x	x	x	x	x	x
Common brown snake		<i>Pseudonaja textilis</i>		x				x
Yellow-bellied sea snake		<i>Pelamis platurus</i>	x	x				
BIRDS								
Non-passerines								
Emu		<i>Dromaius novaehollandiae</i>	x	x	x	x	x	x
Great crested grebe		<i>Podiceps cristatus</i>	x	x		x		
Hoary-headed grebe		<i>Poliiocephalus poliocephalus</i>	x	x	x	x		
Australasian grebe		<i>Tachybaptus novaehollandiae</i>	x	x	x	x		x
King penguin		<i>Aptenodytes patagonicus</i>		x				
Little penguin		<i>Eudyptula minor</i>	x	x				
Wandering albatross		<i>Diomedea exulans</i>	x	x				
Black-browed albatross		<i>Diomedea melanophrys</i>		x				
Grey-headed albatross		<i>Diomedea chrysostoma</i>			x			
Yellow-nosed albatross		<i>Diomedea chlororhynchus</i>			x			
Shy albatross		<i>Diomedea cauta</i>	x	x				
Sooty albatross		<i>Phoebastria fusca</i>		x				
Southern giant-petrel		<i>Macronectes giganteus</i>		x				
Southern fulmar		<i>Fulmarus glacialisoides</i>		x				
Cape petrel		<i>Daption capense</i>	x	x				
Great-winged petrel		<i>Pterodroma macroptera</i>		x				
White-headed petrel		<i>Pterodroma lessonii</i>			x			
Providence petrel		<i>Pterodroma solandri</i>		x				
Mottled petrel		<i>Pterodroma inexpectata</i>		x				
Lesser broad-billed prion		<i>Pachyptila salvini</i>		x				
Slender-billed prion		<i>Pachyptila belcheri</i>		x				
Fairy prion		<i>Pachyptila turtur</i>	x	x				
Streaked shearwater		<i>Calonectris leucomelas</i>		x				
Flesh-footed shearwater		<i>Puffinus carneipes</i>		x				
Wedge-tailed shearwater		<i>Puffinus pacificus</i>		x				
Buller's shearwater		<i>Puffinus bulleri</i>		x				
Sooty shearwater		<i>Puffinus griseus</i>		x				
Short-tailed shearwater		<i>Puffinus tenuirostris</i>	x	x				
Fluttering shearwater		<i>Puffinus gavia</i>	x	x				
Hutton's shearwater		<i>Puffinus huttoni</i>	x	x				
Wilson's storm-petrel		<i>Oceanites oceanicus</i>		x				
White-faced storm-petrel		<i>Pelagodroma marina</i>		x				
Common diving-petrel		<i>Pelecanoides urinatrix</i>		x				
Australian pelican		<i>Pelecanus conspicillatus</i>	x	x	x			x
Australasian gannet		<i>Morus serrator</i>	x	x				
Darter		<i>Anhinga melanogaster</i>	x	x				
Black-faced shag		<i>Leucocarbo fuscescens</i>	x	x				
Pied cormorant		<i>Phalacrocorax varius</i>	x	x	x			x
Little pied cormorant		<i>Phalacrocorax melanoleucos</i>	x	x	x	x		x
Great cormorant		<i>Phalacrocorax carbo</i>	x	x	x	x	x	x
Little black cormorant		<i>Phalacrocorax sulcirostris</i>	x	x	x	x		x
Great frigatebird		<i>Fregata minor</i>		x				
White-tailed tropicbird		<i>Phaethon lepturus</i>		x				

Appendix V: (continued...)

Common name	Species Scientific name	Blocks					
		1	2	3	4	5	6
Pacific heron	<i>Ardea pacifica</i>	x	x	x	x		
White-faced heron	<i>Ardea novaehollandiae</i>	x	x	x	x	x	x
Cattle egret	<i>Ardeola ibis</i>	x	x	x	x	x	
Great egret	<i>Egretta alba</i>	x	x	x	x		
Little egret	<i>Egretta garzetta</i>	x	x	x	x	x	
Intermediate egret	<i>Egretta intermedia</i>		x	x			
Eastern reef egret	<i>Egretta sacra</i>		x				
Striated heron	<i>Butorides striatus</i>		x				
Rufous night heron	<i>Nycticorax caledonicus</i>	x	x	x	x	x	x
Black bittern	<i>Dupetor flavicollis</i>		x				
Australasian bittern	<i>Botaurus poiciloptilus</i>	x	x	x			
Glossy ibis	<i>Plegadis falcinellus</i>		x				
Sacred ibis	<i>Threskiornis aethiopica</i>	x	x	x	x	x	x
Straw-necked ibis	<i>Threskiornis spinicollis</i>	x	x	x	x		x
Royal spoonbill	<i>Platalea regia</i>	x	x	x			
Yellow-billed spoonbill	<i>Platalea flavipes</i>	x	x	x		x	
Magpie goose	<i>Anseranas semipalmata</i>	x		x			
Plumed whistling-duck	<i>Dendrocygna eytoni</i>	x					
Black swan	<i>Cygnus atratus</i>	x	x	x	x		x
Cape Barren goose	<i>Cereopsis novaehollandiae</i>		x				
Australian shelduck	<i>Tadorna tadornoides</i>	x	x	x	x		x
Pacific black duck	<i>Anas superciliosa</i>	x	x	x	x	x	x
Mallard (I)	<i>Anas platyrhynchos</i>	x					
Grey teal	<i>Anas gibberifrons</i>	x	x	x	x	x	x
Chestnut teal	<i>Anas castanea</i>	x	x	x	x		
Australasian shoveler	<i>Anas rhynchotis</i>	x	x				x
Pink-eared duck	<i>Malacorhynchus membranaceus</i>		x				
Hardhead	<i>Aythya australis</i>	x	x		x		x
Maned duck	<i>Chenonetta jubata</i>	x	x	x	x	x	x
Blue-billed duck	<i>Oxyura australis</i>	x					
Musk duck	<i>Biziura lobata</i>	x	x	x			
Osprey	<i>Pandion haliaetus</i>	x	x				
Black-shouldered kite	<i>Elanus notatus</i>	x	x	x	x	x	
Letter-winged kite	<i>Elanus scriptus</i>		x				
Black kite	<i>Milvus migrans</i>					x	
Square-tailed kite	<i>Lophoictinia isura</i>	x	x	x		x	x
Whistling kite	<i>Haliastur sphenurus</i>	x	x	x	x	x	x
Brown goshawk	<i>Accipiter fasciatus</i>	x	x	x	x	x	x
Collared sparrowhawk	<i>Accipiter cirrocephalus</i>	x	x	x			x
Grey goshawk	<i>Accipiter novaehollandiae</i>	x	x	x	x	x	
White-bellied sea-eagle	<i>Haliaeetus leucogaster</i>	x	x	x	x		
Wedge-tailed eagle	<i>Aquila audax</i>	x	x	x	x	x	x
Little eagle	<i>Hieraaetus morphnoides</i>	x	x	x	x		x
Spotted harrier	<i>Circus assimilis</i>	x	x		x		
Marsh harrier	<i>Circus aeruginosus</i>	x	x	x	x	x	x
Black falcon	<i>Falco subniger</i>		x				
Peregrine falcon	<i>Falco peregrinus</i>	x	x	x	x	x	x
Australian hobby	<i>Falco longipennis</i>	x	x	x	x	x	x
Grey falcon	<i>Falco hypoleucos</i>				x		
Brown falcon	<i>Falco berigora</i>	x	x	x	x	x	x
Australian kestrel	<i>Falco cenchroides</i>	x	x	x	x	x	x
Stubble quail	<i>Coturnix novaezelandiae</i>	x	x	x		x	x
Brown quail	<i>Coturnix australis</i>	x	x	x			

Appendix V: (continued...)

Common name	Species	Scientific name	Blocks						
			1	2	3	4	5	6	
King quail		<i>Coturnix chinensis</i>		X					
Painted button-quail		<i>Turnix varia</i>	X	X	X	X			X
Buff-banded rail		<i>Rallus philippensis</i>	X	X					
Lewin's rail		<i>Rallus pectoralis</i>	X	X	X	X			X
Baillon's crake		<i>Porzana pusilla</i>	X	X	X				X
Australian crake		<i>Porzana fluminea</i>	X	X					
Dusky moorhen		<i>Gallinula tenebrosa</i>	X	X	X				X
Purple swamphen		<i>Porphyrio porphyrio</i>	X	X	X	X			
Eurasian coot		<i>Fulica atra</i>	X	X	X				X
Beach thick-knee		<i>Burhinus neglectus</i>		X					
Pied oystercatcher		<i>Haematopus longirostris</i>	X	X	X				
Sooty oystercatcher		<i>Haematopus fuliginosus</i>	X	X					
Masked lapwing		<i>Vanellus miles</i>	X	X	X	X	X	X	X
Banded lapwing		<i>Vanellus tricolor</i>	X	X					
Grey plover		<i>Pluvialis squatarola</i>		X					
Lesser golden plover		<i>Pluvialis dominica</i>	X	X					
Black-fronted plover		<i>Charadrius melanops</i>	X	X	X	X	X	X	X
Hooded plover		<i>Charadrius rubricollis</i>	X	X					X
Mongolian plover		<i>Charadrius mongolus</i>		X					
Double-banded plover		<i>Charadrius bicinctus</i>	X	X					
Large sand plover		<i>Charadrius leschenaultii</i>	X						
Red-capped plover		<i>Charadrius ruficapillus</i>	X	X					
Black-winged stilt		<i>Himantopus himantopus</i>	X	X					
Ruddy turnstone		<i>Arenaria interpres</i>	X	X					
Eastern curlew		<i>Numenius madagascariensis</i>	X	X					
Whimbrel		<i>Numenius phaeopus</i>		X					
Little curlew		<i>Numenius minutus</i>		X					
Grey-tailed tattler		<i>Tringa brevipes</i>		X					
Common sandpiper		<i>Tringa hypoleucos</i>	X	X					
Greenshank		<i>Tringa nebularia</i>		X					
Marsh sandpiper		<i>Tringa stagnatilis</i>		X					
Latham's snipe		<i>Gallinago hardwickii</i>	X	X	X	X	X	X	X
Black-tailed godwit		<i>Limosa limosa</i>	X	X					
Bar-tailed godwit		<i>Limosa lapponica</i>	X	X					
Red knot		<i>Calidris canutus</i>	X	X					
Great knot		<i>Calidris tenuirostris</i>		X					
Sharp-tailed sandpiper		<i>Calidris acuminata</i>	X	X					
Red-necked stint		<i>Calidris ruficollis</i>	X	X					
Curlew sandpiper		<i>Calidris ferruginea</i>		X					
Sanderling		<i>Calidris alba</i>		X					
Broad-billed sandpiper		<i>Limicola falcinellus</i>		X					
Great skua		<i>Stercorarius skua</i>		X					
Arctic jaeger		<i>Stercorarius parasiticus</i>	X	X					
Pomarine jaeger		<i>Stercorarius pomarinus</i>		X					
Silver gull		<i>Larus novaehollandiae</i>	X	X	X				
Pacific gull		<i>Larus pacificus</i>	X	X					
Kelp gull		<i>Larus dominicanus</i>		X					
Whiskered tern		<i>Chlidonias hybrida</i>		X					
Gull-billed tern		<i>Gelochelidon nilotica</i>	X	X					
Caspian tern		<i>Hydroprogne caspia</i>	X	X	X				
Common tern		<i>Sterna hirundo</i>		X					
Arctic tern		<i>Sterna paradisaea</i>		X					
White-fronted tern		<i>Sterna striata</i>		X					

Appendix V: (continued...)

