

plant education . . . of a great urban metropolis. Its display, greenhouses, formal beds, rock garden, and various scientific exhibits are all carefully presented to the public to promote an interest in—and a greater appreciation of—plants.

Lectures, tours, and classes for adults are all part of the program. The great herbarium and library are constantly in use by students from all fields.

A garden with similar purpose but not connected with a university is the Brooklyn Botanic Garden. Donald Wyman has written,

. . . this botanic garden, situated in the heart of a great city, has been doing a splendid work in child and adult education . . . Urban dwellers who come in contact with the garden receive benefit from its interest in teaching of horticulture and the lore of growing plants. No botanic garden could be in more difficult environs, yet possibly because of this, the Brooklyn Botanic Garden continues to render to the people of Brooklyn a real service in teaching the appreciation and beauty of plants as well as their culture.

The Morton Arboretum in Illinois, listing education as its chief function, places considerable emphasis on the establishment of clearly marked nature trails and, interestingly, in the education of children. Classes are given, however, not only for the general public but for instructors in plant study as well. Walks, tours, lectures, and photographic contests are among the ways of interesting pupils as well as their teachers in the plants of the arboretum. Classes in gardening, nature study, and landscape design are conducted for the benefit of all. Valuable information can be learned from the Morton Arboretum as to methods used in its various phases of public education.

The Bowman Hill State Wild Flower Preserve, of Pennsylvania, is said to demonstrate clearly "how effective a well managed cooperative effort can be in education for plant conservation." This garden places exceptional stress on the importance and need for conservation, as its objective, through a comprehensive program of education for increased appreciation of wild flowers and native plants. Those interested in wild flower conservation and display may learn techniques in this garden, especially for labeling and for maintaining and protecting the various collections.

As has been stated, the majority of the botanic gardens in operation today provide some form of program to educate the public in one or many phases of plant study. To list them all or to mention all the ways in which they provide this service would again, as with the many scientific values, produce volumes of information unnecessary to attest further to the educational riches available from botanic gardens. The energies of many people connected with the educational aspects of plant study are boundless, in spite of sometimes limiting funds and resources. To mention the efforts of one garden is not to slight another not mentioned, but only an attempt to give an interesting and clear, but concise, picture of the abundant values and the even greater potential offered by these institutions.

(To be continued)

