Insert
Before the principle of sustained yield was introduced to Western Australia, the timber industry flourished unchecked. The Boranup karri forest was clearfelled to supply the Karridale Mill of M.C. Davies at the turn of the century.

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Boranup today is a fine regrowth forest, and is managed for conservation of flora, fauna and landscape values. It is a popular tourist attraction in the south-west corner of the State.

C. Winfield

SUSTAINING THE YIELD

How do the ideals match the realities of forest management in W.A.?

R. J. Underwood

In an old forest magazine, SYLVAN there is a story about Germany's great poet, Friedrich von Schiller. Schiller, taking rest at Illmenau, Thuringen, in the year 1830, met by chance a forester who was preparing a plan of management for the Illmenau forest. A map of the forest was spread out on which the cuttings for the next 220 years were projected and noted with their number. By its side lay the plan of an ideal coniferous forest which was to have materialized in the year 2050. Attentively and quietly the poet contemplated the telling means of forest organization, and especially the plans for far distant years. He quickly realized, after a short explanation, the object of the work and gave vent to his astonishment. "I had considered you foresters a very common people who did little else than cut down trees and kill game, but you are far from that .... the fruit of your quiet work ripens for a late posterity."[1]

(1) Quoted by H.S. Graves in "Science Newsletter" December 20 1926.

Schiller was observing the preparation of a sustained yield plan for a forest. Developed in Europe in the 17th Century, to this very day the formulae and techniques involved are taught as an ideal to every young forester.

In its most simple expression sustained yield management means balancing the harvest and the growth of a forest so that valued products are produced each year indefinitely. Since the concept was first developed, it has become almost a doctrine of faith for succeeding generations of forest owners and managers - the foresters' credo, if you like.

But like many other doctrines, sustained yield forest management has proven harder to practise than to preach. Moreover, there are many people today who challenge the relevance of a rigid sustained yield model for forests that are managed for multiple uses in modern society.

How well **has** the doctrine of sustained yield stood the test of time and translation to foreign fields? In particular, what is the situation in Western Australia where our restricted area of valuable forests have been under more pressure for agricultural clearing than for conservation for most of the 150 years since European settlement?

These are the questions we will try to answer in this story - a story about the ideals and the realities of forest management in W.A.

Forests, Timber and Conservation

Although the forests of Western Australia have long been managed to provide a wide range of benefits to the community (including protection of water catchments, provision of areas for recreation and solitude and maintenance of habitat for native plants and wildlife) one of its most vital roles has always been, and continues to be, the **supply of timber.** If we seem to concentrate on timber too heavily in this story it is not because the other products of the forest are forgotten, but because the story is easiest to tell from the timber slant.

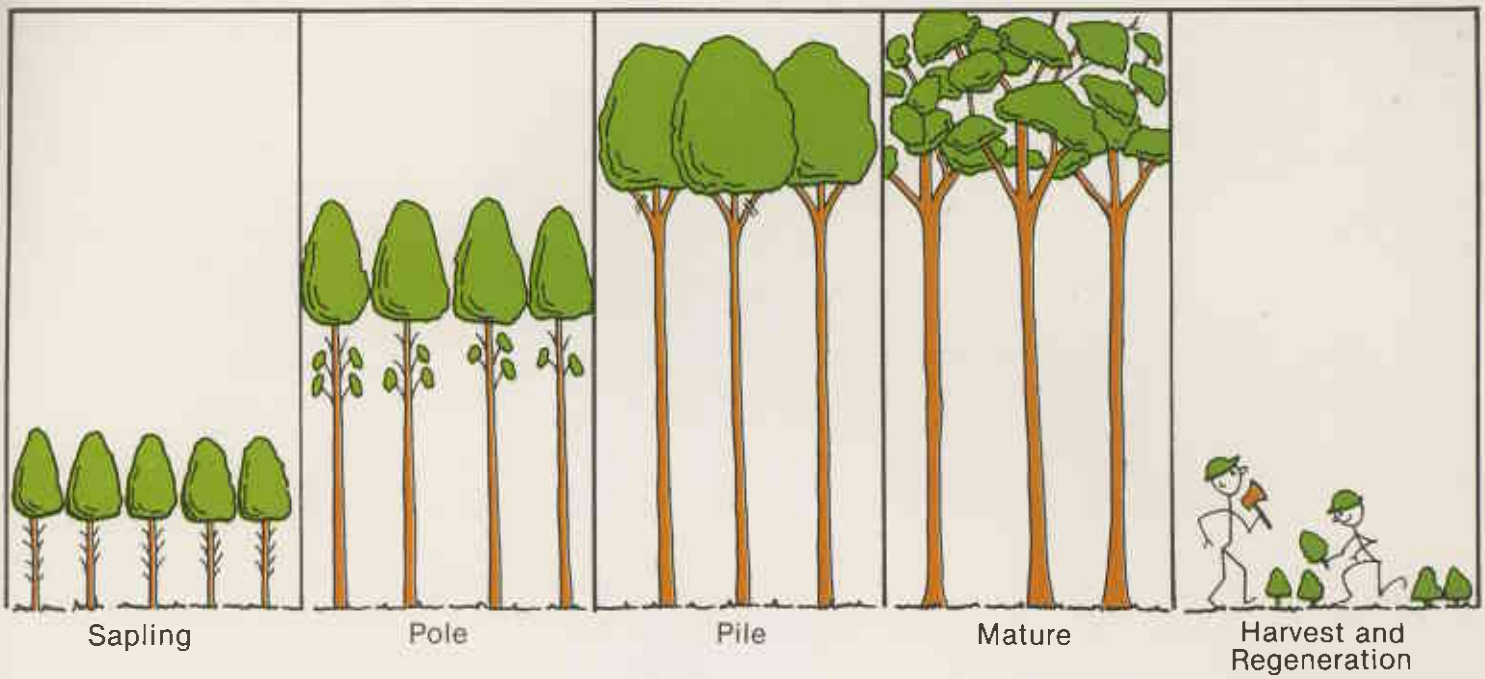
Perhaps no other material is as useful to mankind as is timber. Almost everyone uses it in some form every day: in books, newspapers or lunchwraps, as writing paper or cardboard, as furniture, as an essential constructional material in homes, office, school or factory, for warmth or for cooking, for power generation and transmission, for bridges, wharves and railways, tool