Common name	Species Scientific name	Blocks					
		1	2	3	4	5	6
Sooty tern	<i>Sterna fuscata</i>		X				
Little tern	<i>Sterna albifrons</i>		X				
Crested tern	<i>Sterna bergii</i>	X	X	X			
Superb fruit-dove	<i>Ptilinopus superbus</i>		X				
Rose-crowned fruit-dove	<i>Ptilinopus regina</i>		X				
Topknot pigeon	<i>Lopholaimus antarcticus</i>	X	X				
Feral pigeon (I)	<i>Columba livia</i>	X	X	X			X
Spotted turtle-dove (I)	<i>Streptopelia chinensis</i>		X				
Brown cuckoo-dove	<i>Macropygia amboinensis</i>		X				
Peaceful dove	<i>Geopelia placida</i>	X	X	X		X	
Diamond dove	<i>Geopelia cuneata</i>		X				
Emerald dove	<i>Chalcophaps indica</i>	X	X				
Common bronzewing	<i>Phaps chalcoptera</i>	X	X	X	X	X	X
Brush bronzewing	<i>Phaps elegans</i>	X	X	X	X	X	X
Wonga pigeon	<i>Leucosarcia melanoleuca</i>	X	X	X	X	X	X
Glossy black-cockatoo	<i>Calyptorhynchus lathami</i>	X	X	X			
Yellow-tailed black-cockatoo	<i>Calyptorhynchus funereus</i>	X	X	X	X	X	X
Gang-gang cockatoo	<i>Callocephalon fimbriatum</i>	X	X	X	X	X	X
Galah	<i>Cacatua roseicapilla</i>	X	X	X	X	X	X
Little corella	<i>Cacatua pastinator</i>		X	X			
Sulphur-crested cockatoo	<i>Cacatua galerita</i>	X	X	X	X	X	X
Rainbow lorikeet	<i>Trichoglossus haematodus</i>	X	X	X	X	X	
Musk lorikeet	<i>Glossopsitta concinna</i>	X	X	X	X	X	
Purple-crowned lorikeet	<i>Glossopsitta porphyrocephala</i>	X	X				
Little lorikeet	<i>Glossopsitta pusilla</i>	X	X	X	X		X
Australian king-parrot	<i>Alisterus scapularis</i>	X	X	X	X	X	X
Ground parrot	<i>Pezoporus wallicus</i>	X	X				
Swift parrot	<i>Lathamus discolor</i>	X	X	X			
Crimson rosella	<i>Platycercus elegans</i>	X	X	X	X	X	X
Eastern rosella	<i>Platycercus eximius</i>	X	X	X	X	X	X
Red-rumped parrot	<i>Psephotus haematotus</i>		X				
Blue-winged parrot	<i>Neophema chrysostoma</i>	X	X				
Turquoise parrot	<i>Neophema pulchella</i>		X	X			
Pallid cuckoo	<i>Cuculus pallidus</i>	X	X	X	X	X	X
Brush cuckoo	<i>Cuculus variolosus</i>	X	X	X	X	X	X
Fan-tailed cuckoo	<i>Cuculus pyrrhophanus</i>	X	X	X	X	X	X
Horsfield's bronze-cuckoo	<i>Chrysococcyx basilis</i>	X	X	X	X	X	X
Shining bronze-cuckoo	<i>Chrysococcyx lucidus</i>	X	X	X	X	X	X
Common koel	<i>Eudynamis scolopacea</i>		X				
Channel-billed cuckoo	<i>Scythrops novaehollandiae</i>		X				
Powerful owl	<i>Ninox strenua</i>		X	X		X	X
Southern boobook	<i>Ninox novaeseelandiae</i>	X	X	X	X	X	X
Barking owl	<i>Ninox connivens</i>	X	X	X	X		
Barn owl	<i>Tyto alba</i>	X	X	X			X
Masked owl	<i>Tyto novaehollandiae</i>	X	X	X	X		
Sooty owl	<i>Tyto tenebricosa</i>	X	X	X		X	X
Tawny frogmouth	<i>Podargus strigoides</i>	X	X	X	X	X	X
Australian owl-nightjar	<i>Aegotheles cristatus</i>	X	X	X	X	X	X
White-throated nightjar	<i>Caprimulgus mystacalis</i>	X	X	X		X	X

Appendix V: (continued...)

Common name	Species	Scientific name	Blocks					
			1	2	3	4	5	6
White-throated needle-tail		<i>Hirundapus caudacutus</i>	x	x	x	x	x	x
Fork-tailed swift		<i>Apus pacificus</i>		x				
Azure kingfisher		<i>Ceyx azurea</i>	x	x	x		x	
Laughing kookaburra		<i>Dacelo novaeguineae</i>	x	x	x	x	x	x
Sacred kingfisher		<i>Halcyon sancta</i>	x	x	x	x	x	x
Rainbow bee-eater		<i>Merops ornatus</i>						x
Dollarbird		<i>Eurystomus orientalis</i>		x	x			x
Passerines								
Superb lyrebird		<i>Menura novaehollandiae</i>	x	x	x	x	x	x
Singing bushlark		<i>Mirafrja javanica</i>		x		x		
Skylark (I)		<i>Alauda arvensis</i>	x	x		x		x
Welcome swallow		<i>Hirundo neoxena</i>	x	x	x	x	x	x
Tree martin		<i>Cecropis nigricans</i>	x	x	x	x	x	x
Fairy martin		<i>Cecropis ariel</i>	x	x	x		x	x
Richard's pipit		<i>Anthus novaeseelandiae</i>	x	x	x	x	x	x
Black-faced cuckoo-shrike		<i>Coracina novaehollandiae</i>	x	x	x	x	x	x
White-bellied cuckoo-shrike		<i>Coracina papuensis</i>	x	x	x		x	
Cicadabird		<i>Coracina tenuirostris</i>		x	x	x	x	x
White-winged triller		<i>Lalage sueurii</i>	x	x	x	x		x
White's thrush		<i>Zoothera dauma</i>	x	x	x	x	x	x
Blackbird (I)		<i>Turdus merula</i>	x	x	x	x	x	x
Rose robin		<i>Petroica rosea</i>	x	x	x	x	x	x
Pink robin		<i>Petroica rodinogaster</i>	x	x	x	x	x	x
Flame robin		<i>Petroica phoenicea</i>	x	x	x	x	x	x
Scarlet robin		<i>Petroica multicolor</i>	x	x	x	x	x	x
Red-capped robin		<i>Petroica goodenovii</i>	x	x	x	x		
Hooded robin		<i>Melanodryas cucullata</i>	x	x	x	x		x
Eastern yellow robin		<i>Eopsaltria australis</i>	x	x	x	x	x	x
Jacky winter		<i>Microeca leucophaea</i>	x	x	x	x	x	x
Crested shrike-tit		<i>Falcunculus frontatus</i>	x	x	x	x	x	x
Olive whistler		<i>Pachycephala olivacea</i>	x	x	x	x	x	x
Golden whistler		<i>Pachycephala pectoralis</i>	x	x	x	x	x	x
Rufous whistler		<i>Pachycephala rufiventris</i>	x	x	x	x	x	x
Grey shrike-thrush		<i>Colluricincla harmonica</i>	x	x	x	x	x	x
Black-faced monarch		<i>Monarcha melanopsis</i>	x	x	x	x	x	x
Leaden flycatcher		<i>Myiagra rubecula</i>	x	x	x	x	x	x
Satin flycatcher		<i>Myiagra cyanoleuca</i>	x	x	x	x	x	x
Restless flycatcher		<i>Myiagra inquieta</i>	x	x	x	x	x	x
Rufous fantail		<i>Rhipidura rufifrons</i>	x	x	x	x	x	x
Grey fantail		<i>Rhipidura fuliginosa</i>	x	x	x	x	x	x
Willie wagtail		<i>Rhipidura leucophrys</i>	x	x	x	x	x	x
Eastern whipbird		<i>Psophodes olivaceus</i>	x	x	x	x	x	x
Spotted quail-thrush		<i>Cinclosoma punctatum</i>	x	x	x	x	x	x
Clamorous reed-warbler		<i>Acrocephalus stentoreus</i>	x	x	x	x		
Little grassbird		<i>Megalurus gramineus</i>	x	x	x			x
Golden-headed cisticola		<i>Cisticola exilis</i>	x	x	x	x	x	
Rufous songlark		<i>Cinclorhamphus mathewsi</i>		x	x	x	x	x
Brown songlark		<i>Cinclorhamphus cruralis</i>		x	x			

Appendix V: (continued...)

Common name	Species	Scientific name	Blocks					
			1	2	3	4	5	6
Superb fairy-wren		<i>Malurus cyaneus</i>	x	x	x	x	x	x
Southern emu-wren		<i>Stipiturus malachurus</i>	x	x	x		x	
Eastern bristlebird		<i>Dasyornis brachypterus</i>	x	x				
Pilotbird		<i>Pycnoptilus floccosus</i>	x	x	x	x	x	x
Large-billed scrubwren		<i>Sericornis magnirostris</i>	x	x	x	x	x	x
White-browed scrubwren		<i>Sericornis frontalis</i>	x	x	x	x	x	x
Chestnut-rumped hylacola		<i>Sericornis pyrrhopygius</i>	x	x	x			x
Calamanthus		<i>Sericornis fuliginosus</i>		x				
Speckled warbler		<i>Sericornis sagittatus</i>		x	x			
Weebill		<i>Smicronis brevirostris</i>	x	x	x	x		x
Brown gerygone		<i>Gerygone mouki</i>	x	x	x	x	x	x
White-throated gerygone		<i>Gerygone olivacea</i>	x	x	x	x	x	x
Brown thornbill		<i>Acanthiza pusilla</i>	x	x	x	x	x	x
Buff-rumped thornbill		<i>Acanthiza reguloides</i>	x	x	x	x	x	x
Yellow-rumped thornbill		<i>Acanthiza chrysorrhoa</i>	x	x	x	x	x	x
Yellow thornbill		<i>Acanthiza nana</i>	x			x	x	x
Striated thornbill		<i>Acanthiza lineata</i>	x	x	x	x	x	x
Southern whiteface		<i>Aphelocephala leucopis</i>		x				
Varied sittella		<i>Daphoenositta chrysoptera</i>	x	x	x	x	x	x
White-throated tree-creeper		<i>Climacteris leucophaea</i>	x	x	x	x	x	x
Red-browed treecreeper		<i>Climacteris erythroptis</i>	x	x	x	x	x	x
Brown treecreeper		<i>Climacteris picumnus</i>	x	x	x	x		x
Red wattlebird		<i>Anthochaera carunculata</i>	x	x	x	x	x	x
Little wattlebird		<i>Anthochaera chrysoptera</i>	x	x	x	x	x	x
Spiny-cheeked honey-eater		<i>Acanthagenys rufogularis</i>	x					
Noisy friarbird		<i>Philemon corniculatus</i>	x	x	x			x
Little friarbird		<i>Philemon citreogularis</i>	x	x		x		
Regent honeyeater		<i>Xanthomyza phrygia</i>	x	x	x			
Bell miner		<i>Manorina melanophrys</i>	x	x	x	x	x	x
Noisy miner		<i>Manorina melanocephala</i>	x	x	x			
Lewin's honeyeater		<i>Meliphaga lewinii</i>	x	x	x	x	x	x
Yellow-faced honeyeater		<i>Lichenostomus chrysops</i>	x	x	x	x	x	x
White-eared honeyeater		<i>Lichenostomus leucotis</i>	x	x	x	x	x	x
Yellow-tufted honeyeater		<i>Lichenostomus melanops</i>	x	x	x	x	x	x
Fuscous honeyeater		<i>Lichenostomus fuscus</i>	x				x	x
White-plumed honeyeater		<i>Lichenostomus penicillatus</i>	x	x		x		
Brown-headed honeyeater		<i>Melithreptus brevirostris</i>	x	x	x	x	x	x
White-naped honeyeater		<i>Melithreptus lunatus</i>	x	x	x	x	x	x
Crescent honeyeater		<i>Phylidonyris pyrrhoptera</i>	x	x	x	x	x	x
New Holland honeyeater		<i>Phylidonyris novae-hollandiae</i>	x	x	x	x	x	x
White-cheeked honeyeater		<i>Phylidonyris nigra</i>		x				
Tawny-crowned honeyeater		<i>Phylidonyris melanops</i>	x	x	x			
Eastern spinebill		<i>Acanthorhynchus tenuirostris</i>	x	x	x	x	x	x
Scarlet honeyeater		<i>Myzomela sanguinolenta</i>	x	x	x		x	
White-fronted chat		<i>Epthianura albifrons</i>	x	x		x		
Mistletoebird		<i>Dicaeum hirundinaceum</i>	x	x	x	x	x	x
Spotted pardalote		<i>Pardalotus punctatus</i>	x	x	x	x	x	x
Striated pardalote		<i>Pardalotus striatus</i>	x	x	x	x	x	x

Appendix V: (continued...)

