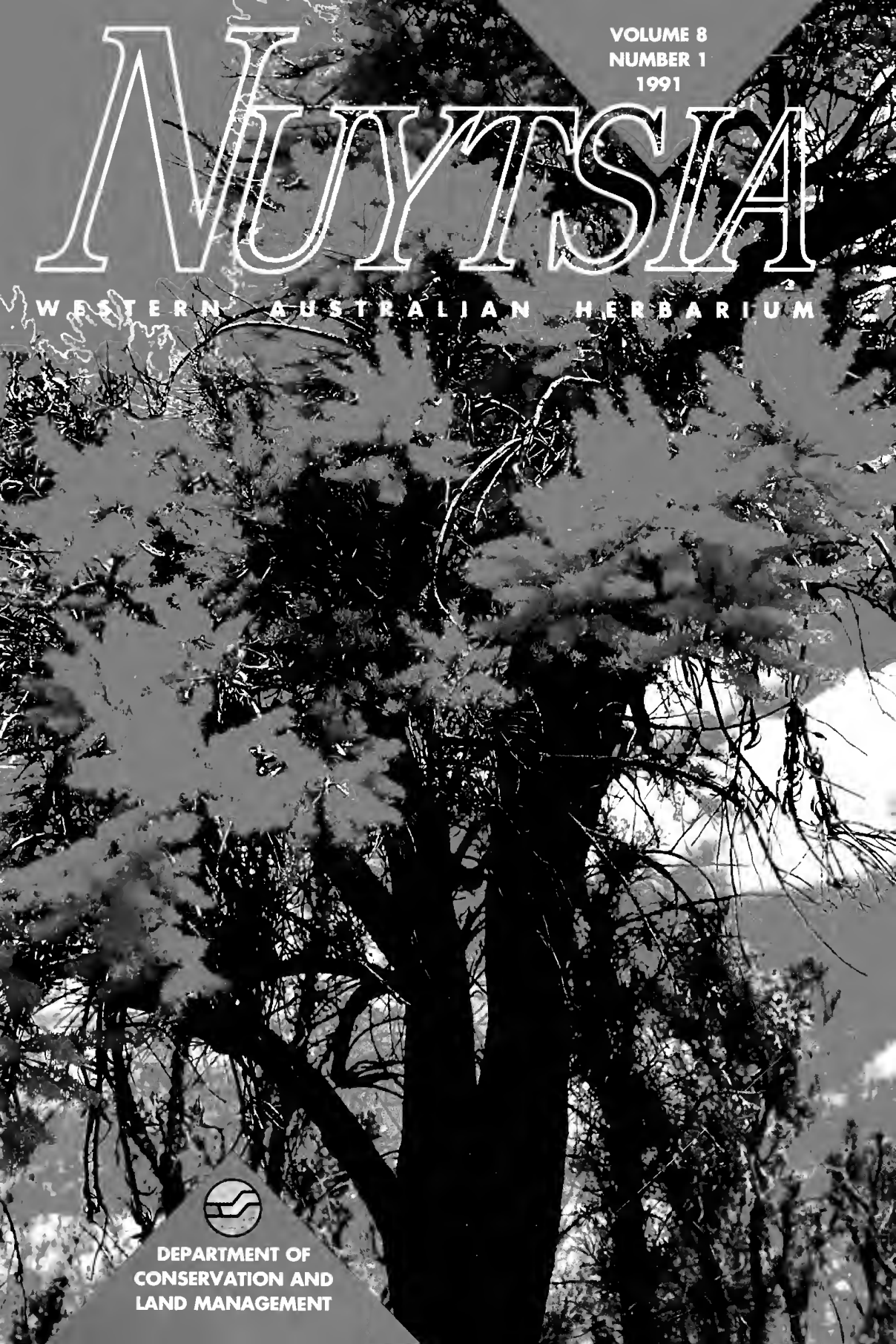
VOLUME 8
NUMBER 1
1991

NUYTSIA

WESTERN AUSTRALIAN HERBARIUM



DEPARTMENT OF
CONSERVATION AND
LAND MANAGEMENT

NUYTSIA

VOLUME 8 NUMBER 1 1991

Western Australian Herbarium
Department of Conservation and Land Management
Como, Western Australia

04689-1

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Cover

Nuytsia floribunda (Labill.) R. Br. ex Fenzl (Loranthaceae) — the Western Australian Christmas Tree is one of the few aborescent mistletoes in the world. This endemic tree is a semi-parasite common in sandy soil from the Murchison River to Israelite Bay. The journal is named after the plant, which in turn commemorates Pieter Nuijts, an ambassador of the Dutch East India Company, who in 1627 accompanied the "Gulde Zeepard" on one of the first explorations along the south coast of Australia.

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A taxonomic revision of *Eucalyptus wandoo, E. redunca*, and allied species (*Eucalyptus* series *Levispermae* Maiden - Myrtaceae) in Western Australia

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Abstract

Brooker, M.I.H. and Hopper, Stephen D. A taxonomic revision of *Eucalyptus wandoo, E. redunca* and allied species (*Eucalyptus* series *Levispermae* Maiden - Myrtaceae) in Western Australia. Nuytsia 8(1): 1-189 (1991). *Eucalyptus* series *Levispermae*, a taxonomically distinct series of 28 species all endemic in Western Australia is revised. The *Levispermae* comprise many trees, mallets and mallees of the Western Australian wheatbelt, and include the important timber and honey-producing wandoo or white gum (*Eucalyptus wandoo* Blakely), the striking blue mallet (*E. gardneri* Maiden), and several common mallees previously included as variants in *E. redunca* Schauer. This revision is based on field studies, seedlings raised in the glasshouse, and standard herbarium research.

Two new subseries are established in *Eucalyptus* series *Levispermae* - subseries *Levispermae*, comprising 27 species (20 of which are newly described and three others here raised to specific rank), and subseries *Desmondenses*, consisting of the single species *E. desmondensis* Maiden & Blakely. *E. subangusta* (Blakely) Brooker & Hopper is a new combination for *E. redunca* var. *subangusta* Blakely. *E. arachnaea* Brooker & Hopper (= *E. redunca* var. *melanophloia* Benth.) and *E. flavida* Brooker & Hopper (= *E. redunca* var. *oxymitra* Blakely) are necessary new names for taxa here elevated to specific rank.

Other new species and subspecies described here for the first time are *E. abdita*, *E. arachnaea* subsp. *arrecta*, *E. capillosa* with two subspecies (*capillosa* and *polyclada*), *E. clivicola*, *E. crispata*, *E. densa* with two subspecies (*densa* and *improcera*), *E. gardneri* subsp. *ravensthorpensis*, *E. hebetifolia*, *E. histophylla*, *E. livida*, *E. luteola*, *E. medialis*, *E. melanophitra*, *E. microschema*, *E. nigrifunda*, *E. phaenophylla* with two subspecies (*phaenophylla* and *interjacens*), *E. pluricaulis* with two subspecies (*pluricaulis* and *porphyrea*), *E. praetermissa*, *E. sparsicoma*, *E. subtilis*, *E. subangusta* subspp. *cerina*, *pusilla* and *virescens*, *E. tumida*, *E. varia* with two subspecies (*varia* and *salsuginosa*), *E. wandoo* subsp. *pulverea* and *E. xanthonema* subsp. *apposita*.

Introduction

The eucalypts of Western Australia are renowned for both their diversity and their attractiveness as ornamental garden plants and street trees. Their popular appeal is reflected in colour treatments given in a number of recent books (e.g. Kelly 1969, 1978; Chippendale 1973; Wrigley and Fagg 1979; Holliday and Watton 1980; Elliot and Jones 1986; Brooker and Kleinig 1990).

Despite the burgeoning popular literature devoted to them, many Western Australian eucalypts are difficult to identify. Because of the existence of many undescribed taxa and insufficient knowledge of morphological variation in some groups, most available keys fail to work and many botanical descriptions are inadequate (e.g. Blackall and Grieve 1954; Blakely 1965; Chippendale 1973, 1988). This applies even for some of the most common mallees of the wheatbelt and the goldfields.

C.A. Gardner, the Government Botanist from 1928 to 1960, proposed a full treatment of the State's eucalypts in the second volume of the Flora of Western Australia. However, this volume was never published. A series of leaflets on Western Australian eucalypts was published by Gardner from 1952-1966. These were subsequently published posthumously in book form (Gardner 1979), but the work covered less than half the species now known in the flora and provided no keys or taxonomic overview.

Pryor and Johnson (1971) and Chippendale (1988) made major contributions in treatments of all eucalypts then known, placing named Western Australian taxa in a broader taxonomic context. However, both works are now considerably outdated as they omit many recently recognised Western Australian species (cf. Brooker and Kleinig 1990).

We have completed taxonomic research on many Western Australian eucalypts over the past two decades (Brooker 1972, 1973, 1974, 1976, 1979, 1981, 1986, 1988; Brooker and Blaxell 1978; Brooker and Done 1986; Brooker and Edgecombe 1986; Brooker and Hopper 1982, 1986, 1989; Hopper 1982).

We are currently aware of the existence of over 100 undescribed taxa in Western Australian eucalypts. Those not treated here will be described in forthcoming publications by ourselves, by P. Grayling and Brooker, or by L.A.S. Johnson and colleagues of the New South Wales National Herbarium (e.g. Johnson and Hill 1991; Hill and Johnson 1991). Many of these undescribed taxa were illustrated in the recently published field guide of Brooker and Kleinig (1990).

The major unresolved taxonomic problems in Western Australian eucalypts are found in "*Symphyomyrtus*", the largest informal subgenus of Pryor and Johnson (1971), and to which the series *Levispermae* belongs. (From hereon informal taxa of Pryor and Johnson and of Johnson and colleagues (e.g. Johnson and Hill 1991), not formally published under the rules of the International Code of Botanical Nomenclature, are referred to within inverted commas.) This subgenus is characterised by two opercula (the outer of which in most species dehisces early in bud development and leaves a persistent necrotic scar at the junction of the inner operculum and the hypanthium), more than two vertical rows of ovules per placenta, unbranched axillary inflorescences, or if apparently compound and terminal then the anthers are adnate.

"*Symphyomyrtus*" includes such economically important Western Australian timber trees as karri (*Eucalyptus diversicolor* F. Muell.), yellow tingle (*E. guilfoylei* Maiden), tuart (*E. gomphocephala* DC.), wandoo (*E. wandoo* Blakely), and many well-known ornamentals with large colourful flowers, e.g. *E. caesia* Benth., *E. macrocarpa* Hook., *E. rhodantha* Blakely & Steedman, *E. conferruminata* Carr & Carr, *E. macrandra* F. Muell. ex Benth., *E. tetraptera* Turcz. and *E. forrestiana* Diels.

Western Australian members of this "subgenus" were placed informally in 7 sections and 30 series by Pryor and Johnson (1971). The relationships and evolution of these sections and series are challenging fields of enquiry, deserving investigation by the detailed numerical approach recently adopted in studies of all eucalypt "subgenera" (Ladiges and Humphries 1983), and of groups within the monocalypts (Ladiges *et al.* 1983, 1986, 1987). At the same time, we consider that significant contributions will also be made by revisionary studies at the series or subseries level. This approach was adopted in previously published works on *E.* ser. *Porantherae* Benth. (= "*Foecundae*", Brooker 1979, 1988), *E.* ser. *Ovulares* Brooker (Brooker 1981), *E.* ser. *Lehmannianae* D. Carr & S. Carr (Carr and Carr 1980), *E.* ser. *Rigentes* Brooker & Hopper (Brooker and Hopper 1989), and *E.* ser. *Contortae* Blakely (= "*Salubres*") and "*Annulatae*" (Johnson and Hill 1991).

Here, we undertake a full revision of *Eucalyptus* series *Levispermae* Maiden (= informal *Eucalyptus* series "*Reduncae*" Pryor and Johnson 1971). This series contains some of the best-known trees and mallees of the Western Australian wheatbelt, including wandoo or white gum (*E. wandoo*), blue mallet (*E. gardneri* Maiden) and several common mallees previously referred to as *E. redunca* Schauer (here including *E. arachnaea*, *E. flavida*, *E. phaenophylla*, *E. tumida*, *E. subangusta* and others).

The series was chosen for revision because it is endemic to south-western Australia where comprehensive field surveys could be completed over a decade, it is clearly circumscribed morphologically (especially by seed and bud characters), it contains economically important species, and because it is now recognised to contain a remarkable array of undescribed taxa that had been attributed to no more than five species by previous authors (Gardner 1945; Blakely 1965; Pryor and Johnson 1971; Chippendale 1973, 1988). Also a number of these undescribed taxa may be rare, endangered or vulnerable, and require names to facilitate conservation and management initiatives, including their placement on the State's list of Declared Endangered Flora (Hopper *et al.* 1990).

Taxonomic History

The protologue of E. redunca. Eucalyptus redunca, the first named species in the *Eucalyptus* ser. *Levispermae*, was published by Schauer in Lehmann's "Plantae Preissianae" in 1844. Several related species and varieties of *E. redunca* have been published since. The status of some has been somewhat in contention and it is useful to dwell upon the protologue of *E. redunca* when considering the subsequent treatment of the various taxa and their recognition as belonging to a distinctive taxonomic series.

A translation published by Maiden (1918) of the original is given as follows:

"Shrubby, leaves somewhat rigid, alternate, lanceolate, inequilateral, narrowed into a petiole, acuminate, glaucous on both sides (the midrib and the margin of a different colour); umbels lateral or axillary, 6-12 flowered, peduncles flattened, two-edged, about ½ inch long; calyx-tube cylindrical; operculum awl-like conical, coriaceous, shining, twice as long and more than the calyx-tube, the point, at least in early full-grown bud, bent back (*redunco*) or twisted.

In interior districts between King George's Sound and York, in the month of October with nearly adult buds (Herb. *Preiss.* No. 234); February and March with young buds (Nos. 245 and 247, see Figure 96); in gravelly sterile land on the hill Konkoberup, near Cape Riche, fruiting in November (No. 232, see Figure 95).

A shrub a fathom high, branchlets angled, with the petiole and the margin and the rib of the leaves reddish-yellow. The leaves 3-4 inches long, 6-12 lines broad. Calyx-tubes (with the pedicel of the bud continuous with it and the same length, an inch long), measuring about 3 lines in breadth. Operculum 6-7 lines long, capsule 3-celled. Fruits umbellate, oblong-clavate, with the pedicel 6-7 lines long, above 2½ lines broad, truncate; capsule included, valves erect, touching the mouth of the calyx-tube."

With hindsight, it is not hard to infer that several entities are likely to be involved, particularly when the species is based on four syntypes, three with such an imprecise locality as "between King George's Sound and York". The only distinctive morphological information given concerns the narrowly conical operculum with the tip *"redunco"* (i.e. turned down). We refer to these observations below.

Subsequent treatments of E. redunca and the discovery of related species. Bentham (1867) gave considerable attention to *E. redunca.* He began somewhat obscurely while referring to Oldfield and Maxwell collections (i.e. not the types) by stating, "In the original form, a shrub or small tree with a smooth white bark" when the protologue states "Shrubby" and "shrub" for the Preiss type collections. The tree form seems to be an allusion to wandoo, yet he separately distinguished this in his following list of varieties as *E. redunca* var. *elata* which he described as a "large tree".

Two more varieties were published by Bentham, namely, *E. redunca* var. *melanophloia* Benth. which is diagnosed by "Leaves larger (i.e. than 3-4 inches long), more prominently veined. - Murchison and South Hutt rivers, a small tree with smooth black bark", and *E. redunca* var. *angustifolia*, a synonym for *E. xanthonema* Turcz. (1847) in the protologue of which Turczaninow gives the unhelpful locality of "W. Australia". However, this is a Drummond specimen ("3rd collection") and must have been collected between Bolgart and Cape Riche (Erickson 1969). The original description of *E. xanthonema* includes features that are reasonably distinctive, e.g. leaves "narrow-linear lanceolate", peduncles finally "very much deflected", "Filaments remarkable for their reddish orange colour", and the quite ambiguous but unqualified "habitus singularis". Deflected peduncles are not a characteristic of this species as we know it and are not evident in the type specimens.

Bentham's placement of *E. redunca* in his comprehensive classification is of no significance today, other than his recognition of the species as belonging to the large *Eucalyptus* series *Normales* Benth. which is diagnosed by characteristics of the stamens. The further division of the *Normales* into a subseries to include *E. redunca* with *E. patens* Benth., *E. diversicolor* F. Muell., *E. aspera* F. Muell., and *E. phoenicea* F. Muell., each belonging to a different subgenus according to Pryor and Johnson (1971) indicates the heterogeneity of this subseries (*Inclusae*).

Mueller's later treatment (1879) of *E. redunca* contributed little to what by the 1870s must have been a group of species frequently encountered in the field. Mueller synonymised *E. xanthonema* with *E. redunca* and referred to *E. redunca* principally as a tree (presumably wandoo) which could be reduced to shrub form over considerable stretches of "poor ground". Mueller's observation that the white colouration of the "bark comes off ..... on friction" probably does not refer to wandoo but most likely to *E. accedens* W.V. Fitzg., the dominant powder-bark species in the area where wandoo would

have been abundant, e.g., the Darling Range. The bark of the northernmost wandoo (*E. wandoo* subsp. *pulverea*), for example in the proposed Lesueur National Park, can be slightly powdery.

Maiden (1918) followed Bentham's treatment, i.e. he recognised *E. redunca* and the three taxa, *E. redunca* vars *elata, angustifolia* and *melanophloia*. In addition, he published *E. redunca* var. *oxymitra* which he characterised largely by the "very long, curved, very acuminate opercula". Later (1923), Maiden revised his concept of *E. redunca* var. *angustifolia* and restored *E. xanthonema* to specific rank on the basis of its "thicker, paler, more falcate lanceolate leaves" in contrast to *E. redunca* (var. *redunca*) although we are not certain what Maiden's concept of *E. redunca* was when he made this statement. We concur with his decision but probably for different reasons. In the same digest he referred to specimens from Cunderdin and Knutsford which may have been "referable to *E. redunca*". Blakely (1934) was to publish a new variety based on these (see below).

A species which we now consider to be closely related to *E. redunca sens. str.* was described by Maiden in 1924 as *E. gardneri*, a mallet with extremely bluish foliage that readily separated it from wandoo. It was also notable for the bark which decorticated in "small, thin flakes, silver-grey to silver-brown, very astringent" (Figure 5d). C.A. Gardner was quoted as saying that the bark resembled, to some extent, that of brown mallet, *E. astringens* Maiden.

Maiden and Blakely (1925) described another new species relevant to this discussion, *E. desmondensis*. The protologue includes quotes of C.A. Gardner that the species was "very close to" *E. redunca* and that it was notably a slender, glaucous, flexuose shrub with thick leaves, known only from Desmond near Ravensthorpe.

In 1925, Maiden erected the *Eucalyptus* series *Levispermae* in his classification of the seeds of *Eucalyptus* species in which he placed the single species, *E. redunca sens. lat.* It is unlikely that he actually saw seed of *E. redunca sens. str.* The description for the series indicates that the seed are essentially "ovate to orbicular", smooth and plump. More familiarity with these seed would have shown that these characters, only tentatively alluded to in 2-dimensional terminology, reveal a seed form unique in the genus (Brooker 1972; Boland *et al.* 1981) - a strong diagnostic character in a natural classification. From the details given in original descriptions of *E. gardneri* (first collected 1922) and *E. desmondensis* (first collected 1924) it is unlikely that he saw seed of these two species at this stage of his research.

In a later classification, Maiden (1931) gave prominence to a character common to many species in the genus, *viz.* the "bisected" cotyledons, and as a consequence, he placed *E. redunca*, *E. redunca* var. *elata* and *E. gardneri* in the large informal "*E.* division *Bisectae*". *E. xanthonema* and *E. desmondensis* are not included in his classification of seedlings. None of the species concerned was treated in his classification of anthers (1923).

Blakely (1934) was the first author to group a number of the relevant species into a discrete taxonomic series, *viz. Eucalyptus* series *Subcornutae*, without reference to Maiden's *Eucalyptus* series *Levispermae* which has priority. The significant features in the diagnosis for Blakely's series are the "horn-shaped buds" and the partial inflexion of the staminal filaments. Despite Maiden and Blakely's quote of Gardner concerning the close relationship of *E. redunca* and *E. desmondensis*, Blakely placed *E. desmondensis* in *Eucalyptus* series *Dumosae* Blakely. The relatively short

operculum of *E. desmondensis* may have obscured its natural affinity with *E. redunca*. Seed and cotyledons do not support Blakely's assignment of *E. desmondensis* (Brooker 1972), but these characters were not referred to by him in the series' digest.

Blakely described one new variety, *E. redunca* var. *subangusta*, based on specimens from Cunderdin and Knutsford which Maiden (1918) had referred to typical *E. redunca*. *E. redunca* var. *elata* was raised to species, *viz. E. wandoo*.

Gardner (1945), in a commentary on the species concept in *Eucalyptus*, gave prominence to the difficulty of defining species in the *E. redunca* group. Without resolving the taxonomic problems, he highlighted the variants of both *E. wandoo* and *E. gardneri* that occur away from the localities where typical forms occur, and tentatively suggested that all relevant taxa be placed in the one species (*E. redunca*).

Pryor (1962), discussing the series concept in *Eucalyptus*, emphasised the value of the cotyledon shape in broadly indicating natural affinities. He recognised that a large number of species, including those of Blakely's *Eucalyptus* series *Subcornutae*, had in common bisected cotyledons, and thus he concurred with the concept of Maiden (1931).

Pryor and Johnson (1971) largely follow Blakely in their informal "*Eucalyptus* series *Reduncae*" but corrected Blakely's anomalous placement of *E. desmondensis*. This species was included in the series but in a monotypic subseries, "*E.* subseries *Desmondensinae*". They expressed some doubt about *E. xanthonema* and stated that it required further investigation. They anticipated subspecies status for *E. redunca* vars *subangusta* and *melanophloia*. *E. redunca* var. *oxymitra* was given informally as a synonym of *E. gardneri*, as was suggested earlier by Gardner (1945).

Chippendale (1973, 1988) largely followed Pryor and Johnson's treatment of the series but reinstated Maiden's name *Eucalyptus* ser. *Levispermae*. *E. redunca* vars *subangusta* and *melanophloia* were synonymised by Chippendale (1988) under *E. redunca* with a note that further research may demonstrate that subspecific or specific rank would be appropriate for these taxa. *E. redunca* var. *oxymitra* was formally synonymised under *E. gardneri* by Chippendale (1988) without comment.

The four syntypes of E. redunca. From our field and herbarium studies, we have found the application of most of the above names relatively easy. We were uncertain, however, as to which form the name *E. redunca* var. *redunca* might refer and we assumed this would be revealed by examination of the syntypes.

From research in many herbaria, we have been able to locate and examine only three of the four (iso-) syntypes, *viz. Preiss* 232 (MEL), 245 (LD), 247 (LD) (Figures 95, 96). We have no reason to believe that the missing syntype (*Preiss* 234) does not belong in the same taxonomic series as the other three. If it is subsequently found to be unrelated, it will not affect the procedure adopted below by our choice of *Preiss* 232 as lectotype.

Table 1. Taxa of *Eucalyptus* ser. *Levispermae* recognised herein.

subseries	"superspecies"	species	subspecies
Levispermae	*"wandoo"*	1. *wandoo*	*wandoo*
			pulverea
		2. *capillosa*	*capillosa*
			polyclada
		3. *livida*	
		4. *nigrifunda*	
	"hebetifolia"	5. *hebetifolia*	
	"abdita"	6. *abdita*	
	"sparsicoma"	7. *sparsicoma*	
	"phaenophylla"	8. *arachnaea*	*arachnaea*
			arrecta
		9. *phaenophylla*	*phaenophylla*
			interjacens
		10. *luteola*	
		11. *tumida*	
		12. *histophylla*	
	"clivicola"	13. *clivicola*	
	"flavida"	14. *flavida*	
	"crispata"	15. *crispata*	
	"subangusta"	16. *subangusta*	*subangusta*
			pusilla
			cerina
			virescens
		17. *subtilis*	
		18. *microschema*	
	"xanthonema"	19. *xanthonema*	*xanthonema*
			apposita
		20. *medialis*	
		21. *melanophitra*	
		22. *praetermissa*	
	"redunca"	23. *gardneri*	*gardneri*
			ravensthorpensis
		24. *densa*	*densa*
			improcera
		25. *pluricaulis*	*pluricaulis*
			porphyrea
		26. *varia*	*varia*
			salsuginosa
		27. *redunca*	
Desmondenses	*"desmondensis"*	28. *desmondensis*	

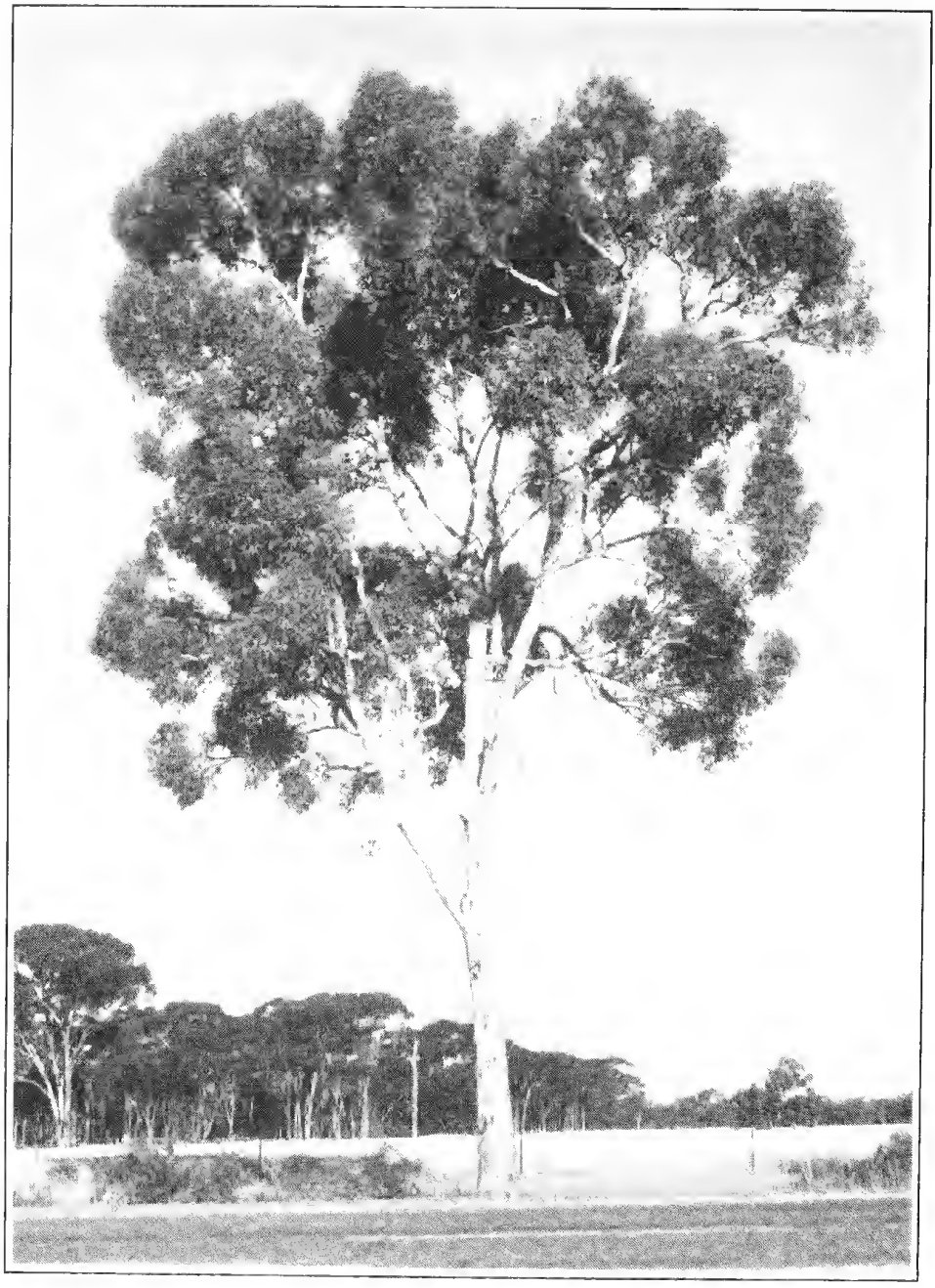

Figure 1. *Eucalyptus wandoo* subsp. *wandoo*, illustrating tree habit (road between Pingelly and Brookton).

Our studies in series *Levispermae* suggest that there are several observable lineages and in Table 1 we show these as informal superspecies (*sensu* Pryor and Johnson 1971). One of these is the group of species that includes *E. wandoo*. We believe that the specimens *Preiss* 242, 247 (syntypes of *E. redunca*) are typical of *E. wandoo* and this conclusion accords with the distributions given on the separate herbarium sheets, imprecise as they are.

Another lineage in the series is the group of taxa whose best-known species is *E. gardneri*. This species is a mallet, notably with dull, bluish leaves, and opercula with the tip recurved. We believe that the syntype, *Preiss* 232, belongs in the *E. gardneri* lineage from comparison of the dull, relatively broad leaves and the opercula (which are given prominence in the protologue for *E. redunca* by the specific epithet "*redunca*" - turned down). In the description of *E. redunca*, it is stated that the typical form is a shrub ("*fruticosa*") suggesting that typical *E. redunca* is not the later named mallet, *E. gardneri*. A search of Konkoberup Hill, one of the localities named in the protologue, has shown the existence of a mallee distinguishable from *E. gardneri* by the mallee habit, smooth bark and green leaves. We have accordingly made *Preiss* 232 (from Konkoberup) the lectotype (Figure 95). From the specimens available in herbaria and from our field observations, this form appears to occur sporadically in a stretch of coastal land between Cape Riche and East Mt Barren. It also occurs in the Ravensthorpe Range.

Since Pryor and Johnson (1971) published their informal classification of the genus, much field exploration has been made of the widespread *Eucalyptus* series *Levispermae* which is now known to occur from Kalbarri to Israelite Bay and inland to the Great Victoria Desert in Western Australia. The taxa of the series in Pryor and Johnson have been confirmed and many more have been discovered.

Morphology

Habit. The tree form (Figure 1) needs little qualification but we contrast it with "mallet" (see below). A single trunk in a mature tree specimen is always present and branching occurs at least 1 m above the ground while in most mature specimens branching begins well above this height. The crown is formed by asymmetrical branching and occupies about a half of tree height.

Mallets (Figure 2) are also single-stemmed (or trunked). The branching is relatively steep-angled and bears a more or less terminal crown that occupies less than half the height of the whole specimen. The trunk is sometimes fluted (Figure 5d) particularly near the base where slight buttressing occurs. Mallets often occur on rises in pure stands with a marked lack of understorey.

Beard (1981: 143) used the term "marlock" for "small single-stemmed trees which regenerate from seed not coppice", and listed as examples species that we regard as mallets, *viz.* "*E. falcata* and *E. gardneri* found on ironstone ridges". (Typical *E. falcata* is a mallee. The tree referred to here as *E. falcata* by Beard is the well-known Silver Mallet, an undescribed species). Subsequently (Beard 1990: 130), other species of mallets, mallees and small trees were also described as marlocks (i.e. *E. annulata* Benth., *E. flocktoniae* (Maiden) Maiden, *E. diptera* C.R.P. Andrews, *E. spathulata* Hook., *E. erythronema* Turcz., *E. forrestiana* Diels, as well as the typical marlock *E. platypus* Hook.).

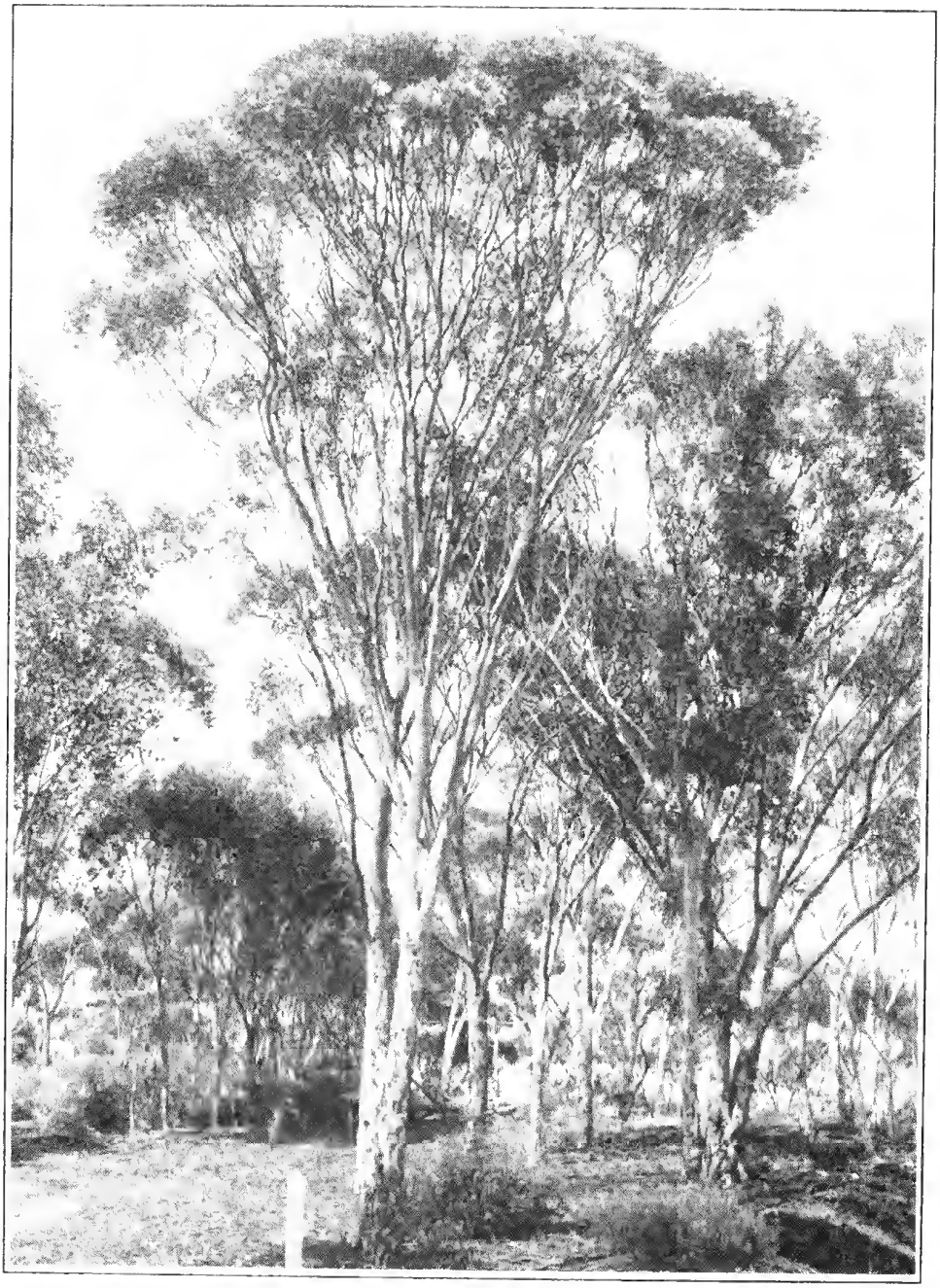

Figure 2. *Eucalyptus clivicola*, a typical mallet (Aerodrome Road, NW of Ravensthorpe).

Because the term "marlock" has been applied to species of the *Levispermae,* we have investigated its various previous applications, and conclude that "marlock" is best used in descriptions of the habit of eucalypts only in its original narrow sense for species such as *E. platypus.*

There has always been ambiguity on this matter, seen in the earliest references to the term known to us. Bentham (1867), in his treatment of *E. platypus*, gives the following note from Maxwell: "forming dense and impenetrable thickets, 'Maalock' of the natives,". This statement is ambiguous as it is not clear whether the term maalok refers to the formation or the species.

Subsequently, Mueller (1879), in describing *E. obcordata* Turcz. (syn. *E. platypus*), stated:

"This is the 'Maalok' of the Aborigines, who must have bestowed that particular designation on this Eucalypt for some obvious reason, be it for its odd appearance, the obstruction offered by its thickets, or the utility of the wood".

Thus the term marlock may not have been a habit designation in its Aboriginal usage. The species to which it referred has the single stem of a mallet but with side branches beginning in the lower half of the trunk.

Subsequent uses of the term marlock are reported in Maiden (1909: 242) (Dr A. Morrison gave the aboriginal name of jarrah *E. marginata* as 'Maalock'). More information was provided by Maiden (1920: 119), who cited correspondence in 1909 from Dr A. Morrison, then Government Botanist of Western Australia, as follows:

"The word 'Maalok' has always appeared to me to be equivalent of the eastern 'Mallee'; but however that may be, I have been informed by a surveyor (Mr F.M. Bee), who was at work in the southern part of the State, that it means literally 'thicket'. It seems to be applied to any stunted bushes on the sand-plains by white men." Maiden gives other quotations indicating that marlock was applied to thickets of several species (e.g. *E. platypus*, *E. cornuta* and *E. occidentalis* and to depauperate forms of what are normally trees (e.g. *E. calophylla*).

The use of the term for an entirely different habit by Burbidge (1952) appears to be based on Maiden's (1921) comment concerning *E. tetragona* (R. Br.) F. Muell. "It is a shrub, always straggly, sometimes attaining a height of 10 feet. It is known as 'white marlock'".

Maiden (1928), discussing *E. forrestiana*, quoted C.A. Gardner's description:

"A Marlock, not a sandplain species, but a species with a very reduced stock, 10-20 feet high, erect and erectly branched."

Burbidge (1952: 73) appears to have followed uses of the term quoted above from Maiden, but defined Marlock as "shrubs or mallee-like plants in which the woody stock is absent or poorly developed". She then listed as marlocks species which we know to be typically mallees (*E. eudesmioides* F. Muell., *E. tetragona*), trees (*E. erythrocorys*) and mallets (*E. forrestiana*).

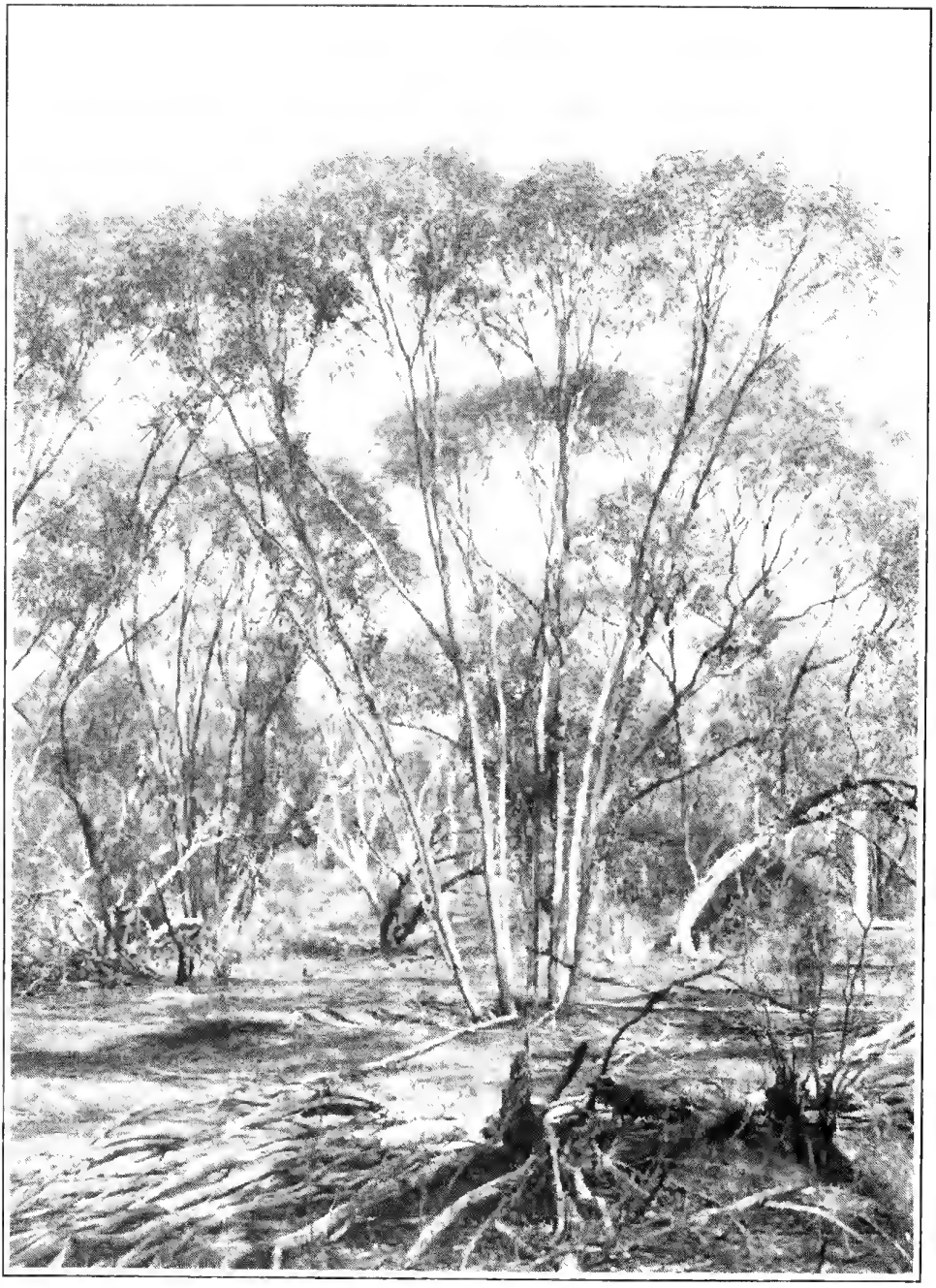

Figure 3. *Eucalyptus subangusta* subsp. *subangusta*, illustrating the erect mallee habit (Canna).

Hill (1989: 98) defined marlock as "a single stemmed shrub with all branches arising at or near ground level but lacking a lignotuber". Brooker and Kleinig (1990: 422) proposed the definition "marlock an effuse non-lignotuberous mallee or small tree". Elsewhere (p. 7), these authors noted "This is the less easily recognised, wiry or effuse shrub, mallee or small tree without distinct erect or oblique stems and supposedly lacking a lignotuber. The inclusion of three habit categories in the marlock does not allow for easy recognition in the field and we do not use the term in the keys. Perhaps *E. grossa, E. crucis* subsp. *crucis, E. orbifolia, E. synandra* and some others might be recognised as marlocks with their indefinable habit."

We would now exclude these last examples cited, since they are all lignotuberous, and advocate confining the term marlock to its original narrow usage for the habit of species such as *E. platypus* (Moort), and for recently named taxa such as *E. conferruminata* D. Carr and S. Carr (Bald Island Marlock). No species of *Eucalyptus* ser. *Levispermae* are marlocks in this sense.

Mallees (Figures 3, 4) are multi-stemmed shrubs seldom exceeding 10 m in height. On germination, the seedlings of mallee species produce a single axis, the dominance of which is either lost or the whole single axis itself is lost through grazing, fire, drought or other factors. After the first few weeks following germination and seedling development, lignotuberous swellings form in the cotyledonary and higher axils. On the loss of the primary axis, vegetative buds in the lignotuber develop. A single shoot seldom attains dominance and the second "vegetative generation" of the individual comprises two or more equally dominant shoots. On maturity the individual plant assumes the well-known mallee habit of several more or less equal stems usually at an angle to the vertical (Figure 3) or that are straggly and effuse (Figure 4). The loss of these mature stems through various causes, results in the development of a new generation of vegetative axes deriving from the lignotuber. While this is a highly successful mode of regeneration of single genotypic individuals, and may prevail through many "vegetative generations", the regenerative capacity by sexual reproduction is by no means lost and the individual mallees usually produce viable seed in large quantities.

Several pairs of related taxa in the series *Levispermae* comprise a mallee taxon and a tree or mallet taxon, e.g. *E. capillosa* subsp. *polyclada* (mallee) and subsp. *capillosa* (tree), *E. pluricaulis* (mallee) and *E. gardneri* (mallet), *E. densa* subsp. *improcera* (mallee) and subsp. *densa* (mallet). Tree-mallee is a term used for large mallees whose stems exceed 10 cm d.b.h. (Muir 1977)

Bark. Rough bark is the dead outer bark which in several species does not shed and year by year accumulates on the trunk or stems (Figure 5a). The height on the trunk or the stems of the rough bark varies with species and may be greatest in mature *E. arachnaea* and *E. melanophitra*, although small specimens of these species may be only "half-barked". Some species are characteristically half-barked, e.g. *E. nigrifunda.* Rough bark does not extend to the branches of any species in the series (cf. jarrah, *E. marginata* Smith). Mature specimens only must be assessed for bark characters. The saplings of the characteristically smooth-barked species, *E. wandoo* (Figure 5c), are completely rough-barked (Figure 5b), a metamorphosis rarely seen in eucalypts.

The presence or absence of rough bark on the mature plant generally characterises a species in *Eucalyptus* ser. *Levispermae* - the exception being *E. flavida* which may be wholly smooth-barked or it may have a black butt, i.e. a stocking of dark rough bark to approximately 1 m. In this instance we do not consider bark characters to be as important diagnostically as, for example, floral characters

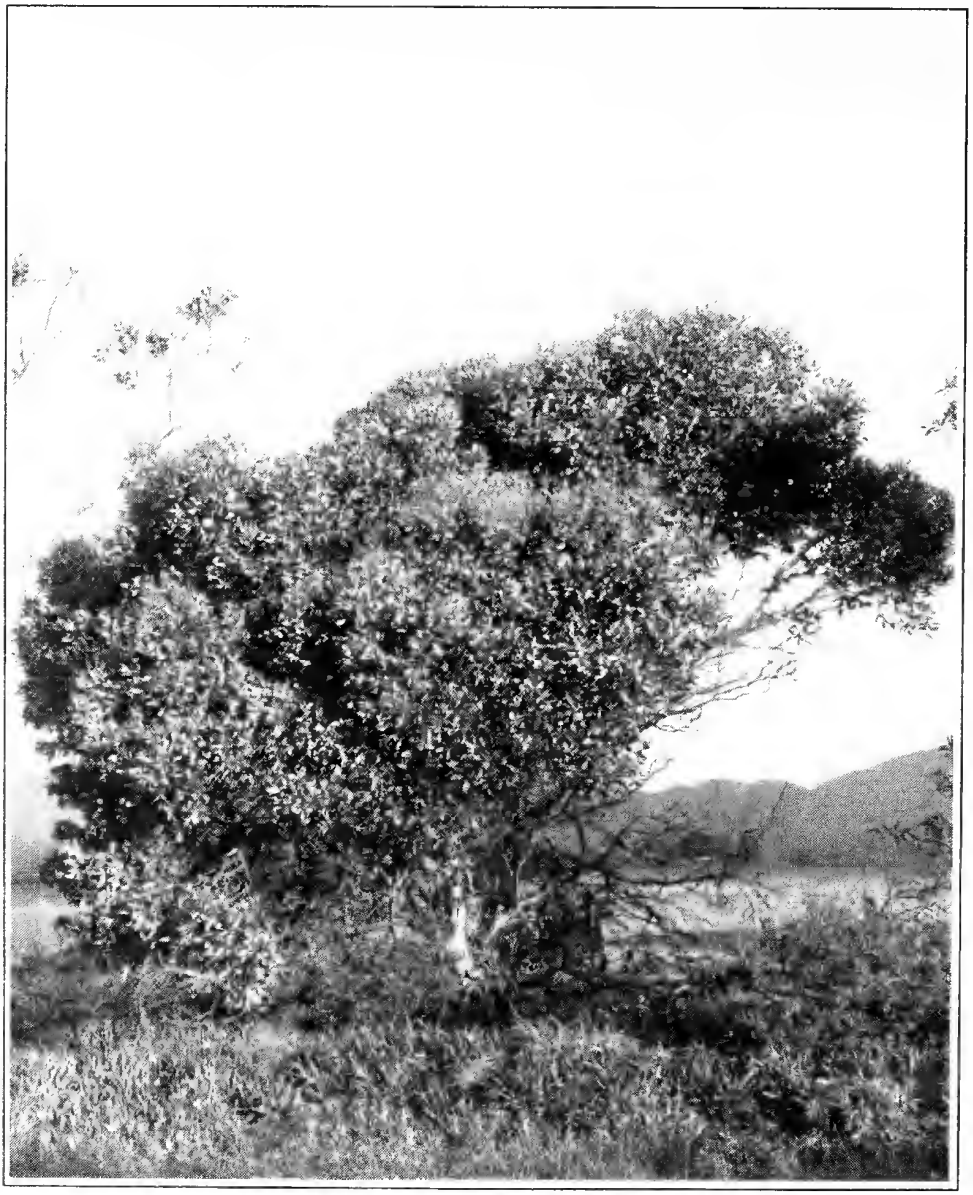

Figure 4. *Eucalyptus pluricaulis* subsp. *porphyrea*, illustrating the effuse mallee habit (Sandalwood Road, N of the Stirling Range).

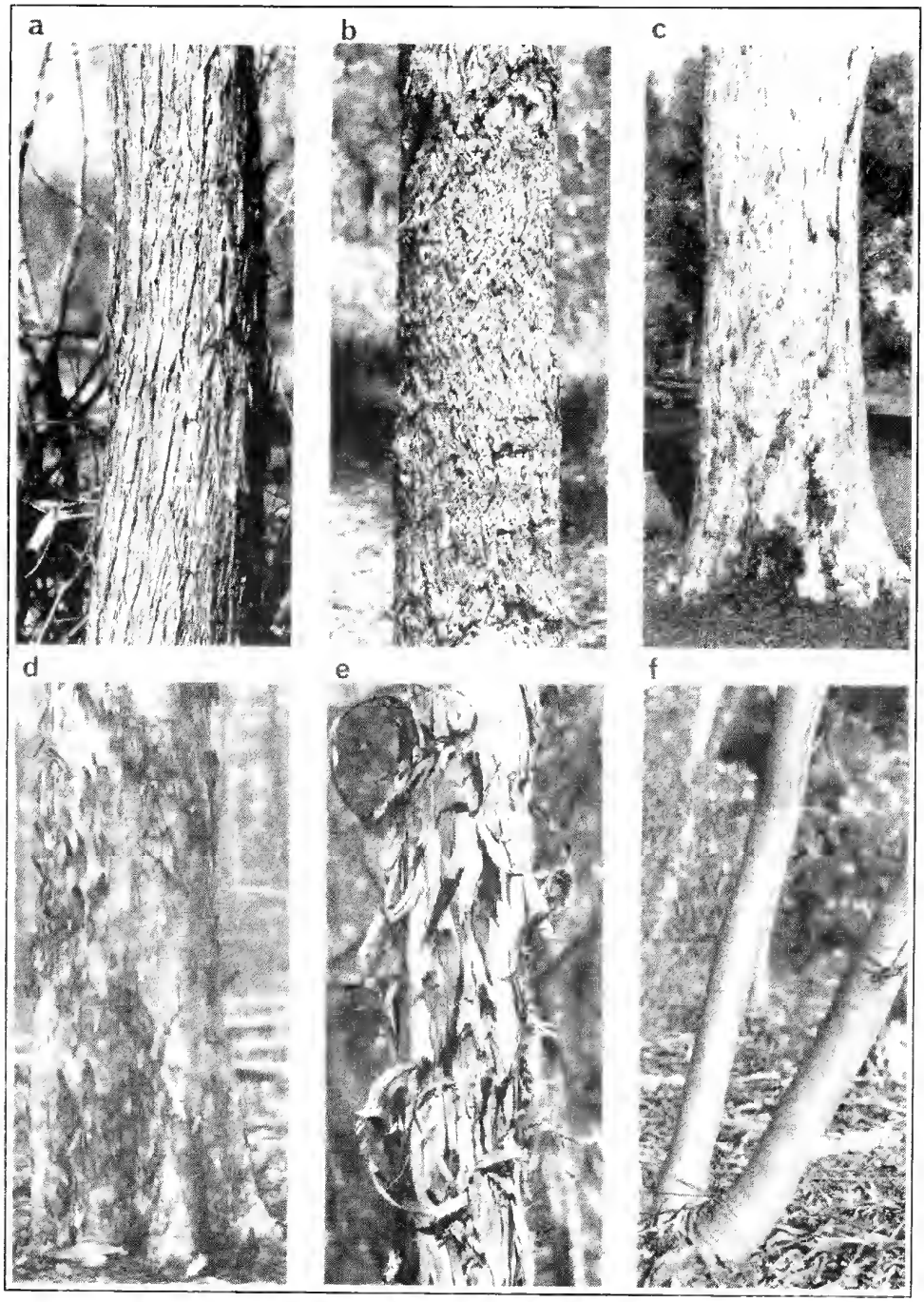

Figure 5. Bark types in *Eucalyptus* ser. *Levispermae*: (a) *E. arachnaea* subsp. *arrecta*; (b) *E. wandoo* subsp. *wandoo* sapling; (c) *E. wandoo* subsp. *wandoo* mature tree; (d) *E. gardneri*; (e) *E. crispata*; (f) *E. subangusta* subsp. *virescens*.

which we find indistinguishable in the two forms of *E. flavida*. Adult and seedling leaf characters also support the concept of a single species in this case.

The shedding of the bark in predominantly smooth-barked species varies from the decortication of irregular slabs in *E. wandoo* (Figure 5c) and *E. capillosa* to the characteristic partly shed curls of dead bark in some of the mallets, e.g. *E. gardneri* (Figure 5d). In *E. crispata* (Figure 5e) such curls are prominent and dense, particularly on the butt. In several species (e.g. *E. subangusta*, Figure 5f), the bark is shed annually leaving completely smooth stems.

Bark colour varies with the time of exposure of new surfaces revealed after the shedding of the oldest bark layer. The persistent weathered surfaces are originally pale or dark and on shedding reveal new surfaces which are bright yellow, orange or coppery. These colours subsequently fade. The colour of new bark in autumn-winter is particularly useful in distinguishing *E. wandoo* (yellow) from *E. capillosa* (orange) where the two species co-occur (e.g. between Kellerberrin and Corrigin). In *E. wandoo* subsp. *pulverea*, the smooth bark is notable in being powdery like the unrelated *E. accedens* (powderbark wandoo).

Bark on the lower trunk of mallets such as *E. clivicola*, *E. densa* and *E. praetermissa* often has horizontal scars up to 90 mm long presumably due to insect attack (e.g. Figure 79).

Cotyledons. The lamina of the cotyledon in all species is deeply divided and forms a Y shape with the petiole (Figure 6).

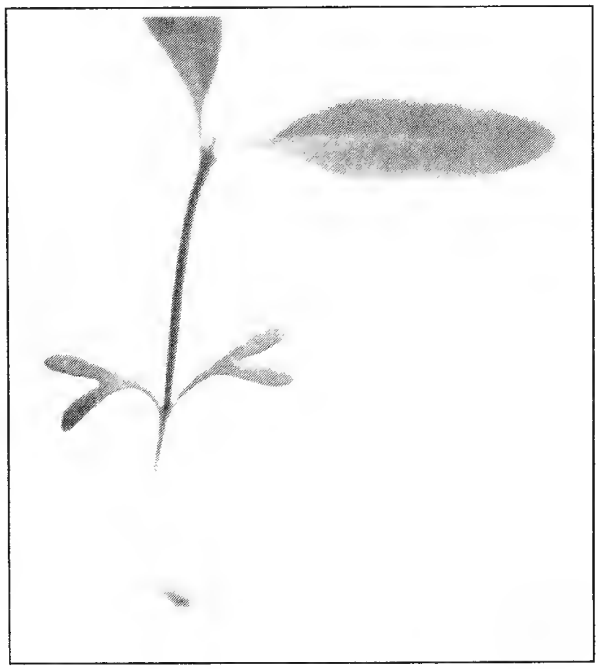

Figure 6. Seedling of *E. redunca* with Y-shaped cotyledons.

Seedlings. Leaves are petiolate throughout the life cycle of all species in the series. In the seedlings, the leaves are produced decussately at the shoot apex and the pairs remain opposite in the elongated seedling for 2-6 nodes, i.e. the seedling phase. Thereafter, leaves become separated at the petiole bases by elongation of the intranodes (alternating). From the onset of intranode development until the plant is approximately 25 cm tall the leaves are juvenile (usually broader than adult leaves). Plants advanced beyond this phase produce adult leaves.

The most striking feature of the seedlings in the series is the trichomes (Figure 7) of *E. capillosa*, *E. livida* and *E. nigrifunda*. These "hairs" on the seedlings are unique in *Eucalyptus* (Figure 8) because of the symmetrical elongation of paired cap cells of the emergent oil glands. The cells are contiguous for about two-thirds their length and divergent and free above (Ladiges 1984). In contrast, the trichomes of *E. arachnaea* are emergent oil glands with short radiating hairs (Ladiges, pers. comm.). Trichomes do not occur in other species of the series.

Other characteristics useful for assessing relationships in the series are the length of intranodes (e.g. up to 5 cm for the fifth intranode in *E. clivicola* and superspecies "*redunca*"), the seedling leaf shape (the leaf is broadest in *E. wandoo* subsp. *pulverea*, and *E. crispata* , Figure 14 and Figure 52, and narrowest in *E. subtilis*, Figure 63), and leaf colour (e.g. the leaves are greyish in *E. wandoo* and related species and shiny green in *E. flavida*).

Pith glands. As noted for a selection of taxa in the series by Carr and Carr (1969), the pith of the branchlets is glandular, except in *E. desmondensis*. Carr and Carr (1969) recorded pith glands as absent in *E. gardneri*, but we have found in this species and other taxa of the superspecies "*redunca*" that glands are present but rare, requiring inspection of ten or more nodes before they are encountered on some plants.

Branchlets. A white surface wax on the branchlets is characteristic of *E. capillosa*, *E. nigrifunda*, *E. desmondensis*, *E. wandoo* subsp. *pulverea* and *E. subangusta* subsp. *cerina*. In the other species the waxiness is rare or never occurs, for example, in the species with shiny green leaves.

Crown. Some species can be recognised from a distance by the crown characters, e.g. the bluish crown of *E. gardneri* and the dense fine crown of *E. densa* (Figure 85). The crowns of *E. histophylla* and *E. microschema* (Figure 67) are also conspicuous as the leaves are held erect while being pendulous or held at various angles in most other species. *E. pluricaulis* subsp. *porphyrea* is easily recognised in the field because of the abundance of purple leaves in the crown (Figure 4).

Adult leaves. Colour, glossiness and size of adult leaves are important diagnostic characters for the species in the series. We caution, however, that colour and glossiness must be assessed on mature crowns because these attributes change in many species from juvenile or coppice leaves to mature adult leaves. Thus, plants of species with glossy green adult leaves (e.g. *E. phaenophylla*) may have a canopy of predominantly dull bluish-green intermediate or juvenile leaves when recovering from wind damage, drought or herbivory. In such cases, it is important to search inside the canopy for fully mature adult leaves and ascertain the colour and glossiness of these.

Figure 7. Scabrid seedling leaf of *E. capillosa* subsp. *capillosa* (left) compared with a glabrous leaf of *E. wandoo* subsp. *wandoo*.

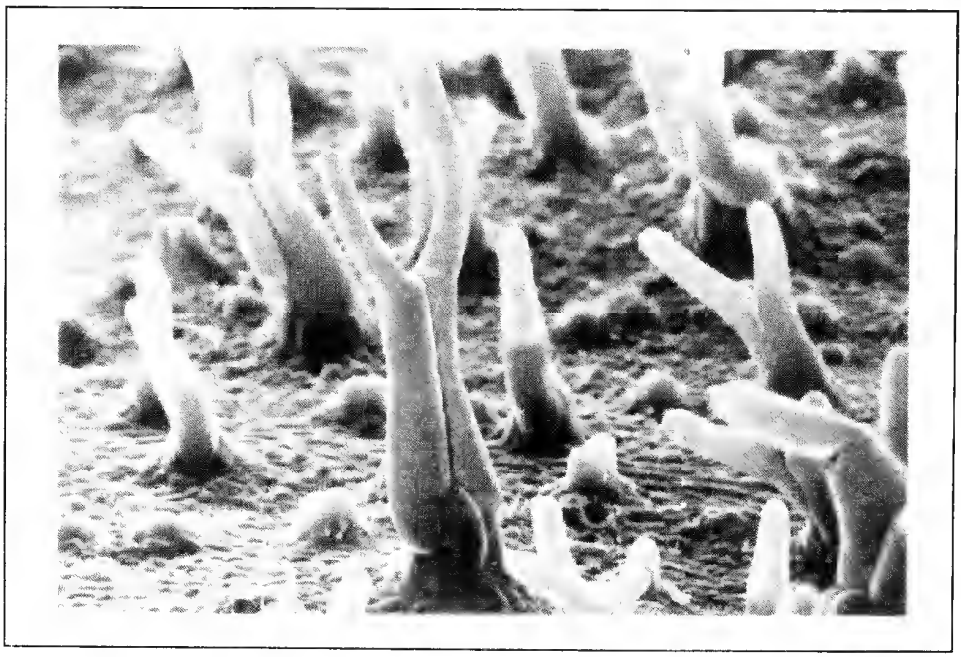

Figure 8. Hairs on the surface of the leaf of *E. capillosa* (electron micrograph courtesy of P.Y. Ladiges).

In *E. wandoo* and related species the adult leaves are dull and vary from blue-green to bluish grey. In *E. arachnaea*, *E. phaenophylla* and *E. tumida* the leaves are glossy green. In *E. gardneri* the leaves are dull and bluish and in *E. redunca*, in the first year at least they are dull and greenish but mature to glossy green well inside the crown.

While most species are constant in colour and glossiness as the adult leaves age, *E. microschema* is notable for the conspicuous crown of dull blue-green leaves, covering glossy green leaves on the older branchlets inside the canopy.

Leaf venation and oil glands (as seen in fresh leaves with transmitted sunlight). In the seedling leaves the venation is typically brochidodromous (Hickey 1973), i.e. side veins extend from the midrib outwards, curving distally and becoming joined well short of the margin in a series of arches. Outside of this paramarginal vein (Carr *et al.* 1986) further veinlets extend towards the margin and again link up to form a second weaker paramarginal vein. Tertiary veining at this stage of growth is weak or absent and oil glands are few but are often clearly seen just inside the leaf margin.

The pattern is superficially similar in the adult leaves (Figure 9) although the arches are less prominent and form what is conventionally known as the intramarginal vein (for some other species Carr *et al.* (*loc. cit.*) showed that the intramarginal vein seen in adult leaves is formed independently of the side veins). Tertiary veining is distinct in all but the narrowest leaves where it is then fragmentary or absent, e.g. *E. densa* and *E. subtilis*. Quaternary veining, when present, is very fragmentary and obscure.

In the species of the series with the narrowest leaves, *E. subtilis*, the side veins themselves are fragmentary and there is no further degree of visible veining.

Oil glands occur in the leaves of all species in the series. They appear to be situated at the intersections of the veinlets or to be "island" bodies in the areoles (Figure 9). They are variable in size in a single leaf and are usually irregular in outline. In *E. subtilis* where the areoles are whole rhomboidal intercostal zones, the oil glands are very numerous, dense and relatively large, and without any visible association with the side veins.

Inflorescences. The inflorescences are axillary and unbranched, i.e. they consist of a single peduncle which subtends 7 to more than 20 flower buds.

Buds. Buds are characteristically narrowly fusiform in most species, varying from 5 mm long in *E. subangusta* subsp. *pusilla* (Figures 56, 57) to 25 mm long in *E. flavida* (Figure 50). In *E. tumida* (see Brooker and Kleinig 1990: 183) and some forms of *E. livida*, the buds are thickened, somewhat curved and almost parallel-sided with an obtuse apex. We describe these as allantoid (sausage-shaped).

The operculum is also obtuse in *E. subangusta* subsp. *subangusta* and *E. desmondensis*, but in many of the taxa it is attenuate and recurved at the tip, notably in the *E.* superspecies "*redunca*" (e.g. Figure 88). Buds of *E. desmondensis* (Figure 98) are broadest in the series, with a conical operculum sometimes equal in length to the hypanthium. In all other species, the operculum is longer than the hypanthium.

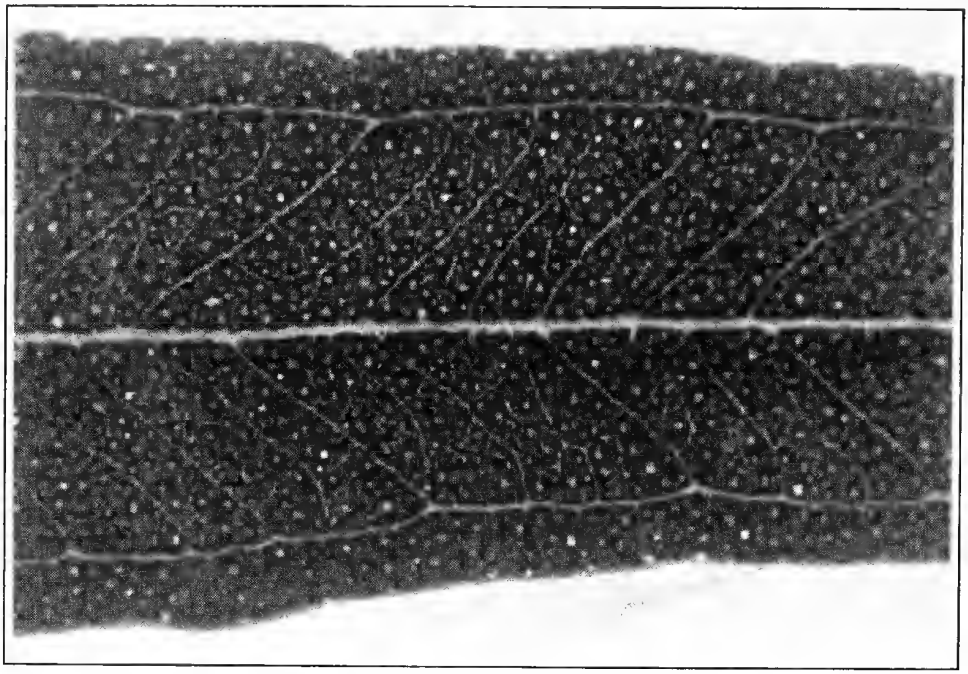

Figure 9. Leaf venation and oil glands of *E. flavida*.

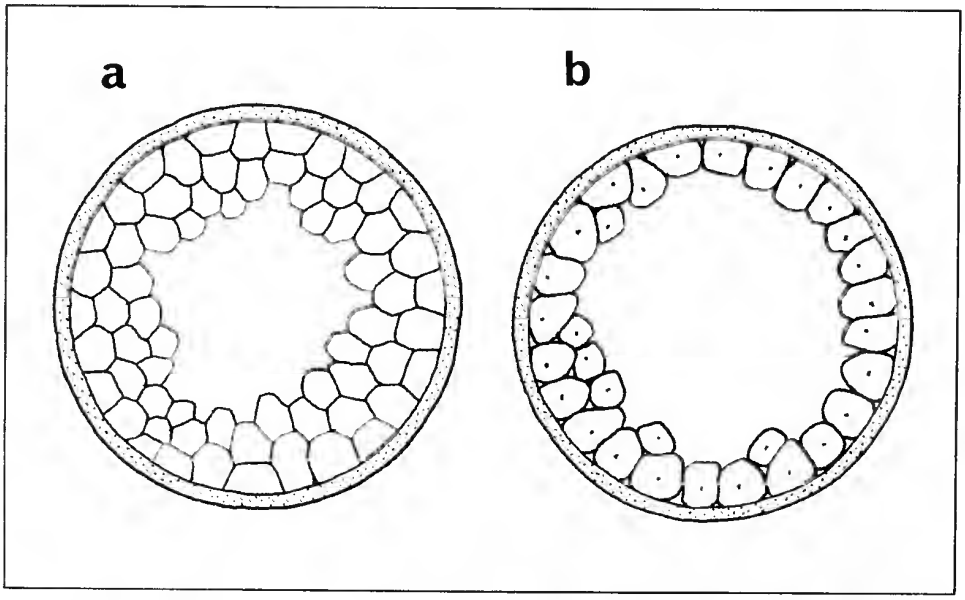

Figure 10. Transverse sections of buds just above the junction of the operculum and hypanthium showing the number of whorls of stamens in (a) *E. flavida* and (b) *E. gardneri*.

A notable though not unique feature of the series is the long period (2-3 years) between bud initiation and anthesis.

Peduncles. The peduncles are always somewhat flattened, in some species distinctly so, and widen distally.

Flowers. Flower colour varies from bright yellow in *E. flavida*, through pale yellow in superspecies "*redunca*", *E. luteola*, *E. tumida* and *E. clivicola*, to creamy white in all other taxa.

Androecium. Two or three whorls (rarely one) of stamens are evident in the unopened flower bud - an outer complete whorl whose individual filaments alternate with those of the next inner whorl and oppose the filaments of the next inner whorl but one - these latter two not always being complete (Figure 10).

The vertical disposition of the filaments is variable and seems to be associated with the relative length of the operculum. In species where the operculum is short, i.e. less than twice the length of the hypanthium, the stamens may be all inflexed, e.g. in *E. desmondensis* and *E. microschema* (Figure 11b, c). In this arrangement all filaments ascend from the staminophore for approximately half their length and are then sharply down-turned with the anthers resting in the "bowl" of the bud - the encircling cavity between the disc and the style. This filament arrangement is common throughout the genus, but not in *Eucalyptus* ser. *Levispermae*.

In most species of the series (Figure 11a), the operculum is much longer than the hypanthium. Then the inflexion of the stamens is not uniform. Most of the filaments of the outer whorl are ascendent for more than half their length and are then sharply down-turned with the anther pendent within the operculum - not deflexed deeply into the bowl. A few outer filaments are usually wholly erect and surmounted by the anther. The innermost filaments in these buds are inflexed for about half their length as in the example described above. This type of varied filament arrangement is unique in the genus.

The number of stamens per flower is variable in the series and is lowest in *E. gardneri* and related species. Occasionally in this group, the stamens are reduced to a single whorl of fewer than 30 stamens, among the least known in eucalypts (Figure 10b).

Seed. In all species of the series the seed coat is completely smooth. The seed of most taxa are otherwise instantly recognisable as belonging to the series by their shape inasmuch as they are spherical or subspherical (Figure 12a). The seed of no other species in the genus *Eucalyptus* resemble these. The seed of *E.* superspecies "*xanthonema*" and *E. subangusta* are modified from the typical in that they are slightly compressed or angular, resulting in a somewhat cuboid appearance (Figure 12b). The seed of *E. crispata* is the most anomalous as it is more compressed, possibly reflecting a hybrid origin for the species as discussed later.

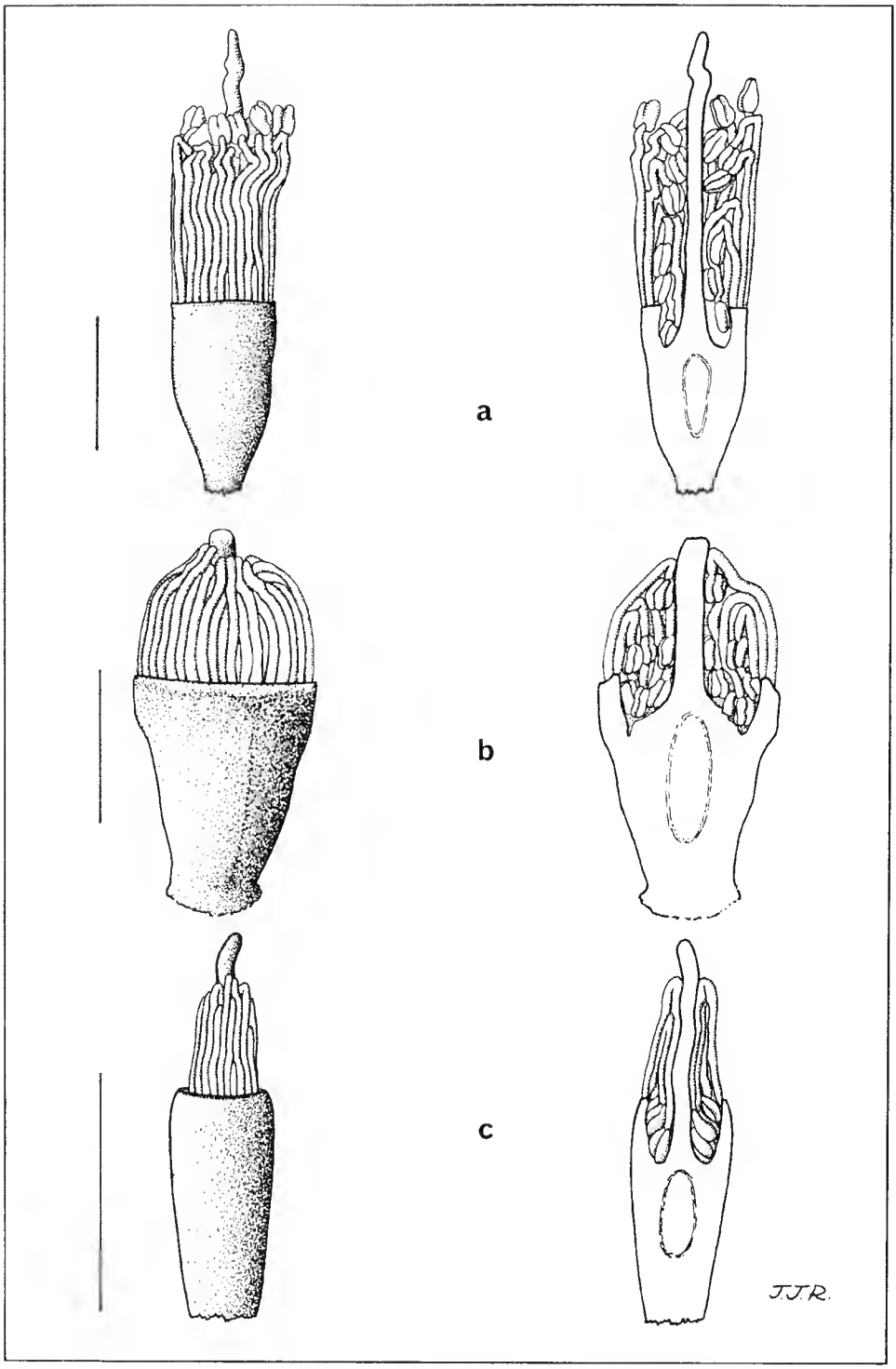

Figure 11. Staminal arrangement as seen in longitudinal views (left row) and longitudinal sections (right row) of buds with the operculum removed in (a) *E. flavida*, (b) *E. desmondensis*, (c) *E. microschema*. Vertical scale bars are 5 mm.

Phytogeography

Eucalyptus ser. *Levispermae* extends from the Kalbarri area southwards to the coast, avoiding only the highest rainfall areas from Busselton to Albany (Figure 13). Inland, the series ranges as far as the Great Victoria Desert (*E. nigrifunda*, *E. flavida*).

