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FORESTRY

FORESTS OF VICTORIA

Introduction

Forests are complex and dynamic ecosystems of living organisms and their physical habitat. The living organisms include plants, animals, birds, fungi, and a vast collection of micro flora and fauna. The physical components of the ecosystem include those associated with the atmosphere, the soils, and the rock formations from which the soils have been derived.

The objectives of forest management vary according to the demand for the benefits that a forest ecosystem can provide and the capability of the ecosystem to supply the desired benefits without detriment to its long-term productive capacity. Forests owned by the community, such as the State forests of Victoria, provide a wide range of benefits both tangible and intangible. The efficient management of forest ecosystems to produce these benefits is a demanding task involving considerable resources of skilled manpower, finance, and equipment. The services of a wide range of expert personnel are required, including foresters, botanists, zoologists, pathologists, entomologists, hydrologists, engineers, surveyors, management specialists, economists, sociologists, landscape architects, and administrators.

Approximately 36 per cent or 8.1 million hectares of the total land area of Victoria is occupied by forests. Of this, 6.9 million hectares are State forest of which 2,890,000 hectares are reserved forest. The reserved forests are permanently reserved as forest land and can be excised or alienated only in exchange for other areas of Crown or private land. The remaining 4 million hectares are mainly protected forest which are not permanently reserved although the Forests Commission is responsible for their management.

The major belt of forest in Victoria is located in the eastern half of the State extending from a point to the north of Melbourne to the New South Wales border. This area forms the southern end of the vast and continuous belt of forest that straddles the Great Dividing Range along the length of the eastern coast of Australia. Other extensive areas of forest in Victoria are situated to the north-west of Melbourne, in the South Gippsland Ranges, the Otway Ranges, the south-western region, the Mallee, and the northern and central parts of Victoria where forests of red gum, ironbark, and box are present.

Types

The forests of Victoria embrace many types ranging from the tallest of hardwood forests in the world, which occupy the cool mountain regions in the east, to the stunted mallee heathlands of the arid north-west. The main types recognised within State forests are mountain forests, stringybark forests, red gum forests, ironbark and box forests, arid woodlands, arid heathlands, and forest plantations. The majority of native forests are hardwoods, while most forest plantations are of softwood species.

Mountain forests

The mountain forests occupy about 840,000 hectares of the cool, high rainfall country in the Central and Eastern Highlands, the South Gippsland Ranges, and the Otway Ranges. The forests comprise two main types, namely, sub-alpine woodland, and ash forests of alpine ash, mountain ash, and shining gum.

The sub-alpine woodland occupies the highest elevations in the State, ranging from approximately 1,400 metres to 1,800 metres. It covers about 210,000 hectares in Victoria and typically consists of snow gum forests interspersed with snow grass and herb plains. Because they occupy an area where the climate is severe, sub-alpine woodlands must be carefully managed to ensure the protection of vegetation and soils.

The sub-alpine woodland yields large quantities of water which is used for domestic, irrigation, and hydro-electric purposes. It also provides an environment suitable for specialised recreational use, including intensively developed ski resorts, scenic roads, and walking tracks. The alpine walking track, which is planned to extend along the total length of the Great Dividing Range, passes through sub-alpine woodland for a considerable portion of its length.

The ash forests of alpine ash, mountain ash, and shining gum extend from the lower limits of the sub-alpine woodland down to elevations of approximately 600 metres, or lower on some southern aspects. They occupy the cool, moist regions to the east of Melbourne and in the South Gippsland and Otway Ranges, and cover a total area of approximately 630,000 hectares.

The mountain forests play an important role in Victoria's economy because they are among the most productive forests in the State, yielding large quantities of wood and water, and providing an environment for recreational activities. They produce large volumes of timber of seasoning quality, and the majority of the hardwood pulpwood used by the paper making industry in Victoria. They occupy significant portions of the catchment areas used to supply water to major population centres. The very tall trees and dense understorey of shrubs and ferns found in ash forests provide magnificent scenery, and afford an excellent habitat for well known wildlife species, such as lyrebirds, possums, and wallabies.