Common name	Species	Scientific name	Blocks					
			1	2	3	4	5	6
Silvereye		<i>Zosterops lateralis</i>	x	x	x	x	x	x
European goldfinch (I)		<i>Carduelis carduelis</i>	x	x	x	x	x	x
European greenfinch (I)		<i>Carduelis chloris</i>	x	x				
House sparrow (I)		<i>Passer domesticus</i>	x	x	x	x	x	x
Tree sparrow (I)		<i>Passer montanus</i>	x			x		
Red-browed firetail		<i>Emblema temporalis</i>	x	x	x	x	x	x
Beautiful firetail		<i>Emblema bella</i>	x	x	x	x		
Diamond firetail		<i>Emblema guttata</i>	x	x	x	x	x	x
Double-barred finch		<i>Poephila bichenovii</i>			x			
Common starling (I)		<i>Sturnus vulgaris</i>	x	x	x	x	x	x
Common mynah (I)		<i>Acridotheres tristis</i>		x				
Olive-backed oriole		<i>Oriolus sagittatus</i>	x	x	x	x	x	x
Spangled drongo		<i>Dicrurus hottentottus</i>	x	x			x	
Satin bowerbird		<i>Ptilonorhynchus violaceus</i>	x	x	x	x	x	x
White-winged chough		<i>Corcorax melanorhamphos</i>	x	x	x	x	x	x
Australian magpie-lark		<i>Grallina cyanoleuca</i>	x	x	x	x		x
Masked woodswallow		<i>Artamus personatus</i>	x				x	
White-browed woodswallow		<i>Artamus superciliosus</i>	x	x	x	x		
Dusky woodswallow		<i>Artamus cyanopterus</i>	x	x	x	x	x	x
Grey butcherbird		<i>Cracticus torquatus</i>	x	x	x	x	x	x
Pied butcherbird		<i>Cracticus nigrogularis</i>		x				
Australian magpie		<i>Gymnorhina tibicen</i>	x	x	x	x	x	x
Pied currawong		<i>Strepera graculina</i>	x	x	x	x	x	x
Grey currawong		<i>Strepera versicolor</i>	x	x	x	x	x	x
Australian raven		<i>Corvus coronoides</i>	x	x	x	x	x	x
Little raven		<i>Corvus mellori</i>	x	x	x	x	x	x

Appendix VI

SIGNIFICANT AND NOTABLE SPECIES IN EAST GIPPSLAND

Key to Appendix VI

Status: R - Rare
 U - Uncommon
 C - Common
 A - Abundant

Distribution: R - Restricted
 M - Moderate
 W - Widespread

Population trend: D - Decreasing
 S - Stable
 I - Increasing
 ? - Unknown
 D? - Possibly decreasing
 S? - Possibly stable

Species	Status		Distribution		Population trend	
	Aust.	Vic.	Aust.	Vic.	Aust.	Vic.
SIGNIFICANT						
Tiger quoll	U	R	M	M	D?	D?
Common wallaroo	A	R	W	R	S	?
Brush-tailed rock-wallaby	C	R	M	R	S?	D?
Long-footed potoroo	-	R	-	R	-	?
Great barred frog	U	R	R	R	D	D
Diamond python	U	R	M	R	D	D
White-faced storm-petrel	U	U	M	M	S	S
Little tern	U	R	M	R	S	D
Glossy black cockatoo	U	R	M	R	D	D
Ground parrot	R	R	R	R	D	D
Turquoise parrot	R	R	M	R	S	I
Masked owl	R	R	M	M	S	S
Eastern bristlebird	R	R	R	R	D	D
Regent honeyeater	R	R	M	M	D	D
Australian grayling	R	R	M	M	D	D
NOTABLE						
Eastern horseshoe-bat	C	U	M	M	?	?
Common bent-wing bat	A	C	M	M	S?	D?
Large-footed myotis	R	R	M	M	?	?
Smoky mouse	-	R	-	R	-	S?
Giant burrowing frog	U	R	M	R	D	D
Blue Mountains tree frog	U	U	M	R	D	D
Jervis Bay tree frog	U	U	M	R	D	D

Appendix VI: (continued...)

Species	Status		Distribution		Population trend	
	Aust.	Vic.	Aust.	Vic.	Aust.	Vic.
Common scaly-foot	U	U	W	M	D	D
Red-throated skink	C	U	M	R	S	S
Swamp skink	R	U	R	M	D	D
She-oak skink	U	R	M	R	D	D
Australian bass	C	U	M	R	D	D
Freshwater herring	R	R	R	R	?	?
Climbing galaxias	U	U	M	M	D	D
Spotted mountain galaxias	U	U	R	M	D	D
Striped gudgeon	U	R	M	R	?	?

Species	Status		Distribution	
	Aust.	Vic.	Aust.	Vic.

Notable birds

Black-faced shag	R	R	R	R	Comment: Study area contains much of the rocky coast line and estuarine habitat to which this species is restricted.
Eastern reef egret	C	R	M	R	Comment: Victorian range is generally restricted to the mudflats and rocky shores in the east of the study area.
Striated heron	C	R	M	R	Comment: Victorian range is restricted to the mudflats in the east of the study area.
Black bittern	U	R	M	R	Comment: Cryptic species known in Victoria from only two records, both in East Gippsland.
Osprey	U	R	M	R	Comment: Undisturbed coast of the study area provides excellent habitat for this rarely recorded raptor.
Square-tailed kite	R	R	W	R	Comment: Recorded over the forests of the study area more often than elsewhere in Victoria.

Appendix VI: (continued...)

Species	Status		Distribution	
	Aust.	Vic.	Aust.	Vic.
Grey goshawk	U	R	M	M
	Comment: Study area is one of the few areas in Victoria where it is known to breed.			
Peregrine falcon	U	U	W	W
	Comment: Pesticide accumulation has led to a serious decrease in egg-shell thickness in Victoria, a dramatic population decline could be imminent.			
King quail	U	R	M	R
	Comment: Victorian population has declined; still found in the coastal heaths and rank vegetation of the study area.			
Hooded plover	R	R	R	R
	Comment: Study area contains much of the undisturbed sandy beach habitat to which it is restricted in Victoria.			
Latham's snipe	U	U	M	W
	Comment: Australia-wide decline due to hunting, and draining of wetlands.			
Powerful owl	R	R	M	M
	Comment: Hollow-dependent species threatened by decrease in suitable tree-hollows due to silvicultural practices.			
Sooty owl	R	R	R	M
	Comment: Hollow-dependent species threatened by decrease in suitable tree-hollows due to silvicultural practices.			
Black-faced monarch	U	U	M	M
	Comment: Migratory species requiring moist gully or creek vegetation; most of its Victorian population breeds in in the study area.			
Southern emu-wren	R	R	M	M
	Comment: Victorian distribution is becoming increasingly fragmented; study area contains much of its preferred heathy habitats.			

Appendix VI: (continued...)

Species	Status		Distribution	
	Aust.	Vic.	Aust.	Vic.
Large-billed scrub-wren	U	R	M	M
	Comment: Study area contains much of the rainforest and closed moist gully vegetation to which it is restricted in Victoria.			
Brown gerygone	U	R	M	R
	Comment: Restricted to moist gully and creek vegetation, especially rainforest; most of its Victorian population breeds in the study area.			
Scarlet honeyeater	U	R	M	M
	Comment: Regularly recorded in Victoria only in the east of the study area, when suitable shrubs and trees are flowering.			
Beautiful firetail	U	R	M	R
	Comment: Restricted to thick vegetation, especially along gullies and creeks; study area contains ample quantities of this habitat.			

Appendix VII

**MAMMAL SPECIES NO LONGER PRESENT IN THE AREA BUT RECORDED
AS SUBFOSSIL REMAINS NEAR THE SNOWY RIVER, EAST OF BUCHAN**

Mountain pygmy-possum	<i>Burramys parvus</i>
Little pygmy-possum	<i>Cercartetus lepidus</i>
Leadbeater's possum	<i>Gymnobelideus leadbeateri</i>
Squirrel glider	<i>Petaurus norfolcensis</i>
Tasmanian bettong	<i>Bettongia gaimardi</i>
White-eared tree-rat	<i>Conilurus albipes</i>
New Holland mouse	<i>Pseudomys novaehollandiae</i>
Broad-toothed rat	<i>Mastacomys fuscus</i>

From Wakefield (1960a and 1960b).

Appendix VIII

BUTTERFLY SPECIES RECORDED IN EAST GIPPSLAND

Records based on Burns (1947, 1960, 1962b, 1963); Common and Waterhouse (1981); Crosby (1951, 1963, 1973, 1975); Hunting (1980a, 1980b); McEvey (1974).

Compiled by A. Yen, Museum of Victoria (1982).

Family HesperIIDae

- Badamia exclamationus* (Fabricius)
 * *Trapezites symmopus symmopus* Hubner
T. eliena (Hewitson)
 * *T. iacchoides* (Waterhouse)
T. maheta praxedes (Plotz)
T. phigalioides Waterhouse
T. phigalia phigalia (Hewitson)
Dispar compacta (Butler)
Pasma tasmanica (Miskin)
Signeta flammeata (Butler)
 * *Toxidia peron* (Latrielle)
T. parvula (Plotz)
T. doubledayi (Felder)
T. andersoni (Kirby)
Hesperilla idothea idothea (Miskin)
H. donnysa patmos Waterhouse
 * *H. masteri masteri* Waterhouse
H. ornata ornata (Leach)
 * *H. picta* (Leach)
Mesodina halyzia halyzia (Hewitson)
Taractrucera papyria papyria (Boisduval)
Ocybadistes walkeri sothis Waterhouse
Suniana lascivia lascivia (Rosenstock)
 * *Telicota ancilla ancilla* (Herrick-Schaffer)

Family Papilionidae

Graphium macleayanum macleayanum (Leach)

Family Peridae

- Catopsilia pyrantha crokera* (W.S. Macleay)
Eurena smilax (Donovan)
Delias aganippe (Donovan)
D. harpalyce (Donovan)
 * *D. nigrina* (Fabricius)
 * *D. nysa nysa* (Fabricius)
Anaphaeis java teutonia (Fabricius)
 * *Appias paulina ega* (Boisduval)
Pieris rapae rapae (Linnaeus)

Family Nymphalidae

- Danaus plexippus plexippus* (Linnaeus)
D. chrysippus petilia (Stoll)
 * *D. hamatus hamatus* (W.S. Macleay)
Euphloea core corrinna (W.S. Macleay)
 * *Hypocysta euphemia* Westwood

Appendix VIII: (continued...)

Family Nymphalidae (continued...)

- Argynnina cyrila* Waterhouse and Lyell
Geitoneura acantha ocrea (Guest)
G. klugii klugii (Guerin-Meneville)
Heteronympha merope merope (Fabricius)
H. mirifica (Butler)
H. paradelpha paradelpha Lower
H. banksii banksii (Leach)
Tisiphone abeone albifascia Waterhouse
Xois arctoa arctoa (Fabricius)
* *Hypolimnua bolina nerina* (Fabricius)
Vanessa kershawi (McCoy)
V. itea (Fabricius)
Junonia villida calybe (Godart)

Family Lycaenidae

- Lucia limbaria* Swainson
Acrodipsas cuprea (Sands)
* *A. brisbanensis brisbanensis* (Miskin)
* *Paralucia pyrodiscus pyrodiscus* (Rosenstock)
P. aurifera (Blanchard)
Hypochrysops delicia delos (Waterhouse and Lyell)
H. ignitus ignitus (Leach)
H. byzos byzos (Boisduval)
Ogyris abrota Westwood
O. olane ocela Waterhouse
Jalmenus evagoras evagoras (Donovan)
Pseudalmenus chlorinda zephyrus Waterhouse and Lyell
Candalides absimilis (Felder)
C. consimilis goodingi (Tindale)
C. acastus (Cox)
C. hyacinthus hyacinthus (Semper)
C. xanthospilas (Hubner)
Nacaduba biocellata biocellata (C. and R. Felder)
Neolucia agricola agricola (Westwood)
N. mathewsi (Miskin)
Theclinesthes serpentata serpentata (Herrich-Schaffer)
* *T. sulphitius sulphitius* (Miskin)
Zizina labradus labradus (Godart)

* Indicates east coast or subtropical species

Appendix IX

FISH SPECIES FOUND IN EAST GIPPSLAND STREAMS,
LAKES, AND ESTUARIES

Notes:

1. The mountain galaxias and freshwater blackfish are the only species listed that are confined exclusively to fresh water.
2. Both the striped gudgeon and freshwater herring are uncommon in the study area and their distribution is not well known.
3. Introduced species.
4. The black stingray, big-eye sprat, and latchet gurnard are essentially marine species but are occasionally found in East Gippsland estuaries.