Taxa are concentrated most in the southern wheatbelt from the Stirling Range east to the Ravensthorpe district (Figure 13), a pattern seen also in several other mallee series and in the genus as a whole (Hopper 1979).

Closely related species (e.g. *E. phaenophylla*, *E. luteola* and *E. tumida*) typically have allopatric or parapatric distributions, as do subspecies within species (e.g. Figures 14, 16, 32). Thus, geographical speciation (Grant 1981) appears to have been the predominant mode of divergence in the series. A detailed study of the evolution of the series is beyond the scope of the present work.

In the *Eucalyptus* superspecies "*redunca*", speciation appears to have involved divergence in preferences for both topography and substrate. For example, *E. gardneri* is notably a mallet of lateritic hilltops, *E. densa* a mallet or mallee of heavy soils, and *E. varia* subsp. *salsuginosa* is the only taxon in the series found in saline flats and drainage lines.

Taxonomic concepts

In assigning rank to taxa in the *Eucalyptus* ser. *Levispermae*, we have given weight to both morphological distinctions and apparent reproductive isolation when (and if) in sympatry. Thus, morphologically differentiated taxa that grow together and do not intergrade, or that produce only rare hybrids without extensive introgression, are treated as species. Examples of such species often found in sympatry include *E. wandoo* and *E. subangusta*, *E. wandoo* and *E. gardneri* or *E. wandoo* and *E. capillosa*. Allopatric, closely allied taxa with minor morphological distinctions are treated as subspecies (e.g. the subspecies of *E. subangusta*).

In contrast, allopatric related taxa that are clearly distinct morphologically are here treated as species, even though we lack the benefit of observing their reproductive behaviour in sympatry. Assigning rank to such allopatric taxa must rest on morphological considerations alone in the absence of biosystematic information. Thus, we consider *E. histophylla* to be sufficiently distinct from *E. tumida* to be a distinct species, even though these taxa are close relatives. Geographically sympatric but ecologically isolated taxa could also be treated as either species or subspecies. *E. pluricaulis* subsp. *pluricaulis* and subsp. *porphyrea* are taxa of this sort.

In assigning species status, we have generally given weight to readily perceived habit characters (i.e. the dominant form in a population) without implying that habit is of absolute reliability (see Key). For example, the mallet *E. gardneri* is recognised as a species distinct from its mallee congener *E. pluricaulis*. The two species can grow in close proximity but on different soils and topography, i.e. *E gardneri* on lateritic hills and *E. pluricaulis* on lower ground.

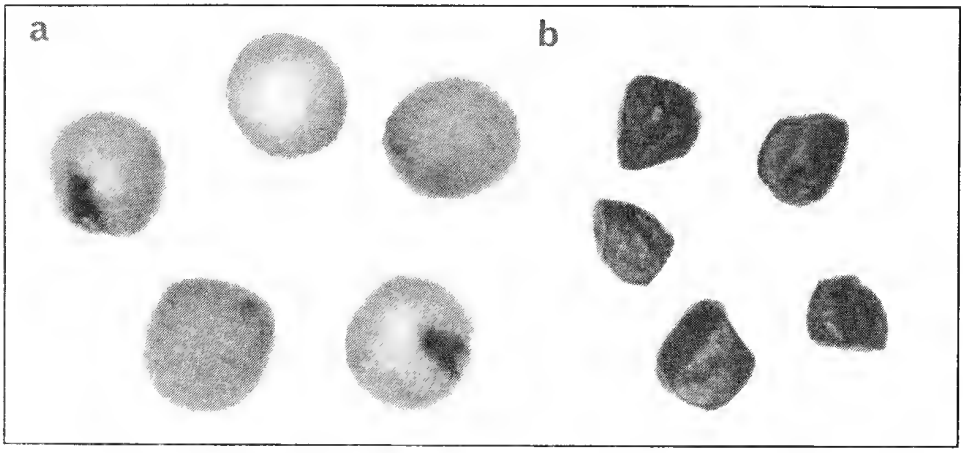

Figure 12. Seed of (a) *E. redunca* (*M.I.H. Brooker* 8658), and (b) *E. subangusta* subsp. *subangusta* (*MIHB* 7914).

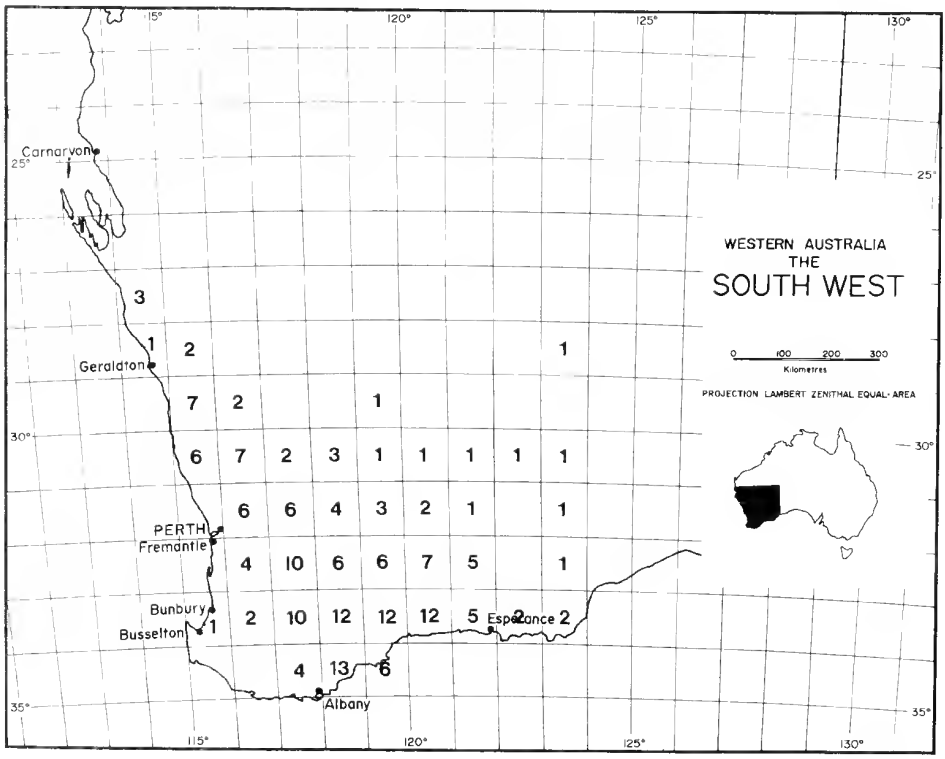

Figure 13. Map showing the distribution and density in 1° x 1° squares of taxa of *Eucalyptus* ser. *Levispermae* in southern Western Australia.

With 28 species now recognised in the series (Table 1), we clearly do not share the views of Mueller (1879) and Gardner (1945), who proposed that all taxa known to them and now included in the *Eucalyptus* series *Levispermae* except *E. desmondensis* should be regarded as variants of a single polymorphic species (i.e. *E. redunca*).

We recognise informal superspecies, following Pryor and Johnson (1971), for groups of species that share one or more characters not seen elsewhere in the series, or for single species that have such characters and no clear relatives. Our treatment is deliberately informal in this respect because much more work is needed before an accurate assessment of relationships and evolution within the series is possible.

We wish to stress that this treatment of the *Eucalyptus* ser. *Levispermae* is a synthesis of current knowledge gained from extensive field, glasshouse and herbarium observations, but it may not be the last word on the taxonomy of the group. It erects hypotheses on relationships and rank that we hope will be examined by future workers using new techniques and further characters.

Materials and methods

This study is based upon field observations, glasshouse studies and collections of all taxa of the series, together with morphological investigations of herbarium material from the major Australian herbaria (PERTH, NSW, MEL, AD, CANB (which now includes FRI), CBG) and some overseas herbaria (K, BM, LD, KW, W). Type specimens of all previously described taxa have been examined, apart from *Preiss* 234 (an untraced syntype of *E. redunca*). Measurements given in descriptions are from dry herbarium specimens or fresh seedlings. Notes on distribution, habitat and conservation status were derived from our own field studies. Terminology for vegetation structure follows Muir (1977).

We have found observation of most taxa in the field essential for confident identification. Characteristics of the habit, bark, canopy, adult leaf colour and glossiness, flower colour, glaucousness of branchlets, and pith glands are all readily determined in the field, and are rarely recorded on herbarium specimens.

Leaf glossiness was assessed in reflected sunlight and scored as either dull, slightly glossy (satin-like) or glossy. The presence of pith glands was determined in the field with a 10x hand lens by splitting up to 15 branchlet nodes per plant on each of 1-10 individuals in at least two populations of each taxon.

Seed for glasshouse studies were collected from individual plants of all taxa and a voucher herbarium specimen(s) taken from the same individuals. Seed was germinated and 5-10 seedlings of each collection grown on in the glasshouse until the fifth node leaves had fully developed. A cotyledon and a fifth node leaf of each seedling was sampled and photocopied to enable measurements to be taken at a later date. Fresh seedlings were scored for the node at which the leaves started to alternate, for colour (on a five point scale from green to blue-green), for hairiness and for the length of the fifth internode.

Our taxonomic method is based explicitly on the whole living plant with some emphasis upon its environment. We do not hold to the notion that genetic fixity and expression is necessarily shown adequately on herbarium specimens, label information included, particularly for trees in contrast to herbs (which can often be preserved whole in herbaria).

Davis and Heywood (1963) stated that "Great care must be taken not to assume, *ab initio*, that species we have recognised in the herbarium (often from limited samples that are not even contemporaneous with one another) are valid representatives of natural populations in the gene pool sense".

We extend the idea of "limited samples" to limited information, as speciation in *Eucalyptus* involves site adaptation, natural colour (see under *E. xanthonema*), bark characteristics, leaf category, leaf disposition etc., all of which cannot be expressed in a dried herbarium specimen and, to be useful, require a standardised glossary of terms in the collector's notes.

The series *Levispermae* , until our research, is a cautionary example of taxonomy based on limited data.

Descriptions

Eucalyptus series ***Levispermae*** Maiden Crit. Rev. Gen. *Eucalyptus* 7: 144 (1925). *E.* series *Subcornutae* Blakely, "Key Eucalypts" 111 (1934). *E.* series "*Reduncae*" Pryor and Johnson, "Class. Eucalypts" 44 (1971).

Type: *E. redunca* Schauer.

Trees, mallets or mallees, with or without lignotubers. Bark wholly smooth, with partly decorticated flakes, or rough on lower part of trunk or stems. Branchlets with or without pith glands, glaucous or not. Cotyledons bisected. Seedling leaves petiolate, opposite for 2-6 pairs, elliptic to ovate, green or glaucous, glabrous or hairy. Juvenile leaves petiolate, alternating, lanceolate, elliptic, deltoid or cordate, green or glaucous, glabrous or hairy. Adult leaves petiolate, alternating, linear to broadly lanceolate, concolorous, green, bluish green or glaucous, dull or glossy. Inflorescences axillary, unbranched. Peduncles always flattened, broadening towards the top. Buds pedicellate or sessile, fusiform to double-conic, sometimes curved, outer operculum lost early in bud formation, inner operculum acutely or obtusely conical or horn-shaped, sometimes uncinate. Outer filaments erect with anthers held upwards, or erect for most of their length and finally deflexed near the top with anthers pendulous, inner ones erect for half their length, then inflexed with anthers pendulous towards the base of the operculum cavity; rarely with all filaments inflexed. Anthers versatile, dorsifixed, narrow-oblong, opening by parallel longitudinal slits. Filaments white, cream, or yellow. Ovary sunk into hypanthium, of 3-4 loculi; ovules in 4 vertical rows on an elongated placenta. Style long, to underside of operculum. Fruit pedicellate or rarely sessile, cupular, cylindrical or barrel-shaped. Seed subspherical to spherical, or sometimes somewhat cuboid, rarely ovoid, smooth, whitish to light grey-brown; hilum ventral.

Distribution. Widespread in south-western Western Australia (Figure 13) apart from the highest-rainfall forested areas, from the Kalbarri region (north of the Murchison River) to Israelite Bay, and inland between Laverton and Balladonia.

Notes. Eucalyptus ser. *Levispermae* would be placed in the large "division *Bisectae*" (Maiden 1931) because of the deeply divided lamina of the cotyledons (Figure 6). This "division" comprises (as "*E.* sect. *Bisectaria*") more than 100 species in Pryor and Johnson's classification (1971) and many more species have been published since.

There are two diagnostic characters for the *E.* series *Levispermae*:

i) the peduncles are always somewhat flattened (in some species distinctly flattened) and widen distally;

ii) the seed coat is completely smooth (Figure 12).

Additional characters found in most species include:

i) the fusiform bud with the operculum longer than the hypanthium;

ii) the spherical or subspherical seed (Figure 12);

iii) the occurrence within the bud of few erect and many inflexed staminal filaments (Figure 11).

We know of no explicit discussion of the relationship of the series to others in *Eucalyptus*. Blakely (1934) placed *E.* series *Subcornutae* after *E.* series *Cornutae* without explanation. Many of the *Levispermae* species share the elongated operculum found in all species of the *Cornutae* (we exclude *E. gomphocephala* from this series). However, no other diagnostic characters appear to be common to these two series, and we consider their relationship to be superficial.

In Pryor and Johnson's (1971) phylogenetic classification, the *Levispermae* (syn. "*Reduncae*") are separated from the species included in Blakely's *Cornutae* by the series "*Erythronemae*". *E. erythronema* itself has leaf characters in common with *E. eremophila* of the *Cornutae*, but there are no diagnostic characters in the "*Erythronemae*" known to us that are shared with the *Levispermae*.

The other adjacent series to the *Levispermae* in Pryor and Johnson (1981) is the "*Accedentes*", which also shares no diagnostic characters. The bud and fruit shapes of *E. desmondensis* are similar to species of the "*Accedentes*" (*E. accedens*) and the "*Erythronemae*" (*E. cylindriflora*).

From the order of series of Section "*Bisectaria*" in Pryor and Johnson (1971), two large subgroups are evident though not defined explicitly. One comprising series "*Cornutae*" to "*Loxophlebae*" (and including thereby the *Levispermae*) is largely characterised by the presence of pith glands, and the other comprising series "*Cneorifoliae*" to "*Foecundae*" in which pith glands are absent.

The anomaly in this arrangement is the *Levispermae*, which includes most species with conspicuous pith glands, one without, and some where pith glands are present but rare and often difficult to detect (a similar anomaly applies to the series "*Incrassatae*" in section "*Dumaria*"). This factor, and the absence of shared derived characters in common with other series, suggest that the series *Levispermae* is taxonomically isolated.

It is of interest to note that rare inter-series natural hybrids with members of the *Levispermae* have been found (see end of taxonomic treatment below), involving species of the "*Loxophlebae*" (*E. loxophleba* x *wandoo*), the *Accedentes* (*E. accedens* x *pluricaulis*), the "*Erythronemae*" (*E. recondita* x *xanthonema*), the *Cornutae s. lat.* (*E. spathulata* x *wandoo*) the "*Grossae*" (*E. grossa* x *histophylla*), the "*Dumosae*" (*E. conglobata* x *wandoo*, *E. arachnaea* x *obtusiflora*), the "*Incrassatae*" (*E. desmondensis* x *incrassata*, *E. incrassata* x *medialis*, *E. incrassata* x *pluricaulis*, *E. incrassata* x *phaenophylla* subsp. *phaenophylla*). Several of these hybrids represent an intersectional cross, as the series "*Dumosae*" and "*Incrassatae*" are in section "*Dumaria*".

Twenty-eight species are recognised in the series. *E. desmondensis* stands apart from all other taxa, and is placed in the monotypic subseries *Desmondenses* which is distinguished in the following key.

Key to subseries of *E.* ser. *Levispermae*

1. Stems slender with sparse sometimes drooping crown; branchlets glaucous, lacking pith glands; operculum broadly conical, ± equal to hypanthium; all stamens completely inflexed ..... subseries *Desmondenses*

1. Stems thick with crown dense, erect or spreading; branchlets glaucous in few taxa, pith glands present; operculum narrowly conical to attenuate, usually longer than hypanthium; not all stamens completely inflexed except in *E. microschema* ..... subseries *Levispermae*

Twelve informal superspecies are recognisable within the *E.* subseries *Levispermae* (Table 1). The superspecies "*wandoo*" is characterised by the tree or tree-mallee habit, large, often hairy seedling leaves, dull adult leaves more than 1.5 cm wide and compact spindle-shaped buds 1-2 cm long. It comprises a group of parapatrically replaced taxa, with *E. wandoo* distinct in its glabrous seedlings from *E. capillosa*, *E. livida* and *E. nigrifunda*, all of which have hairy seedlings.

The superspecies "*phaenophylla*" comprises a group of mallees with glossy adult leaves more than 1 cm wide and buds more than 1.5 cm long, often with the operculum conspicuously narrower than the hypanthium at their junction. Again, this is a widespread parapatrically replaced group of taxa. The easternmost species, *E. tumida* and *E. histophylla*, have more allantoid buds than their western congeners. *E. arachnaea* stands apart from all other members of the superspecies in its rough bark and very slender often uncinate opercula.

The superspecies "*subangusta*" includes three species of smooth-barked mallees (or rarely small mallets) whose adult leaves are usually dull and narrow (less than 1 cm wide) and with small buds less than 1 cm long. The taxa in this superspecies replace each other parapatrically or allopatrically. *E. subtilis* has the narrowest seedling and adult leaves in the series *Levispermae*, and is isolated geographically and morphologically from the other two species in the superspecies.

The superspecies "*xanthonema*" has four species of mallees or mallets with dull adult leaves usually less than 1.5 cm wide and narrow spindle-shaped buds to 1.5 cm long with finely attenuate often uncinate opercula. It has a restricted distribution in the southern wheatbelt. *E. melanophitra* stands apart from the other species in its rough basal bark.

The superspecies "*redunca*" includes five species of mallees or mallets with dull seedling leaves, usually dull blue-green adult leaves, the characteristic elongate buds to 2.5 cm long and yellow stamens. The component taxa more or less replace each other parapatrically, although there are some cases of geographical sympatry (e.g. *E. gardneri* and *E. pluricaulis*). There appear to be two groups of species within the superspecies, with *E. redunca* and *E. varia* having yellow-green new growth and green scarcely bluish adult leaves, while *E. gardneri*, *E. densa* and *E. pluricaulis* have purplish new growth and conspicuously blue-green adult leaves.

The superspecies "*hebetifolia*", "*abdita*", "*sparsicoma*", "*clivicola*", "*flavida*", "*crispata*" and "*desmondensis*" are all monotypic, each having one or more conspicuous characters that isolate them from all other taxa in the *E.* ser. *Levispermae*. Relationships among and within these superspecies warrant further investigation.

Key to species and subspecies of the *Eucalyptus* subser. *Levispermae*

1. Tree or mallet (see habit definitions)
    2. Adult leaves glossy or becoming glossy by second year of growth (new growth or coppice may be dull)
        3. Operculum more than 15 mm long; juvenile leaves lanceolate, glossy green; N and E of Kalgoorlie ..... 14. *E. flavida*
        3. Operculum less than 15 mm long; juvenile leaves deltoid to ovate, dull blue-green
            4. Bark smooth; Ongerup, Ravensthorpe Range and Bandalup Hill ..... 13. *E. clivicola*
            4. Bark rough; between Mingenew and Morawa ..... 8b. *E. arachnaea* subsp. *arrecta*
    2. Adult leaves remaining dull throughout growth cycle
        5. Branchlets glaucous
            6. Basal bark usually rough, dark; adult leaves to 15 mm wide; buds to 10 x 2 mm; fruit to 5 x 4 mm; Great Victoria Desert ..... 4. *E. nigrifunda*
            6. Basal bark smooth white, grey, cream, orange or salmon pink; adult leaves to 24 mm wide; buds to 19 x 4 mm; fruit to 10 x 6 mm
                7. Juvenile leaves hairy; east central wheatbelt to W of Menzies ..... 2a. *E. capillosa* subsp. *capillosa*
                7. Juvenile leaves glabrous; N wheatbelt from Mt Lesueur and Coomberdale to Three Springs ..... 1b. *E. wandoo* subsp. *pulverea*

5. Branchlets not glaucous

8. Basal bark rough; buds to 15 x 3 mm; lower Coraekerup Creek and Pallinup River areas; E of the Stirling Range ..... 21. *E. melanophitra*

8. Basal bark smooth or with scattered partly-detached flakes; buds to 26 x 5 mm

9. Operculum more than 10 mm long; crown intensely blue-green, new growth usually purplish

10. Adult leaves more than 15 mm wide; usually on lateritic ridges

11. Operculum more than 15 mm long; west central wheatbelt - Cadoux area ..... 23a. *E. gardneri* subsp. *gardneri*

11. Operculum less than 15 mm long; Ravensthorpe Range ..... 23b. *E. gardneri* subsp. *ravensthorpensis*

10. Adult leaves less than 12 mm wide; usually in depressions or flat country; southern wheatbelt from Ongerup east to Ravensthorpe and north-east to Hyden ..... 24a. *E. densa* subsp. *densa*

9. Operculum less than 10 mm long; crown grey-green to blue-green; new growth not purplish

12. Buds to 7 x 2 mm; fruit to 3 x 3 mm; small mallet to 5 m tall; northern wheatbelt, particularly Mullewa to Paynes Find ..... 16b. *E. subangusta* subsp. *pusilla*

12. Buds more than 7 x 2 mm

13. Mallet or small to medium-sized tree maturing to more than 8 m; new bark creamy grey, pinkish or yellow; adult leaves green or blue-grey; juvenile leaves not hairy

14. Mallet; bark cream, grey or pinkish, often with loosely held non-decorticated dead fragments held on the lower 1 m; black horizontal insect scars often present on lower trunk; buds to 14 mm long; Beaufort Inlet ..... 22. *E. praetermissa*

14. Small to medium-sized tree; bark white, grey or yellow, often with scattered loosely held dark rough-barked fragments; insect scars absent; buds to 19 mm long: Darling Range and western wheatbelt, south-east to Stirling Range and lower Pallinup River ..... 1a. *E. wandoo* subsp. *wandoo*

13. Small tree to 7 m; new bark orange; adult leaves conspicuously grey; juvenile leaves hairy; western and southern goldfields ..... 3. *E. livida*

1. Mallee (see habit definitions)

15 Stems to 4 m, slender with sparse sometimes weeping crown; branchlets glaucous, without pith glands; adult leaves to 10 x 3.5 cm, dull, blue-grey; operculum conical, ± equal to hypanthium; Ravensthorpe Range ..... 28. *E. desmondensis*

15. Without the above combination of characters

16. Adult leaves glossy, green (mature characteristics may only be evident on second year leaves inside crown)

17. Operculum more than 15 mm long; juvenile leaves glossy, green; flowers yellow; fruits to 10 x 6 mm; N and E of Kalgoorlie ..... 14. *E. flavida*

17. Operculum less than 15 mm long; juvenile leaves dull, bluish green to green

18. Operculum narrower than hypanthium at join on mature buds

19. Basal bark smooth

20. Buds to 2.5 mm diam., operculum conspicuously narrower than hypanthium; stems ± straight; central and southern wheatbelt ... 9a. *E. phaenophylla* subsp. *phaenophylla*

20. Buds to 4 mm diam., operculum only slightly narrower than hypanthium; stems straggly; Jerramungup and Boxwood Hills east to Ravensthorpe Range ..... 9b. *E. phaenophylla* subsp. *interjacens*

19. Basal bark rough

21. Basal bark loosely held; leaves erect, less than 10 mm wide; buds to 10 mm long; Pingrup-Lake Chinocup area ..... 7. *E. sparsicoma*

21. Basal bark tightly held; leaves not prominently erect, to 15 mm wide; buds to 18 mm long in spidery clusters; northern and central wheatbelt ..... 8a. *E. arachnaea* subsp. *arachnaea*

18. Operculum same width as hypanthium at join on mature buds

22. Buds less than 1 cm long

23. Basal bark persistent as partially decorticated curling flakes; adult leaves to 15 mm wide; peduncles to 16 mm long; Yandanooka-Eneabba area ..... 15. *E. crispata*

23. Basal bark smooth; adult leaves to 10 mm wide; peduncles to 10 mm long; wheatbelt between Manmanning and Watheroo, and near Narembeen ..... 16d. *E. subangusta* subsp. *virescens*

22. Buds more than 1 cm long

24. Leaves conspicuously erect

25. Buds more than 15 mm long; between Fraser Range and Balladonia ..... 12. *E. histophylla*

25. Buds less than 10 mm long; east and south-east of Newdegate ..... 18. *E. microschema*

24. Leaves held at various angles

26. Basal bark smooth; adult leaves to 20 mm wide; juvenile leaves to 6 cm wide

27. Adult leaves to 11 x 2 cm; mature buds allantoid, to 20 x 3 mm; E and NE of Ravensthorpe to Israelite Bay ..... 11. *E. tumida*

27. Adult leaves to 10 x 1.5 cm; mature buds fusiform, to 15 x 4 mm; Jerramungup and Boxwood Hills east to Ravensthorpe Range ..... 9b. *E. phaenophylla* subsp. *interjacens*

26. Basal bark loose, rough; adult leaves to 12 mm wide; juvenile leaves to 3 cm wide; E of Hyden, 90 Mile Tank area ..... 10. *E. luteola*

16. Adult leaves dull throughout the crown, blue-green or green

28. Leaves conspicuously erect

29. Buds more than 15 mm long; between Fraser Range and Balladonia ..... 12. *E. histophylla*

29. Buds less than 10 mm long; E and SE of Newdegate ..... 18. *E. microschema*

28. Leaves held at various angles

30. Leaves less than 10 mm wide

31. Basal bark rough; buds to 30 x 4 mm; saline or swampy ground; Dalyup River-Gibson ..... 26b. *E. varia* subsp. *salsuginosa*

31. Basal bark smooth

32. Crown blue-green; buds to 20 x 4 mm

33. Adult leaves less than 9 mm wide, new growth often purplish; maximum height 3 m; Ravensthorpe-Jerramungup area ..... 24a. *E. densa* subsp. *improcera*

33. Adult leaves 9-13 mm wide, new growth yellow-green; maximum height 7 m; Esperance sandplain (Dalyup River east to Thomas River) ..... 26a. *E. varia* subsp. *varia*

32. Crown green; buds to 17 x 3 mm

34. Buds distinctly pedicellate, to 17 mm long; operculum attenuate, often hooked at tip

35. Leaves less than 7 mm wide; SE of Williams to Jerramungup ..... 19a. *E. xanthonema* subsp. *xanthonema*

35. Leaves 9-15 mm wide; Stirling Range ..... 19a. *E. xanthonema* subsp. *apposita*

34. Buds tapering to pedicel, to 7 mm long; operculum conical, not hooked at tip; adult leaves to 6 mm wide; 90 Mile Tank to S of Norseman ..... 17. *E. subtilis*

30. Leaves more than 10 mm wide

36. Mature buds less than 12 mm long; operculum not curled at tip

37. Fruit to 3 x 3 mm; buds to 7 x 2 mm; Mullewa and Paynes Find south to Wongan Hills ..... 16b. *E. subangusta* subsp. *pusilla*

37. Fruit more than 3 x 3 mm; buds to 10 x 3 mm

38. Branchlets glaucous; operculum often acute; far eastern central wheatbelt .... 16c. *E. subangusta* subsp. *cerina*

38. Branchlets not glaucous; operculum obtuse; northern and central wheatbelt

39. Bark smooth; notably on yellow sandplain in the northern wheatbelt ..... 16a. *E. subangusta* subsp. *subangusta*

39. Bark at base in partly decorticated curls; on lateritic breakaways; Yandanooka-Eneabba area ..... 15. *E. crispata*

36. Mature buds more than 12 mm long; operculum apex often recurved

40. Operculum less than 10 mm long, attenuate or blunt

41. Basal bark loose, rough

42. Thin stemmed (to 10 cm diam.); leaves to 15 mm wide; buds to 14 mm long; Kalgan Plains, Stirling Range ..... 20. *E. medialis*

42. Thick stemmed (to 20 cm diam.); leaves to 18 mm wide; buds to 17 mm long; Jitarning to Tincurrin and Dryandra ..... 5. *E. hebetifolia*

41. Basal bark smooth

43. Branchlets glaucous; newly exposed bark bright orange; central eastern wheatbelt ..... 2b. *E. capillosa* subsp. *polyclada*

43. Branchlets not glaucous

44. Leaves always dull

45. Leaves green; newly exposed bark not orange; buds fusiform; operculum acute; seedling leaves glabrous; Stirling Range ... 19b. *E. xanthonema* subsp. *apposita*

45. Leaves conspicuously grey; newly exposed bark bright orange; buds allantoid or fusiform; operculum blunt; seedling leaves hairy; Coolgardie district south to Kumarl - Peak Charles ..... 3. *E. livida*

44. Leaves maturing green and slightly glossy, at first blue-green; buds fusiform; operculum acute; W of Dandaragan ..... 6. *E. abdita*

40. Operculum more than 12 mm long, attenuate

46. Basal bark rough; saline or swampy ground; Dalyup River-Gibson ..... 26b. *E. varia* subsp. *salsuginosa*

46. Basal bark smooth; slopes, plains or lateritic hills

47. Straggly shrub; mature adult leaves purplish; Tarin Rock south to Stirling Range and Fitzgerald River National Park ..... 25b. *E. pluricaulis* subsp. *porphyrea*

47. Erect-stemmed mallees; mature adult leaves green or blue-green

48. Leaves green; coastal from Cape Riche to Fitzgerald River National Park and Ravensthorpe Range ..... 27. *E. redunca*

48. Leaves blue-green

49. Leaves to 18 mm wide; new growth often purplish; widespread in the wheatbelt from Three Springs south to the Stirling Range ... 25a *E. pluricaulis* subsp. *pluricaulis*

49. Leaves to 13 mm wide; new growth yellow-green; Esperance sandplain (Dalyup River east to Thomas River) ... 26a. *E. varia* subsp. *varia*

Subseries *Levispermae*

Trees, mallets or mallees. Bark smooth, or with partly decorticated flakes, or rough at the base or over half to most of stems or trunk. Stems in mature plants not conspicuously slender; crown dense, erect or spreading, not pendulous. Branchlets and infloreseences not glaucous, or with distinct though light wax overlay. Branchlets with or without pith glands. Peduncles always flattened and widening towards distal end, slender or stout. Buds fusiform and elongated, if relatively short then slender. Operculum ± equal in length to hypanthium or much longer; narrower than or equal in width to hypanthium, narrowly conical to attenuate. Staminal filaments varying from erect, to inflexed near top, or inflexed from about half the length of the filament. Flowers white or yellow. Seed subspherical to spherieal, or in some cuboid, rarely ovoid.

This subseries, comprising 27 of the 28 species in the *E.* ser. *Levispermae* (Table 1), covers the whole geographical range of the series (Figure 13). The monotypic subseries *Desmondenses* is restricted to the Ravensthorpe district.

1. ***Eucalyptus wandoo*** Blakely, "Key to the Eucalypts" 112 (1934). - *E. redunca* Schauer in Lehm. Pl. Preiss. 1:127 (1844), *pro parte*.: - *E. redunca* Schauer var. *elata* Benth., Fl. Austral. 3: 253 (1867).

Type: Kalgan River, Western Australia, *Oldfield* s.n. (syn: K)

Colour illustration. Brooker & Kleinig, (1990: 163)

Tree to 25 m tall; bole in large old trees often aseending from characteristic above-ground circular pedestal (Figure 5e). Bark on saplings fibrous, light grey to yellowish grey, on mature trees always smooth, white, grey, yellow or pale orange; northern specimens (subsp. *pulverea*) with slightly powdery bark; whole trunk often with scattered loosely held dark rough-barked fragments. Branchlets glaueous or not; pith glandular. Leaves of the seedling remaining opposite for 3 or 4 pairs, then alternating, cordate to ovate, to 13 x 10 cm; slightly glossy green in Darling Range to Stirling Range speeimens, dull grey and waxy in northern and western wheatbelt speeimens. Adult leaves lanceolate, to 15 x 2.4 em; dull (rarely glossy), greenish grey to blue-grey. Inflorescences to 17-flowered; peduncles to 1.8 cm long. Buds fusiform, to 1.9 x 0.4 cm, opercula conical, straight or sometimes slightly recurved at the top. Flowers white. Fruit pedicellate, obconieal to eylindrical, to 1 x 0.6 cm. Seed light brown to grey-brown, subspherical to cuboid.

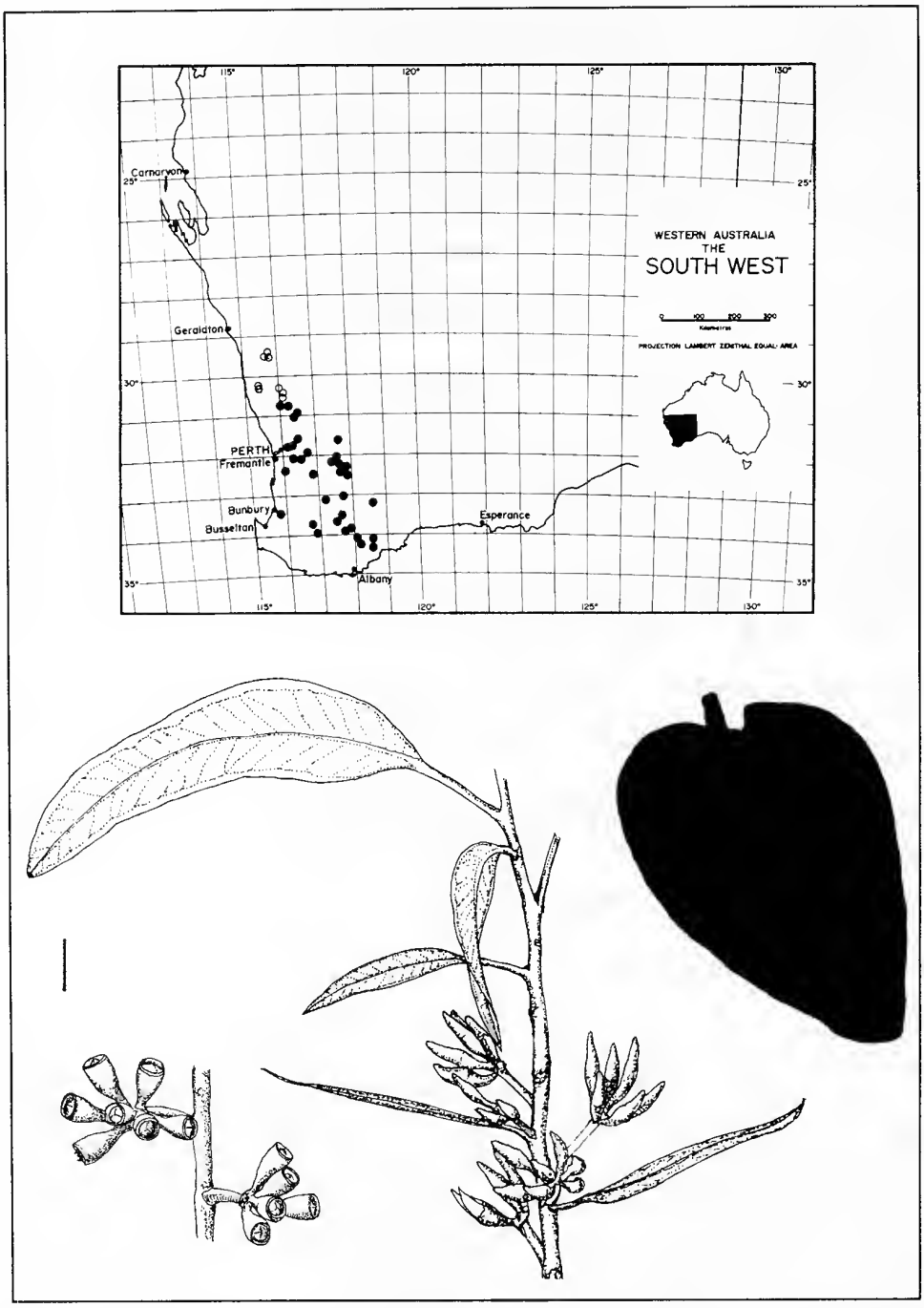

Figure 14. Distribution of *E. wandoo* subsp. *wandoo* (●) and *E. wandoo* subsp. *pulverea* (○), and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf of *E. wandoo* subsp. *wandoo* (scale bar = 1 cm).

Notes. E. wandoo is the well-known white gum of the Darling Range and Great Southern agricultural region. It is distinguished from eastern wandoo (*E. capillosa*) by its consistent tree habit and taller form, glabrous cordate to ovate seedling leaves, blue-green adult canopy, and less colourful new bark.

Wandoo has an extremely hard and durable timber. It is also important to beekeepers and in reafforestation for salinity control in south-western Australia.

Extensive stands have suffered crown dieback in recent years, due mainly to wood-boring insect larvae (P. Brown, pers. comm.).

There are two subspecies.

1a. ***Eucalyptus wandoo*** Blakely subsp. ***wandoo***

Tree to 25 m with non-powdery bark that is pale yellow when fresh, ageing to white or grey, and branchlets not glaucous; juvenile leaves up to 10 x 7 cm. (Figures 1, 5b, 5c, 7, 14, 96)

Specimens examined. WESTERN AUSTRALIA: Guildford, April 1901, *C. Andrews* s.n.(PERTH); Stirling Range, Jan. 1941, *F.M. Bennett* near Mt Hassell, Stirling Range (CANB, PERTH); near Toodyay, March 1937, *W.E. Blackall* s.n. (PERTH); Albany, Dec. 1937, *W.E. Blackall* (PERTH); c. 35 miles from Perth towards Brookton, 18 May 1969, *M.I.H. Brooker* 1749, 1750 (PERTH); 17 miles SE of Wickepin towards Harrismith, 3 Nov. 1969, *M.I.H. Brooker* 2258 (CANB, NSW, PERTH); 18 miles from York towards Quairading, 12 July 1970, *M.I.H. Brooker* 2632 (CANB, MEL, PERTH); 11 miles W of Quairading, 12 July 1970, *M.I.H. Brooker* 2633 (CANB, MAAS, PERTH); 8 miles S of Kulin, 13 July 1970, *M.I.H. Brooker* 2650 (CANB, PERTH); highest hill between Burngup and the main Lake Grace - Newdegate Road, 20 April 1972, *M.I.H. Brooker* 3590 (PERTH); 12.6 km E of rail crossing at Carani, 30° 59'S 116° 31'E, 26 Aug. 1982, *M.I.H. Brooker* 7590 (CANB, NSW, PERTH); 1.9 km along N boundary fire trail from Bluff Knoll road, Stirling Range, 7 Oct. 1982, *M.I.H. Brooker* 7691 (CANB, NSW, PERTH); 2.2 km along N boundary fire trail from Bluff Knoll road, Stirling Range, 7 Oct. 1982, *M.I.H. Brooker* 7692, 7693 (CANB, NSW, PERTH); 15.3 km NE of Calingiri, towards Wongan Hills, 16 Feb. 1983, *M.I.H. Brooker* 7968 (CANB, NSW, PERTH); 1.4 km W of Tincurrin North Road on Narrogin - Harrismith road, 32° 56'S 117° 45'E, 4 May 1983, *M.I.H. Brooker* 8101 (CANB, NSW, PERTH); Salt River Road, N of Stirling Range National Park 22 Feb. 1985, *M.I.H. Brooker* 8868 (CANB, MEL, NSW, PERTH); Borden - Bremer Bay road, 34° 19'S 118° 33'E, 3 March 1985, *M.I.H. Brooker* 8876 (CANB, MEL, NSW, PERTH); Monjebup Creek, upstream from crossing on Toompup South Road, 34° 19'S 118° 40'E, 3 March 1985, *M.I.H. Brooker* 8882 (CANB, MEL, NSW, PERTH); c. 15 km SSW of Corrigin, 32° 27'S 117° 48'E, 8 Dec. 1985, *M.I.H. Brooker* 9130 (CANB, MEL, NSW, PERTH); 100 m N of rail crossing, SW of Corrigin, 32° 23'S 117° 47'E 8 Dec. 1985, *M.I.H. Brooker* 9131 (CANB, MEL, NSW, PERTH); 4 km SSE of Walebing on highway, 30° 45'S 116° 12'E, 28 Jan. 1986, *M.I.H. Brooker* 9170 (CANB, MEL, NSW, PERTH); 3 km S of Quairading, 15 July 1987, *M.I.H. Brooker* 9705 (AD, CANB, MEL, NSW, PERTH); 20 km SE of Quairading towards Corrigin, 15 July 1987, *M.I.H. Brooker* 9707 (AD, CANB, MEL, NSW, PERTH); 31 km SE of Quairading, towards Corrigin, 15 July 1987, *M.I.H. Brooker* 9709 (AD, CANB, MEL, NSW, PERTH); 6.1 km E of Shepherd road, 32° 05'S 117° 48', 23 Aug. 1988, *M.I.H. Brooker* 10043 (AD, CANB, MEL, NSW, PERTH); 1 mile N of Highbury, 9 Sept. 1947,

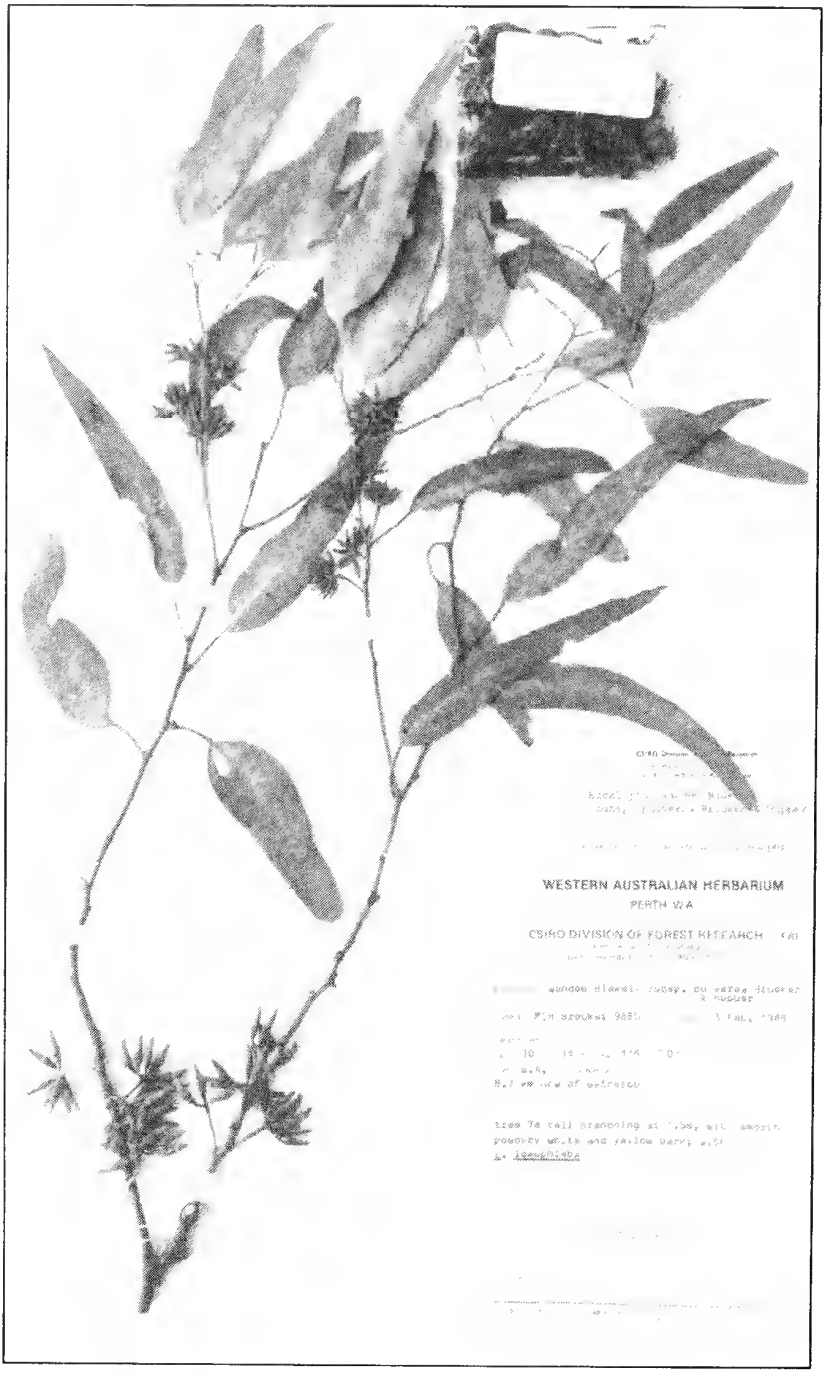

Figure 15. Holotype of *E. wandoo* Blakely subsp. *pulverea* Brooker & Hopper.

N.T. Burbidge 2331 (CANB); Boyagin Fauna Sanctuary, SW of Brookton, 19 Jan. 1973, *N.T. Burbidge* 8088 (CANB, PERTH); Boxwood Hill - Toompup road, 26 km NW from Chillinup Pool turnoff, 34° 09'S 118° 30'E, 15 Jan. 1979, *M.D. Crisp* 5166 (CBG, NSW, PERTH); 29 km from Broomehill along road to Gnowangerup, 33° 53'S 117° 55'E, 15 Jan. 1979, *M.D. Crisp* 5178 (CBG, CANB, NSW, PERTH); 8 km E of Katanning 33° 42'S 117° 38'E, 15 Jan. 1970, *M.D. Crisp* 5190, (CBG, CANB, MO, NSW, PERTH); 5 km from Darkan along road to Williams, 33° 18'S 116° 45'E, 22 Jan. 1979, *M.D. Crisp* 5374 (CBG, PERTH); Sources of the Blackwood River, 1888, *Miss Cronin* s.n. (PERTH); Newcastle (= Toodyay), Feb. & Aug. 1901, *F.L.E.Diels & E.A.L. Pritzel* s.n. (PERTH); Mackey Road turnoff 451/2 mile peg on Brookton Hwy, 12 June 1969, *H. Demarz* 1288 (PERTH); Swan River, *s. dat., J. Drummond* 81, 84 (LD); Foothills, 25 March 1983, *H. Demarz* 9597 (CANB, PERTH); York to Perth road, 1 mile W of The Lakes, 20 Sept. 1966, *Rex Filson* 8965 (MEL, PERTH); Midland Junction, March 1901, *W.V. Fitzgerald* (PERTH); Tambellup, 25 June 1920, *C.A. Gardner* 24 (PERTH); Harrismith, 5 March 1924, *C.A. Gardner* 2104 (PERTH); 15 miles E of Boulder Rock along Brookton Hwy, 10 Sept. 1977, *A.M. George* 133 (PERTH); 0.7 miles E of Arthur river, 15 Aug. 1967, *E. Holm* s.n. (CANB); c. 2 km NW of Gorge Rock on Corrigin - Kondinin road, 32° 27'S 117° 59'E, 14 June 1985, *S.D. Hopper* 4423 (PERTH); E boundary of Twine Nature Reserve, E of Narembeen, 32° 07'S 118° 59'E, 1 Oct. 1990, *S.D. Hopper* 7853 (PERTH); Katanning, 14 Aug. 1963, *Sheikh Ibrahim* (PERTH); Wooroloo, *anno* 1907, *M. Koch* 1358 (PERTH); Spring Valley Road, 2 km S of Serpentine Falls, Serpentine, 5 July 1979, *G.J. Keighery* 2385 (CANB, PERTH); Crooked Brook, between Dardanup and Boyanup, 17 Nov. 1980, *G.J. Keighery* 3542 (PERTH); 5 miles WNW of Katanning, 26 Sept. 1952, *Key & Wallace* (CANB); Cohen Brook, Helena River Gorge, 1 Dec. 1966, *L. McGann* (CANB, PERTH); Benderine Rock, N of Bungulla, 31° 32'S 117° 39'E, ?Jan. 1967, *B.Y. Main* (PERTH); Broomehill, 16 April 1904, *A. Morrison* (PERTH); 14 miles E of Tambellup, Jan. 17 1970, *K. Newbey* 3092 (PERTH); S Mobrup road, c. 2 miles W of Towerup road, SW of Kojonup, 18 Nov. 1970, *D. Nicholas* (AD, BRI, CANB, K, MEL, NSW, PERTH); King George Sound to York, Feb. 1840, *L. Preiss* 247 (LD); King George Sound to York, 7 March 1840, *L. Preiss* 245 (LD); Avon district, April 1901, *E.A. Pritzel* 313 (BM, PERTH); Darlington, 6 July 1949, *B.A. Roark* (PERTH); Coates' Siding 24 Oct. 1917, *F.M. Schock* (PERTH); Helena Valley, May 1978, *J. Seabrook* 550 (PERTH); York road 43 miles from Perth, 19 Oct. 1962, *F.G. Smith* 1592 (PERTH); 89 miles S of Williams, near Cranbrook, 11 Dec. 1962, *F.G. Smith* 1607 (PERTH); Barakin, 1 June 1948, *N.H. Speck* (PERTH); Darling Scarp, Lesmurdie, Oct. 1953, *G.M. Storr* (PERTH); Marradong, 5 June 1961, *M.M.H. Wallace* s.n. (CANB).

Distribution and habitat. Darling Range and adjacent foothills and coastal plain from Gingin and Bindi Bindi south towards Donnybrook and south-east through the western part of the wheatbelt to the Stirling Range and lower Pallinup River (Figure 14). There is a recently discovered disjunct outlier on a granite outcrop 50 km east of Narembeen, some 120 km to the east of the main occurrence. Typically *E. wandoo* subsp. *wandoo* occurs in more or less pure stands forming an open forest. The understorey is usually open heath. Preferred soils are predominantly fine textured in undulating terrain.

Conservation status. Widespread and abundant. Well represented in conservation reserves.

Flowering period. December-May.

Notes. Subsp. *wandoo* differs from subsp. *pulverea* in the absence of powder bark, its consistently yellow new bark, its smaller seedling leaves, and its non-glaucous branchlets. The two subspecies appear to intergrade north of Gingin, e.g. *M.I.H. Brooker* 9889 (AD, CANB, MEL, NSW, PERTH) is from a population with very slight powder bark and pale yellow new bark.

The Twine Reserve disjunct population east of Narembeen (*M.I.H. Brooker* 10541)has glossy adult leaves within the canopy and may warrant taxonomic recognition. This population is presumably a relict from wetter times when the distribution of *E. wandoo* extended continuously to the eastern wheatbelt. Like the Jilakin Rock population of jarrah, and the Goddard's Soak population of *E. rudis*, the Twine Reserve stand of *E. wandoo* occurs well to the east of the main range of the species, and is confined to favourable soils receiving high runoff from a large granite outcrop.

1b. ***Eucalyptus wandoo*** Blakely subsp. ***pulverea*** Brooker & Hopper, subsp. nov. (Figure 14, 15)

A subspecie typica statura parviore, cortice pulvereo, saepe pallido-aurantiaco ubi novo et ramulis glaucis differt.

Typus: 8.7 km N of Watheroo, Western Australia, 3 February 1988, *M.I.H. Brooker* 9885 & *C. Sounness* (holo: PERTH; iso: AD, CANB, MEL, NSW).

Tree to 15 m tall with powdery bark often pale orange when fresh ageing to white or grey, glaucous branchlets, and juvenile leaves up to 13 x 10 cm.

Specimens examined. WESTERN AUSTRALIA: c. 1 mile SE of Mt Lesueur, 6 Jan. 1970, *M.I.H. Brooker* 2351 (AD, CANB, PERTH); 7 miles N of Three Springs, 23 April 1970, *M.I.H. Brooker* 2530 (PERTH); Gully NE of Mt Peron, 30° 06'S 115° 12'E, 2 March 1983, *M.I.H. Brooker* 8001 (CANB, NSW, PERTH); 6.1 km NE of Arrino towards Morawa, 29° 23'S 115° 38'E, 1 Nov. 1984, *M.I.H. Brooker* 8733 (CANB, NSW, MEL, PERTH); 6.9 km SE of Arrino towards Three Springs, 29° 28'S 115° 40'E, 3 June 1985, *M.I.H. Brooker* 9032 (CANB, MEL, NSW, PERTH); 7.4 km N of Coomberdale, 30° 24'S 116° 03'E, 27 Jan. 1986, *M.I.H. Brooker* 9169 (CANB, MEL, NSW, PERTH); 5.2 km N of Moora, 30° 35'S 116° 01'E, 1 Feb. 1988, *M.I.H. Brooker* 9876 (AD, CANB, MEL, NSW, PERTH); 12 km N of Moora, 30° 32'S 116° 02'E, 3 Feb. 1988, *M.I.H. Brooker* 9886 (AD, CANB, MEL, NSW, PERTH); 5.7 miles N of Three Springs, 19 Oct. 1966, *G.M. Chippendale* 38 (CANB, PERTH); proposed Mt Lesueur Reserve, E of Mt Peron, 30° 06'S 115° 13'E, 21 May 1981, *E.A. Griffin* 3152 (PERTH).

Distribution and habitat. Northern wheatbelt from the Cataby area to Morawa district (Figure 14). The subspecies occurs in more scattered stands than typical *E. wandoo*, but occurs in similar vegetation structure and soils.

Conservation status. Widespread in disjunct populations. Often locally abundant but poorly represented in conservation reserves.

Flowering period. Unknown.

Etymology. The subspecific epithet refers to the powdery bark (Latin *pulvereus*, dusty).

Notes. The powdery bark, often pale orange when fresh, the glaucous branchlets, and the larger juvenile leaves distinguish *pulverea* from *E. wandoo* subsp. *wandoo*.

With the description of *E. wandoo* subsp. *pulverea*, there are now two powderbark wandoos, *E. accedens* being the other taxon usually known as Powderbark Wandoo. Although not closely related, *E. accedens* and *E. wandoo* subsp. *pulverea* look similar as trees, and grow together at several sites in the Eneabba region. However, *E. accedens* differs in having grey-white seedling leaves, larger fruits, thicker shorter buds with a conical operculum shorter than the hypanthium, and grey-brown cuboid seed with a reticulate (not smooth) surface.

2. ***Eucalyptus capillosa*** Brooker & Hopper, sp. nov. (Figures 7, 8, 16, 17, 18)

Eucalypto wandoo Blakely affinis a qua habitu variabili, arbore vel frutice; cortice novo aurantiaco, ramulis glaucis, foliis plantularum pubescentibus differt.

Typus: 9.5 km N of Merredin on Nungarin road, Western Australia, 15 September 1982, *M.I.H. Brooker* 7620 (holo: PERTH; iso: CANB, NSW).

Differs from *E. wandoo* in being generally a smaller tree or mallee, with hairy seedlings having more pairs of opposite leaves (5 or 6), pubescent seedling stems, and adult leaves which also are green rather than blue-green or glaucous. The newly exposed bark of the mature tree or mallee is more colourful (bright orange) than in *E. wandoo*. The branchlets are glaucous and peduncles are to 3 mm wide.

Etymology. The specific epithet refers to the hairy seedlings (Latin *capillosus*, hairy).

Notes. E. capillosa is the wheatbelt or eastern wandoo. The contrasting characters (outlincd in the diagnosis) are evident where *E. capillosa* and *E. wandoo* grow together in a belt from Kellerberrin south-east to Corrigin. This is particularly so in winter when the newly exposed orange bark of *E. capillosa* contrasts with the less colourful yellow bark of *E. wandoo.* Further east a few isolated populations around Lake Barlee appear to be smooth barked intergrades between *E. capillosa* subsp. *capillosa* and *E. nigrifunda.*

It is possible that the explorer Ernest Giles was the first European to publish observations on *E. capillosa* (Giles 1889). On Octobcr 6 1875 when camped 25 miles WNW of Queen Victoria Spring he noted "...where we camped there were a number of well-grown cucalyptus-trees with yellow bark". Giles encountered thesc yellow-barked trees again on October 13 near Ularring and on October 24 W of Pigeon Rocks, placcs where *E. capillosa* is the only such prominently yellow-orange barked tree.

There are two subspecies, one a tree and the other a robust tree-mallee.

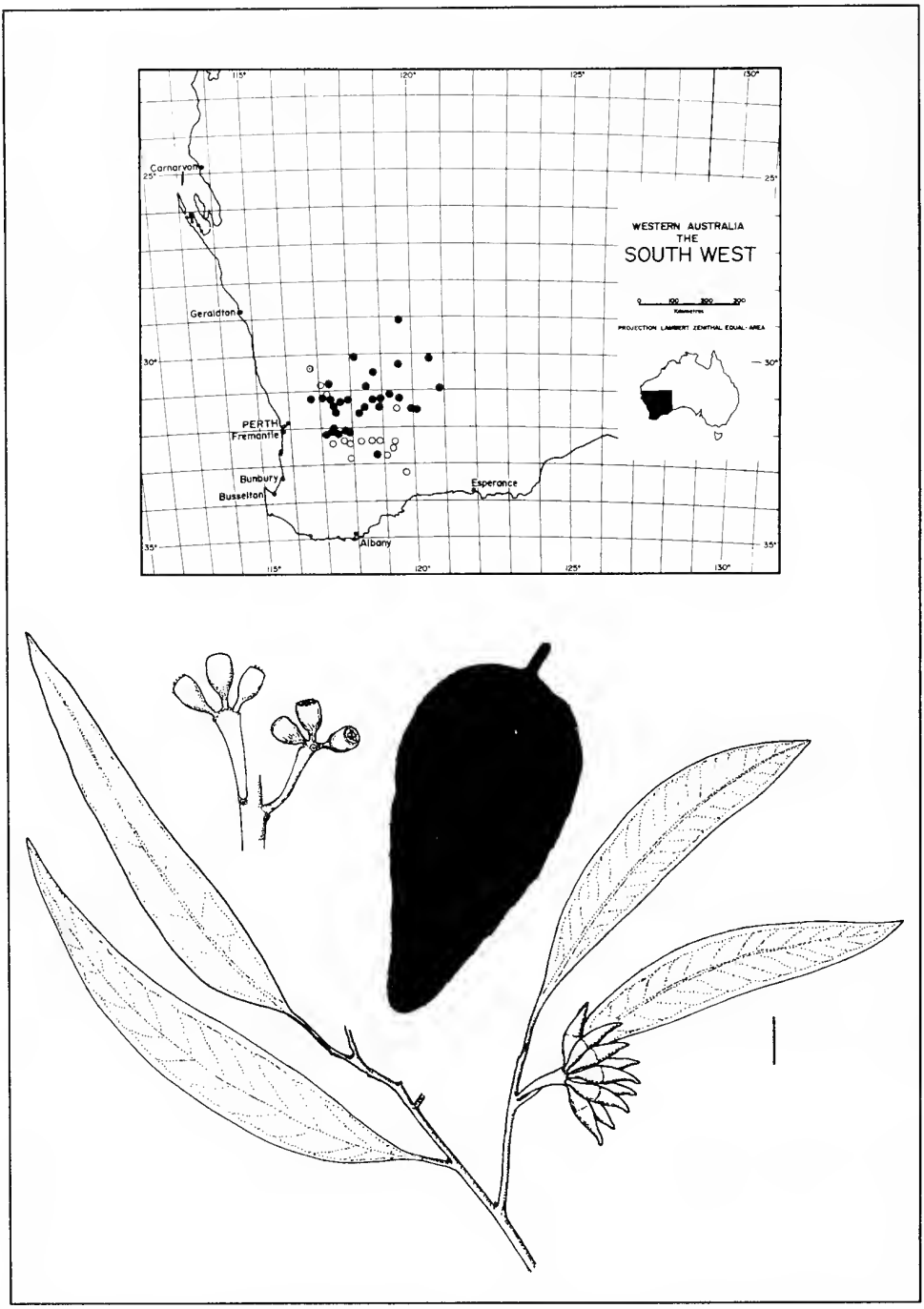

Figure 16. Distribution of *E. capillosa* subsp. *capillosa* (●) and *E. capillosa* subsp. *polyclada* (o), and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf of *E. capillosa* subsp. *capillosa* (scale bar = 1 cm).

2a. ***Eucalyptus capillosa*** Brooker & Hopper subsp. ***capillosa*** (Figures 7, 8, 16, 17)

Colour illustration. Brooker & Kleinig, (1990: 164)

A small to medium-sized tree (to 12 m tall).

Specimens examined. WESTERN AUSTRALIA: 2 miles N of Wyalkatchem, 30 June 1959, *T.E.H. Aplin* 507 (PERTH); Oxendale Farm via Yelbeni, Trayning, *s. dat., M. Barnes* s.n. (PERTH); Sandford Rock (sic), 15 Jan. 1970, *M.I.H. Brooker* 2429 (CANB, MEL, PERTH); 13.5 miles N of Kellerberrin towards Yelbeni, 16 July 1970, *M.I.H. Brooker* 2691 (CANB, PERTH); 22.6 km W of Bodallin, 31° 16'S 120° 02'E, 20 Aug. 1979, *M.I.H. Brooker* 6389 (CANB, NSW, PERTH); 123 km W of Coolgardie, 31° 16'S 120° 00'E, 23 Aug. 1979, *M.I.H. Brooker* 6471 (CANB, NSW, PERTH); 15.4 km NW of Southern Cross towards Bullfinch, 31° 07'S 119° 13'E, 24 Aug. 1979, *M.I.H. Brooker* 6477 (CANB, NSW, PERTH); 9.5 km N of Merredin on Nungarin Rd, 31° 26'S 118° 25'E, 15 Sept. 1982, *M.I.H. Brooker* 7620 (CANB, NSW, PERTH); c. 25 km W of Nukarni, 31° 19'S 117° 56'E, 5 Sept. 1982, *M.I.H. Brooker* 7625 (CANB, NSW, PERTH); Chiddarcooping Nature Reserve, E boundary, 17 Feb. 1983, *M.I.H. Brooker* 7976 (CANB, NSW, PERTH); 0.4 km W of Trayning road on Breakell road, 30° 52'S 117° 14'E, 26 Jan. 1984, *M.I.H. Brooker* 8438 (CANB, NSW, PERTH); 31 km W of Wyalkatchem, 31° 12'S 117° 05'E 26 Jan. 1986, *M.I.H. Brooker* 9164 (CANB, MEL, NSW, PERTH); 31 km W of Trayning, 31° 12'S 116° 45'E, 26 Jan. 1986, *M.I.H. Brooker* 9165 (CANB, MEL, NSW, PERTH); 4.7 km S of Cadoux - Koorda road on Rabbit Proof Fence road, 30° 50'S 117° 13'E, 2 July 1986, *M.I.H. Brooker* 9380 (CANB, MEL, NSW, PERTH); 2 km S of Quairading, 15 July 1987, *M.I.H. Brooker* 9704 (AD, CANB, MEL, NSW, PERTH); 31 km S of Quairading, 32° 08'S 117° 38'E, 15 July 1987, *M.I.H. Brooker* 9708 (AD, CANB, MEL, NSW, PERTH); 4.5 miles SW of Merredin, 6 March 1967, *G.M. Chippendale* 85 (CANB, PERTH); 5.1 miles E of Carribin (*sic*), 6 March 1967, *G.M. Chippendale* 89 (CANB, PERTH); Yorkrakine Rocks (= Sanford Rock), 7 miles NE of Westonia, 6 March 1967, *G.M. Chippendale* 92 (CANB, PERTH); Noongar, 31° 20'S 18° 58'E, 12 Sept. 1976, *R. Coveny* 8374 & *B. Haberley* (NSW, PERTH); N of Bullabulling, Aug. 1928, *J.H. Frank* (PERTH); 3 km N of Karroun Hill, 1 June 1988, *J.A. Friend* (PERTH); Bullabulling, 31 May 1949, *C.A. Gardner* 9271 (PERTH); Lake Barlee, 18 Oct. 1966, *C.A. Gardner* 19032 (PERTH); 3 miles E of Carrabin, 31 Aug. 1957, *J.W. Green* 1709 (PERTH); Tammin, 20 May 1959, *B.J. Grieve* (PERTH); Tammin, 25 Nov. 1959, *B.J. Grieve* (PERTH); Walyahmoning Rock, 39 km ESE of Bonnie Rock, 30° 38'S 118° 45'E, 6 Sept. 1978, *S.D. Hopper* 1122 (PERTH); 4 km W of Mt Bebb, 32° 05'S 117° 47'E, 13 June 1985, *S.D. Hopper* 4396 (PERTH); Sorenson's Nature Reserve, 8.9 km W of Babakin, 32° 07'30"S 117° 55'E, 13 June 1985, *S.D. Hopper* 4402 (PERTH); c. 13 km S along Kalgarin South Rd from Pederah East Rd, 32° 42'S 118° 46'E, 27 Aug. 1986, *S.D. Hopper* 5223 (PERTH); NW of Mt Holland, 33° 12'S 119° 45'E, 2 Sept. 1986, *S.D. Hopper* 5423 (PERTH); NW slopes of County (Quajabin) Peak, 25 km NE of Brookton, 32° 12'S 117° 11'E, 4 July 1988, *S.D. Hopper* 6367 (PERTH); Chiddarcooping Hill Reserve, N of Warralakin, 2 May 1978, *G.J. Keighery* 1634 (PERTH); Bungalbin Hills, NE of Koolyanobbing, 15 May 1978, *G.J. Keighery* 1760 (PERTH); 6 miles N of Merredin on road to Nungarin, 4 June 1955, *A.R. Main* (PERTH); 12 km SW of Callion, c. 104 km NNW of Coolgardie, 22 Aug. 1981, *K. Newbey* 8762 (PERTH); Duri, 15 April 1953, *R.D. Royce* 3999 (PERTH); 32 m S Karalee, 26 Mar. 1969, *R.D. Royce* 8575 (CANB, PERTH); Westonia, 27 July 1917, *F.M.C. Schock* (PERTH); 40 km W of Southern Cross, 12 April 1966, *P.G. Wilson* 4114, 4115 & *S.G.M. Carr* (PERTH).

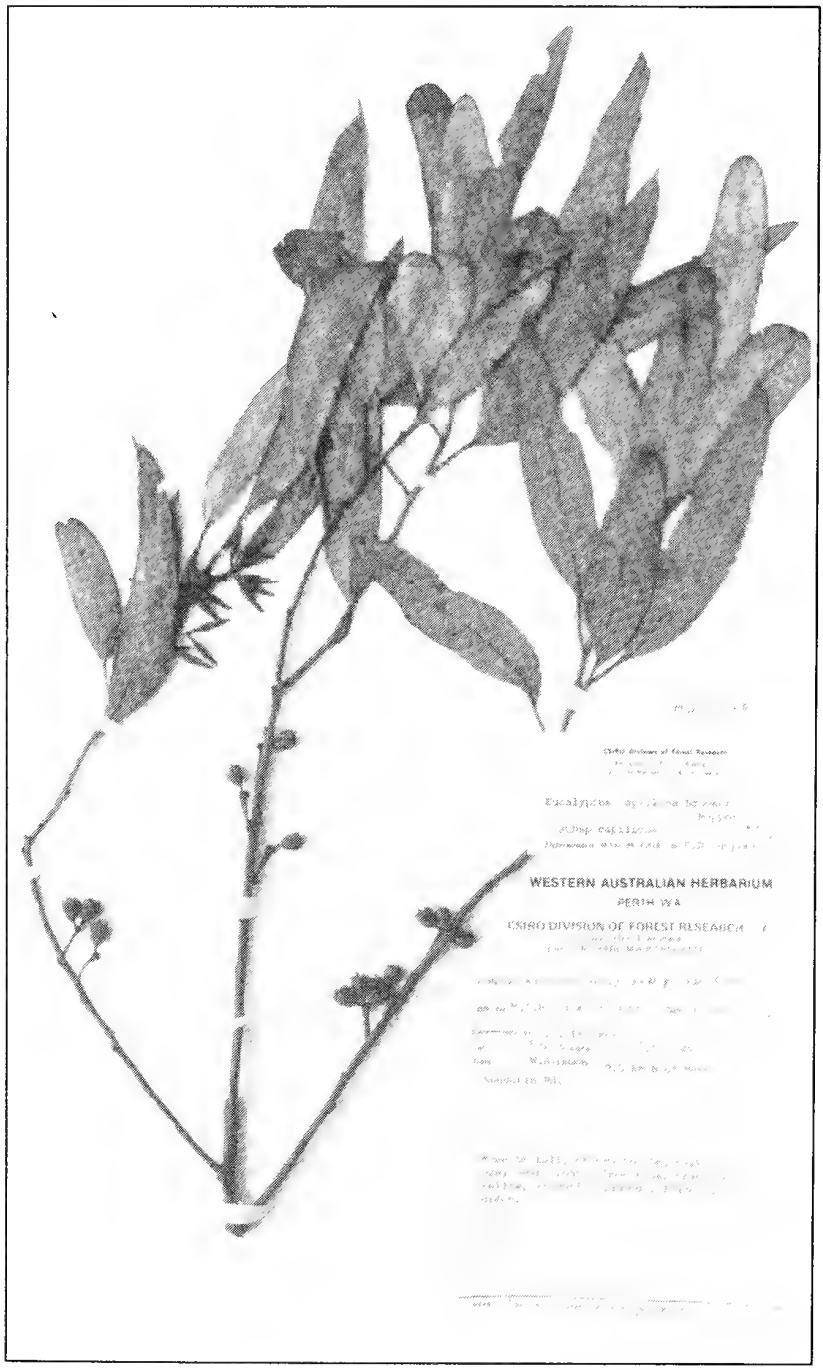

Figure 17. Holotype of *E. capillosa* Brooker & Hopper subsp. *capillosa*.

Distribution and habitat. Central and eastern wheatbelt mainly east of a line between Pithara, Kellerberrin and Corrigin (Figure 16). There is a westerly outlier at County Peak, 25 km NE of Brookton, where the subspecies grows on the summit and breakaway, while *E. wandoo* occurs below on the surrounding slopes. *E. capillosa* subsp. *capillosa* forms open forests on heavy soils. Notably in the eastern part of its range between Southern Cross and Coolgardie it occupies elevated sites on decomposing granitic breakaways. The understorey is often very open low heath.

Conservation status. Widespread in disjunct populations, where it is often locally abundant. Well represented on nature reserves.

Flowering period. February - ?

Notes. E. capillosa subsp. *capillosa* is closely related to a mallee form we recognise below as *E. capillosa* subsp. *polyclada*. There is extensive intergradation of the two taxa in a narrow belt where their ranges overlap, especially near Corrigin. However, the two taxa retain their distinct habits over most of their ranges, and prefer somewhat different habitats. Subspecific rank seems appropriate.

2b. ***Eucalyptus capillosa*** Brooker & Hopper subsp. ***polyclada*** Brooker & Hopper, subsp. nov. (Figures 16, 18)

A subspecie typica habitu fruticoso ("mallee"), et occupanti clivos glareosos arenaceos vallium vadosarum differt.

Typus: 4.8 km NE of Kulin on Kondinin Road, 32° 38'S 118° 12'E, Western Australia, 14 Sept. 1988, *M.I.H. Brooker* 10075 (holo: PERTH; iso: AD, CANB, MEL, NSW).

Colour illustration. Brooker & Kleinig (1990: 165).

It differs from the typical subspecies by the mallee habit, to 6 m tall, and occupies sandy, gravelly slopes of broad valleys.

Specimens examined. WESTERN AUSTRALIA: 8.5 miles E of Hyden, 14 July 1970, *M.I.H. Brooker* 2662 (CANB, MEL, PERTH); 6 miles NW of Holt Rock towards Hyden, 14 July 1970, *M.I.H. Brooker* 2676 (PERTH); 13.6 km E of Hyden, 12 Aug. 1979, *M.I.H. Brooker* 6323 (CANB); 5.4 km from Hyden track on Sheoak Rock track, 32° 23'S 119° 28'E, 9 Aug. 1984, *M.I.H. Brooker* 8626 (CANB, MEL, NSW, PERTH); 1 km S of Pithara, 30° 25'S 116° 40'E, 3 Nov. 1985, *M.I.H. Brooker* 9056 (CANB, MEL, NSW, PERTH); NNE of Kondinin, 32° 27'S 117° 20'E, 8 Dec. 1985, *M.I.H. Brooker* 9132 (CANB, MEL, NSW, PERTH); 31 km W of Wyalkatchem, 31° 12'S 117° 05'E, 26 Jan. 1986, *M.I.H. Brooker* 9163 (CANB, MEL, NSW, PERTH); c. 0.5 km S of Pithara, 13 March 1986, *M.I.H. Brooker* 9212 (CANB, PERTH, NSW, MEL); Dragon Rock Reserve, between rock and Pingaring - Holt Rock road, 32° 47'S 119° 04'E, 21 Oct. 1986, *M.I.H. Brooker* 9481 (AD, CANB, PERTH, NSW, MEL); 0.5 km E of Roseborough Road, E of Harrismith, 19 May 1987, *M.I.H. Brooker* 9653 (CANB, MEL, NSW, PERTH); 6 km SW of The Humps, 32° 21'30"S 118° 55'E, 14 June 1985, *S.D. Hopper* 4412 (PERTH); 0.3 km N of Scrivener Rocks, 32° 19'30"S 118° 49'E, 14 June 1985, *S.D. Hopper* 4413 (PERTH); 8 km SW of Scrivener Rocks, 32° 22'S 118° 45'E, 14 June 1985,

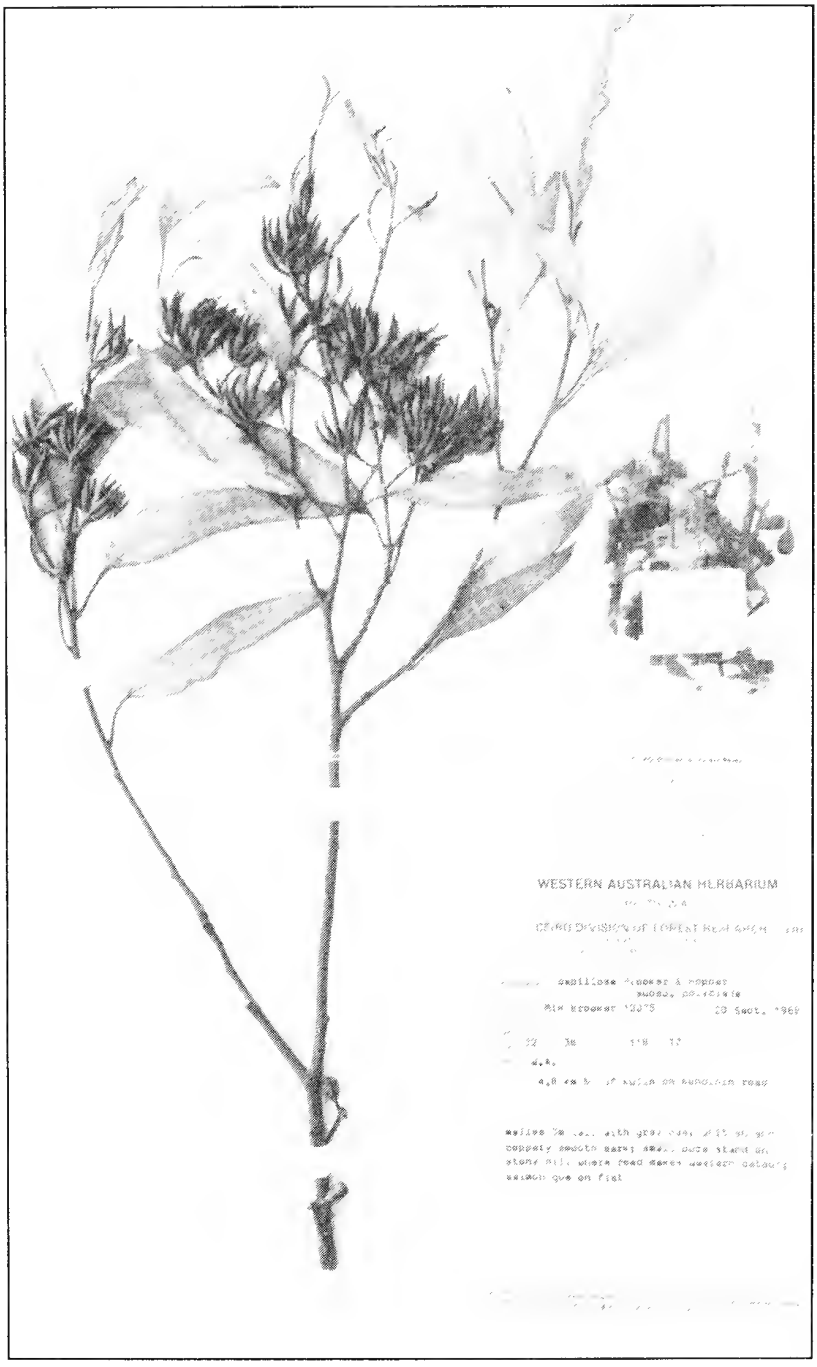

Figure 18. Holotype of *E. capillosa* Brooker & Hopper subsp. *polyclada* Brooker & Hopper.

