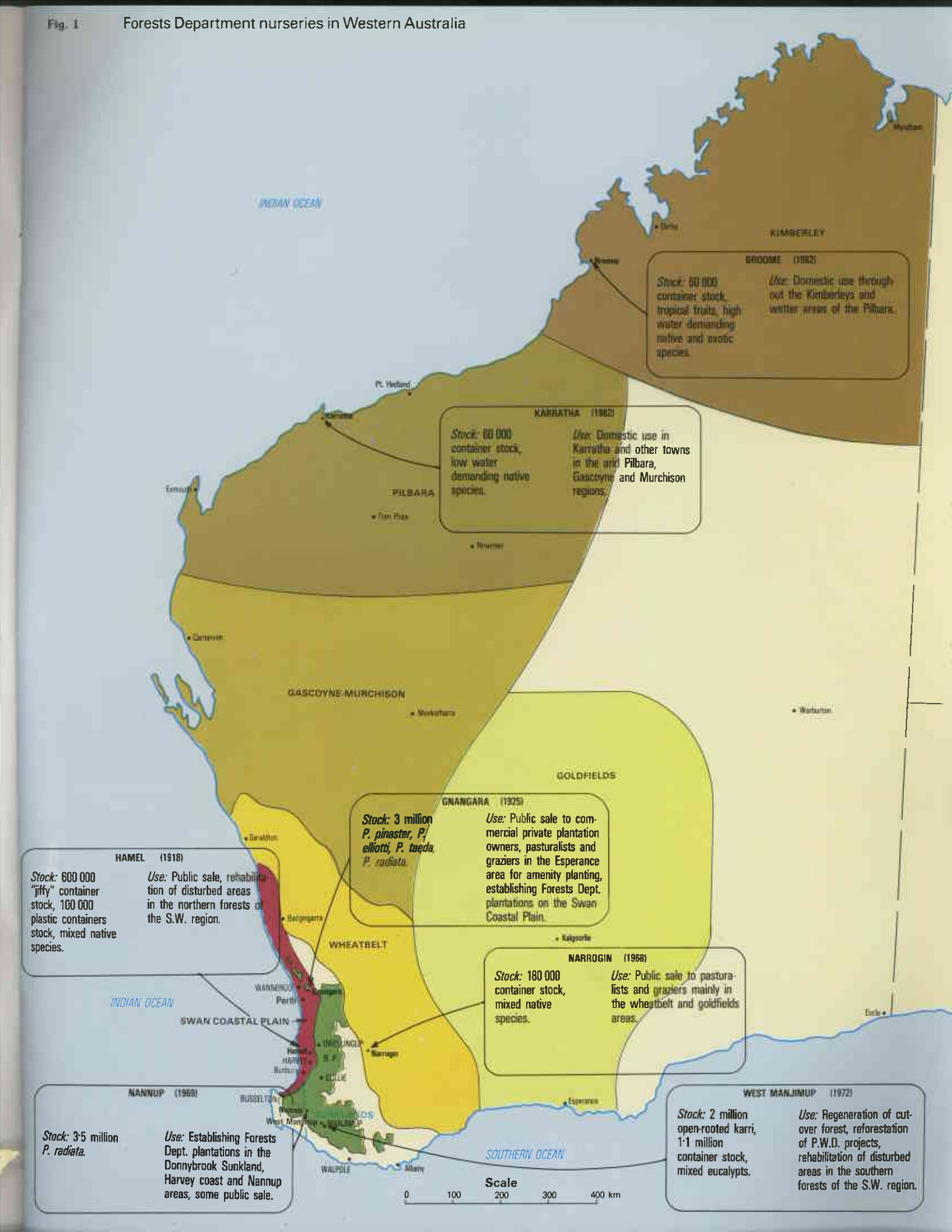
FROM GERMINANTS TO GIANTS - The Manjimup Nursery

by Rick Sneeuwjagt

"Ask of the trees themselves how they should be treated, and they will teach you more than can be learned from books". *

Basic skills in the growing of plants have been with us since ancient times. At least since the Roman Empire nurseries in one form or another have been established to enable the study of botany and the cultivation of all sorts of plants, including trees. The profession of forestry itself grew up around the art of tree growing, called silviculture. Silvicultural knowledge has been consistently passed down through successive Western cultures through the Middle Ages and into the modern era, and with increasing population pressures has become vital in sustaining these cultures. Silviculture has become complex and even though much is known about European tree species, is still evolving. The transplanting during the 18th and 19th centuries of European culture to "the Antipodes" further broadened silvicultural knowledge and research with the discovery of a whole continent of different tree species and soil types. The pioneering of nursery practices in Western Australia, only 153 years settled, is very much a part of forestry today. Much research has been conducted in recent years developing appropriate nursery techniques for raising trees in our unique environment.