Stringybark forests

The stringybark forests of Victoria include a wide variety of forest types in which various stringybark eucalypts and associated species occur. They are the most extensive of the Victorian forest types and occupy practically all the forest land on the coastal plains, and in the foothills to the north and south of the Great Dividing Range up to elevations of 900 metres. The total area of stringybark forests is 4,300,000 hectares.

The presence of the root-rot fungus *Phytophthora cinnamomi* (Rands) in the stringybark forests is currently causing concern. Sections of the coastal silvertop forest in eastern Gippsland and other stringybark forests in south-west Victoria have been damaged, and in some cases killed, by the fungus. A detailed research programme is currently in progress, and in the meantime controls have been imposed to restrict the spread of the fungus through transfer of soil by trucks and tractors.

The stringybark forests provide wood, water, and recreation. They yield some 65 per cent of the total volume of timber produced from State forests. The principal uses of the timber are for house framing, general construction, and wood pulp for hardboards, paper, and packaging material. A large portion of the total yield is now coming from the extensive forests of eastern Gippsland. Some areas of intensively managed stringybark forest in the central part of Victoria have been producing regular timber yields for over a century and some have entered their third rotation of timber production. In western Victoria, where they are practically the only reserves of original native vegetation, they are an important source of timber for farm buildings, fencing, and fuel.

Stringybark forests occupy the water catchments of many cities and towns in Victoria. They are rich in birds, animals, and wildflowers, and their distinctive character makes them an attractive location for recreational activities. They attract large numbers of day visitors throughout the year, and are frequently used for fishing, camping, and hiking, especially during the early summer and autumn months.

Red gum forests

The red gum forests are the most widely distributed of the Victorian forest types although their total area is relatively small. Extensive areas of river red gum can be found along the flood plains of the Murray River downstream from Cobram, and along the northern reaches of its tributaries. Savannah woodlands of red gum occur on the western plains and the species is common along watercourses throughout most of Victoria.

The red gum forests produce substantial quantities of wood and are extensively used for recreational pursuits. In addition, they play an important role in the control of water flows along the Murray River system and its tributaries. The forests have supported a viable timber industry since the earliest days of settlement. Red gum timber is used for sawmilling, sleepers, posts, and piles, and because of its strength, durability, and attractive appearance it is keenly sought.

The open woodland and gentle slopes of the red gum forests are well suited for outdoor recreation. Roads and tracks are inexpensive to construct and there are many suitable sites for camps and picnics. Streams and billabongs are focal points for recreation and the numerous species of birds and animals associated with the water are major attractions. The red gum forests also provide an excellent grazing area for domestic stock and native animals.

Ironbark and box forests

The major areas of ironbark and box forests occur on poor soils in the north-central regions of Victoria where low rainfall and hot, dry summers are characteristic of the climate. The main forests are mixtures of red ironbark and box eucalypts with the species mixture generally being determined by the fertility and water holding capacity of the soil. The ironbark and box forests are used for railway sleepers, fencing timbers, and fuel, and they are highly valued for honey production and recreation.

Arid woodlands and heathlands

The arid woodlands and heathlands occupy large areas of the Murray Basin plain in the north-west of Victoria. They are forests of tremendous diversity with a wealth of plant species and many distinct associations. The diversity of these ecosystems is mainly a result of variations in soil type and the history of the areas they occupy. The arid woodlands and shrublands offer environments suitable for recreation and they are of considerable scientific and aesthetic interest. Because they occupy low rainfall areas, and are of a stunted form, they are of relatively minor value for water and wood production.

Forest plantations

The lack of native species suitable for the commercial production of softwood and the presence of derelict and marginal farmland have led to the development of extensive forest plantations in Victoria. The total area of these plantations (including privately owned plantations) is approximately 195,000 hectares.

Early planting trials covering a wide range of softwood species indicated that radiata pine was eminently suited to the medium rainfall environments of Victoria, and it has been used in the majority of plantations. Small areas of Corsican pine, maritime pine, ponderosa pine, and Douglas fir have also been established. Mountain ash is the only native species that has been used on any significant scale for plantation purposes.