S.D. Hopper 4416 (PERTH); 26 km ENE of Bendering, 32° 21'30"S 118° 34'30"E, 14 June 1985, *S.D. Hopper* 4419 (PERTH); Nature Reserve, 7 km ENE of Bendering, 32° 22'S 118° 12'E, 14 June 1985, *S.D. Hopper* 4422 (PERTH); 13 km SE of Corrigin on road to Kondinin, 32° 25'30"S 117° 57'30"E, 14 June 1985, *S.D. Hopper* 4424 (PERTH); 8.5 km SSW of Cadoux, 2.9 km N along Hale Road from junction with Manmanning Road, 30° 50'S 117° 05'E, 13 June 1988, *A. Napier & A. Kelly* 247 (PERTH); 10 miles S of Cheritan's Find, Marvel Loch, 24 March 1969 *R.D. Royce* 8551 (CANB, PERTH).

Distribution and habitat. Central wheatbelt, from Pithara in the north-west to east of Hyden and Lake King (Figure 16). The subspecies occurs in tall mallee, favouring gravelly sands on slopes in undulating terrain.

Conservation status. Occurs in disjunct populations, in which it is often locally abundant. Represented in nature reserves.

Flowering period. Unknown.

Etymology. The subspecific epithet refers to the mallee habit (Greek *poly* , many and *clada*, stems).

Notes. E. capillosa subsp. *polyclada* is the common "mallee wandoo" of the lower northern and central eastern wheatbelt. East of Hyden in areas such as the Ironcaps it is replaced by the related *E. livida*, which is distinguished by the nonglaucous branchlets, grey leaves and allantoid buds. *E. capillosa* subsp. *polyclada* intergrades with and in places co-occurs with the wheatbelt wandoo, *E. capillosa* subsp. *capillosa* (e.g. N and NE of Corrigin).

3. ***Eucalyptus livida*** Brooker and Hopper, sp. nov. (Figures 19, 20, 21)

Eucalypto capillosae Brooker & Hopper affinis a qua glaucedinem deficienti, foliis adultis distincte cinereis, pedunculis latioribus, alabastris fructibusque robustioribus differt.

Typus: 17 km from highway towards Peak Charles, Western Australia, 3 April 1988, *M.I.H. Brooker* 9929 (holo: PERTH; iso: AD, CANB, MEL, NSW).

Colour illustration. Brooker & Kleinig (1990: 166).

Mallee or small tree with smooth stems. Pith of branchlets glandular. Branchlets not glaucous. Bark grey over bright orange. Leaves of the seedling remaining opposite for 4-6 pairs, then alternating, ovate, to 7 x 4.5 cm, green, hairy. Adult leaves petiolate, alternating, lanceolate, to 10 x 1.5 cm, dull, conspicuously grey or rarely grey-green. Inflorescences to 11-flowered. Peduncles to 0.5 cm wide. Buds allantoid or fusiform, to 1.9 x 0.4 cm. Some outer stamens erect, inner ones partly or completely inflexed, all fertile. Flowers not seen. Fruit cupular, to 0.7 x 0.5 cm, valves not exserted. Seed light brown, subspherical to rarely cuboid.

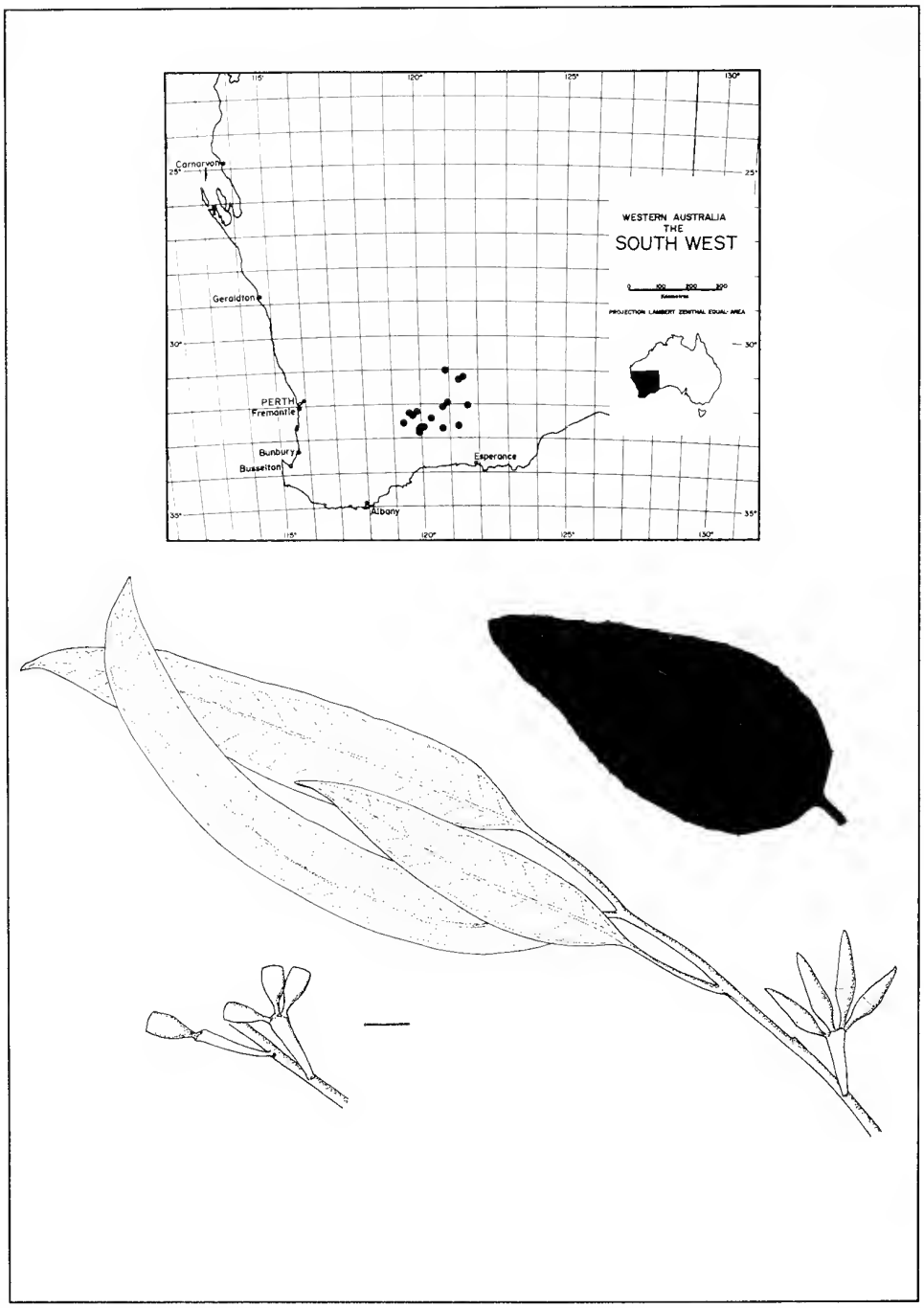

Figure 19. *Eucalyptus livida* distribution, buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

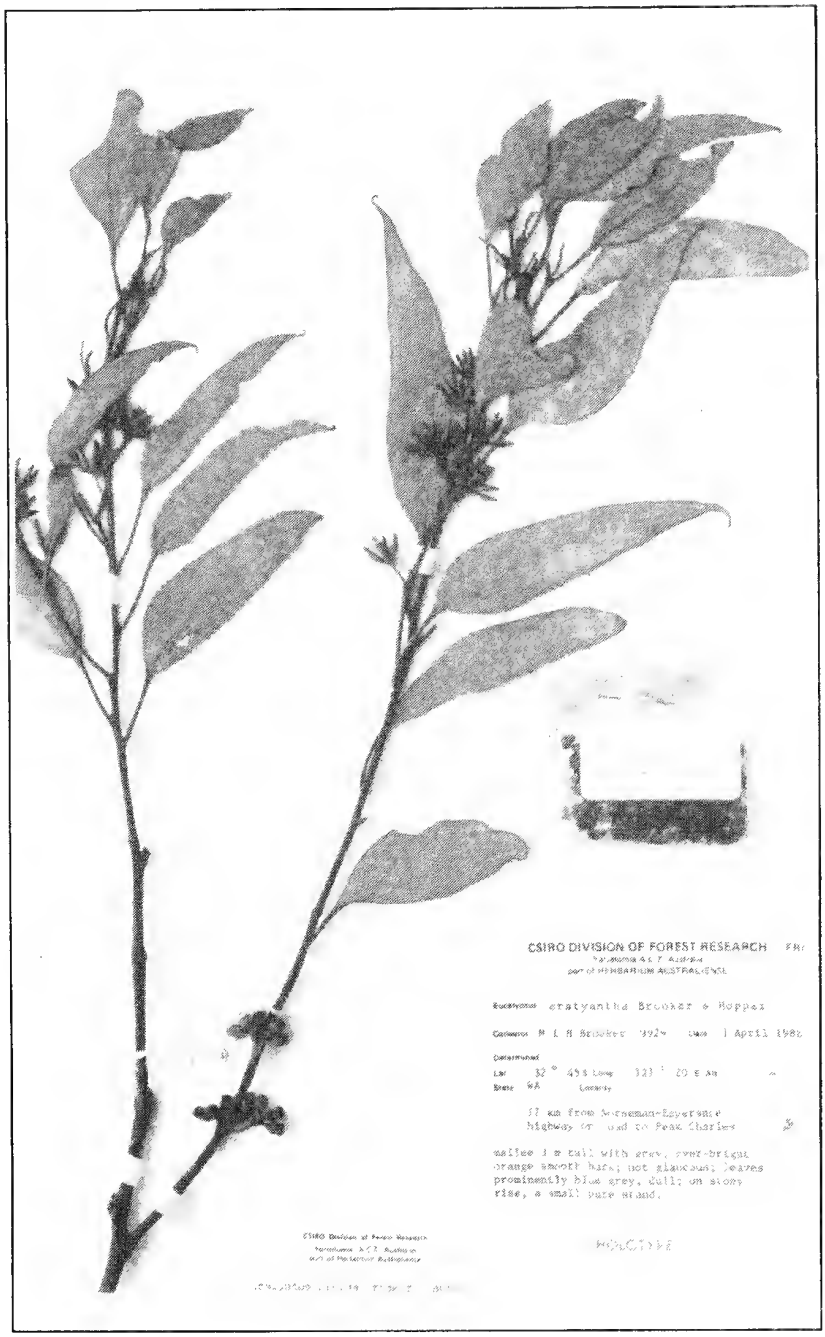

Figure 20. Holotype of *E. livida* Brooker & Hopper.

Specimens examined. WESTERN AUSTRALIA: N of Bullabulling, 25 May 1964, *J.S. Beard* 3336 (PERTH); 44 km SE of Coolgardie, 31° 15' S 121° 28' E, 9 Nov. 1981, *M.I.H. Brooker* 7055 (CANB, NSW, PERTH); 8.9 km W of Coolgardie Norseman road on Hyden track, 32° 01'S 121° 35'E, 7 Nov. 1983, *M.I.H. Brooker* 8351 (CANB, NSW, PERTH); 74 km W of highway on Lake King Road, 32° 42'S 120° 48'E, 12 Feb 1985, *M.I.H. Brooker* 8845 (CANB, MEL, NSW, PERTH); NW of North Ironcap, E of Hyden, 32° 20'S 119° 37'E, 24 Aug. 1988, *M.I.H. Brooker* 10054 (AD, CANB, MEL, NSW, PERTH); North Ironcap summit, 32° 21'S 119° 40'E, *M.I.H. Brooker* 10060 (AD, CANB, MEL, NSW, PERTH); on Hyden track between cross roads and Marvel Loch, 8 Dec. 1966, *S. Chambers* 184 (PERTH); 46 km from Coolgardie along Eyre Highway towards Norseman, 31° 15'S, 121° 29'E, 1 Feb. 1979, *M.D. Crisp* 5624 (CBG, NSW, PERTH); Hyden-Norseman Road, ± 35 miles W of Eyre Highway, 6 Feb, 1963, *A.S. George* 4334 (PERTH); 21 km NW of Holt Rock P.O. on track to Hyden, 32° 32'S 119° 16'E, 5 Oct, 1976, *L. Haegi* 120g (AD, PERTH); 96.6 km W of Norseman-Coolgardie Road on track to Hyden, 3 km W of McDermid Rock, 32° 01'S 120° 46'E, 7 Nov. 1983, *K. Hill* 615 and *L. Johnson, D. Blaxell, I. Brooker* and *S. Hopper* (CANB, NSW, PERTH); 115.7 km E of Lake King, 32° 41'S 120° 42'E, 17 Sept. 1976, *R. Hnatiuk* 760778 (PERTH);, Kumarl Road, 16 km WNW of Kumarl siding, 24.5 km NE of Peak Charles, 32° 44'S 121° 20'E, 6 Sept. 1982, *S.D. Hopper* 2501 (PERTH); 9.6 km SE along main road from Diggers Rock to Hatters Hill, 32° 45'S 119° 36'E, 30 Aug. 1986, *S.D. Hopper* 5305 (PERTH); Hatters Hill, 32° 51'S 119° 59'E, 30 Aug. 1986, *S.D. Hopper* 5308 (PERTH); 15.9 km S of Mt Holland on Lake Cronin-Southern Cross road, 32° 18'S 119° 45'E, 2 Sept. 1986, *S.D. Hopper* 5402 (PERTH); Top slopes of North Ironcap, 33° 22'S 119° 40'E, 3 Sept. 1986, *S.D. Hopper* 5430 (PERTH); 13.5 km NE of Hatters Hill on Lake Hope track, 32° 44'00"S 120° 04'00"E, 28 Sept. 1988, *S.D. Hopper* 6868 (PERTH); 5.6 km NE of Hatters Hill on Lake Hope track, 32° 47'30"S 120° 01'00"E, 28 Sept. 1988, *S.D. Hopper* 6871 (PERTH); Hatters Hill, 3 Sept. 1970, *K.R. Newbey* s.n. (PERTH); North Ironcap, 7 July 1979, *K. Newbey* 5213 (PERTH); 29 km SW of McDermid Rock, 114 km W of Norseman, 15 July 1979, *K. Newbey* 5304 (CANB, PERTH); 0.3 km SE of Hatters Hill, 40 km NE of Lake King, 8 Aug 1979, *K. Newbey* 5449 (PERTH); 3 km NW of Lake Cronin, c. 83 km E of Hyden, 17 July 1981, *K. Newbey* 8305 (PERTH); Gibraltar, c. 24 km W of Coolgardie, 11 April 1966, *P.G. Wilson* 4102 and *S.G.M. Carr* (PERTH); near Gibraltar, c. 22 km WSW of Coolgardie, 25 Aug. 1968, *P.G. Wilson* 782 (PERTH).

Distribution and habitat. Central and southern goldfields, particularly from Coolgardie to Norseman, and south to the Kumarl - Peak Charles area and west to the North Ironcap - Hatters Hill area (Figure 19). *E. livida* grows in a pure tall mallee formation, usually confined to small elevated breakaways of decomposing granite or rarely banded ironstone. Detailed ecological notes on associates and habitats of *E. livida* are given in Newbey and Hnatiuk (1988: 24, 27, 99, 111), where the species is referred to as *E.* aff. *wandoo* or *E.* aff. *redunca.*

Conservation status. Locally abundant but in widely disjunct populations on vacant Crown land. Poorly represented on nature reserves.

Flowering period. Unknown.

Etymology. The epithet refers to the canopy colour (Latin *lividus*, blue or leaden colour).

Notes. E. livida, which may be a tree or mallee, is the eastern and south-eastern representative of

E. superspecies "*wandoo*". It differs from *E. capillosa* in the non-glaucous branchlets, strikingly grey leaves and more robust peduncles, buds and fruit. The seedlings are hairy.

E. livida is a conspicuous dominant usually emergent above other vegetation (Figure 21). It has horticultural potential in dry country particularly on elevated stony ground.

4. ***Eucalyptus nigrifunda*** Brooker & Hopper, sp. nov. (Figures 22, 23)

Ab *Eucalypto wandoo* Blakely cortice non-decorticato nigro basi, plantulis pubeseentibus et foliis adultis, alabastris fructibusque parvioribus differt.

Typus: Boll Point (28° 50'S 123° 30'E) WSW of Mt Carlon, Western Australia, 14 May 1984, *M.I.H. Brooker* 8587 & *S.D. Hopper* (holo: PERTH; iso: AD, CANB, MEL, NSW).

Colour illustration. Brooker & Kleinig (1990: 167).

Differs from *E. wandoo* Blakely by the basal, rough, black bark, the pubescent seedlings and the smaller adult leaves (to 11 x 1.5 cm), buds (to 1 x 0.2 cm) and fruit (to 0.5 x 0.4 cm).

Specimens examined. WESTERN AUSTRALIA: W of Lake Rason, 215 km NW of airstrip, Great Victoria Desert, 14 May 1984, *M.I.H. Brooker* 8584 (CANB, MEL, NSW, PERTH); Laverton in sandy spinifex country S of Lake Rason, c. Nov. 1971, *Richmond* 5 (PERTH).

Distribution and habitat. Known only from the Great Victoria Desert (Figure 22), where it forms a low woodland confined to breakaways of decomposing granite and adjacent slopes and plains.

Conservation status. Possibly rare, but in need of further survey. Known from few disjunct populations on vacant Crown land. Not recorded on a nature reserve.

Flowering period. Unknown.

Etymology. The specific epithet refers to the dark butt (Latin *nigri*, black and *fundus*, bottom).

Notes. *E. nigrifunda* is a recently discovered desert wandoo. It is a tree usually with dark basal rough bark and with smaller leaves, buds and fruit than *E. wandoo* and *E. capillosa*. The branchlets are glaucous and the seedlings hairy. The typical form comes from the Great Victoria Desert. Populations to the west (e.g. in the Lake Barlee area and west of Menzies, *C.A. Gardner* 19032 (PERTH)) lack the black butt and may be intergrades between *E. capillosa* and *E. nigrifunda*.

5. ***Eucalyptus hebetifolia*** Brooker & Hopper, sp. nov. (Figures 24, 25, 26)

Frutex "mallee" ad 5 m altus, cortice inferiore aspro laxo, griseo super flavido. Plantae glabrae. Folia adulta lanceolata, pallido-viridia, hebeta. Opercula hypanthio angustiora. Semina subsphaerica vel cuboidea.

Figure 21. *E. livida* showing mallee habit (NE of North Ironcap).

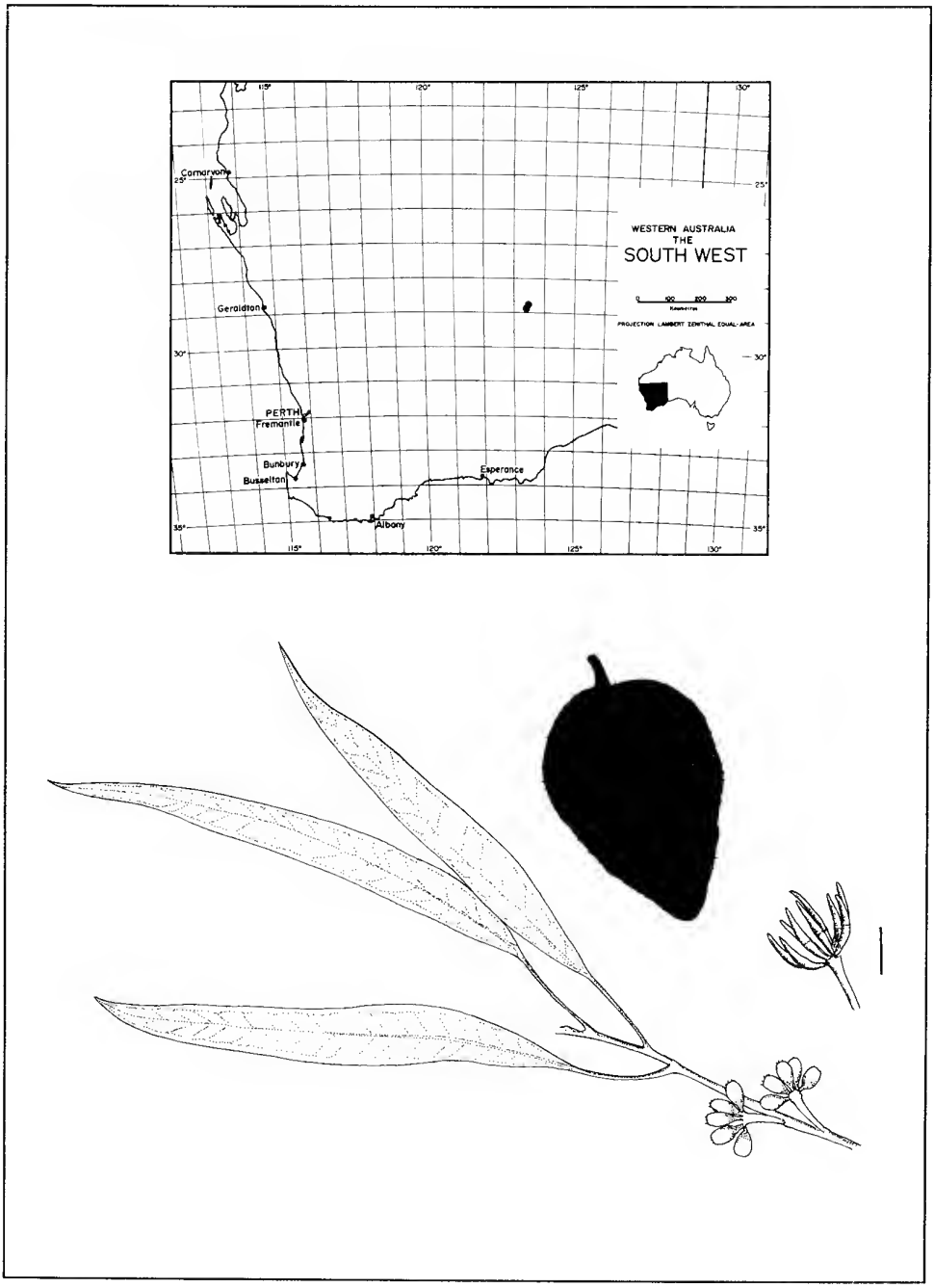

Figure 22. *Eucalyptus nigrifunda* distribution, buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

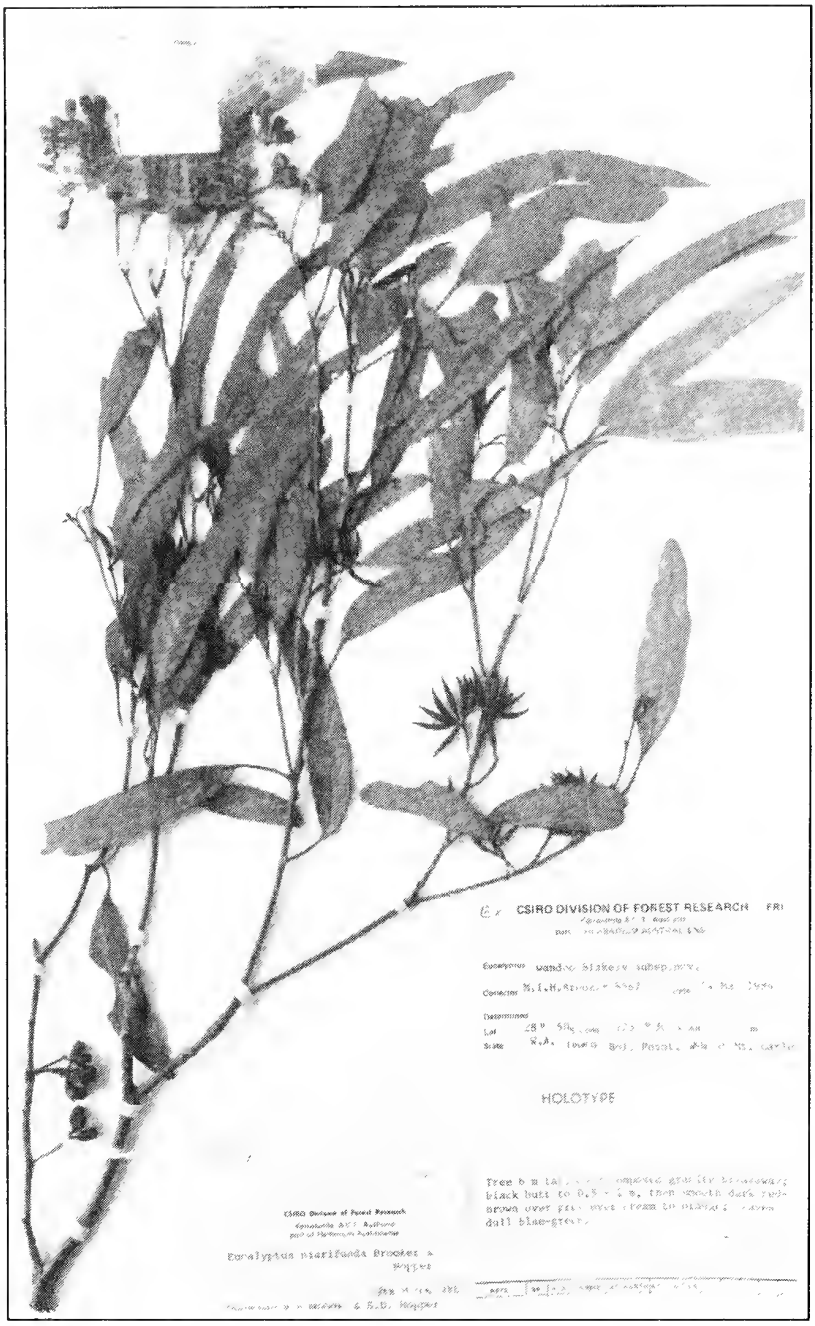

Figure 23. Holotype of *E. nigrifunda* Brooker & Hopper.

Typus: 0.4 km N of Tincurrin on Tincurrin North Road, Western Australia, 3 May 1988, *M.I.H. Brooker* 9941 & *C.J. Ranford* (holo: PERTH; iso: AD, CANB, MEL, NSW).

Mallee to 5 m tall with loose grey over yellow rough bark to 1 m, smooth above. Pith of branchlets glandular. Leaves of the seedling remaining opposite for 2 or 3 pairs, then alternating, broadly lanceolate, to 10 x 4 cm, bluish green, glabrous. Adult leaves lanceolate, to 12 x 1.8 cm, dull, light green. Inflorescences to 13-flowered. Peduncles to 1.8 cm long. Buds to 1.7 x 0.3 cm, with operculum narrower than hypanthium. Flowers very pale yellow to creamy white. Fruit pedicellate, cupular, to 0.7 x 0.6 cm. Seed light grey-brown, subspherical to cuboid.

Specimens examined. WESTERN AUSTRALIA: 6.1 km E of Jitarning rail crossing towards Wickepin, 32° 46'S 117° 57'E, 5 May 1983, *M.I.H. Brooker* 8108 (CANB, NSW, PERTH); Dryandra Block, Dryandra Rd, 32° 48'S 116° 58'E, 27 June 1986, 1983, *M.I.H. Brooker* 9366 (AD, CANB, NSW, PERTH); 2 km S of Wickepin - Harrismith Road on Tincurrin North Road, 3 May 1988, *M.I.H. Brooker* 9940 & *C.J. Ranford* (AD, CANB, MEL, NSW, PERTH); 10.3 km from Dudinin towards Jitarning, 32° 52'S 117° 57'E, 19 July 1988, *M.I.H. Brooker* 9986 (AD, CANB, MEL, NSW, PERTH); Harrismith, 5 March 1924, *C.A. Gardner* 2105 (PERTH); 6.5 km W of Kukerin, 29 Oct. 1975, *J.W. Green* 4547 (PERTH); Reserve, 16.1 km SSE of Tincurrin siding by road, 12 km SSE by air, 33° 05'S 117° 50'E, 11 Sept. 1982, *S.D. Hopper* 2570 (PERTH); Harrismith South Road, 1.5 km N of Grays Road, SSW of Harrismith, 33° 02'S 117° 33'E, 11 March 1988, *S.D. Hopper* 6345 (CANB, PERTH); 700 m NW of Tincurrin siding, 32° 58'S 117° 47'E, 11 March 1988, *S.D. Hopper* 6347 (CANB, PERTH); Tincurrin rd, 1.2 km N of Tincurrin siding, 32° 58'S 117° 47'E, 11 March 1988, *S.D. Hopper* 6348 (CANB, PERTH).

Distribution and habitat. Central wheatbelt, mainly between Jitarning, Tincurrin and Dryandra (Figure 24). Grows on high ground in undulating terrain. Soils are sandy gravels. Associated eucalypts include *E. wandoo* subsp. *wandoo*, *E. incrassata*, *E. phaenophylla* subsp. *phaenophylla* and *E.* aff. *leptophylla*.

Conservation status. Geographically restricted and known mainly from small disjunct populations on roadsides. Recorded from only one nature reserve. Requires further survey.

Flowering period. December-January.

Etymology. The epithet refers to the dull leaves which contrast with the glossy leaves of *E. phaenophylla* (Latin *hebes*, dull and *folium*, leaf).

Notes. E. hebetifolia is a robust dull-leaved mallee occurring west of the distribution of *E. capillosa* subsp. *polyclada*, from which it differs in its glabrous seedlings, non-glaucous branchlets and rough basal bark. It is easily distinguished from *E.* superspecies *"phaenophylla"* by its dull leaves, but *E . hebetifolia* has in common with that superspecies the operculum narrower than the hypanthium at the join, apart from *E. phaenophylla* subsp. *interjacens*, in which the character is somewhat variable.

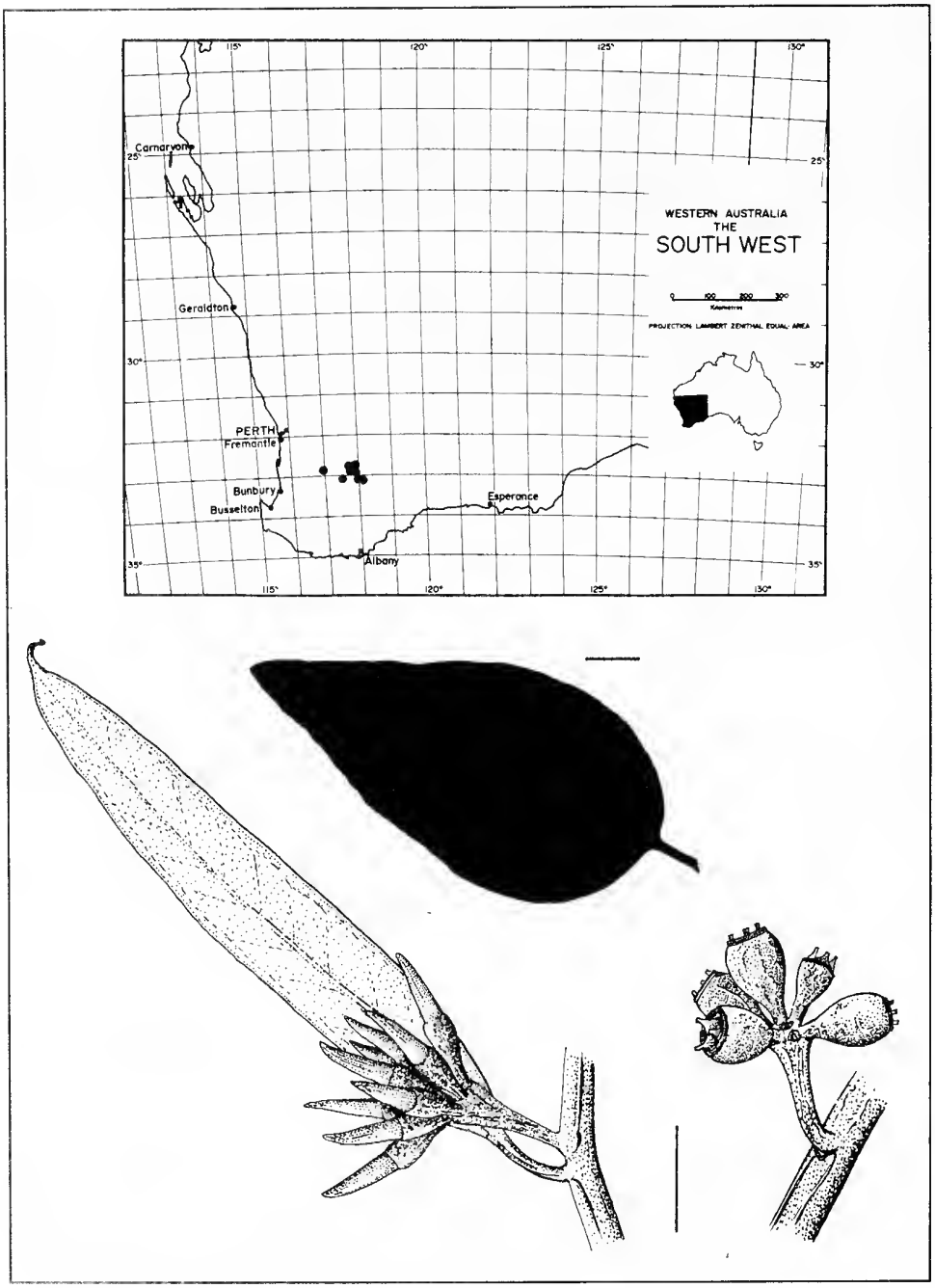

Figure 24. *Eucalyptus hebetifolia* distribution, buds, fruits, adult leaf and silhouette of a fifth node seedling leaf (scale bars = 1 cm).

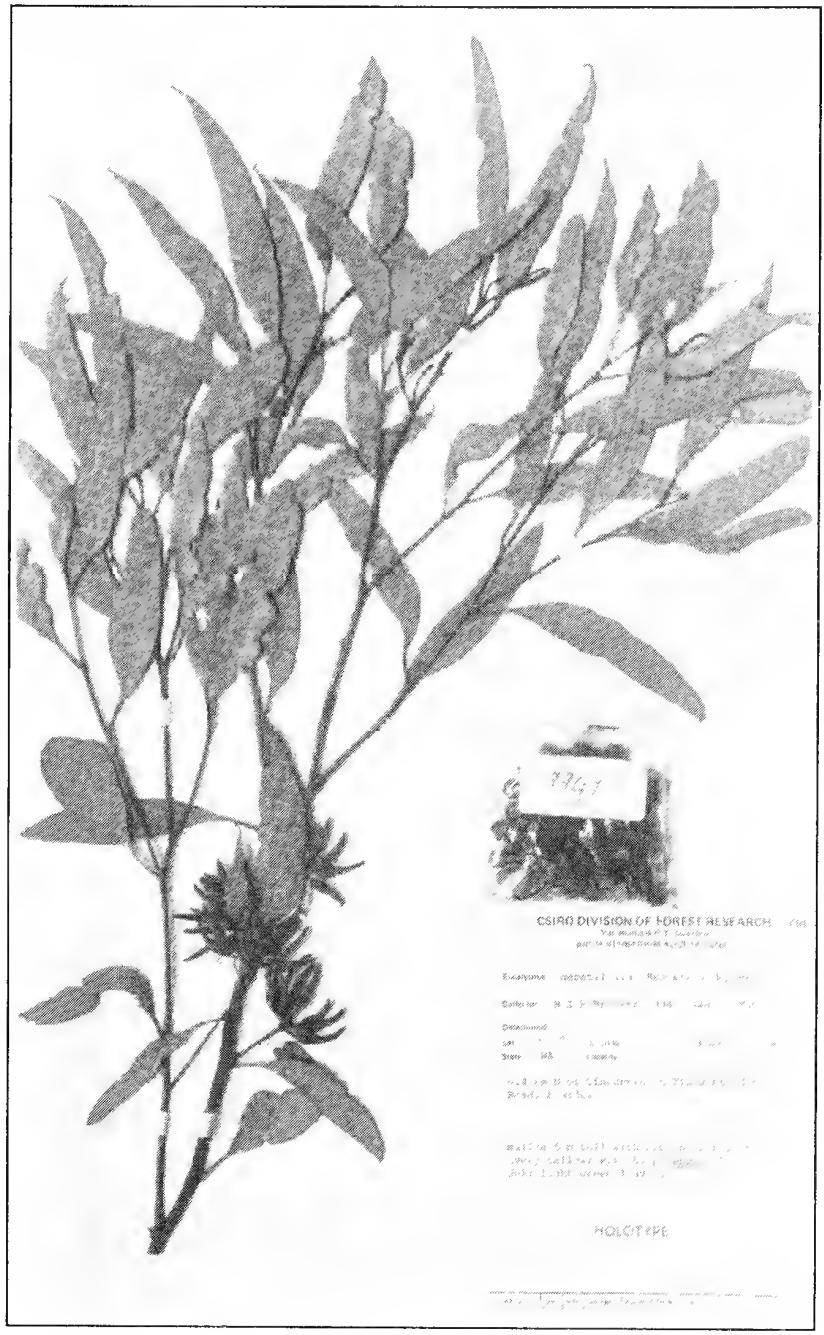

Figure 25. Holotype of *E. hebetifolia* Brooker & Hopper.

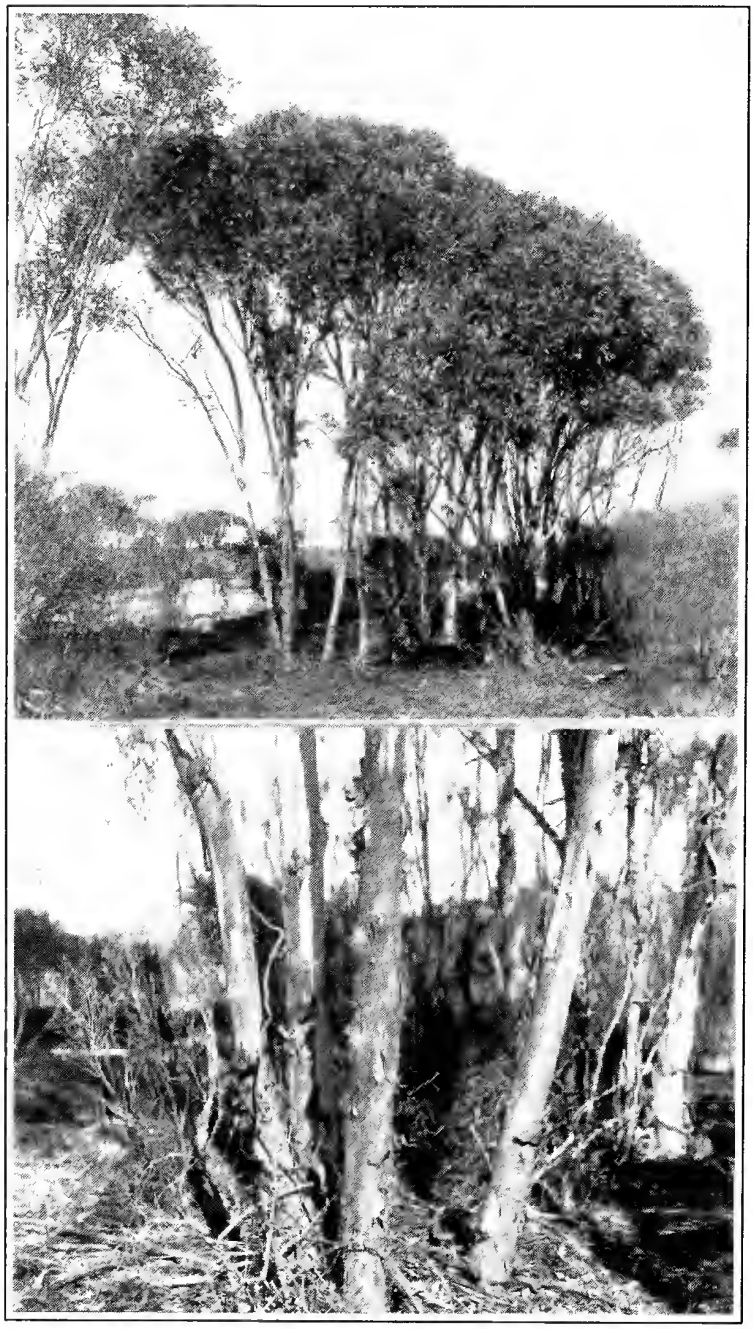

Figure 26. *E. hebetifolia* mallee habit (N of Tincurrin), and trunks.

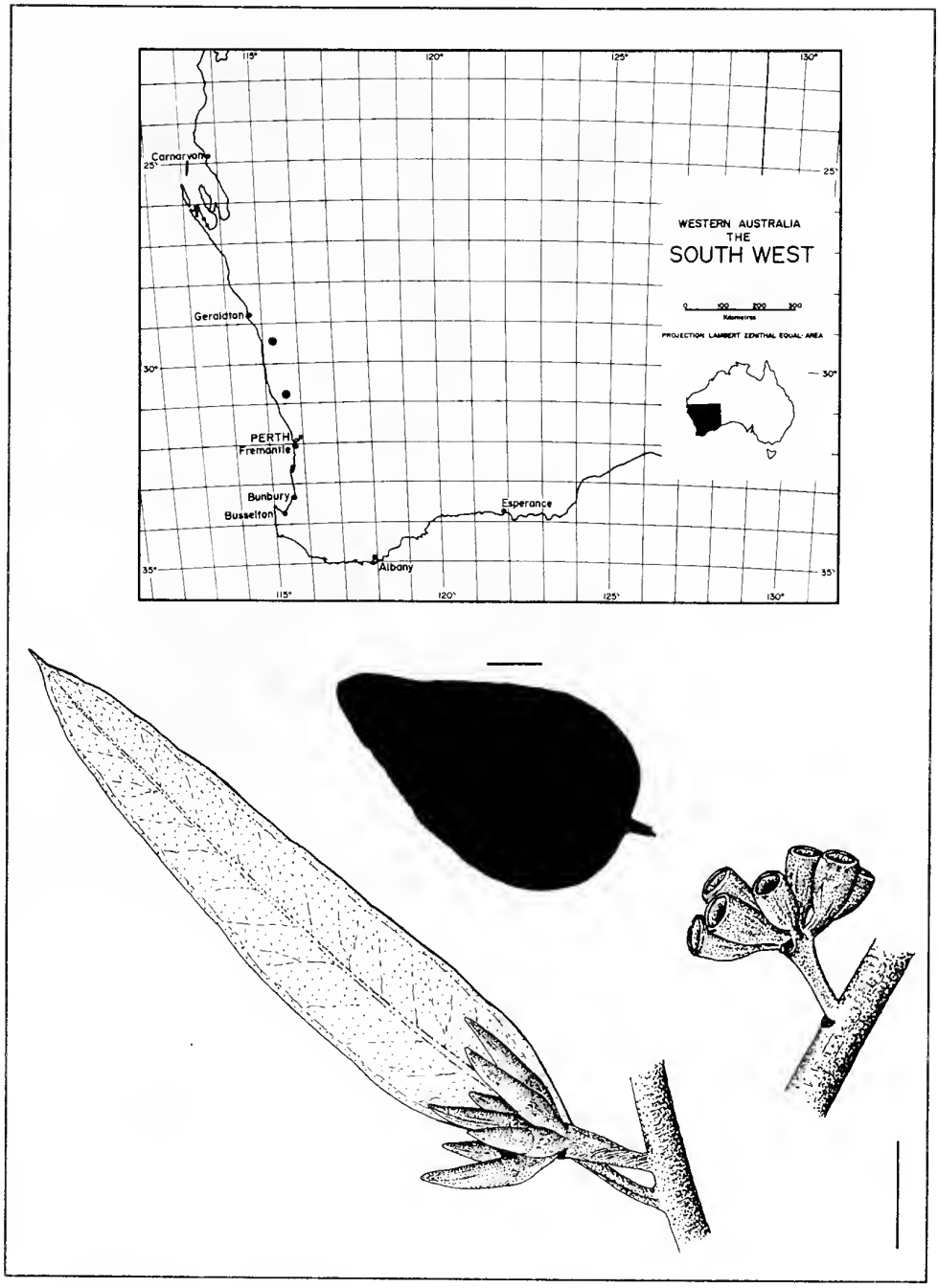

Figure 27. *Eucalyptus abdita* distribution, buds, fruits, adult leaf and silhouette of a fifth node seedling leaf (scale bars = 1 cm).

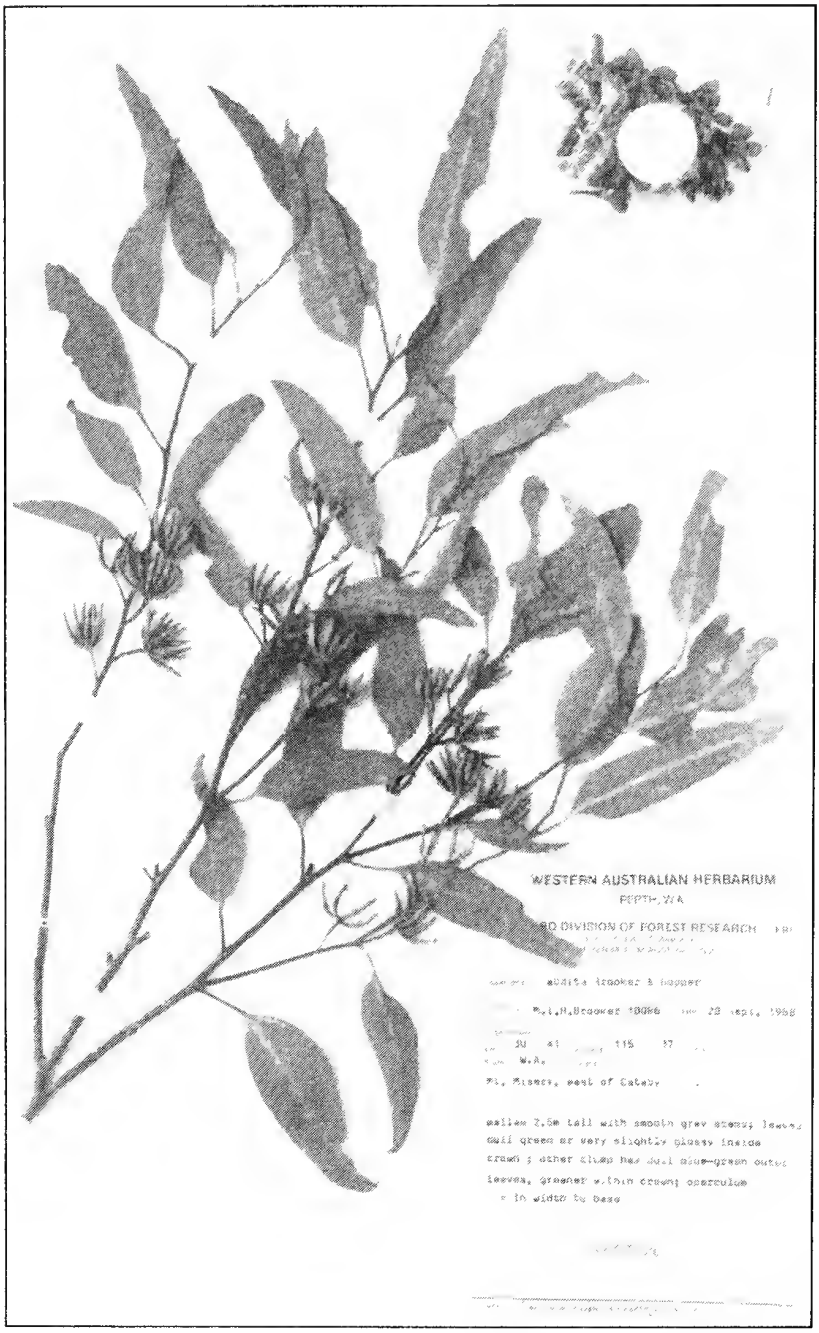

Figure 28. Holotype of *E. abdita* Brooker & Hopper.

6. ***Eucalyptus abdita*** Brooker & Hopper, sp. nov. (Figures 27, 28)

Frutex "mallee" ad 3 m altus cortice laevi. Medulla ramulorum glandulifera. Folia plantularum late ovata, thalassiea, ad 8.5 x 5 cm, glabra. Folia adulta primo leviter thalassica, postremo viridia, leviter nitentia, ad 9 x 2 em. Inflorescentiae ad 11-florae, alabastris fusiformibus et opereulo aequanti hypanthium diametro, ad 1.4 x 0.3 cm, apice acuto et aliquot leviter redunco. Fructus pedicellati, obeoniei vel leviter doliiformes, ad 0.6 x 0.4 em. Semina subsphaerica vel cuboidea.

Typus: Mt Misery, 30° 41'S 115° 37'E, Western Australia, 20 Sept. 1988, *M.I.H. Brooker* 10086 & *S.D. Hopper* (holo: PERTH; iso: AD, CANB, MEL, NSW).

A mallee to 3 m tall with smooth grey stems. Pith of branehlets glandular. Leaves of the seedling remaining opposite for 4 or 5 pairs, then alternating, broadly ovate, to 8.5 x 5 cm, bluish green, glabrous. Adult leaves lanceolate, to 9 x 2 cm, at first blue-green and dull, finally green and slightly glossy. Infloreseenees to 13-flowered. Pcduneles to 1 em long. Buds pedieellate, fusiform, to 1.4 x 0.3 cm; operculum equal in diameter to hypanthium, with a sharply acute apex sometimes slightly reeurved. Fruit pedieellate, obconieal to slightly barrel-shaped, to 0.6 x 0.4 cm. Seed light grey-brown, subspherical to cuboid.

Specimens examined. WESTERN AUSTRALIA: 10.3 miles south-west of Three Springs towards Eneabba, 7 January 1970, *M.I.H. Brooker* 2355 (CANB, PERTH); 30 km east of Eneabba towards Carnamah, 20 August 1982, *M.I.H. Brooker* 7577 (CANB); below southern searp of Mt Peron, 2 March 1983, *M.I.H. Brooker* 7991 (CANB); type loeality, 18 August 1988, *M.I.H. Brooker* 10032 (CANB); E boundary of proposed Mt Adams Nature Reserve, 4.1 km N of Tomkins Rd on Burges Rd, 29° 26'S 115° 20'E, 23 July 1986, *M.I.H. Brooker* 9407 & *S.D. Hopper* (AD, CANB, MEL, NSW, PERTH).

Distribution and habitat. Of disjunct distribution, known from Mt Misery near Dandaragan, north west to Mt Peron and north to Three Springs (Figure 27). It grows on lateritic soils sometimes near breakaways. Associated eucalypts are *E. arachnaea* subsp. *arachnaea,* and *E. gittinsii* Brooker & Blaxell.

Conservation status. Requires further survey. Apparently rare and vulnerable.

Flowering period. Unknown.

Etymology. The epithet refers to our overlooking *E. abdita* at the type locality because of a mistaken first impression that the species was *E. pluricaulis*. Most plants in the type population had dull blue-green immature leaves in the canopy in March 1988 when we first saw *E. abdita*. It was only on close inspection in September 1988 that we reeognised the species as a distinct new taxon with slightly glossy adult leaves, and therefore unrelated to *E. pluricaulis* (Latin *abditus*, hidden, concealed).

Notes. E. abdita differs from *E. pluricaulis* in its green slightly glossy mature leaves contrasting with the dull blue-green new growth, and in its shorter less attenuate buds. The latter resemble more those of *E. hebetifolia* and *E.* superspecies "*wandoo*" than those of *E. pluricaulis*. Because the operculum

equals the hypanthium at the join, *E. abdita* appears not to be closely related to *E. phaenophylla* or *E. arachnaea*. Its relationships require further investigation.

7. ***Eucalyptus sparsicoma*** Brooker & Hopper, sp. nov. (Figures 29, 30, 31)

Frutex ("mallee") ad 5 m altus caulibus exilibus et canopiis parvis terminalibus. Cortex peculiaris, super latera occidentale in taeniis non decorticantibus tenentibus, orientale laevis vel omnino corticae aspero. Medulla ramulorum glandulifera. Folia adulta anguste lanceolata, ad 7 x 0.9 cm, nitentia, viridia. Inflorescentiae axillares, ad 11-florae; pedunculi complanati. Alabastra pedicellata, ad 1 x 0.3 cm, operculo distincte hypanthio angustiore. Fructus pedicellati, cupulati, ad 0.8 x 0.5 cm. Semina subsphaerica vel cuboidea.

Typus: 0.8 km E of Chinocup road, Western Australia, 11 January 1988, *M.I.H. Brooker* 9850 (holo: PERTH; iso: AD, CANB, MEL, NSW).

A mallee to 5 m tall with slender stems and small terminal crowns of small narrow leaves. Bark sometimes unusual with the western sides of the stems covered with non-decorticated ribbons of rough bark while the eastern sides are smooth pinkish grey and light grey; other mallees with rough bark all round the trunk. Pith of branchlets glandular. Leaves of the seedling remaining opposite for 2 pairs, then alternating, elliptical to ovate, to 7 x 2.5 cm, blue-green. Adult leaves narrowly lanceolate, to 7 x 0.9 cm, concolorous, glossy, green. Inflorescences axillary, unbranched, to 11-flowered. Peduncles flattened, to 1 cm long. Buds pedicellate, fusiform, to 1 x 0.3 cm, with operculum distinctly narrower than hypanthium. Some outer stamens erect, inner ones partly or completely inflexed, all fertile. Flowers not seen. Fruit pedicellate, cupular, to 0.8 x 0.5 cm; valves not exserted. Seed light grey-brown, subspherical to cuboid.

Specimens examined. WESTERN AUSTRALIA: type locality, 11 January 1988, *M.I.H Brooker* 9849 (AD, CANB, MEL, NSW, PERTH); N of Nyabing - Pingrup road on Chinocup road, 8 March 1988, *M.I.H. Brooker* 9902, 9903 & *S.D. Hopper* (AD, CANB, MEL, NSW, PERTH); 0.9 km E of Tincurrin Nth road on Stock Route 3, 32° 56'S 117° 48'E, 12 December 1988, *M.I.H Brooker* 10144 (AD, CANB, MEL, NSW, PERTH); Pingrup, 22 Feb. 1952, *C.A. Gardner* 10322 (PERTH).

Distribution and habitat. Known only from near Tincurrin and the southern side of Lake Chinocup (Figure 29), where it grows in white or pale brown sand or sandy loam on flat to gently sloping terrain. At Lake Chinocup, it forms an emergent shrub mallee formation with *E. scyphocalyx*, *E.* aff. *flocktoniae*, *E.* aff. *occidentalis* and *E. phaenophylla* subsp. *phaenophylla* over heath or low scrub of *Melaleuca uncinata*, sometimes over a *Borya sphaerocephala* R. Br. herbfield.

Conservation status. Requires further survey. Apparently geographically restricted but locally abundant and represented on a nature reserve.

Flowering period. December-March.

Etymology. The specific epithet refers to the characteristic crown (Latin *sparsus*, sparse and *coma*, crown of leaves).

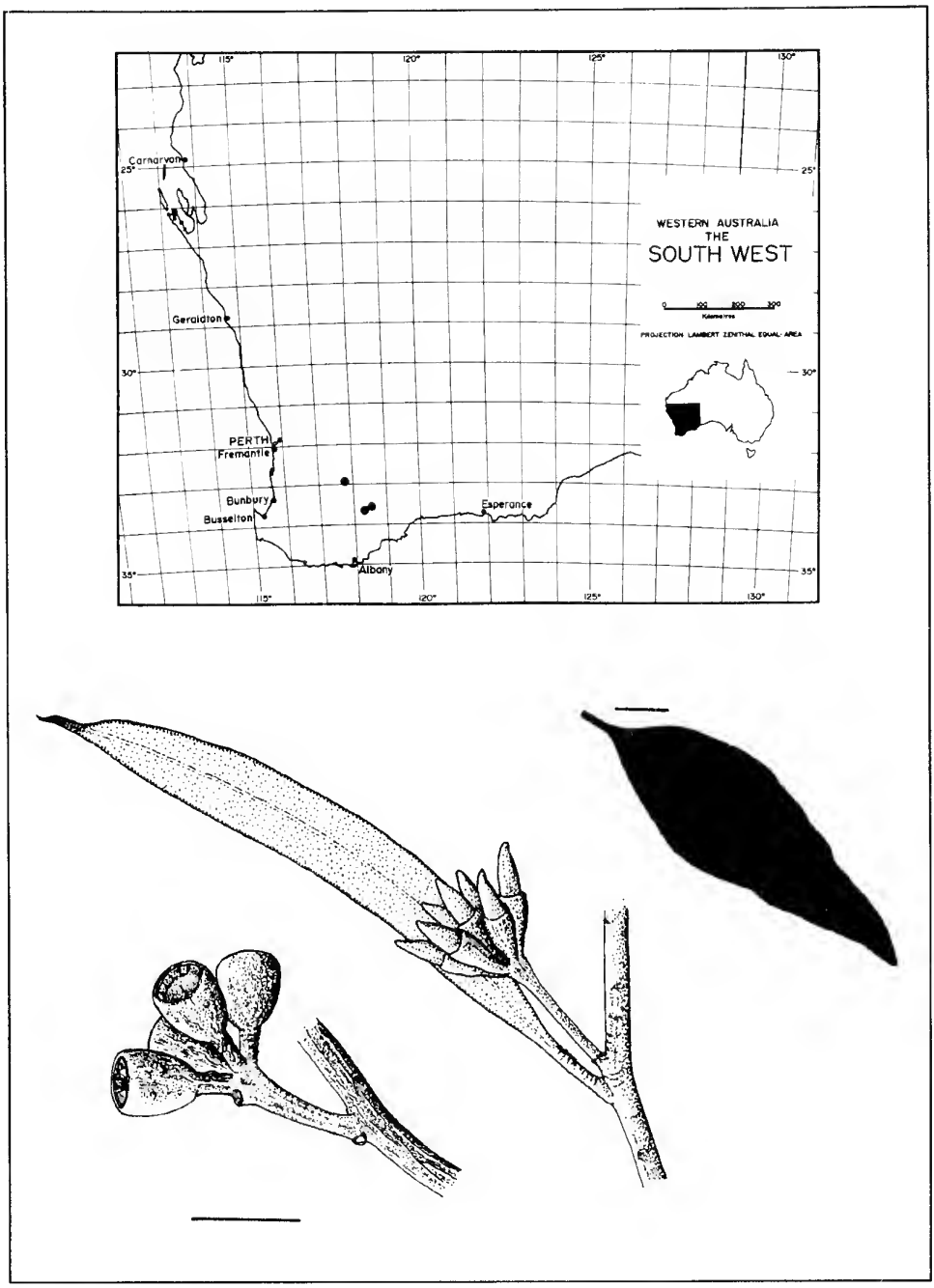

Figure 29. *Eucalyptus sparsicoma* distribution, buds, fruits, adult leaf and silhouette of a fifth node seedling leaf (scale bars = 1 cm).

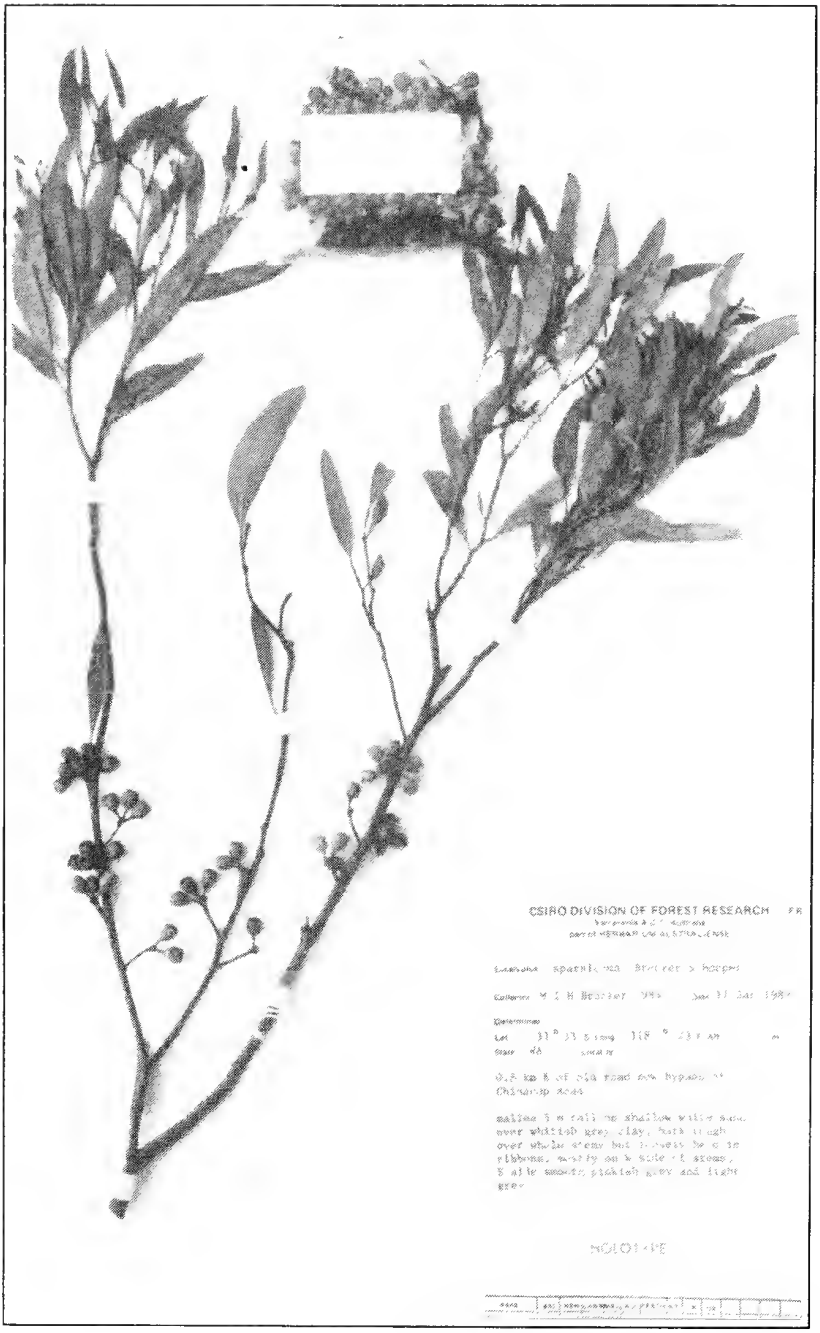

Figure 30. Holotype of *E. sparsicoma* Brooker & Hopper.

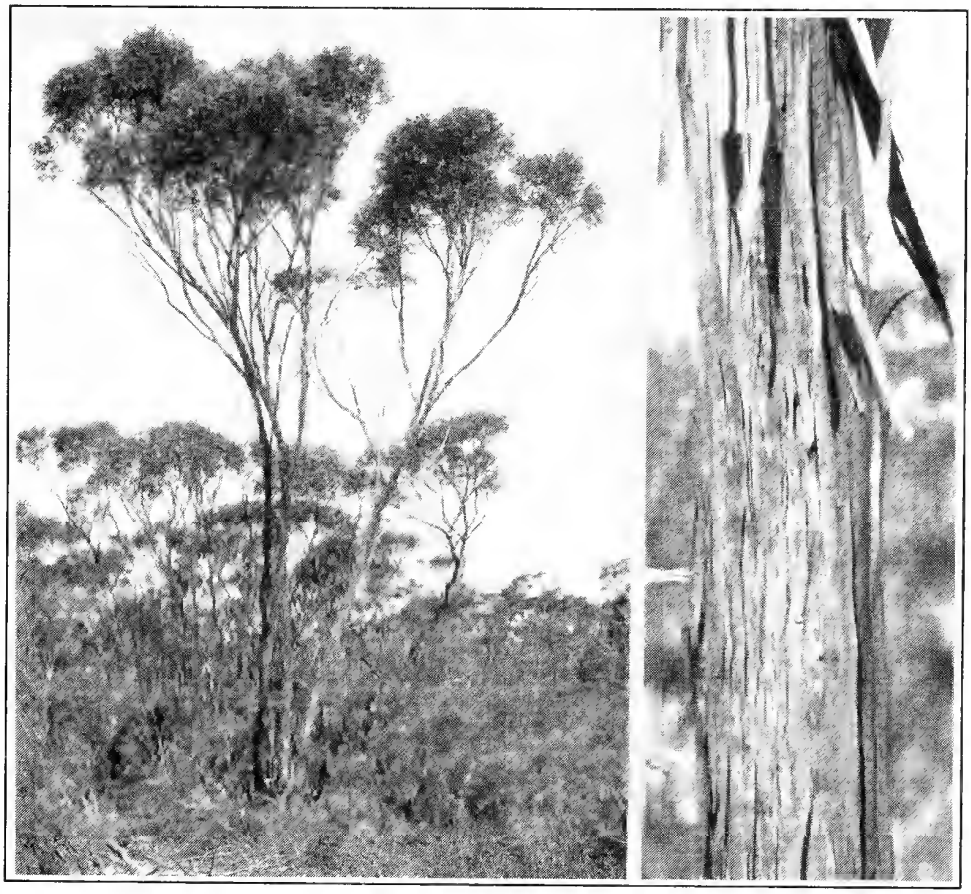

Figure 31. *E. sparsicoma* mallee habit (S of Lake Chinocup), and trunk and bark.

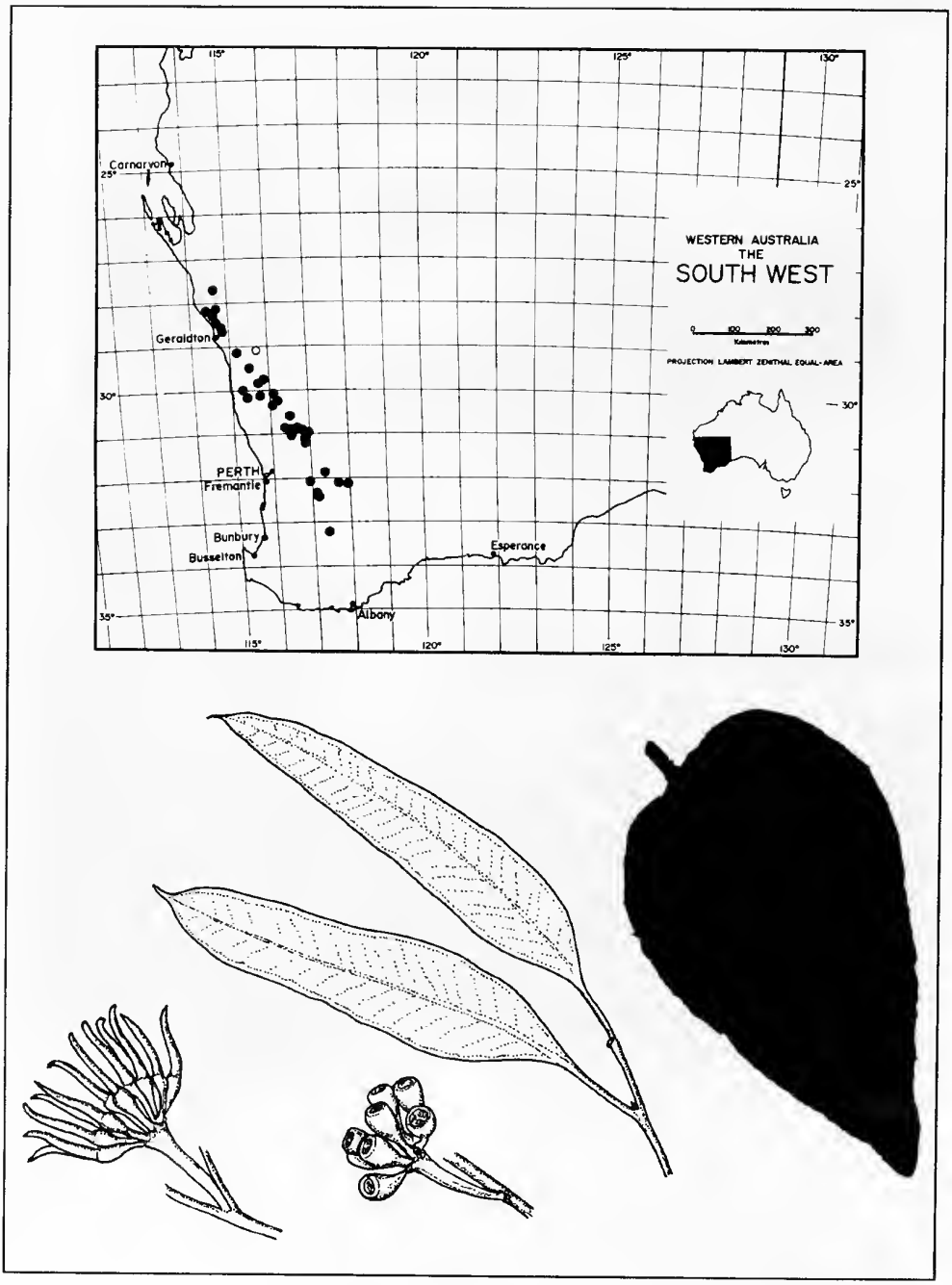

Figure 32. Distribution of *E. arachnaea* subsp. *arachnaea* (●) and *E. arachnaea* subsp. *arrecta* (○), and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf of *E. arachnaea* subsp. *arachnaea* (scale bar = 1 cm).

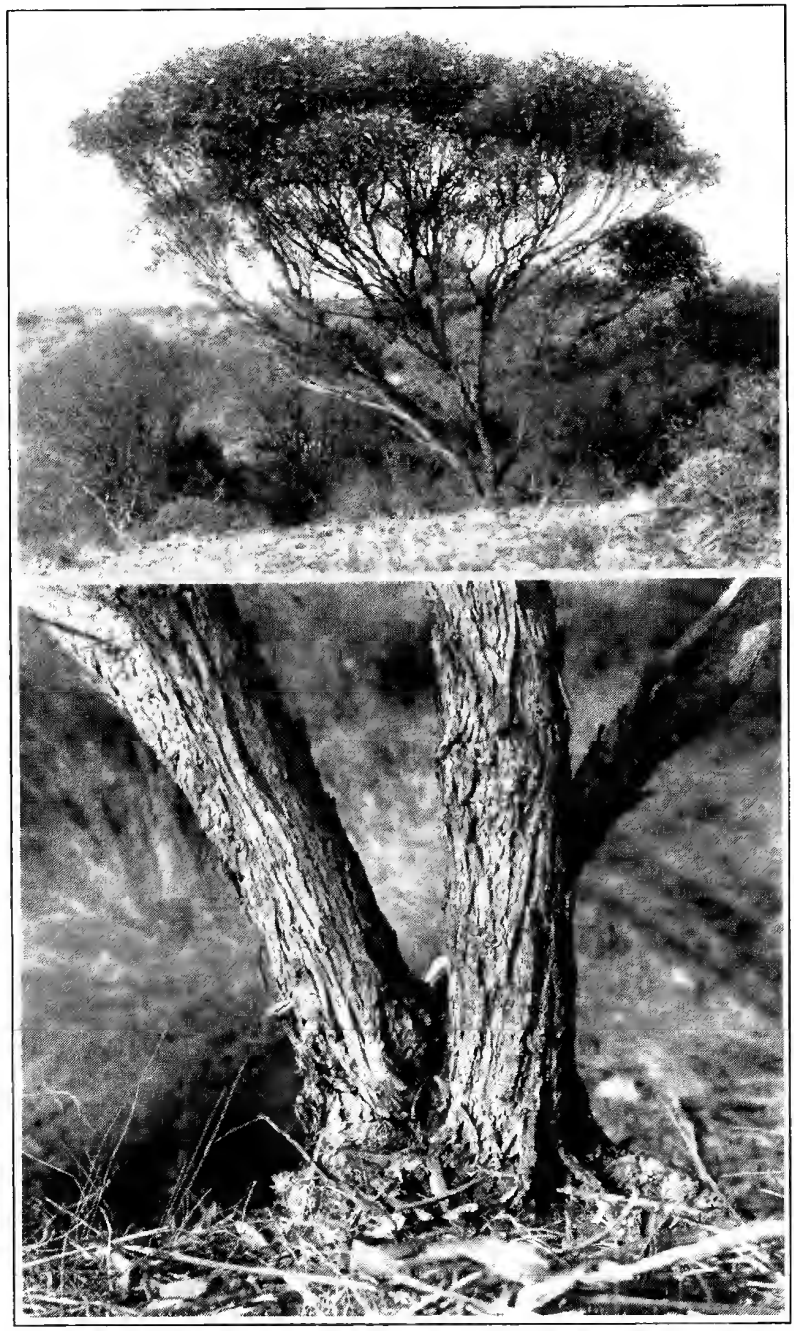

Figure 33. *E. arachnaea* subsp. *arachnaea* mallee habit at Howatharra, and stems and bark.

Notes. E. sparsicoma has glossy leaves and the operculum narrower than the hypanthium like *E. phaenophylla*, but differs in its terminal crown, rough bark held in loose ribbons, smaller buds and its smaller erect leaves.

8. ***Eucalyptus arachnaea*** Brooker & Hopper, nom. et stat. nov. *E. redunca* Schauer var. *melanophloia* Benth. "Fl. Austral." 3: 253 (1867). *Type*: Cheeanga thicket, Murchison River, Western Australia, *Oldfield* s.n. (holo: K; iso: NSW).