The principle of sustained yield was developed in Europe in the 17th century. This second rotation spruce forest in Germany is one hundred and fifty years old and ready to be harvested and replanted yet again.

R Underwood

Fig. 1

THE IDEAL MANAGED FOREST



handles or musical instruments. The list seems to be never-ending.

One early Western Australian forester wrote, in 1925:

Without timber life would be shorn of most of its joys and comforts; without it man would never have emerged from barbarism; fire as a means of preparing food and providing warmth would have been unknown, and travelling that included the crossing of wide rivers, or of seas would have been impossible.[2]

In addition to this manifold utility timber has yet two further priceless attributes. **First,** it is a renewable resource. Unlike even the richest deposit of minerals which, once mined out can never be replaced, forests can continue to yield timber for all time. **Second,** the properly managed timber harvest will not affect all the other prime values of the forest, such as soil and catchment protection, recreation and the provision of fauna habitats.

With proper management, the production and utilization of all forest values can be sustained indefinitely.

Long regarded as the cornerstone of forestry, sustained yield management has recently become embodied in world conservation philosophy. The International Union for Conservation of Nature and Natural Resources has defined "Conservation" as

the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations.[3]

The History of the Sustained Yield Concept in Forestry

Despite the beauty and utility of trees and timber, the **clearing** rather than the **conservation** of forests has been the preoccupation of societies across most of recorded history. Although the Romans were keenly interested in forests and tree planting for nuts and timber, and the nobility of the Middle Ages created forest reserves where they could ride and hunt, it was not really until the middle of the 17th Century, that the first formal attempts at "modern" forest conservation and management began in central and western Europe. The most innovative concept to emerge from this period was that of "sustention" or sustained yield of timber.

The concept evolved in Germany in the years after the end of the disastrous Thirty Years War in 1650. At that time, Germany consisted of over three hundred small, land-locked independent states, mini-states, and independent townships governed by princes, counts, abbots, bishops and civic councils. These were poorly serviced by roads and river transport; there were no railways. During the period of stability which ensued at the end of the War, populations increased, cities, towns and hamlets were rebuilt and there was a great expansion in industry and public works. Suddenly the

(2) S. L. Kessell in "A Primer of Western Australian Forestry".

(3) IUCN: World Conservation Strategy.

H. Bradbury

Most of the jarrah forest in Western Australia has been harvested once. Prime jarrah regrowth such as this 60-year-old near Mundaring will be available again for harvest around the year 2050.

Photo Courtesy Millars Pty Ltd

Boranup Mill, 1899. This was one of three large mills operating from the Boranup forest between about 1877 and 1920. When the forest was cut out, the mill was closed.

depletion of local forests became a serious and widespread problem. In one region it was said "it was not possible to find a sufficient tree upon which to hang a forester!"* Even worse, the timber famines were accompanied by flooding, erosion and landslides where ancient forests had been recklessly cut from mountainous regions.

From these problems, modern forestry was born. Conservation ordinances were introduced, forests were planted, protected and tended according to working plans, and the idealized concept of local forests forever supplying the needs of local communities emerged. Foresters began to measure tree volumes, assess growth rates and timber yields, determine the most appropriate age at which trees should be felled (i.e. the "rotation"), and prescribe the annual allowable harvest for each product for each forest. The sought-after situation for every forest was one where each year's harvest exactly equalled each year's growth. Where such a situation prevailed and was constant year after year, the forest was said to be "normal". All over Europe the idea of management for sustained yield caught on and was espoused by forester, forest owner and local community alike.