The prime use of forest plantations is for wood production, but they also provide valuable cover for water catchments, and recreational benefits, such as those obtained from driving, picnics, and general scenic enjoyment. Another benefit from plantation development has been the reforestation of abandoned farmlands and rehabilitation of lands degraded by mining and bad farming practices.

Management

Since 1919, the State forests of Victoria have been managed by the Forests Commission under various Forests Acts. The *Forests Act* 1958 provides for State forests to be managed to produce a sustained yield of wood, and to provide protection for water catchments, recreational and educational opportunities for people, a habitat suitable for native flora and fauna, and a range of minor forest products such as forage for grazing, honey, essential oils, gravel, and stone. The Forests Commission also had explicit responsibilities under the Act to protect State forests from misuse and damage by fire, insects, and fungi.

On 1 September, 1983, the Forests Commission was amalgamated with the Department of Crown Lands and Survey and parts of the Ministry for Conservation, to form the Department of Conservation, Forests and Lands. This Department is responsible for the management of most of the public land in Victoria.

From 1 July 1984, the State Forests and Lands Service, one of the divisions of the new Department, became responsible for the management of State forest. Field management is organised through eighteen regions.

Establishment and tending of State forest plantations

The establishment of plantations to meet future requirements for wood and to reafforest derelict areas of farmland continued in 1983-84. A total of 579 hectares of native hardwood plantations was established during 1983-84 (compared with 443 hectares in 1982-83), the main planting being mountain species in the eastern Strzelecki Ranges of South Gippsland. A total of 2,068 hectares of new softwood plantations was established in 1983-84 (compared with 3,512 hectares in 1982-83), almost all of which was radiata pine. Softwood plantings were concentrated in six of the eight development zones where it is planned to establish an area of plantation sufficient to support large and integrated wood-using industries.

STATE FOREST SOFTWOOD PLANTATIONS, ESTABLISHMENT AND TENDING ACTIVITIES, VICTORIA
(hectares)

Area	Activity					
	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84
New planting	3,667	2,940	2,608	3,128	3,512	2,068
Re-planting felled areas	520	719	620	568	607	605
Thinning –						
Commercial	940	1,094	1,775	2,120	1,523	1,840
Non-commercial	149	5	—	167	22	11
Pruning	342	127	196	101	172	351
Fertilisation	3,631	3,488	2,218	743	3,327	2,642
Cleaning –						
Ground	4,772	6,064	4,558	4,435	5,594	4,437
Aerial	9	—	398	760	1,796	3,071

Source: Forests Commission, Victoria.

STATE FOREST HARDWOOD PLANTATIONS, ESTABLISHMENT ACTIVITY, VICTORIA
(hectares)

Activity	Mountain forests			Stringybark and other species		
	1981-82	1982-83	1983-84	1981-82	1982-83	1983-84
New planting	246	245	432	125	198	147

Source: Forests Commission, Victoria.

Regeneration and tending of native forests

The regeneration and tending of native forests is aimed at maintaining them in a healthy, productive condition so that they can continue to supply benefits to the community in perpetuity.

A total of 28,311 hectares of native forest was subjected to regeneration or other silvicultural treatment in 1983-84, compared with 18,970 hectares in 1982-83.

NATIVE STATE FORESTS ESTABLISHMENT AND SILVICULTURAL TREATMENT, VICTORIA
(hectares)

Activity	Mountain forests			Stringybark and other species		
	1981-82	1982-83	1983-84	1981-82	1982-83	1983-84
Aerial seeding	1,445	323	2,109	1,018	636	1,793
Hand seeding	1,071	604	782	1,368	706	585
Induced seed fall *(a)*	57	15	14	3,398	2,411	2,582
Regeneration felling/ natural seed fall	109	243	191	7,727	6,968	7,328
Liberation felling	75	54	64	1,005	1,003	5,688
Thinning	17	16	14	3,114	2,483	3,503
Coppicing	—	—	—	508	389	493
Other	29	130	129	2,334	2,989	3,036

(a) Artificially induced seed fall from standing trees.
Source: Forests Commission, Victoria.