Appendix X

INQUIRY INTO THE VICTORIAN TIMBER INDUSTRY

The Report of the Board of Inquiry into the Timber Industry was received by the Council just prior to the publication of this descriptive report. The Terms of Reference, Report Summary and response by the government are reproduced in full below, as it is considered that they will provide useful information to those intending to make submissions to the Council concerning the use of public land in the East Gippsland area. Readers are encouraged to obtain the full Report which is available from the Melbourne, and Regional, Offices of the Department of Conservation, Forests and Lands, together with the government's response.

Some explanation of the terminology adopted in the report is required here, because the eastern portion of the State has been referred to in a number of different ways in the Inquiry Report. The Land Conservation Council's East Gippsland area is depicted on Map 7 facing page 194 of this descriptive report, and includes the whole of the Orbost administrative Region, and a small portion of the Bairnsdale administrative Region of the Department of Conservation, Forests and Lands. The East Gippsland Division (Section 11.2, Inquiry Report) is the Statistical Division adopted by the Australian Bureau of Statistics for data-collection purposes, and comprises the Shires of Maffra, Avon, Bairnsdale, Omeo, Tambo, and Orbost, as well as the Cities of Bairnsdale and Sale.

The Far East Gippsland Hardwood Production Zone referred to in the Inquiry Report corresponds exactly with the Land Conservation Council's East Gippsland area, while the East Gippsland Hardwood Production Zone lies to the west of the study area and includes sawmilling centres such as Heyfield, Benambra, Swifts Creek and Buchan.

EXTRACTS FROM REPORT OF THE BOARD OF INQUIRY INTO THE TIMBER INDUSTRY - JUNE 1985

1.2 TERMS OF REFERENCE

The following Terms of Reference were laid down:

The Inquiry will investigate and report on all aspects of the timber industry in Victoria. In particular, the Inquiry will provide options for a long-term strategy for the development of Victoria's timber and forest products industries consistent with the Government's social, economic, employment and environmental policies and objectives.

The Inquiry will work within the following guidelines:

1. The introduction of harvesting on regional sustainable yield;
2. The need to minimise any adverse effect in the industry on employment and on the stability of dependant communities;
3. the continued viability of the industry consistent with the optimum economic return to the State and with approved environmental and land use policies.

In developing options the Inquiry will take into consideration and quantify where necessary:

1. the contribution of the timber and forests products industries to the Victorian economy;

2. the economics of the industry including trends in investments, ownership, industry integration (vertical and/or horizontal), import competition and the need for a competitive timber industry;
3. the efficiency of the industry, including the need and scope for restructuring and the potential and options for future development and diversification;
4. the employment, social, economic and environmental consequences of the strategy options;
5. the role of new technology and the management of technological change;
6. the scope for retraining of timber industry employees both within the industry and in alternative fields;
7. timber location, quality and volume - current and future - and the efficient and equitable allocation of timber resources;
8. resource use efficiency and product trends;
9. the role of private forestry and options for encouraging and extending reforestation of private land; and
10. the compatibility of resource utilisation with the retention and protection of other forest values.

The Inquiry will specifically investigate and report on:

1. the economic and environmental effects of current and proposed pulpwood harvesting schemes;
2. the extent to which it is possible, and desirable, for Victoria to be self-sufficient in wood products;
3. the need for and effectiveness of forward planning in the industry.

And it is hereby directed that the said Ian Ferguson shall, with as little delay as possible and by 31 May 1985, at the latest, report under his hand his opinion resulting from this Inquiry, and it is hereby directed that legal representation before the Board shall not be permitted.

The Terms of Reference require that options developed by the Inquiry are to be based on the decisions made by the Government in regard to land use. The Inquiry therefore has no reference to review or comment on land use decisions and these are clearly not its function. However, the long-term implications of those decisions for the Timber Industry are matters to be considered by the Inquiry.

SUMMARY

The scope of the report is considerable and the principal focus of this summary is therefore on the major recommendations, rather than on the conclusions and the detail of some of the recommendations.

Chapter 2: Forestry and the regional economy

The Timber Industry is trade-exposed in character (Section 2.4). It also has extensive linkages with other industries which contribute significantly to maintaining the infrastructure of the rural economy (Section 2.3.1).

Chapter 3: The wood processing industries

The Timber Industry is predominantly in Australian ownership. The market structures and degrees of concentration vary widely within different sectors of the industry.

Chapter 4: Self-sufficiency

Self-sufficiency should not be adopted as a basis for the planning of wood production in Victoria (Section 4.5).

Chapter 5: Cost-competitiveness

The overwhelming emphasis in softwood sawmilling is to larger-scale mills which enjoy substantial economies of scale. This does not preclude the development of small mills in locations where the resource is limited and speciality or local markets can be developed (Section 5.2.1).

Hardwood sawmilling is more diverse in scale and in the degree of further processing. However, technological change will tend to favour larger-scale mills. The present system of log allocation restricts efficient adaptation to change (Section 5.2.1).

The sole hardboard producer seems well placed to meet future cost pressures. Most particleboard producers are similarly placed but will suffer very severe competitive pressures. Plywood producers similarly face severe competitive pressures and suffer from limitations in wood supply at present (Section 5.2.2.).

Pulp and paper producers operate technologically advanced plants and pulp and newsprint production is generally cost-competitive by international standards. Paper (other than newsprint) production suffers limitations because of the limited size of the Australian market (Section 5.2.3).

The present regulation concerning the use of rail freight in the designated zone of East Gippsland should be abolished and an investigation carried out into the need for a direct subsidy of rail cartage of timber (Section 5.3).

The prospects for growth in terms of import replacement and exports are substantial, if the industry can become more cost-competitive (Section 5.4).

Chapter 6: The demand for wood

More research should be carried out to refine the data and methodology used in the preparation of forecasts (Sections 6.1 to 6.4). Future trends for sawn timber are most open to debate and may hinge on the capacity of the sawmilling industry to become more cost-competitive (Section 6.3).

Chapter 7: The forest estate

The public forest estate dominates the supply of hardwood, environmental

services, and other forest produce in Victoria (Section 7.2). Although 63% of the public land area is designated for wood production, along with other uses, only about 31% of the area so designated is currently considered available for wood production (Section 7.2.1).

A little under a half of the area of softwood plantations is privately-owned, principally by wood-processing interests, and contributes a similar proportion to the supply of softwood in Victoria (Section 7.3).

The inventory procedures used by the Department of Conservation, Forests and Lands generally seem appropriate, as do the standards of reliability of the inventory estimates. However, some additional attention should be given to estimates of the length of future cutting available in old-growth forests in East Gippsland. A Regional network of computing facilities should be developed to facilitate application of recommended planning methods. The central inventory branch should be strengthened to train Regional staff, monitor standards, and service computing, research and other specialized needs (Section 7.4.3).

Chapter 8: The supply of wood

Silvicultural methods to ensure adequate regeneration are generally well developed for hardwood forests. Those for planting and treatment of softwood plantations are more intensive and well developed (Section 8.2).

The amount of wood made available from public forests is currently regulated according to two principles - multiple use and sustained yield. However, literal adherence to the ideal of a sustained (constant) yield is not practicable, nor does the Department attempt to enforce it rigidly. Forecasts of availability have been prepared by the Department based on sustained yield calculations (Section 8.3).

The matching of forecasts of consumption and production for wood products in Victoria fails to address a critical issue, that of trade. Supply and demand interactions are more complex than the matching of these forecasts would suggest. The exercise of matching forecasts is potentially misleading and imprecise, and should not be used to define options for planning softwood planting (Section 8.5).

Chapter 9: Regional sustainable yield

The traditional sustained yield model should not be used in the planning of wood production (Section 9.2.1). The objective for managing public forests should be to maximize the net social benefits to the community (Section 9.2.2). That objective can best be translated into four operational principles for planning and management of public forests. The provision of wood and other market goods should be:

1. economically viable,
2. environmentally sensitive, with respect to the provision of environmental services and other non-market goods,
3. sustainable with respect to the interests of future generations, and
4. assisted by public participation in the planning process (Section 9.3).

Legislation should be amended to include clear definitions of objectives embracing environmental goods and services, as well as wood and other

forest produce. This legislation should not define priorities for these objectives, this being more appropriately done in Regional Management Plans (Section 9.3.2).

The principle of sustainability should not be interpreted as implying a steady-state approach in the immediate future. Rather, it should be seen as a set of possible constraints on the state of the forest at the end of the planning horizon (say 50 years hence) to protect the interests of future generations (Section 9.3.3).

The implementation of regional sustainable yield should be based on the four principles enumerated above and should correspond geographically with the administrative Regions of the Department of Conservation, Forests and Lands. The preparation of Regional Management Plans should be a legislative requirement, with provision for revision every five to ten years. These plans may be supplemented by more detailed plans for individual forests or parks within the Region (Section 9.4.1).

The State Forests and Lands Service of the Department should strengthen greatly its capacity to provide the necessary services in inventory and planning work. Modern planning methods should be introduced to exploit better the flexibility available in the rate and/or manner of cutting of wood over time. At least three specialist teams should be established to develop computer-based modelling systems (Section 9.4.2).

Formal public participation in the planning process should be developed by the formation of Regional Advisory Committees (Section 9.3.4 and 9.4.3). Membership should be broadly representative of interests and should include specialist expertise, where appropriate, but should not normally exceed ten members.

An Annual Conference of the chairpersons of the Regional Advisory Committees should be held and the Chairperson of that Conference should be appointed to the State Advisory Committee (Section 9.4.3).

Chapter 10: Efficient and equitable allocation

Average aggregate sales of wood from public forests have generally been maintained at levels somewhat lower than the commitments under licences and agreements (Section 10.2 and 10.3).

Consideration should be given to the sale of about 25% of the sawlog cut through short-term timber sales by tender or auction, where possible. The possibilities of developing a centralized log yard or yards for the sale of some regrowth ash logs from the Central Highlands should be examined immediately (Section 10.5.1).

Compliance with safety and occupational health rules should not be included among the conditions of any licence. However, serious contraventions should be dealt with vigorously, by requiring immediate correction and closure of the mill, if necessary (Section 10.5.2).

No major fee should be imposed on the transfer of licences but the provisions of licences should include a requirement for mandatory and verifiable reporting of goodwill or transfer payments (Section 10.5.2).

Renewal should be an option for licences, subject to the introduction of a competitive element in the determination of price and retention. The existing licensee should have the right of renewal subject to matching the highest tender price (Section 10.5.2).

Holders of licences which are "subject to availability" should be given five years' notice of termination of the licence. Where possible thereafter, the Department should make available an equivalent volume through short-term timber sales by tender or auction (Section 10.5.2).

Other holders of existing licences should be offered a choice between:

1. Immediate conversion to a transferable, renewable licence of 15 years' duration, subject to payment of a licence fee of \$90,000.
2. Immediate conversion to a transferable, renewable licence of 10 years' duration, subject to payment of a licence fee of \$30,000.
3. Maintenance of the present licence for a period of 5 years, followed by provision for an equivalent volume to be made available, where possible, through short term timber sales by tender or auction (Section 10.5.2).