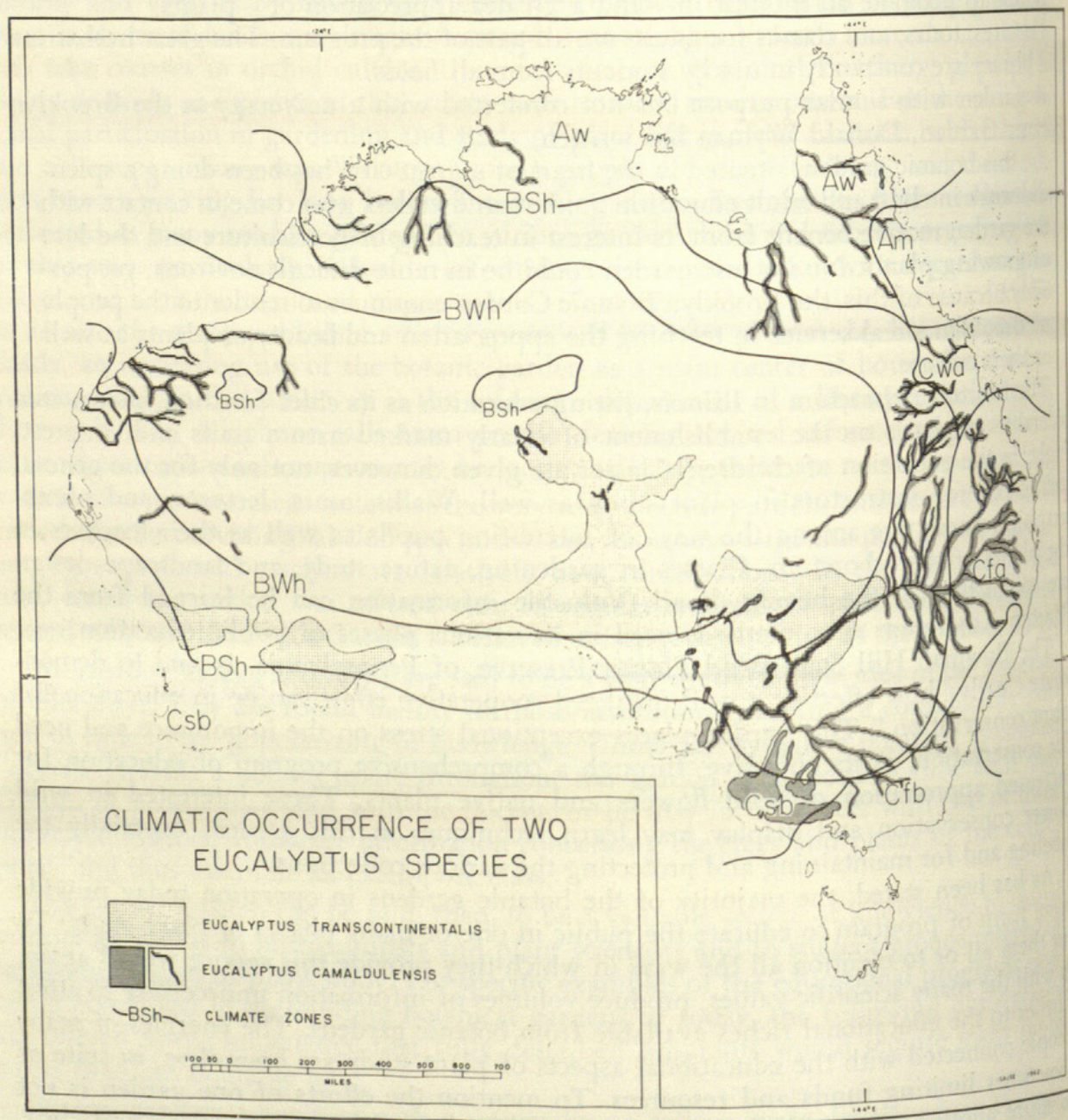
THE CLIMATIC OCCURRENCE OF TWO EUCALYPTUS SPECIES

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The distribution of any flora depends mostly on the climate in which it is found. The Australian continent displays a variety of climates suitable for varied types of plant communities.

Out of the six hundred known endemic species of Eucalyptus on the Australian continent, there are two which have the widest geographical distribution throughout all of the climatic regions. The species we are concerned with are highly adaptable and include; *Eucalyptus transcontinentalis*. Maiden. (The Boongul) and *Eucalyptus camaldulensis*,

Dehn. (Murray Red Gum). As we can see on the climatic reference map, both species have a wide range as far as ecological preference is concerned.



Australian continent showing climatic regions and occurrence of two Eucalyptus species on uplands and along drainage basins.

Type "A" *Tropical Rainy Climates*: Coolest month above 54.4°F . Rainfall is above 35" and small daily range in Temperature. Annual range only 2°F . Plants referred to as Megatherms and can endure excessive rainfall.

Region Am. *Tropical Monsoon*: Short dry season. Total rainfall enough to support rain-forest. Mean annual temperature around 80°F . Rainfall above 40" to 200".

Region Aw *Tropical Savanna*: Has a dry season in winter. Is found poleward from the equator, and rain comes from migratory equatorial moist air masses when the sun is high. Temperature range is greater than the Tropical Monsoon.

Type "B" *Dry Desert Climates*: Potential evaporation if water were available—is greater than any measureable precipitation. Very large annual temperature range. Extreme maximum temperatures. The plants are Xerophytes and can endure drought with high temperatures for long periods of time.

Region BW. *Desert*: Annual temperature greater than 64.4°F . Daily range often over 40.0°F . Effectiveness of rainfall depends on season in which it occurs. Usually found toward interior of continents.