SILVICULTURAL TREATMENT OF NATIVE FOREST TYPES IN STATE FORESTS, VICTORIA, 1982-83
(hectares)

Treatment	Area treated					
	Ash forest	Stringy-bark gum	Box, Iron-bark	Red gum	Native pine	Total
Aerial seeding	323	636	—	—	—	959
Hand seeding	604	696	—	10	—	1,310
Induced seed fall	15	2,271	—	140	—	2,426
Regeneration felling/ natural seed fall	243	4,708	370	1,890	—	7,211
Liberation felling	54	993	—	10	—	1,057
Thinning	16	56	1,036	1,006	385	2,499
Coppicing	—	30	294	65	—	389
Other	130	1,260	424	1,305	—	3,119
Total	1,385	10,650	2,124	4,426	385	18,970

Source: Forests Commission, Victoria.

SILVICULTURAL TREATMENT OF NATIVE FOREST TYPES IN STATE FORESTS, VICTORIA, 1983-84
(hectares)

Treatment	Area treated					
	Ash forest	Stringy-bark gum	Box, Iron-bark	Red gum	Native pine	Total
Aerial seeding	2,109	1,793	—	—	—	3,902
Hand seeding	782	585	—	—	—	1,367
Induced seed fall	14	2,566	16	—	—	2,596
Regeneration felling/ natural seed fall	191	5,589	513	1,226	—	7,519
Liberation felling	64	5,379	113	196	—	5,752
Thinning	14	468	1,770	740	525	3,517
Coppicing	—	185	108	200	—	493
Other	129	1,613	816	607	—	3,165
Total	3,303	18,178	3,336	2,969	525	28,311

Source: Forests Commission, Victoria

Research and development

The Forests Commission maintains a research programme to ensure that factual information is available for planning and monitoring forest management practices to meet changing community needs. Both short and long-term studies are in progress into many aspects of silviculture of both native hardwood and exotic softwood forests, and also into genetics and tree breeding, entomology and pathology, protection, hydrology, other environmental effects, and planning techniques.

In nurseries, studies are being made of the nutritional and soil physical requirements of both eucalypts and conifers, the treatment of seeds and seedlings, methods of site preparation, planting and seeding, fertiliser and nursery techniques, and the identification and control of pests, weeds, and diseases, for the efficient production of seedlings.

Investigations are being conducted to develop cultural practices for optimal establishment and growth of first and second rotation radiata pine plantations and maintenance of long-term site productivity. A tree breeding programme with *Pinus radiata* is now yielding improved seeds for general planting purposes, and crossbreeding is proceeding to further develop the desired characteristics. The natural variation in several eucalypt species is being examined in extensive field studies, and the offspring of outstanding individuals are being grown in progeny trials and seed orchards.

The use of tree planting for salinity control in dry land and irrigated farming areas is under investigation with regard to the short-term and long-term salt tolerance of tree and shrub species, their annual water use and effect on the water table.

Other silvicultural studies concern the use of native trees as an effluent disposal system; the regeneration of burnt sites and high-elevation forests; the reforestation of former pine plantation sites; and the effects of thinning on growth and wood quality of eucalypts and conifers.

Continuing surveys of the mechanisms of, and factors controlling, the biology of major pests and diseases of forests, are concerned with specifying the timing and type of control procedures to be adopted; monitoring and evaluating the effectiveness of these measures; assessing the likely environmental impact of control measures; and providing service information within and outside the Department.

The major emphasis in entomological research is directed at the sirex wood wasp *(Sirex noctilio)* and its impact on the management of *Pinus radiata* plantations; and at a bark beetle *(Ips grandicollis)* which is potentially a serious pest of *Pinus radiata*. Pathological research continues on the cinnamon fungus *(Phytophthora cinnamomi)* and honey fungus *(Armillaria)* including assessment of site and stand characteristics associated with eucalyptus-crown dieback, and the rate of spread and effect of the fungi on different species in mixed eucalypt forests.