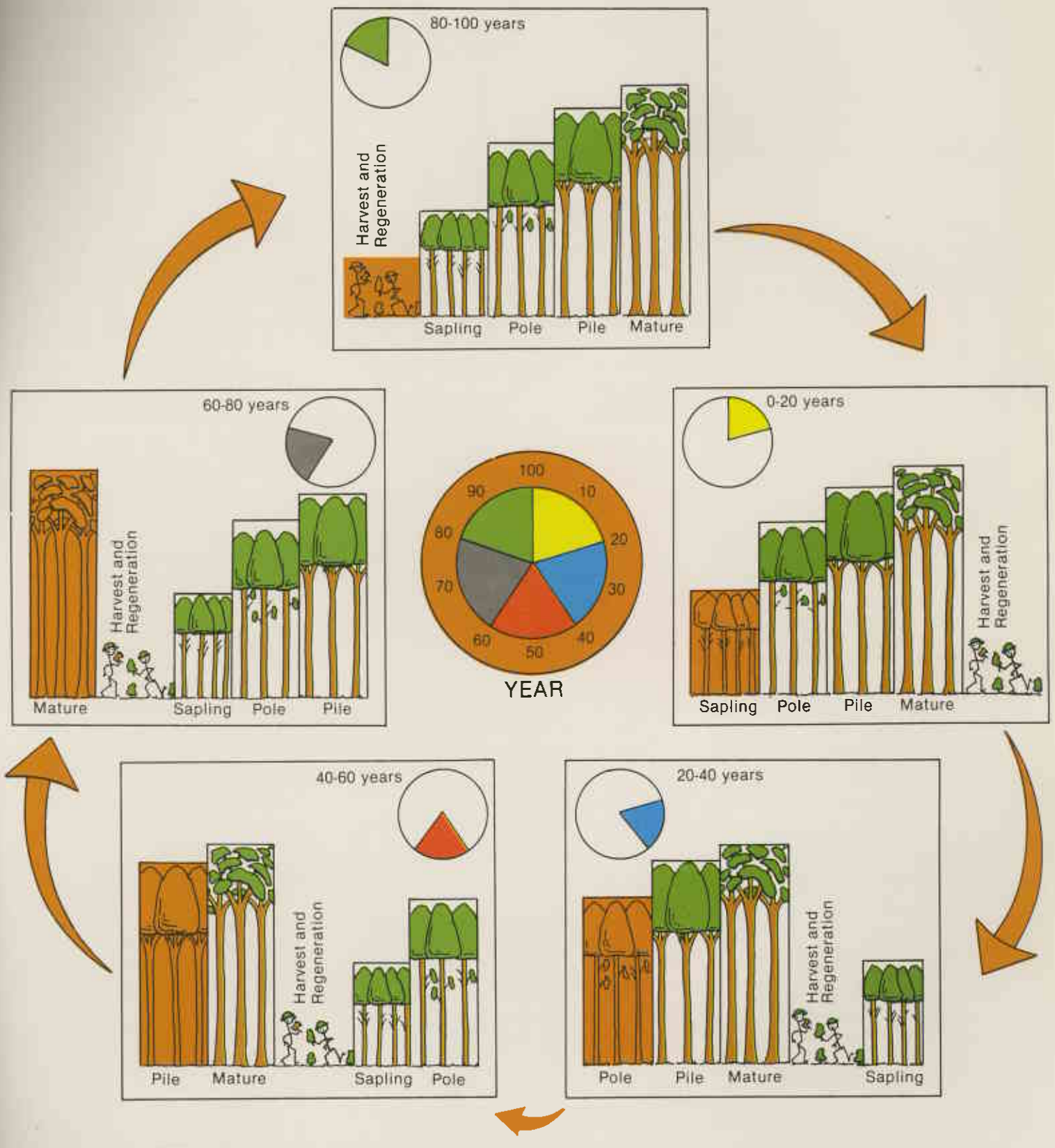
These developments in the Central European countries in the 18th and 19th centuries were not paralleled in Britain or in North America or Australia. As a great maritime trading nation and the possessor of forest-rich colonies where timber was plentiful and free, Britain had no need for scientific forestry at this period. (Indeed it was not until the British Isles were blockaded by German submarines in World War I that the British recognized a need for domestic national forests). In North America, as in the coastal fringes of Australia where European settlement was concentrated, the vast natural forests were regarded as limitless, or worse, a liability, *to be sawn up, ringbarked or otherwise destroyed to make room for the settler.*[4]

In Western Australia, the native forests were exploited without a thought for the future for nearly a century after first settlement. It was not until 1918 that a Forests Act "for the better management of forests" was passed and the first Conservator of Forests appointed. However, a further thirty years were to elapse before State forests were secured in the face of persistent demands for more

* A forester in those times was a gamekeeper whose main duty was the prevention of poaching by the peasantry. Forests were owned by the landed aristocracy, or by the Church or Town Councils.