Renewal of licences for those resources which would not support a ten-year term, should be granted to the existing licence holders, without going to tender. They should be terminated when the old-growth resource is exhausted.

When existing Agreements are reviewed, provision should be made for conversion to a so-called "evergreen" form, providing for a rolling 20 year term subject to a five-yearly review. The use of agreements should not be restricted to one particular product. Pre-qualification registration of intending purchasers should be utilized, followed by tendering by eligible companies. The tender bid should address both a reference price, or prices, for wood and a one-time licence fee (Section 10.5.2).

The costs of growing wood should only be considered as one of the five points to be taken into consideration in pricing wood from public forests, not the primary point (Section 10.6.1).

Transfer or goodwill payments for transfers of licences should be monitored and taken into account in periodic reviews of the pricing wood from public forests (Section 10.6.2).

Appropriate indices should be prepared for transaction prices of wood products and used to make quarterly rise or fall adjustments to the prices of wood from public forests. Greater flexibility should be introduced into licences and agreements for variation in the amount cut in any one year, within certain constraints (Section 10.6.3).

The residual pricing system should be improved. In consultation with sawmillers (and others), access to provide summaries of costs should be developed. Aspects connected with rail haulage of sawn timber, the point of price determination, differences in logging costs and the treatment of sawmill residues should be revised (Section 10.6.4).

A Controller of Licences, with direct access to the Minister of Conservation, Forests and Lands, should not be appointed. A mechanism for appeals relating to the conditions of a licence (or agreement) should be introduced, utilizing the Administrative Appeals Tribunal as an arbitrator. Methods of measurement used for the sale of wood should be investigated and the most cost-effective methods introduced, the costs being borne equally by purchaser and seller (Section 10.7).

Chapter 11: The role of private forestry

Native vegetation occurs only as relatively small and scattered remnants throughout most of the State. However, private hardwood forests of some significance for wood production are to be found in the Otways, North-Eastern and East Gippsland Divisions (Section 11.2).

Private softwood plantations are of much greater significance for wood production, nearly half the total area in Victoria being privately owned mainly by industrial and investment companies (Section 11.3).

The exchange of information regarding the public and private wood resource should be encouraged through the formation of appropriately constituted sub-committees of the Regional Advisory Committees (Section 11.4.3).

Adequate information on the economics of private tree- and forest-growing is lacking (Section 11.5).

The Victorian Government should make representations to the Commonwealth Government on the following aspects of taxation:

1. The tax-free status accorded to Stanton-type contracts (lump-sum sales) should be abolished.
2. The provisions for tax deductibility for taxpayers other than afforestation companies should be changed to allow a tax rebate of one-third of the expenditure on tree planting and maintenance, whatever the purpose of that planting.
3. The present provisions for taxation of personal taxable income received from wood production should be set at the minimum marginal rate (Section 11.6.1).

The present Farm Forestry Loan Scheme should be abolished by immediate conversion of personal loans to grants. All future interest payments should be waived (Section 11.6.2).

Future tree planting programmes on private land should be directed towards specific verifiable goals and should be encouraged by cash grants on completion of the tree planting (Section 11.6.2).

A Code of Forest Practices should be prepared at a State level, with provision for appropriate regional variations, for incorporation in Planning Schemes or Interim Development Orders. The Code should have two divisions, one for public and another for private land. The Code for private land should deal with the impact of forest operations on environmental values; it should not prescribe the preparation of management or harvesting plans because these would not be commensurate with the problem. The Code for private land should include provision for operations to be supervised and approved by licensed private foresters (Section 11.6.3).

The Code of Forest Practice should be administered through an independent State committee, the State Advisory Committee. This Committee should have the power to establish a Forest Practices Tribunal to examine complaints and to conduct spot checks of operations on private or public lands. The Tribunal should have powers to order restoration work, impose penalties, and cancel the licenses of private foresters.

Chapter 12: Environmental services and other forest produce

Environmental services supplied by Victorian forests are manifold in

character and growing in importance. Sensitive management of forest operations can do much to minimize their impact on the supply of these services (Sections 12.2 to 12.4).

Some illegal harvesting of tree-ferns may be taking place on State forests. Present arrangements for policing these activities are unsatisfactory. The Department of Conservation, Forests and Lands should review its practices and develop an effective low-cost method of control (Section 12.5.2).

Further investigations of broombrush and eucalyptus oil harvesting on State forests and Crown lands should be instituted by independent consultants to the Department of Conservation, Forests and Lands (Sections 12.5.3 and 12.5.4).

Chapter 13: Compatibility of resource utilization with other forest values

Research must be maintained into the effects of fertilizers in the growth and ecology of eucalypt forests, on the processes involved in nutrient losses and gains, and on mapping and understanding of forest soils. Provided this is done, it should be possible to avoid or ameliorate any problems that arise through harvesting and related practices. Research should be undertaken by the Department of Conservation, Forests and Lands to see whether flora and fauna surveys can be integrated with those of the timber resource, to reduce costs and improve coverage (Section 13.3.1).

Although in a minority, certain environmental services are incompatible with timber production and harvesting activities (Section 13.3).

The adequacy of a reserve should recognize not only its extent, but the population structure, characteristics of the species, existence of linking corridors between reserves, and the nature and distribution of the forest type. The Regions should be provided with greater access to specialist advice for the preparation of Regional Management Plans, so these aspects can be considered (Section 13.3.1).

A small committee of experts should be appointed as soon as possible to draw up a definition of rainforest and guidelines for the reservation of rainforest in Victoria, and to advise on a programme of reservation (Section 13.3.1).

Research should be carried out on the impact of buffer strips of varying widths on water quality and on biological communities in streams. The discretionary power to conduct felling to maintain the health of stands in buffer strips should be deleted (Section 13.3.2).

Areas likely to receive intensive visitor use or otherwise of special significance should be excluded from normal logging operations because of the adverse aesthetic impact and because of noise, dust and safety problems (Section 13.3.3).

The results of research into habitat trees should be incorporated into planning models for the regions concerned (Section 13.4.1).

The delineation of coupe boundaries should recognize the need for wildlife corridors, landscape aesthetics, water production and honey production as well as the safe use of regeneration burns (Section 13.4.1).

The Department should continue to ensure that the same species composition is maintained as occurred naturally on the site in hardwood forests (Section 13.4.1).

Regional Managers should encourage more field trials of variations of the conventional silvicultural systems, subject to proper monitoring of the results (Section 13.4.2).

Legally enforceable provisions regarding the control of logging operations should be incorporated in new legislation governing the management of public forests. These should be linked to the proposed Code of Forest Practice, with provision for appeals and complaints through the Forest Practices Tribunal (Section 13.5). The Regional Code of Practice should set the general guidelines for prescription (Section 13.5.4). Each coupe must be the subject of a specific written prescription. Prescriptions for logging operations should be clear, workable, and enforceable in terms of monitoring and control. Similar prescriptions should also be prepared for clearing and planting operations in softwood plantations (Section 13.6).

Where especially sensitive or erodible areas are to be logged, the Department should specify the particular logging system to be used, in order to minimize compaction and erosion (Section 13.5.2). Further training of field officers should be undertaken to enable them to incorporate surveys of soil types within their pre-logging inventory of logging coupes (Section 13.5.2). Field officers should be encouraged to exercise their judgment in recommending temporary closure of logging operations and Regional Managers should be given enforceable powers to close logging operations where they deem it appropriate (Section 13.5.2).

Prescriptions for logging coupes should include specification of remedial works to be carried out by the logging operator (Section 13.5.3).

Specifications for adequate road drainage must be met. Research should be conducted to find cheaper forms of drainage and culvert works. Roads not needed for access after logging should be closed to traffic and suitable bars installed to reduce drainage problems (Section 13.7).

Written instructions should be prepared and issued to staff and licensees on the methods to be used for cleaning machines to avoid transmittal of the cinnamon fungus (Section 13.8).

Further research is needed into the effects of large-scale spraying programmes, especially with respect to insectivorous fauna. Baiting with pesticides must be kept well away from wildlife refuges, and special care needs to be taken near the habitat of the long-footed potoroo (Section 13.8).

Chapter 14: Pulpwood harvesting

The sale of sawmill residues, whether for domestic consumption or for export wood-chips, should be encouraged (Section 14.2).

The additional environmental effects of integrated harvesting over sawlog-only harvesting seem small (Section 14.3).

The additional economic effects of integrated harvesting over sawlog-only harvesting represent substantial gains in net social benefit, sufficient to outweigh any possible social costs incurred in terms of environmental effects.

However, rampant clear-felling must not be permitted and forest practices must give due concern to environmental services. In addition, any pulpwood harvesting operation must be tied to sawlog harvesting.

Consideration should be given to proposals for pulpwood harvesting provided that:

1. A specific amount, duration and location of chipping and processing plant or port of export are specified.
2. The project rests on integrated harvesting based on existing sawlog-only operations, together with the utilization of saw-mill residues.
3. A Code of Forest Practice covering all harvesting operations is drawn up and implemented.
4. The proposer/s, Department and Regional Advisory Committee/s concerned prepare a long-term plan containing three alternative sets of strategies for the first ten years of harvesting, selected from a much wider array examined by means of modern planning models.
5. An Environmental Impact Statement and detailed social cost-benefit analyses are prepared, the former giving specific reference to the environmental impact of the alternative sets of strategies for the first ten years of harvesting.
6. Public input is solicited on the results of the previous step.
7. Recommendations on the proposed plan of operation for the project are prepared by the Regional Advisory Committee/s and the State Advisory Committee.
8. Further public input is solicited following publication of the proposed plan prepared according to Step 7.
9. A final recommendation on the proposed plan is prepared by the State Advisory Committee and forwarded to the Government for incorporation as the basis of an evergreen type agreement. Any agreement should include provision for a thorough review after five years.

Chapter 15: Local government and other issues

Two options should be considered in relation to local government authority concerns regarding road damage due to logging trucks:

1. The forward planning of logging traffic and co-ordination of that planning between the Department of Conservation, Forests and Lands, local government authorities, and Road Construction Authority should be improved to enable the Road Construction Authority to make provision for funding grants in advance of major changes in logging traffic routes.
2. A log transport toll should be collected by the Department of Conservation, Forests and Lands, based on a sliding scale in relation to distance.

The first option is preferred (Section 15.2.1).

Two options should be considered in relation to local government authority concerns regarding the loss of rates due to purchase of land for pine (and other species) planting by the Department of Conservation, Forests and Lands:

1. The Department should henceforth make ex gratia annual payments to local government authorities in lieu of rates on any land newly purchased for wood production.
2. The Victoria Grants Commission should be directed to include a specific grant component in allocations to local government authorities in lieu of the aforementioned rates.

The first option is preferred (Section 15.2.2).

The relationship between the Urban Forests Development Committee and the Garden State Committee should be reviewed with a view to amalgamation. More funding should be allocated to the establishment of urban forests by the Department of Conservation, Forests and Lands. A properly staged plan of development extending over a period of years should be prepared (Section 15.3).

Fuel reduction burning seems a highly cost-effective method of aiding fire prevention activities. Although fuel reduction burning has some undesirable effects, it is a necessary part of fire prevention planning. Nevertheless, fire prevention planning should give more explicit attention to the potential conflicts between fuel reduction burning and areas of high conservation, recreation and honey production value. Greater public involvement is needed in fire prevention planning, together with better communication of the plans. Research is needed into virtually all aspects of fuel reduction burning and related fire prevention and suppression measures, and should be accorded a high priority in the relation to the programme of work within the Department of Conservation, Forests and Lands over the next ten years (Section 15.4).

Chapter 16: Technology, training and research

The development of training programmes should give particular attention to increasing the representation of females and members of disadvantaged groups in the training and employment programmes of the Department of Conservation, Forests and Lands and VTITC (Section 16.2).

The TAFE Certificate of Applied Sciences (Conservation and Resource Conservation) should be rationalized. The respective Ministers involved should establish an inquiry to be conducted by an independent person from outside the public service to examine future arrangements and related matters of in-service training within the Department of Conservation, Forests and Lands (Section 16.2.1).