Fig. 1 Forests Department nurseries in Western Australia



EARLY STATE NURSERIES

The State Government's first nursery was established at Guildford in 1896 to provide tree seedlings for government reforestation projects. This site was found to be unsuitable and was superseded in 1897 with the establishment of a nursery on the old de Hamel Estate some three kilometres south of Waroona. The Hamel Nursery was developed primarily to supply commercial tree seedlings for State Government plantations, but gradually its functions expanded to include the provision of ornamental trees for the Education Department's school plantations, and for street and park plantings for Shires and other public bodies, as well as providing trees to farmers.

Then in 1925 the Forests Department's first pine nursery was established at Gnangara near Perth with the aim of establishing *Pinus pinaster* and *P. radiata* plantations in Western Australia. Several other pine nurseries were set up, including the one at Nannup established in the 1960s. Altogether, 3½ million pine seedlings are now raised annually for Departmental and private pine planting projects.

The increased demand for tree seedlings suitable for planting in low rainfall areas of the wheatbelt and goldfields lead to the establishment of another nursery at Kalgoorlie in 1947. After functioning for seven years this nursery was transferred to the Dryandra Forest headquarters, and again in 1968 to its present location in Narrogin.

MANJIMUP NURSERY

In 1967, the Forests Department acquired the grounds and buildings of the Agricultural Tobacco Research station situated on a reserve of 160 ha, seven kilometres west of Manjimup, as a training centre for forestry field staff cadets. By 1972, a eucalypt nursery was also established at the centre, and during the next 10 years this has developed into one of the biggest and most sophisticated eucalypt nurseries in Australia.

The need for a karri nursery is based on the fact that karri will only seed well every three to six years. Regeneration of logged areas using seed trees can only be achieved at these times. In order that the cut over areas with poor karri seed crops are brought into production with a minimum delay, it is necessary to supplement the seed tree system by artificial regeneration means, such as broadcast seeding or planting. Broadcast seeding is not favoured because karri seed is scarce, and both difficult and expensive to collect. The raising of seedlings under the controlled conditions of a nursery represents the most efficient use of the seed and provides the means of stocking all growing sites for optimum development.

The Nursery Process

Tree nursery practice is based on some universal principles. Seeds are sown into prepared soil beds or pots. After germination, the young plants are carefully nurtured until they are old enough to withstand the stress of transplanting out into the field and the forest.

There are two different types of seedlings produced: (i) open grown (or "bare-root") seedlings which are raised in beds and then uprooted for transplanting in the field, and (ii) container (or "potted") seedlings, raised individually in small pots.

Although nearly 100 different eucalypt species are raised at the Manjimup nursery, the principal species grown is karri. The bulk of the karri is raised as bare-root seedlings. These are used in the regeneration of our karri forests.

Bare-root karri seedlings are relatively easy to raise and transplant most successfully. On most sites, survival rates of 90 per cent can be expected, followed by rapid growth. However, on particularly harsh or arid sites, the bare-root seedlings are less successful. On these sites container grown plants must be used to ensure successful survival and growth.

Production at Manjimup Nursery

Research trials in the early 1970s lead to the first developments of low-cost techniques for raising open-grown, or bare-root karri seedlings. The first wide-scale operational production of bare-root karri seedlings was achieved in 1972. The modest total of 22 000 seedlings in that year increased to 120 000 in 1973, with further large increases in subsequent years. The annual production reached 2.5 million in 1978 and has been at that level since.