(4) C.E. Lane-Poole in Woods and Forests Department Annual Report.

Fig. 2 "The ideal forest after it has been converted to sustained yield."



Follow the progress of a stand of trees from regeneration to harvest.

UNEVEN DISTRIBUTION OF AGE CLASSES
IN AN UNCUT FOREST

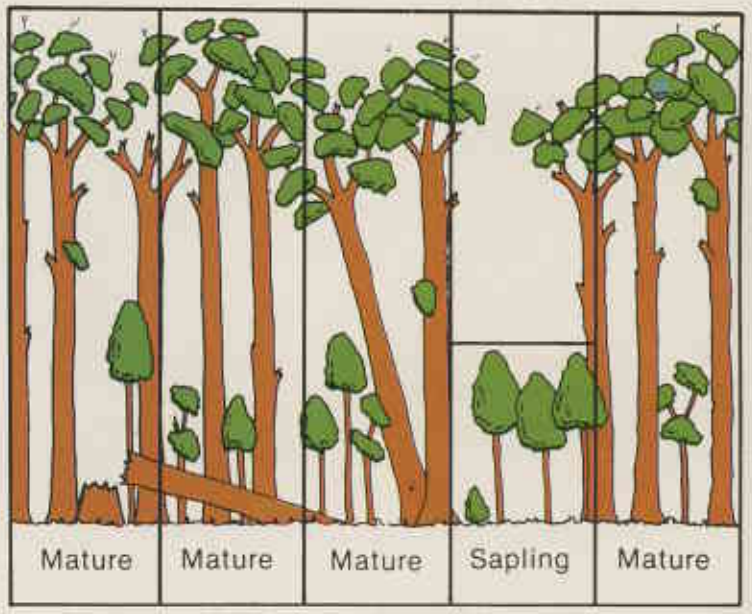


Fig. 3
A typical uncut forest never occurs with the "ideal" range of age classes and takes many years to convert. It will require initial cutting levels above or below the final sustained yield.

If equal areas are cut during this conversion period, yield will not be constant. Usually, equal volumes are logged, thus requiring adjustments later to the managed forest.

agricultural land. It was not until the late 1970s, nearly 150 years after settlement, that a groundswell of popular public interest in forest conservation emerged.

It is interesting to observe that one of the major elements of popular concern today is with the question of sustained yield management, as exemplified in the bumper sticker slogans which call for the "saving" of native forests from mining or overcutting.

How Sustained Yield Works: the Ideal

The principle of sustained yield timber management can be simply explained but it is less easy to implement in the forest and has rarely been achieved for any length of time anywhere in the world.

In simplistic terms, the sustained yield of a forest is the volume of timber that can be harvested each year for an indefinite period. A common analogy is that of money in the bank: if, say $100.00 is invested and earns $10.00 interest each year, $10.00 can be spent by the investor each year "forever" without ever affecting the value of the capital.

Imagine a small forest which has been managed for sustained yield of sawmilling quality logs (sawlogs) for a long time. The forest is carefully measured and found to carry 50 000 cubic metres of sawlogs.

By further careful measurement it is determined that the forest is growing an extra net 500 cubic metres of sawlogs every year. (The net increase is made up of growth of young trees to a size big enough to mill, **plus** growth in the dimensions of existing large trees, **less** losses of timber volume through death and decay of old trees - not an easy figure to determine!)

The sustained yield of sawlogs for this forest is then said to be 500 cubic metres. This means that so long as the area and fertility of the forest remains the same, and provided the area which is cut each year is restocked with trees so that the overall net growth of timber remains at 500 cubic metres of logs suitable for milling, **then,** 500 cubic metres of logs may be harvested each year for as long as you like without depleting the forest.

What Really Happens

The sustained yield concept, in its purest mathematical form (i.e., annual harvest must equal annual growth) has a universally appealing simplicity. This is because it represents "working conservation" at its best: the sustainable utilization of a natural resource for the long-term good of society.

The sustained yield scheme of management offers attractive advantages: timber is always available to the local consumer; industry gets an even flow of raw material; the forest owner can predict works programmes and income for years ahead; and forest-based communities have an assured and stable future.

Indeed the concept is so appealing that an outcry can arise from a concerned public when it appears that sustained yields are being exceeded. This has happened recently in Western Australia, with claims from some quarters that "overcutting" of the native forest is a serious problem. In particular, concern has focussed on the karri forest, where stands are being felled to produce sawn timber and pulpwood. Part of this concern stems from a wholly

understandable repugnance to the sight of beautiful trees being cut down.