The Department of Conservation, Forests and Lands should examine and develop the machinery for a conservation corps scheme, to prepare school-leavers and young unemployed persons for the workplace (Section 16.2.1).

The holding of a "Qualified Faller" ticket should be required for any faller or chainsaw operator employed in commercial logging of public forests. Further funding should be provided to the VTITC for the additional instructor/s required. The VTITC should be required to examine a change from the present contract system of payment to fallers, to one of salary plus production bonus. The Government should establish a Logging Training and Research Centre at the Victorian School of Forestry and Land Management, Creswick. The Centre should be funded by special levies on all wood sold from State forests, together with matching government funds (Section 16.2.2).

Adherence to safety standards in sawmills in Victoria seems poor. The Government should act on the forthcoming recommendations of an Inter-

Departmental Working Party, as a matter of urgency (Section 16.2.3).

The proposed Timber Industry Training Centre being established by the VIITC should be reconsidered in terms of site and funding. Further funding should be provided to create a viable centre (Section 16.2.3).

The TAFE Board should be asked to examine the establishment of a woodcraft course in Gippsland, perhaps at Bairnsdale. The Department of Conservation, Forests and Lands should fund a trial of a Woodcraft Resource Centre at Bairnsdale to utilize and stock timber suitable for woodcraft left unutilized in normal logging operations (Section 16.2.4).

The Victorian Government should seek Commonwealth matching funds on a 1:2 (State:Commonwealth) basis for the establishment of four field-based Experiment Stations, attached to the Department of Conservation, Forests and Lands. Much of the research should be directed towards environmental services and problems (Section 16.3.1).

Victorian Government subsidies to research in the wood-processing industry should be directed to research, development and technology transfer (not market research). The Government should match the industry contribution to this research on a 1:2 (State:industry) basis, through a Timber Industry Research Committee, which would replace the Timber Promotions Council. All sections of the Timber Industry should be encouraged to contribute to this funding at a rate of 3% of the amount paid for State wood (Section 16.3.4).

Chapter 17: Options for softwood plantations and private forestry

A Native Forest Purchase and Rehabilitation Account should be established. Any public land planted by the State for wood production should be valued by the Valuer-General's Office and a cash transfer of that amount made from Departmental funds to the Account. Funds in the Account should be available for the purchase of privately-owned forest or its rehabilitation for environmental purposes, thus ensuring that the use of public land for pine planting is not at the expense of the public native forest estate and the environmental services it supplies (Section 17.3).

The Department of Conservation, Forests and Lands should be able to bid up to prices which would yield a real rate of return of 6% on the purchase of land and subsequent investment in wood production (Section 17.3).

The State should maintain its investment in existing plantations, subject to a more comprehensive review when more complete financial analyses become available (Section 17.4).

The Department of Conservation, Forests and Lands should revise analyses of the costs, revenues and profitability of softwood plantations regularly, preferably annually. More comprehensive analyses based on planning models for the region and plantation zone concerned should be prepared (Section 17.4).

Efforts should be made to secure further markets for pulpwood from State plantations in the Portland zone and to investigate alternatives, such as non-commercial thinning (Section 17.5.2).

The present perception of Crown land as a cost-less source of land for pine planting should not be perpetuated (Section 17.5).

In undertaking new planting, the State should seek commitments from the

major private companies involved that they will also contribute to new planting (Section 17.5).

The Department of Conservation, Forests and Lands should examine alternative scheduling of the cut and of the specifications of pulpwood and sawlogs in the North-East so that it may take advantage of any future expansion in the pulpwood market (Section 17.5.3).

The release of further sawlog supplies by 1991 from North-East plantations should be in two large tenders of roughly equal size.

Three options are offered for consideration in relation to grants to encourage private forestry:

1. No State grants to private forestry for wood production.
2. Cash grants to new private planting for wood production of \$200 per ha for softwoods and \$300 per ha for hardwoods to a maximum of 40 ha per owner.
3. Cash grants to new planting for wood production of \$400 per ha for softwoods and \$600 per ha for hardwoods to a maximum of 40 ha per owner.

The second option is preferred, subject to the other taxation incentives being implemented. Failing this, the third option is preferred (Section 17.6).

The State should not engage in joint venture agreements with private land-owners.

Chapter 18: Options for State hardwood forests

Two options for the North-Eastern hardwood supply zone are offered:

1. Maintain the cut at the present level until the old-growth resource is exhausted.
2. Institute an immediate drastic reduction in the cut to the sustained yield level.

The first option is preferred (Section 18.2).

The Government should give urgent attention to finding alternative forms of employment to ameliorate the impact of mill closures. The Department of Conservation, Forests and Lands should develop a comprehensive programme of assistance, including re-location and re-training assistance and silvicultural works in forests (Section 18.2).

The licence allocations to sawmills in Far East Gippsland and East Gippsland should be revised immediately to the levels of average sales over the past five years. Those licences "subject to availability" should be given notice of termination three years hence. Financial assistance should be offered to those licensees who undertake voluntary mergers or take-overs resulting in a substantial decrease in the volume to be allocated to the new venture. Neither of the two main options offered by the Department of Conservation, Forests and Lands for Far East Gippsland are recommended. The preferred option involves reducing the cut by the measures mentioned earlier relating to average sales and "subject to availability" licences. If further reductions prove necessary, they

should be effected through a lottery device. Decisions on National Park proposals should be taken as soon as possible so that the future for mills in this zone can be determined (Section 18.3).

The two main options for East Gippsland are as follows:

1. Reduce the sawlog intake to about 75 000 cu.m. per annum in 1990.
2. Continue the present level of sawlog cut until the old-growth resources in the respective districts are exhausted and then reduce to a level which can be supported by the regrowth forests.

The second option is preferred. However, measures mentioned earlier for Far East Gippsland relating to average sales and "subject to availability" licences should also be implemented. Assistance should be offered to mills that rationalize cutting through mergers or takeovers and so reduce the allocation required (Section 18.4).

The Central Highlands and South Gippsland zones have the potential to support a steadily increasing cut of sawlogs and to provide a basis for the development of new mills and industry. Planning models should be prepared to determine the programme for this expansion (Section 18.5).

A comprehensive evaluation of the box-ironbark and red gum forests is required to determine the levels of cut that are compatible with the provision of environmental services (Section 18.6).

In general, the Otways forests are capable of supplying most if not all of the environmental services desired while supporting economically viable wood production (Section 18.6.1).

An inventory of the wood resource in the South Western zone should be carried out as soon as possible (Section 18.6.2). Research on the honey fungus in the Midlands zone should be maintained and practices reviewed in the light of the results (Section 18.6.3). The prices of wood sold for sleeper cutting in the Northern, North-Western and Western zones should be increased progressively by the Department of Conservation, Forests and Lands (Section 18.6.4).

Every possible avenue should be explored to develop alternative opportunities for employment for those workers displaced as a result of mill closures in the North-East and East Gippsland (Section 18.7).

Chapter 19: Forward Planning

Greater attention must be given to forward planning of financial and other requirements of the Department of Conservation, Forests and Lands through a rolling (preferably five years) program budgets. Within that framework, the Regions of the Department should be encouraged to operate as decentralized profit centres with respect to wood production activities.

The State Advisory Committee should be encouraged to co-ordinate indicative planning for the Timber Industry and for the supply of environmental services, with major reviews every five years. At longer intervals, inquiries similar to the present should be considered.

18.3 FAR EAST GIPPSLAND

The situation in Far East Gippsland is more serious than in any other hardwood zone in the State. Current commitments are for the supply of about 390 000 cu.m. per annum of sawlogs to some 20 sawmills in 10 separate towns or locations. Average annual sales over the past five years have been about 320 000 cu.m. per annum.

The difference between commitments and sales suggest an initial step which may provide some relief from the problems outlined below. Given the greater flexibility in annual cut proposed under the licence changes discussed in Section 10.5.2, trimming of the licence levels back to those of average sales would provide a painless but positive contribution; I recommend that this be done immediately.

The Department of Conservation, Forests and Lands believes that cutting cannot be sustained at the current levels of commitment. It has advocated options involving either (1) an immediate reduction to about 150 000 cu.m. per annum or (2) maintenance of the present cut until 1995, followed by a reduction to 100 000 cu.m. per annum. In the former case, the old-growth resource would be exhausted by the year 2050. In the latter case the year of exhaustion would be later. In either event, a massive sudden decline in the sawlog cut is involved, either now or in 1995.

Other factors complicate the issue further, the first being the assumptions made by the Department of Conservation, Forests and Lands concerning utilisation standards. The Department has estimated availability on the basis of current utilisation standards. However, it notes that an additional supply of about 50 000 cu.m. per annum of sawlogs is available on areas carrying sawlog volumes less than 40 cu.m. per ha, currently considered too low for economic logging. The Department implies that this supply would only become available if integrated sawlog and pulpwood harvesting was introduced.

I believe this latter proviso to be unnecessary. In my view, the impact of the prospective decline in sawlog availability will change utilisation standards, including those relating to the economics of logging. Thus, in the long run, at least 40 000 cu.m. per annum of the above increment in sawlog supply will be utilised, with or without integrated pulpwood operations. Some change in utilisation standards on existing logging areas is also likely, which in my estimation, would add a further 5% or 10 000 cu.m. per annum.

On the other hand, proposals for further dedications of National Parks in the region have the potential impact of reducing the supply of sawlogs. The Department has also prepared estimates of sawlog availability based on the dedication of the proposed Rodger-Bowen-Deddick, Errinundra, and Mt Kaye-Coopracambra National Parks. This may be viewed as a worst case scenario for the Timber Industry resulting in a decrease of about 60 000 cu.m. per annum in sawlog availability in the long-term. This impact is probably understated because the proposals involve old-growth areas and would therefore accelerate the introduction of cutting of regrowth forests. The present level of cut would also fall to 100 000 cu.m. per annum, if the second option were to be chosen.

The basic figures and the adjustments cited above leave much to be desired. The original estimates of availability assume a uniform, 80-year rotation throughout the area. The adjustments proposed are simplistic in character. None of these estimates utilise the detail of the inventory data available,

the possibility of alternative silvicultural strategies, or the scope for investment in existing regrowth stands. The latter, it must be said, is probably very limited because the regrowth forests remaining after the Ash Wednesday fire season are very restricted in area. Thus it is with considerable reservation that I summarise, in Table 18.1, my estimates for the major options in relation to the sawlog cut.

TABLE 18.1 Options for the sawlog cut in Far East Gippsland

Option	Fate of National Parks proposals	Sawlog cut (cu.m/annum)	
		Before 1995	After 1995
Reduce cut immediately	Rejected	265 000	265 000
	Accepted	205 000	205 000
Reduce cut after 1995	Rejected	320 000	165 000
	Accepted	260 000	105 000

There are no avenues for maintaining the present sawlog cut with supplies from other zones. The adjacent zone, East Gippsland, is in a similar plight. It would be nonsensical to consider shipping logs from, for example, the Central Highlands. Besides being grossly uneconomic such a move would eliminate the considerable prospects for the development of a cost-competitive industry based on that resource.

Two means of implementing any reduction in the sawlog cut seem evident:

1. No licences for allocations which are 'subject to availability' should be issued after expiry of current 3-year licences of this sort. This would reduce commitments by 20 250 cu.m. per annum and the 'average sales' basis proposed for all licences in the zone by 13 500 cu.m. per annum, yielding a new allocated volume of about 306 500 cu.m. per annum.
2. Financial assistance should be offered to those licensees who undertake voluntary mergers or take-overs resulting in a substantial decrease in the volume to be allocated to the new venture. This should be arranged through the Business Assistance Programs of the Department of Industry, Commerce and Technology.

To date I have avoided indicating a preferred option. This is because I am profoundly sceptical about both.

Unlike the Benalla-Mansfield case in Section 18.2, or the Bruthen-Nowa Nowa case in the following section, the old-growth resource will not be exhausted in two to five years. There is a very substantial volume of old growth forest remaining in Far East Gippsland, with or without acceptance of the national park proposals. The principal effect of the options proposed by the Department of Conservation, Forests and Lands is to re-distribute the cutting of this old-growth over time. In the first option this is achieved by way of decrease in the cut followed by a relatively constant rate of cutting until the year 2050. In the second option, the initial decrease is deferred for ten years, but is much greater and is followed by a relatively constant but much lower rate of cutting to the year 2050.