Region BS. *Subtropical Steppe*: Due to milder temperatures and an increase of rainfall a short grass prairie and shrub vegetation occurs. Precipitation usually 10-20 inches. High temperature range.

Type "C" *Humid Mesothermal Climates*: Distinguished from "B" by a sufficient amount of precipitation. Mean annual temperatures from 26.6°F. to 64.4°F. This type is usually found on the subtropical margins of the middle latitudes. The climatic regions are divided according to the temperature and precipitation and length of summer seasons as one goes toward the poles. The vegetation in this climate is able to withstand both cold and warm conditions.

Region Cs. *Mediterranean Dry Summer*: With a winter maximum in rainfall. Has marine influence extending inland for some distance.

Region Cf. *Humid Subtropical*: More than 2.4" in each month of the year. Duration of warm season depends on latitude.

Region Cw. *Winter Dry Mesothermal*: Usually associated with the "Am" Monsoon. Lower temperatures usually attributed to higher elevation or higher latitude keep the average annual temperature below 64.4°F.

SUBTYPES

- a. Warmest month above 71.6°F. (Hot Summer)
- b. Warmest month below 71.6°F., and 4 months above 50.0°F. (Warm Summer)
- f. More than 2.4" rainfall in each month of the year.
- h. Hot and dry; mean temperature all months above 64.4°F.
- s. Summer drought; rainfall in driest month has to be less than 1.2" in order to be classes as "w." "s" subtype.

w. Winter drought; rainfall in driest month has to be less than 2.4" in order to be classed as a *Eucalyptus transcontinentalis*: As a tree in western Australia it may grow from 50'-70' high. Going eastward it appears as a mallee (native name for *Eucalyptus* thicket; shrubby species with a bulbous rootstock from which ascend several stems) and towards the arid interior it appears as a low suppressed marlock (dwarf species of *Eucalyptus* with a reduced rootstock) in discontinuous isolated clumps. Being a more xeric species it has no preference for a high water table.

Its principal occurrence is from 24°-35½°S. In western Australia and western south Australia it is found on extensive plains from 1000'-1400'. In New South Wales and Victoria it is found on lower hills and plains at 500'-1300'. The climatic map indicates its preference for the "BSh" and "BWh" climatic zones with extremes in daily minimum and maximum temperatures. Maximum readings during the day may well be over 100°F, and minimum night readings may drop to 35°-40°F. Thus, this species is able to endure diurnal ranges in excess of 50°F. Minimum record temperatures in the cool season may go as low as 24°F. Rainfall throughout this zone is from October to March and may be only three to four inches in the western part of its range. Average rainfall throughout its range is 9"-15". The number of days of rainfall occurrence is 40-80. In the northern part of the "B" climates rainfall variability lessens and measurements are more uniform throughout the year.

The climatic map shows that the Boongul appears in an open and continuous distribution throughout the greater part of its range, and is not confined to ecological niches. Its appearance on the map places it in open and exposed areas; thus it has no preference for mesic conditions.

This species is a more durable and xeric type; suitable for planting in the high Mojave Desert and the low Colorado Deserts here in southeastern California.

When young its natural growth is in a mallee form, but if adequate water is supplied it will quickly loose this habit. Its natural mallee form makes it ideal as a border planting, in a rockery or a lawn specimen with a unique appearance. Heavy watering is accompanied with rapid growth during the warm season. For planting purposes the Boongul grows on sandy to medium clay loams. Solanized brown soils are also suitable. When in bloom, the flowers are very attractive with bright yellow filaments. The anthers are broad thick and white. The juvenile leaves are glaucous and sessile. They are

broadly lanceolate to narrowly ovate 4 cm. broad and 2 cm. wide. The mature leaves are glaucous, petiolate, lanceolate and acuminate 10 cm. long and 2 cm. wide.

Propagation by seeds is rapid; immediate transplanting into one gallon cans is desirable for rapid growth.