A programme of raising container seedlings commenced at Manjimup in 1976, mainly to provide karri seedlings for rehabilitation of log loading areas, snig tracks and gravel pits. Later, several other eucalypt species were included to meet expanding demands for fast growing, dieback-resistant, or salt-tolerant trees for reforestation projects

Forester Rick Sneeuwjagt has seen the Manjimup Nursery grow to its present capacity of over 3.5 million plants.

throughout the south-west of the State.

By 1978, the annual container stock production at Manjimup was about 200 000. In 1979 the Department accepted the responsibility for raising and establishing some 600 000 container tree seedlings annually for the Public Works Department project in the Wellington catchment. This involves the reforestation of repurchased farms with the aim of reducing the salinity of streams within this catchment east of Collie.

Raising Bare-Root Karri Seedlings

In order to produce a successful bare-root tree seedling, the nurseryman must condition his stock to withstand desiccation during lifting, transport and transplanting. The plant must be capable of rapid shoot and root growth once established in the field. An ideal tree seedling must be robust, with a large fibrous root system. It must also feature a single, sturdy shoot about 35cm long, with 15 to 20 toughened leaves that do not readily dry out or become damaged by the effects of wind, sun, frost or defoliating insects.

To achieve the ideal plant a strict programme of conditioning treatments must be followed in each stage of the seedling's development in the nursery bed.

Seed and Sowing

The karri seed is collected in the forest during periods of peak seed production. Forests Department crews collect the seed from the crowns of trees felled during timber harvesting.

Because karri seed is very tiny - one kilogram contains up to 600 000 seeds - the operation is difficult and costly and requires careful planning and supervision.

Seed collected from the various river systems and zones within the karri forest are stored separately so that the nursery seedlings can be returned to locations close to their origin to maintain the genetic integrity of the new stands with the neighbouring forest.

R. Sneeuwjagt

▲ Prior to the development of raising bare-root seedlings, karri wildlings like these one-year olds were transplanted from the wild into logged areas of forest.

G. Pearl

▲ *Eucalyptus globulus* and *camaldulensis* raised at Manjimup nursery are used for reforestation of cleared land in the salt-affected Wellington catchment.

R. Sneeuwjagt

Sprinklers that produce a mist spray are ► preferred for watering nursery stock, as these do not wash out the fine seed, nor damage the fragile germinant.

R. Sneeuwagt

▲ Root pruning of the bare-root seedlings promotes a fibrous root system and a sturdy plant.

Before sowing in the nursery, the small karri seed is coated with a special clay powder containing a fungicide and an insecticide. This process, known as pelletting, makes the seed easier to handle and provides extra protection against disease and insect attack.

Six rows of seeds are mechanically sown into each bed in December. The newly sown beds must be kept moist by watering whilst the seeds are germinating and until the plants are about 10cm tall. Watering is gradually tapered off once the seedlings are well established. By the time the seedlings are 20 to 25cm tall, they are watered only when they begin to wilt. This is to encourage the development of hardy plants.

Root Pruning

The practice of regular root pruning on a monthly basis of the bare-root planting stock has been found to be the most effective way of producing sturdy plants with a high capacity for survival in a variety of conditions. Root pruning undercuts the plant causing callousing of the tap root and the subsequent formation of a mat of fine lateral roots. At the same time, the shoot growth is arrested and leaves become toughened and leathery.

G. Read

◄ A mechanical root-pruner undercuts karri seedlings to promote a fibrous root system necessary for growth of sturdy plants.

When the seedlings are approximately 15cm tall the tap roots are trimmed off with a thin, sharp blade on a high speed cutting mechanism mounted on the rear of the nursery tractor. It is essential that this operation be done carefully with minimal shock to the seedlings: the soil needs to be moist to reduce plant stress, and the tap root must be cut cleanly and accurately to avoid root distortion or damage.

Lifting of the bare-root seedlings can take place as soon as the forest soils are thoroughly wet. The plants are gently pulled from the ground and bundled, then loosely wrapped in wet hessian sacks for transit by truck to the planting areas.

Planting

Bare-root karri seedlings are used for the regeneration of cut over forest. The clear felled areas have previously been burned to reduce logging debris and competing understorey trees and scrub to a minimum. Burning the debris releases locked-up nutrients to the soil and the resulting ashbed provides excellent growing sites for the new transplants, and growth in height of two metres per year is common for the first five years or so.