Research into the ecology of birds and animals in the forests is being conducted to assess the influence of management practices on forest flora and fauna. Studies look at the distribution and abundance of species and their habitats in the various layers of forest vegetation, especially in streamside reserves and corridors of native vegetation in plantations, and in plantations and adjacent native forests after utilisation. Emphasis is also being given to evaluating the effect of harvesting, flooding, pesticide application, fire, and controlled burning on water quality and yield, nutrient status, site productivity, and flora, fauna, and wildlife habitats. This information is used to develop forest management procedures which allow for the efficient production of wood consistent with the conservation of other forest values such as water quality, recreation, and wildlife habitat.

Information for planning forest management is generated by computer analysis of growth habits of major commercial species under various cultural regimes. These data enable prediction of the quantities and sizes of future timber supplies as stands develop under different patterns of use.

Forest protection

The 1983-84 fire season was the mildest experienced in the past ten years. During the season, Forests Commission personnel attended 217 wildfires, being the lowest number since 1973-74 (193) and less than half the ten-year average of 498 per year. These fires burnt a total of 14,735 hectares of State forest, national park, and protected public land, being the smallest area over the past decade and about one-ninth of the ten-year average of 132,000 hectares. The total area of these public lands burnt in the past six fire seasons up to and including 1983-84, is shown in the following table:

AREAS OF STATE FOREST, NATIONAL PARK, AND PROTECTED PUBLIC LAND BURNT BY WILDFIRES, VICTORIA
(hectares)

Year	State forest	National park	Protected Public Land	Total
1978-79	37,454	3,610	—	41,064
1979-80	25,773	628	1,235	27,636
1980-81	388,681	40,561	2,731	431,973
1981-82	16,657	2,139	67	18,863
1982-83	360,430	74,725	158	435,313
1983-84	8,983	2,559	3,193	14,735

Source: Department of Conservation, Forests and Lands.

The 1980-81 fire season had commenced very early, during September and October, in East Gippsland due to a combination of prolonged dry conditions over the autumn/winter period and the occurrence of strong winds. A very serious fire situation developed in East Gippsland during early October when about 70 fires were burning concurrently in this region. Extensive fires also occurred later in the season in western parts of the State; two large fires, started by lightning, burnt a total of 256,500 hectares. Forests Commission personnel attended 793 fires throughout the season while the area of public lands burnt totalled 431,973 hectares — being 160 and 325 per cent of the ten-year averages, respectively.

During the 1981-82 fire season, Forests Commission personnel attended 468 wildfires which burnt a relatively small area totalling 18,863 hectares, being 94 and 15 per cent of the ten-year averages, respectively.

The 1982-83 fire season was marked by the most destructive wildfires since the holocaust of 1939. A record drought period, which continued throughout the winter and spring after 1981-82, was accompanied by periods of hot and windy weather during the spring and summer months. Major outbreaks of fire occurred from November 1982 to March 1983, inclusive, with the most disastrous fires on 16 February (referred to as 'Ash Wednesday').

In 1982-83, Forests Commission personnel attended 823 fires during the season and the areas of public lands burnt totalled 435,313 hectares, being 165 and 330 per cent of the ten-year averages, respectively. The most extensive fires occurred in East Gippsland during February and March, burning 127,000 and 126,000 hectares, respectively. The most damaging fires occurred on 8 January near Daylesford when two Forests Commission employees died, 11 homes were destroyed, and 13,940 hectares of State forest burnt; and on 16 February when 47 persons died, 2,080 homes were destroyed and 85,500 hectares of State forest and national park burnt.

The wildfires occurring in State forest, national park, and protected public land originated from a variety of sources and by various agencies. The tables below illustrate the respective 'source' and 'agency' which caused wildfires in these areas during each of the past six years. Such tables have been developed and standardised by the Commission from and including the 1978-79 annual report and replace the table, based on twelve causes, previously used.