Very few people prefer the view of a clearfelled "coupe" to a lofty stand of trees; and if the regeneration process is not understood, it is easy to imagine clearfelled forest as being destroyed.

In the minds of many people "clearfelling" means "overcutting" and both are synonomous with "overgrazing". The latter is a term used in agriculture to describe a situation when prolonged grazing on an area can lead to irreversible degradation of soils and vegetation.

Of course it is possible for cutting without regeneration, especially when **combined** with grazing, to lead to forest destruction. This has happened in many of the ancient countries surrounding the Mediterranean Sea since Biblical times, and is a serious problem even today in developing countries of the "Third World", where population pressures exceed the productivity of the land[5].

However, clearfelling does not mean overcutting. Parts of a forest can be clearfelled in a planned and systematic manner without ever resulting in overcutting. And overcutting, does not by itself degrade a forest, unless regeneration measures are not undertaken. Cutting followed by reforestation does not destroy a forest. Even overcutting (that is, exceeding the sustained yield harvest) has no degrading effects so long as adequate regeneration is established. The undesirable effects of overcutting are social and economic, not environmental, since it may lead to discontinuous timber supplies rather than permanent loss of forest. Deliberate overcutting may even be necessary for a certain period of time in order to achieve the goal of restructuring a forest to achieve sustained yield.

(5) Forest Sector Policy Paper, World Bank, 1978.

Fig. 4
The yield of a forest may be made up of different products, and the proportion may vary with age and size.

In an uncut forest the proportion of low grade material is often higher than in a managed forest, because of its age and past effects of fire and disease.

THE TIMBER YIELD IS MADE UP OF DIFFERENT PRODUCTS

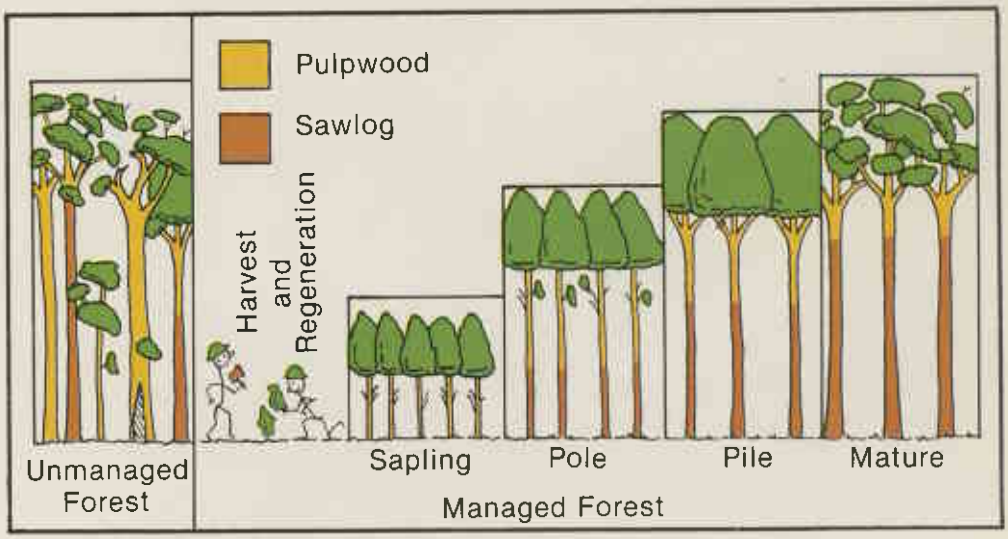
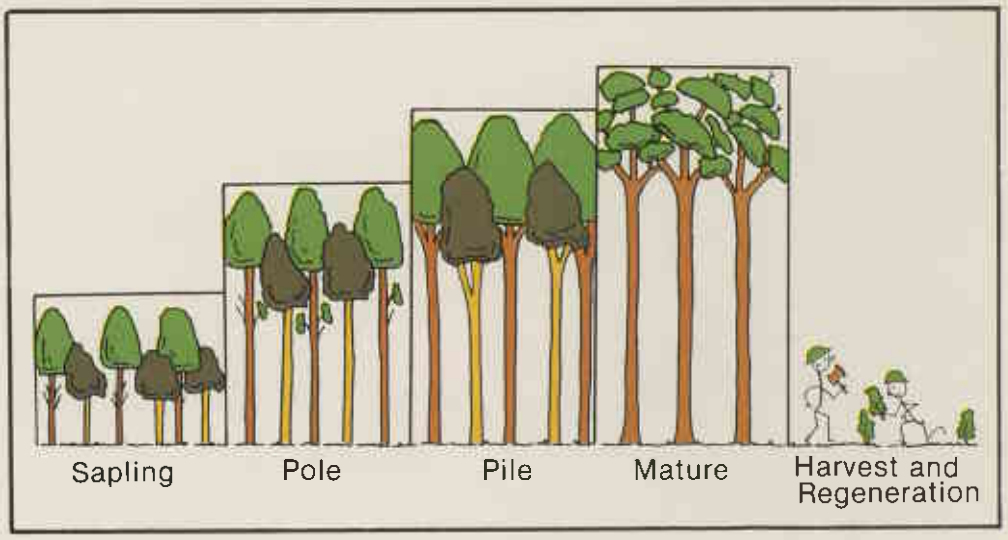


Fig. 5
The forest may also consist of different species and different sites, each with different growth rates and characteristics.