A mallee to 7 m tall or a tree to 10 m. Bark rough and tightly held on lower part of stems at least, dark grey to grey-black. Pith of branchlets glandular. Leaves of the seedling remaining opposite for 3 or 4 pairs, then alternating, deltoid to broadly lanceolate, to 12 x 5 cm, blue-green to glaucous, slightly or very hairy particularly on margins. Adult leaves lanceolate, to 9 x 1.5 cm, very glossy green. Inflorescences to 13-flowered; peduncles to 2 cm long. Buds shortly pedicellate, fusiform, to 1.8 x 0.3 cm, operculum narrower than hypanthium at the join, horn-shaped, usually recurved at the tip. Flowers white. Fruit shortly pedicellate, shortly cylindrical (just longer than broad), to 0.7 x 0.5 cm. Seed light brown, more or less spherical (Figures 5a, 32, 33, 34, 35).

Etymology. A new specific epithet is required for this taxon because the varietal name *melanophloia* used by Bentham is already in use at the species level, i.e. Silver-leaved Ironbark *E. melanophloia* F. Muell. of Queensland and northern New South Wales. The new name refers to the spidery clusters of buds seen particularly in the fresh state (Latin *arachnaeus*, spidery).

Notes. E. arachnaea belongs to the superspecies "*phaenophylla*", a group of species that is characterised by the operculum being clearly narrower than the hypanthium and by the glossy green leaves. *E. arachnaea* is widespread although sporadic as it characteristically occupies low stony rises or lateritic breakaways as in the Morseby Range. It differs from related species (*E. phaenophylla, E. tumida, E. histophylla*) by the rough bark in mature specimens, verrucose seedlings and more delicate buds which are often seen in spidery masses within the crown.

There are two subspecies.

8a. ***Eucalyptus arachnaea*** Brooker & Hopper subsp. ***arachnaea***, subsp. nov.

Colour illustration. Brooker & Kleinig (1990: 181).

A mallee to 7 m tall (Figures 32, 33).

Specimens examined. WESTERN AUSTRALIA: 3 miles S of Carnamah, 22 May 1962, *T.E.H. Aplin* 1480 (PERTH); Between Dongara and Northampton, Sept 1932, *W.E. Blackall* (PERTH); 15 miles from Northampton on Lynton road, April 1952, *G.E. Brockway* (PERTH); 5 miles E of Brookton, 22 July 1969, *M.I.H. Brooker* 1866 (PERTH); 7 miles N of Watheroo, 23 April 1970, *M.I.H. Brooker* 2529 (AD, CANB, PERTH); between Goomalling and Konnongorring, 31° 10'S 116° 49'E, 2 Jan. 1980, *M.I.H. Brooker* 6756, 6757 (CANB, NSW, PERTH); Kalguddering Rock, 30° 58'S 116° 46'E, 2 Jan. 1980, *M.I.H. Brooker* 6762 (CANB, NSW, PERTH); Dam paddock, "Mingaree", W of Coorow, 21 May 1982, *M.I.H. Brooker* 7518 (CANB, NSW, PERTH); Depression W of interseetion of

Mudge Rd and Coorow-Greenhead Rd, 21 May 1982, *M.I.H. Brooker* 7521 (CANB, NSW, PERTH); 12.6 km E of Bindi Bindi, 21 May 1982, *M.I.H. Brooker* 7531 (CANB, NSW, PERTH); Tootbardi Rd, N of Badgingarra, 19 Aug. 1982, *M.I.H. Brooker* 7570 (CANB, NSW, PERTH); 28 km E of Great Northern H'way, E of Carani, 30° 59'S 116° 58'E, 26 Aug. 1982, *M.I.H. Brooker* 7580, 7581 (CANB, NSW, PERTH); 12.6 km E of rail crossing at Carani, 30° 59'S 116° 31'E, 26 Aug. 1982, *M.I.H. Brooker* 7589B (CANB, NSW, PERTH); Wongan Hills, road to radio tower, 30° 52'S 116° 38'E, 26 Aug. 1982, *M.I.H. Brooker* 7598 (CANB, NSW, PERTH); 4 km S Piawaning, 30° 54'S 116° 23'E, 26 Aug. 1982, *M.I.H. Brooker* 7601 (CANB, NSW, PERTH); 30 km from Tammin on York Rd, 31° 48'S 117° 19'E, 15 Sept. 1982, *M.I.H. Brooker* 7632, 7633 (CANB, NSW, PERTH); Between Hutt River and Northampton, 28° 17'S 114° 22'E, 25 Jan. 1983, *M.I.H. Brooker* 7939 (CANB, NSW, PERTH); 23 km NW of Strawberry on Burma Road, 29° 05'S 115° 10'E, 26 Jan. 1983, *M.I.H. Brooker* 7946 (CANB, NSW, PERTH); 15.3 km NE of Calingiri towards Wongan Hills, 30° 59'S 116° 33'E, 16 Feb. 1983, *M.I.H. Brooker* 7965 (CANB, NSW, PERTH); Howatharra Gap, between Geraldton and Northampton, 28° 33'S 114° 36'E, 25 May 1983, *M.I.H. Brooker* 8119 (CANB, NSW, PERTH); 11.6 km N of Murchison River bridge on Carnarvon road, 27 May 1983, *M.I.H. Brooker* 8136 (CANB, NSW, PERTH); between Conway's house and railway, N Wongan Hills area, 30° 51'S 116° 41'E, 29 June 1983, *M.I.H. Brooker* 8186 (CANB, NSW, PERTH); 20.6 km N of Northampton on highway 1, 28° 08'S 114° 39'E, 31 Oct. 1984, *M.I.H. Brooker* 8723 (CANB, NSW, PERTH); Hill E of Mt Horner, 29° 07'S 115° 06'E, 4 Feb. 1985, *M.I.H. Brooker* 8814 (CANB, MEL, NSW, PERTH); WSW of Arrino, 29° 27'S 115° 27'E, 3 June 1985, *M.I.H. Brooker* 9031 (CANB, MEL, NSW, PERTH); 13.9 km along Rob Road from Chillimony Road, W of Northampton, 8 May 1986, *M.I.H. Brooker* 9276 (CANB, PERTH, NSW, MEL); Weam Nature Reserve, 32° 23'S 117° 06'E, 27 June 1986, *M.I.H. Brooker* 9374 (CANB, PERTH, NSW, MEL); rocky paddock, Coonawarra Downs, Victoria Location 10817 (S of Tootbardi Road), 4 June 1987, *M.I.H. Brooker* 9657 (AD, CANB, MEL, NSW, PERTH); c. 1 km NW of Wagin, 33° 19'S 117° 21'E, 11 Jan. 1988, *M.I.H. Brooker* 9843 (AD, CANB, MEL, NSW, PERTH); 1 km N of fence (E-W) on N-S track, South Eneabba Nature Reserve, 30° 00'S 115° 16'E, 20 Sept. 1988, *M.I.H. Brooker* 10080 (AD, CANB, MEL, NSW, PERTH); 22 miles N of Geraldton, 2 Sept. 1947, *N.T. Burbidge* 2098 (CANB); Wongan Hills, Sept. 1924, *Carne & Gardner* (PERTH); Marchagee, 28 Sept. 1966, *G. Clover* s.n. (PERTH); 4.4 km NE of Moonyoonooka turnoff Nanson-Geraldton Rd, Heinrich's Farm, East Morseby Range, 28° 40'S 114° 43'E, 25 Aug. 1983, *R.J. Cranfield* 2920 (PERTH); Coorow Rd approx 46 km, 7 June 1977, *H. Demarz* 6534 (PERTH); Oakajee, Feb. 1973, *R. Edmiston* 334 (PERTH); Moresby Range, 7 May 1964, *A.R. Fairall* 1474 (PERTH); Watheroo, 12 Nov. 1974, *Forests Department* L184 (PERTH); Wongan Hills, Sept. 1924, *C.A. Gardner* s.n. (PERTH); Hutt River, 18 Aug. 1961, *C.A Gardner* 13171 (PERTH); 3 miles W of Manmanning, 4 Nov. 1956, *J.W. Green* 806 (PERTH); 50 km SE of Eneabba, 5 km E of eastern boundary of Alexander Morrison National Park, 18 Sept. 1987, *J.W. Green* 5484, 5485 (PERTH); 37 km N of Geraldton, 28° 34'S 114° 37'E, 5 Aug. 1976, *R. Hnatiuk* 760402 (PERTH); 2.6 miles S of Piawaning, 8 May 1967, *E. Holm* s.n. (CANB); 15.4 km SSW of Hutt River Ruins on Port Gregory Rd, 24 km N of Northampton, 28° 17'S 114° 26'E, 25 Jan. 1983, *S.D. Hopper* 2715 (PERTH); 11.6 km N of Murchison River Bridge, North West Coastal Hwy, 27° 44'S 114° 42'E, 27 May 1983, *S.D. Hopper* 2758 (PERTH); 500 m SW of North West Coastal Hwy, 13.1 km N of Murchison River Bridge, 27° 43'S 114° 40'E, 23 Aug. 1983, *S.D. Hopper* 3333 (PERTH); 4 km W of Mt Bebb, 32° 05'S 117° 47'E, 13 June 1985, *S.D. Hopper* 4397 (PERTH); Sorenson's Nature Reserve, 8.9 km W of Babakin, 32° 07'30"S 117° 55'E, 13 June 1985, *S.D. Hopper* 4401 (PERTH); Wyalgimia Hill, E of the tallest breakaway, between Gilgering and Gwambygine, 32° 01'S 116° 56'E, 25 Aug. 1986, *S.D. Hopper* 5201 (PERTH); White Peak Station, c. 18 km NE of Geraldton, 29 Aug. 1980, *G.J. Keighery* 3282 (PERTH); White Peak c. 20 km NE Geraldton,

31 Aug. 1980, *G.J. Keighery* 3334 (PERTH); e. 15.4 km S of Northampton along NW Coastal Hwy, 28° 31'S 114° 37'E, 21 Aug. 1983, *C.M. Lynch* 66 (PERTH); Howatharra Hill Reserve, 21 road miles N of Geraldton, 25 Oet. 1974, *D. & N. McFarland* NM1097 (CANB, NFLD, PERTH); *ibid,* 9 Feb. 1975, *D. &. N. McFarland* NM1087 (CANB, PERTH); SE from Port Gregory, 26 May 1952, *D.H. Penny* (PERTH); Watheroo, 4 Nov. 1954, *R.D. Royce* 4941 (PERTH); 15 miles Lynton Road, 1 Mareh 1966, *E.M. Scrymgeour* 273, 274 & *S.G.M. Carr* (PERTH); 370 miles N.W. Coastal Highway, 3 Mareh 1966, *E.M. Scrymgeour* 313 & *S.G.M. Carr* (PERTH);.

Distribution and habitat. Western part of northern and central wheatbelt, to north of the Murehison River in the north-west, and to Wagin in the south (Figure 32). Oeeurs in tall mallee often with *E. pluricaulis*, *E. erythronema*, *E. anceps*, *E. flocktoniae*, *E. pyriformis*, *E. astringens* and *E. gardneri*, on gravelly lateritic breakaways and slopes.

Conservation status. Widespread and loeally abundant in disjunet populations that are well represented on eonservation reserves.

Flowering period. April.

Notes. A mallee subspecies west and north-west of subsp. *arrecta.* Along with *E. subangusta*, this subspeeies is a common member of the series throughout the northern wheatbelt.

8b. ***Eucalyptus arachnaea*** Brooker & Hopper subsp. ***arrecta*** Brooker & Hopper, subsp. nov. (Figures 5a, 32a, 34, 35)

A subspecie typiea habitu arboreo altiore (ad 10 m) et foliis adultis nitentioribus.

Typus: west of Morawa, 29° 08'S 115° 44'E, Western Australia, 3 Feb. 1988, *M.I.H. Brooker* 9879 & *C. Sounness* (holo: PERTH; iso: AD, CANB, MEL, NSW).

It differs from the typieal subspeeies by the tree habit to 10 m tall and glossier adult leaves.

Specimens examined. WESTERN AUSTRALIA: type loeality, 9 Sept. 1987, *M.I.H. Brooker* 9757, 9760 (AD, CANB, MEL, NSW, PERTH).

Distribution and habitat. Known only from the type locality west of Morawa (Figure 32) where it forms a low open forest with *E. subangusta* subsp. *pusilla.* The site is a shallow creekline on terrain high in the landscape. Broombush (*Melaleuca uncinata*) is prominent in the understorey. The soil is gravelly loam.

Conservation status. In urgent need of further survey. The type locality has been left uneleared deliberately by the present owner. This is the rarest taxon known in the series.

Flowering period. Unknown.

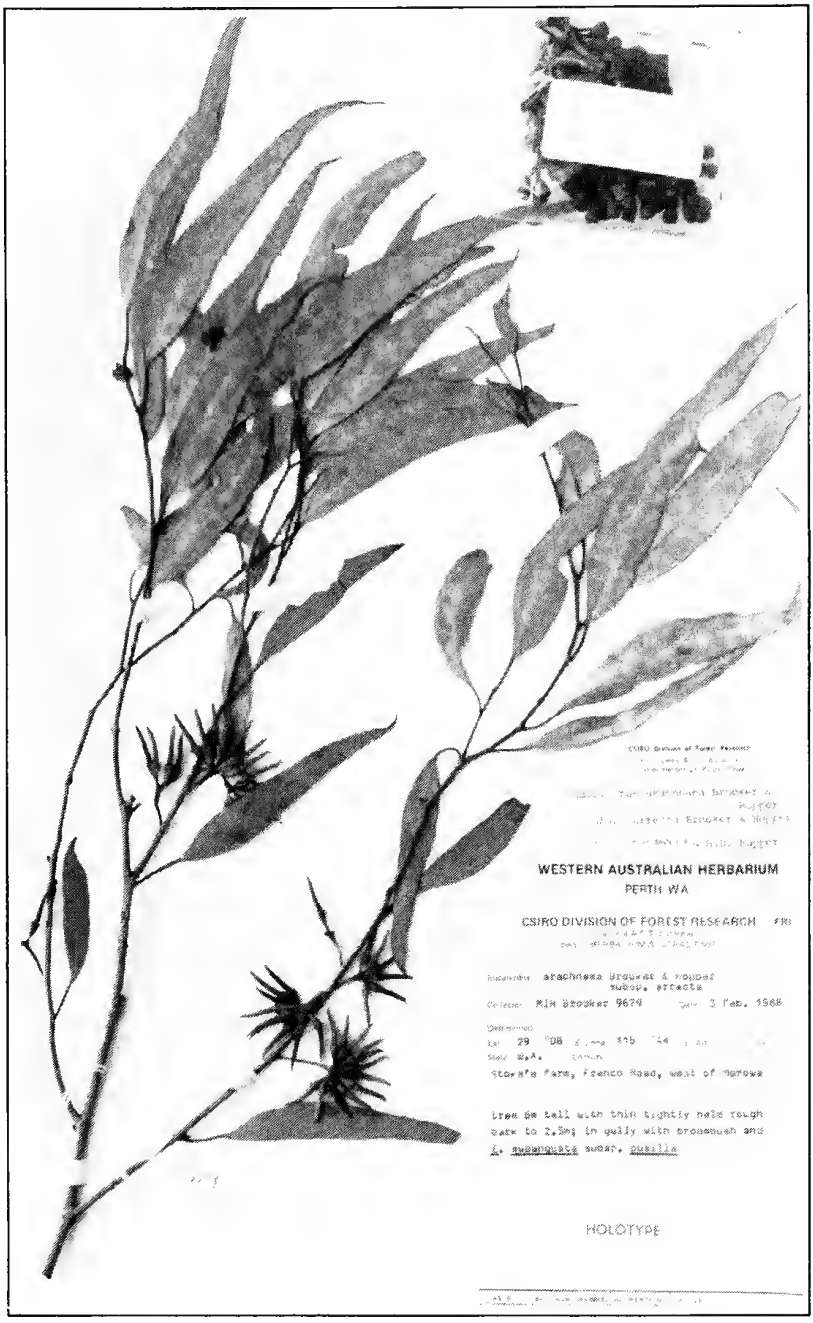

Figure 34. Holotype of *E. arachnaea* Brooker & Hopper subsp. *arrecta* Brooker & Hopper.

Figure 35. *E. arachnaea* subsp. *arrecta* tree habit at type locality, and trunk and bark.

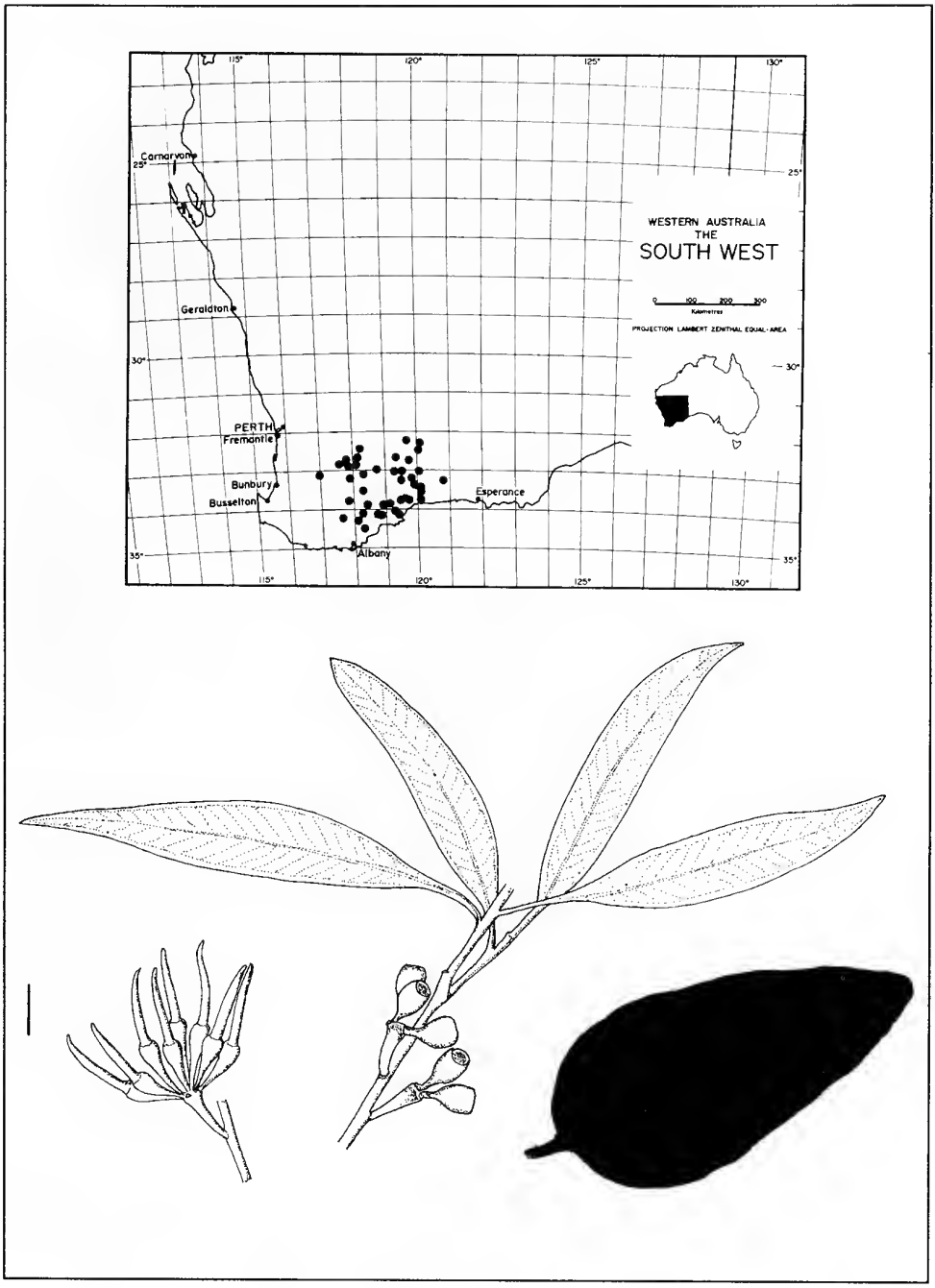

Figure 36. *Eucalyptus phaenophylla* subsp. *phaenophylla* distribution, buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

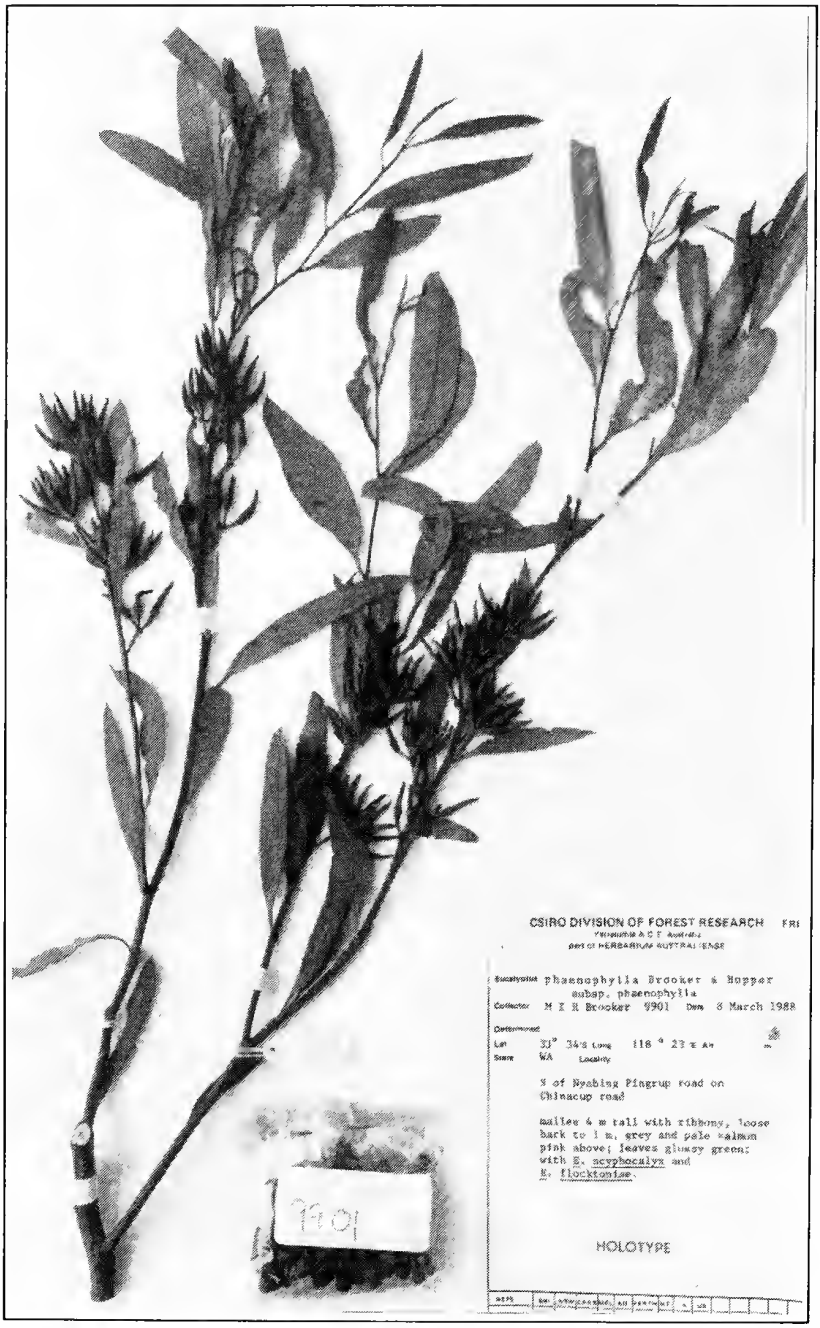

Figure. 37 Holotype of *E. phaenophylla* Brooker & Hopper subsp. *phaenophylla*.

Figure 38. *E. phaenophylla* subsp. *phaenophylla* mallee habit (NW of North Ironcap), and stems and bark.

Etymology. From the Latin *arrectus*, upright, alluding to the tree habit.

Notes. This subspecies occurs to the east of the range of *E. arachnaea* subsp. *arachnaea*, from which it is completely isolated (Figure 32). It is a striking tree to 10 m tall growing on very stony sites with a variety of associated species including *E. stowardii* Maiden, *E. oldfieldii* F. Muell., *E. subangusta* subsp. *pusilla*, *E. obtusiflora* DC and *E. horistes* Johnson & Hill, all of which notably grow on sandy soils elsewhere. *E. arachnaea* subsp. *arrecta* is easily recognised among these because of its tree form, height and very glossy leaves, smaller than those of the equally shiny leaves of *E. stowardii*.

9. ***Eucalyptus phaenophylla*** Brooker & Hopper, sp. nov. (Figures 36, 37, 38, 39, 40)

Eucalypto arachnaeae Brooker & Hopper affinis, caulibus cortice laevi, plantulae minus pubescentibus, et floribus flavidibus differt.

Typus: N of Nyabing-Pingrup road on Chinocup Rd, 33° 34'S, 118° 23'E, Western Australia, 8 March 1988, *M.I.H Brooker* 9901 (holo: PERTH; iso: AD, CANB, MEL, NSW).

A mallee to 4 m tall with grey over coppery smooth stems, occasionally with partly decorticated ribbons or flakes of bark near base. Leaves of the seedling remaining opposite for 3 or 4 pairs, then alternating, ovate, to 9 x 6 cm, bluish green, glabrous. Adult leaves lanceolate to broadly lanceolate, to 10 x 1.5 cm, glossy green. Inflorescences to 13-flowered; peduncles to 2 cm long. Buds pedicellate, fusiform, to 1.8 x 0.4 cm. Flowers pale yellow. Fruit pedicellate, obconical, cylindrical or barrel-shaped, to 0.7 x 0.5 cm. Seed light grey-brown, more or less spherical.

Etymology. The specific epithet refers to the shiny leaves (Greek *phaeno*, shiny and *phyllon*, leaf).

Notes. E. phaenophylla may be seen as a southern sister species to *E. arachnaea*, from which it differs in the smooth bark (which may often be blackish) and non-verrucose seedlings. The massed inflorescence clusters generally lack the spidery effect of *E. arachnaea*. The narrowed operculum seen best in *E. arachnaea* is still clearly evident in *E. phaenophylla* subsp. *phaenophylla* but is less pronounced. This character may be seen particularly in the young buds of other taxa, *viz.*, *E. tumida* and *E. histophylla*. It is a variable character in *E. phaenophylla* subsp. *interjacens* which we consider to be a form linking *E. phaenophylla* subsp. *phaenophylla* and *E. tumida*.

There are two subspecies.

9a. ***Eucalyptus phaenophylla*** Brooker & Hopper subsp. ***phaenophylla*** (Figures 36, 37, 38)

Colour illustration. Brooker & Kleinig (1990: 182).

Stems more or less straight. Buds to 2.5 mm diam; operculum always conspicuously narrower than hypanthium at join.

Specimens examined. WESTERN AUSTRALIA: Lake Hurlstone, 5 May 1959, *T.E.H. Aplin* s.n. (PERTH); near Peringillup, 1952, *W.A. Atkins* 85 (PERTH); Dunn Rock Nature Reserve, 30 km SW of Lake King, 33° 20'S 119° 30'E, 15 April 1984, *D.J. Backshall* DJB93 (PERTH); E of Kulin, 22 Oct. 1977, *J.S. Beard* 8152 (CANB); 39 km SW of Fitzgerald, Ravensthorpe Ongerup Rd, 27 Aug. 1974, *A.C. Beauglehole* 49211 (PERTH); NE of Ravensthorpe, Sept. 1981, *E.M. Bennett* (AD, CANB, K, MEL, PERTH); NW end of Stirling Range, near Cranbrook, 22 Oct. 1975, *D.F. Blaxell* W75/247 (K, NSW, PERTH); 2 miles from Lake Grace on Newdegate road, 27 Oct. 1970, *D.J. Boland* 240 (CANB); 17 miles SE of Wickepin towards Harrismith, 3 Nov. 1969, *M.I.H. Brooker* 2257a (CANB, NSW, PERTH); 1/2 mile E of Carganocking Hill, S of Kulin, 13 July 1970, *M.I.H. Brooker* 2653 (CANB, MEL, PERTH); Bordcn rubbish dump, 6 Oct. 1982, *M.I.H. Brooker* 7677, 7678, (CANB, NSW, PERTH); 2 km W of Corackerup Creek, ncar E boundary of reserve, 6 Oct. 1982, *M.I.H. Brooker* 7689 (CANB); West shouldcr of Toolyelup Peak, Stirling Range, 9 Oct. 1982, *M.I.H. Brooker* 7719 (CANB, NSW, PERTH); Kojaneerup Springs road, cornc r with Chillinup road, 34° 30'S 118° 21'E, 23 March 1983, *M.I.H. Brooker* 8044 (CANB, NSW, PERTH); 0.3 km W of Dudinin turn-off on Kulin-Wickepin road, 32° 47'S 117° 53'E, 5 May 1983, *M.I.H. Brooker* 8104 (CANB, NSW, PERTH); near Cargonocking Hill, 32° 45'S 118° 08'E, 5 May 1983, *M.I.H. Brooker* 8110, 8111, (CANB, NSW, PERTH); 19.6 km N of Ravensthorpe-Jerramungup road on road to Lake King, 33° 25'S 119° 56'E, 7 June 1983, *M.I.H. Brooker* 8173 (CANB, NSW, PERTH); 36 km W of Mt Day road on Hyden-Norseman track, 32° 17'S 120° 11'E, 7 Nov. 1983, *M.I.H. Brooker* 8360 (CANB, NSW, PERTH); 7.1 km S towards Hamersley Drive from Old Ongerup Road, 33° 45'S 119° 49'E, 23 Nov. 1983, *M.I.H. Brooker* 8375 (CANB, NSW, PERTH); 5.8 km W of Chester Pass Road on Scenic Drive, Stirling Range, 34° 24'S 118° 05'E, 24 Nov. 1983, *M.I.H. Brooker* 8380 (CANB, NSW, PERTH); 7.3 km from Hyden track on Sheoak Rock track, 23° 22'S 119° 29'E, 9 Aug. 1984, *M.I.H. Brooker* 8627 (CANB, MEL, NSW, PERTH); 6.8 km N of T junction turn-off to E. Mt Barren on Ravensthorpe road, 33° 53'S 120° 09'E, 20 Feb. 1985, *M.I.H. Brooker* 8853 (CANB, MEL, NSW, PERTH); NW of Burngup, 33° 00'S 118° 39'E, 9 Dec. 1985, *M.I.H. Brooker* 9139 (CANB, MEL, NSW, PERTH); Toorackie, S of Williams, 33° 10'S 116° 59'E, 19 Feb. 1986, *M.I.H. Brooker* 9185 (CANB, MEL, NSW, PERTH); c. 30 km from Wickepin towards Harrismith, 32° 55'S 117° 48'E, 16 Dec. 1987, *M.I.H. Brooker* 9831 (AD, CANB, MEL, NSW, PERTH); 11 km S of Pingaring Holt Rock road, S of Dragon Rock, 32° 50'S 119° 02'E, 21 Oct. 1986, *M.I.H. Brooker* 9475 (CANB, MEL, NSW, PERTH); Chinocup Road, 33° 31'S 118° 23'E, 17 Dcc. 1987, *M.I.H. Brooker* 9842 (AD, CANB, MEL, NSW, PERTH); near base of West Mt Barren, Fitzgerald River National Park, 34° 13'S 119° 26'E, 12 Jan. 1988, *M.I.H. Brooker* 9864 (AD, CANB, MEL, NSW, PERTH); Reserve 13496 (Loc. 11092), Dookanooka, 2 Dec. 1987, *R.C. Burking* 1 (PERTH); Stirling Range National Park, 12.8 miles from Chester Pass Road along Stirling Range Drive toward Red Gum Pass (at picnic spot), 23 Oct. 1968, *E.M. Canning* WA/68 6703 (CBG, PERTH); 147 m.p. between Lake Grace and Dumblcyung, 4 April 1968, *S.G.M. Carr* 681 (PERTH); 15.9 miles SW of Ravensthorpe, 26 March 1968, *G.M. Chippendale* 422 (CANB, PERTH); 25 miles W of Ravensthorpe, 11 Jan. 1969, *H. Demarz* D1085 (PERTH); Hassel Hwy, 1.9 miles W of Bremer Bay turn-off, 12 Feb. 1970, *H. Demarz* 2205 (PERTH); S of Newdegate, 17 Jan. 1986, *H. Demarz* 11247 (PERTH); Corackerup Reserve, 1 Feb. 1977, *T. Evans* (CANB, PERTH); 11 km E of Dumbleyung, 27 May 1984, *D. Fell* DF0201 (PERTH); Harrismith, 6 March 1924, *C.A. Gardner* 1604, 1609, 1611, 2111, 2109 (PERTH); Nyabing, July 1952, *C.A. Gardner* 10322a (PERTH); 65 miles E of Hyden, 5 Feb. 1963, *A.S. George* 4313 (PERTH); 19 miles E of Dumblcyung, 21 Feb. 1966, *A.S. George* 7558, 7560, *et S.G.M. Carr* (PERTH); 35 miles E of Ongerup, 13 march 1957, *J.W. Green* 1176 (CANB, PERTH); 15 miles N of Ravensthorpe, 14 March 1957, *J.W. Green* 1209 (PERTH); 14 miles E of Ongerup, 3 Aug. 1957, *J.W. Green* 1470 (PERTH); 12.8 miles E of Newdegate (7.7 miles W of Hyden turn-

off), 27 Sept. 1975, *J.W. Green* 4478 (PERTH); 27.2 miles W of Ravensthorpe (5.4 miles W of West River), 28 Sept. 1975, *J.W. Green* 4527 (PERTH); 7.6 km NE of Dumbleyung, 29 Oct. 1975, *J.W. Green* 4544 (PERTH); 34 km W of Lake King, 29 Oct. 1975, *J.W. Green* 4561 (PERTH); 13 km W of Lake King, 29 Oct. 1975, *J.W. Green* 4568, 4569 (PERTH); 13 km E of Fitzgerald township on Ravensthorpe to Jerramungup road, 31 Oct. 1975, *J.W. Green* 4617 (PERTH); Southern Ironcap, SE slopes, 11 Nov. 1978, *J.W. Green* 4898 (PERTH); 10 km N of Dunn Rock on Old Newdegate Road, 18 Nov. 1986, *J.W. Green* 5043 (PERTH); 54 km E of Newdegate on Old Newdegate Road, 18 Nov. 1986, *J.W. Green* 5051 (PERTH); 26 km W of Ravensthorpe on Old Ongerup Road, 22 Oct. 1987, *J.W. Green* 5572 (PERTH); 5.5 km NW of Ongerup on property of K. Newbey, 33° 55'S 118° 27'E, 23 Oct. 1983, *K. Hill* 338, *L. Johnson & D. Blaxell* (NSW, PERTH); 0.7 km S along Norman Rd from Cowalellup Rd, SE of Ongerup, 34° 11'S 118° 43'E, 23 Oct. 1983, *K. Hill* 344, *L. Johnson & D. Blaxell* (NSW, PERTH); 9 km NE of Kondinin, near trig point, 32° 27'S 118° 21'E, 8 Nov. 1983, *K. Hill* 647, *L. Johnson, D. Blaxell, I. Brooker & S. Hopper* (CANB, NSW, PERTH); Cargonocking Hill, 6.5 km SW of Kulin on road to Harrismith, 32° 42'S 118° 06'E, 8 Nov. 1983, *K. Hill* 655, *L. Johnson, D. Blaxell, I. Brooker & S. Hopper*, (CANB, NSW, PERTH); 16 km SE of Kulin, 32° 43'S 118° 17'E, 8 July 1977, *R.J. Hnatiuk* 770154 (PERTH); 5 km WNW of Ongerup, 4.5 km N of Foster Rd from Ongerup Rd, 33° 55'S 118° 27'E, 31 July 1982, *S.D. Hopper* 2404 (PERTH); 16 km SE of Cowalellup Rock, NE corner of Coraekerup Nature Reserve, 34° 08'S 118° 42'E, 31 July 1982, *S.D. Hopper* 2405 (PERTH); Stirling Range National Park, 1 km S of Salt River Rd on internal EW firebreak, 34° 20'S 117° 42'E, 9 Oct. 1982, *S.D. Hopper* 2648 (PERTH); c. 14 km SW of Ravensthorpe, 1.7 km W of Moir Rd on the track to Phillips River, 30 Sept. 1987, *S.D. Hopper* 6161 (PERTH); 12 miles E of Lake Grace, Feb. 1958, *P.R. Jeffries* 580207 (PERTH); 1 km on Rollands Rd from Carmody Rd (before Clare Rd), 33° 23'S 120° 52'E, 20 Jan. 1981, *G.J. Keighery* 3717 (PERTH); Reserve No. 20046, 25 km NE of Nyabing, 19 Jan. 1978, *J.M. Koch* N30 (PERTH); Pingrup, 21 km S at 110 mile peg, 27 Feb. 1975, *O.W. Loneragan* L231 (PERTH); Nyabing, Dec. 1957, *V. McDoudle* 083, 084 (PERTH); 6.4 km from Jerramungup towards Ongerup, 5 Jan. 1978, *E. Mullins* 371 (CANB); 14 miles E of Ongerup, 29 April 1962, *K. Newbey* s.n. (PERTH); 4 miles E of Dumbleyung and 2 miles on road S, 30 Oct. 1968, *M.E. Phillips* s.n. (CANB, CBG 021982); Tarin Hill, near Lake Grace, June 1924, *Ralph & Stanford* (PERTH); 18 miles E of Lake King, May 1969, *B.A. Rockel* A60 (CANB); 10 miles E of Broomehill, 13 Jan. 1954, *R.D. Royce* 4788 (PERTH); 25.5 km (16 miles) E of Lake King townsite, 9 Aug. 1968, *R.A. Saffrey* 405 (PERTH); about 30 km N of Bremer Bay in the Fitzgerald River Reserve, 7 Oct. 1970, *P.G. Wilson* 10203 (PERTH).

Distribution and habitat. Southern wheatbelt from Wickepin to the Stirling Range, and to east of Jerramungup (Figure 36). A common component of mallee communities on plains and undulating terrain.

Conservation status. Widespread and abundant. Well represented on conservation reserves.

Flowering period. January.

Notes. E. phaenophylla subsp. *phaenophylla* is the most abundant taxon in the series. In the past it has been called *E. redunca*. It differs from subsp. *interjacens* in its more upright straight-stemmed habit, and its more slender buds with the operculum noticeably narrower than the hypanthium at the join.

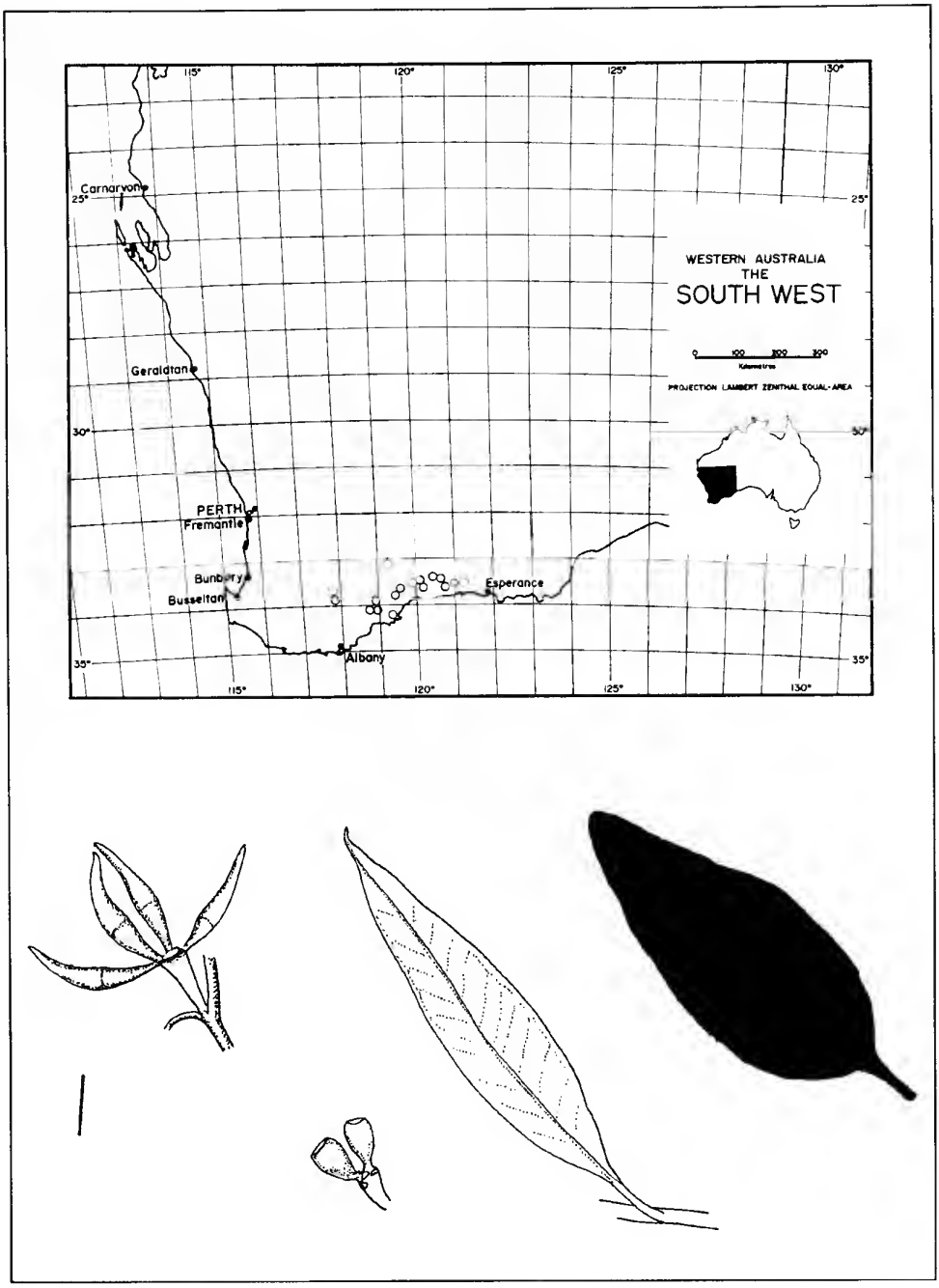

Figure 39. *Eucalyptus phaenophylla* subsp. *interjacens* distribution, and buds, fruits, adult leaf and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

Figure 40. Holotype of *E. phaenophylla* Brooker & Hopper subsp. *interjacens*.

9b. ***Eucalyptus phaenophylla*** Brooker & Hopper subsp. ***interjacens*** Brooker & Hopper, subsp. nov. (Figures 39, 40)

A subspecie typica habitu effusiore, alabastris validioribus et operculo aequanti hypanthium diametro differt.

Typus: 8.5 km E of Jerramungup, Western Australia, 23 November 1983, *M.I.H. Brooker* 8374 (holo: PERTH; iso: CANB, MEL, NSW).

It differs from the typical subspecies in the more straggly habit, the more robust buds (to 4 mm diam.), and operculum more or less equalling the width of the hypanthium at the join.

Specimens examined. WESTERN AUSTRALIA: Ravensthorpe Range, 2 Sept. 1968, *E.M. Bennett* 2539 (CANB, PERTH); Ravensthorpe Range, Sept. 1980, *E.M. Bennett* s.n. (PERTH); 90 km W of Esperance on Ravensthorpe road, 33° 45'E 121° 00'E, 22 June 1978, *D.F. Blaxell* 1689 (PERTH); Pallinup River, Jan. 1964, *G.E. Brockway* (PERTH); 5.6 miles from Fitzgerald crossroads turn-off S to Fitzgerald Reserve, 5 Apr. 1974, *M.I.H. Brooker* 4430 (CANB, PERTH); Bandalup Hill area, 7 Apr. 1974, *M.I.H. Brooker* 4466 (CANB); 13.3 km S of Eldverton turn-off on Hopetoun road, 33° 45'S 120° 12'E, 10 April 1983, *M.I.H. Brooker* 8079 (CANB, NSW, PERTH); 6.8 km N of T junction turn-off to E. Mt Barren on Ravensthorpe Road, 33° 53'S 120° 09'E, 20 Feb. 1985, *M.I.H. Brooker* 8853 (CANB, MEL, NSW, PERTH); c. 200 m N of Ongerup-Bremer Bay road on Corackerup road, 34° 13'S 118° 36'E, 3 March 1985, *M.I.H. Brooker* 8874 (CANB, MEL, NSW, PERTH); Ravensthorpe Range access road, Floater Road, 33° 30'S 120° 02'E, 21 March 1985, *M.I.H. Brooker* 8893 (CANB, MEL, NSW, PERTH); 32 km ESE of Muckinwobert Rock, on West Point Rd, 33° 28'S 120° 37'E, 26 March 1983, *M.A. Burgman* 1051 & *S. McNee* (CANB, PERTH); 3.3 km N of Rawlinson Rd on West Point Road, reserve 31754, 33° 26'S 120° 35'E, Oct. 1984, *M.A. Burgman* 4597 (PERTH); 12.9 miles N of Hopetoun, 16 March 1967, *G.M. Chippendale* 217 (CANB, PERTH); Location 900, in gully leading to Yerrilup Creek, c. 13 km N of coast at Stokes Inlet, 26 Sept. 1968, *Hj. Eichler* 19989 (AD, PERTH); Location 1134, c. 40 km N of mouth of Oldfield River, 21 Oct. 1968, *Hj. Eichler* 20374 (AD, CANB, PERTH); near Jerramungup east, 9 Oct. 1967, *A. Fairall* 2333 (CANB); Oldfield River, 15 Aug. 1965, *C.A. Gardner* 16164 (PERTH); Oldfield Location 1002, near Dallinup Creek, 33° 34'S 120° 40'E, 1 June 1979, *A.S. George* 15718 (PERTH); 50 miles E of Ongerup, 13 March 1957, *J.W. Green* 1186 (PERTH); 23 km S of Ravensthorpe, 30 Oct. 1975, *J.W. Green* 4587 (PERTH); 15 km S of Ravensthorpe, 30 Oct. 1975, *J.W. Green* 4592 (PERTH); 16 km S of Ravensthorpe, 30 Oct. 1975, *J.W. Green* 4593 (PERTH); 13 km E of Fitzgerald River township on Ravensthorpe to Jerramungup Road, 31 Oct. 1975, *J.W. Green* 4617 (PERTH); 13.5 km SE of Munglinup, 8.1 km W of Torradup River, 33° 48'S 120° 57'E, 10 Sept. 1982, *S.D. Hopper* 2559 (PERTH); 24 km from Hopetoun on Ravensthorpe Rd, 33° 36'S 120° 18'E, 22 Sept. 1976, *R.J. Hnatiuk* 761294 (PERTH); Bremer Bay, Sept. 1957, *J. Laws* (PERTH); Swamp Rd, N of Bremer Bay, Sept. 1958, *J.M. Laws* (PERTH); Young River crossing, Esperance-Jerramungup Road, 20 Dec. 1971, *B.R. Maslin* 2548 (CANB, PERTH); near Young River, Location 886, c. 21 km NNW of the coast at Stokes Inlet, 20 Oct. 1968, *A.E. Orchard* 1669 (AD, PERTH); 31 miles W of Ravensthorpe, 16 Jan 1970, *S.L. Paull* 97 (CANB, L, PERTH, RSA); between Ravensthorpe and Hopetoun, 13 Sept. 1971, *S. Paust* 744, 746 (PERTH); 10 miles E of Broomehill, 13 Jan. 1954, *R.D. Royce* 4777, 4781, 4784 (PERTH); 20 m E of Katanning, 14 Jan 1954, *R.D. Royce* 4802 (PERTH); near Esperance, 1945,

D.L. Serventy (PERTH); 33.5 km N of Hopetoun along road to Ravensthorpe, 33° 40'S 120° 06'E, 4 Sept. 1986, *P.S. Short* 2698, *M. Amerena & B.A. Fuhrer* (MEL, PERTH); 6 km from Munglingup along road to Ravensthorpe, 33° 41'S 120° 48'E, 5 Nov. 1982, *A. Strid* 21159 (PERTH); 11 miles E of Newdegate on the highway to Lake King, 20 March 1970, *M.D. Tindale* 222 & *B.R. Maslin* (NSW, PERTH); 20 km W of Bremer Bay township, 1 Oct. 1966, *P.G. Wilson* 4344 (CANB, PERTH); 20 km N of Hopetoun, 5 Oct. 1966, *P.G. Wilson* 5515 (CANB, PERTH); Block 1136, Oldfield district, 33° 30'S 120° 45'E, 28 Sept. 1968, *P.G. Wilson* 8063 (CANB, K, PERTH); 7 miles N of Hopetoun, 11 Oct. 1967, *D. Young* 304 (PERTH).

Distribution and habitat. Jerramungup and Boxwood Hills east to Ravensthorpe Range, possibly extending westwards to Katanning and Broomehill (Figure 39). Common in species-rich mallee communities on plains and undulating terrain.

Conservation status. Abundant and well represented in Fitzgerald River National Park and adjacent reserves.

Flowering period. January-March.

Etymology. The subspecific epithet (Latin *interjacens*, coming between) indicates the morphological and geographical situation of this subspecies between *E. phaenophylla* subsp. *phaenophylla* and *E. tumida.*

Notes. This subspecies appears to link *E. phaenophylla* subsp. *phaenophylla* and *E. tumida.* The narrowed operculum may be seen in the immature buds of subsp. *interjacens* and both buds and fruits are somewhat robust resembling those of *E. tumida* to the east which has larger leaves, buds and fruit. The buds of subsp. *interjacens* are usually fusiform while those of *E. tumida* are allantoid.

10. ***Eucalyptus luteola*** Brooker & Hopper, sp. nov. (Figures 41, 42)

Frutex "mallee" ad 4 m altus cortice emortuo ferenti laxo ad basin. Medulla ramulorum glandulifera. Folia adulta leviter nitentia, viridia vel olivacea. Alabastra robusta fusiformia, ad 2 x 0.3 cm, operculo aequanti hypanthium diametro. Flores luteoli. Semina subsphaerica laevia.

Typus: 2.5 km SW of 90-mile Tank, NE of Lake King, Western Australia, 12 Feb. 1985, *M.I.H. Brooker* 8847 (holo: PERTH; iso: AD, CANB, MEL, NSW).

A mallee to 4 m tall with loose rough bark to 1 m, smooth above. Pith of branchlets glandular. Leaves of the seedling remaining opposite for 2 or 3 pairs, then alternating, ovate to lanceolate, to 7 x 3 cm, glabrous. Adult leaves narrowly lanceolate, to 11 x 1.2 cm, slightly glossy, green to olive-green. Inflorescences to 11-flowered; peduncles to 1.5 cm long, conspicuously flattened. Buds distinctly pedicellate, fusiform, to 2 x 0.3 cm; operculum equal in width to hypanthium at the join, to 1.4 cm long. Flowers pale yellow. Fruit pedicellate, barrel-shaped to obconical, to 0.7 x 0.6 cm. Seed pale grey-brown, subspherical.

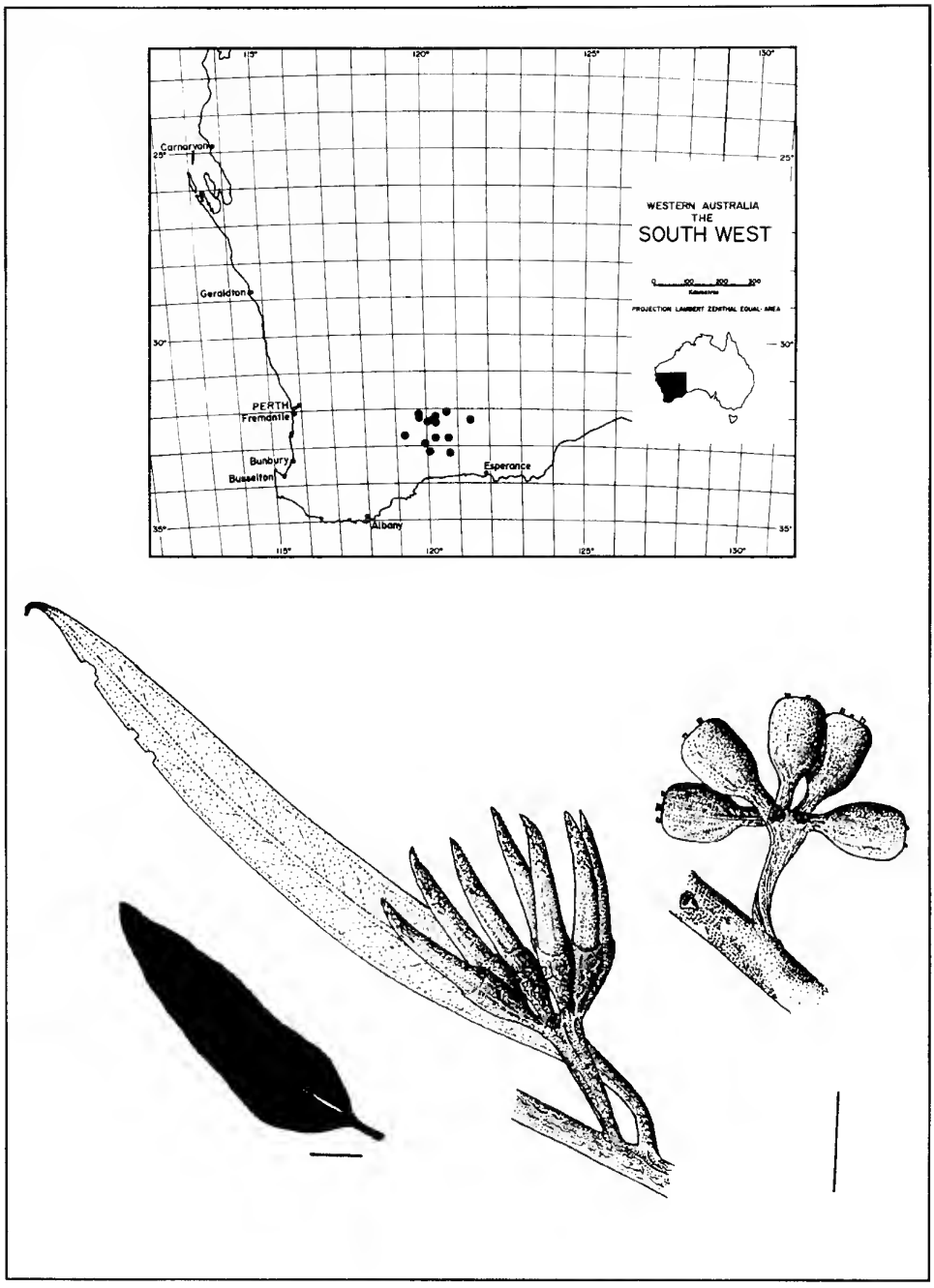

Figure 41. *Eucalyptus luteola* distribution, buds, fruits, adult leaf and silhouette of a fifth node seedling leaf (scale bars = 1 cm).

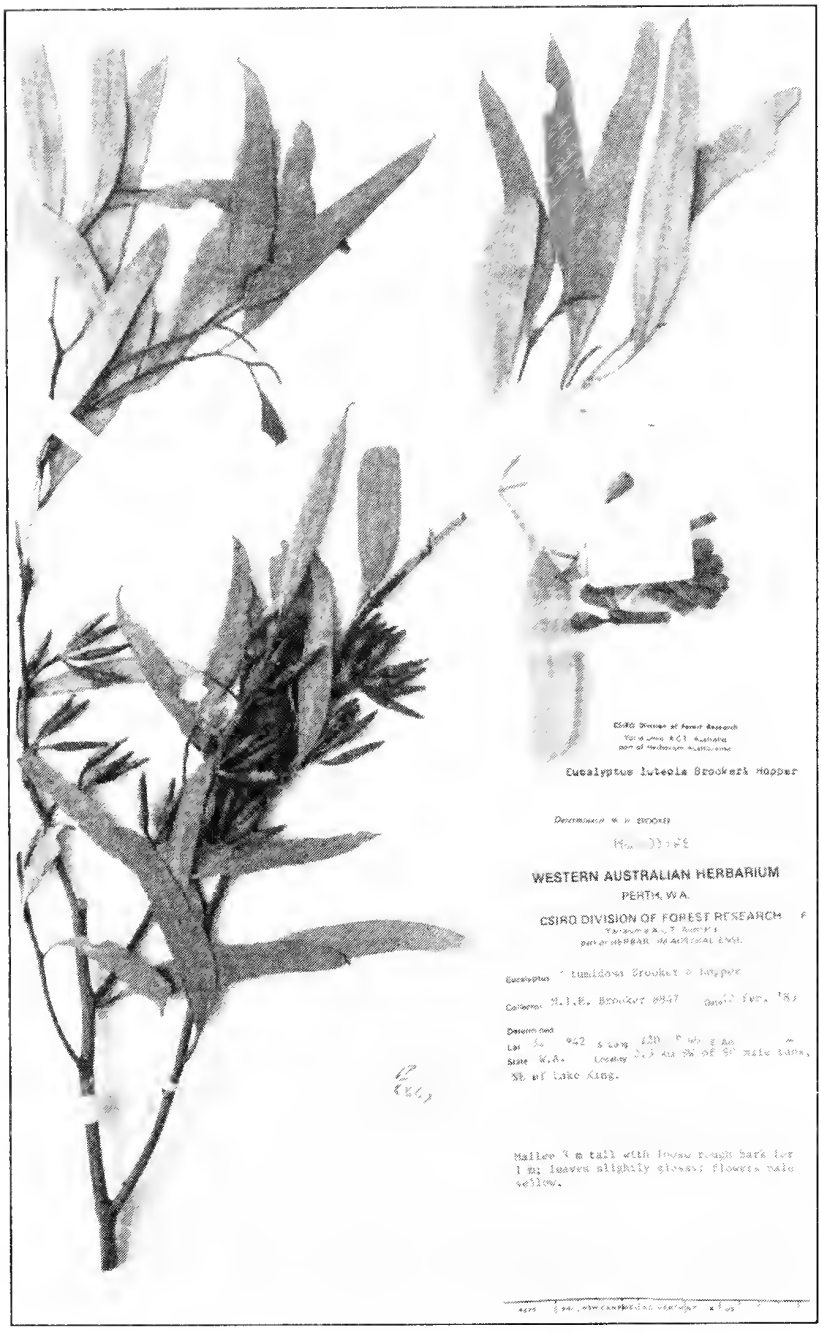

Figure 42. Holotype of *E. luteola* Brooker & Hopper.

Specimens examined. WESTERN AUSTRALIA: 121 km E of Hyden, 3 Oct. 1975, *D.F. Blaxell* DFB/W75/34 & *M.I.H. Brooker* (CANB, CANB, K, NSW, PERTH); 101 km W of Coolgardie-Norseman Road on Hyden-Norseman track, 32° 04'S 120° 42'E, 7 Nov. 1983, *M.I.H. Brooker* 8355 (CANB, NSW, PERTH); 36 km W of Mt Day road on Hyden-Norseman track, 32° 17'S 120° 11'E, 7 Nov. 1983, *M.I.H. Brooker* 8360 (CANB, NSW, PERTH); 26.6 km S of cross roads on Varley road, 22 July 1988, *M.I.H. Brooker* 10014 (AD, CANB, MEL, NSW, PERTH); 65 miles E of Hyden, 5 Feb. 1963, *A.S. George* 4313 (PERTH); 153.3 km W of Norseman-Coolgardie Rd on track to Hyden, 32° 15'S 120° 16'E, 7 Nov. 1983, *K. Hill* 633, *L. Johnson, D. Blaxell, I. Brooker, S. Hopper* (CANB, NSW, PERTH); Ninety Mile Tank, 14 km SSW of Mt Glasse, Bremer Range, 32° 41'S 120° 41'E, 6 Sept. 1982, *S.D. Hopper* 2495 (PERTH); 0.4 km SW of Ninety Mile Tank, 32° 41'S 120° 41'E, 27 Sept. 1988, *S.D. Hopper* 6855 (PERTH); 20 km NNE of Ravensthorpe, 300 m W of Moolyal Road and 1.4 km N of Woodenup Rd on SE corner of proposed Moolyal Nature Reserve, 8 April 1991, *S.D. Hopper* 7918 (CANB, PERTH); 1 km on Rollands Road from Carmody Road (before Clare Road), 33° 23'S 120° 52'E, 20 Jan. 1981, *G.J. Keighery* 3717 (PERTH); Mt Holland area, E of Hyden, 16 August 1966, *A. Kessel* 417 (PERTH); Frank Hann National Park, 32° 59'S 120° 00'E, 11 July 1978, *D. Monk* 038 (PERTH); Frank Hann National Park, 32° 47'S 120° 22'E, 2 Aug. 1978, *D. Monk* 083, 301, (CANB, PERTH); Frank Hann National Park, 32° 22'S 120° 15'E, 8 Aug. 1978, *D. Monk* 334 (PERTH); 6 km S of Mt Gibbs, c. 36 km ENE of Lake King (Frank Hann N.P.), 14 Nov. 1979, *K. Newbey* 6582 (PERTH).

Distribution and habitat. East of Hyden, between the rabbit proof fence and the Norseman-Coolgardie highway, extending south to near Ravensthorpe (Figure 41). Grows in yellow sand or sandy loams in open mallee over heath with *E. conglobata*, *E. spathulata* subsp. *grandiflora*, *E.* aff. *flocktoniae*, *E. leptocalyx*, *E. incrassata*, and *E. sporadica* Brooker & Hopper *ined.*

Conservation status. Widespread in disjunct scattered stands on vacant Crown land. Recorded on Frank Hann National Park and the proposed Moolyal Nature Reserve.

Flowering period. February - April.

Etymology. From the Latin *luteolus*, pale yellow, alluding to the flower colour.

Notes. E. luteola is related to *E. phaenophylla*, from which it differs in its narrower juvenile leaves, lighter green usually narrower adult leaves, more conspicuously flattened peduncles, the operculum about the same width as the hypanthium at the join, and its preference for yellow sandplain. The two species grow close together near Ravensthorpe and northwards towards Hyden, and may intergrade in this belt. *E. luteola* has smaller buds, fruits and adult leaves than *E. tumida*.

11. ***Eucalyptus tumida*** Brooker & Hopper, sp. nov. (Figures 43, 44)

Eucalypto phaenophyllae Brooker & Hopper subsp. *phaenophyllae* foliis adultis majoribus (ad 11 x 2 cm), alabastris fructibusque robustioribus et operculo maturo aequanti hypanthium diametro differt.

Typus: 2.7 km west of Styles road on Norwood road, NE of Esperance, Western Australia, 9 April 1983, *M.I.H. Brooker* 8068 (holo: PERTH; iso: CANB, NSW).

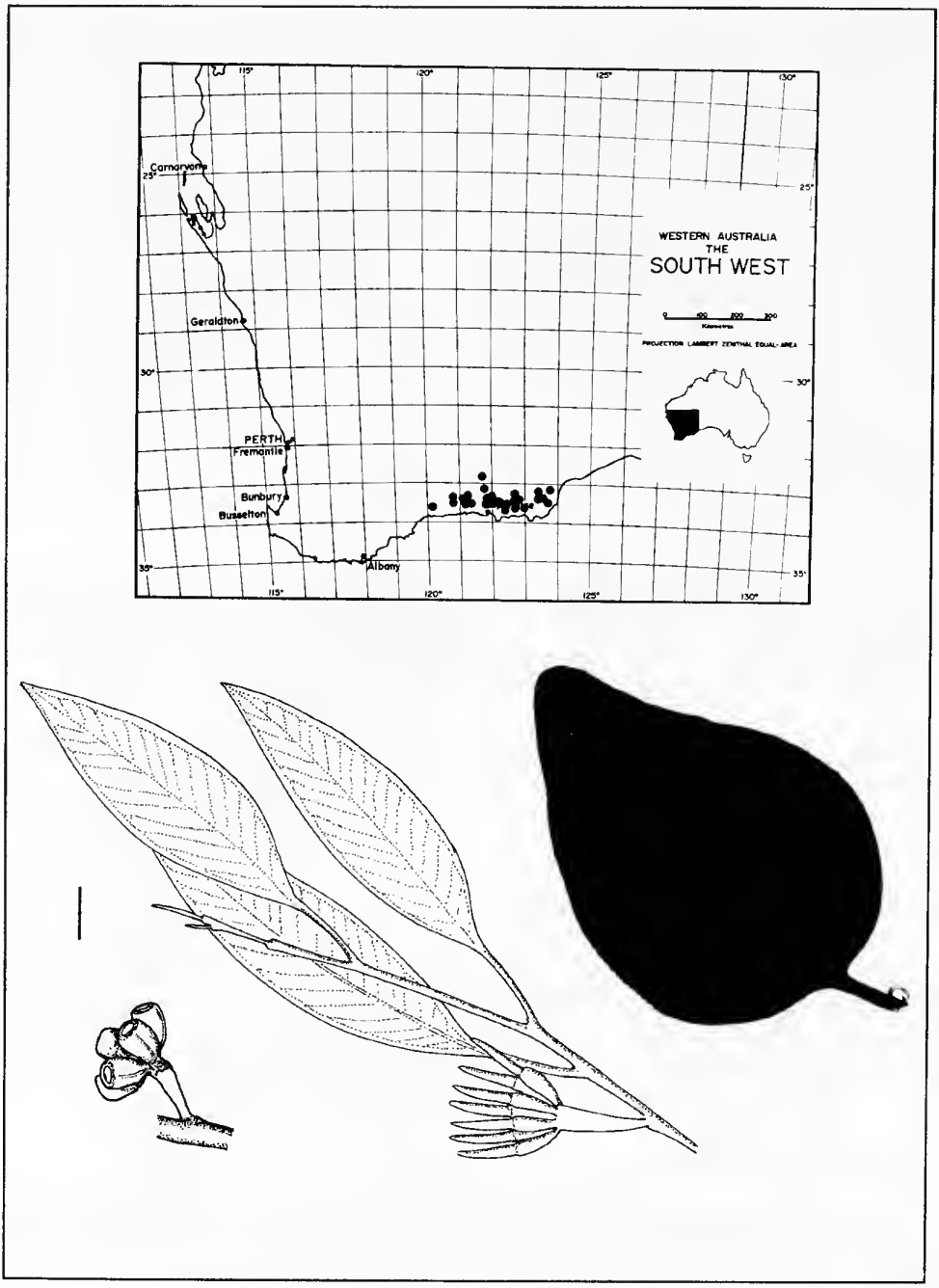

Figure 43. *Eucalyptus tumida* distribution, and immature buds, mature fruits, mature adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

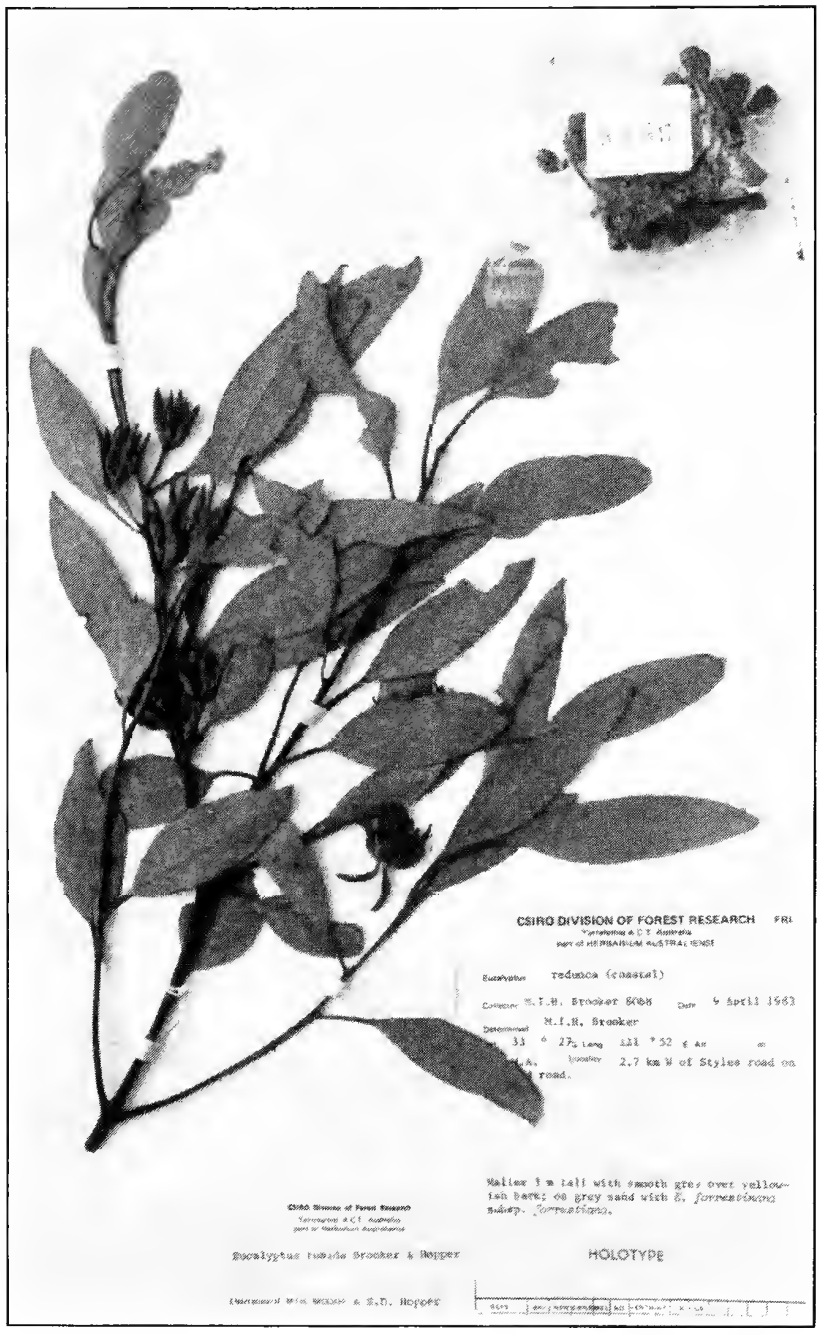

Figure 44. Holotype of *E. tumida* Brooker & Hopper.

Colour illustration. Brooker & Kleinig (1990: 183).

It differs from *E. phaenophylla* in the larger adult leaves (up to 11 x 2 cm), the more robust allantoid buds (to 2 x 0.3 cm) and fruit (to 0.8 x 0.7 cm) and the operculum on mature buds equalling the width of the hypanthium at the join.

Specimens examined. WESTERN AUSTRALIA: slope of Mt Ragged, 19 Oct. 1970, *T.E.H. Aplin* 4347 (PERTH); 35 miles E of Esperance, 4 Nov. 1962, *J.S. Beard* 2317 (PERTH); 25 miles NE of Condingup, 16 Sept. 1970, *J.S. Beard* 6351 (PERTH); Scadden, 15 Feb. 1970, *M.I.H. Brooker* 2503 (CANB, MEL, PERTH); Tower Hill, Mt Ragged, 10 April 1974, *M.I.H. Brooker* 4530 (CANB, PERTH); 1 km NE Lanes Rd on Coolinup Rd, NE of Esperance, 33° 41'S 122° 22'E, 12 Aug. 1982, *M.I.H. Brooker* 7545 (CANB, NSW, PERTH); 2.7 km W of Styles Road on Norwood Road, 33° 27'S 121° 52'E, 9 April 1983, *M.I.H. Brooker* 8068 (CANB, MEL, NSW, PERTH); Ned's Corner Road, 3 km N of Cascades townsite, 33° 28'S 121° 06'E, 9 April 1983, *M.I.H. Brooker* 8075 (CANB, NSW, PERTH); 11.4 km from Israelite Bay track on Mt Ragged track, 8 April 1985, *M.I.H. Brooker* 8917 (CANB, MEL, NSW, PERTH); 10 km due SSW of Mt Burdett, 0.7 km NE of Scadden Rd on Wittenoom Road, 33° 33'36"S 122° 07'21"E, 2 Aug. 1983, *M.A. Burgman* MAB 1593 & *S. McNee* (PERTH); 520.6 mile peg on Norseman-Salmon Gums Rd, 29 March 1968, *S.G.M. Carr* 625 (PERTH); Grasspatch, 49 mls N of Esperance, 31 March 1968, *S.G.M. Carr* 628, 631 (PERTH); 1.7 miles S of Gibsons Soak on Norseman-Esperance Rd, 31 March 1968, *S.G.M. Carr* 642 (PERTH); 39.3 miles W of Esperance, 15 March 1967, *G.M. Chippendale* 192 (CANB, PERTH); 32.6 miles E of Esperance, 25 March 1968, *G.M. Chippendale* 409 (CANB, PERTH); c. 75 km NE of Esperance, 7 Aug. 1980, *M.A. Clements* 1815 (CBG 8005162, PERTH); Mt Ragged Range, 2.5 km S of Tower Peak, 33° 28'S 123° 28'E, 6 Jan. 1979, *M.D. Crisp* 4845 (CBG, NSW, PERTH); c. 40 km NE of Condingup, junction of Beaumont Road and Parmango Road, 33° 30'S 122° 49'E, 26 Nov. 1985, *D.B. Foreman* 1253 (MEL, PERTH); 2.3 miles N of Salmon Gums, 15 Dec. 1940, *C.A. Gardner* s.n. (PERTH); N of Scadden, Dec. 1940, *C.A. Gardner* s.n. (PERTH); 5 miles southward from Salmon Gums, 7 Nov. 1953, *C.A. Gardner* 11171 (PERTH); 46 km N of Israelite Bay, 12 Feb. 1966, *C.A. Gardner* 16381 (PERTH); Mt Ragged, 7 Dec. 1960, *A.S. George* 2109 (PERTH); 8 km S of Ravensthorpe, 30 Oct. 1975, *J.W. Green* 4603 (PERTH); Cape Arid National Park, 33° 45'S 123° 00'E, 19 Sept. 1976, *R. Hnatiuk* 761072 (PERTH); along Point Malcolm Road, 33° 47'S 123° 45'E, 20 Sept. 1976, *R. Hnatiuk* 761139 (PERTH); 5 km WSW of Gora Hill, 8.4 km NE of Cape Arid N.P. W boundary, Mt Ragged track, 33° 33'S 123° 19'E, 7 Sept. 1982, *S.D. Hopper* 2522 (PERTH); Mt Ragged, 8 km E of Mt Symmons, Cape Arid National Park, 33° 27'S 123° 29'E, 8 Sept. 1982, *S.D. Hopper* 2533, 2534 (PERTH); Springdale Road, 5.5 km E of Hopetoun-Ravensthorpe road, 33° 55'S 120° 13'E, 29 Sept. 1987, *S.D. Hopper* 6144 (PERTH); 1 km S of junction between Coomalbidgup and Griffiths Roads, 33° 30'S 121° 20'E, 21 Jan. 1981, *G.J. Keighery* 3706 (PERTH); Griggs Road, 10 km E of Lort River, 21 Jan. 1981, *G.J. Keighery* 3755 (PERTH); 15 miles SW of Mount Ragged, June 1973, *O. Loneragan* 34 (PERTH); Kau Rock Reserve, 0.8 km from Coolinup Rd along Kau Rock Road, 33° 33'S 122° E, 22 Sept. 1985, *L.J. Nunn* 258 (PERTH); near Young River, 20 Oct. 1968, *A. Orchard* 1669 (CANB); 10 miles S of Red Lake siding, 18 April 1953, *R.D. Royce* 4061 (PERTH); W face of Mount Ragged, 3 Oct. 1970, *R.A. Saffrey* 1322 (CANB, PERTH); Sheoaks Hill, 29 km E of Mt Ragged and 19 km W of Israelite Bay, 3 Oct. 1970, *R.A. Saffrey* 1370 (CANB, PERTH); 5 miles N of Scadden, 10 April 1966, *E.M. Scrymgeour* 458 (PERTH); 9.8 km E of Scadden on Scadden Rd, 21 Aug. 1982, *P. van der Moezel* 163 (PERTH); 6 km E of Scadden on Scadden Rd,

26 March 1984, *P. van der Moezel* 325 (PERTH); Norseman-Esperance Road between Circle Valley and Red Lake, 69 miles S of Norseman, 7 Sept. 1963, *J.H. Willis* 2 (MEL, PERTH).