In 1983-84, lightning accounted for 10.6 per cent of the total outbreaks, while of the balance, 18.4 per cent were attributed to deliberate lighting, 15.7 per cent to landholders' burn-off escapes, 12.9 per cent to campfires and barbeques, and 12.0 per cent to cigarettes and matches. The ten-year averages for these causes are 25.2, 17.8, 14.8, 8.7, and 7.8 per cent, respectively.

CAUSES OF FOREST WILDFIRES BY AGENCY, VICTORIA

Cause by agency	Number of fires					
	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84
Lightning	113	154	207	128	230	23
Children	8	20	38	26	39	13
Employee –						
Forest industry	8	10	19	7	27	6
Forest Department	6	31	26	21	24	10
Other Departments	8	10	10	14	14	10
Other industry	3	8	13	4	5	3
Recreationist –						
Bushwalker	3	2	4	4	2	1
Camper	19	28	27	23	31	21
Hunter	12	31	23	9	35	18
Day Visitor	10	36	50	19	53	7
Resident –						
Permanent	10	31	45	39	49	22
Part-time	2	22	19	10	18	6
Farmer –						
Full-time	36	47	79	40	66	20
Part-time	12	20	26	14	32	10
Military	2	1	1	—	2	—
Traveller	7	18	17	22	54	14
Grazing leaseholder	3	6	7	—	5	—
Other	29	50	32	18	89	15
Unknown	50	188	150	70	48	18
Total	341	713	793	468	823	217

Source: Department of Conservation, Forests and Lands.

CAUSES OF FOREST WILDFIRES BY SOURCE, VICTORIA

Cause by source	Number of fires					
	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84
Lightning	113	154	207	128	230	23
Exhaust –						
chainsaw	6	4	2	7	7	1
other	5	15	7	8	11	2
Snigging, hauling	—	—	—	—	2	2
Burning vehicle, etc.	9	14	7	4	11	7
Pipe/cigarette/match	25	50	56	39	78	26

CAUSES OF FOREST WILDFIRES BY SOURCE, VICTORIA — *continued*

Cause by source	Number of fires					
	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84
Campfire/barbeque	28	75	60	43	66	28
Prescribed burning	2	18	15	8	5	4
Burn off –						
railway	—	1	—	—	—	—
grass/scrub, etc.	18	34	70	21	39	13
windrow/heap	20	19	36	19	30	8
Train	6	2	2	6	2	2
Deliberate lighting	33	157	167	84	149	40
Waste disposal –						
domestic	11	13	10	12	15	5
industrial	5	18	17	13	26	11
Power transmission	9	15	5	10	17	4
House,stove/flue	2	5	5	4	9	3
Burning building	1	6	2	1	2	1
Fireworks	1	—	1	—	—	—
Relight –						
wildfire	—	4	10	3	12	1
prescribed fire	2	9	10	10	9	7
burn-off	9	28	27	21	61	13
Other	15	21	29	14	24	10
Unknown	21	51	48	13	18	6
Total	341	713	793	468	823	217

Source: Department of Conservation, Forests and Lands.

Fire prevention works are effected in State forest in accordance with the fire prevention plans prepared for each of the forty-three forest districts. During 1983-84, the summary of major works (excluding fuel reduction burning) is shown in the following table:

MAJOR FIRE PROTECTION INSTALLATIONS ON STATE FOREST, VICTORIA, 30 JUNE 1984

Work	Unit	Construction	Maintenance	Total in use
Firebreaks	kilometres	790	2,759	3,560
Helipads	number	13	160	270
Airstrips	"	1	17	22
Dams, weirs, tanks	"	64	1,436	2,328
Towers and lookouts	"	4	85	85
Dugouts and shelters	"	1	44	44

Source: Department of Conservation, Forests and Lands.

A summary of fuel reduction burning effected in State forest during each of the past six years is shown in the following table:

AREA OF STATE FOREST TREATED BY FUEL REDUCTION BURNING, VICTORIA

Year	Area	Percentage of State forest
	(hectares)	
1978-79	98,950	1.6
1979-80	345,045	5.5
1980-81	477,160	7.5
1981-82	167,135	2.6
1982-83	62,345	1.0
1983-84	370,000	5.8

Source: Department of Conservation, Forests and Lands.