The gains in social net benefits from either of those options are not clear. True, they would provide a better balanced (more uniform) distribution of age

classes by area than is otherwise likely. In that sense they aid the attainment of the sustained yield model discussed in Chapter 9. But let us contrast that status against a more gradual diminution of the cut, assuming an immediate decision to reduce it to 306 500 cu.m. per annum.

Assuming it proved necessary in the light of the National Park additions and creations and subsequent examination by planning models, the cut could be reduced modestly by 10% at intervals of ten years by a lottery device, discussed later, until the desired level was attained. This would result in an age-class distribution which is rather less uniform than would be the outcome of either of the Departmental options. But would those differences be significant in terms of the environmental services? I believe not. There would still be a complete array of age classes. All cutting would be carried out with due regard for the environmental services under the Code of Forest Practices. The differences in these distributions have no obvious major consequences for environmental services that I can identify.

On the other hand, premature closure of a significant component of sawmilling activity would have very severe employment and social consequences. I believe that adherence to the sustained yield model has led the Department to advocate options which are not in the best interests of Victoria and especially of the residents of Far East Gippsland.

The preferred option, then, is to reduce the cut using the avenues outlined earlier but to avoid imposing a brutal reduction simply to achieve better balanced distribution of age classes. If subsequent examination through planning models identifies a need to reduce the cut, it could be effected through a lottery at the time of licence renewal.

By way of simple example, let us suppose the cut is 300 000 cu.m. per annum and that there is a desire to reduce it by 10%. Three hundred tickets would be printed, thirty of which are suitably identified as losers, each representing a reduction of 1 000 cu.m. per annum. Each sawmiller would draw at random a number of tickets equal to his allocation in thousands of cubic metres and would incur the reductions imposed by drawing any losing tickets. This would doubtless lead, in some cases, to closure and sale of the remaining licence allocation. In other cases, the sawmiller may be able to survive on a reduced allocation. In any event, such a device seems preferable to an across-the-board reduction of allocation, which disadvantages everyone.

Whatever the option chosen in relation to the sawlog cut, the further option of pulpwood harvesting remains, as discussed in Chapter 14. Because the magnitude of any pulpwood project is unknown, estimates of its impact on employment are not feasible. Nevertheless, it is evident that such a project does offer one of the very few opportunities for positive economic development in this zone. This is not to eschew tourism, vegetable growing, or similar possibilities, all of which are desirable contributions given the very weak and limited basis of the economy in the zone.

The weakness of the economy is not aided by the current uncertainty in the sawmilling industry. The majority of sawmills currently have one year's life from the areas currently available to them. In some case radical shifts from one area to another have been made by the Department, following decisions to place a moratorium on cutting in a particular area. As a result, forward planning and investment in the industry is virtually non-existent. The people of Far East Gippsland deserve better treatment. Decisions on National Park proposals, and on the future of the industry in the light of the options discussed above, must be taken as soon as possible.

PULPWOOD HARVESTING

14.6 ECONOMIC EFFECTS

As with the provision of all forms of market or non-market services, integrated or joint harvesting involves some additional costs and some additional benefits. Attempts have been made previously to evaluate the social costs and benefits of proposed schemes involving pulpwood harvesting in the Otways and in East Gippsland. These provide a specific basis for consideration of the economic effects of such schemes.

An evaluation of the Otways proposal by an Inter-departmental Task Force has indicated that the net social benefits from pulpwood harvesting would be substantial for a project producing 70 000 tonnes per annum of wood-chips but marginal or unfavourable for one producing 45 000 tonnes per annum. This evaluation has been the subject of some internal criticisms within the Department of Conservation, Forests and Lands and these have subsequently been drawn to the attention of the Inquiry. In part, the criticisms point to a misconception of the structure of the chipping operation, which has led to substantial over-estimating of some costs and to some minor errors or differences of opinion over other costs. The gist of these criticisms, which seem to be well founded, is that the net social benefit of the larger (75 000 tonnes per annum) project is substantially greater than indicated by the original evaluation. In part, the criticisms focus on a recommendation of the original report that any project should be restricted to the harvesting of those areas of forest which would be economic for the harvesting of sawlogs alone. This is essentially a separate issue, which is addressed in a following section, and the discussion can proceed assuming for the moment that no additional areas of forest are logged.

The revised estimates of net social benefit for the Otways project range from \$1.0 to \$5.8 million, depending on the price of wood-chips. These values must be weighed subjectively against the possible social costs attributable to the environmental effects. The preceding review of these effects suggests that these costs would be small and therefore far outweighed by the net social benefits from the project.

The East Gippsland proposal was much larger, involving the proposed production and sale of some 800 000 tonnes per annum of pulpwood. The specific nature of the project was, however, not stated; several options, ranging from the building of a pulp plant locally to the export of wood-chips from East Gippsland were mentioned. An economic evaluation was carried out as part of an environmental effects statement commissioned by the Ministry of Conservation, but did not distinguish between the options.

I have some difficulties with the evaluation, because in a project this large it seems desirable to address specifically questions concerning the quantities, locations, and timings of the wood cut. This may have not been done because the options were so broad, but whatever the reason, the result is that the evaluation based on an analysis at the forest and is only a thumbnail sketch of the costs and benefits of the project as a whole.

Even though not at a project level, an analysis at the forest has a place in order to examine further the economics for an area on which sawlog-only harvesting is about to take place. We can then pose the question: would the State and society be advantaged or disadvantaged if integrated sawlog and pulpwood harvesting was to be permitted on that area?

This more specific and limited question can be addressed quite simply from the data available. For example, let us assume that the price received for pulpwood is \$5.00 per cubic metre, a conservative figure. Let us likewise assume that the anticipated savings in associated regeneration work, and the additional revenues from extra sawlog resulting from pulpwood harvesting are negligible, a very conservative assumption. The additional costs per tonne of pulpwood incurred by the State include those associated with extra road maintenance, extra regeneration (seed-collection) works, extra field supervision and extra office administration. These additional costs range from \$2.50 per tonne to \$3.00 per tonne. Thus there is a net gain from \$2.00 to \$2.50 per tonne of pulpwood removed.

These figures signal that the State is cutting off its nose to spite its face in foregoing the option to sell pulpwood from areas that are currently harvested for sawlogs alone. The potential average net gain on those areas is \$160 to \$700 per hectare in East Gippsland. Based on the earlier review (Section 13.5), the social costs attributable to the environmental effects of pulpwood harvesting are small and seem likely to be far outweighed by the net social benefit derived from it.

In making this analysis I make no judgment on recommendations about the scale of a project in East Gippsland or elsewhere. That issue can be addressed only by a thorough examination of possible projects using a regional planning model (or models, in this case). The scale and associated uncertainties of the East Gippsland proposal give rise, in my view, to the widespread concerns that are aptly summarised in the commissioned report on flora and fauna conservation:

"... any further development of pulpwood harvesting would undoubtedly increase the impact of logging operations in the State by extending timber harvesting into areas which would not otherwise be harvested for economic reasons. Extensive logging or short rotation lengths would threaten the conservation of species that rely on features of mature forest."

This 'thin edge of the wedge' type argument seems to underlie much of the public antipathy towards the pulpwood harvesting proposals. It conjures up a spectre of rampant clearfelling without concern for the environmental services or other non-wood produce that our public forests provide. To an extent these concerns are justified, given that indiscriminate clear-felling has been known to occur, though not in Victorian public forests for a great many years. However, rampant clear-felling must not be permitted and forest practices must give due concern to environmental services. In addition, pulpwood harvesting must be tied to sawlog harvesting requirements.

On this basis I believe that the concerns, while well-intentioned, are misplaced. The issues of importance concern harvesting practices and planning, not the product removed. Regional planning models are needed to demonstrate where, when and how much wood is to be removed, and under what mixture of silvicultural systems. The extent and type of operations would then be in no doubt, and no wedge would exist; indeed, a wedge must not exist. These models, together with the accompanying prescriptions concerning forest practices on the areas to be logged, should allay those concerns.

In East Gippsland, for example, pulpwood harvesting would not involve more extensive operations provided - and this would have to be stipulated clearly at the outset - the extent of operations is determined by sawlog harvesting requirements. The essence of the planning is to balance the sawlog and pulpwood supplies drawn from a diverse array of harvesting operations so that the individual sawlog commitments are met and, at the same time, the pulpwood commitment is also met. Achieving this balance is not a trivial procedure, but

it is feasible; the effect is that, because the ratio of sawlog to pulpwood volume varies greatly, the pulpwood commitment drives only the geographic distribution of the harvesting operation. Moreover, proper planning and control, based on the recommendations of this report, should ensure that the visual and other environmental impacts are barely perceptible, relative to existing operations.

There can be only one exception to this arrangement - one which will probably not be relevant in East Gippsland for some time; thinning of regrowth forests for pulpwood alone should be permissible. This helps to accelerate sawlog production, improves the economics of wood growing and probably reduces the area required to support a given supply of sawlogs.

Concerns over extension of harvesting into those areas carrying less than 40 cu.m. per ha of sawlog volume are also misplaced. As the scarcity of sawlogs from old-growth forests bites home (see Chapter 18), most of these areas will be cut for sawlogs, with or without pulpwood harvesting. Thus the critical issue for these areas is whether appropriate provision has been made for the protection and maintenance of environmental services, not whether pulpwood is also harvested.

Concern over short rotation lengths is also misplaced. The economics of growing wood do not favour pulpwood-only rotations for the species involved. Nevertheless, they could change over time. The control on the use of short rotations stems from the planning model. It will determine and show whether the proposed pulpwood commitment can be met from integrated harvesting operations alone. If not, either the proposed commitment must be reduced or the project scrapped.

Integrated and joint sawlog and pulpwood harvesting are already widely practiced in Victoria. The APM Ltd pulp mill at Maryvale in Gippsland has drawn its hardwood supplies from such operations in Central and South Gippsland and Central Highlands since the 1940's and from the Heyfield area since the 1950's. The Hardboards Australia Ltd mill at Bacchus Marsh has likewise drawn its hardwood supplies from such operations in Midlands zone since 1961. Smorgon Consolidated Industries Ltd pulp mill drew its hardwood supplies from such operations in the Otways for a period of ten years until 1980. The Department of Conservation, Forests and Lands has licensed and supervised integrated or joint harvesting operations in four of the 11 'hardwood supply zones' for many years.

It would be idle to claim that all of the past operations have been perfect in their recognition of environmental services. Nevertheless, the results in terms of the regenerated forest are generally good, certainly better than much of the previous sawlog-only harvesting has been able to achieve. Where improvements are needed in these operations, they lie in the general domain of greater attention to planning and control of forest practices, not in the specifics of pulpwood harvesting.

INTRODUCTION

In 1984 the Government announced details of the first comprehensive inquiry into the timber industry in Victoria since the turn of the century. The Inquiry, conducted by Professor Ian Ferguson, Professor of Forest Science at the University of Melbourne, was required to review all aspects, and provide options for a long-term strategy for the sustainable development of the timber and related industries in Victoria.

Professor Ferguson presented his Report to the Hon. Joan Kirner, M.L.C., Minister for Conservation, Forests and Lands on 21 June 1985. The Government has endorsed the general principles of the Report which provide clear directions for the future of the Department of Conservation, Forests and Lands as the planner and manager of the public forest resource.

BACKGROUND

It is imperative that in Victoria's 150th year decisions are taken which will ensure that our public forest estate is maintained and all existing values are protected for future generations. The Government accepts the Board's view that a proper and sensitive balance between protection and production can and must be achieved.

The Report clearly outlines the fundamental changes which will take place in the timber industry in the foreseeable future, including those caused by: decline of the mature hardwood timber resource; the increasing utilisation of regrowth timber, especially 1939 regrowth mountain ash; the relocation of the centre of sawmilling activity from East Gippsland to Central Victoria and South Gippsland; and the increasing availability of softwood sawlogs. The Government accepts the Board's description of these fundamental changes. The process by which these changes are achieved must be efficient and equitable and requires further attention.