THE TIMBER YIELD MAY VARY ACCORDING TO THE SPECIES



C. Winfield

The process of harvest, utilization and regrowth in the karri forest.

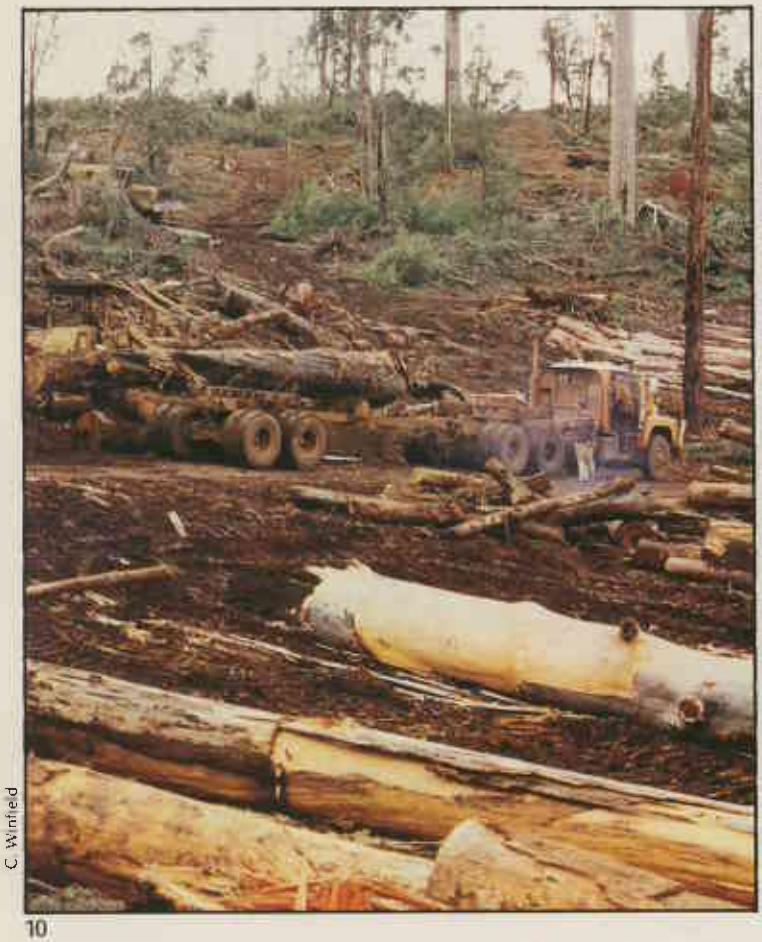
Top Left
The mature tree is felled.

Centre Left
Logs are yarded and loaded onto trucks.

Below
The karri sawlog provides a huge volume of timber.

Top Right
The majority of karri timber is used for beams in roof construction as karri is available in very long lengths and is strong enough to span large distances.

Bottom Right
Fire under seed trees in the logged karri area — the first step in regeneration of a new forest.