Eucalyptus camaldulensis: (Murray Red Gum) This is a very lofty tree from 80-120'. Its maximum size depends on the climatic region in which it is found growing. The bark is very smooth and deciduous. It is usually a dull white or ash color. The young branches are a brown-red color and show four different faces or plates which fade out as the branch matures.

The Murray Red Gum occurs in pure stands in river valleys and on flood plain areas. It is found in the "Aw" Savanna Woodland formation at widely spaced intervals. In this zone the species develops a magnificent globular crown. Lack of competition in this zone can account for its graceful appearance.

As far as distribution is concerned, it is found from 15-38°S. Its principal occurrence is 33°-36°S. This is where the climate has allowed the species to grow to its optimum form; and it is probably in a dynamic equilibrium with the climate. This is undoubtedly the center of origin for the species.

In southern Australia it is found on terrain that is regularly flooded. In areas of low rainfall (10-15") this species relies on a fairly high water table. It will grow on badly drained flats which dry out when no rainfall occurs. In southeast Australia it is found at elevations of 50'-1000'. In south Australia it is found up to 2000'.

Reference to the climatic map indicates that the species has a definite interest toward mesic conditions and prefers river bottoms. Its discontinuous distribution from one river bottom to another portrays a good example of polytopy. (Polytopy is defined as species of a genus that occupy more than one single distinct area separated from each other by barriers; such as small bodies of water or landforms.)

In all regions of Australia the root system of this species is regarded as a perfect binder for banks of water courses, thus protecting them from erosion. This species withstands winter frosts but is also found in the frost free areas of Australia. Throughout most of its range it is subject to some type of seasonal drought. Its ability to endure winter drought in north Australia and summer drought in the south shows its remarkable adaptation possibilities.

Record maximum temperatures in its range are from 85°F., to 98°F. Minimum temperatures are from 23°F., to 26°F. There are 40-150 days of rainfall occurrence. Average rainfall in its range is 10-25". The growth form of the tree of course depends on the amount of rainfall received and the season in which it occurs. If the rain comes in summer it is usually in greater quantity, but less effective because of higher temperatures and greater evaporation. Winter rainfall is more effective if temperatures are not too low, and adequate percolation into the ground will replenish water supplies for spring growth.

E. camaldulensis is found growing with *E. transcontinentalis*, but only at higher elevations. The appearance of *E. transcontinentalis* is rather sparse at these elevations. The present stands in the northwestern portion of western Australia suggest a one time richer flora under more mesic conditions.

The flowering period depends on the climate. When in bloom it portrays a fairly large white flower. The juvenile leaves are opposite with three to four pairs. They are petiolate and slightly glaucous. They are narrow to broad lanceolate 6-9 cm. long and 2½ to 4 cm. wide. The mature leaves are alternate and petiolate at 12-22 cm. long and 8 cm. wide.

For planting purposes the species will obtain optimum growth under silty soils of great depth. It will also grow well in sandy soil with sub-surface moisture. *E. camaldulensis* is probably one of the most adaptable species in the genus. Its ability to withstand extreme climatic conditions enables it to be used in many areas. It is used extensively for windbreaks in arid and semiarid areas and also as a shade tree. Its moderately hard wood is used for a variety of things in Australia.

SUMMARY

From reference of the climatic map one can see that around 5/6 of Australia is under arid and semiarid conditions. The country is approximately the size of the United States with 2,948,366 sq. miles, (U.S.A. 3,082,809) and possesses some of the world's most lush and outstanding vegetation. *Eucalyptus* species along with *Acacia* species can be found growing all over the Australian continent. The Australian vegetation has an identity of its own which is quite different than any flora here in the northern hemisphere.

With emphasis on climatology one is able to understand the ecological requirements of plants that can be introduced into the United States; whether for agriculture, horticulture or forestry, suitable research on adaptation requirements is essential for fruitful results.



Eucalyptus camaldulensis. A handsome and graceful specimen located on the western side of the Australian Plant Section at the Arboretum. Photo: Denis Kucera



Gause, Gerald W. 1962. "The Climatic occurrence of two eucalyptus species." *Lasca leaves* 12(Autumn 1962), 83–87.

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