The Government agrees with the Board's view that the timber industry must be given appropriate recognition for the significant contribution which it makes to the expanding economy of our State. The industry is not in decline, rather it is experiencing change and the Government's aim is to facilitate the transition to a more efficient and progressive industry.

The Board emphasises that the Government, through the Department of Conservation, Forests and Lands, has a social, as well as an economic responsibility to mitigate the adverse impact of any industry relocation or restructure. The Government accepts that it has a role in assisting those affected by changes in the timber industry.

FOREST MANAGEMENT PRINCIPLES

The Government accepts the Board's recommendation that all public forest management should be based on the following four principles:

- * economically viable with respect to the provision of wood and other market goods;
- * environmentally sensitive with respect to the provision of non-market goods and services;
- * sustainable with respect to the interests of future generations; and

- * assisted by public participation in the planning process.

The Government also accepts the Board's recommendations that a Code of Practice for Forest Management and that Regional Management Plans should be prepared to ensure that forest resources are managed in the best interests of the community. The preparation of these important documents will involve extensive public participation and will provide for the maintenance of economic and environmental values.

PROCESS

The Government recognises that the Report provides a basis for planning the future of the timber industry. However there are a number of issues which require further consideration and development. The Government has therefore decided to seek public comment on most aspects and recommendations of the Report.

Some recommendations can be acted upon immediately. Those which the Government believes are not in the long-term interests of the timber industry and sound forest management have been rejected.

The Government has accepted the Board's recommendations relating to further research and study. These recommendations will be referred to the existing research review process which has provision for public participation.

The Board emphasises the importance of the Government providing long-term security for the timber industry. The Government is demonstrating its commitment to providing a secure future for the industry by accepting the recommendation for long-term (10 and 15 years) sawlog licences.

Those recommendations on which Government decisions have already been taken are listed in Appendix 1. All other recommendations and options in the Report are available for further discussion and public comment. The comments received will be taken into consideration in the preparation of the Victorian Government Timber Industry Strategy document to be finalised by December, 1985.

ECONOMIC STRATEGY

In 1984 the Government released the 10 year economic strategy for the State, "Victoria: The Next Step". Since then a number of related policy documents and strategies have been released, including:-- "Victoria: Brown Coal, The Next Step"; "Victoria: The Best is Within Your Reach: Tourism Strategy"; "Victoria: Growth is Our Business. State and Regional Industry Policies".

In the Economic Strategy, the Government has identified areas of competitive strength including:

- * the extent and diversity of Victoria's industrial skill base;
- * the availability of a rural resource base with a diverse range of soils and climates, close to transport infrastructure; and
- * the central location of the Port Phillip Region as a transport, distribution and communications hub for South Eastern Australia.

Based on these, the Government's regional development policies have been designed to encourage industries in which the State has a competitive advantage. In the manufacturing sector this includes the resource processing industries. A re-structured and integrated timber industry will be in a strong position to take advantage of the State's competitive strengths.

The Government's policies focus on encouraging small and medium firms with growth potential operating in the trade exposed sectors of manufacturing. The Govern-

ment reaffirms its support for the sawmilling and timber products industries and they have been specifically identified in the document "Victoria: Growth is Our Business" as industries to be encouraged.

CONSERVATION STRATEGY

The Government has also demonstrated a strong commitment to sound management and care of the natural environment by preparing a draft State Conservation Strategy. The State Conservation Strategy discussion paper identified five basic objectives:

- * to maintain ecological processes and life support systems;
- * to preserve genetic diversity;
- * to ensure the sustainable use of renewable resources;
- * to protect and manage natural systems and their diversity; and
- * to ensure that non-renewable resources are not depleted at rates greater than those which enable transition to use of more abundant materials and ultimate sustainable use of renewable resources.

These points are compatible and consistent with the four key objectives identified by the Board of Inquiry and they will be incorporated in the planning and management of public forests.

The Government has accepted the Board's recommendations relating to the protection of rainforests and will develop clear guidelines for their preservation. Also, specific prescriptions will be prepared for each logging coupe which will increase the level of public knowledge of and involvement in harvesting operations.

TIMBER INDUSTRY STRATEGY

The Timber Industry Strategy document to be developed from the Report of the Timber Industry Inquiry will provide, for the first time, direction and security for the industry enabling it to develop and invest with a sense of certainty and stability.

The Timber Industry Strategy will be consistent with both the Economic and the Conservation Strategies, and will be finalised by December 1985.

The Report of the Inquiry provides a base for addressing the structural and locational changes confronting the industry. It provides the basis for developing a detailed strategy to implement those changes which will strengthen the State's economy, regional economies and the industry, at the same time ensuring environmentally sound management practice.

The Government is now developing a comprehensive Timber Industry Strategy to complement both the Economic and Conservation Strategies and it is important that the public be given the opportunity to participate in its development.

PUBLIC COMMENT

Public comment on the Report of the Board of Inquiry into the Timber Industry is welcome.

There are a number of key issues which require special consideration and on which specific comments are sought. These include:

- * licensing procedures;
- * pulpwood harvesting; and

* strategies for industry relocation and restructuring.

The timetable for the preparation of the Policy document is outlined in Appendix 2.

All comments should be directed to:

The Hon. Joan Kirner, M.L.C.
Minister for Conservation, Forests and Lands
240 Victoria Parade
East Melbourne, Vic. 3002.

and should be received by Monday, 16th September, 1985.

GOVERNMENT ACTION ON RECOMMENDATIONS OF REPORT OF TIMBER INDUSTRY INQUIRY
(APPENDIX 1)

CHAPTER 9 REGIONAL SUSTAINABLE YIELD

1. It therefore becomes necessary to develop a set of operational principles which are broadly consistent with the basic objective and substantially capable of reconciliation one with the other. Accordingly, I recommend that public forest management should be:
 - (i) economically viable with respect to the provision of wood and other market goods;
 - (ii) environmentally sensitive with respect to the provision of non-market goods and services;
 - (iii) sustainable with respect to the interests of future generations; and
 - (iv) assisted by public participation in the planning process. (p.121).

Accepted.

2. The Regions must then become the bases for the preparation of Regional Management Plans. The preparation of these Plans should be a requirement stipulated by law, with mandatory provision made for periodic revision at intervals of between five and ten years. (p.129).

Accepted.

CHAPTER 10 EFFICIENT AND EQUITABLE ALLOCATION

1. Having said that, I do not recommend that compliance with safety and occupational health rules be included among the conditions of a licence. (p.150).

The Government will investigate further the possibility of including occupational health and safety requirements in long-term licences.

2. Licences should be of a fixed duration, either ten or fifteen years and should be put to tender near the end of that period. However, the existing licensee would have the right to retain the licence for a further term, subject to matching the highest tender price. (p.151).

The need for longer (10 or 15 years) licences is accepted. The procedure to achieve this is subject to further public comment.

3. I recommend that the following choices be offered to existing licence holders, at the date of expiry of their current licences:

- (1) Immediate conversion to a transferable renewable licence of 15 years' duration, subject to payment of a licence fee of \$90,000.
- (2) Immediate conversion to a transferable renewable licence of 10 years' duration, subject to payment of a licence fee of \$30,000.
- (3) Maintenance of the present licence, for a period of five years after the Government's decision. Following the expiry of the licence at that time, provision would be made for additional short-term sales by tender or auction, of equivalent volume to that involved in the licence, provided resources permit. No licence fee would be payable in this case. (p.152).

There are disadvantages and advantages with both these systems and it is imperative that this issue be resolved satisfactorily; so detailed comments on either or both of the recommendations, or even new proposals, will be welcomed.

If Professor Ferguson's proposal is accepted by the Government, the recommended licence fees will need to be reviewed to reflect a more realistic market value.

N.B. 1. In 1983 the Forests Advisory Committee made the following recommendation:-

"That the Forests Commission:

8. amend its system of log licensing as follows:

- d. give five years notice of changes to the existing licence system after which long-term licences will come up for re-issue where possible by tender or otherwise on negotiated terms;"

2. This recommendation was accepted by the Minister of Forests, the Honourable Rod Mackenzie, M.L.C., and has been implemented. Negotiations for long-term licences and agreements have been concluded or are underway.

CHAPTER 11 THE ROLE OF PRIVATE FORESTRY

1. Nevertheless, a relatively simple and low cost system to improve forest practices, is essential.

I recommend that:

- (a) A Code of Forest Practices should be prepared at a State level, with provision for appropriate regional variations, for incorporation in Planning Schemes or Interim Development Orders. (p.186).

Accepted.

CHAPTER 13 COMPATIBILITY OF RESOURCE UTILISATION WITH OTHER FOREST VALUES

1. Rainforests

In view of differences of opinion expressed in evidence to the Inquiry, I recommend that a small committee of experts be appointed to draw up a definition and guidelines for reservation, and to advise on a programme of reservation. This programme should be pursued as a matter of some urgency. (p.224).

Accepted.

2. Considerable variation in prescriptions is possible, and indeed desirable, between different regions. However, the prescriptions need to be clear and workable in the field and the system must lend itself to monitoring and enforcement. (p.233).

Accepted.

3. Each coupe must be the subject of a specific written prescription. That prescription must include a map of suitable scale clearly identifying the areas (such as 'stream' buffers) to be excluded from logging. The prescriptions must include specifications concerning habitat trees and the means by which they (and boundary trees) are to be identified. They must include the provisions for logging to be suspended if compaction or erosion conditions demand. They must also specify the remedial work to be carried out on log landings, etc.. (p.233).

Accepted.

CHAPTER 14 PULPWOOD HARVESTING

1. Rampant clear-felling must not be permitted and forest practices must give due concern to environmental services. In addition, pulpwood harvesting must be tied to sawlog harvesting requirements. (p. 249).

Accepted.

CHAPTER 16 TECHNOLOGY, TRAINING AND RESEARCH

1. The development of training programmes should give particular attention to increasing the representation of females and members of disadvantaged groups in the training and employment programmes of the Department of Conservation, Forests and Lands and VTITC (Section 16.2). (p.xxix).

Accepted.

2. Adherence to safety standards in sawmills in Victoria seems poor. The Government should act on the forthcoming recommendations of an Inter-Departmental Working Party, as a matter of urgency (Section 16.2.3). (p.xxx).

Accepted.

CHAPTER 18 OPTIONS FOR STATE HARDWOOD FORESTS

1. The Government should give urgent attention to finding alternative forms of employment to ameliorate the impact of mill closures. The Department of Conservation, Forests and Lands should develop a comprehensive programme of assistance, including re-location and re-training assistance and silvicultural works in forests (Section 18.2). (p.xxxiv/xxxv).

Accepted.

2. (a) The licence allocations to sawmills in Far East Gippsland and East Gippsland should be revised immediately to the levels of average sales over the past five years.

Public comment.

- (b) Those licences "subject to availability" should be given notice of termination three years hence.

Public comment.

- (c) Financial assistance should be offered to those licensees who undertake voluntary mergers or take-overs resulting in a substantial decrease in the volume to be allocated to the new venture.

Public comment.

- (d) Neither of the two main options offered by the Department of Conservation, Forests and Lands for Far East Gippsland are recommended. The preferred option involves reducing the cut by the measures mentioned earlier relating to average sales and "subject to availability" licences.

Public comment.

- (e) If further reductions prove necessary, they should be effected through a lottery device.

Rejected.

- (f) Decisions on National Park proposals should be taken as soon as possible so that the future for mills in this zone can be determined (Section 18.3). (p.xxxv).

Public comment.

3. Every possible avenue should be explored to develop alternative opportunities for employment for those workers displaced as a result of mill closures in the North-East and East Gippsland (Section 18.7). (p.xxxvii).

Accepted.

PUBLIC PARTICIPATION - TIMETABLE FOR PREPARATION OF GOVERNMENT TIMBER INDUSTRY STRATEGY (APPENDIX 2)

DATE	ACTION
21 June	Report received by Minister for Conservation, Forests and Lands
29 July	Report released for public comment
16 September	Closing date for public comments
14 October	Draft Timber Industry Strategy paper released for public comment
14 November	Closing date for public comments
December	Release of Government Timber Industry Strategy.