C. Winfield

C. Winfield

Overcutting in the Karri Forest

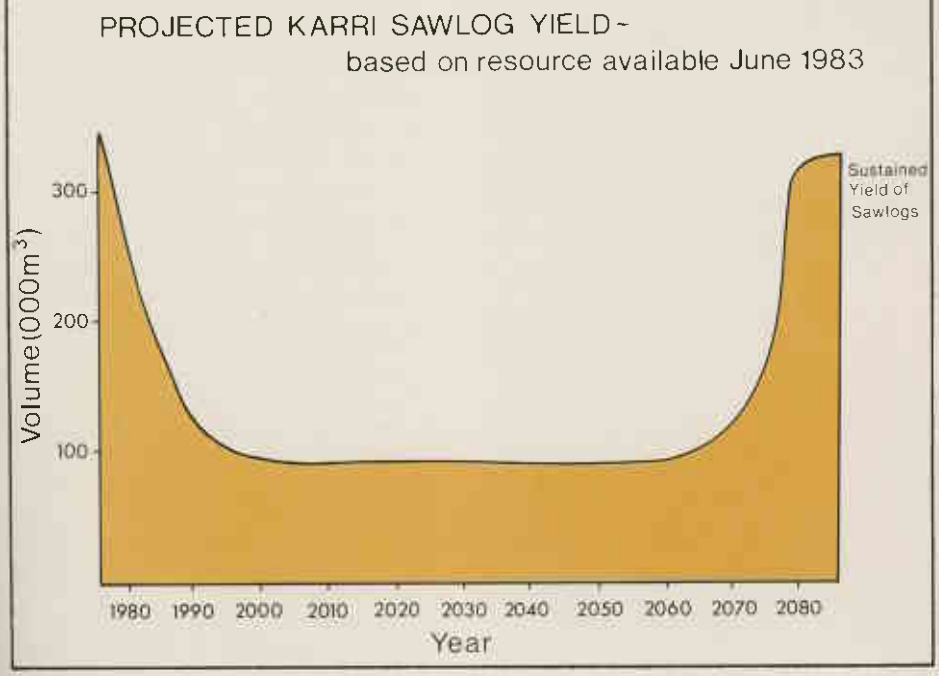
The situation in the karri forest serves to illustrate one of the major difficulties in the "construction" of a sustained yield forest. The problem is that **in a virgin forest[6] there is no net growth of timber.** The virgin forest is in a state of natural equilibrium where the death and decay of old trees is balanced by the regrowth of younger ones. In other words the sustained yield figure for a virgin forest is zero. Therefore as soon as harvest begins, yield (products removed) exceeds growth. If a forest is being properly managed, harvest must be accompanied by regeneration (replanting or reseeding) of the areas cut over. Many years then elapse before the regrowth forests are old enough to yield the desired product. Therefore for every virgin forest, there must be a "conversion period", that is a time during which the forest is converted to a condition when sustained yield management is possible. Conversion periods of up to 250 years or more are necessary for some forest types. (See the opening paragraph of this story.)

The karri forest is being "overcut" at the moment because the harvest of large sawlogs exceeds the present growth of large sawlogs. However, as the graph shows (Figure 6) the present level of sawlogs cut is part of a long-term plan to achieve sustained yield around the year 2080. During this conversion period, karri sustained yields will decline for a period, but will then increase substantially as volumes become available from the regrowth stands.

Has the advent of woodchipping in the karri forest led to overcutting? The answer to this question is no. Woodchips are produced from logs unsuitable for sawmilling and therefore play no part in the sustained yield calculations for sawlogs. If sawlog and woodchip log production are taken jointly, the karri forest is actually being undercut, not overcut.

(6) A virgin forest in this instance means one which has not been cut over. Karri forest cutting is still concentrated in virgin stands.

Fig. 6
The yield of karri sawlogs will be less than the ultimate sustained yield during the conversion period.



C. Winfield

New Karri forest approximately 8 years old (right) will be ready to harvest in about a hundred years' time.

Are There Other Difficulties with Applying the Sustained Yield Concept?

In addition to the problems of turning a virgin forest into a "sustained yield" forest, there are a number of other difficulties in matching the reality to the ideal of sustained yield forestry.

Firstly, the sustained yield model is purely a mathematical one, based on the area of forest, its growth rate and the dimensions of the products involved. The influence of the market, and of political and economic factors is completely ignored in the model. Timber consumption by the community does not follow the strictures of arithmetic, but varies according to the laws of supply and demand, the economic climate, the fluctuations in the interstate and international trade and commerce from year to year, and the impact of changes in customs or technology.

Secondly, a strict compliance with sustained yield formulae may be undesirable in times of national crisis or stress. Many world and local examples can be cited of situations where an "overcut" of the forest was necessary in times of war, or following population explosions or industrial or political revolution. It may also be necessary to exceed the sustained yield cut following a natural disaster in the forest, such as the great bushfires in Victoria in 1939, the terrible ice-storms in Europe in the early 1970s, and the Mt St Helen's volcanic explosion in the NW Pacific coastal forests of the USA in 1980. In these situations huge volumes of timber must unexpectedly be salvaged almost "overnight" to avoid their wastage, and overcutting is the inevitable result.

There may be other times when a forest owner may deliberately choose to overcut the sustainable yield for a few years. For example, in the case of privately owned forest it may be necessary to generate some urgently needed income or to take advantage of a sudden market opportunity.

So we see that while the pure sustained yield system has advantages and wide appeal, it is not easy to fit into the real world. Market or economic influences, or a natural disaster in the forest may often dictate a need to overcut for a limited period of time. Conversely there may be times when the market doesn't **want** the cut, or for one reason or another the forest simply fails to produce expected yields. In such situations an undercut will be forced on the forest owner by factors beyond his or her control.