Distribution and habitat. East and north-east of Ravensthorpe, east to Israelite Bay (Figure 43). Common in species-rich mallee on plains or undulating terrain, and hillslopes such as on the western side of Mt Ragged. Not recorded on coastal sandplain.

Conservation status. Common and widespread, with many populations on nature reserves and national parks.

Flowering period. January-March.

Etymology. The specific name refers to the buds which are the largest in the series (not as broad as the buds of *E. desmondensis*) and have at maturity a swollen appearance (Latin *tumidus*, swollen).

Notes. Of the southern shiny-leaved species in the series, *E. tumida* has the largest leaves, buds and fruits. *E. varia* is the only other species of the series known to grow within the distribution of *E. tumida* but is clearly distinct in the narrow dull bluish leaves, more slender uncinate buds and pale yellow flowers. *E. tumida* differs from *E. phaenophylla* in its larger adult leaves and allantoid mature buds.

12. ***Eucalyptus histophylla*** Brooker & Hopper, sp. nov. (Figures 45, 46)

Frutex "mallee" ad 4 m altus cortice laevis cinereo vel subrosea. Medulla ramulorum glandulifera. Folia juvenilia ovata vel lanceolata, ad 11 x 4 cm, leviter nitentia, viridia. Folia adulta anguste lanceolata vel lanceolata, ad 11 x 1.1 cm, erecta tenentia, primo hebeta postremo leviter nitentia. Inflorescentiae ad 13-florae. Pedunculi ad 1.8 cm longi. Alabastra fusiformia, operculo vix hypanthio angustiore. Fructus cylindrici, ad 0.9 x 0.5 cm.

Typus: 32.5 km W of Balladonia Motel towards Norseman: 16.6 km E of road to Newman Rock, Western Australia, 10 July 1983, *S.D. Hopper* 2941 (holo: PERTH; iso: CANB).

Colour illustration. Brooker & Kleinig (1990: 184).

A mallee to 4 m tall. Bark smooth, dark grey, light grey, light brown or pale pinkish. Leaves of the seedling remaining opposite for 2-4 pairs, then alternating, ovate to lanceolate, to 11 x 4 cm, glabrous. Adult leaves, narrowly lanceolate to lanceolate, held erect, to 11 x 1.1 cm, maturing slightly glossy, green, to 18 cm long. Buds pedicellate, fusiform, to 2 x 0.3 cm; operculum horn-shaped, not conspicuously narrower than hypanthium at the join. Flowers not seen. Fruit pedicellate, cylindrical, to 0.9 x 0.5 cm. Seed light grey-brown, subspherical.

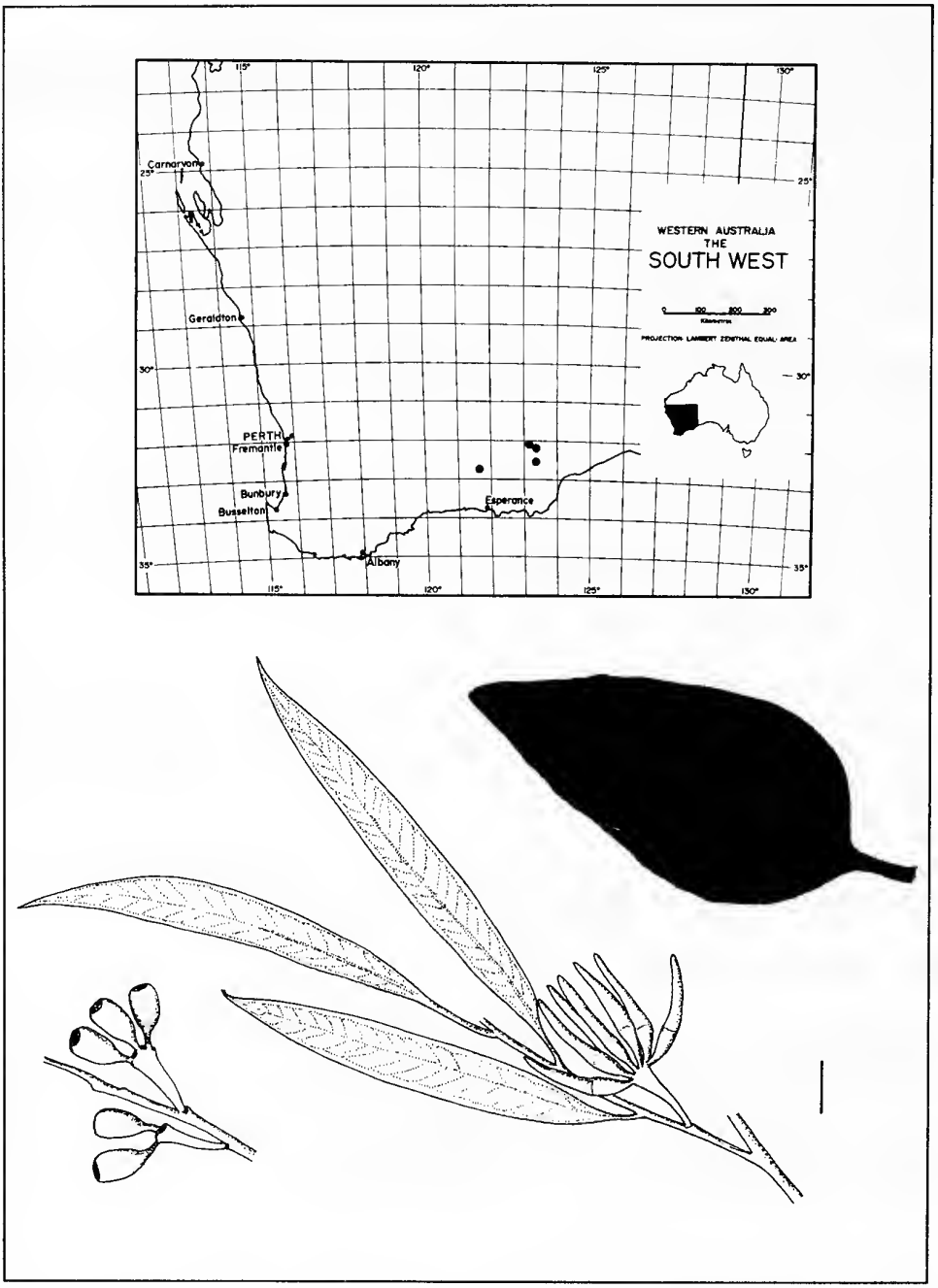

Figure 45. *Eucalyptus histophylla* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

Figure 46. Holotype of *E. histophylla* Brooker & Hopper.

Specimens examined. WESTERN AUSTRALIA: 131 mile peg on Norseman road, 17 July 1952, *P.H. Barrett* s.n. (PERTH); c. 26 km NW of Balladonia on Norseman road, 32° 16'S 123° 24'E, 22 Aug. 1979, *M.I.H. Brooker* 6447 (CANB, NSW, PERTH); 30 km W of Balladonia, 28 April 1982; *M.I.H. Brooker* 7485 (CANB, NSW, PERTH); 37.8 km NW of Balladonia towards Norseman, 32° 10'S 123° 15'E, 10 Feb. 1985, *M.I.H. Brooker* 8835 (CANB, MEL, NSW, PERTH); 40 km NW of Balladonia, 32° 10'S 123° 12'E, 9 Jan. 1986, *M.I.H. Brooker* 9147 (CANB, MEL, NSW, PERTH); 33 km W of Balladonia Roadhouse on Hwy 1, 32° 12'S 123° 19'E, 14 Nov. 1983, *K. Hill* 705 & *D. Blaxell* (NSW, PERTH); Dundas Nature Reserve, 4 km E of Boingarring Rock, 21 Aug. 1989, *S.D. Hopper* 7359 (PERTH); Dundas Nature Reserve, Boingarring Rock, 21 Aug. 1989, *S.D. Hopper* 7362 (PERTH); Mt Coobaninya, 22 Aug. 1989, *S.D. Hopper* 7408 (PERTH); Mt Buraminya, 23 Aug. 1989, *S.D. Hopper* 7446 (PERTH); 48 km from Norseman on Esperance road, 3 Jan. 1978, *E. Mullins* 331 (CANB); Dundas Nature Reserve, Boingaring Rocks, 40 km WSW of Balladonia Hotel, 32° 13'05"S 124° 27'50"E, 30 Sept 1987, *K. Newbey* 11778 (PERTH).

Distribution and habitat. Between Fraser Range and Balladonia and southwards on granite rocks to Mt Buraminya (Figure 45). *E. histophylla* is known from sites north-west and west-south-west of Balladonia where it grows in tall mallee with *E. eremophila* (Diels) Maiden, *E. fraseri* (Brooker) Brooker, *E.* sp. nov. aff. *transcontinentalis* Maiden, *E. leptophylla* and *E. indurata* Brooker and Hopper *ined.* However, it is common though sporadically distributed around granite outcrops further south, where it is often the only eucalypt present.

Conservation status. Poorly surveyed but known on Dundas Nature Reserve.

Flowering period. Unknown.

Etymology. The specific epithet refers to the erect leaves (Greek *histos*, upright and *phyllon*, leaf).

Notes. E. histophylla, as the epithet implies, is characterised by the erect leaves which make it easy to recognise in the field. The leaves are narrower than those of *E. tumida*, and only become glossy within the crown by the second year. *E. histophylla* has not been seen in flower so comparisons for this character with the beautiful, yellow-flowered *E. flavida* have not been possible.

Surveys by S.D. Hopper in 1989 established that *E. histophylla* occurs predominantly on granite outcrops, an unusual habitat for taxa in the series.

13. ***Eucalyptus clivicola*** Brooker & Hopper, sp. nov. (Figures 2, 47, 48, 49)

Arbor parva ("mallet") vel frutex ("mallee") ad 7 m alta caulibus exilibus et cortice laevi cinereo extus cuprino intus. Folia adulta nitentia viridia. Inflorescentiae ad 11-flores. Alabastra operculo aequanti hypanthium diametro, redunco. Fructus doliiformes, ad 0.9 x 0.6 cm. Semina subsphaerica vel raro cuboidea.

Typus: 9.6 km south of the Eldverton turn-off on the Hopetoun road, Western Australia, 10 April 1983, *M.I.H. Brooker* 8078 (holo: PERTH; iso: CANB, NSW).

Colour illustration. Brooker & Kleinig (1990: 186).

A mallet or rarely a mallee to 12 m tall with smooth, grey over pale yellow to coppery bark; trunk or stems slender, often with prominent horizontal insect scars 3-10 cm long. Pith of branchlets glandular, sometimes rarely so. Leaves of the seedling remaining opposite for 3 or 4 pairs, then alternating, deltoid to ovate, with occasional teeth around edges, to 9 x 6 cm, at first dull, becoming slightly glossy, blue-green, glabrous. Adult leaves narrowly lanceolate to lanceolate, to 10 x 1.8 cm, glossy, green. Inflorescences up to 11-flowered; peduncles to 1.4 cm long. Buds attentuate, to 1.8 x 0.4 cm; operculum recurved at the tip, more or less equal to hypanthium at join on mature buds. Flowers pale yellow. Fruit pedicellate, barrel-shaped, to 0.9 x 0.6 cm. Seed light grey-brown, subspherical to rarely cuboid.

Specimens examined. WESTERN AUSTRALIA: 3.3 km E of Ongerup on Jerramungup Rd, 6 Oct. 1982, *M.I.H. Brooker* 7682, 7683, (CANB, NSW, PERTH); W side of Mt Desmond, 33° 38'S 120° 08'E, 4 June 1983, *M.I.H. Brooker* 8161 (CANB, NSW, PERTH); 9.8 km S of the Eldverton turn-off on Hopetoun road, 33° 44'S 120° 10'E, 23 Nov. 1983, *M.I.H. Brooker* 8376 (CANB, NSW, PERTH); 3.3 km E of Ongerup on Jerramungup road, 6 Oct. 1982, *M.I.H. Brooker* 7682 (CANB); E of Mt Short, N of Ravensthorpe, 33° 28'S 120° 02'E, 18 Jan. 1985, *M.I.H. Brooker* 8805 (CANB, MEL, NSW, PERTH); 30.6 km E along East Road, E of Pingrup, 33° 29'S 119° 00'E, 19 Feb. 1985, *M.I.H. Brooker* 8850 (CANB, MEL, NSW, PERTH); Corner of Magner Road and Ongerup-Jerramungup Road, 33° 57'S 118° 32'E, 21 Feb. 1985, *M.I.H. Brooker* 8861 (CANB, MEL, NSW, PERTH); c. 1 km SE of Bandalup Hill, 33° 39'S 120° 22'E, 11 April 1985, *M.I.H. Brooker* 8942 (CANB, MEL, NSW, PERTH); 1 km W of Pingrup on Borden Ongerup rd, 34° 01'S 118° 19'E, 18 May 1987, *M.I.H. Brooker* 9637 (AD, CANB, MEL, NSW, PERTH); 13.2 miles S of Ravensthorpe, 16 March 1967, *G.M. Chippendale* 209 (CANB, PERTH); 8 miles N of Ravensthorpe, 14 March 1957, *J.W. Green* 1203 (PERTH); 8 km S of Ravensthorpe, 30 Oct. 1975, *J.W. Green* 4598, 4603 (PERTH); 15.2 km SW of Ravensthorpe on Moir Road, 13 Nov. 1978, *J.W. Green* 4906 (PERTH); c. 2 km W of Young River along West Point Road, 33° 22'S 120° 45'E, 22 Oct. 1983, *K. Hill* 309, *L. Johnson & D. Blaxell* (NSW, PERTH); 0.7 km S along Norman Road from Cowalellup Road, SE of Ongerup, 34° 11'S 118° 43'E, 23 Oct. 1983, *K. Hill* 341, *L. Johnson & D. Blaxell* (CANB, NSW, PERTH); 3.5 km E of Ongerup on Jerramungup Rd, 33° 56'S 118° 31'E, 1 Aug. 1982, *S.D. Hopper* 2411 (PERTH); 11 km SSE of Mt Desmond, Kundip, 33° 42'S 120° 11'E, 2 Aug. 1982, *S.D. Hopper* 2419 (PERTH); 28 km NE of Bandalup Hill, 33° 28'S 120° 35'E, 4 Aug. 1982, *S.D. Hopper* 2444 (PERTH); Fitzgerald River National Park, 1.7 km W of Fitzgerald River crossing on Colletts Track, 34° 05'S 119° 33'E, 5 Oct. 1984, *S.D. Hopper* 4221 (PERTH); 4.4 km E of Quiss Rd, on the N boundary of Fitzgerald River National Park, 33° 58'S 119° 14'E, 1 Oct. 1987, *S.D. Hopper* 6168 (PERTH); Fitzgerald River National Park, on W slope of Twertup Creek, 33° 58'S 119° 16'E, 1 Oct. 1987, *S.D. Hopper* 6172 (PERTH); 1 km S of Bandalup Hill, 33° 30'S 122° 20'E, 20 Jan. 1981, *G.J. Keighery* 3719 (PERTH); near Woolbrunup Hill, Fitzgerald River National Park, 11 May 1981, *G.J. Keighery* 3929 (PERTH); Pitchy-ritchy picnic area, Phillips River, Fitzgerald River National Park, 33° 55'S 120° 03'E, 3 July 1988, *N. Mcquoid* 21 (PERTH); Ravensthorpe Range, 8 Nov. 1935, *Milesi & Gardner* (PERTH); Kundip, 22 April 1953, *R.D. Royce* 4137, 4139 (PERTH).

Distribution and habitat. From west of Ongerup to the Ravensthorpe Range and north-east of Bandalup Hill, and north to the Lake Magenta area (Figure 47). Often forms pure stands of low open forest on breakaways, rarely on flat terrain. It may grow with other mallets such as *E. platypus* and *E. astringens*.

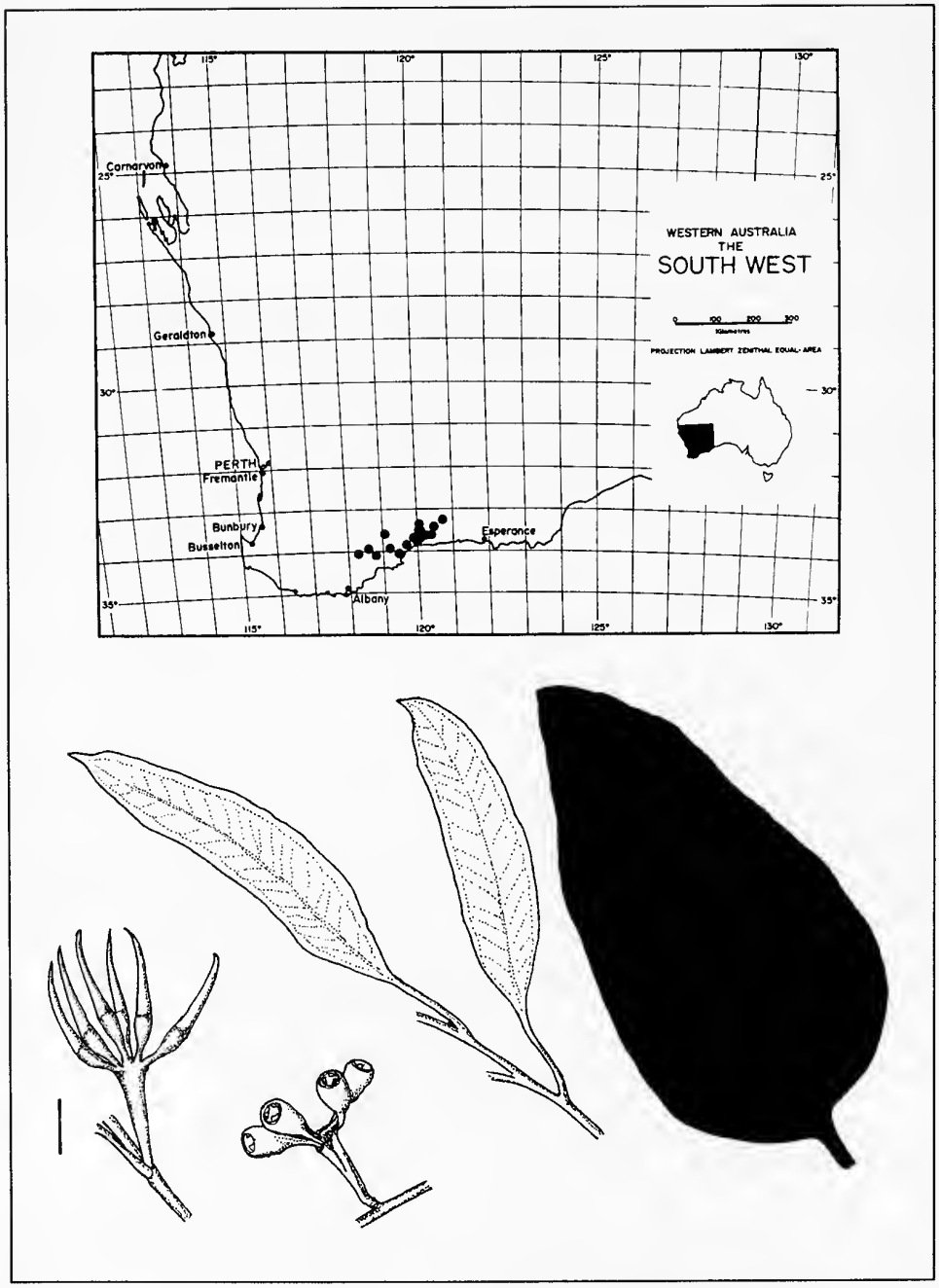

Figure 47. *Eucalyptus clivicola* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

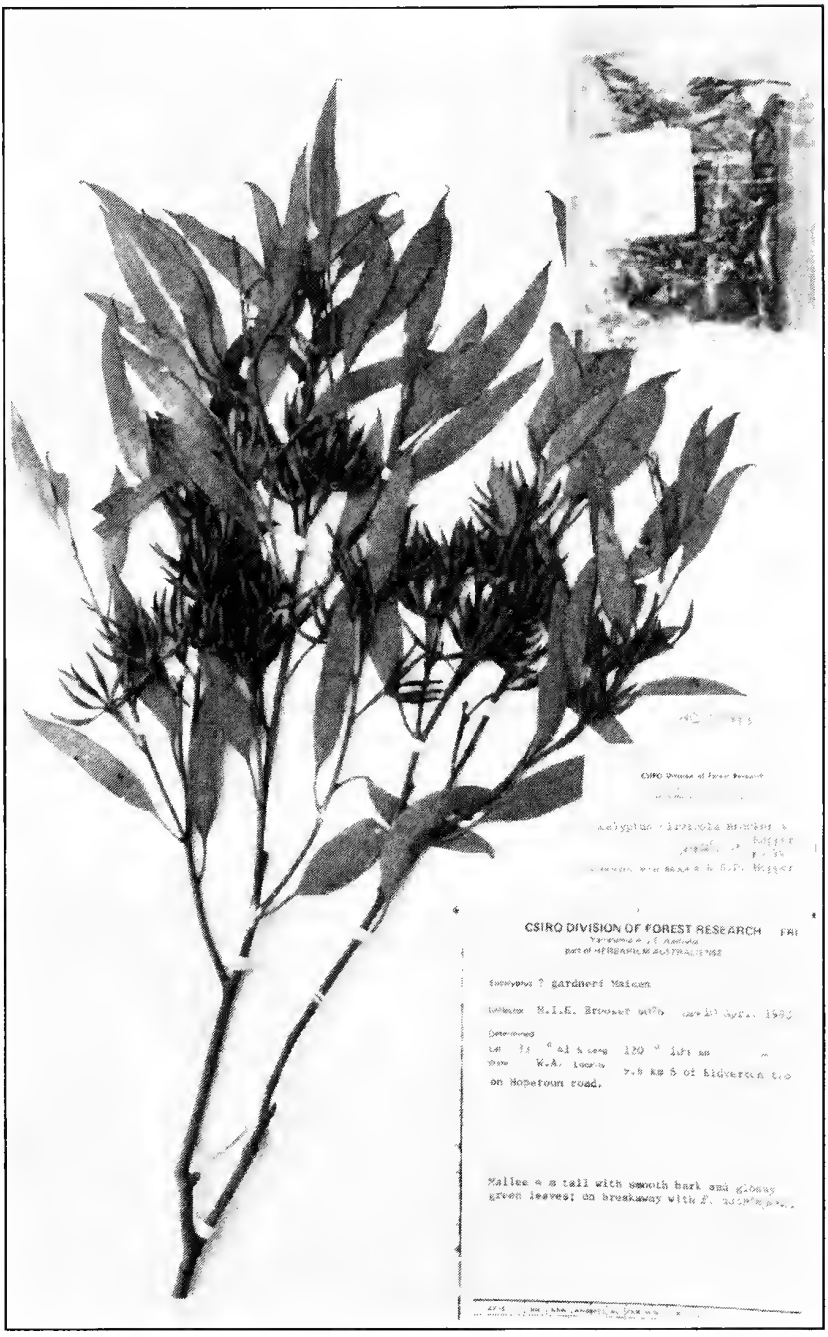

Figure 48. Holotype of *E. clivicola* Brooker & Hopper.

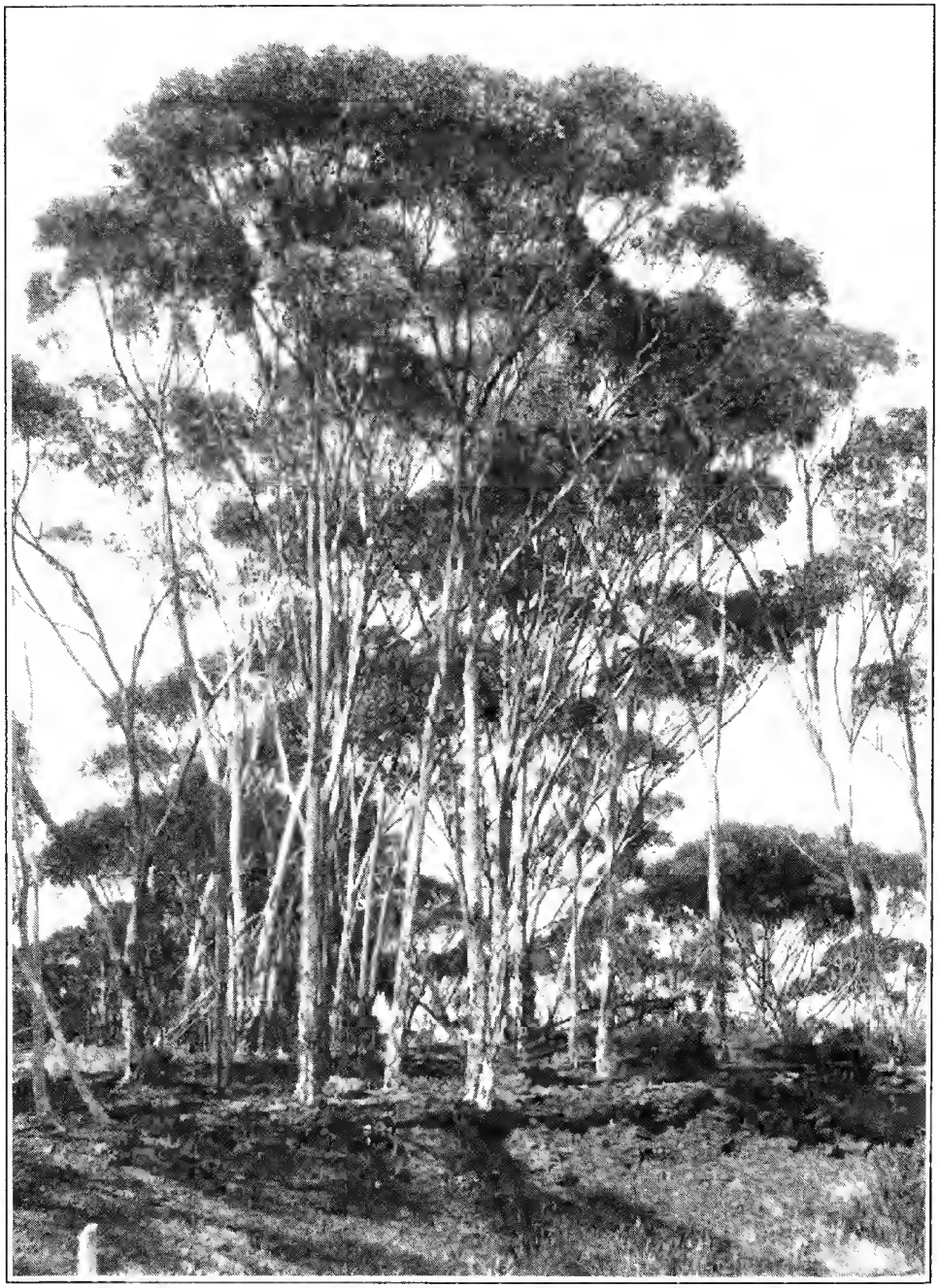

Figure 49. *E. clivicola* showing mallet habit (NW of Ravensthorpe).

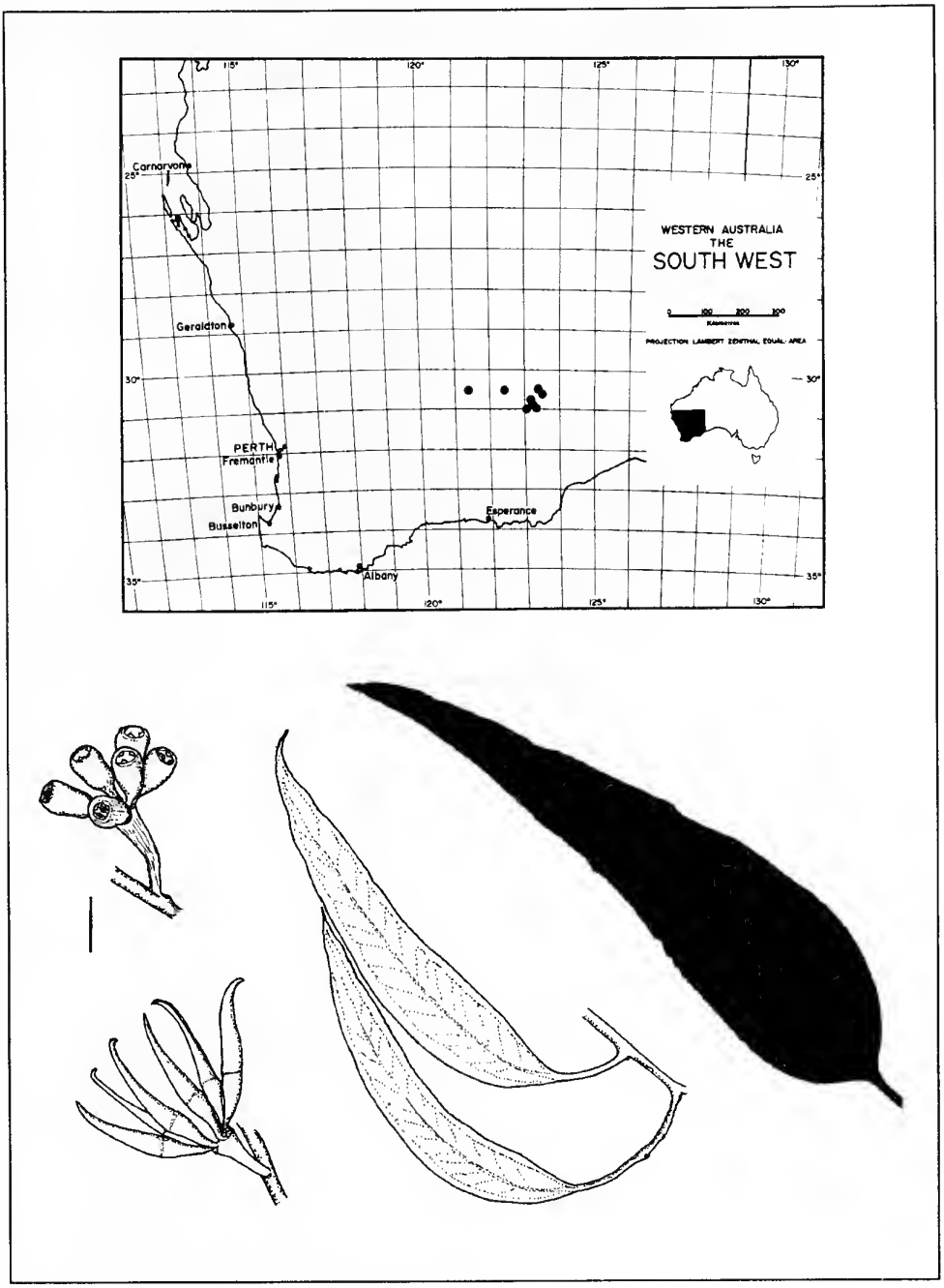

Figure 50. *Eucalyptus flavida* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

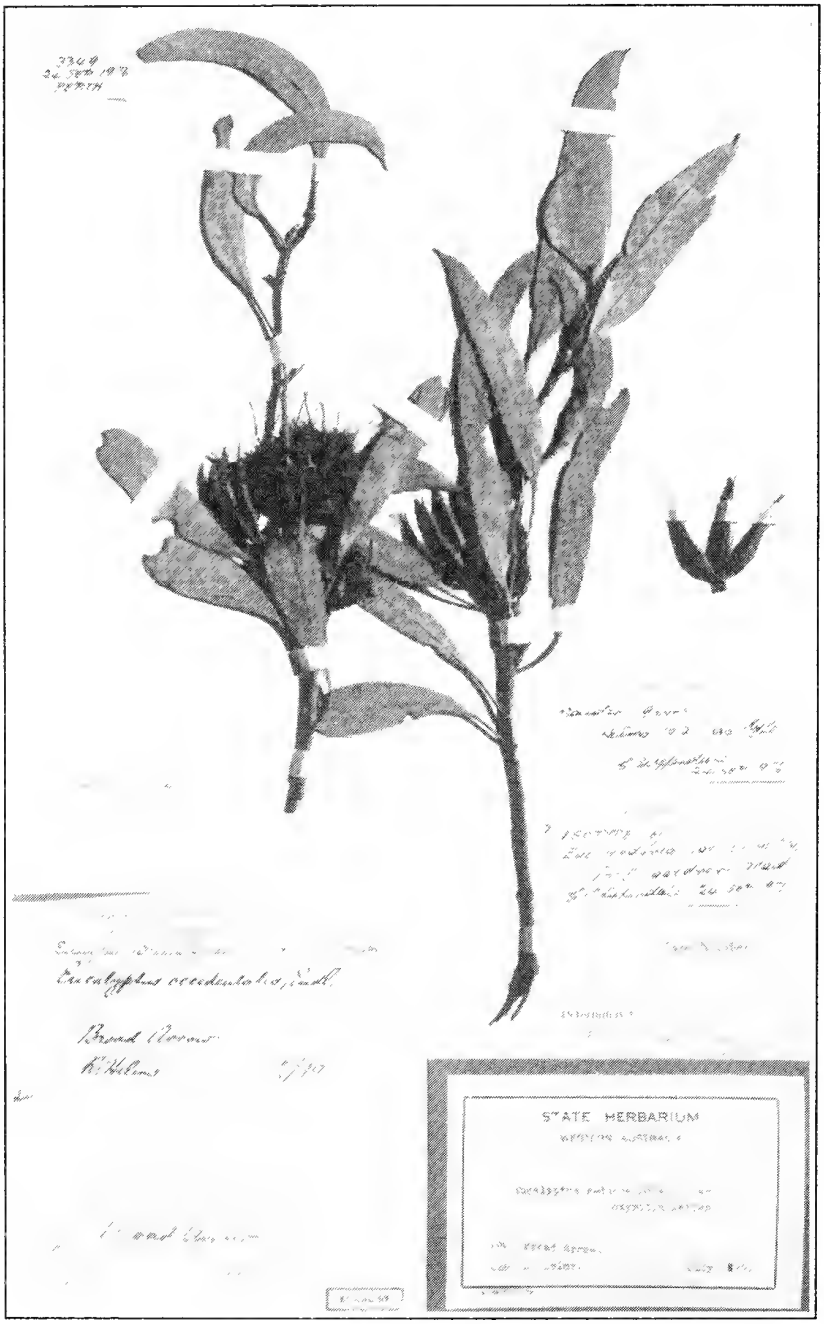

Figure 51. Isotype of *E. flavida* Brooker & Hopper.

Conservation status. Locally abundant in disjunct populations, several of which occur on conservation reserves such as Fitzgerald River National Park and Lake Magenta Nature Reserve.

Flowering period. December-May.

Etymology. The specific name refers to the topography of many occurrences (Latin *clivus*, hill and *cola*, dwelling).

Notes. E. clivicola is a mallet occurring on breakaways or other high ground. We propose the common name "green mallet" for it, alluding to the green canopy. In young buds it has the narrowed operculum seen in *E. phaenophylla*. With its mallet habit, bright glossy green leaves and yellow flowers, it is likely to be a useful ornamental.

14. ***Eucalyptus flavida*** Brooker & Hopper, nom. et stat. nov. *E. redunca* Schauer var. *oxymitra* Maiden, "Crit. Revis. Gen. *Eucalyptus*." 4: 98 (1918). *Type*: Broad Arrow, Western Australia, July 1899, *R. Helms* 102 (holo: NSW; iso: CANB, K, MEL, PERTH). (Figures 9, 10a, 11a, 50, 51)

Colour illustration. Brooker & Kleinig (1990: 185).

A mallee or tree to 8 m tall, either with a stocking to 2 m of coarse, flaking, brown-black, rough bark, or smooth, grey, grey-green, or coppery over whole stems. Pith of branchlets glandular. Leaves of the seedling remaining for 2 or 3 pairs, then alternating, broadly lanceolate, to 14 x 3.5 cm, glossy, green, glabrous. Adult leaves petiolate, alternating, lanceolate to falcate, to 11 x 1.5 cm, slightly glossy, light green. Inflorescences to 11-flowered; peduncles to 1.5 cm long. Buds pedicellate, fusiform, to 3 x 0.4 cm, operculum long, horn-shaped, attenuate, often narrower than hypanthium at join, recurved at tip. Flowers yellow. Fruit pedicellate, cylindrical to slightly barrel-shaped, to 1 x 0.6 cm. Seed light grey-brown, more or less spherical.

Specimens examined. WESTERN AUSTRALIA: 2 km S of Broad Arrow, 30° 28'S 121° 22'E, 4 Nov. 1983, *M.I.H. Brooker* 8341 (CANB, NSW, PERTH); 52 km E of Karonie, 31° 02'S 123° 03'E, *M.I.H. Brooker* 8342 (CANB, NSW, PERTH); c. 2 km S of Broad Arrow, 30° 28'S 121° 20'E, 13 Nov. 1985, *M.I.H. Brooker* 9086 (CANB, MEL, NSW, PERTH); 16.7 km NE of Coonana, 30° 51'S 123° 15'E, *M.I.H. Brooker* 9629 (AD, CANB, MEL, NSW, PERTH); 13 km from Kurnalpi to Pinjin, 24 June 1987, *M.I.H. Brooker* 9664 (AD, CANB, MEL, NSW, PERTH); Broad Arrow, 11 Nov. 1962, *C. Davies* s.n. (PERTH); Broad Arrow, Nov. 1961, *O.I.C. Forests Dept.* Kalgoorlie 6331/61 (PERTH); Coonana Reserve, 106 m Trans Railway, 8 June 1939, *Forests Dept.* (PERTH); Between Cundeelee Mission and 12 mile rockhole, 9 Nov. 1963, *A.S. George* 5989 (PERTH); 17.7 miles N of Cundeelee Mission, 19 Oct. 1966, *A.S. George* 8616 (PERTH); 1 km S of Broad Arrow on Kalgoorlie road (37 km N of Kalgoorlie), 100 m E of road, 30° 27'S 121° 20'E, 4 Nov. 1983, *K. Hill* 551 *& L Johnson, D. Blaxell and I. Brooker* (CANB, NSW, PERTH); c. 1.2 km SE of Broad Arrow hotel, 39 km N of Kalgoorlie, 30° 27'S 121° 20'E, 4 Nov. 1983, *S.D. Hopper* 3579 (PERTH); 12 km S of Queen Victoria Springs, 13 Aug. 1984, *S.D. Hopper* 3938 (PERTH); 1.3 km N of railway along E boundary of Coonana Sandalwood Reserve, 31° 01'S 123° 15'E, 14 Aug. 1984, *S.D. Hopper* 3939 (PERTH); 9 miles S of Queen Victoria Springs, 26 Jan. 1956, *R.D. Royce* 5292 (PERTH); Cundeelee Mission, N of Zanthus, 27 Jan. 1956, *R.D. Royce* 5339 (PERTH); Cundeelee, 27 Jan. 1956, *R.D. Royce* 5340 (PERTH); Cundeelee, 27 Jan. 1956, *R.D. Royce* 5340 (PERTH); Goddard's Creek, 28 Jan 1956, *R.D. Royce* 5363 (PERTH).

Distribution and habitat. North and east of Kalgoorlie (Figure 50). *E. flavida* grows in open low woodlands and mallee usually on gently undulating terrain. Soils are red loam with quartz or calcrete. Associated eucalypts are *E.* aff. *longicornis*, *E. griffithsii* Maiden, *E.* aff. *transcontinentalis* Maiden, *E. clelandii* (Maiden) Maiden and *E. rigidula* Maiden.

Conservation status. Locally abundant in disjunct populations, a few of which are on reserves such as Queen Victoria Spring Nature Reserve.

Flowering period. November-December.

Etymology. A new specific epithet is needed for this taxon because Maiden's varietal name *oxymitra* is already in use at the species level for Sharp-capped Mallee, *E. oxymitra* Blakely, of the central Australian region. The new specific epithet refers to the colour of the flowers (Latin *flavidus*, yellow).

Notes. The glossy green lanceolate juvenile leaves of this species are unique in the series. Its long slender uncinate buds, yellow stamens and long barrel-shaped fruits suggest affinities with *E. redunca*, *E. pluricaulis*, *E. varia*, *E. densa* and *E. gardneri*, but the consistent presence of pith glands and the juvenile leaves in *E. flavida* isolates this species somewhat from the superspecies "*redunca*". The copious flower production and inland distribution of *E. flavida* indicate suitability as a hardy ornamental. Birds such as Yellow-throated Miners and Red Wattlebirds have been observed taking nectar from flowers in the wild (Hopper unpubl.).

15. ***Eucalyptus crispata*** Brooker & Hopper, sp. nov. (Figures 5e, 52, 53, 54)

Frutex ("mallee") ad 5 m altus cortice inferiore decorticanti crispato superiore laevi cineraceo, foliis adultis hebetibus vel nitentibus, et alabastris plerumque brevioribus crassioribusque quam affinibus. Semina cuboidea vel plano-ovoidea.

Typus: near Yandanooka, Western Australia, 13 March 1986, *M.I.H. Brooker* 9207 & *S.D. Hopper* (holo: PERTH; iso: CANB, MEL, NSW).

Colour illustration. Brooker & Kleinig (1990: 180).

A mallee to 5 m tall, erect or spreading. Bark towards base of stems held in partly decorticated curls, smooth grey above. Pith of branchlets glandular. Leaves of the seedling remaining opposite for about 2 pairs, then alternating, ovate to deltoid, to 10 x 9 cm, glabrous, slightly glossy, blue-green. Adult leaves petiolate, alternating, lanceolate to falcate, to 9 x 1.5 cm, dull or glossy, green. Inflorescences to 13-flowered. Peduncles to 1.6 cm long. Buds to 1 x 0.4 cm, shorter and broader than most related species, operculum cylindrical to conical. Fruit sessile to shortly pedicellate, obconical to cupular, to 0.5 x 0.5 cm. Seed light grey-brown, cuboid to compressed-ovoid.

Specimens examined. WESTERN AUSTRALIA: Type locality, 13 March 1986, *M.I.H. Brooker* 9205, 9208, 9209 & *S.D. Hopper* (CANB, MEL, NSW, PERTH); NE of Eneabba, 21 Nov. 1986, *M.I.H. Brooker* 9555 (CANB, MEL, NSW, PERTH); 1 km N of EW fence on N-S track, west of South Eneabba Nature Reserve, 30° 00'S 115° 16'E, 20 Sept. 1988, *M.I.H. Brooker* 10080 (AD, CANB, MEL, NSW, PERTH); type locality, 13 March 1986, *S.D. Hopper* 4772, 4773, 4774, 4775, 4776 (PERTH).

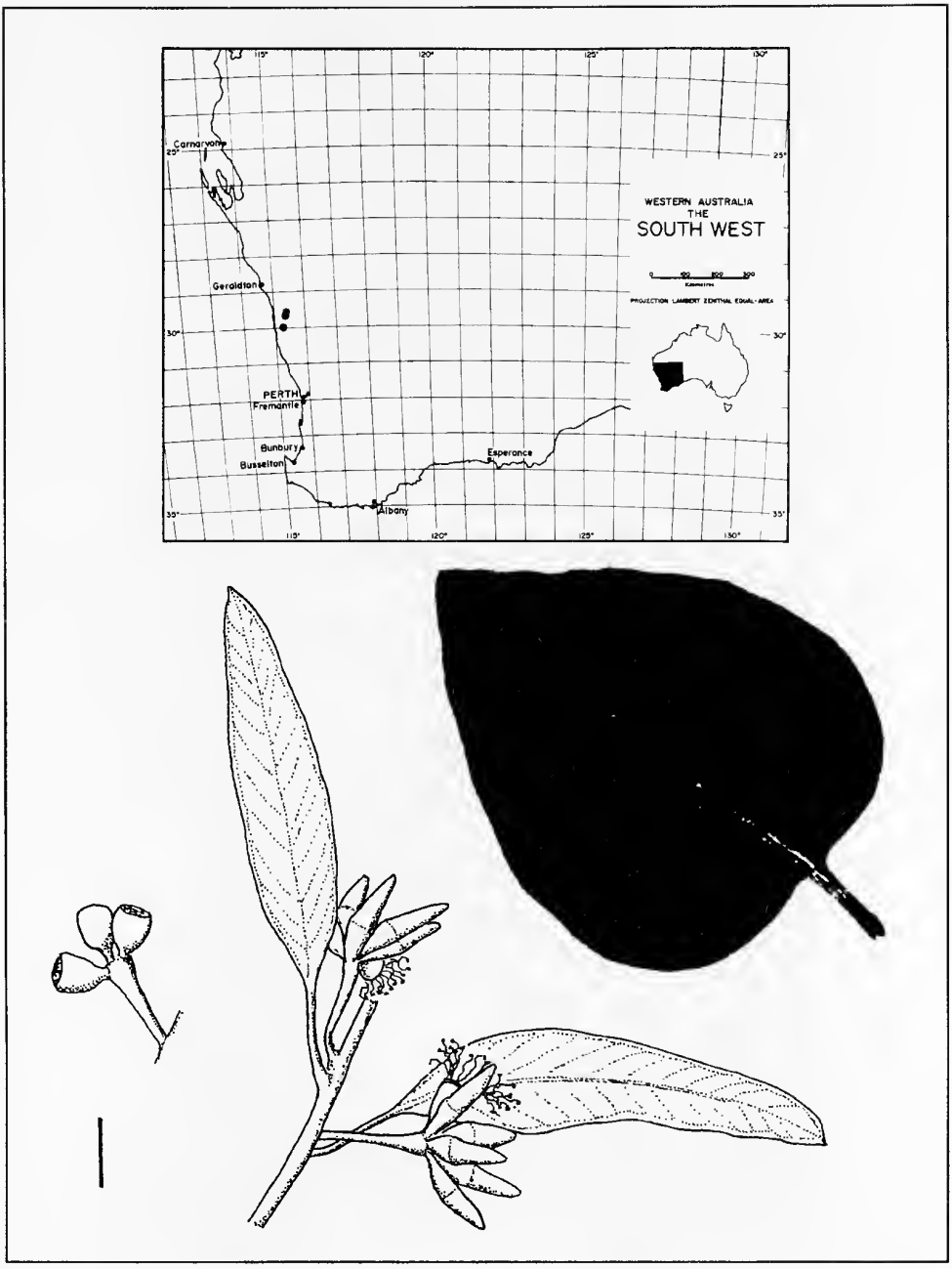

Figure 52. *Eucalyptus crispata* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

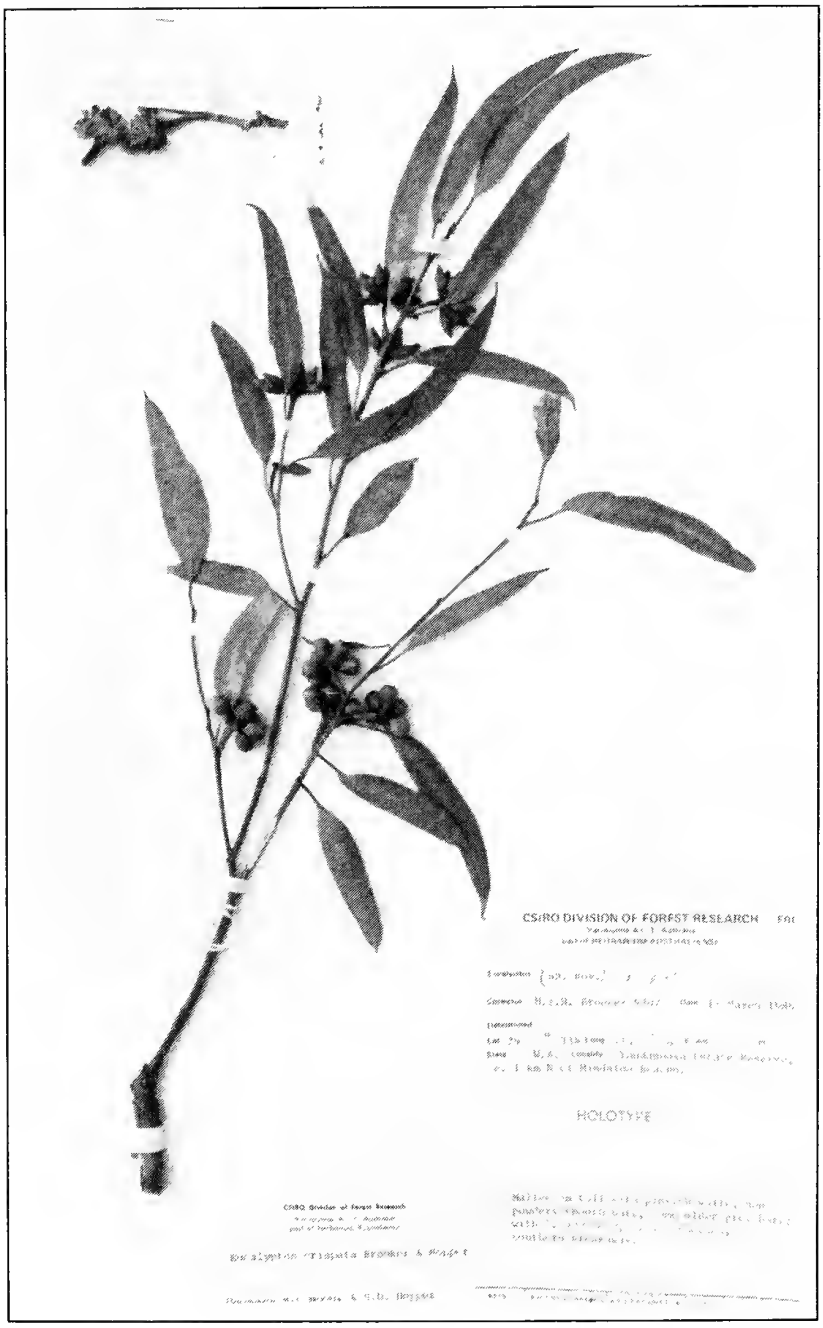

Figure 53. Holotype of *E. crispata* Brooker & Hopper.

Figure 54. *E. crispata* mallee habit at type locality, and stems and bark.

Distribution and habitat. Known from lateritic breakaways south of Mingenew where it occurs in several small pure stands, and a single occurrence near Eneabba (Figure 52).

Conservation status. Rare and vulnerable. Currently declared as Endangered Flora under the Wildlife Conservation Act (Hopper *et al.* 1990). Population sizes are small and will need to be monitored to ensure against accidental destruction.

Flowering period. ? April.

Etymology. The specific epithet refers to the curled, partly detached basal bark (Latin *crispatus*, curled).

Notes. E. crispata is a rare mallee known only from two localities. The crisped basal bark is unique in the series. The buds are relatively short and fat though variable while the seedling leaves vary from ovate to cordate (similar to *E. accedens* and *E. leprophloia* Brooker & Hopper *ined.* although not seen to segregate within family lots of four parents tested). The seed are somewhat ovoid. While of fairly uniform appearance in the field, the species may be of recognisably recent hybrid origin with the parentage of *E. accedens* and *E. arachnaea*, both of which co-occur with *E. crispata*.

16. ***Eucalyptus subangusta*** (Blakely) Brooker & Hopper, comb. et stat. nov.; *E. redunca* Schauer var. *subangusta* Blakely, "Key to the Eucalypts." p. 111 (1934). *Lectotype* (here designated): Cunderdin, Western Australia, *W.V. Fitzgerald* s.n. (Figures 3, 5f, 12b, 55, 56, 57, 58, 59, 60, 61, 62)

A mallee or mallet with smooth, grey over pink or coppery bark. Pith of branchlets glandular. Leaves of the seedling remaining opposite for 4-6 pairs, then alternating, lanceolate to ovate, to 9 x 4 cm, dull, green, blue-grey or glaucous, glabrous. Adult leaves petiolate, alternating, narrowly lanceolate to lanceolate, to 11 x 1 cm, dull or rarely glossy (in subsp. *virescens*), light green, maturing to blue-green. Inflorescences to 17-flowered; peduncles to 1 cm long. Buds shortly pedicellate, fusiform, to 1 x 0.3 cm, operculum oblong, obtuse or acute at tip; few stamens erect, flowers white. Fruit shortly pedicellate, cupular (i.e. about as long as broad), to 0.5 x 0.5 cm (as broad as long). Seed light grey-brown, subspherical to cuboid.

Typification: In the protologue for var. *subangusta*, Blakely presumably refers to Maiden's treatment of *E. redunca* var. *angustifolia* Benth. that alludes to two Drummond specimens, 67 and 187, which are the syntypes of var. *angustifolia* (now *E. xanthonema*). There are three further specimens which are most simply referred to by their localities, *viz.* Cunderdin, Knutsford and Golden Valley. Blakely then cited one of these, Cunderdin, in the illustrations (Plate 140, number 6) which becomes the type of *E. redunca* var. *subangusta*.

This specimen in NSW is clearly the smooth-barked mallee of the yellow sandplains in the central and northern wheatbelt. However, Blakely's description of a tree, 7 m tall, with rough bark is at odds with any known specimen of var. *subangusta* as we interpret the type. We feel justified in rejecting the description in Blakely which further includes a comparison of var. *subangusta* with typical *E redunca* which he is unlikely to have examined. We therefore present, above, the new comprehensive description for the taxon represented by the type specimen.

The second and third of the specimens referred to by Maiden, Knutsford and Golden Valley, we treat later under *E. subangusta* subsp. *cerina*. Maiden considered that the two localities were one and the same place. Golden Valley appears on present-days maps, but not Knutsford.

Notes. E. subangusta is one of the taxa that has been commonly confused with *E. redunca*. Extensive fieldwork has shown it to be a distinctive species of yellow sandplains in the northern and central wheatbelt. Rather than with *E. redunca*, its affinities lie closely with *E. microschema*, *E. subtilis* and to a lesser extent with superspecies "*wandoo*" (Table 1). *E. subangusta* differs from *E. microschema* in its larger stature, softer less erect usually dull leaves and preference for sandplain. From *E. subtilis* it differs in the broader juvenile and adult leaves, the latter maturing blue-green, and in the oblong, usually obtuse opercula.

It clearly differs from *E. wandoo*, *E. capillosa* subsp. *capillosa* and *E. nigrifunda* in the mallee habit. From *E. capillosa* subsp. *polyclada* it differs in the narrower leaves, oblong or narrowly conical never uncinate opercula and smaller cupular fruit. It differs from *E. livida* in the smaller green to blue-green leaves, smaller buds and smaller fruits, and from *E. crispata* in the smooth bark and smaller leaves and fruits. The seed in *E. subangusta* are unusual in the series for being slightly angular rendering them somewhat cuboid.

There are four subspecies.

16a. ***Eucalyptus subangusta*** (Blakely) Brooker & Hopper subsp. ***subangusta*** (Figures 3, 12b, 55)

Colour illustration. Brooker & Kleinig (1990: 168).

A mallee with non-waxy branchlets, adult leaves dull, to 11 x 1 cm, buds to 1 x 0.3 cm with obtuse or acute opercula, and fruit to 0.5 x 0.5 cm.

Specimens examined. WESTERN AUSTRALIA: 9 miles E of Pithara, 23 July 1971, *K.M. Allan* 712 (BRI, CANB, PERTH); 4 miles N of Tammin, 29 June 1959, *T.E.H. Aplin* 505 (PERTH); 2 miles S of Cramphorne, Oct. 1945, *E.T. Bailey* 334 (PERTH); 10 miles S of Mullewa, 26 Sept. 1973, *J.S. Beard* 6690 (CANB); Between Carnamah and Perenjori, 5 Nov. 1974, *J.S. Beard* 7353 (PERTH); 53 miles E of Dalwallinu, 2 Oct. 1976, *J.S. Beard* 7977 (PERTH); 17 miles from Wongan Hills, on Cadoux road, 5 Oct. 1976, *J.S. Beard* 8006 (PERTH); Between Yuna and Mullewa, Sept. 1940, *W.E. Blackall* 4852 (PERTH); 20 km NW of Hyden, 4 Oct. 1975, D.*E. Blaxell* W75/75 (CANB, K, NSW, PERTH); 3 miles E of Tammin, 3 June 1969, *M.I.H. Brooker* 1780 (PERTH); 1 mile S of Bencubbin, 22 July 1969, *M.I.H. Brooker* 1892 (PERTH); 1/2 mile N of Bendering, 13 July 1970, *M.I.H. Brooker* 2643, 2644 (BRI, CANB, MEL, PERTH); 7 miles W of Moorine, 15 July 1970, *M.I.H. Brooker* 2689 (CANB, MEL, NSW, PERTH); 10 1/2 miles E of Pithara, 4 May 1972, *M.I.H. Brooker* 3692 (CANB, PERTH); 15 km E of Gunyidi, 21 May 1982, *M.I.H. Brooker* 7526 (CANB, NSW, PERTH); S of Mt Rupert, Wongan Hills, NW of Mt Mathilde, 21 May 1982, *M.I.H. Brooker* 7533 (CANB, NSW, PERTH); 12.6 km E of rail crossing at Carani, 30° 59'S 116° 31'E, 26 Aug. 1982, *M.I.H. Brooker* 7586 (CANB, NSW, PERTH); Wongan Hills, NE-facing slope, c. 1 km S of road to Gap, 30° 52'S 116° 40'E, 26 Aug. 1982, *M.I.H. Brooker* 7594 (CANB, NSW, PERTH); 4 km S of Piawaning, 30° 54'S 116° 23'E, 26 Aug. 1982, *M.I.H. Brooker* 7600,

7602, (CANB, NSW, PERTH); c. 1.5 km N of Dowerin on Cadoux Rd, 31° 13'S 117° 03'E, 14 Sept. 1982, *M.I.H. Brooker* 7604, 7605 (CANB, NSW, PERTH); 4.3 km N of Dowerin on Cadoux Rd, 31° 11'S 117° 03'E, 14 Sept. 1982, *M.I.H. Brooker* 7608 (CANB, NSW, PERTH); 21 km NE of Doodarding towards Koorda, 30° 51'S 117° 22'E, 14 Sept. 1982, *M.I.H. Brooker* 7612 (CANB, NSW, PERTH); 6 km SW of Koorda towards Doodarding, 30° 52'S 117° 27'E, 14 Sept. 1982, *M.I.H. Brooker* 7614 (CANB, NSW, PERTH); Corner Scotsman's Rd and Cleary-Paynes Find Road, 30° 22'S 117° 34'E, 11 Jan. 1983, *M.I.H. Brooker* 7914 (CANB, NSW, PERTH); 0.5 km W of Wandana Rd at N end, N or Yuna, 28° 03'S 115° 03'E, 25 Jan. 1983, *M.I.H. Brooker* 7938 (CANB, NSW, PERTH); c. 4 km W of Kalannie, 30° 20'S 117° 04'E, 8 Feb. 1983, *M.I.H. Brooker* 7953 (CANB, NSW, PERTH); 6.1 km N of Merindo N. Road on Kulja Central Road, 30° 18'S 117° 18'E, 9 Feb. 1983, *M.I.H. Brooker* 7961 (CANB, NSW, PERTH); 101 km W of Coolgardie-Norseman road on Hyden track, 32° 04'S 120° 42'E, 7 Nov. 1983, *M.I.H. Brooker* 8355 (CANB, NSW, PERTH); Mason's road E of Watheroo, 2 Sept. 1984, *M.I.H. Brooker* 8687 (CANB, MEL, NSW, PERTH); 0.5 km S of Tammin, 31° 39'S 117° 29'E, 15 Nov. 1985, *M.I.H. Brooker* 9104 (CANB, MEL, NSW, PERTH); 17.7 km N of Murchison River on NW Coastal Hwy, 27° 40'S 114° 42'E, 6 May 1986, *M.I.H. Brooker* 9266 (CANB, MEL, NSW, PERTH); N boundary of Kalbarri National Park, 27° 24'S 114° 26'E, 9 Oct. 1986, *M.I.H. Brooker* 9473 (CANB, MEL, NSW, PERTH); 3.5 km W of Dowerin, 31° 13'S 116° 59'E, 23 July 1987, *M.I.H. Brooker* 9726 (AD, CANB, MEL, NSW, PERTH); S of Pintharuka road, 9.6 km from Mingenew-Morawa road via Yandanooka Road, W of Morawa, 29° 06'S 115° 38'E, 9 Sept. 1987, *M.I.H. Brooker* 9754 (AD, CANB, MEL, NSW, PERTH); 0.5 miles S of Wubin, 21 Oct. 1966, *G.M. Chippendale* 59 (CANB, PERTH); 3.6 miles S of Kalannie, 21 Oct. 1966, *G.M. Chippendale* 65 (CANB, PERTH); 22.8 miles SW of Merredin, 6 March 1967, *G.M. Chippendale* 88 (CANB, PERTH); 1.4 miles W of Karalee, 7 March 1967, *G.M. Chippendale* 104 (CANB, PERTH); 9.1 miles E of Pithara, 9 Aug. 1967, *G.M. Chippendale* 250 (CANB, PERTH); 9.4 miles NE of Bruce Rock, 10 Aug. 1967, *G.M. Chippendale* 256 (CANB, PERTH); Cadoux, 3 Nov. 1981, *H. Demarz* 9126 (PERTH); Mogumber, March 1901, *Dr Diels & Pritzel* (PERTH); 6 km E of Koorda, 12 Nov. 1974, *Forests Department* L182 (PERTH); Dowerin, 19 Aug. 1920, *C.A. Gardner* 657 (PERTH); 2 miles S of Dalwallinu gate, Rabbit-proof Fence, 14 Jan. 1947, *C.A. Gardner* 8523 (PERTH); Bendering, 19 Oct. 1949, *C.A. Gardner* 9478 (PERTH); 3 miles N of Yerecoin, 21 Aug. 1957, *J.W. Green* 1486 (PERTH); Tammin - Cunderdin Rd, 26 June 1959, *B.J. Grieve* (PERTH);; Tammin, Oct. 1959, *B.J. Grieve* (PERTH); 40 miles S of Mullewa, 3 April 1967, *E. Holm* s.n. (CANB); Kalbarri National Park, c. 2 km NE of Junga Dam, 13 Sept. 1979, *S.D. Hopper* 1301 (PERTH); 5.2 km N of Yerecoin siding, 4 km S of Piawaning siding, 30° 53'S 116° 24'E, 26 Aug. 1982, *S.D. Hopper* 2483 (PERTH); 5 km WNW of Scrivener Rocks, 32° 19'30"S 118° 46'E, 14 June 1985, *S.D. Hopper* 4415 (PERTH); Dowerin, west, 11 Nov. 1974, *O.W. Loneragan* L233 (PERTH); 6 miles out of Wongan Hills, 3 Oct. 1962, *F. Lullfitz* L1659 (PERTH); Wongan Hills, 3 Oct 1903, *A. Morrison* (PERTH); 9 miles from Wongan Hills towards Piawaning, 3 Oct. 1962, *M.E. Phillips* s.n. (CANB, CBG 024965); Walebing, Feb. 1950, *Popplewell Bros.* (PERTH); 7 miles N of Bruce Rock, 14 April 1953, *R.D. Royce* 3983 (PERTH); Water Reserve, Caron, 10 miles S of Perenjori, 11 April 1962, *R.D. Royce* 6813 (PERTH); Watheroo National Park, W. of Watheroo, 8 Oct. 1971, *R.D. Royce* 9762 (PERTH); 14.6 miles Lynton Road, 1 March 1966, *E.M. Scrymgeour* 272 & *S.G.M. Carr* (PERTH); 390.8 miles NW Coastal Highway, 3 March, 1966, *E.M. Scrymgeour* 322, 323 & *S.G.M. Carr* (PERTH); 212.6 miles Morawa-Perth Road, 5 March 1966, *E.M. Scrymgeour* 393 & *S.G.M. Carr* (PERTH); W of Manmanning townsite, next to Avon Loc. 19405, 30° 51'S 117° 05'E, 24 March 1987, *B.H. Smith* 840 (AD, CHR, FRI, HO, MEL, NSW, PERTH).

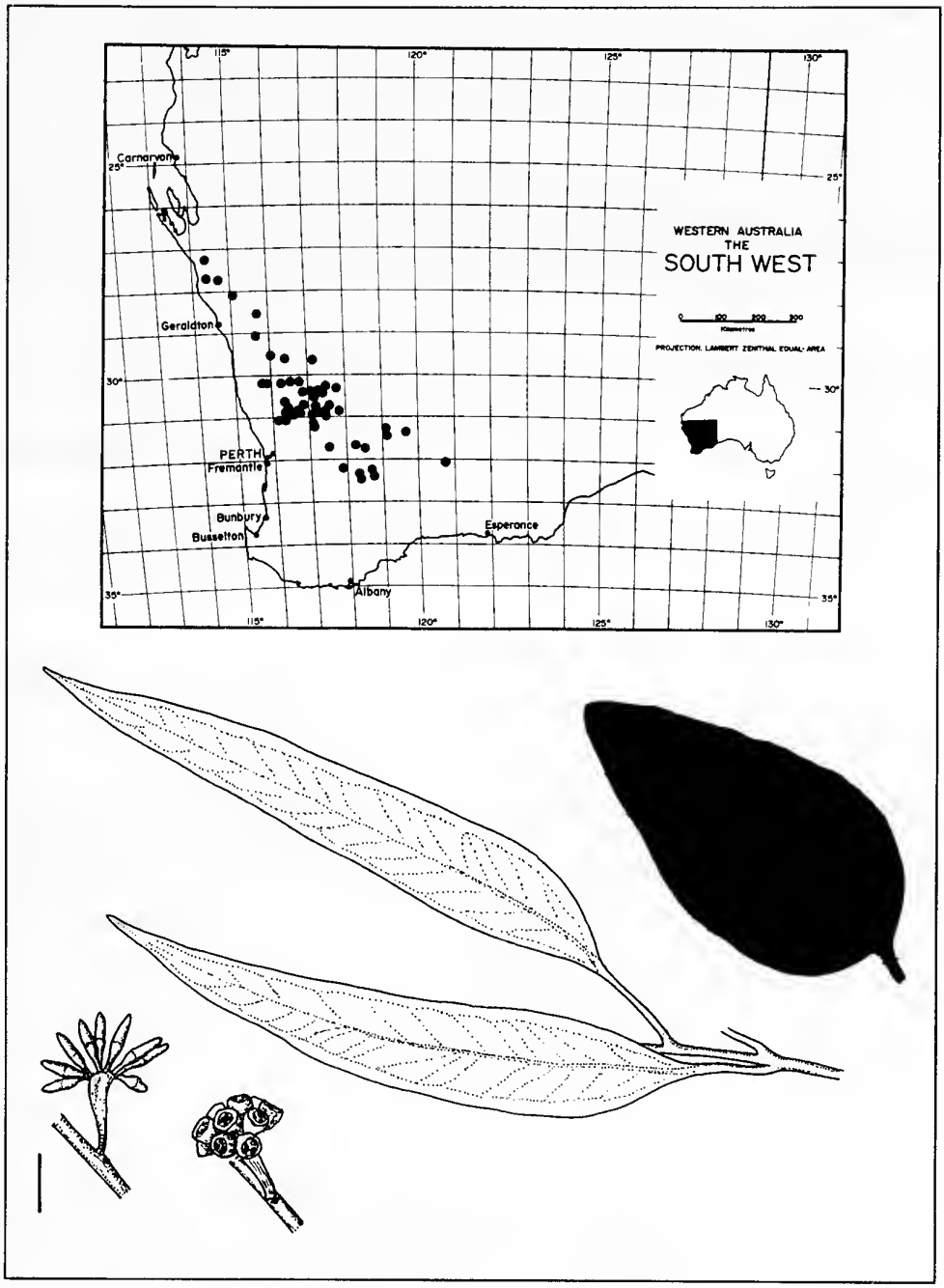

Figure 55. *Eucalyptus subangusta* subsp. *subangusta* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

Distribution and habitat. Central and northern wheatbelt, north to Kalbarri and south-east to Norseman (Figure 55). Occurs in low to tall mallee, usually on plains of yellow or red sand.

Conservation status. Widespread and abundant. Well represented on nature reserves.

Flowering period. January - ?

Notes. This is one of the most common mallees in the northern wheatbelt. It differs from subsp. *pusilla* in its larger buds and fruits, its consistent mallee habit, and its preference for light sandy soil. Subsp. *subangusta* lacks the glaucous branchlets and consistent acuminate operculum of subsp. *cerina*. It has dull leaves unlike the glossy leaves of subsp. *virescens*.

16b. ***Eucalyptus subangusta*** (Blakely) Brooker & Hopper subsp. ***pusilla*** Brooker & Hopper, subsp. nov. (Figures 56, 57, 58, 59)

A subspecie typica habitu variabili frutice ("mallee") vel arbore ("mallet") alabastris fructibusque parvioribus differt.

Typus: 15.8 km east of Mullewa towards Pindar, Western Australia, 12 June 1985, *M.I.H. Brooker* 9039 (holo: PERTH; iso: CANB, NSW, MEL).

Colour illustration. Brooker & Kleinig (1990: 169).

It differs from the typical subspecies in the variable mallee or mallet habit, smaller buds (to 0.7 x 0.2 cm) and fruit (to 0.3 x 0.3 cm).

Specimens examined. WESTERN AUSTRALIA: Yuna East Reserve, 24 Oct. 1974, *J.S. Beard* 7155 (PERTH); 53 miles E of Dalwallinu, 2 Oct. 1976, *J.S. Beard* 7977 (PERTH); Between Kulja and Koorda, 13 Oct. 1937, *W.E. Blackall* 3519 (PERTH); 59 km NW of Wubin towards Paynes Find, 20 Jan. 1976, *M. Blackwell* 34 (CANB); 6.5 km S of Mt Gibson turn-off on Gt Nthn Highway, 20 Oct. 1978, *J. Briggs* 222 (CANB); 32.4 km NE Carnamah towards Perenjori, 19 Oct. 1978, *J. Briggs* 314 (CANB); 40 miles NE of Wubin towards Paynes Find, 11 Aug. 1969, *M.I.H. Brooker* 1972, 1973 (PERTH); 15.3 km NE of Calingiri towards Wongan Hills, 30° 59'S 116° 33'E, 16 Feb. 1983, *M.I.H. Brooker* 7966 (CANB, NSW, PERTH); 15.4 km E of Mullewa towards Pindar, 28° 22'S 115° 41'E, 24 Jan. 1984, *M.I.H. Brooker* 8414 (CANB, MEL, NSW, PERTH); 84 km SW of Paynes Find, 29° 40'S 117° 08'E, 18 Oct. 1984, *M.I.H. Brooker* 8718 (CANB, NSW, PERTH); 15.8 km E of Mullewa towards Pindar, 28° 31'S 115° 40'E, 12 June 1985, *M.I.H. Brooker* 9039 (CANB, MEL, NSW, PERTH); 39 km NE of Wubin, 29° 53'S 116° 53'E, 15 April 1986, *M.I.H. Brooker* 9226 (CANB, MEL, NSW, PERTH); 82.5 km S of Paynes Find, 18 April 1986, *M.I.H. Brooker* 9262 (CANB, PERTH, NSW, MEL); Stoke's farm, Franco Road, W of Morawa, 29° 08'S 115° 44'E, 3 Feb. 1988, *M.I.H. Brooker* 9880 (AD, CANB, MEL, NSW, PERTH); 69 mile peg from Geraldton on Magnet-Geraldton Rd, 19 March 1968, *S.G.M. Carr* 455 (PERTH); 4 miles SSE of Kulja, 24 June 1978, *S. Charlton* s.n. (CANB, PERTH); 0.4 miles E of Pithara, E of railway line, 21 Jan. 1966, *G.M. Chippendale* 63 (CANB, PERTH); Tardun, 8 Aug. 1967, *G.M. Chippendale* 246 (CANB,

PERTH); Mt Gibson, 206 mile, 12 Nov. 1974, *Forests Department* L181 (PERTH); 3 miles S of Canna, 23 Aug. 1957, *J.W. Green* 1532 (PERTH); 4.8 km N of Yerecoin siding, 4.2 km S of Piawaning siding, 30° 53'S 116° 24'E, 26 Aug. 1982, *S.D. Hopper* 2485 (PERTH); Sorenson's Nature Reserve, 8.9 km W of Babakin, 32° 07'30"S 117° 55'E, 13 June 1985, *S.D. Hopper* 4404 (PERTH); N boundary of Kalbarri National Park, 27° 24'S 114° 30'E, 7 Aug. 1986, *S.D. Hopper* 5168 (PERTH); East Yuna Reserve, c. 70 km NE Geraldton, 33 km WNW Mullewa, 12-16 Oct. 1976, *B.G. Muir* 61(2.6)1, 61(2.6)2 (PERTH); "Crossroads", SE corner, Yandegin, 15 Aug. 1979, *P. de Rebeira* 125 (PERTH); 221.6 miles along Morawa-Perenjori Road, 5 March 1966, *E.M. Scrymgeour* 388 & *S.G.M. Carr* (PERTH); Near Monger's Lake, 5 March 1966, *E.M. Scrymgeour* 390 & *S.G.M. Carr* (PERTH); 212.6 miles Perth-Morawa Road, 5 March 1966, *E.M. Scrymgeour* 395 & *S.G.M. Carr* (PERTH); Buntine, 3 July 1951, *N.H. Speck* (PERTH); Dalwallinu, 3 July 1952, *N.H. Speck* (PERTH); Wubin, 3 July 1952, *N.H. Speck* (PERTH).

Distribution and habitat. Northern wheatbelt, from Wongan Hills to Mullewa and extending north-east to Paynes Find (Figure 56). Grows in low woodland or tall mallee with *E. arachnaea*, *E. hypochlamydea* Brooker, *E. celastroides* subsp. *virella*, *E. leptopoda* and *E. horistes* Johnson & Hill. Preferred soils are fine textured, reddish, often with surface stony rubble.

Conservation status. Poorly surveyed. Locally abundant and widespread in disjunct populations.

Flowering period. Unknown.

Etymology. The subspecific epithet refers to the small buds and fruits, which are the smallest in the series. (Latin *pusillus*, very small).

Notes. E. subangusta subsp. *pusilla* extends further north-east than the typical subspecies, from which it differs in the smaller buds and fruits, occasional mallet habit (Figure 58) and preference for heavier soils. It lacks the glaucous branchlets of subsp. *cerina* and the glossy leaves of subsp. *virescens*.

16c. ***Eucalyptus subangusta*** (Blakely) Brooker & Hopper subsp. ***cerina*** Brooker & Hopper, subsp. nov. (Figures 56, 60)

A subspecie typica ramulis inceratis et semper operculis conicis differt.