A central strategy of fire protection in Victorian forests is to dispose of the dry plant litter, such as bark and leaves, which is shed by eucalypt trees every year in great quantities. The periodic removal of accumulations of this flammable material is the most effective way of preventing intense destructive wildfires during the fire season and enables fire fighters to more readily control any such outbreaks.

Control of these accumulated fine fuels in eucalypt forests is an important factor in protecting adjacent settled areas and private property, intensive-use forest recreation areas, softwood and hardwood timber production areas, plus water supply catchments and significant wildlife habitat areas. This control is achieved by the most natural means of fuel reduction (or controlled) burning operations during the spring and autumn months when weather conditions and dryness of the fuels are suitable for slow, controllable fires that burn at low intensities. These operations are carried out in accordance with district fire prevention plans, updated each year, and have resulted in an average of approximately 200,000 hectares being treated in this way each year over the past two decades.

The methods of ignition are twofold. On small areas, ground lighting is usually done by men moving through the area on foot and lighting separate fires on a pre-determined grid pattern. Where larger areas are being burnt, aerial techniques are used and incendiary capsules are dropped at regular controlled intervals from helicopters or fixed-wing light aircraft; the spacings of these fires are adjusted to suit the conditions of topography, forest fuels, and weather of each situation.

The burning prescriptions provide that the prescribed fires shall be contained within the planned areas; perimeter control lines are established by use of existing roads and tracks, natural features (creeks, etc.) and previous such burns, and supplemented, where necessary, by pre-arranged strip burning on the perimeter.

The fuel reduction system has been developed as a result of research on the conditions under which fires can be lit and kept at low intensities, also on the effects of controlled fires and wildfires on the vegetation, wildlife, forest growth, and timber quality.

Major improvements have been made during the past decade in the methods of suppressing wildfires by the use of aircraft. An effective technique of aerial attack on some fires has been developed in which small agriculture-type aircraft, fitted with hoppers of 550 to 1,500 litres capacity, are loaded with fire retardant which is released during flight on the vegetation near the fire edge. The retardant has a persistent or lasting effect on the vegetation cover, as compared to water, and is usually applied in one or more strips around isolated fires in very remote areas (such as lightning strikes) or to troublesome sections of other fires. The retardant slows up or prevents the spread of the fire edge and enables fire fighters to more readily achieve control of the fire. These aircraft operate from airstrips within the forest where facilities have been installed for storage, mixing, and loading the retardant mixture, and also from other airstrips with similar facilities, near the forest. Similar light aircraft are also used for fire reconnaissance of extensive forest areas, especially after 'dry' thunderstorms have occurred, to pin-point any fires resulting from lightning strikes or other causes.

Helicopters are also used to great effect in fire suppression to transport fire observers searching for new or suspected fires, fire control officers directing ground fire fighting operations from the air, and men, equipment, and supplies into remote or difficult access areas. There are 270 helipads which have been developed in forest areas to enable helicopters to land with fire fighting resources. In more recent years, a helicopter has been fitted with a suspended bucket of about 1,600 litres capacity which is filled with water by immersion in a water storage and the load released vertically on to the fire, this method being especially effective on a troublesome hot-spot or a 'spot' fire away from the main fire.

Further references: Fire protection, *Victorian Year Book* 1965, pp. 553-4; Economic aspects of forests, 1967, pp. 361-2; Commonwealth-State Reforestation Agreement, 1969, pp. 372-4; Forests of Victoria, 1972, pp. 1-26; Victorian School of Forestry, 1977, pp. 399-400; Victoria's forests and man, 1978, pp. 1-35; R. J. Hamer Forest Aboretum, 1979, pp. 313-14; Forests along the Great Dividing Range, 1980, pp. 325-6; Tree planting on farms, 1981, p. 324; Developments in forestry since 1934, 1984, pp. 303-23

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