The end result is a juggling process with harvests and growths varying

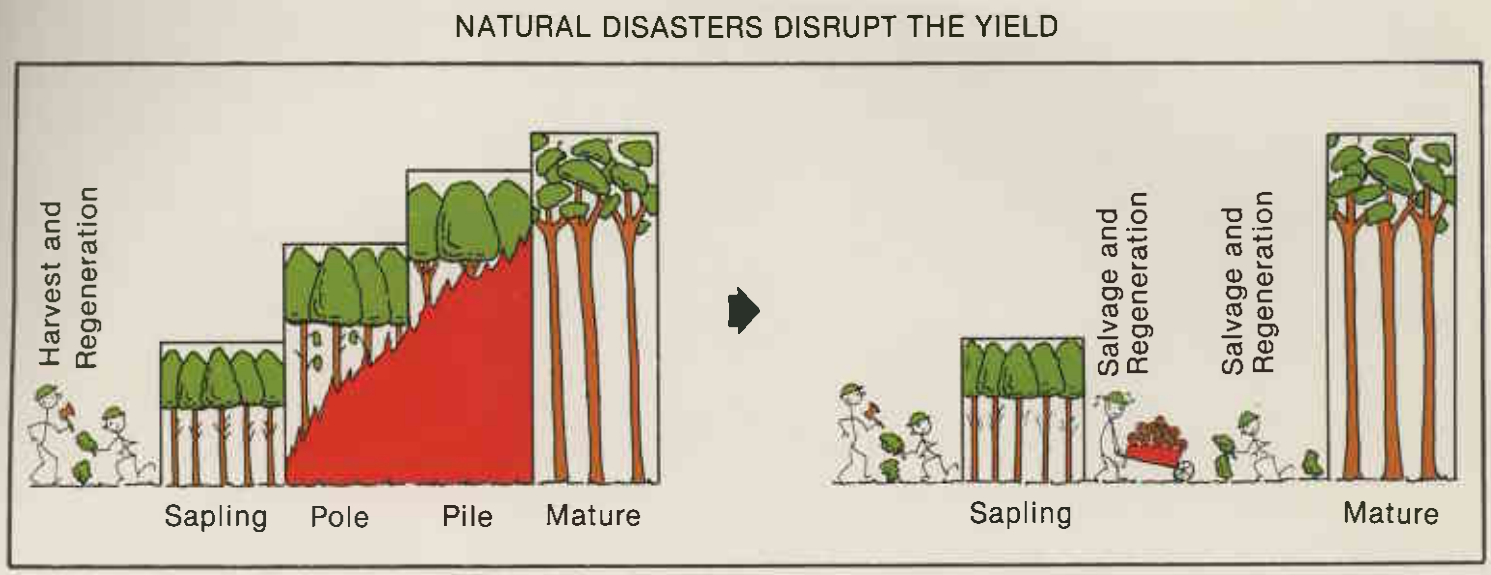


Fig. 7
Even in a well regulated forest a natural disaster may require the salvage of more than the sustained yield. Adjustments must be made later to restore the "normal" forest.

from year to year, with the aim being an equalization over periods of ups and downs.

The preference of the forester, in most cases, is to undercut by a small margin whenever he or she has a say in the matter. This provides the security of a reserve of timber which can be used to meet an unpredicted and pressing need, and provides a buffer against a natural disaster such as fire or wind storm. A great advantage of timber, compared with many other "crops", is that it does not spoil if harvest is delayed. Perhaps the most difficult problem in planning a forest for the future is to predict the needs and the values of future populations. This is an unusually difficult time to make predictions about the future, because of rapid social, economic and technological changes. A good example is the problem encountered by geographers in predicting population trends in Australia.

Foresters have no greater skills in foretelling the future than anyone else. However, they are accustomed to thinking and planning a long way ahead, and to reviewing and modifying their plans at frequent intervals.

A sustained yield plan for a forest may be disrupted by natural disasters. In 1978, cyclone Alby severely damaged pine plantations near Nannup, necessitating an urgent salvage of timber at a greater cutting rate than originally planned.

F. McKinnell

H. Bradbury

Twenty-year-old wandoo regrowth in the catchment of the Helena River. These areas were heavily logged for sawlogs and woodchips (for tannin extraction) during the 1950s and regenerated in 1963.

H. Bradbury

Powderbark wandoo glows pink in the autumn. The wandoo forest is currently *undercut*. The primary use in the area is water catchment protection; secondary uses being recreation, conservation of flora and fauna and scientific study.

Despite these difficulties, both history and instinct point to timber being a perennially useful material. Timber substitutes, such as steel, aluminium, concrete and plastics are all environmentally less desirable and consume far greater energy in their manufacture. Moreover, the forests from which timber is available on a perpetually renewable basis also offer a wide and satisfying range of social, recreational and protective functions.

Every enterprise and every society needs goals and ideals. Management in reponse to day-to-day impulses can only lead to chaos. The principle of sustained yield management, however difficult to apply, represents a desirable goal for forestry in Western Australia. Like the rulers of the independent States and principalities in the Europe of the 17th and 18th centuries, the State of Western Australia (on behalf of the people) has chosen a policy of long-term self sufficiency in timber supplies.

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