Forests Department crews use planting spears making sure that the seedlings are correctly and firmly planted. The roots must not be distorted or exposed to the air. They then add fertilizer to each tree soon after planting enabling the young seedlings to compete successfully with the scrub regrowth that develops rapidly in the first year.

Raising Container Stock

The Forests Department has raised container-grown seedlings in its nurseries since the first days of their establishment. At Manjimup this was in 1976. The container system employed in these nurseries was to sow the seed in seed boxes and transfer the seedling at the two to four leaf stage into a range of pots. The first to be used were small earthenware pots, called Thumb Pots.

R. Sneeuwagt

◄ Lifting six-month-old bare-rooted karri seedlings from the nursery for transport to reforestation areas.

After many years of research, current techniques involve the use of "Jiffy" pots. These are a Scandinavian product made from peat and wood fibre pressed into strips. This peat pot is inexpensive, moisture retentive and light and easy to handle. Because the seedling roots can penetrate the pot wall, the pot itself is planted. This avoids root disturbance during transplanting.

Potting the Plants

Trays of peat pots are filled with a specially prepared soil mix and carefully measured combinations of fertilizer. The light soil mix drains freely and holds nutrients well. This aids plant growth whilst reducing the opportunity for disease organisms that develop in wet soil conditions.

The process of soil mixing and filling has now been mechanized. The exact soil quantity is automatically fed into the trays of pots at a rate of up to 50 000 pots an hour.

Hygiene is a prime consideration in every aspect of all nursery procedures and is something that must be carefully planned and implemented. This will ensure that the nursery stock is not lost through disease and that infected plants and soils are not distributed into the field where they may initiate infection on healthy sites.

All soil filled peat pots and trays are sterilized in a process called steam-air pasteurizing. The filled trays are stacked on racks in a steam chamber whilst aerated steam at 60° C is circulated between the trays for 30 minutes. This heat treatment eliminates all weeds and unwanted pathogens such as *Phytophthora cinnamomi* (dieback disease). However, some beneficial micro-organisms remain in the soil, as these are generally more heat tolerant than the pathogens.

After they are cooled, the sterilized soil filled trays are transferred to the propagating room where a special machine is used to sow one seed in each Jiffy pot.

After seeding, the trays are moved outdoors where seedlings are allowed

G. Read.

▲ Two-week old marri *(Eucalyptus Calophylla)* seedlings are raised in the Jiffy pots for outplanting in jarrah/marri logging areas.

G. Read.

▲ Soil-filled trays stacked on racks are wheeled into the steam chamber for sterilization against infection.

G. Read.

► Here germinants are evenly spaced out by hand, one plant per Jiffy pot. Note the hygienic conditions in the nursery processing room.

C. Pead

Nursery practices of soil-filling and seeding are now part of an automatic process.

R. Sneeuwjagt

◄ One of the major advantages of the Jiffy pot is that the roots eventually grow through the peat walls. This specimen is ready for outplanting.

Planting Jiffy pot (or container-grown) seedlings on a former log loading site where the soil has been ripped and fertilized.

R. Sneeuwjagt.

to germinate in warm, moist conditions. Shade protection has not been found necessary at Manjimup where the summer climate rarely stays very hot and dry for long periods. Frequent light watering during the early stages of germination and seedling development is essential to ensure a moist soil environment for the seed and seedling root system.

As the seedling develops, watering frequency is gradually reduced to let the soil surface dry between applications. This is done to harden the plants so that they are conditioned to successfully cope with the harsh environment of the planting sites.

The final phase of the nursery container stock programme involves the loading and delivery of the seedling trays to the planting sites. The system is designed to cope with the need to shift large numbers of seedlings easily and rapidly, and involves the use of tractor drawn trolleys, loading conveyors and large container trailers. Thus, the task of sorting and loading a full trailer consignment of up to 90 000 seedlings can be carried out in two hours by a team of four people.

In recent years the Forests Department has acquired nurseries at Karratha and Broome to provide suitable tree and shrub species for planting in the Pilbara and Kimberley regions in the north of the State. Nursery practices like those developed at Manjimup will continue to cater for the ever increasing demand for planting projects all over Western Australia.

*From Brown, J. and Nisbet, J., **The Forester**, William Blackwood and Sons, London, 1894.