Typus: Chiddarcooping Nature Reserve, E-W road, east end, 30° 51'S 118° 42'E, Western Australia, 17 Feb. 1983, *M.I.H. Brooker* 7972 (holo: PERTH; iso: CANB, NSW).

Colour illustration. Brooker & Kleinig (1990: 170).

It differs from the typical subspecies by the white, waxy branchlets and consistently conical opercula.

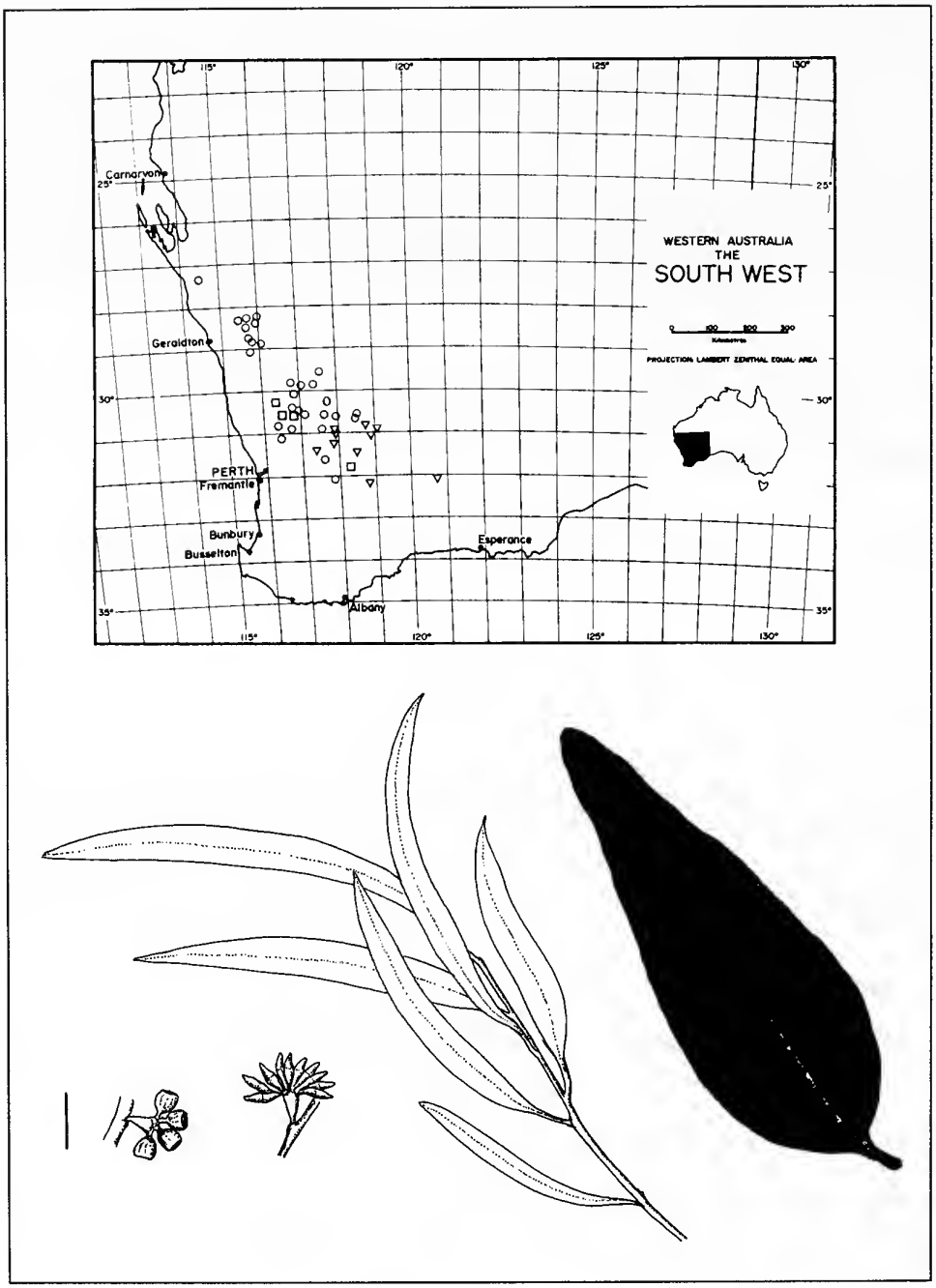

Figure 56. Distribution of *Eucalyptus subangusta* subsp. *pusilla* (○), subsp. *cerina* (▽) and subsp. *virescens* (□), and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm) of *Eucalyptus subangusta* subsp. *pusilla*.

Figure 57. Holotype of *E. subangusta* (Blakely) Brooker & Hopper subsp. *pusilla* Brooker & Hopper.

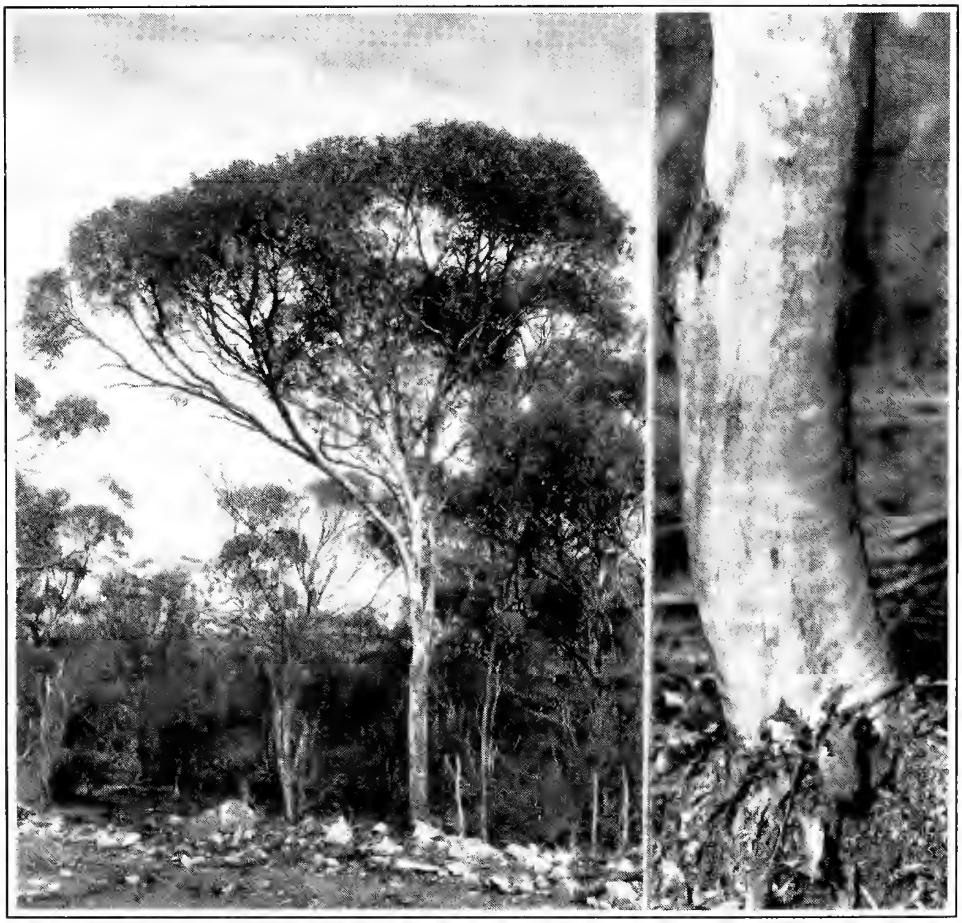

Figure 58. *E. subangusta* subsp. *pusilla* mallet habit near Mt Gibson, and trunk and bark.

Figure 59. *E. subangusta* subsp. *pusilla* mallee habit near Mt Gibson, and stems and bark.

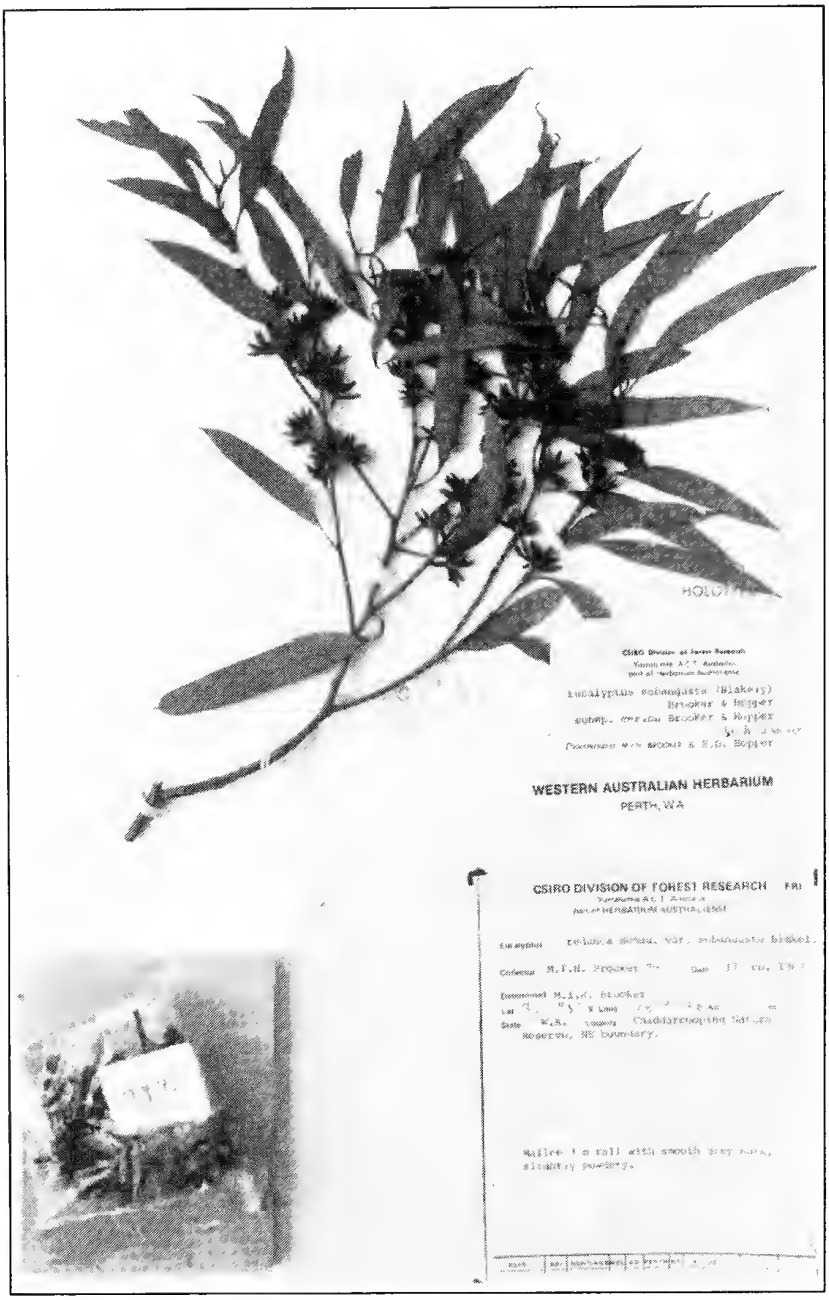

Figure 60. Holotype of *E. subangusta* (Blakely) Brooker & Hopper subsp. *cerina* Brooker & Hopper.

Specimens examined. WESTERN AUSTRALIA: 2 miles E of Merredin Golf Course, 4 June 1969, *M.I.H. Brooker* 1791 (PERTH); c. 25 km W of Nukarni, 31° 19'S 117° 56'E, 15 Sept. 1982, *M.I.H. Brooker* 7624 (CANB, NSW, PERTH); Chiddarcooping Nature Reserve, E-W road, east end, 30° 51'S 118° 42'E, 17 Feb. 1983, *M.I.H. Brooker*, 7974 (CANB, NSW, PERTH); 24 km W of Bodallin, 31° 22'S 118° 40'E, 7 April 1983, *M.I.H. Brooker* 8056 (CANB, NSW, PERTH); WSW of Bullfinch, 31° 02'S 118° 58'E, 22 Oct. 1986, *M.I.H. Brooker* 9493, 9494 (AD, CANB, MEL, NSW, PERTH); "Oxendale", Barnes Road, SE of Yelbeni, 23 July 1987, *M.I.H. Brooker* 9727 (AD, CANB, MEL, NSW, PERTH); 5.1 miles E of Carrabin, 6 March 1967, *G.M. Chippendale* 90 (CANB, PERTH); Near Golden Valley (N of Bullfinch), 30° 53' S 119° 02'E, 9 Dec. 1891, *R. Helms* (PERTH); near Knutsford, W.A., 9 Dec. 1891, *R. Helms* (NSW); 5 km WNW of Scrivener Rocks, 32° 19'30" S 118° 46'E, 14 June 1985, *S.D. Hopper* 4415 (PERTH); Chiddarcooping Nature Reserve, 0.3 km E of W boundary and 1.3 km S of Morrison Road along track running NE, 30° 54'S 118° 37'E, 6 July 1988, *S.D. Hopper* 6418 (CANB, MEL, NSW, PERTH); 32 km W of Knap Rock, Hyden-Norseman road, 32° 05'S 120° 42'E, 8 May 1978, *G.J. Keighery* 1695 (PERTH); Between Carrabin and Westonia, c. 40 km W of Southern Cross, 12 April 1966, *P.G. Wilson* 4120, 4121 & *S.G.M. Carr* (PERTH).

Distribution and habitat. Eastern central wheatbelt, from Yelbeni to east of Southern Cross (Figure 56). *E. subangusta* subsp. *cerina* grows in low woodland, mallee or shrubland, usually on red clay loams with species such as *E.* aff. *loxophleba* and *E. sheathiana.*

Conservation status. Widespread and abundant, with populations known on conservation reserves such as Chiddarcooping Nature Reserve.

Flowering period. Unknown.

Etymology. The subspecific epithet refers to the glaucous (white, waxy) branchlets (Latin *cerinus*, waxy).

Notes. E. subangusta subsp. *cerina* is restricted to the eastern central wheatbelt. It is distinguished from other subspecies in the glaucous branchlets, and in its preference for heavier soils than those occupied by the typical subspecies.

16d. ***Eucalyptus subangusta*** (Blakely) Brooker & Hopper subsp. ***virescens*** Brooker & Hopper, subsp. nov. (Figures 5f, 56, 61, 62)

A subspecie typica foliis adultis virescentibus leviter nitentibus differt.

Typus: c. 1 km N of Roach Road on Tank North Road, NW of Narembeen, Western Australia, 23 Aug. 1988, *M.I.H. Brooker* 10045 & *C.J. Ranford* (holo: PERTH; iso: AD, CANB, MEL, NSW).

Differs from the typical subspecies in the light green, slightly glossy adult leaves.

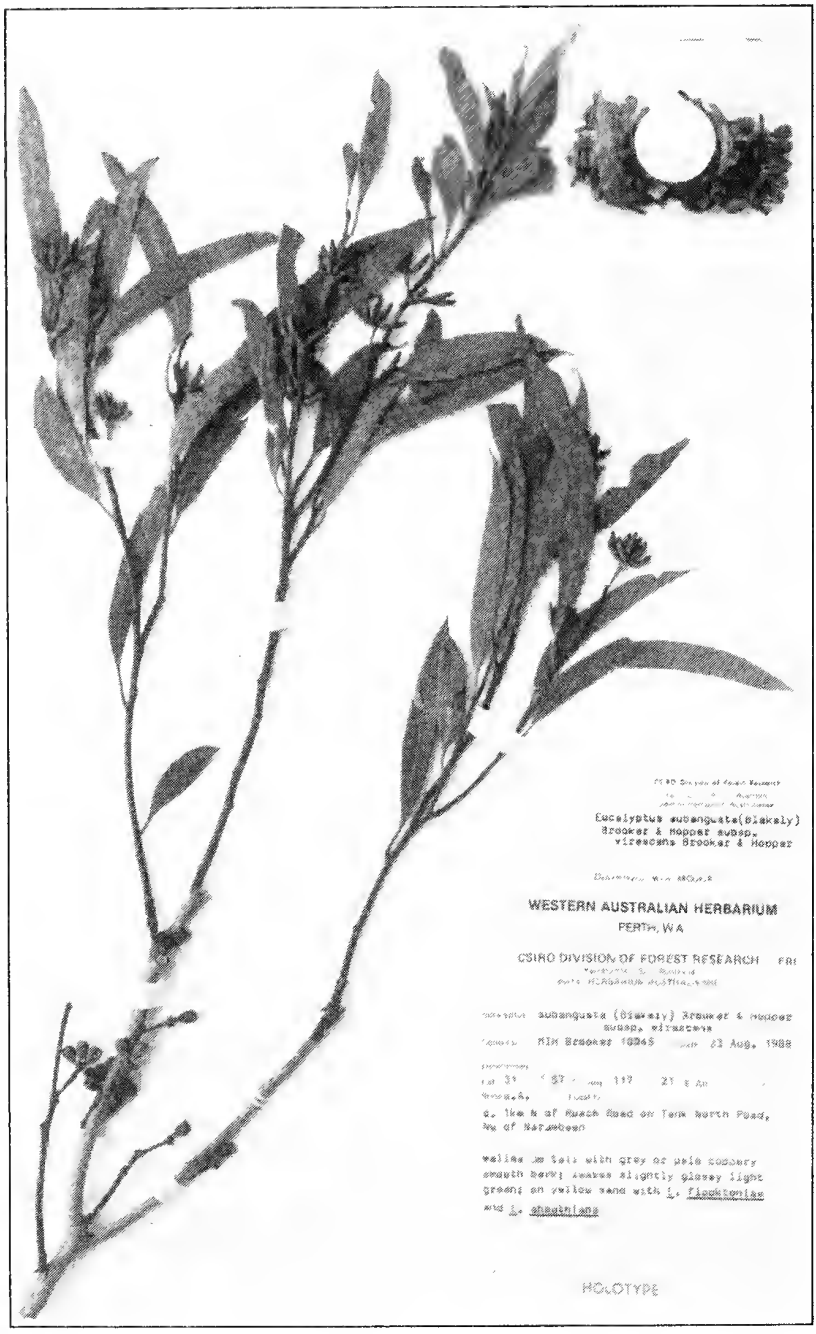

Figure 61. Holotype of *E. subangusta* (Blakely) Brooker & Hopper subsp. *virescens* Brooker & Hopper.

Figure 62. *E. subangusta* subsp. *virescens* showing mallee habit.

Specimens examined. WESTERN AUSTRALIA: 14 miles E of Narembeen, 17 July 1970, *J.S. Beard* 5910 (CANB); 20 km NW of Hyden, 4 Oct. 1975, *D. Blaxell* W75/75 (CANB); 25.7 km S of Koorda towards Wyalkatchem, 31° 00'S 117° 27'E, 14 Sept. 1982, *M.I.H. Brooker* 7616 (CANB, NSW, PERTH); Mason's Road E of Watheroo, 2 Sept. 1984, *M.I.H. Brooker* 8687 (CANB, MEL, NSW, PERTH); between Miling and Pithara, 30° 27'S 116° 30'E, 15 April 1986, *M.I.H. Brooker* 9225 (CANB, MEL, NSW, PERTH); W of Manmanning, 2.8 km E of Hourigan Road along Jones Road, 30° 26'S 116° 53'E, 23 Oct. 1986, *M.I.H. Brooker* 9497 (CANB, MEL, NSW, PERTH); type locality, 23 Aug. 1988, *M.I.H. Brooker* 10046, 10047 & *C.J. Ranford* (AD, CANB, MEL, NSW, PERTH).

Distribution and habitat. Eastern part of the central wheatbelt where it is known from the type locality and at a few scattered sites between Manmanning and Watheroo (Figure 56). Soils occupied range from yellow sand (with *E. flocktoniae*, *E. sheathiana*, *E. kochii* and *E. erythronema*) to white clay (with *E. yilgarnensis* and *E. erythronema*).

Conservation status. Poorly known. All four recorded populations are on road verges in largely cleared agricultural land. The subspecies, therefore, is in urgent need of further survey.

Flowering period. Unknown.

Etymology. The subspecific epithet refers to the colour and glossiness of the adult leaves, which contrast to the dull blue-green leaves of all other subspecies (Latin *viridis*, green and *-escens*, becoming).

Notes. This subspecies is the least-known in the species. It is notably variable in its site requirements, with soils ranging from sand to white clay. Morphologically it is consistent, differing from the other three subspecies in its green glossy adult leaves. These features become manifest in the older leaves within the crown.

17. ***Eucalyptus subtilis*** Brooker & Hopper, sp. nov. (Figures 63, 64)

Ab *Eucalypto subangusta* (Blakely) Brooker & Hopper foliis juvenilibus adultisque angustioribus, nervis secundariis infirmis, et operculis semper attenuatis differt.

Typus: 0.7 km south of rail crossing, south of Norseman, 32° 32'S 121° 36'E, Western Australia, 12 Feb. 1985, *M.I.H. Brooker* 8841 (holo: PERTH; iso: CANB, MEL, NSW).

Colour illustration. Brooker & Kleinig (1990: 171).

A mallee to 3 m tall. Bark smooth, dark grey and pinkish grey. Pith of branchlets glandular. Leaves of the seedling remaining opposite for 3 or 4 pairs, then alternating, narrowly lanceolate to lanceolate, to 8 x 2 cm. Adult leaves linear, to 8 x 0.6 cm, dull to slightly glossy, light green; secondary veins weak with indistinct connections to the midrib and intramarginal vein. Inflorescences to 11 flowered; peduncles to 0.6 cm long. Buds short, to 0.7 x 0.3 cm, opercula conical, attenuate. Flowers white. Fruit sessile, cupular, to 0.4 x 0.4 cm. Seed light grey-brown, subspherical to cuboid.

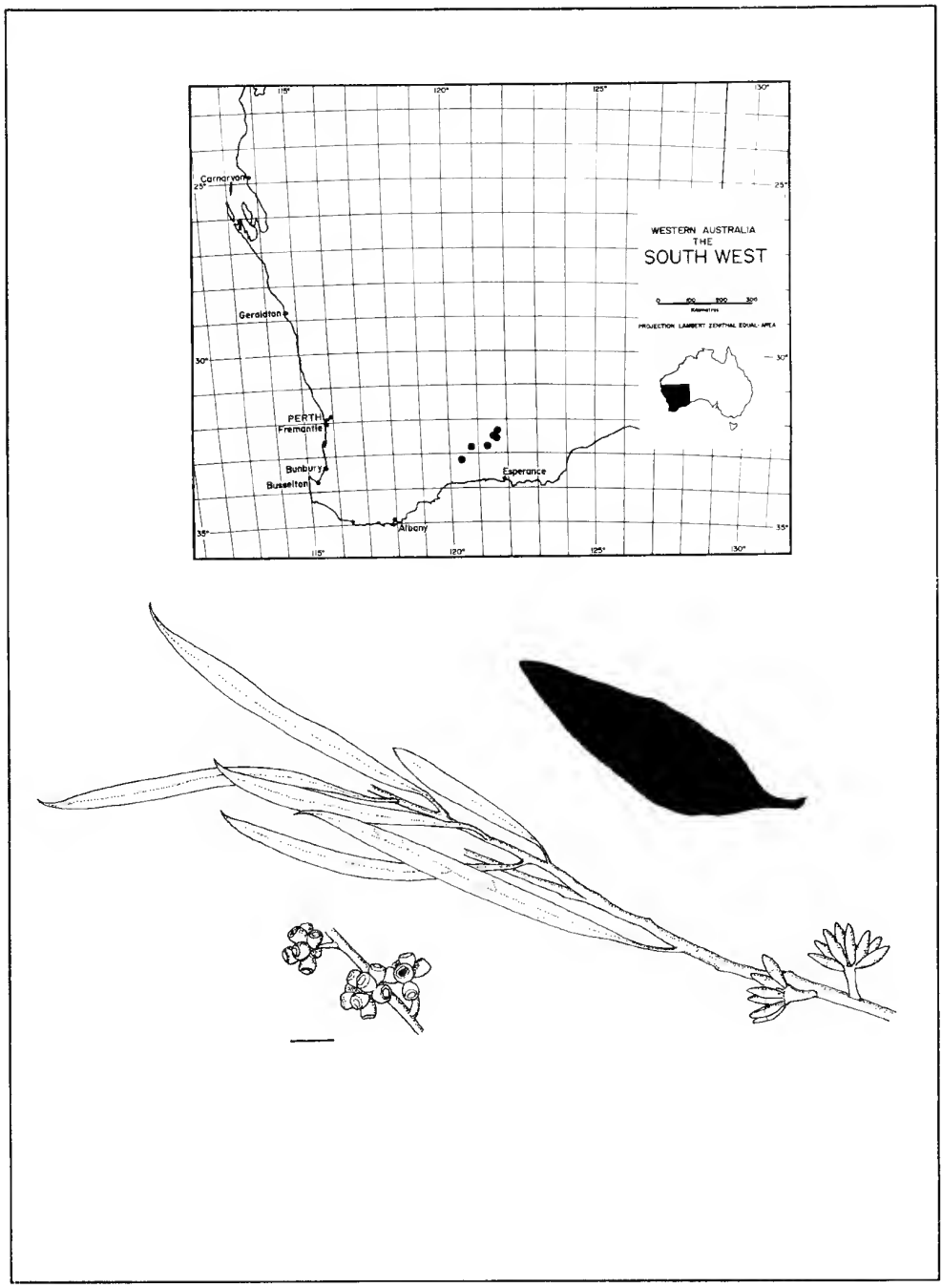

Figure 63. *Eucalyptus subtilis* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

Figure 64. Holotype of *E. subtilis* Brooker & Hopper.

Specimens examined. WESTERN AUSTRALIA: 43 km S of Norseman on Esperance road, 32° 31'S 121° 35'E, 21 June 1978, *D.F. Blaxell* 1671, 1672 (CANB, NSW, PERTH); 26.4 miles S of Norseman towards Esperance, 15 Feb. 1970, *M.I.H. Brooker* 2494 (CANB, NSW, PERTH); Between Norseman and Salmon Gums, 10 Nov. 1981, *M.I.H. Brooker* 7071 (CANB, NSW, PERTH); Road to Peak Charles, 2 May 1982, *M.I.H. Brooker* 7510 (CANB, NSW, PERTH); 25 miles S of Norseman, 20 Sept. 1947, *N.T. Burbidge* 2712 (CANB); 23 km NE of Coujinup Hill, 33° 12'31" S 120° 28'12"E, 11 Aug. 1983, *M.A. Burgman* 1949 & *S. McNee* (PERTH); 28 km SW of Norseman-Esperance highway along road to Peak Charles, 32° 45'S 121° 19'E, 20 Sept. 1979, *M.D. Crisp* 5986, 5987 *J. Taylor & R. Jackson* (CBG, PERTH); 447 mile peg on Salmon Gums-Norseman rd, 20 March 1968, *S.G.M. Carr* 611 (PERTH); 477.5 mile peg on Salmon Gums-Norseman rd, 29 March 1968, *S.G.M. Carr* 612 (PERTH); 27 miles S of Norseman, 7 Nov. 1953, *C.A. Gardner* 11160 (PERTH); 15 km E of Ninety Mile Tank, 18.5 km SSE of Mt Glasse, Bremer Range, 32° 42'S 120° 52'E, 6 Sept. 1982, *S.D. Hopper* 2499 (PERTH).

Distribution and habitat. Ninety Mile Tank to the Peak Charles-Kumarl area south of Norseman (Figure 63). Predominantly in low mallee or shrubland on fine textured soils in sand plain.

Conservation status. Widespread in patchy disjunct populations on vacant Crown land. Not recorded on a conservation reserve.

Flowering period. February - ?

Etymology. The specific epithet refers to the narrow leaves (Latin *subtilis*, fine, slender).

Notes. E. subtilis is a conspicuously narrow-leaved species allied to *E. subangusta* and has the narrowest juvenile and adult leaves in the series. Apart from leaf width it differs from *E. subangusta* in the stiffer light green adult leaves with weak secondary veining and in the consistently conical opercula. It has narrower leaves and a taller habit than *E. microschema*.

18. ***Eucalyptus microschema*** Brooker and Hopper, sp. nov. (Figures 11c, 65, 66, 67)

Species *Eucalypto subangustae* cognata a qua statura inferiore, foliis adultis leviter nitentibus, pedunculis valde complanatis, operculo hypanthio angustiore, et crescenti in solo cineraceo argillaceo differt.

Typus: 40.9 km along Old Ravensthorpe Road from Newdegate - Lake King Road, 33° 22'S 119° 25'E, Western Australia, 24 November 1987, *M.I.H. Brooker* 9813 (holo: PERTH; iso: AD, CANB, MEL, NSW).

Mallee to 2 m tall with grey over pinkish grey smooth stems. Crown dense. Pith of branchlets glandular. Leaves of the seedling remaining opposite for 4 or 5 pairs, then alternating, ovate to broadly lanceolate, to 10 x 3 cm, bluish-green, glabrous. Adult leaves stiff, narrowly lanceolate, to 8 x 0.9 cm, olive-green, at first dull, maturing glossy inside crown, held erect. Peduncles short (<1 cm long), broad and strongly flattened. Buds shortly pedicellate, fusiform, to 1 x 0.3 cm; operculum attenuate, narrower than hypanthium at join. Flowers creamy white or pale yellow. Fruit shortly pedicellate, cupular, to 0.6 x 0.5 cm. Seed light grey-brown, subspherical to cuboid.

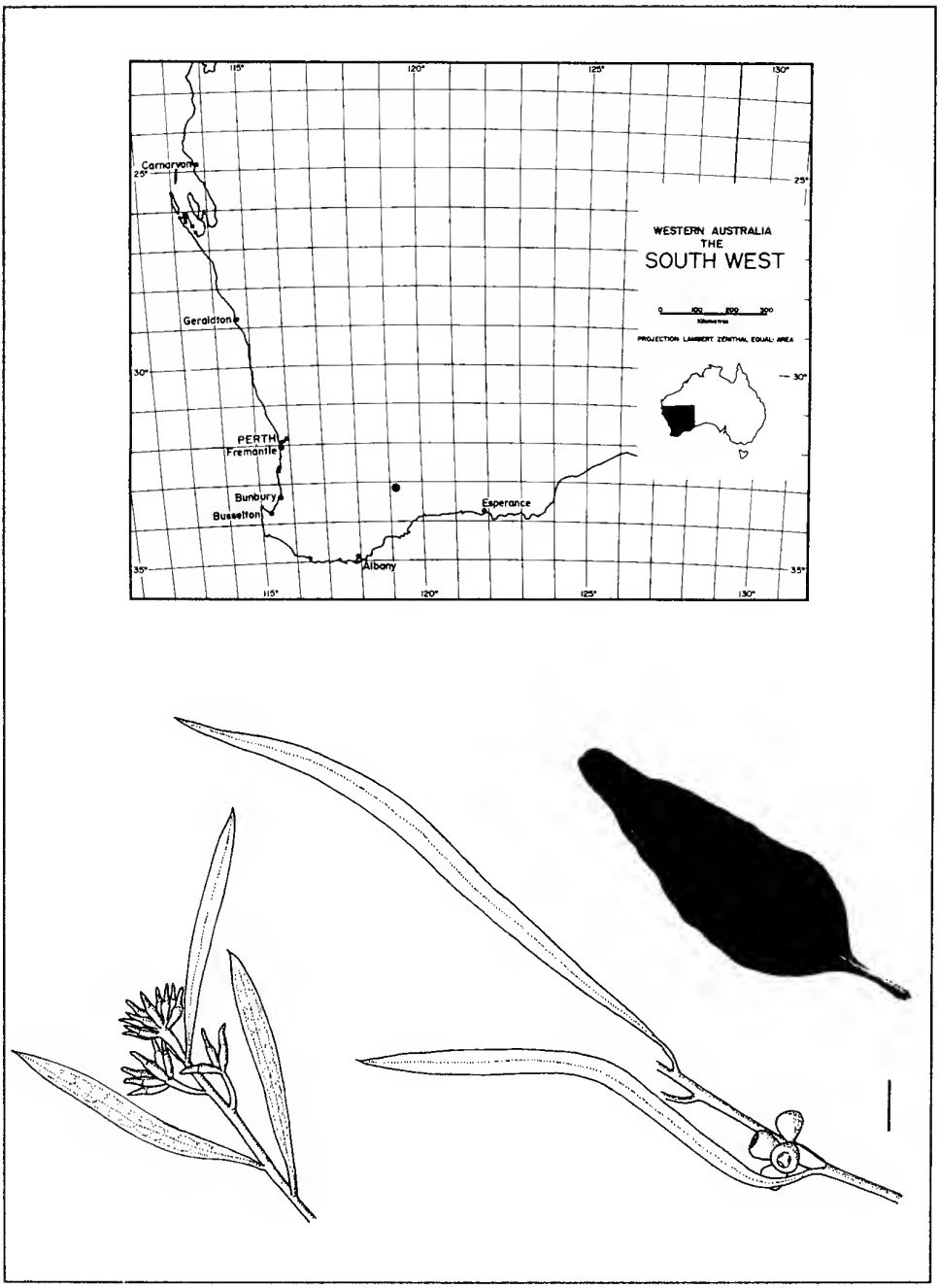

Figure 65. *Eucalyptus microschema* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

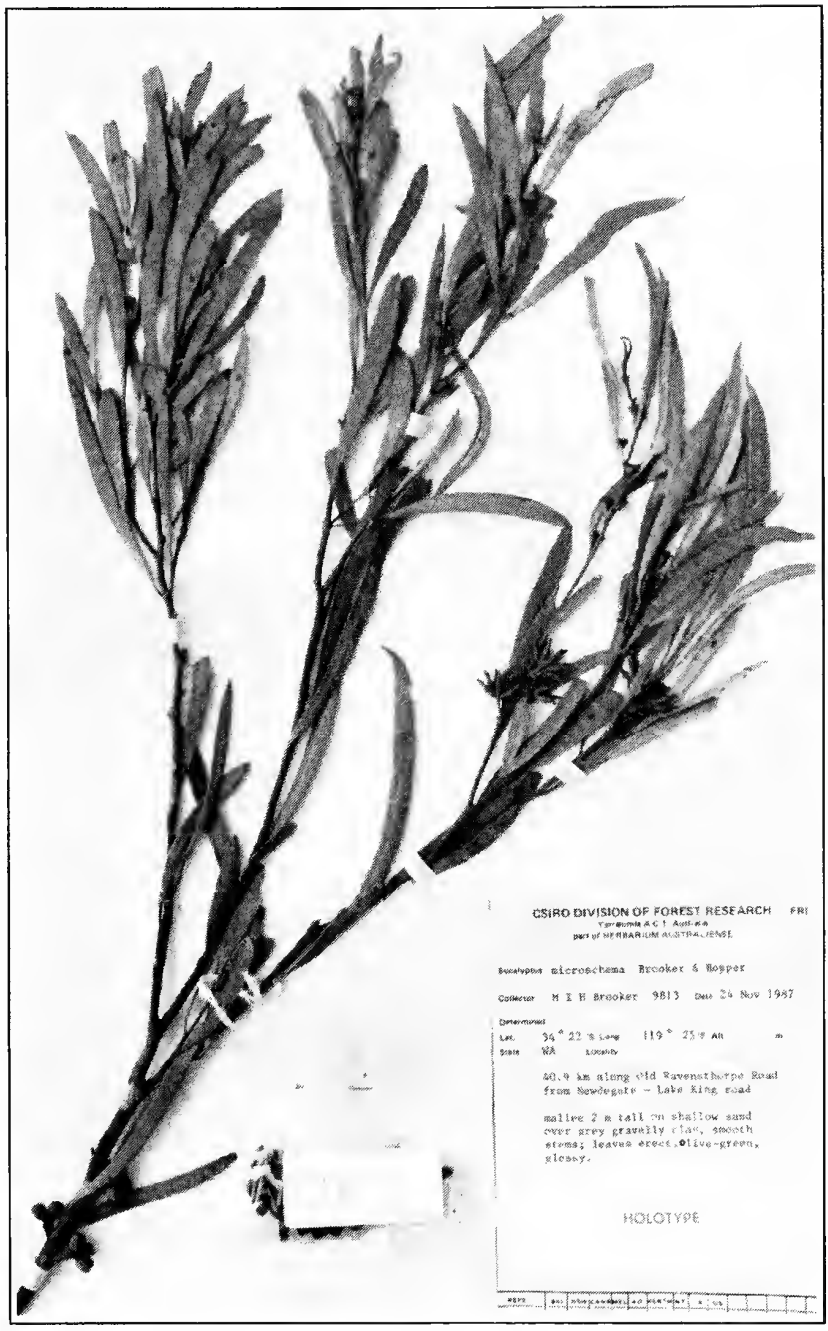

Figure 66. Holotype of *E. microschema* Brooker & Hopper.

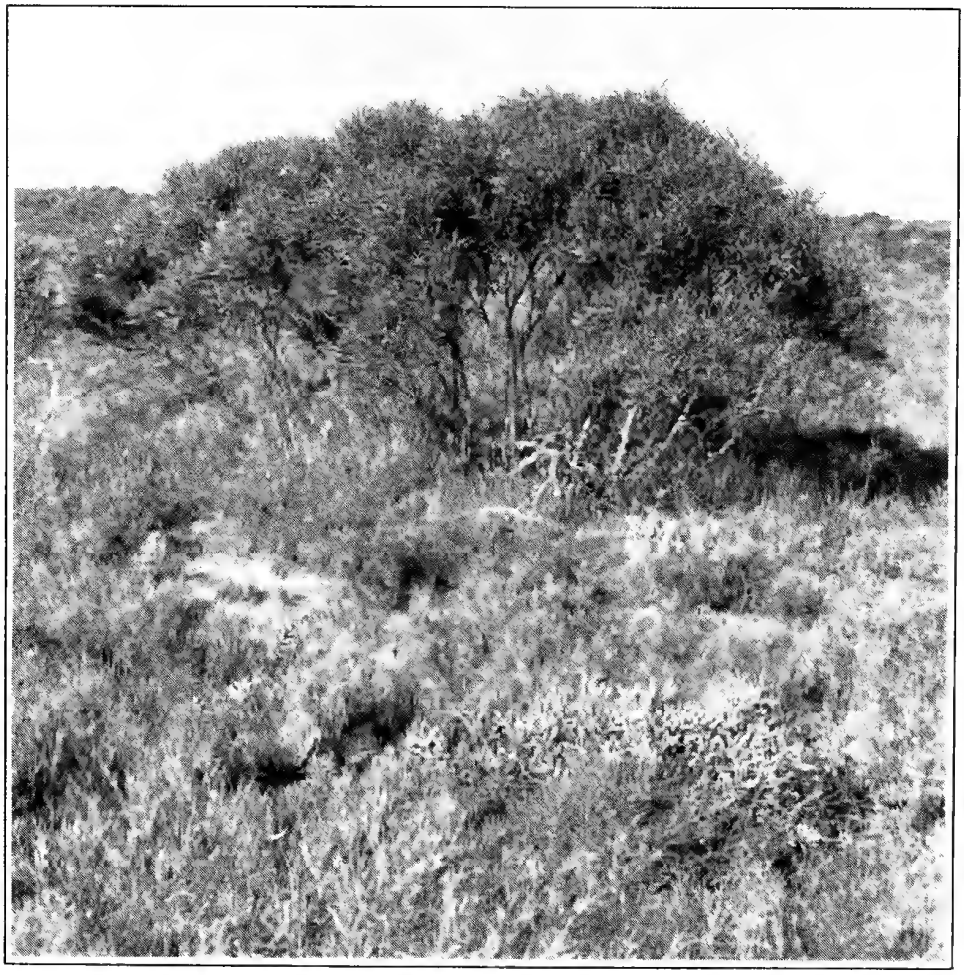

Figure 67. *E. microschema* showing compact mallee habit (SE of Newdegate).

Specimens examined. WESTERN AUSTRALIA: 23 km E of Newdegate, 15 July 1987, *M.I.H. Brooker* 9713 and *S.D. Hopper* (CANB, PERTH, NSW, MEL, AD); 50.7 km along Old Ravensthorpe Road from Newdegate-Lake King Road, 33° 21'S 119° 30'E, 24 Nov. 1987, *M.I.H. Brooker* 9815 (AD, CANB, MEL, NSW, PERTH); 41.3 km along Old Ravensthorpe Road from Newdegate-Lake King Road, 33° 23'S 119° 26'E, 24 Nov. 1987, *M.I.H. Brooker* 9814 (AD, CANB, MEL, NSW, PERTH); Junction of Taylor Road and Old Ravensthorpe Road, 22 Oct. 1987, *J.W. Green* 5576 (PERTH).

Distribution and habitat. East and south-east of Newdegate in the southern wheatbelt (Figure 65). Grows in low shrubland as a scattered emergent in clumps of few individuals. Soils typically are shallow grey-white sand over white clay on plains or undulating hill tops. Associated eucalypts include *E. tetragona*, *E. eremophila*, *E. pileata*, *E. albida* and *E. loxophleba* subsp. *gratiae*.

Conservation status. Poorly surveyed. The known populations are in areas undergoing agricultural land clearance. The species, therefore, is in urgent need of further survey. Not known on a conservation reserve.

Flowering period. July - September.

Etymology. From the Greek, *micros*, small and *schema*, form, alluding to the small stature of this mallee.

Notes. This recently discovered species probably is allied to *E. subangusta*, from which it differs in its smaller habit, stiff erect leaves that become glossy with age, strongly flattened peduncles, the narrowed opercula and its preference for heavy white clay soils. Its leaves are broader than those of *E. subtilis*.

19. ***Eucalyptus xanthonema*** Turcz. Bull. Nat. Soc. Mosc. XX., 1: 163 (1847); *Type*: Nova Hollandia. *Drummond* 3rd collection, no. 67 (iso: BM, CGE, E, FL, G, K, MEL); *E. redunca* Schauer var. *angustifolia* Benth. "Fl. Austral." 3: 253 (1867). *Types*: as for *E. xanthonema* and *Drummond* 5th collection, no. 187 (Figures 68, 69, 70)

A mallee to 4 m with smooth grey stems and rather dense crown. Pith of branchlets glandular. Leaves of the seedling remaining opposite for 2-6 pairs, then alternating, ovate to lanceolate, to 10 x 1.5 cm, slightly glossy, green, glabrous. Adult leaves narrowly lanceolate to linear, thin, with a sudden conspicuous acumen, to 0.9 x 0.6 cm, dull, light green. Inflorescences up to 11-flowered; peduncles to 0.7 cm long. Buds shortly pedicellate, fusiform, to 1.7 x 0.3 cm, operculum conical, acute. Flowers white to very pale yellow. Fruit shortly pedicellate, barrel-shaped to cupular, to 0.5 x 0.5 cm. Seed light grey-brown, sub-spherical to cuboid.

Notes. Regarded by Chippendale (1973) as an obscure and rarely collected species, *E. xanthonema* is now recognised to be a common mallee of the Stirling Range - Jerramungup area. It is characterised by the mallee habit, dull usually narrow leaves with a conspicuous acumen, slender uncinate buds and small barrel-shaped to cupular fruit. It differs from *E. medialis* in its lower stature, smooth bark and narrower leaves. It may be confused with *E. subtilis* and narrow-leaved forms of *E. subangusta* which differ in the shorter, tapered rather than distinctly pedicellate buds with a conical operculum and the consistently cupular fruit.

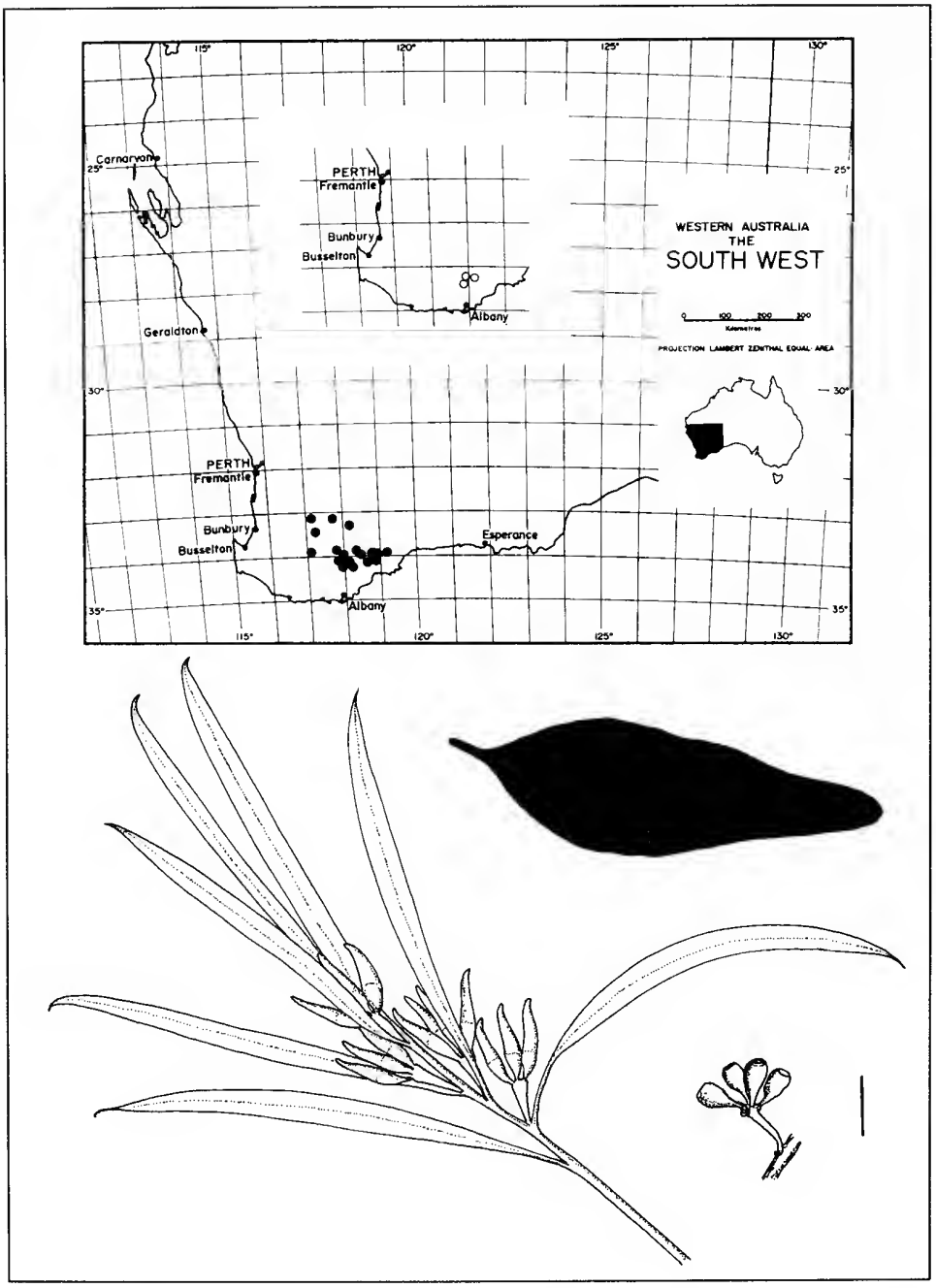

Figure 68. Distribution of *E. xanthonema* subsp. *xanthonema* (●) and *E. xanthonema* subsp. *apposita* (○), and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf of *E. xanthonema* subsp. *xanthonema* (scale bar = 1 cm).

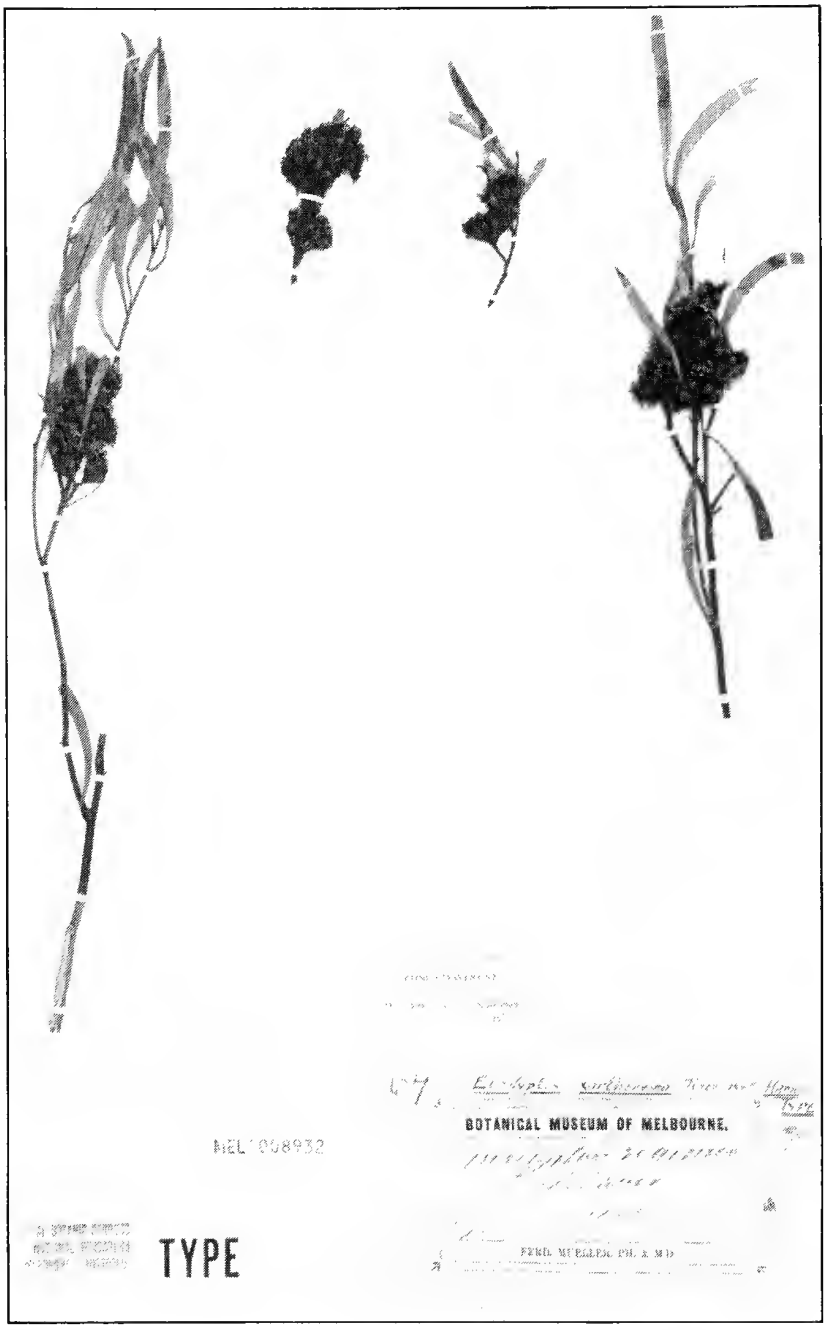

Figure 69. Isotype of *E. xanthonema* Turcz. subsp. *xanthonema* (MEL).

The epithet given by Turczaninow suggests yellow flowers, but an inspection of several isotypes and other collections indicates that the stamens are white to very pale yellow when fresh and darken in colour on drying.

There are two subspecies.

19a. ***Eucalyptus xanthonema*** Turcz subsp. ***xanthonema*** (Figures 68, 69)

Colour illustration. Brooker & Kleinig (1990: 172).

Adult leaves green, thin, to 0.7 cm wide.

Specimens examined. WESTERN AUSTRALIA: 10-15 km N of Dumbleyung, on Mt Pleasant Nature Reserve no. 15197, 1985, *D. Backshall* 108 (PERTH); Stirling Range Nat. Park, 25 Sept. 1975, *J.S. Beard* 7468 (PERTH); 4.2 km W of Needilup-Boxwood Hill Rd, on road to Ongerup, 6 Oct. 1982, *M.I.H. Brooker* 7086 (CANB, NSW, PERTH); roadside NE of Newbey's farm, Ongerup, 6 Oct. 1982, *M.I.H. Brooker* 7681 (CANB, NSW, PERTH); Stirling Range, 2.5 km along N boundary fire trail from Bluff Knoll Road, 7 Oct. 1982, *M.I.H. Brooker* 7696 (CANB, NSW, PERTH); 0.4 km SE of Chester Pass Road on Bluff Knoll Road, Stirling Range, 34° 21'S 118° 13'E, 21 March 1983, *M.I.H. Brooker* 8029 (CANB, NSW, PERTH); Beaufort River crossing, Albany Highway, 33° 50'S 117° 04'E, 21 Nov. 1983, *M.I.H. Brooker* 8367 (CANB, NSW, PERTH); 8.4 km W of Jerramungup-Albany road on Stock Road, 34° 01'S 118° 52'E, 23 Nov. 1983, *M.I.H. Brooker* 8377 (CANB, NSW, PERTH); 1.7 km S of Jerramungup, 33° 57'S 118° 55'E, 3 March 1985, *M.I.H. Brooker* 8873 (CANB, MEL, NSW, PERTH); E of Amelup, 34° 16'S 118° 15'E, 13 April 1985, *M.I.H. Brooker* 8951 (CANB, MEL, NSW, PERTH); 6.6 km S of Jerramungup on Albany road, 33° 58'S 118° 55'E, 27 Nov. 1985, *M.I.H. Brooker* 9121 (CANB, MEL, NSW, PERTH); 2.9 km N of Piessevillc Road, 33° 09'S 117° 03'E, 9 Dec. 1985, *M.I.H. Brooker* 9145 (CANB, MEL, NSW, PERTH); 37 km SE of Pingrup-Borden road on RPF road, 33° 50'S 118° 45'E, 27 Jan. 1987, *M.I.H. Brooker* 9567 (AD, CANB, MEL, NSW, PERTH); Needilup, almost opposite loading shed, 33° 57'S 118° 47'E, 13 Jan. 1988, *M.I.H. Brooker* 9866 (AD, CANB, MEL, NSW, PERTH); 110 km NE of Albany, 8 Nov. 1978, *R.J. Cranfield* 1111 (PERTH); 17 km S of Jerramungup, 21 Nov. 1979, *H. Demarz* D7844 (CANB, PERTH); Ravensthorpe District, Nov. 1944, *C.A. Gardner* s.n. (CANB, PERTH); Fitzgerald River, 11 Nov. 1935, *C.A. Gardner & A.J. Milesi* (PERTH); 19 miles E of Dumbleyung, 21 Feb. 1966, *A.S. George* 7560 & *S.G.M. Carr* (PERTH); 31 miles E of Cranbrook, 12 March 1957, *J.W. Green* 1168A (PERTH); 34 miles E of Cranbrook, 12 March 1957, *J.W. Green* 1170 (PERTH); 2 km E of Jerramungup, 31 Oct. 1975, *J.W. Green* 4622 (PERTH); 5 km NW of Ongerup, 33° 55'S 118° 27'E, 23 Oct. 1983, *K. Hill* 332, *L. Johnson & D. Blaxell* (CANB, NSW, PERTH); N side of Stirling Range; Camel Lake Nature Reserve, N of Stirling Range, SW corner on Salt River Road, 22 March 1982, *S.D. Hopper* 2109 (PERTH); 5 km WNW of Ongerup, 4.5 km N of Foster Rd from Ongerup Rd, 33° 57'S 118° 27'E, 31 July 1982, *S.D. Hopper* 2403 (PERTH); Stirling Range N.P., adjacent to caravan park, N boundary of park, 34° 20'S 118° 12'E, 23 Nov. 1983, *S.D. Hopper* 3591, 3592 (PERTH); 4.4 km E of Quiss Road on N boundary of Fitzgerald River National Park, 33° 58'S 119° 14'E, 1 Oct. 1987, *S.D. Hopper* 6168 (PERTH); Gnowellen Rd, 6 km N Ellen's Peak, Amelup to Cape Riche, 11 May 1982, *G.J. Keighery* 4837 (PERTH); Phillips Ranges, n.d., *Maxwell* 398 (MEL); 3 miles NW of Ongerup, 17 June 1952, *K. Newbey* 244 (PERTH); 5 km NW of Ongerup, 14 Sept. 1969, *K. Newbey* 2877 (PERTH); 10 km E of Broomehill, 13 Jan. 1954, *R.D. Royce* 4789

(PERTH); Reserve no. 9648, 10 miles SE of Wagin, 6 Nov. 1963, *H.B. Shugg* s.n. (PERTH); Cranbrook-Borden Rd, July 1952, *N.H. Speck* s.n. (PERTH); Along No. 2 Vermin Proof Fence c. 15 km SSE of Jerramungup and 55 km N of Bremer Bay, 2 Oct. 1966, *P.G. Wilson* 4394 (PERTH).

Distribution and habitat. Southern wheatbelt, from south-east of Williams to east of Jerramungup (Figure 68). Often in tall mallee or low open forest as an understorey species on plains or broad valley floors. Preferred soils are fine textured.

Conservation status. Locally abundant in scattered populations, several of which are on conservation reserves.

Flowering period. September-February.

Notes. More widespread than subsp. *apposita*, with greener, narrower, thinner leaves.

19b. ***Eucalyptus xanthonema*** Turcz. subsp. ***apposita*** Brooker & Hopper, subsp. nov. (Figures 68, 70)

Ab subspecie typica foliis adultis longioribus, latioribus, crassioribus saepe falcatis et leviter glaucis differt.

Typus: Madyerip track, 0.6 km E of Donnelly Track, Stirling Range National Park, Western Australia, 22 March 1983, *M.I.H. Brooker* 8040 (holo: PERTH; iso: CANB, MEL, NSW).

Differs from the typical subspecies by the broader (to 1.5 cm wide), longer, thicker, often falcate, slightly bluish-green adult leaves.

Specimens examined. WESTERN AUSTRALIA: turn-off to Trio Peak on Formby South Rd, Stirling Range, 5 Oct. 1982, *M.I.H. Brooker* 7673 (CANB, NSW, PERTH); 2.2 km along N boundary firetrail from Bluff Knoll Rd, Stirling Range, 7 Oct. 1982, *M.I.H. Brooker* 7694 (CANB, NSW, PERTH); scenic drive, Stirling Range, 2.6 km E of Magog Picnic area, 8 Oct. 1982, *M.I.H. Brooker* 7709 (CANB, NSW, PERTH); 21.6 km W of Borden-Stirling Range road on Salt River road, 9 Oct. 1982, *M.I.H. Brooker* 7715 (CANB, NSW, PERTH); 8 km N of Stirling Range Drive turn-off on Chester Pass Road, 34° 23'S 118° 10'E, 11 April 1983, *M.I.H. Brooker* 8092, 8093 (CANB, NSW, PERTH); 5 km S of Amelup on Chester Pass Rd, 34° 18'S 118° 12'E, 23 Oct. 1983, *K. Hill* 353 (CANB, NSW, PERTH); 7.1 km E of Yetermerup Rd along Salt River Rd, 34° 18'S 117° 58'E, 22 March 1982, *S.D. Hopper* 2105 (PERTH).

Distribution and habitat. Apparently endemic in the Stirling Range National Park (Figure 68). Occurs in mallee or shrubland.

Conservation status. Common in scattered populations in the Stirling Range National Park.

Flowering period. ?December-January.

Etymology. From the Latin, *appositus*, placed against, side by side, alluding to its affinity with and

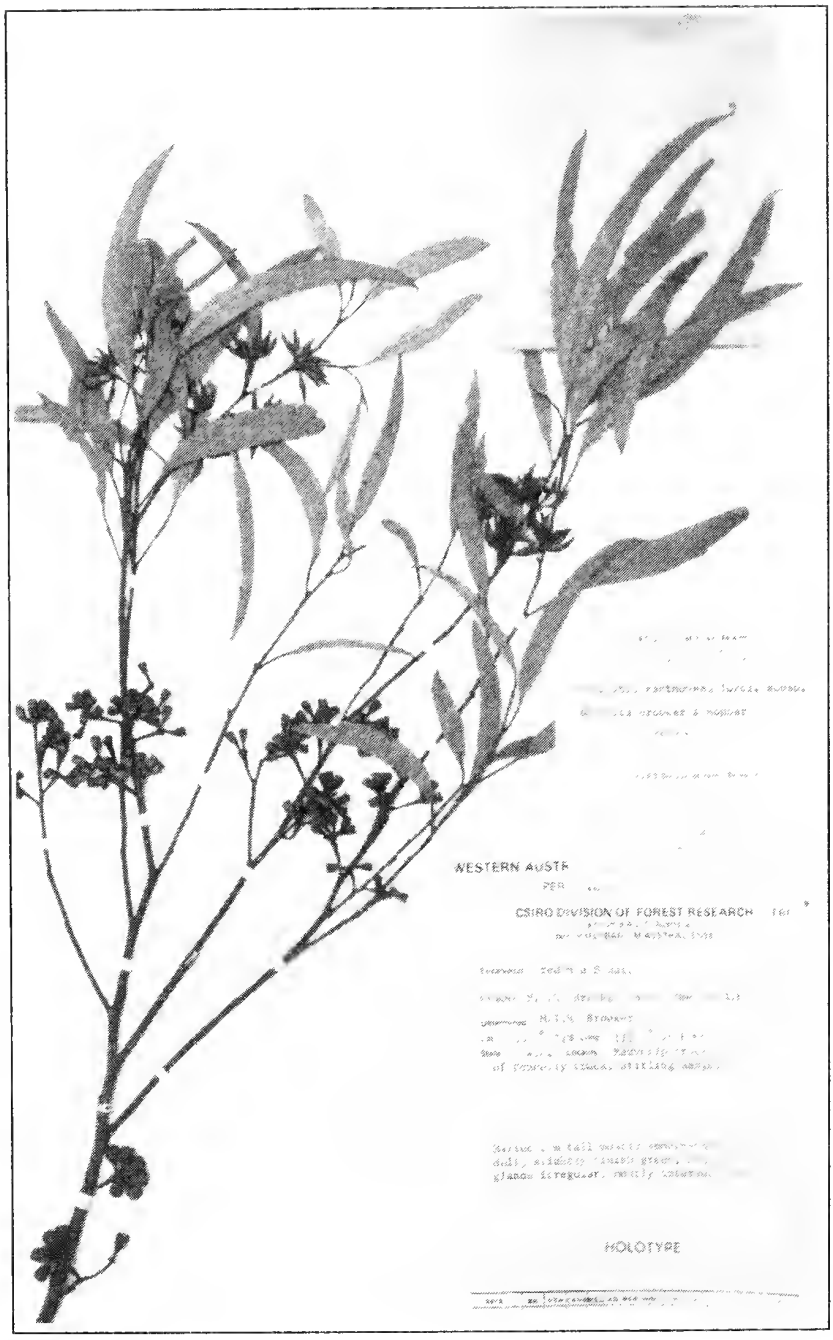

Figure 70. Holotype of *E. xanthonema* Turcz. subsp. *apposita* Brooker & Hopper.

geographical position compared to the nominate subspecies.

Notes. Subsp. *apposita* is intermediate in leaf size between subsp. *xanthonema* and *E. medialis*.

20. ***Eucalyptus medialis*** Brooker and Hopper, sp. nov. (Figures 71, 72, 73)

Frutex ("mallee") ad 5 m altus cortice ad basin leviter aspro, supra laevi atrocineraceo vel pallido-cineraceo super pallido-aurantiaco. Medulla glandulifera. Folia adulta lanceolata, ad 8 x 1.5 cm, hebeta. Alabastra pedicellata fusiformia, vel leviter curvata, ad 1.4 x 0.3 cm. Fructus pedicellati, cupulati vel obconici, ad 0.7 x 0.6 cm, valvis saepe exsertis, semina subspheroidea vel leviter cuboidea.

Typus: Chester Pass Road, 5.3 km NE of Formby South Road, Stirling Range National Park, 34° 23'S 118° 12'E, Western Australia, 20 July 1988, *M.I.H. Brooker* 9997 (holo: PERTH; iso: AD, CANB, MEL, NSW).

Mallee to 5 m tall with some flaky rough bark retained at the base, smooth dark grey and light grey over pale orange above. Pith of branchlets glandular. Leaves of the seedling remaining opposite for 4 or 5 pairs, then alternating, ovate, to 7.5 x 3 cm, blue-green, glabrous. Adult leaves lanceolate, to 8 x 1.5 cm, dull, green. Peduncles to 2 cm long, widening towards the top. Buds pedicellate, fusiform or slightly curved, to 1.4 x 0.3 cm. Operculum relatively short. Fruit pedicellate, cupular to obconical, to 0.7 x 0.6 cm, with valves slightly exserted and erect or spreading outwards radially. Seed light grey-brown, subspherical to slightly cuboid.

Specimens examined. WESTERN AUSTRALIA: N end of Stirling Range, 22 Oct. 1975, *D.F. Blaxell* W75/247 (NSW, PERTH); 8.4 km S by firetrail from Salt River Road, SW of Donnelly Peak, Stirling Range, 9 Oct. 1982, *M.I.H. Brooker* 7722 (CANB, NSW, PERTH); 8.4 km S by firetrail from Salt River Road, SW of Donnelly Peak, Stirling Range, 9 Oct 1982, *M.I.H. Brooker* 7722 (CANB, MEL, NSW, PERTH); 0.4 km SE of Chester Pass road on Bluff Knoll Road, Stirling Range, 34° 21'S 118° 13'E, 21 March 1983, *M.I.H. Brooker* 8030 (CANB, MEL, NSW, PERTH); Stirling Range, 1 km S along Ellen track from N boundary, 34° 20'S 118° 20'E, 23 March 1983, *M.I.H. Brooker*, 8047 (CANB, MEL, NSW, PERTH); 8 km N of Stirling Range Drive turn-off on Chester Pass Road, 11 April 1983, *M.I.H. Brooker* 8092, 8093 (CANB, NSW, PERTH); uphill from picnic site at Mt Trio, Stirling Range, 22 February 1985, *M.I.H. Brooker* 8867 (CANB, NSW, PERTH); 0.4 km along Bluff Knoll road from Chester Pass Road (50 m to N), Stirling Range National Park, 25 November 1987, *M.I.H. Brooker* 9821 (AD, CANB, MEL, NSW, PERTH); 14 km E of Red Gum Pass road, 28 March 1968, *G.M. Chippendale* 436 (CANB); near Mount Gog, Stirling Range, 10 March 1969, *A.R. Fairall* 2511 (PERTH); Stirling Range National Park, 10 km ENE of Bluff Knoll, 34° 23'S 118° 22'E, 7 Oct. 1982, *S.D. Hopper* 2629 (PERTH); Stirling Range National Park, 4.2 km S of Salt River Rd on internal W firebreak, 34° 21'S 117° 42'E, 9 Oct. 1982, *S.D. Hopper* 2650 (PERTH); 1 km WNW along Woogenillup road from Kamballup store, 34° 34'S 117° 59'E, 5 Oct. 1987, *S.D. Hopper* 6177 (PERTH); Stirling Range, S slopes of Mt Success, 9 May 1975, *G.J Keighery* 2274 (PERTH); ridgeline 500 m SW of Ellen's Peak, Stirling Range, 11 May 1982, *G.J. Keighery* 4936 (PERTH); near Moir Hill, Gnowellen Road, SE margin Stirling Range, 15 Nov. 1982, *G.J. Keighery* 5855 (PERTH); South Stirlings, 17 June 1963, *F. Lullfitz* L1283 (PERTH); 17 miles N of Albany on Borden road, May 1969, *B. Rockel* A3 (PERTH).

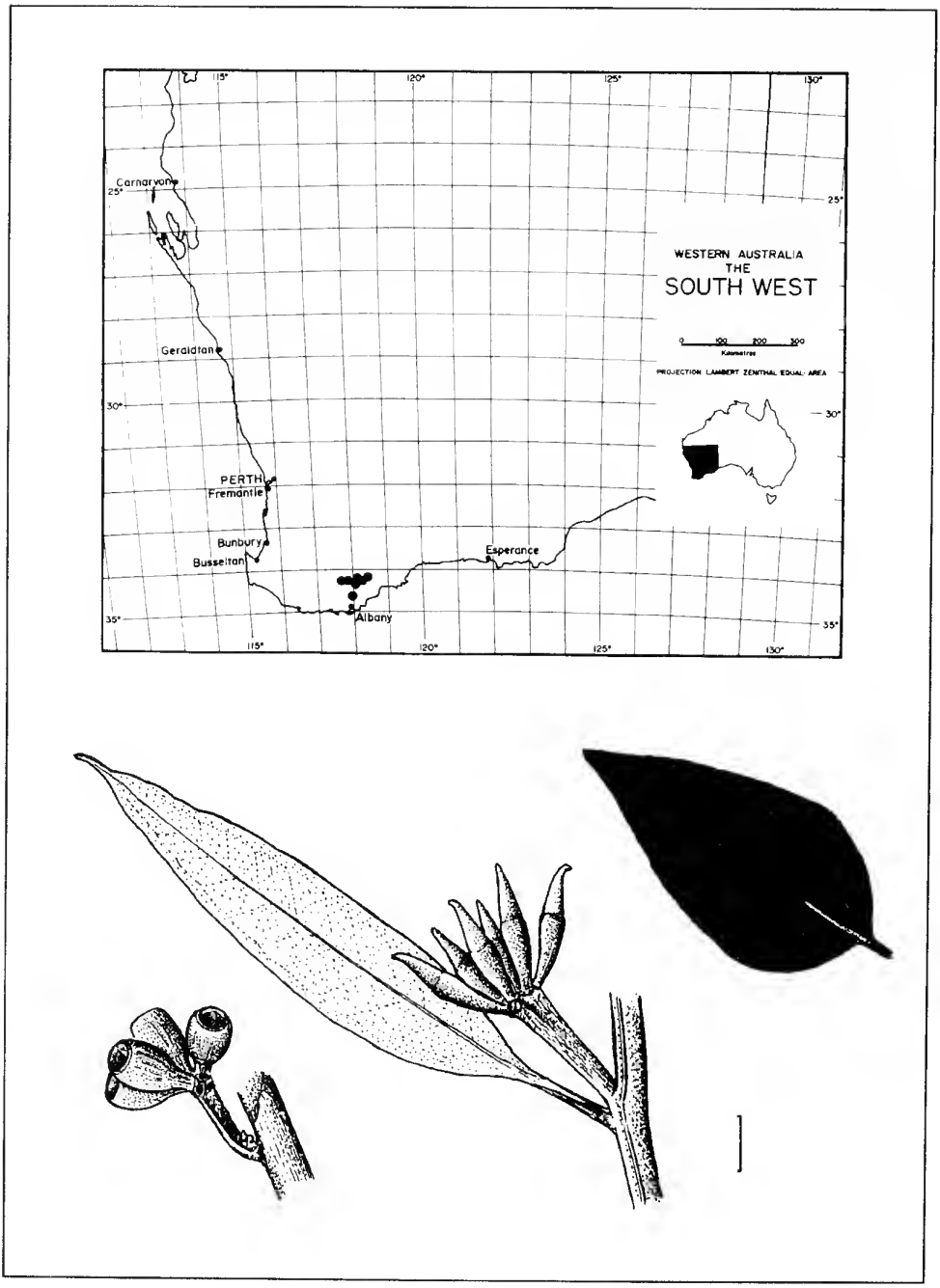

Figure 71. *Eucalyptus medialis* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

Figure 72. Holotype of *E. medialis* Brooker & Hopper.

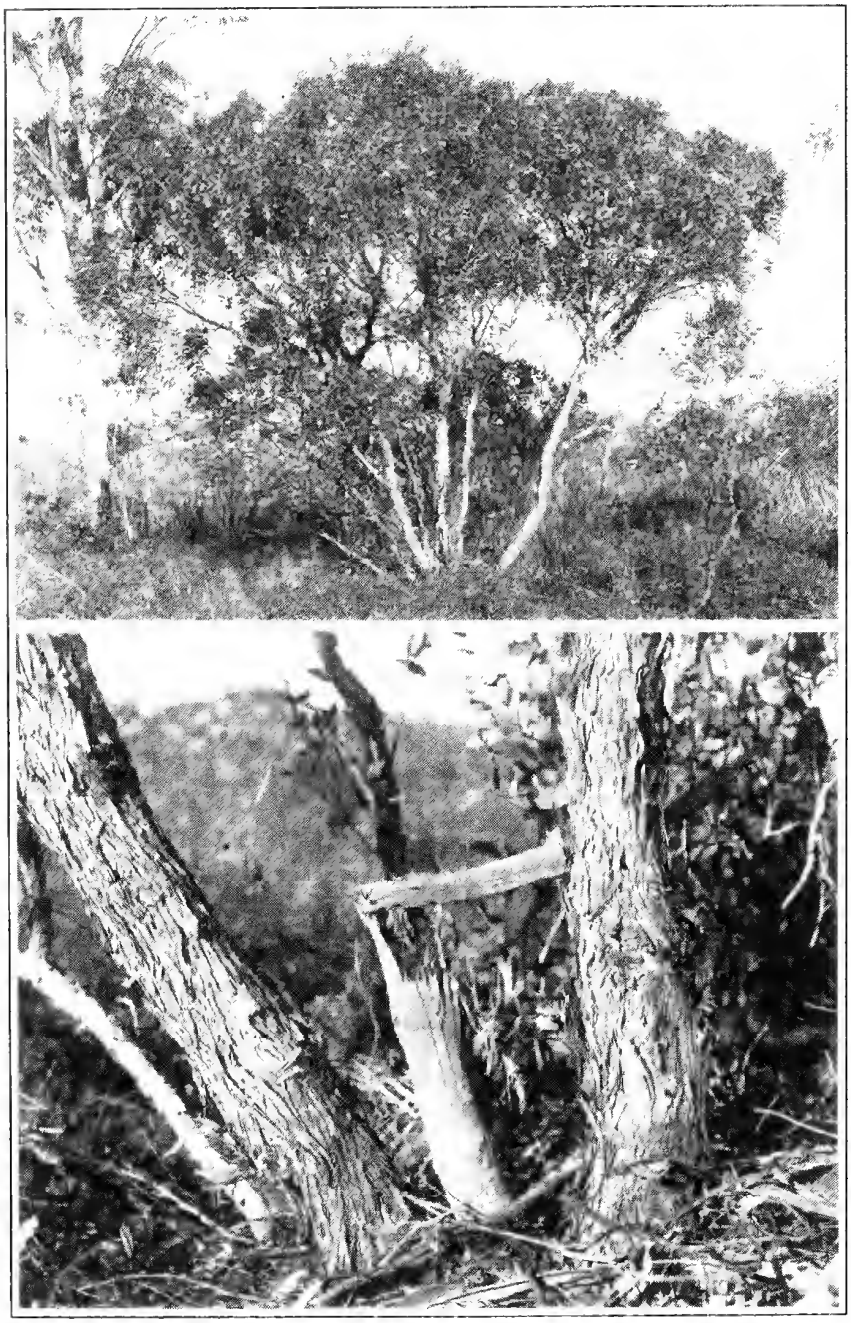

Figure 73. *E. medialis* mallee habit, and stems and bark.

Distribution and habitat. Lower slopes and plains in and around the Stirling Range (Figure 71). *E. medialis* is a common component of tall mallee in association with *E. tetragona* and *E. incrassata*. Soils are usually white sand.

Conservation status. Locally common throughout the Stirling Range National Park.

Flowering period. Unknown.

Etymology. From the Latin, *medialis*, middle, in allusion to its morphological intermediacy with respect to *E. xanthonema* and *E. melanophitra*.

Notes. E. medialis differs from *E. xanthonema* in its taller stature, rough basal bark and broader leaves. It is a common mallee in the Stirling Range National Park, west of the distribution of *E. melanophitra*, which is a mallet with distinct rough bark over part or most of the trunk.

E. medialis has similar dull green adult leaves to *E. redunca* but it has smaller buds and fruit, rough basal bark, and conspicuous glands in the pith of the branchlets.

21. ***Eucalyptus melanophitra*** Brooker & Hopper, sp. nov. (Figures 74, 75, 76)

Arbor parva ("mallet") ad 4 m alta, cortice leproso ad basin vel investienti truneum totum. Folia plantularum leviter pubescentia. Folia adulta hebeta veneta, parva, ad 8 x 1 em. Alabastra fusiformia, ad 1.5 x 0.3 em. Flores albi. Fructus breviter pedicellati, ad 0.6 x 0.5 em. Semina subsphaerica vel euboidea.

Typus: e. 1 km west of Coraekerup Creek, north of Toompup South road, 34° 10'S 118° 40'E, Western Australia, 3 March 1985, *M.I.H. Brooker* 8885 (holo: PERTH; iso: CANB, NSW, MEL, AD).

Colour illustration. Brooker & Kleinig (1990: 173).

A mallet to 4 m tall. Bark over whole or only base of trunk rough, dark, flaky, smooth grey above. Pith of branchlets glandular. Leaves of the seedling remaining opposite for about 4 pairs, then alternating, ovate to broadly laneeolate, 5-10 x 3-4 cm, dull, bluish green, slightly hairy. Adult leaves laneeolate to faleate, to 8 x 1 em, dull green, often uncinate or with a fine acumen. Buds fusiform, to 1.5 x 0.3 em with many opercula slightly narrower than hypanthium. Flowers white. Fruit shortly pedieellate, barrel-shaped to eupular, to 0.6 x 0.5 cm. Seed light grey-brown, subspherical to euboid.

Specimens examined. WESTERN AUSTRALIA: 2 km W of Coraekerup Creek, near the E boundary of reserve, 6 Oct. 1982, *M.I.H. Brooker* 7688 (CANB, NSW, PERTH); 0.7 km S along Norman Road from Cowalellup Road, 34° 12'S 118° 42'E, 21 Feb. 1985. *M.I.H. Brooker* 8863 (CANB, MEL, NSW, PERTH); Breakaway W of Corackerup Creek on Toompup South Road, 34° 20'S 118° 41'E, 3 March 1985, *M.I.H. Brooker* 8884 (CANB, MEL, NSW, PERTH); 6.2 km from Highway 1 on Borden-Bremer Bay Road, 34° 21'S 118° 33'E, 19 Feb. 1986, *M.I.H. Brooker* 9182 (CANB, MEL, NSW, PERTH); Eyre distriet, Chillinup Pool on Pallinup River, 34° 21'S 118° 38'E, 14 Jan. 1979, *M.D. Crisp* 5146 (CBG, PERTH); 0.7 km S along Norman Road from Cowalellup Road, 34° 11'S

118° 43'E, 23 Oct. 1983, *K. Hill* 341 (CANB, NSW, PERTH); 11.6 km SE of Cowalellup Rock, NE corner of Corackerup Nat. Res., 34° 08'S 118° 42'E, 31 July 1982, *S.D. Hopper* 2406 (PERTH); 1.5 km SSE of Chillinup on Stockwell Rd, 34° 21'30"S 118° 38'30"E, 1 Feb. 1988, *A. Napier & A. Taylor* 230 (CANB, PERTH).

Distribution and habitat. Pallinup River and Corackerup Nature Reserve areas, usually on stony breakaways (Figure 74). Grows in low closed or open forest with *E. redacta* Brooker & Hopper *ined.*, *E. platypus* and *E. annulata*.

Conservation status. Locally abundant in disjunct populations across a narrow geographical range. Known on one nature reserve.

Flowering period. February.

Etymology. From the Greek, *melano*, dark, black and *phitros*, bole, trunk, alluding to the black butt.

Notes. This is a recently discovered species drawn to the attention of SDH in 1982 by the late Ken Newbey, who studied in detail the vegetation of the Corackerup Nature Reserve as part of his M.Phil. degree at Murdoch University.

We consider the affinities of *E. melanophitra* to be with *E. xanthonema*, from which it differs in the mallet habit, rough basal bark, broader leaves, and occurrence on breakaways, and with *E. medialis*, which is a mallee, not of breakaways, with larger leaves and only loose rough basal bark.

22. ***Eucalyptus praetermissa*** Brooker & Hopper, sp. nov. (Figures 77, 78, 79)

Arbor ("mallet") ad 10 m alta cortice pro parte maxima laevi cremeo, cineraceo vel subroseo, saepe fragmentis nondecorticantibus ad basin. Medulla ramulorum glandulifera. Folio adulta viridia, hebeta. Inflorescentiae axillares, ad 15-florae; pedunculi valde complanati. Alabastra pedicellata, fusiformia vel leviter curvata, ad 1.5 x 0.4 cm; operculum decrescens in apicem tenuem. Fructus pedicellati, obconici, doliiformes vel cupulati, ad 0.7 x 0.5 cm. Semina cuboidea vel leviter plano-ovoidea.

Typus: Beaufort Inlet, north side, Western Australia, 29 Nov. 1984, *M.I.H. Brooker* 8744 (holo: PERTH; iso: CANB, NSW).

A mallet to 10 m tall with mostly smooth, cream, grey or pinkish bark but often with loosely held non-decorticated dead fragments held on the lower 1 m. Black horizontal insect scars often present. Pith of branchlets glandular. Leaves of the seedling remaining opposite for about 4 or 5 pairs, then alternating, ovate, to 7 x 2.5 cm, green to blue-green, glabrous. Adult leaves petiolate, alternating, lanceolate, to 10 x 2 cm, concolorous, dull, green. Inflorescences axillary, unbranched, to 15-flowered; peduncles strongly flattened, to 1.8 cm long. Buds pedicellate, fusiform or slightly curved, to 1.5 x 0.4 cm; operculum tapering to a fine point. Some outer stamens erect, inner ones partly or completely inflexed, all fertile. Flowers creamy white to pale yellow. Fruit pedicellate, obconical, cupular or barrel-shaped, to 0.7 x 0.5 cm; valves not exserted. Seed light brownish grey, cuboid to slightly compressed-ovoid.

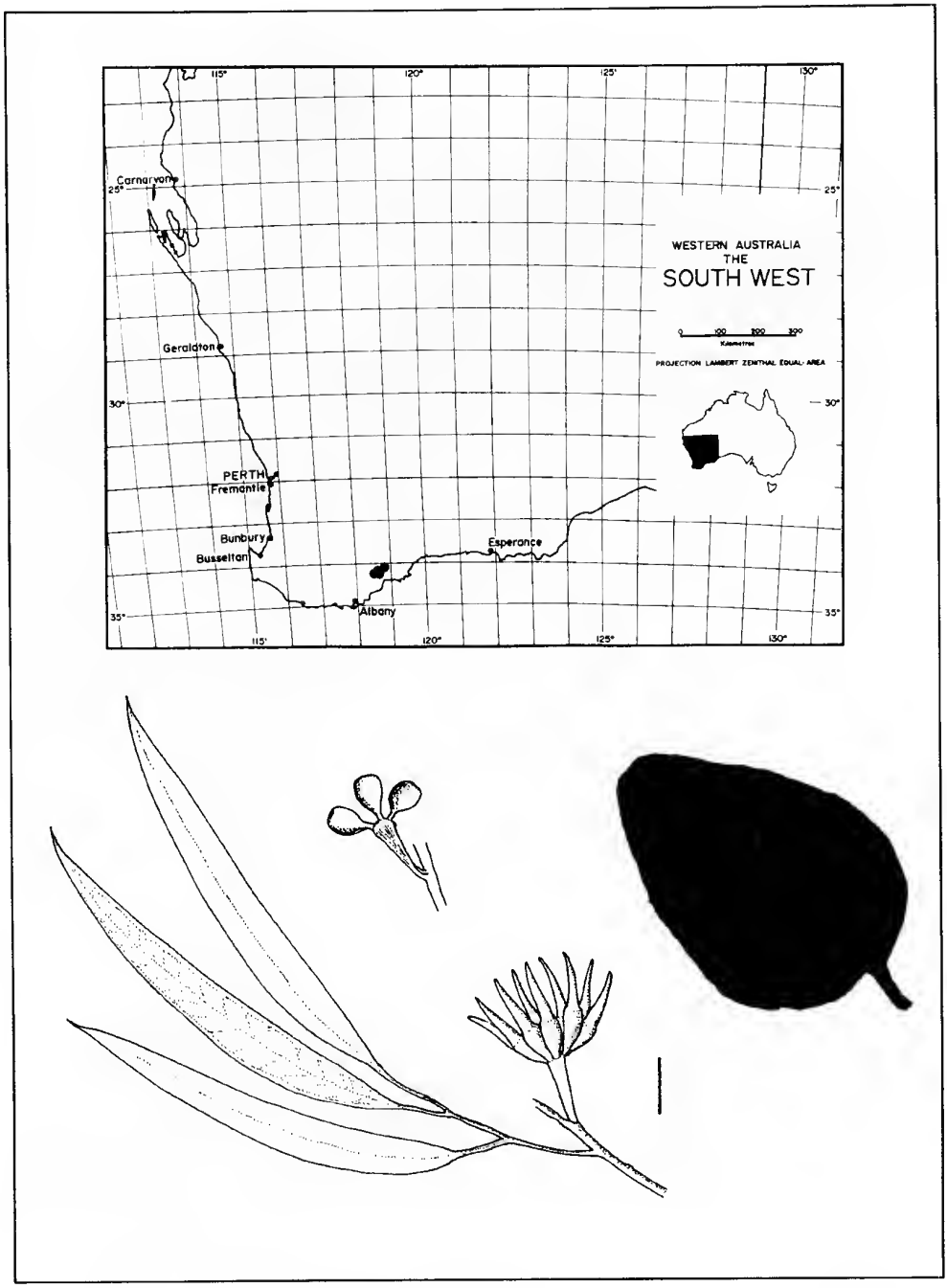

Figure 74. *Eucalyptus melanophitra* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

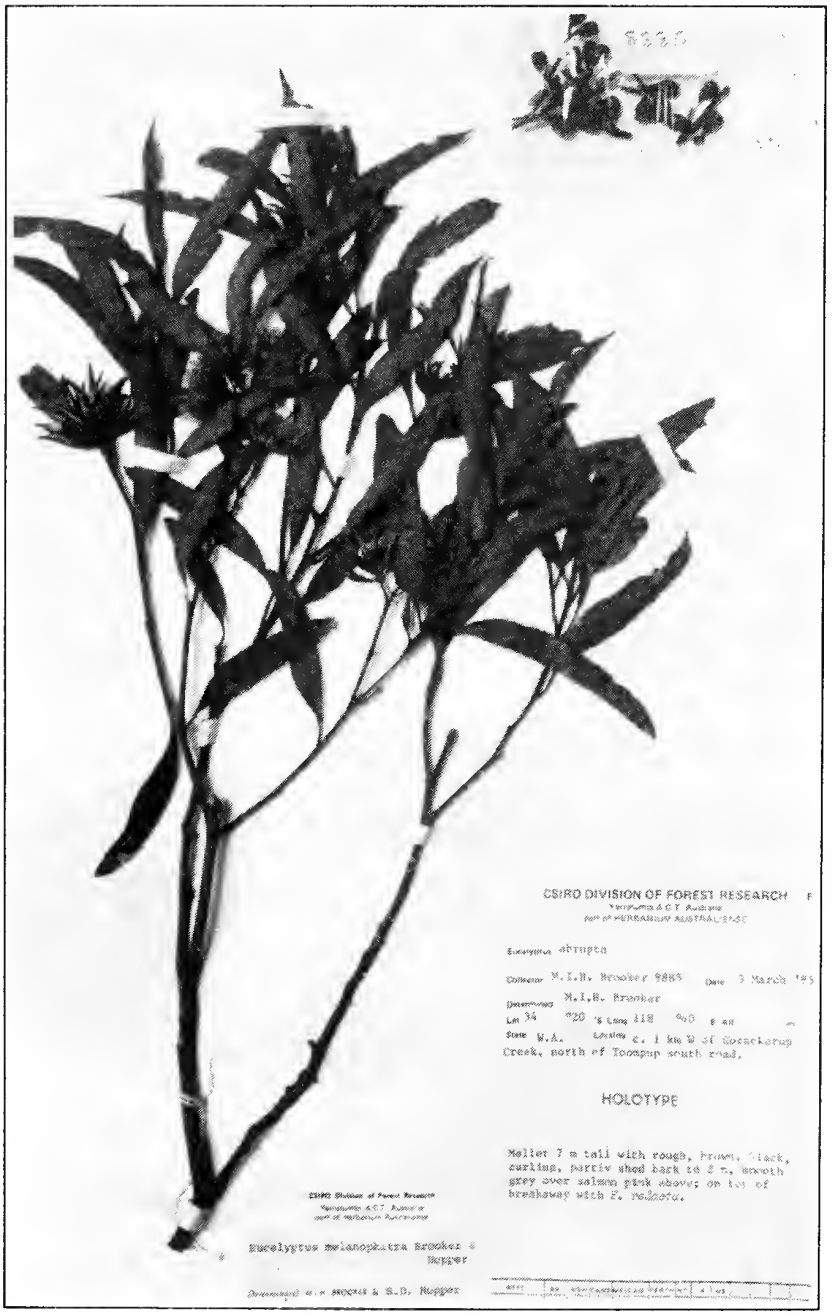

Figure 75. Holotype of *E. melanophitra* Brooker & Hopper.

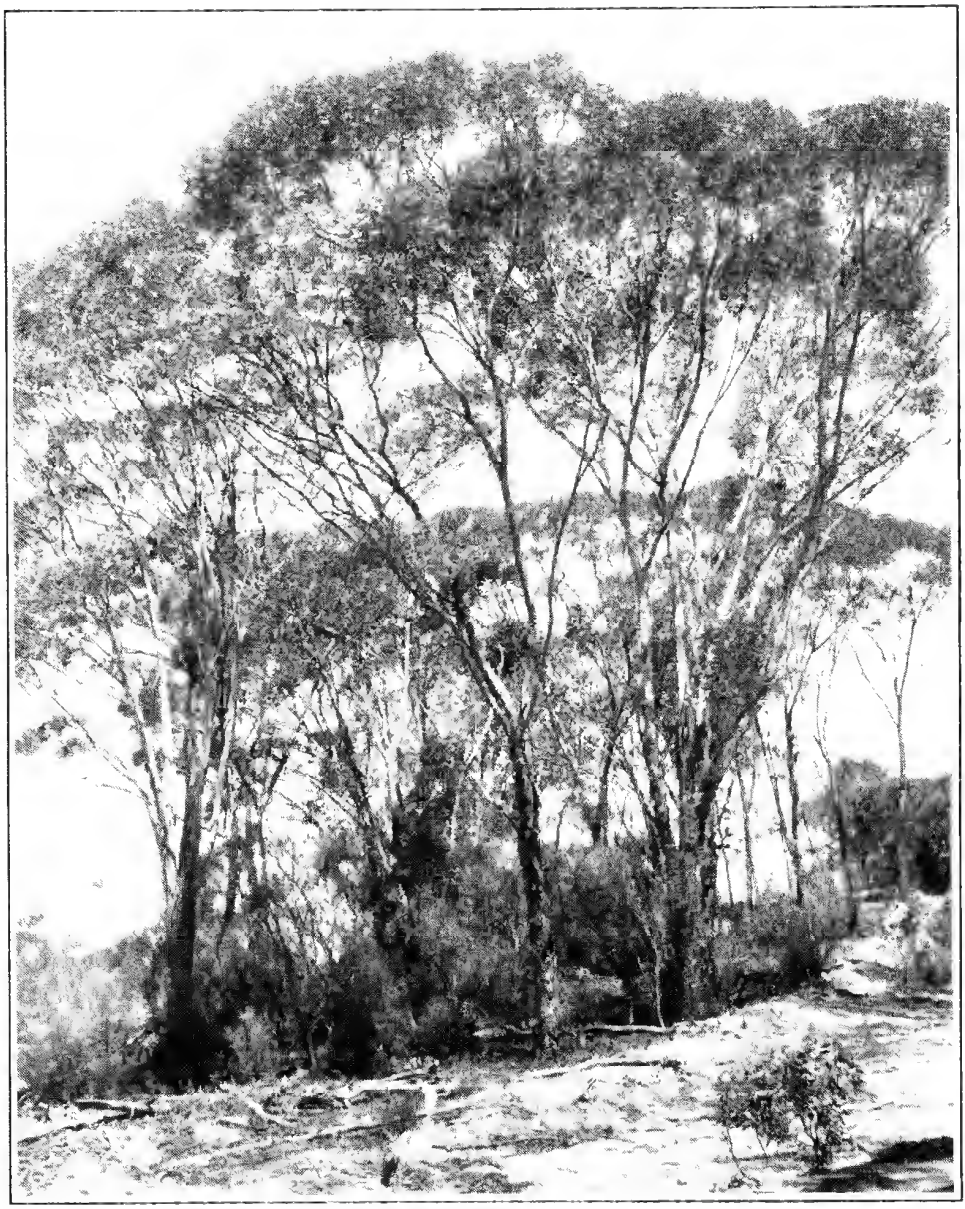

Figure 76. *E. melanophitra* showing mallet habit (SE of Ongerup).

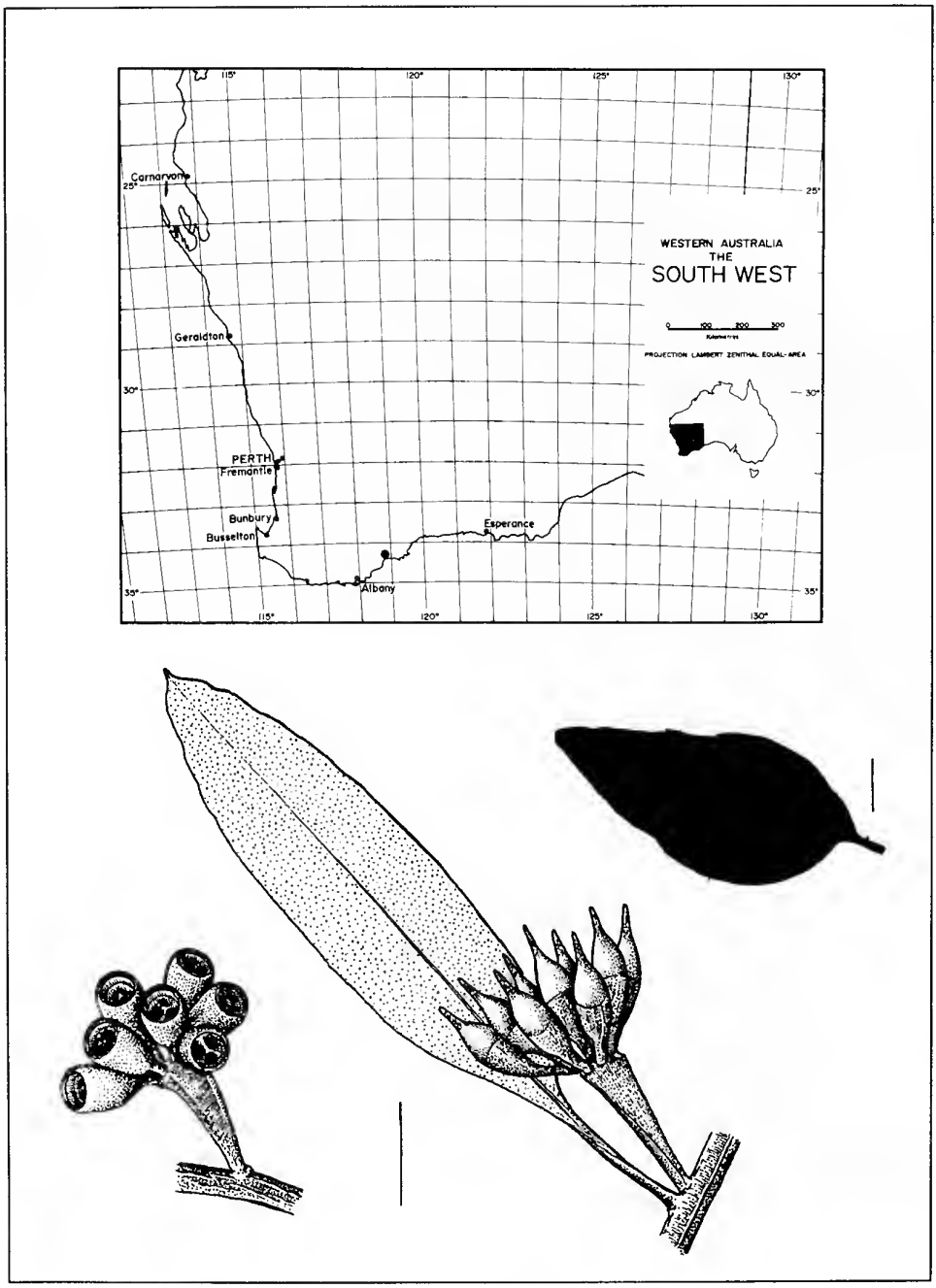

Figure 77. *Eucalyptus praetermissa* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

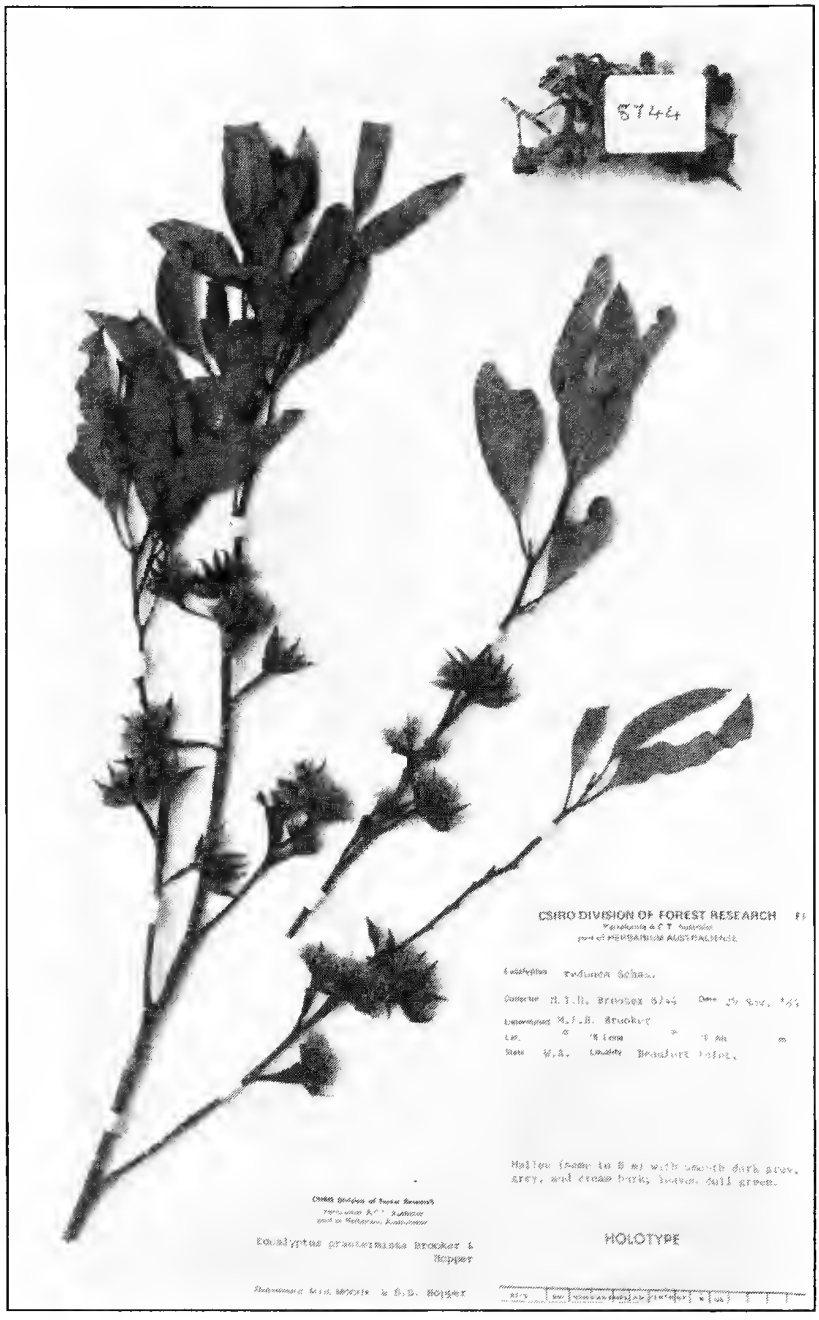

Figure 78. Holotype of *E. praetermissa* Brooker & Hopper.

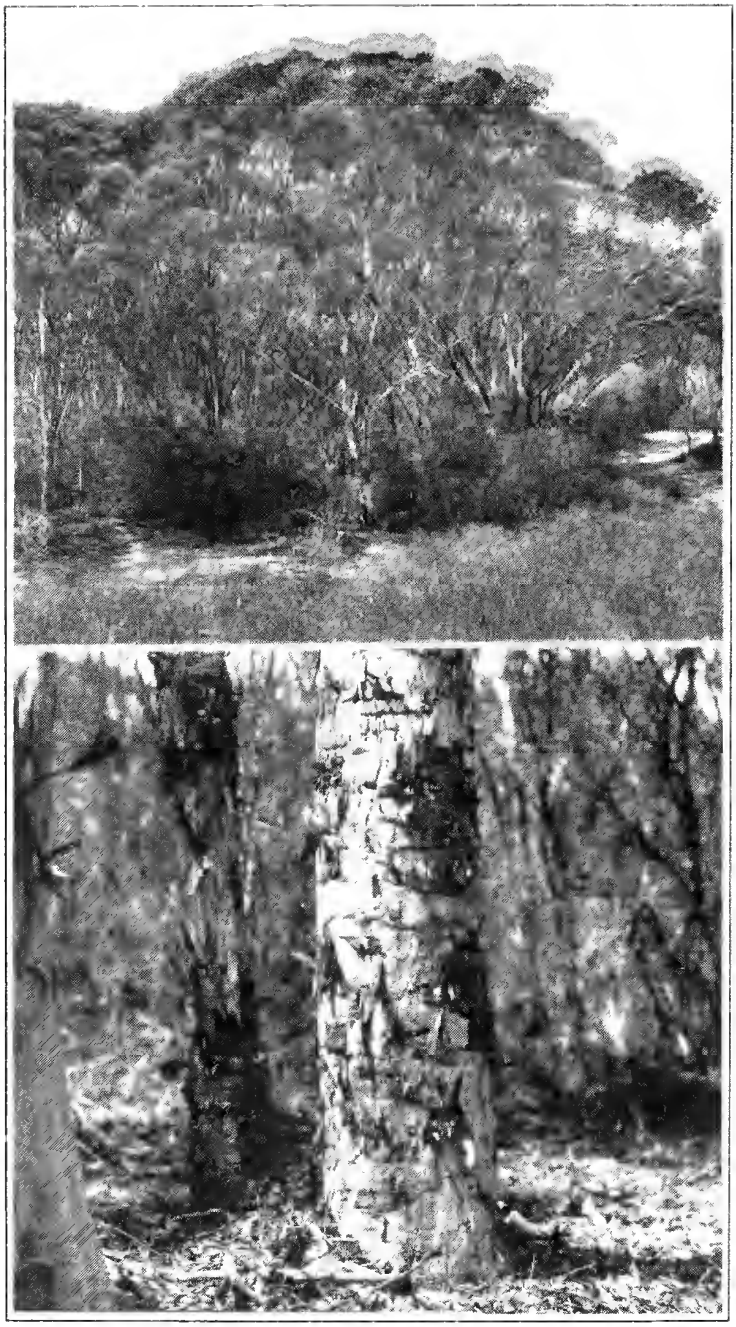

Figure 79. *E. praetermissa* mallet habit, and trunk and bark.

Specimens examined. WESTERN AUSTRALIA: Beaufort Inlet, 14 Nov. 1981, *M.I.H. Brooker* 7166 (CANB), 21 February 1985, *M.I.H. Brooker* 8866 (CANB, NSW, PERTH), 12 Jan. 1988, *M.I.H. Brooker* 9852, 9853 (AD, CANB, MEL, NSW, PERTH); Millers Point Road, 7.7 km S of Bremer Bay Road, 34° 27'S 118° 53'E, 28 Sept. 1987, *S.D. Hopper* 6134 (PERTH); Millers Point, 4 Jan. 1962, *K.R. Newbey* 144 (PERTH).

Distribution and habitat. Known only from the north side of Beaufort Inlet on the south coast of W.A. (Figure 77), where it occurs at the foot of coastal slopes on flats above the inlet. It co-dominates dense low forests with *E. platypus* var. *heterophylla*, *E. newbeyi* and *E. redacta* Brooker & Hopper *ined.* The soil is fine grey sand.

Conservation status. Vulnerable but locally abundant. Further populations may be located nearby on future surveys. Not known on a conservation reserve.

Flowering period. January.

Etymology. The specific epithet refers to our neglecting this species for several years following our first encounter with it in 1981. For some time, we considered it to be a variant of *E. reduncа*, and only recognised its distinctions in recent years. Also, despite its impressive stature and proximity to a well-known recreational area, no botanists other than the late Ken Newbey and ourselves had collected the species (Latin *praetermissus*, neglected).

Notes. E. praetermissa is a tall mallet that grows in dense stands with a terminal crown. In less crowded situations, a large crown is formed (Figure 79).

Of the dull-leaved superspecies in the series, it is distinct from "*reduncа*" in its shorter buds and consistently glandular pith. The somewhat cuboid seed align *E. praetermissa* with superspecies "*subangusta*" and superspecies "*xanthonema*", and distinguish it from superspecies "*wandoo*". Its larger stature, attenuate buds and crisped bark distinguish it from "*subangusta*".

Within superspecies "*xanthonema*" where it seems best placed, *E. praetermissa* is distinguished from *E. xanthonema* and *E. melanophitra* by its larger leaves, and from *E. medialis* by its mallet habit, much larger stature and smooth bark with persistent partly decorticated fragments.

23. ***Eucalyptus gardneri*** Maiden, "Crit. Revis. Gen. *Eucalyptus*" 7: 53 (1924). *Type*: near Bendering, Western Australia, 6 February 1922, *C.A. Gardner* 1239 (NSW) " ... in gravelly loam on rising ground, forming thicket-like growths with *E. astringens*" (Figures 5d, 10b, 80, 81, 82)

A mallet to 15 m with bark mostly smooth, often satiny, grey over pale salmon pink, or with dark reddish brown partly decorticated flakes. Pith of branchlets rarely glandular. Leaves of the seedling remaining opposite for 2-4 pairs, then alternating, deltoid to ovate, to 10 x 6 cm, slightly glossy, blue-green or purplish, some slightly toothed around edges, glabrous. Adult leaves lanceolate, to 9 x 2.3 cm, dull, bluish to blue-grey. Inflorescences to 11-flowered; peduncles to 2.1 cm long. Buds long,

attenuate, to 2.6 x 0.5 cm, operculum recurved at the tip; stamens sometimes reduced to a single whorl, outer erect, inner when present partly or completely inflexed, all fertile. Flowers pale yellow. Fruit pedicellate, barrel-shaped, to 1.1 x 0.7 cm. Seed light grey-brown, more or less spherical.

Notes. E. gardneri (blue mallet) is typically a mallet of lateritic breakaways. The trunk of the typical subspecies has imperfectly decorticated flakes of bark and the crown is easily recognised from a distance by the dull bluish leaves. In the past several other taxa have been included in *E. gardneri*. We consider them to be the distinct species *E. pluricaulis*, *E. densa* and *E. redunca* which differ in habit, habitat, crown formation and leaf characters (see notes under each species below). *E. gardneri* is used for roadside planting and is a source of nectar for honey producers in winter (Smith 1969).

There are two subspecies.

23a. ***Eucalyptus gardneri*** Maiden subsp. ***gardneri*** (Figures 5d, 10b, 80, 81, 82)

Colour illustration. Brooker & Kleinig (1990: 175)

Buds narrowly fusiform, mature operculum more than 15 mm long.

Specimens examined. WESTERN AUSTRALIA: Hyden, 7 Sept. 1966, *M. Barrow* 70 (PERTH); 13.3 km WSW of Wickepin towards Corrigin, 32° 49'S 117° 22'E, 4 May 1983, *M.I.H. Brooker* 8094 (CANB, NSW, PERTH); 2.7 km E of Wedin Nth road on Narrogin-Harrismith road, 32° 55'S 117° 43'E, 4 May 1983, *M.I.H. Brooker* 8100 (CANB, NSW, PERTH); 6.1 km W of Jitarning rail crossing towards Wickepin, 32° 46'S 117° 57'E, 5 May 1983, *M.I.H. Brooker* 8107 (CANB, NSW, PERTH); c. 9 km NE of Kondinin on Trig Road, 32° 27'S 118° 17'E, 8 Nov. 1983, *M.I.H. Brooker* 8363 (CANB, NSW, PERTH); NW of Hyden, 32° 18'S 118° 43'E, 9 Aug. 1984, *M.I.H. Brooker* 8632 (CANB, MEL, NSW, PERTH); NW of Burngup, 33° 00'S 118° 39'E, 9 Dec. 1985, *M.I.H. Brooker* 9138 (CANB, MEL, NSW, PERTH); 8.3 km N of Nyabing on Kukerin road, 33° 26'S 118° 08'E, 9 Dec. 1985, *M.I.H. Brooker* 9143 (CANB, MEL, NSW, PERTH); Corner of Piesseville road and road to north, 33° 10'S 117° 03'E, 9 Dec. 1985, *M.I.H. Brooker* 9146 (CANB, MEL, NSW, PERTH); Toorackie, S of Williams, 33° 10'S 116° 59'E, 19 Feb. 1986, *M.I.H. Brooker* 9184 (CANB, MEL, NSW, PERTH); 5 km E of Cadoux, 2 July 1986, *M.I.H. Brooker* (CANB, PERTH, NSW, MEL): 26.6 miles W of Lake Grace on rd to Dumbleyung, 4 April 1968, *S.G.M. Carr* 683 (PERTH); 9 km NE of Kondinin, near trig point, 32° 27'S 118° 21'E, 27 Jan. 1979, *M.D. Crisp* 5520 (CBG, NSW, PERTH); 1 km N of Narrogin-Wagin road, 16 Sept. 1984, *D. Foreman* 729 (CANB); Wagin, 13 June 1920, *C.A. Gardner* 509 (PERTH); Lyndhurst, near Wagin, 15 June 1920, *C.A. Gardner* 9 (PERTH); Bendering, 6 Feb. 1922, *C.A. Gardner* 1230 (PERTH); Lyndhurst, Wagin, 7 Feb. 1923, *C.A. Gardner* 1408 (PERTH); Wagin, 7 Feb. 1923, *C.A. Gardner* 1908 (PERTH); 4 miles N of Wagin, nr Jaloran Road, *C.A. Gardner* 1996 (PERTH); "Lyndhurst", Wagin, 2 Sept. 1923, *C.A. Gardner* 1496 (PERTH); Harrismith, 6 March 1924, *C.A. Gardner* 1615, 2115 (PERTH); 22 miles E of Dumbleyung, 21 Feb. 1966, *A.S. George* 7561 & *S.G.M. Carr* (PERTH); 5 km SE of Kukerin turnoff, 39.9 km NE of Dumbleyung, 33° 10'S 118° 05'E, 5 Aug. 1982, *S.D. Hopper* 2456 (PERTH); Bendering Nature Reserve, 18 km ENE of Bendering, 32° 21'30"S 118° 29'30" E, 14 June 1985, *S.D. Hopper* 4421 (PERTH); 3.25 miles NE of Manmanning, on N side of Avon Loc. 24909, 30° 50'S 117° 09'E, 6 July

1986, *B.H. Smith* 657 (MEL, PERTH); 2 miles N of Dumbleyung, on the road to Kukerin, 19 March 1970, *M.D. Tindale* 156 & *B.R. Maslin* (NSW, PERTH); Dragon Rocks (Nature Reserve No. 36128), 26 Jan. 1983, *K. Wallace* (PERTH).

Distribution and habitat. Mainly in the west central wheatbelt from Brookton to Narembeen. Also east of Cadoux in the northern wheatbelt (Figure 80). *E. gardneri* subsp. *gardneri* typically forms pure stands of open to closed forest with very sparse understory on lateritic breakaways.

Conservation status. Locally abundant in scattered disjunct populations, some of which occur on nature reserves.

Flowering period. March - September.

Notes. E. gardneri subsp. *gardneri* has longer and more slender buds than subsp. *ravensthorpensis*.

23b. ***Eucalyptus gardneri*** Maiden subsp. ***ravensthorpensis*** Brooker & Hopper, subsp. nov. (Figure 80)

A subspecie typica alabastris validioribus et operculis parvioribus differt.

Typus: Ravensthorpe Range, ca. 5 km E of Ravensthorpe, 800 m ENE of Highway 1 along Carlingup Road, then 800 m NNW to revegetating gravel pit, 10 April 1991, *S.D. Hopper* 7929 (holo: PERTH; iso: CANB, MEL, NSW)

Differs from the typical subspecies in the more robust fusiform buds, and smaller mature operculum less than 15 mm long. It also has smaller juvenile leaves.

Specimens examined. WESTERN AUSTRALIA: 5 miles E of Ravensthorpe, 6 Nov. 1969, *M.I.H. Brooker* 2291 (CANB, PERTH); 4.8 km N of Ravensthorpe-Jerramungup road towards Lake King, NW of Ravensthorpe, 33 ° 33'S 120° 00'E, 7 June 1983, *M.I.H. Brooker* 8171 (CANB, MEL, NSW, PERTH); Ravensthorpe Range, 12 km E of Ravensthorpe on edge of Highway 1, 33° 36'S 120° 11'E, *M.D. Crisp* 4985 (CANB, CBG 7900793, NSW, PERTH); 10 km E of Ravensthorpe, 11 Dec. 1979, *H. Demarz* D7941 (CANB, PERTH); Ravensthorpe Range, Jan. 1924, *C.A. Gardner* 1591 (PERTH); type locality, 10 April 1991, *S.D. Hopper* 7930 (CANB, PERTH); Ravensthorpe Range, 10 km E of Ravensthorpe along Highway 1, then 1 km S along firebreak, 9 April 1991, *S.D. Hopper* 7925 (CANB, PERTH).

Distribution and habitat. Confined to the Ravensthorpe Range within 20 km of Ravensthorpe. Grows on rocky slopes and gravelly breakaways with silver mallet (*E.* aff. *falcata*), green mallet (*E. clivicola*), and *E. tetragona*.

Conservation status. Locally abundant in scattered disjunct populations, all of which occur on a proposed nature reserve.

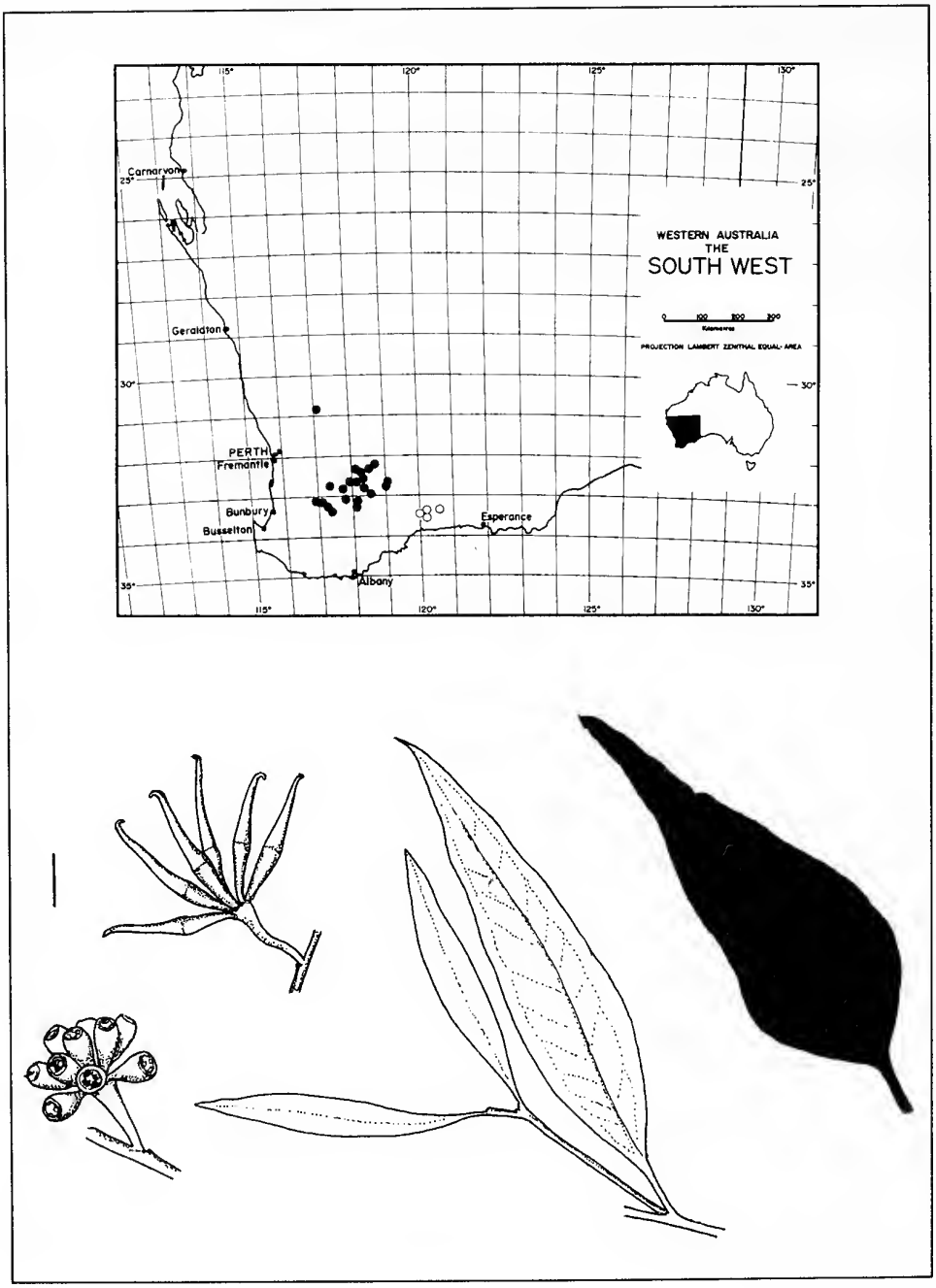

Figure 80. Distribution of *Eucalyptus gardneri* subsp. *gardneri* (●) and *E. gardneri* subsp. *ravensthorpensis* (○), and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf of *E. gardneri* subsp. *gardneri* (scale bar = 1 cm).

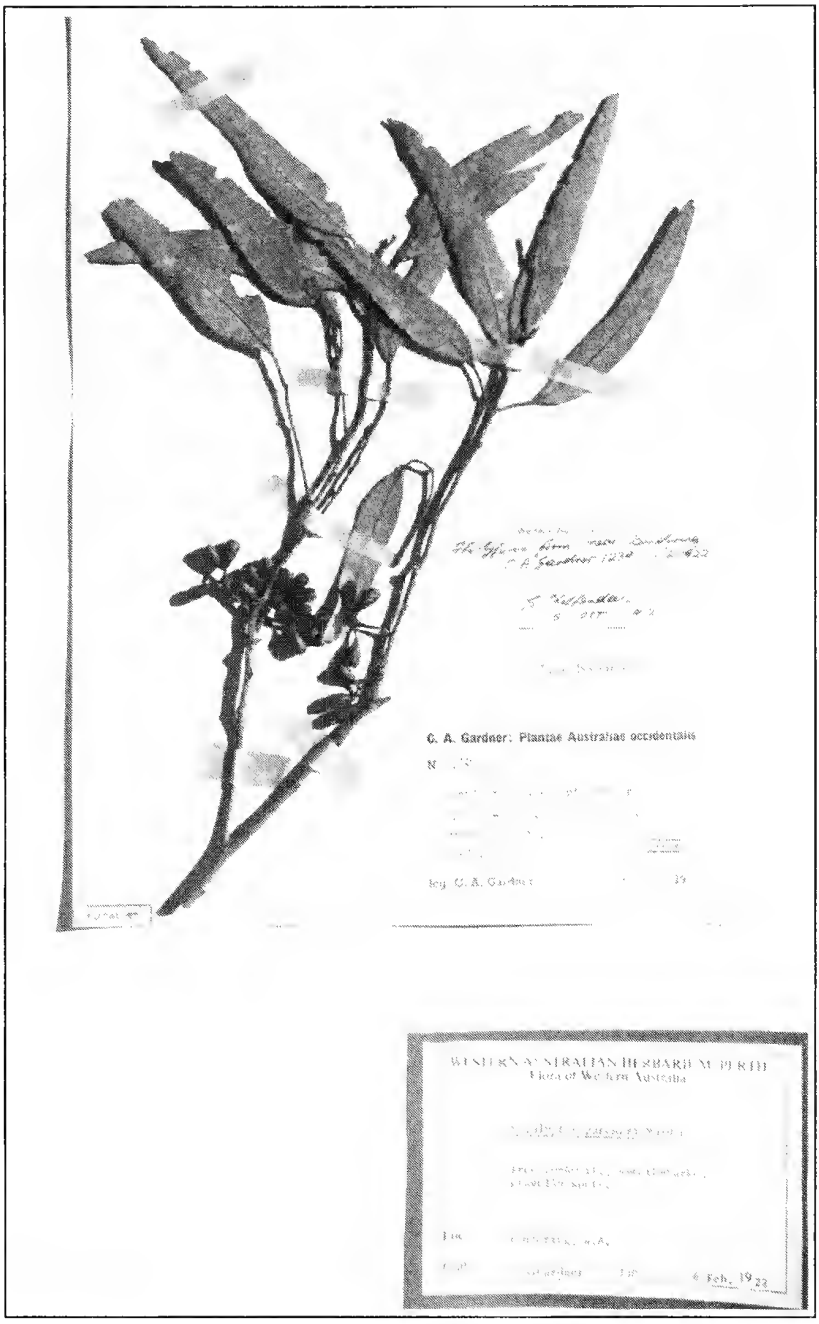

Figure 81. Isosyntype of *E. gardneri* Maiden subsp. *gardneri*.

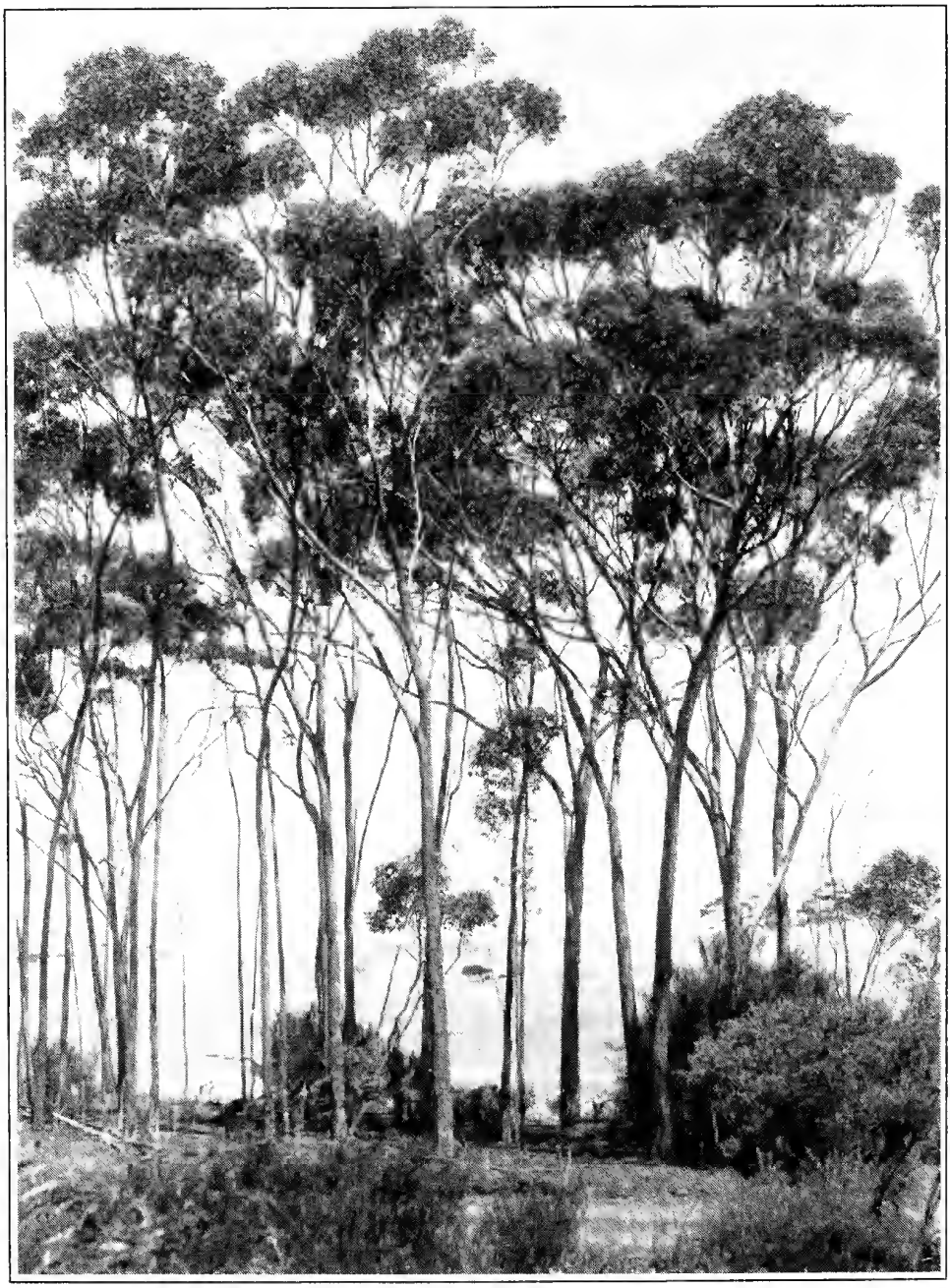

Figure 82. *E. gardneri* subsp. *gardneri* showing mallet habit.

Flowering period. - ?

Etymology. The epithet is taken from the Ravensthorpe Range, to which the subspecies is confined.

Notes. E. gardneri subsp. *ravensthorpensis* is disjunct from and has shorter and more robust buds than the typical subspecies, as well as smaller juvenile leaves. Its bark often appears smoother also, lacking the small adherent pieces seen on subsp. *gardneri*. The shorter buds of subsp. *ravensthorpensis* presumably are less derived than the longer buds of subsp. *gardneri*. If so, subsp. *ravensthorpensis* may be a relictual taxon. Interestingly, it is confined to the same range of hills as *E. desmondensis*, which appears to be a relictual taxon with no close relatives.

24. ***Eucalyptus densa*** Brooker & Hopper, sp. nov. (Figures 83, 84, 85, 86, 87)

Eucalypto gardneri Maiden affinis a qua statura parviore, foliis juvenilibus adultisque angustioribus et cortice saepe laeviore differt.

Typus: 32.7 km along East Road towards Lake Magenta, Western Australia, 33° 29'S 118° 56'E, 14 Jan. 1985, *M.I.H. Brooker* 8778 (holo: PERTH; iso: CANB, MEL, NSW).

With affinity to *Eucalyptus gardneri* Maiden from which it differs in the smaller stature, narrower juvenile leaves (to 8 x 3.5 cm), narrower adult leaves (to 8 x 0.8 cm), and usually smooth bark.

Etymology. The specific epithet refers to the dense crown (Latin *densus*, dense).

Notes. E. densa has been referred to for many years as the dense-crowned, narrow-leaved form of *E. gardneri*, usually growing away from breakaways. It has been widely planted as a fine-leaved blue mallet (e.g. at Kings Park). It is easily distinguished from *E. pluricaulis* by the narrower leaves and dense crown. New growth is characteristically pink or purplish.

There are two subspecies.

24a. ***Eucalyptus densa*** Brooker and Hopper subsp. ***densa*** (Figures 83, 84, 85)

Colour illustration. Brooker & Kleinig (1990: 176).

A short-trunked mallet with a dense crown often to ground level.

Specimens examined. WESTERN AUSTRALIA: Laurier, nr Gnowangerup, Feb. 1920, *W.B. Alexander* s.n. (PERTH); Dunn Rock Nature Reserve, 30 km SW of Lake King, 33° 20'S 119° 30'E, 15 Apr. 1984, *D.J. Backshall* DJB6 (PERTH); Hopetoun plain, 8 Nov. 1952, *P.H. Barrett* 44 (PERTH); Pingrup, E of Katanning, 23 Sept. 1933, *W.E. Blackall* 3070 (PERTH); 10.5 km E of Ravensthorpe on Esperance Rd, 33° 35'S 120° 10'E, 13 Sept. 1978, *D.F. Blaxell* 1734 (NSW, PERTH); c. 80 km E of Hyden, 13 Sept. 1978, *J. Briggs* 99 (CANB); 30 miles S of Lake King, 5 Sept. 1969, *M.I.H. Brooker* 2287 (CANB, NSW, MAAS, PERTH); 3.4 km S of Hyden-Norseman Rd on road 6 km W of crossroads (0.2 km E of road), 32° 27'S 119° 40'E, 11 Aug. 1979, *M.I.H. Brooker* 6314

(CANB, NSW, PERTH); Upper Dalyup River, 12 Nov. 1981, *M.I.H. Brooker* 7118 (CANB, NSW, PERTH); roadside NE of Newbey's farm, 6 Oct 1982, *M.I.H. Brooker* 7680 (CANB); 19.6 km N of Ravensthorpe-Jerramungup road towards Lake King, NW of Ravensthorpe, 33° 25'S 119° 56'E, 7 June 1983, *M.I.H. Brooker* 8172 (CANB, NSW, PERTH); Sheoak Rock track, E of Hyden, 32° 24'S 119° 27'E, 9 Aug. 1984, *M.I.H. Brooker* 8625 (CANB, MEL, NSW, PERTH); 13.8 km N of Needilup just S of RPF road, 30 Nov. 1984, *M.I.H. Brooker* 8747 (CANB, NSW, MEL, PERTH); 1 km E of Tarco Road, 33° 14'S 119° 23'E, 15 July 1987, *M.I.H. Brooker* 9714, 9715 (AD, CANB, MEL, NSW, PERTH); 5.6 km from Millsteed Rd on Long Creek Rd, S of Lake King, 15 July 1987, *M.I.H. Brooker* 9717 (AD, CANB, MEL, NSW, PERTH); 43 km N of Needilup, 33° 33'S 119° 17'E, 16 July 1987, *M.I.H. Brooker* 9725 (AD, CANB, MEL, NSW, PERTH); 24 miles N of Kojonup, 12 December 1951, *N.T. Burbidge* 3674 (CANB); c. 61 km E of Hyden, 13 Aug. 1965, *C.A. Gardner* 16114 (PERTH); Forrestania corner, 4 km S then 1 km E from Norseman-Hyden track, 32° 27'S 119° 41'E, 7 Nov. 1983, *K. Hill* 638 & *L. Johnson, D. Blaxell, I. Brooker, S. Hopper* (CANB, NSW, PERTH); 37 km NNE of Holt Rock, 73 km E of Hyden, 32° 26'S 119° 39'E, 16 Aug. 1978, *S.D. Hopper* 1062 (PERTH); 2 km SW of Middle Ironcap, 32 km ENE of Holt Rock, 32° 35'S 119° 44'E, 17 Aug. 1978, *S.D. Hopper* 1093 (PERTH); 9 km WNW of Ongerup, 6 km ENE of Ongerup Rock, 33° 54'S 118° 27'E, 31 July 1982, *S.D. Hopper* 2410 (PERTH); 8 km NNW of Bandalup Hill, N boundary of West Point Farm, 33° 24'S 120° 22'E, 4 Aug. 1982, *S.D. Hopper* 2439 (PERTH); 25 km NE of Bandalup Hill, 33° 29'S 120° 33'E, 4 Aug. 1982, *S.D. Hopper* 2442, 2443 (PERTH); 23 km W of Lake King settlement, 30.5 km E of Newdegate, 33° 06'S 119° 27'E, 5 Aug. 1982, *S.D. Hopper* 2454 (PERTH); 4.2 km E of Lake King general store, 9 km WSW of Burkett Rocks, 33° 05'S 119° 45'E, 5 Sept. 1982, *S.D. Hopper* 2492 (PERTH); S of Jilbadgi Nature Reserve, where the road turns due N, 34° 13'S 119° 50'E, 2 Sept. 1986, *S.D. Hopper* 5403 (PERTH); Frank Hann National Park: 17.7 km E of Rabbit Proof Fence on Lake King - Norseman road (at major bend NE), 33° 00'S 120° 15'E, 27 Sept. 1988, *S.D. Hopper* 6853 (PERTH); Frank Hann National Park: 27 km SW of Ninety Mile Tank on Lake King - Norseman road, 32° 51'S 120° 28'E, 27 Sept. 1988, *S.D. Hopper* 6854 (PERTH); W end of Lake Hope; 2.3 km SE of Hatters Hill - Lake Hope track along track to Ninety Mile Tank, 32° 32'30"S 120° 19'E, 28 Sept. 1988, *S.D. Hopper* 6860 (PERTH); W end of Lake Hope; 11.4 km SW of Ninety Mile Tank track along Hatters Hill - Lake Hope track, 32° 36'00"S 120° 12'30"E, 28 Sept. 1988, *S.D. Hopper* 6865 (PERTH); 15 km NE of Hatters Hill along Lake Hope track, 32° 43'30"S 120° 05'00"E, 28 Sept. 1988, *S.D. Hopper* 6867 (PERTH); 4 km NE of Hatters Hill along Lake Hope track, 32° 48'S 120° 00'30"E, 28 Sept. 1988, *S.D. Hopper* 6874 (PERTH); 20 km ESE of Mt Gibbs, Frank Hann National Park, c. 40 km ENE of Lake King, 11 Aug. 1979, *K. Newbey* 5504 (PERTH); 15 km E of Dunn Swamp, c. 90 km ENE of Ravensthorpe, 15 Nov. 1980, *K. Newbey* 8135 (PERTH); Ravensthorpe, 26 June 1924, *Ralph & Stanford* (PERTH); 6 miles N of Ongerup, May 1969, *B. Rockel* A23 (PERTH); 15 miles N of Ravensthorpe, May 1969, *B.A. Rockel* A52 (CANB); SW of gate in Rabbit Proof Fence, E of Lake King, 7 Aug. 1968, *R.A. Saffrey* 336 (CANB, E, L, NSW, PERTH).

Distribution and habitat. Southern wheatbelt from Ongerup east to the Ravensthorpe area and north-east to the Hyden - Lake Hope district (Figure 83). Forms pure stands in closed or open low forest with sparse understorey, usually on heavy soils in broad valley floors. Occasionally it is found on higher ground in gently undulating terrain.

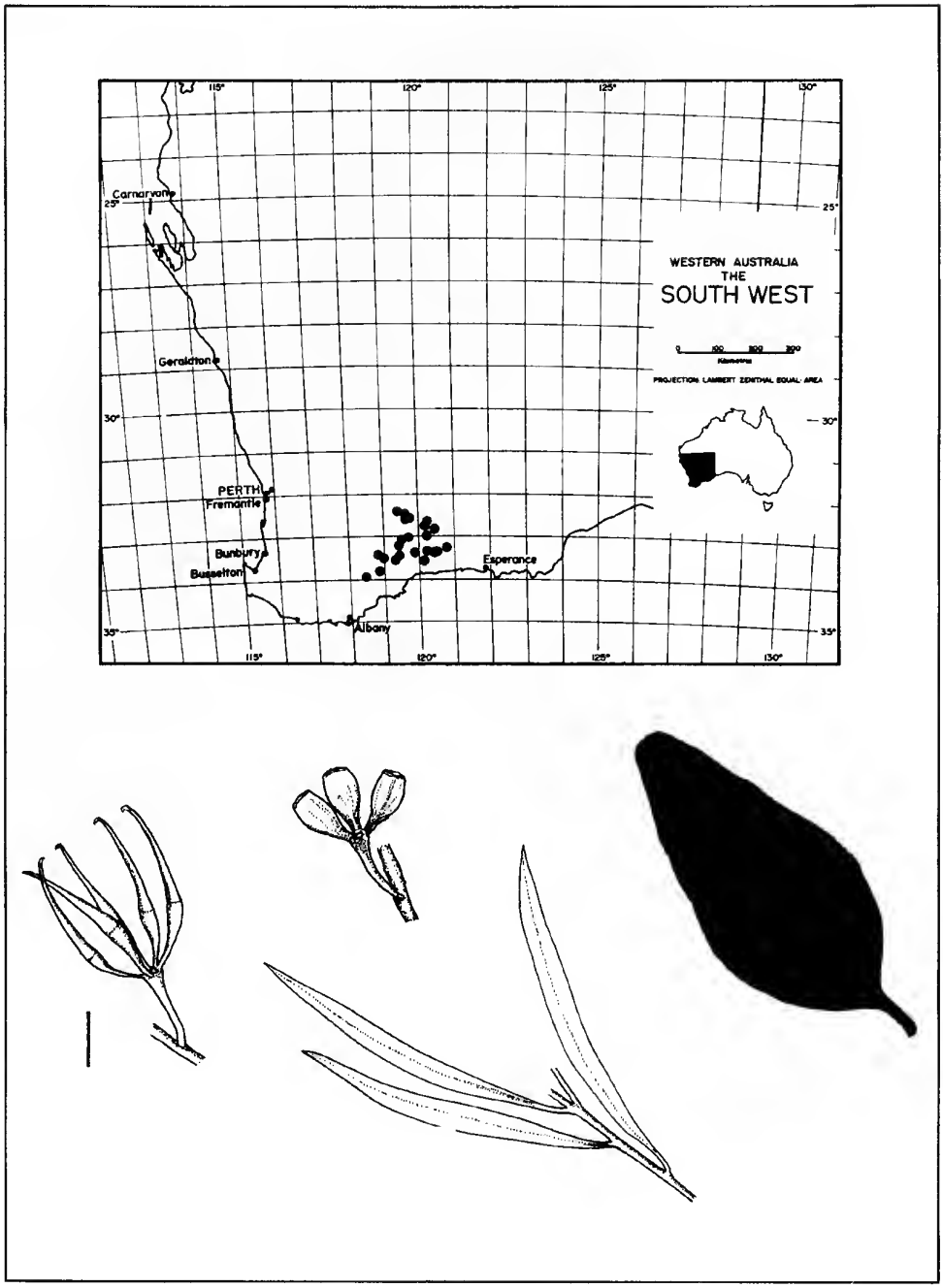

Figure 83. *Eucalyptus densa* subsp. *densa* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

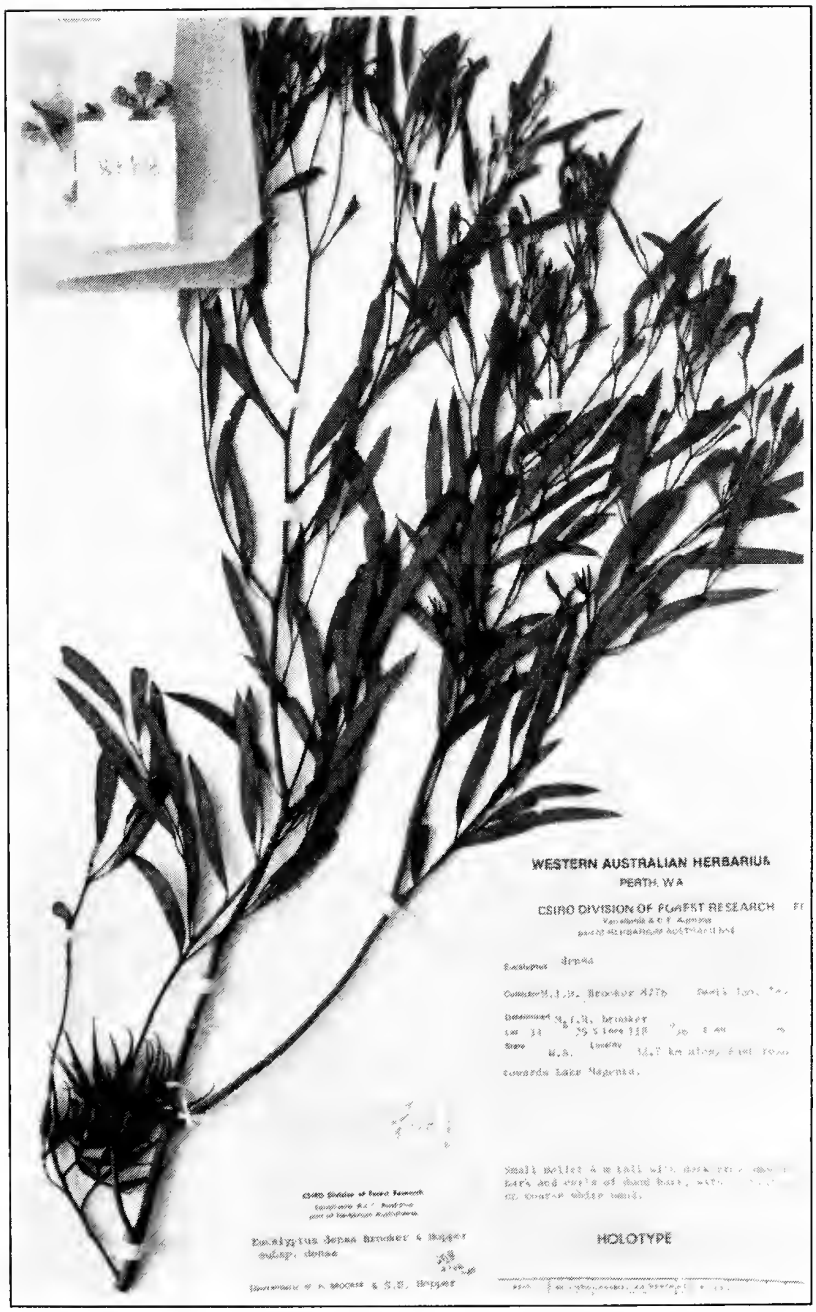

Figure 84. Holotype of *E. densa* Brooker & Hopper subsp. *densa*.

Figure 85. *E. densa* subsp. *densa* mallet habit, and trunk and bark.

Conservation status. Locally abundant in scattered disjunct populations, some on nature reserves and many on undisturbed vacant Crown land east of the Rabbit Proof Fence.

Flowering period. Newbey & Newbey (1987) recorded peak flowering at Ongerup between May and August.

Notes. This subspecies is frequently seen in the southern wheatbelt as a dense-crowned mallet occupying either low-lying sites or higher ground. With its compact stature, blue leaves and yellow flowers it has considerable horticultural merit.

Newbey & Newbey (1987) noted that numbers of Yellow-throated Miners and Red Wattlebirds rose sharply and peaked during the flowering of *E. densa* subsp. *densa* (referred to as *E. gardneri* by these authors) in 1978 near Ongerup. The subspecies appears to be an important nectar resource for birds elsewhere as well (Hopper, unpubl.).

24b. ***Eucalyptus densa*** Brooker & Hopper subsp. ***improcera*** Brooker & Hopper, subsp. nov. (Figures 86, 87)

A subspecie typica statura inferiore, habitu fruticoso differt.

Typus: 7.2 km W along Aerodrome Road from Lake King - Ravensthorpe road, Western Australia, 19 May 1987, *M.I.H. Brooker* 9646 & *P. Grayling* (holo: PERTH; iso: CANB, NSW, MEL, AD).

Colour illustration. Brooker & Kleinig (1990: 177).

Mallee to 3 m tall with slender stems and grey over coppery smooth bark. Pith of branchlets usually without glands. Adult leaves to 9 x 0.8 cm, dull, bluish green. Buds to 2 x 0.4 cm. Flowers yellow. Fruit barrel-shaped to truncate-pyriform, to 1 x 0.8 cm.

Specimens examined. WESTERN AUSTRALIA: Hopetoun Plains, 8 Nov. 1952, *P.H. Barrett* 15, 16 (PERTH); Ravensthorpe Range, May 1979, *E.M. Bennett* (PERTH); 15.1 km from East Mt Barren car park on Hamersley Drive, 33° 55'S 119° 55'E, 10 April 1983, *M.I.H. Brooker* 8080 (CANB, NSW, PERTH); 20.1 km S of Jerramungup on Albany Road, 34° 09'S 118° 56'E, 10 April 1983, *M.I.H. Brooker* 8081 (CANB, NSW, PERTH); Between Beaufort Inlet and Jerramungup, 3 June 1983, *M.I.H. Brooker* 8158 (CANB, NSW, PERTH); type locality, 19 May 1987, *M.I.H. Brooker* 9645 & *P. Grayling* (AD, CANB, MEL, NSW, PERTH); 11.8 km W of Ravensthorpe - Lake King road on Aerodrome Road, 16 July 1987, *M.I.H. Brooker* 9722 & *S.D. Hopper* (AD, CANB, MEL, NSW, PERTH); c. 12 km N of Gairdner turn-off on highway, 34° 08'S 118° 57'E, 12 Jan. 1988, *M.I.H Brooker* 9851 (AD, CANB, MEL, NSW, PERTH); 29 km NNE of Coujinup Hill, 33° 05'S 120° 30'E, 12 May 1983, *M.A. Burgman* 1335 & *S. McNee* (PERTH); 1.4 miles from Jerramungup towards Albany, 1 Nov. 1968, *E.M. Canning* 6945 (CBG, PERTH); between Ravensthorpe & Ongerup, 3 April 1968, *S.G.M. Carr* 670 (PERTH); near No Tree Hill, S of Ravensthorpe, 3 Dec. 1960, *A.S. George* 1979 (PERTH); 8 miles S of Ravensthorpe, 14 March 1957, *J.W. Green* 1218 (PERTH); 12.5 km W of Ravensthorpe, 31 Oct. 1975, *J.W. Green* 4608 (PERTH); 2.5 km S of Ravensthorpe (Hwy 1) along Moir Road, 30 Sept. 1987, *S.D. Hopper* 6159 (PERTH); c. 14 km SW of Ravensthorpe,

1.7 km W of Moir Road along track to Phillips River, 30 Sept. 1987, *S.D. Hopper* 6160 (PERTH); Ravensthorpe Range, ca. 8 km NE of Ravensthorpe, 10 April 1991, *S. D. Hopper* 7931 (CANB, PERTH); Gairdner River, 2 March 1961 & 2 April 1961, *K. Newbey* s.n. (PERTH); Ravensthorpe, 26 June 1924, *Ralph & Stamford* (PERTH); 11 km SE of Ravensthorpe next to copper mine, 13 Aug. 1968, *R.A. Saffrey* 499 (CANB, PERTH); near Esperance, 1945, *D.L. Serventy* (PERTH).

Distribution and habitat. Common in the southern wheatbelt from south of Jerramungup to the Ravensthorpe district (Figure 86). Occurs in low mallee or shrubland on impoverished shallow grey-white sand over clay. Occasionally it is found in tall mallee as an understorey species on pegmatite hills.

Conservation status. Common in scattered populations, some of which occur on conservation reserves.

Flowering period. May to July.

Etymology. From the Latin, *improcerus*, short, undersized, alluding to its stature compared to the nominate subspecies.

Notes. Distinguished from subsp. *densa* by its mallee habit and lower stature. It has been overlooked for many years.

25. ***Eucalyptus pluricaulis*** Brooker & Hopper, sp. nov. (Figures 4, 88, 89, 90)

Frutex "mallee" ad 3 m altus cortice laevi. Folia juvenilia binata ad 3-5 nodos tum alternantia, petiolata, ovata, ad 8 x 4 cm interdum porphyrea. Folia adulta petiolata, alternantia, lanceolata, ad 10 x 1.8 cm, glauca, hebeta. Inflorescentiae ad 11-florae. Alabastra pedicellata, fusiformia, ad 2.5 x 0.4 cm, operculis reduncis. Fructus pellicellati doliiformes, ad 1 x 0.6 cm. Semina plus minusve sphaerica.

Typus: depression W of intersection of Mudge Rd and Coorow-Greenhead Rd, Western Australia, 21 May 1982, *M.I.H. Brooker* 7522 (holo: PERTH; iso: CANB, NSW).

A mallee to 5 m tall with grey or grey-brown over coppery to pinkish grey smooth bark. Pith of branchlets usually without glands. Leaves of the seedling remaining opposite for 3-5 pairs, then alternating, ovate, to 8 x 4 cm, glabrous. Adult leaves petiolate, alternating, lanceolate, to 10 x 1.8 cm, dull, blue-green. Inflorescences to 11-flowered; peduncles to 1.2 cm long. Buds pedicellate, fusiform, to 2.5 x 0.4 cm, recurved at tip. Flowers yellow. Fruit pedicellate, barrel-shaped, to 1 x 0.6 cm. Seed light grey-brown, more or less spherical.

Etymology. The specific epithet refers to the mallee habit (Latin *pluri*, many, and *caulis*, stem), in contrast to the related tree *E. gardneri*.

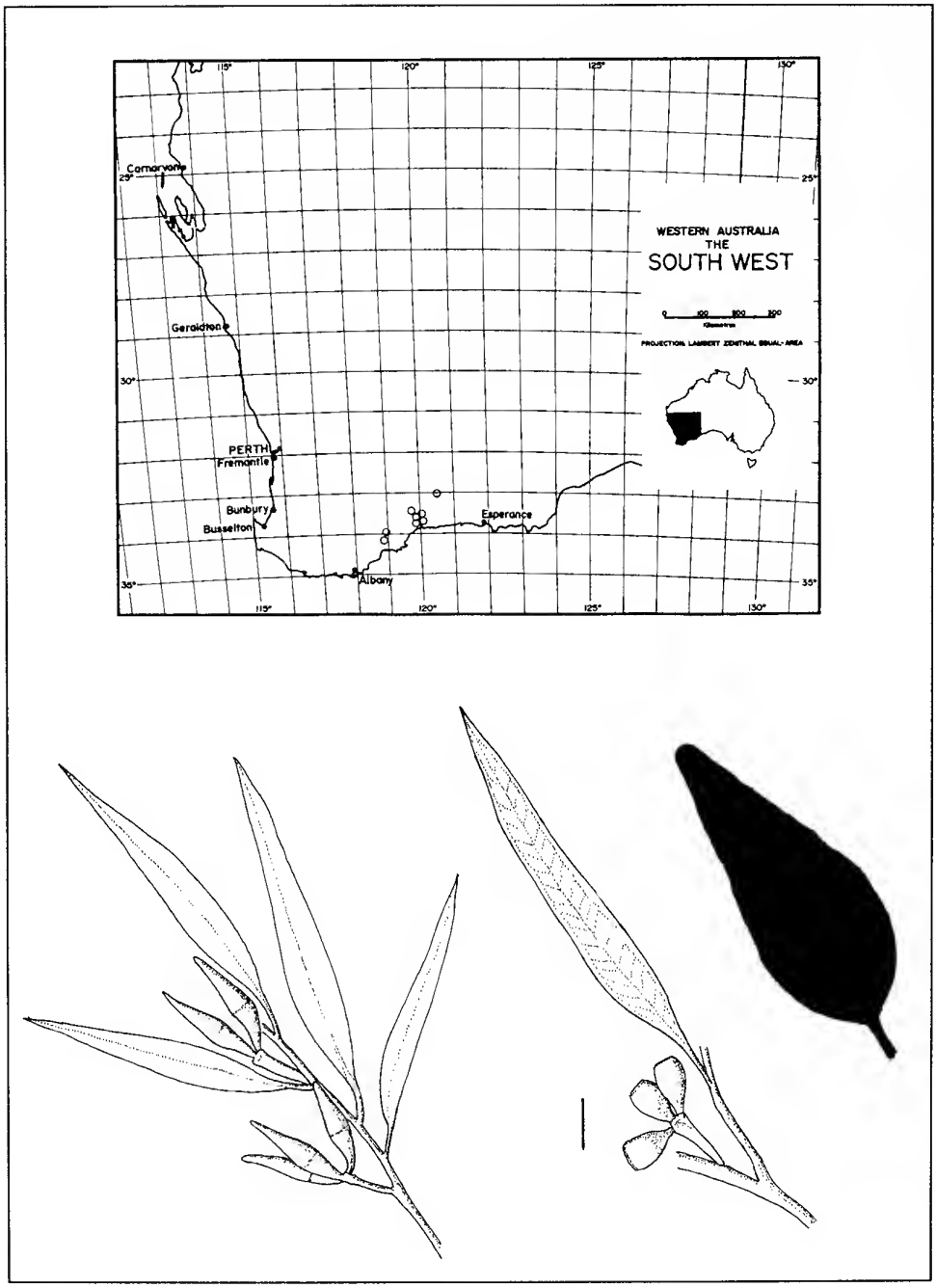

Figure 86. *E. densa* subsp. *improcera* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1cm).

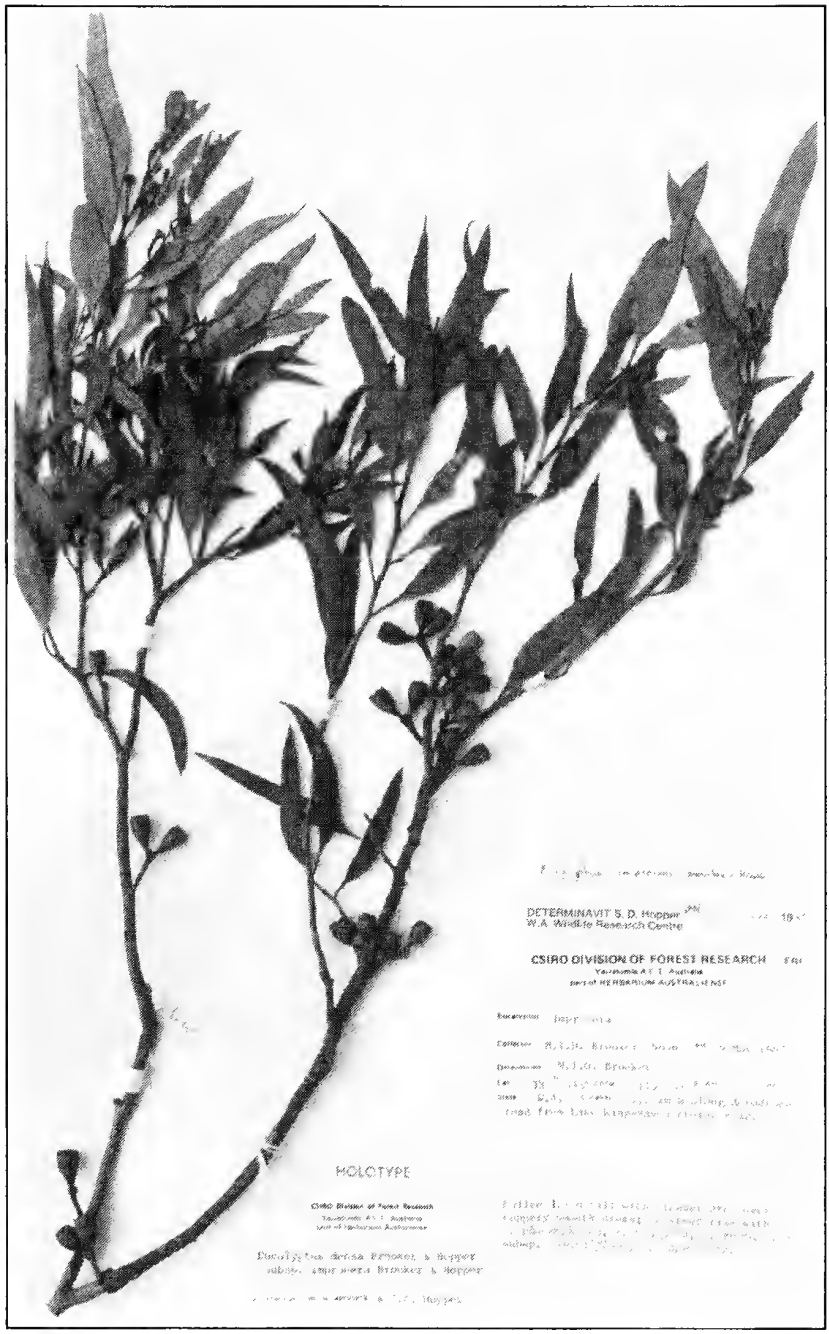

Figure 87. Holotype of *E. densa* Brooker & Hopper subsp. *improcera* Brooker & Hopper.

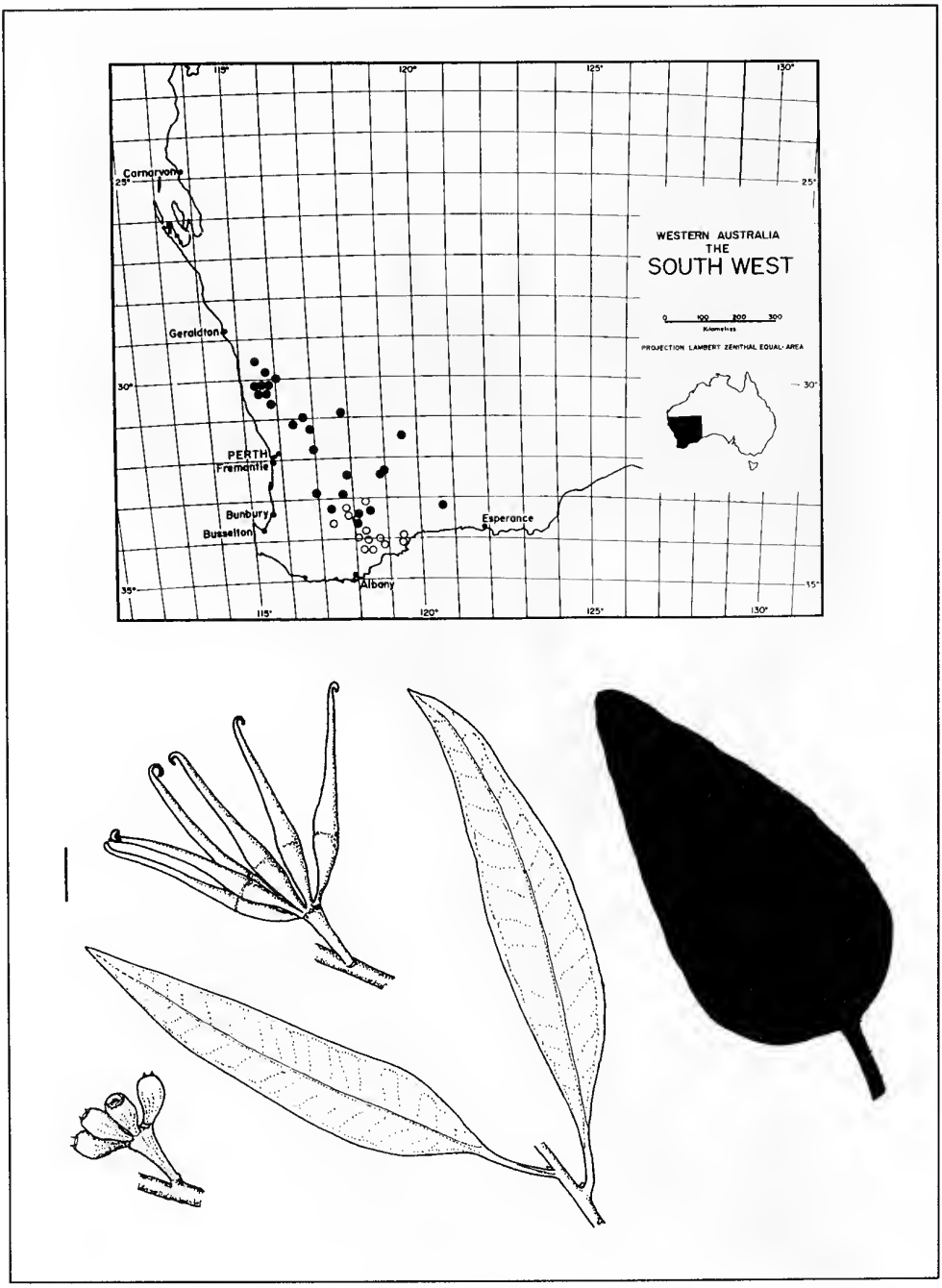

Figure 88. Distribution of *E. pluricaulis* subsp. *pluricaulis* (●) and subsp. *porphyrea* (○), and buds, fruits, adult leaves and fifth node seedling leaf of *E. pluricaulis* subsp. *pluricaulis* (scale bar = 1 cm).

Figure 89. Holotype of *E. pluricaulis* Brooker & Hopper subsp. *pluricaulis*.

Notes. E. pluricaulis has been referred to as a mallee form of *E. gardneri* for many years (e.g. Elliott and Jones 1986). It differs from *E. gardneri* in the mallee habit and smooth bark, retaining these features when growing on lateritic breakaways within the geographical range of *E. gardneri*. *E. pluricaulis* resembles *E. redunca* in habit but is clearly distinguished by the blue-green leaves and, to a lesser extent, the longer more attenuate buds. It differs from *E. varia* in its smaller stature, its less dense canopy, its larger juvenile and adult leaves and its purplish new growth.

There are two subspecies.

25a. ***Eucalyptus pluricaulis*** Brooker & Hopper subsp. ***pluricaulis*** (Figures 88, 89)

Colour illustration. Brooker & Kleinig (1990: 178).

An erect mallee with blue-green adult leaves, and with inflorescences up to 11-flowered.

Specimens examined. WESTERN AUSTRALIA: 41 miles E of Brookton, 22 July 1969, *M.I.H. Brooker* 1868 (PERTH); 9 miles S of Wickepin, 3 Nov. 1969, *M.I.H. Brooker* 2254 (CANB, NSW, PERTH); 16 miles E of Quairading towards Corrigin, 12 July 1970, *M.I.H. Brooker* 2637 (CANB, K, MEL, NSW, PERTH); road from The Humps to Mt Walker, 32° 14'S 118° 57'E, 31 Dec. 1979, *M.I.H. Brooker* 6745 (CANB, NSW, PERTH); Williams' farm (Hi Vallee) Tootbardi rd, N of Badgingarra, 30° 08'S 115° 22'E, 19 Aug. 1982, *M.I.H. Brooker* 7565 (CANB, NSW, PERTH); Tootbardi Rd, N of Badgingarra, 19 Aug. 1982, *M.I.H. Brooker* 7572 (CANB, NSW, PERTH); Wongan Hills, c. 100 m S of radio tower, 30° 52'S 116° 38'E, 26 Aug. 1982, *M.I.H. Brooker* 7599 (CANB, NSW, PERTH); c. 4 km N of Mt Michaud on EW track, 30° 07'S 115° 12'E, 1 March 1983, *M.I.H. Brooker* 7989 (CANB, NSW, PERTH); Hill SE of Mt Benia, 30° 15'S 115° 15'E, 3 March 1983, *M.I.H. Brooker* 8011 (CANB, NSW, PERTH); 15.3 km S of Wickepin towards Taarblin Lake, 32° 53'S 117° 34'E, 4 May 1983, *M.I.H. Brooker* 8097 (CANB, NSW, PERTH); c. 10 km ESE of Wickepin, 32° 40'S 117° 35'E, 5 May 1983, *M.I.H. Brooker* 8103 (CANB, NSW, PERTH); 4.2 km N of T junction, SE of Mt Adams, 29° 27'S 115° 19'E, 27 May 1983, *M.I.H. Brooker* 8140 (CANB, NSW, PERTH); Newman Block, Chomley road, 19 June 1986, *M.I.H. Brooker* 9358 (CANB, NSW, PERTH); Newman Block, Chomley road, NW of Wagin, 33° 09'S 117° 10'E, 19 June 1986, *M.I.H. Brooker* 9361 (CANB, PERTH, NSW, MEL); Dryandra State Forest, Dryandra Block, 27 June 1986, *M.I.H. Brooker* 9367 (CANB, PERTH, NSW, MEL); Gura Road, Dryandra State Forest, 27 June 1986, *M.I.H. Brooker* 9372 (CANB, PERTH, NSW, MEL); E of Badgingarra, 30° 34'S, 115° 38'E, 21 July 1986, *M.I.H. Brooker* 9393 (CANB, PERTH, NSW, MEL); North Bungulla Nature Reserve, 23 July 1987, *M.I.H. Brooker* 9730 (CANB, PERTH, NSW, MEL); c. 16 km E of Yerramulla Road, 30° 17'S, 115° 27'E, 14 Aug. 1987, *M.I.H. Brooker* 9738 (CANB, PERTH, NSW, MEL); Yandan Hill, 30° 45'S 115° 36'E, 18 Aug. 1987, *M.I.H. Brooker* 9739 (CANB, PERTH, NSW, MEL); 29 km NNE of Coujinup Hill, 33° 05'S 120° 30'E, 12 May 1983, *M.A. Burgman* 1335 & *S. McNee* (PERTH); Coorow, 21 May 1961, *R.S. Coleman* (PERTH); Mudge Road, 2-3 km N of Coorow-Green Head Rd, 30° 01'S 115° 44'E, 6 Sept. 1984, *D.B. Foreman* 573 (AD, CBG, HO, MEL, NSW, PERTH); Goomalling, 17 Aug. 1920, *C.A. Gardner* 130 (PERTH); Dumbleyung, 12 Nov. 1931, *Gardner & Blackall* 1340 (PERTH); SE slopes of Mt Lesueur, near the summit, 25 Aug. 1948, *C.A. Gardner* 9088 (PERTH); 4 km NW of Wongan Hills (near railway line), 30 Aug. 1976, *A.M. George* 93 (PERTH); NW of Badgingarra, 13 Aug. 1965, *A.S. George* 6765 (PERTH); Northam, Oct. 1900, *I.H. Gregory* (PERTH); SE slope of Mt Lesueur, NE of Jurien, 30° 11'S 115° 12'E, 17 July

1979, *E.A. Griffin* 1926 (CANB, PERTH); near Mt Lesueur Reserve, N of Mt Lesueur, 7 Aug. 1985, *E.A. Griffin* 4156 (PERTH); on lateritic mesa E of Coomallo Creek, near jctn Brand Hwy & Jurien Road, 11 Aug. 1977, *R.J. Hnatiuk* 770781 (PERTH); c. 2 km SW of Piawaning, 12 June 1980, *S.D. Hopper* 1225, 1226 (CANB); c. 9.5 km SSW of New Norcia, 31° 03'S 116° 11'E, 10 Dec. 1986, *S.D. Hopper* 5841 (PERTH); Hi-Valley farm (D & J Williams), c. 10 km NE Coomallo Creek, 26 Aug. 1980, *G.J. Keighery* 3191 (PERTH); Translator Tower hill, Wongan Hills, 30 June 1983, *K.F. Kenneally* 8799 (CANB); W from Wongan Hills, 1 Oct. 1903, *A. Morrison* (PERTH); Tarin Rock Reserve, c. 28 km W of Lake Grace, 14 Sept. 1975, *B.G. Muir* 5(2.6) (PERTH); Bendering Reserve, A20338, 23 km NNE Kondinin, 29 May 1975, *B.G. Muir* 144(2.9) (PERTH), and 18 Aug. 1975, *B.G. Muir* 146(2.1) (PERTH); Reserve 15855, 11 km SE of Highbury, 3 Aug. 1979, *B.G. Muir* 811 (PERTH); 25 km SW of Southern Cross, 10 Sept. 1979, *K. Newbey* 5845 (PERTH); 1 mile W of Kulin, on road to Wickepin, 15 Sept. 1971, *S. Paust* 892 (PERTH).

Distribution and habitat. Widespread from west of Three Springs and near Mt Peron in the north to east of Southern Cross and Ravensthorpe (Figure 88). Grows in scattered populations in tall mallee with species such as *E. falcata* and *E. arachnaea* subsp. *arachnaea*. Often favours slopes near breakaways.

Conservation status. Widespread in small disjunct populations, some of which are on nature reserves.

Flowering period. May-August.

Notes. A widespread mallee differing from the more localised subsp. *porphyrea* in its taller stature, more upright stems, and blue-green canopy. Differs from *E. varia* in its smaller maximum stature, less dense canopy, wider adult leaves and blue-green to purple new growth.

25b. ***Eucalyptus pluricaulis*** subsp. ***porphyrea*** Brooker & Hopper, subsp. nov. (Figures 4, 88, 90)

A subspecie typica habitu inferiore effuse, foliis adultis porphyreis, alabastris multioribus differt.

Typus: 57.8 km south of Jerramungup on Albany road, Western Australia, 10 April 1983, *M.I.H. Brooker* 8082 (holo: PERTH; iso: CANB, NSW).

Colour illustration. Brooker & Kleinig (1990: 179).

It differs from the typical subspecies in the lower stature, straggly habit, abundance of purplish leaves in the adult crown, and more buds per inflorescence (11-15).

Specimens examined. WESTERN AUSTRALIA: 4 miles N of crossroads, N of Mt Bland, Fitzgerald Reserve, 3 Aug. 1970, *M.I.H. Brooker* 2711 (PERTH); 15.1 miles S of Fitzgerald crossing towards Fitzgerald Reserve, 5 April 1974, *M.I.H. Brooker* 4436 (CANB, PERTH); 4 km S of Borden on road to Stirling Range, 6 Oct. 1982, *M.I.H. Brooker* 7676 (CANB, NSW, PERTH); 4.7 km W of Norman Road on Ongerup Road, 6 Oct. 1982, *M.I.H. Brooker* 7687 (CANB, NSW, PERTH); Sounness block, S of Amelup, N of Stirling Range, 7 Oct. 1982, *M.I.H. Brooker* 7699 (CANB, NSW, PERTH); 57.8 km

S of Jerramungup on Albany road, 34° 19'S 118° 46'E, 10 April 1983, *M.I.H. Brooker* 8083 (CANB, NSW, PERTH); 1.2 km S along Hills Road from Tarin Rock Road, 33° 06'S 118° 10'E, 16 Dec. 1987, *M.I.H. Brooker* 9835 (AD, CANB, MEL, NSW, PERTH); Corackerup Reserve, 1 Feb 1977, *T. Evans* (CANB, K, MEL, PERTH); 12 miles W of Ongerup, 13 March 1957, *J.W. Green* 1174 (CANB, PERTH); 6 km NNW of Bluff Knoll: N boundary (Stirling Range National Park), 4.8 km E of Chester Pass Rd, 34° 20'S 118° 15'E, 24 March 1982, *S.D. Hopper* 2140 (PERTH); 9.8 km SW of Boxwood Hill, 3.8 km NW of Toompup-Bremer Bay Rd, 34° 13'S 118° 43'E, 30 July 1982, *S.D. Hopper* 2395 (PERTH); 2 km SW of Tarin Rock, Tarin Rock Nature Reserve, 33° 02'S 118° 12'E, 5 Aug. 1982, *S.D. Hopper* 2455 (PERTH); 5.5 km SW of Ward Hill, 21 km E of Wagin on rd to Dumbleyung, 33° 17'S 117° 35'E, 5 Sept. 1982, *S.D. Hopper* 2489 (PERTH); 5 km N of Mongining Hill, 6.5 km S of Coomelberrup Rock, 33° 31'S 117° 48'E, 11 Sept. 1982, *S.D. Hopper* 2565 (PERTH); 8.8 km W of Woodanilling, 3.8 km E of Albany Hwy on Woodanilling Rd, 33° 33'S 117° 08'E, 24 July 1984, *S.D. Hopper* 3829 (PERTH); Gnowellen Rd, 6 km N Ellen Peak, nr Amelup to Cape Riche, 11 May 1982, *G.J. Keighery* 4838 (CANB, PERTH); Gnowangerup, north east, 27 Feb. 1975, *O.W. Loneragan* L234 (PERTH); 11 m E of Broomehill, 13 Jan. 1954, *R.D. Royce* 4791 (PERTH).

Distribution and habitat. Tarin Rock south to Stirling Range and Fitzgerald National Park (Figure 88). Grows in low to tall mallee on high ground on fine-textured gravelly loams.

Conservation status. Widespread in small disjunct populations, a few of which occur on nature reserves.

Flowering period. March-June.

Etymology. The subspecific epithet refers to the predominant colour of the crown (Latin *porphyreus*, purple).

Notes. This subspecies has potential as an ornamental with its purple leaves and yellow flowers. It is illustrated in Elliott and Jones (1986, p.100) under the name *E. gardneri*. North-western populations near Woodanilling and Tarin Rock (e.g. *Brooker* 9835, *Hopper* 2455, 3829) are more upright and may be intergrades with the typical subspecies, but are still striking in their purple-coloured new growth.

26. ***Eucalyptus varia*** Brooker & Hopper, sp. nov. (Figure 91, 92, 93)

Frutex "mallee" habitu vario, foliis juvenilibus et adultis immaturis glaucis vel flavo-viridibus, non porphyreis non cinereis. Alabastra pedicellata, fusiformia, ad 2.5 x 0.4 cm, operculis attenuatis, reduncis. Fructus pedicellati, doliiformes, ad 1 x 0.6 cm. Semina plus minusve sphaerica.

Typus: 90 km E of Esperance P.O., Western Australia, 33° 45'S 122° 47'E, 7 Feb 1989, *M.I.H. Brooker* 10168, *S.D. Hopper & D. Vincent* (holo : PERTH; iso : AD, CANB, MEL, NSW).

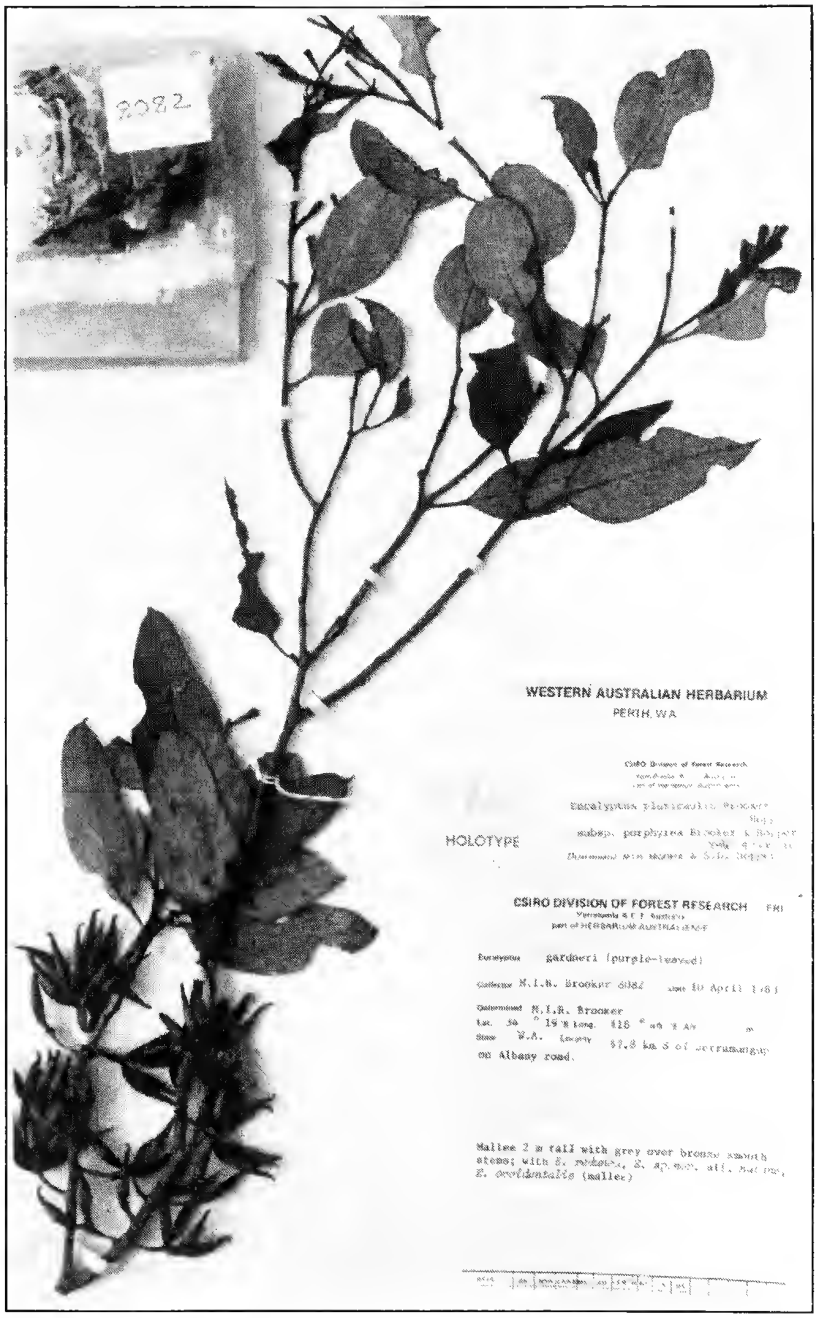

Figure 90. Holotype of *E. pluricaulis* Brooker & Hopper subsp. *porphyrea* Brooker & Hopper.

A mallee of variable habit, low and effuse or erect to 7 m tall, with rough or smooth bark. Leaves of the seedling remaining opposite for 3-5 pairs, then alternating, ovate, to 8 x 4 cm, glabrous, blue-green or yellow-green. Pith of branchlets usually without glands. Adult leaves petiolate, alternating, lanceolate, to 8 x 1.3 cm, dull, light bluish green, in the first 1-2 years, older leaves inside crown and rarely seen, glossy, green. Inflorescences to 11-flowered; peduncles to 1.2 cm long. Buds pedicellate, fusiform, to 2.5 x 0.4 cm, attenuate, recurved at tip. Flowers not seen. Fruit pedicellate, barrel-shaped, to 1 x 0.6 cm. Seed light grey-brown, more or less spherical.

Etymology. From the Latin *varius*, varying, referring to the variable stature, bark, adult leaf width and habitat.

Notes. E. varia resembles *E. pluricaulis* but it differs particularly in the leaf colour and width. The new growth is blue-green or yellow green, never purplish, while the adult leaves are light bluish green and never grey. The adult and juvenile leaves are generally narrower and thinner than those of *E. pluricaulis*. *E. varia* is perhaps more closely related to *E. redunca*, which has similar colouration on the new growth, but *E. redunca* differs in its broader greener adult leaves, lower stature and consistently smooth bark.

There are two subspecies.

26a. ***Eucalyptus varia*** Brooker & Hopper subsp. ***varia***

A mallee with smooth bark, varying in habit from a dwarf plant 1 m tall to an erect mallee 7 m tall, not growing in saline situations (Figures 91, 92).

Specimens examined. WESTERN AUSTRALIA: 17.4 miles N of Esperance, 18 Sept. 1971, *K.M. Allan* 763 (AD, CANB, PERTH); 16.3 miles S of Scadden, 14 Nov. 1970, *J.Baker* 77 (CANB); c. 15 km E of Esperance on road to Cape le Grand, 33° 47'S 122° 00'E, 22 June 1978, *D.F. Blaxell* 1678 (CANB, NSW, PERTH); 18 km E Dalyup, 33° 48'S 121° 44'E, 28 Dec. 1979, *M.I.H. Brooker* 6699 (CANB, NSW, PERTH); 1 km S of Fisheries Road on Tyrrel's Road, 33° 43'S 122° 09'E, 9 April 1983, *M.I.H. Brooker* 8066 (CANB, NSW, PERTH); 19.4 km N of Fisheries Road on Dempster Road, 33° 36'S 122° 00'E, 9 April 1983, *M.I.H. Brooker* 8067 (CANB, NSW, PERTH); corner Dalyup North and Speddingup West Roads, 7 Feb. 1989, *M.I.H. Brooker* 10166 (AD, CANB, NSW, MEL, PERTH); 45.1 miles E of Esperance, 25 March 1968, *G.M. Chippendale* 408 (CANB, PERTH); Buyi Billanak Homestead, c. 12 km SE of Condingup Peak, 19 Sept. 1968, *N.N. Donner* 2665 (AD, PERTH); headwaters of Thomas River, c. 8 km SW of Boyatup Hill, 5 Oct. 1968, *N.N. Donner* 2911 (AD, CANB, PERTH); Loc. 900 in gully leading to Yerritup creek, 26 sept. 1968, *Hj. Eichler* 19989 (CANB); 10 miles N of Esperance, 20 Oct. 1931, *Gardner & Blackall* 1093 (PERTH); 67 miles E of Esperance, 11 Dec. 1960, *A.S. George* 2187 (PERTH); 82 km E of Esperance on Merrivale Road, between Alexander Road and Daniels Road, 21 Nov. 1986, *J.W. Green* 5170 (PERTH); Maidavale Road, 33° 48'S 122° 20'E, 19 Sept. 1976, *R.J. Hnatiuk* 761004 (PERTH); Escarpment of tributary of Thomas River, 9.5 km SSW of Boyatup Hill, 3 km NNW of Belinup Hill, 33° 49'S 123° 02'E, 9 Sept. 1982, *S.D. Hopper* 2551 (PERTH); 4 km ENE of Mt Hawes, 15 km SW of Condingup Peak, 33° 49'S 122° 25'E, 9 Sept. 1982, *S.D. Hopper* 2552 (PERTH); 2 km from mouth of Thomas River (Cape Arid National Park), 12 Oct. 1985, *G.J. Keighery* 7833 (PERTH); near Howick Hill, 3 km E of woolsheds of Mt Howick Station, Location 259, 18 Sept. 1968, *A.E. Orchard* 1066

(AD, PERTH); 554 m.p. Norseman-Esperance Rd, 17 Sept. 1962, *F.G. Smith* 1572 (PERTH); Glenelg Hills, Nov. 1929, *H. Steedman* (PERTH); 20 km E of Scadden on Styles Rd, 2 July 1984, *P. van der Moezel* 384 (PERTH); 67 km E of Esperance near Mungliginup Creek, 30 Sept. 1968, *P.G. Wilson* 8076 (PERTH).

Distribution and habitat. North-west of Esperance (Dalyup area) east to the Thomas River (Figure 91) on sandplain or lateritic slopes in mallee and heath.

Conservation status. Widespread in disjunct populations, a few of which occur on nature reserves.

Flowering period. Unknown.

Notes. E. varia subsp. *varia* is the easternmost taxon of the *E.* superspecies "*redunca*". It differs from *E. varia* subsp. *salsuginosa* in its smooth bark and preference for non saline habitats.

26b. ***Eucalyptus varia*** subsp. ***salsuginosa*** Brooker & Hopper, subsp. nov. (Figures 91, 93)

A subspecie typica habitu effuso et constanter demisso, cortice aspero, et habitatione salina differt.

Typus: 4 km W of highway on Speddingup West Road, Western Australia, 33° 29'S 124° 42'E, 9 Feb. 1989, *M.I.H. Brooker* 10167, *S.D. Hopper & D. Vincent* (holo : PERTH; iso : AD, CANB, MEL, NSW).

It differs from the typical subspecies in the straggly habit, constantly lower maximum stature (to 4 m), rough bark, and saline habitat.

Specimens examined. WESTERN AUSTRALIA: E of Dalyup, 28 Dec. 1979, *M.I.H. Brooker* 6699 (CANB); 3.9 km W of highway on Speddingup West Road, 33° 01'S 121° 42'E, 17 January 1985, *M.I.H. Brooker* 8795 (CANB, MEL, NSW, PERTH); 4.4 km E of junction of Robins and Speddingup West Roads, 33° 31'S 121° 31'E, 7 Feb. 1989, *M.I.H. Brooker* 10165, *S.D. Hopper & D. Vincent* (AD, CANB, MEL, NSW, PERTH).

Distribution and habitat. Known only from a few localities north and north-west of Esperance, particularly on tributaries of the Dalyup River (Figure 91). Grows along salt drainage lines or on seasonally wet flats.

Conservation status. Poorly known, requiring further survey. The saline habitat occupied by *E. varia* subsp. *salsuginosa* is rarely cleared for agriculture.

Flowering period. Unknown.

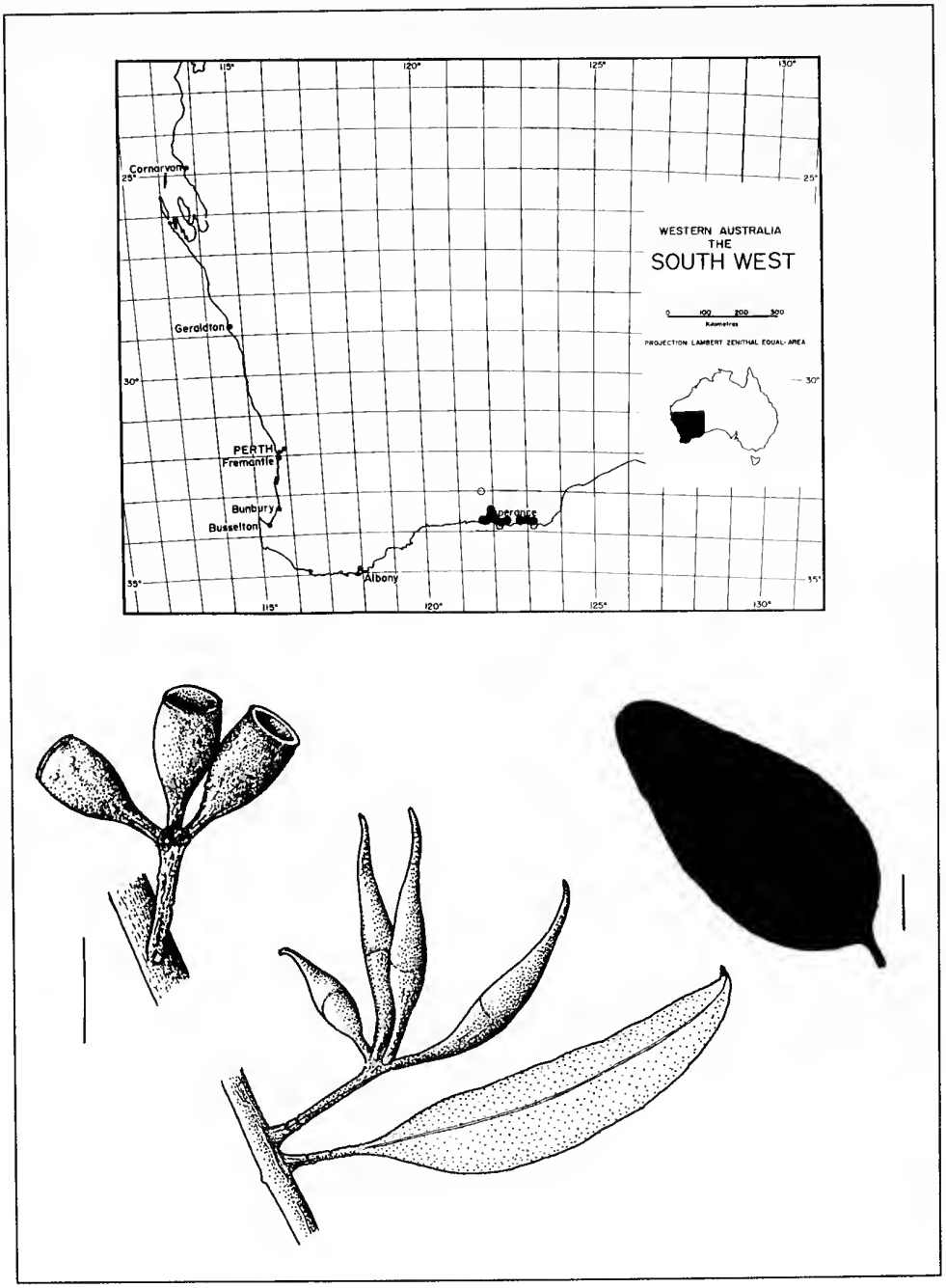

Figure 91. Distribution of *Eucalyptus varia* subsp. *varia* (●) and subsp. *salsuginosa* (○) and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf of *E. varia* subsp. *salsuginosa* (scale bar = 1 cm).

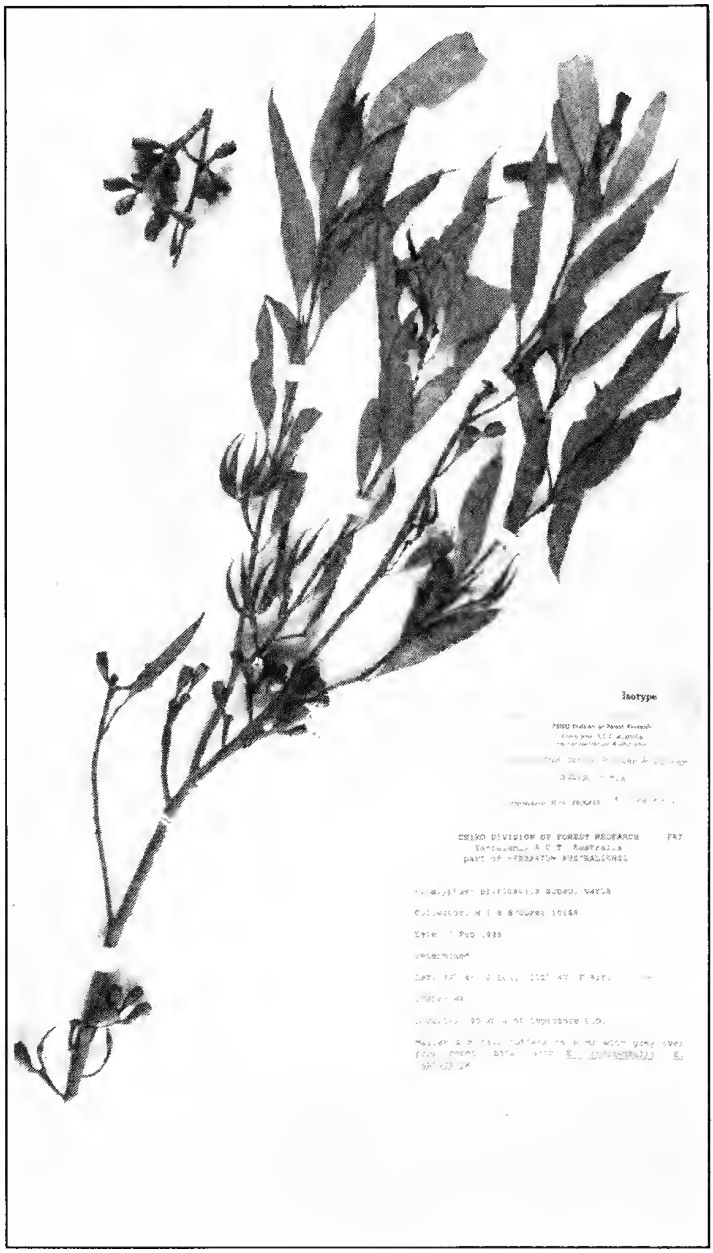

Figure 92. Isotype of *E. varia* Brooker & Hopper subsp. *varia* Brooker & Hopper.

Figure 93. Isotype of *E. varia* Brooker & Hopper subsp. *salsuginosa* Brooker & Hopper.

Etymology. From the Latin, *salsuginosus*, in braekish plaees, alluding to the saline habitat oeeupied by the speeies.

Notes. The thiek rough basal bark and saline habitat distinguish *E. varia* subsp. *salsuginosa* from all other taxa of *E.* superspeeies "*redunca*".

27. ***Eucalyptus redunca*** Schauer in Lehm. Pl. Preiss. 1: 127 (1844). *Lectotype* (here designated): "in gravelly sterile sand on the hill Konkoberup, near Cape Riehe", Western Australia, *Preiss* 232 (leeto: MEL). (Figures 12a, 94, 95, 97)

Colour illustration. Brooker & Kleinig (1990: 174).

A mallee to 3 m tall with smooth, light grey to grey-brown over pinkish grey or pale orange bark. Pith of branehlets rarely glandular. Leaves of the seedling remaining opposite for 2-4 pairs, then alternating, broadly laneeolate to ovate, to 5 x 3 em, dull, blue-green, glabrous. Adult leaves laneeolate, to 9 x 2 em, in the first 1-2 years dull, green, older leaves inside erown and rarely seen, glossy, green. Infloreseenees to 15-flowered; peduneles to 2 em long. Buds pedieellate, fusiform, to 2.8 x 0.4 em; opereulum long, horn-shaped, attenuate, often reeurved at the tip. Flowers pale yellow. Fruit pedieellate, barrel-shaped, to 1.1 x 0.8 em. Seed light brown, more or less spherieal.

Specimens examined. WESTERN AUSTRALIA: In Fitzgerald River Flat, 8 Sept. 1970, *T.E.H. Aplin* 3614 (PERTH); Fitzgerald Inlet, Fitzgerald Reserve, 3 August 1970, *M.I.H. Brooker* 2699 (CANB, PERTH); N slope of Woolburnup, 6 April 1974, *M.I.H. Brooker* 4449 (CANB); 13.3 km S of Eldverton turn-off on Hopetoun road, 33° 45'S 120° 12'E, 10 April 1983, *M.I.H. Brooker* 8079 (CANB, NSW, PERTH); traek to Hamersley River, Fitzgerald National Park, 33° 53'S 119° 53'E, 4 Sept. 1984, *M.I.H. Brooker* 8658 (CANB, NSW, PERTH); Konkoberup Hill (Mt Melville), 29 Nov. 1984, *M.I.H. Brooker* 8743 (CANB, NSW, PERTH); 12.2 km E of Telegraph track on Hamersley Drive, Fitzgerald National Park, 33° 54'S 119° 53'E, 18 Dec. 1984, *M.I.H. Brooker* 8762 (CANB, NSW, PERTH); 12.2 km E of Telegraph traek on Hamersley Drive, Fitzgerald River National Park, 18 Dee. 1984, *M.I.H. Brooker* 8792 (AD, CANB, MEL, NSW, PERTH); hill 50 m W of Pt Anne eampsite, 34° 10'S 119° 34'E, 12 Jan. 1988, *M.I.H. Brooker* 9860 (AD, CANB, MEL, NSW, PERTH); Ravensthorpe Range, 12 km E of Ravensthorpe, edge of Highway 1, 33° 36'S 120° 11'E, 10 Jan. 1979, *M.D. Crisp* 4985 (CBG, CANB, NSW, PERTH); Cape Riehe, 34° 36'S 118° 47'E, May 1983, *N.J. Davidson* s.n. (HO, PERTH); 10 km E of Ravensthorpe, 11 Dee. 1979, *H. Demarz* D7941 (CANB, PERTH); Hamersley R., S. of Ravensthorpe, 1 Dee. 1960, *A.S. George* 1880 (PERTH); Eldverton, SE of Ravensthorpe, 22 Feb. 1966, *A.S. George* 7583 & *S.G.M. Carr* (PERTH); W of lower Fitzgerald R., Fitzgerald River Reserve, 34° 05'S 119° 30'E, 12 July 1970, *A.S. George* 9956 (PERTH); Pt Ann, Reserve 24048, 34° 10'S 119° 34'E, 15 July 1970, *A.S. George* 10042 (PERTH); near Cape Riehe, Mareh 1854, *W.H. Harvey* s.n. (PERTH); 3.6 km N of Cape Riehe, 17 km SE of Wellstead, 34° 36'S 118° 46'E, 30 July 1982, *S.D. Hopper* 2399 (PERTH); 12.5 km WSW of Annie Peak, 31.1 km S down Hamersley Drive, 33° 51'S 119° 55'E, 1 Aug. 1982, *S.D. Hopper* 2414 (PERTH); Bremer Bay area, Aug. 1971, *A. Kessell* 972 (PERTH); Between Hamersley River and East Mt Barren, 30 Sept. 1970, *B.R. Maslin* 827 (ANU, PERTH); Swamp Rd, 1.0 km N of Bremer Bay Road, 34° 23'S 119° 23'E, 17 Nov. 1985, *A.N. Rodd* 5009 (NSW, PERTH); Old telegraph line NNW of Mid Mount Barren, Fitzgerald Reserve, 6 Oet. 1970, *R.A. Saffrey* 1424 (PERTH).

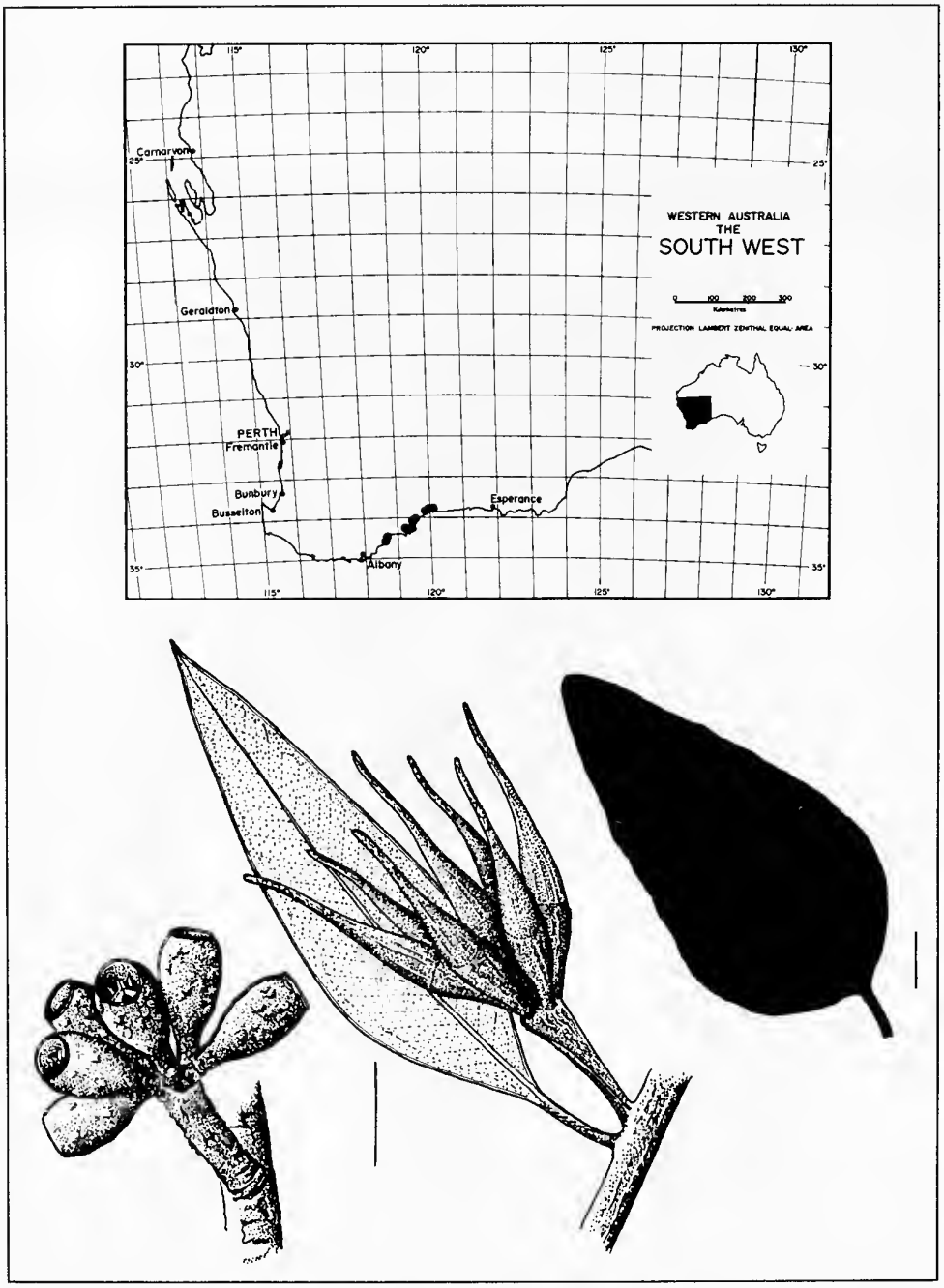

Figure 94. *Eucalyptus redunca* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

Figure 95. Lectotype of *E. redunca* Schau.

Figure 96. Syntypes of *E. reduncа* Schau. (syn. *E. wandoo*).

Figure 97. *E. redunca* stunted coastal mallee habit (East Mt Barren), and taller inland mallee habit (Ravensthorpe Range).

Distribution and habitat. Coastal areas from Cape Riche east to Fitzgerald River National Park and the Ravensthorpe Range (Figure 94). Usually in low or tall mallee communities on plains and undulating terrain in sand. On windswept coastal slopes it is reduced to an almost prostrate shrub in dense low heath. At the type locality it occurs on the lower slopes of a lateritic rise and on nearby surrounding plain with *E. goniantha, E. redacta, E. tetragona, E. angulosa* and *Banksia media.* In the Ravensthorpe Range it is an upright mallee occurring with *E. uncinata, E.* aff. *occidentalis, E. conglobata, E. eremophila* and *E. desmondensis.*

Conservation status. Occurs in small disjunct populations, most of which are on reserves, including the Fitzgerald River National Park.

Flowering period. Not known.

Notes. As discussed earlier, the name *E. redunca* has been mis-applied for many years. It is now recognised to be of restricted south coastal distribution and characterised by the mallee habit, finally glossy adult leaves, long uncinate buds and pale yellow flowers. These latter characters indicate its affinity with *E. varia, E. gardneri, E. densa* and *E. pluricaulis.*

A notable feature of *E. redunca* is that the canopy is almost always predominantly dull and green. Most leaves appear to retain the dull wax of new growth for a long period. The glossy adult leaves are rare and usually confined to older wood inside the canopy. Also, the new growth of *E. redunca* is yellow green, a feature shared with *E. varia*, and contrasting with the purplish-blue new growth of *E. gardneri, E. pluricaulis* and *E. densa.*

The previously broad application of the name *E. redunca* to mallees extending well inland and to the north of typical populations on the south coast parallels the taxonomic history of many other south-west Australian groups (e.g. *Borya nitida* (Liliaceae) and its allies recently described by Churchill (1987)). Many genera and species groups were first collected by botanists such as Labillardière and Robert Brown who travelled with sea-going explorers along the south coast. Subsequent treatments of the flora used the south-coastal taxa as a baseline, and often placed within them similar looking taxa collected inland and further north. We anticipate that future detailed studies of south-western taxa will bring to light other examples of this trend.

Subseries Desmondenses

Eucalyptus ser. ***Levispermae*** subseries ***Desmondenses*** Brooker & Hopper, subser. nov.

A subserie typica caulibus gracilibus, canopio macilento penduloque, alabastris brevibus crassisque, filamentis staminum omnium inflexis differt.

Typus: E. desmondensis Maiden & Blakely

Mallee with smooth or basally rough bark. Stems slender, crown thin, finally drooping. Branchlets shiny red with wax overlay; pith glands absent. Peduncles stout, flattened, widening distally. Buds short and thick. Operculum ± equal in length to hypanthium. All staminal filaments inflexed. Flowers yellow. Seed spherical.

The single species in this subseries is confined to the Ravensthorpe district where it occupies low hilly country adjacent to and on the Ravensthorpe Range.

28. ***Eucalyptus desmondensis*** Maiden & Blakely, J. Roy. Soc. New South Wales 59: 183 (1925). *Type*: Desmond, near Ravensthorpe, Western Australia, May 1924, *C.A. Gardner* 2183 (NSW). (Figures 11b, 98, 99, 100)

Colour illustration. Brooker & Kleinig (1990: 162).

A mallee to 4 m tall with slender stems supporting a finally drooping crown of few leaves. Bark at base rough and flaky or stem smooth all over. Branchlets shiny, red beneath an overlay of white wax. Pith of branchlets without glands. Leaves of the seedling remaining opposite for 3 or 4 pairs, then alternating, ovate to cordate, to 8 x 6 cm, glaucous to whitish grey, glabrous. Adult leaves lanceolate to broadly lanceolate, to 10 x 3.5 cm, dull, blue-grey. All inflorescence structures with a white wax overlay. Inflorescences to 15-flowered; peduncles stout, strongly flattened, to 2 cm long. Buds shortly pedicellate, fusiform, to 1.1 x 0.6 cm; operculum conical, more or less equal to hypanthium; all filaments inflexed. Flowers yellow. Fruit sessile to subsessile, cupular to cylindrical, to 1.1 x 0.9 cm. Seed light grey-brown, more or less spherical.

Specimens examined. WESTERN AUSTRALIA: Near Kundip, 9 Nov. 1952, *P.H. Barrett* 2 (PERTH); Mt Desmond, 6 miles S of Ravensthorpe on Hopetoun Road, 2 Nov. 1962, *J.S. Beard* 2274 (PERTH); 15 km SW of Ravensthorpe, 23 June 1981, *K. Bradby* (PERTH); Kundip, 6 Nov. 1969, *M.I.H. Brooker* 2299 (CANB, MEL, PERTH); 5.8 miles S of Ravensthorpe, 16 March 1967, *G.M. Chippendale* 205 (CANB, PERTH); Ravensthorpe Range, 1.5 km SW of Mt Desmond, 33° 37'S 120° 08'E, 9 Jan. 1979, *M.D. Crisp* 4976 (CANB, NSW, PERTH); approx. 3 miles S of Ravensthorpe, 9 Dec. 1969, *H. Demarz* 2006 (PERTH); Desmond, nr Ravensthorpe, 18 May 1924, *C.A. Gardner* s.n. (PERTH); Desmond, near Ravensthorpe, Sept. 1925, *Gardner & Blackall* (PERTH); Desmond, near Ravensthorpe, 25 Nov. 1931, *C.A. Gardner* 2935 (CANB, PERTH); Desmond, 25 Nov. 1931, *Gardner & Blackall* 1399 (PERTH); Mount Desmond, nr Ravensthorpe, Jan. 1935, *C.A. Gardner* s.n. (PERTH); Ravensthorpe district, Nov. 1944, *C.A Gardner* (PERTH); Mt Desmond, 17 Oct. 1964, *C.A. Gardner* 14852 (PERTH); Mt Desmond, 16 Aug. 1965, *C.A. Gardner* 16184 (PERTH); 5 1/2 miles SE of Ravensthorpe, 22 Feb. 1966, *A.S. George* 7576 *& S.G.M. Carr* (PERTH); Desmond, 5 miles S of Ravensthorpe, 14 March 1957, *J.W. Green* 1212 (PERTH); S of Ravensthorpe, March 1957, *P.R. Jefferies* 573031 (PERTH); 0.5 km N of Kundip towards Ravensthorpe, 25 May 1983, *G.J. Keighery* 6066 (CANB, PERTH); Mt Desmond near Ravensthorpe, 24 April 1967, *A. Kessell* 598, 599 (PERTH); SE of Ravensthorpe, 29 March 1962, *K. Newbey* 199 (PERTH); 13 km NNE of Kybulup Pool, 15 km SSW of Ravensthorpe, 21 Oct. 1977, *K. Newbey* 5102 (PERTH); Mt Desmond, S of Ravensthorpe, 22 April 1953, *R.D. Royce* 4135 (PERTH); 9 km SE of Ravensthorpe on Hopetoun road, 13 Aug. 1968, *R.A. Saffrey* 495 (CANB, PERTH).

Distribution and habitat. Eucalyptus desmondensis is of restricted distribution but is most easily seen along the Ravensthorpe-Hopetoun road. Gardner (1960) stated that it is "distributed over a fairly large area of the Ravensthorpe Range, and some distance to the east of this". This is supported by a recent survey by E. Bennett (pers. comm.) who reported that the species is abundant and widespread in the Ravensthorpe Range to west of Moir road and Carracuttup Pool, and to east-north-east of Ravensthorpe

on both sides of the Carlinup road, particularly on granitic sands (Figure 98). It grows as an emergent from heath with associates such as *Allocasuarina campestris*.

Conservation status. Vulnerable. No populations are known to be on conservation reserves. All are on Crown land covered by mining leases or on private property. The species is locally abundant, and recovers well from the lignotuber after bushfires.

Flowering period. May to November.

Notes. E. desmondensis is the only species in subseries *Desmondenses*. It differs from all other species in the series by the peculiar slender straggly habit somewhat reminiscent of the quite unrelated *E. sepulcralis* F. Muell. and *E. lansdowneana* J.E. Brown. The peduncles are stout, the buds are fat and relatively short, and all staminal filaments are inflexed. All inflorescence structures are glaucous. The flowers are yellow. This combination of characters makes it clearly divergent from subseries *Levispermae*, several species of which grow in close proximity, *viz. E. redunca, E. phaenophylla* subsp. *interjacens, E. clivicola, E. gardneri* subsp. *ravensthorpensis* and *E. densa*.

Natural hybrids

Systematic studies of natural hybridisation in eucalypts have been much neglected, although some data have accumulated (Griffin *et al.* 1988). In the case of the *Levispermae*, attempts to review the importance of natural hybridisation would have been futile before the current revision in view of the unusually large number of undescribed taxa we have documented.

In any event, Griffin *et al.* (1988) noted that no records of interspecific hybrids within the series existed in Chippendale and Wolf's (1984) EUCALIST herbarium data base, nor in the literature. Two putative hybrids with members of other series of section '*Bisectaria*' were listed, one each with a member of series *Cornutae* (i.e. *E. gomphocephala* x *E. wandoo* - which we have been unable to relocate and consider a doubtful determination because the putative parents are allopatric and taxonomically isolated) and series *Loxophlebae* (*E. loxophleba* x *E. wandoo* - well documented, see below). No natural hybrids between *Levispermae* species and those of other sections within subgenus '*Symphyomyrtus*' were known.

Griffin *et al.* (1988) supported Pryor and Johnson's (1981) conclusion that members of section '*Bisectaria*' had a "low propensity to hybridise". It was suggested that, within '*Symphyomyrtus*', "the large section *Bisectaria* (113 species) seems to have the most well developed barriers at the species level, since inter and even intraseries combinations are rare." However, Griffin *et al.* (1988) noted that such indications could be due to inadequate sampling or taxonomic interpretation, rather than reflecting real variation in rates of natural hybridisation.

In the case of the *Levispermae*, we have established through field, glasshouse and herbarium studies the occurrence of natural hybrids derived from many species combinations. Specimens are cited below for six intersectional crosses, seven interseries crosses and 12 crosses within the series *Levispermae*. Because most of these hybrids are easily overlooked (we collected specimens from all putative hybrids encountered during the study, and these were few), it seems probable that additional combinations will be discovered in the future.

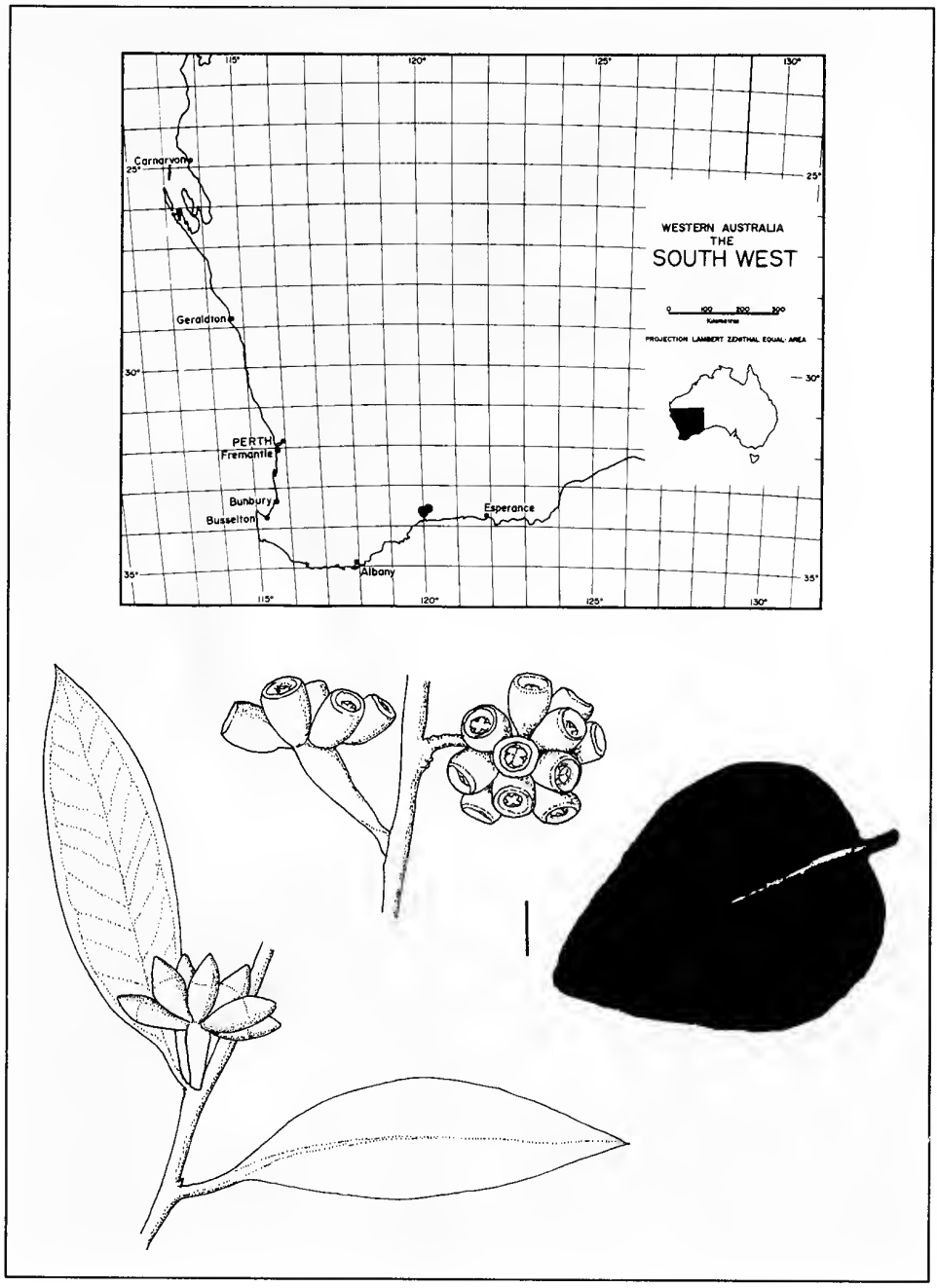

Figure 98. *Eucalyptus desmondensis* distribution, and buds, fruits, adult leaves and silhouette of a fifth node seedling leaf (scale bar = 1 cm).

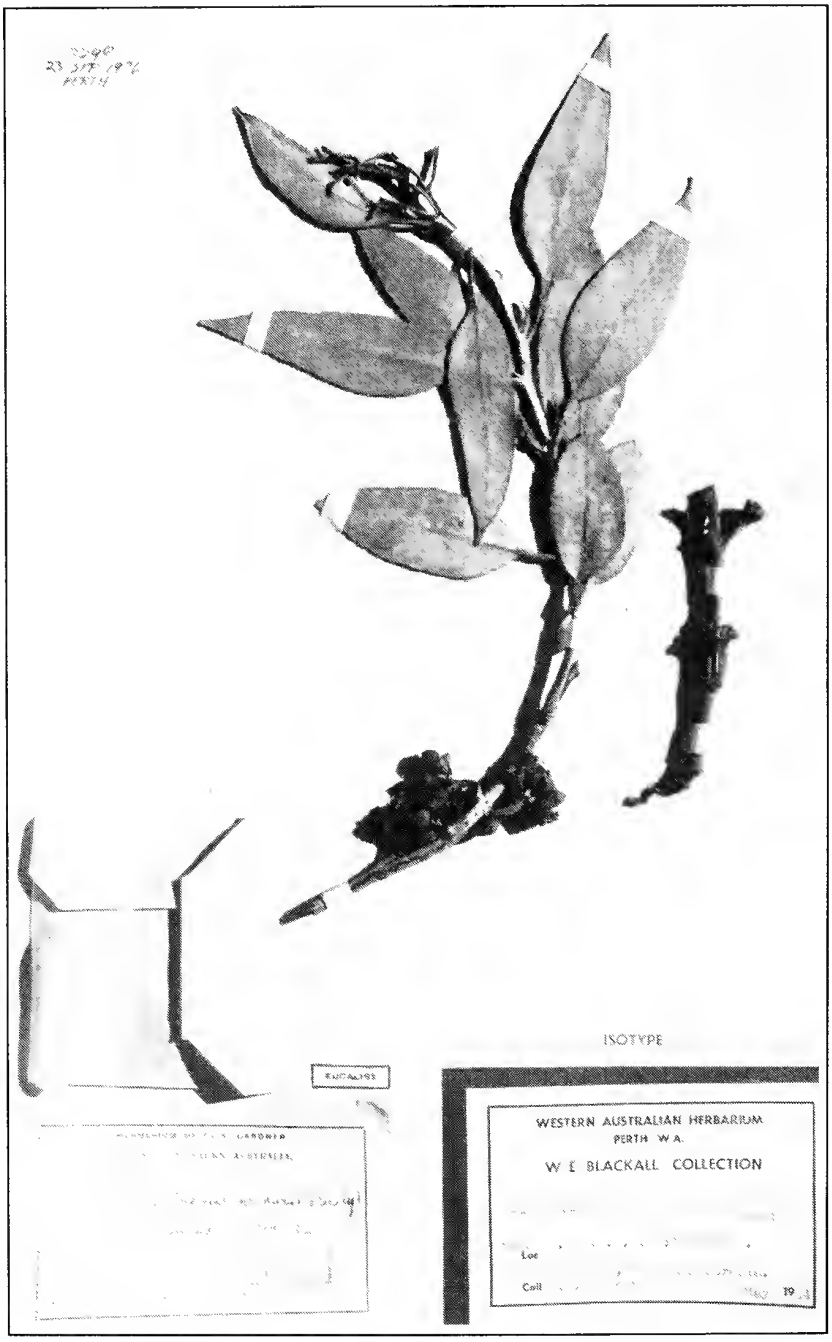

Figure 99. Isotype of *E. desmondensis* Maiden & Blakely.

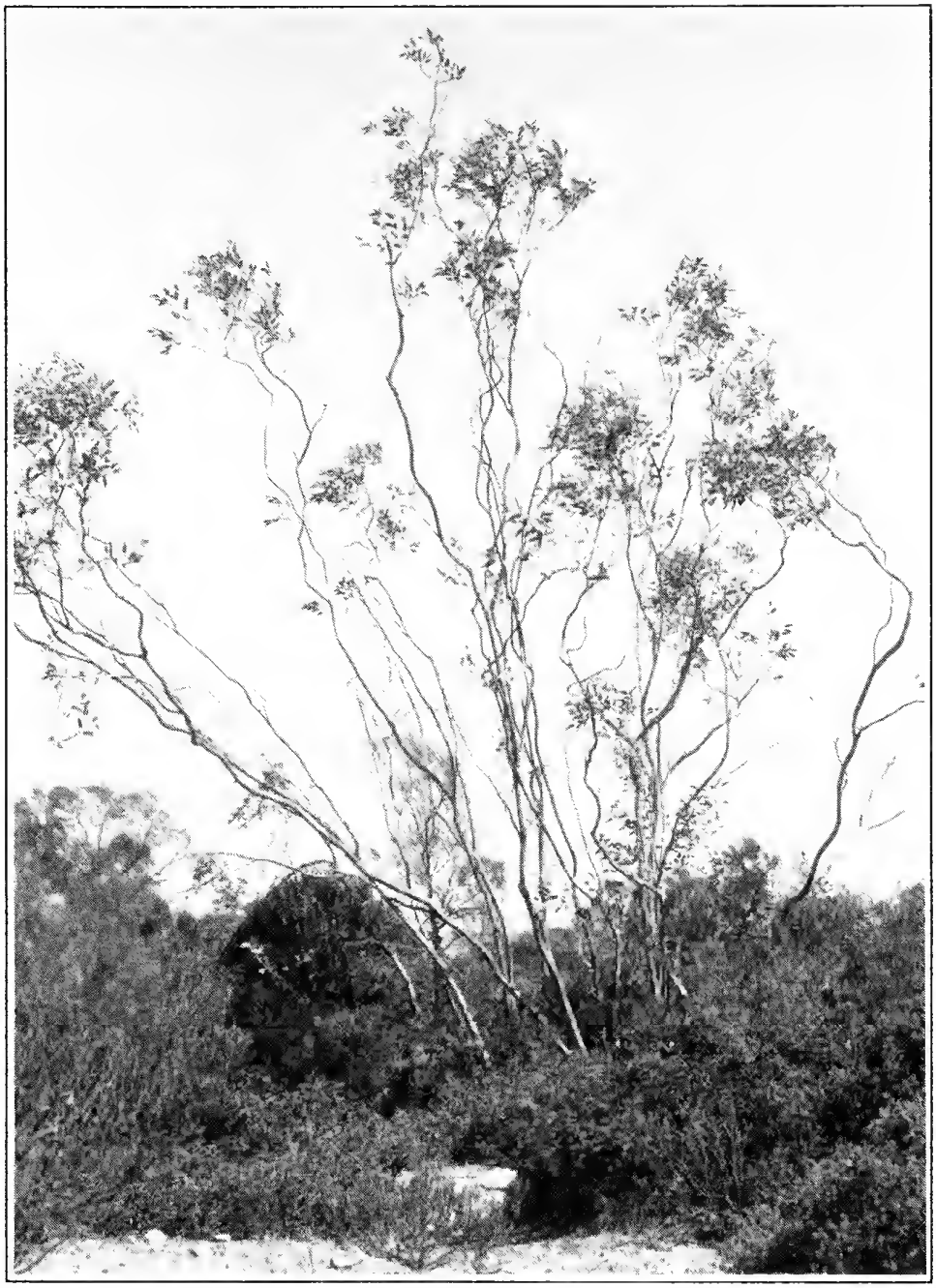

Figure 100. *E. desmondensis* mallee habit near Mt Desmond.

The evidence for hybridisation in individuals depends on morphological intermediacy between putative parents in habit, bark, canopy, leaves, buds, fruits and seeds, combined with their rare occurrence in the field in mixed populations of both parents. Where the parental taxa differ in their cotyledons and seedling attributes, we have also grown progeny of the putative hybrids to test for segregation.

We list below specimens that meet these criteria. Rather than name these hybrids with their own epithet, we have used the hybrid formula of the putative parents in alphabetical order. In one instance (*E. crispata*) we have named plants of possible hybrid origin but in this case there are many individuals in known populations, and these are relatively morphologically uniform. They do not vary continuously from the form of one parent to that of the other as is seen in a hybrid swarm.

Just as previous taxonomic treatments of the series have underestimated the number of recognisable taxa, past treatments of natural hybridisation (e.g. Griffin *et al.* 1988) are here shown to be inadequate. Until revisionary and extensive field studies of many other groups in *Eucalyptus* have been completed, we urge caution in attempts to derive significant conclusions about rates of hybridisation from the data bases that were reviewed by Griffin *et al.* (1988).

Intersectional hybrids

Eucalyptus arachnaea Brooker & Hopper subsp. ***arachnaea*** x ***E. obtusiflora*** DC.

Specimens examined. WESTERN AUSTRALIA: breakaway SSE of Mt Horner, north of Pincher's Road, 29° 10'S 115° 08'E, 4 Feb. 1985, *M.I.H. Brooker* 8818 (CANB, MEL, NSW, PERTH); south slope of flat-top hill north of Pincher's Road, 29° 09'S 115° 06'E, 3 June 1985, *M.I.H. Brooker* 9027 (CANB, MEL, NSW, PERTH); 12.8 km SW of Three Springs towards Eneabba, 29° 34'S, 115° 40'E, 21 Nov. 1986, *M.I.H. Brooker* 9553 (CANB, MEL, NSW, PERTH).

Eucalyptus conglobata (R.Br. ex Benth.) Maiden x ***E. wandoo*** Blakely subsp. ***wandoo***

Specimen examined. WESTERN AUSTRALIA: 3.7 km from highway on road to Woodanilling, 33° 33'S 117° 07'E, 8 March 1988, *M.I.H. Brooker* 9897 (AD, CANB, MEL, NSW, PERTH).

Eucalyptus desmondensis Maiden & Blakely x ***E. incrassata*** Labill.

Specimens examined. WESTERN AUSTRALIA: c. 10 km S of Ravensthorpe on Hopetoun road, 33° 36'S 120° 08'E, 23 June 1978, *D.F. Blaxell* 1696 (NSW, PERTH); track to *E. bennettiae*, c. 50 m off road N of Mine, 33° 38'S 120° 08'E, 12 April 1985, *M.I.H. Brooker* 8943 (CANB, NSW, PERTH).

Eucalyptus incrassata Labill. x ***E. medialis*** Brooker & Hopper

Specimens examined. WESTERN AUSTRALIA: 0.9 km S of Bluff Knoll road on firetrail near Chester Pass road, Stirling Range, 10 Oct. 1982, *M.I.H. Brooker* 7735 (CANB, NSW, PERTH); 6.5 km WNW of Bluff Knoll, 0.9 km SW of Bluff Knoll Rd, 34° 19'S 118° 13'E, 5 May 1982,

S.D. Hopper 2290 (PERTH); Stirling Range National Park, 3 km S of Bluff Knoll Rd along Chester Pass Rd, 34° 21'S 118° 11'E, 11 April 1983, *S.D. Hopper* 2743 (PERTH); Stirling Range National Park, 3 km S of Bluff Knoll Rd on Chester Pass Rd, 34° 21'S 118° 11'E, 11 April 1983, *S.D. Hopper* 3588, 3589, 3590 (PERTH); hilltop W of Luscombe's house off Washpool Rd, 34° 35'20"S 117° 52'00"E, 27 Feb. 1988, *A. Napier* s.n. (PERTH); Stirling Range National Park, 3.7 km N of S boundary along N-S firebreak 200 m E of Chester Pass Road, 7 Oct. 1987, *A. Taylor* 83 (PERTH).

Eucalyptus incrassata Labill x ***E. phaenophylla*** Brooker & Hopper subsp. ***phaenophylla***

Specimens examined. WESTERN AUSTRALIA: c. 8 km NW of Nyabing, 33° 22'S 118° 03'E, 19 July 1988, *M.I.H. Brooker* 9989 (AD, CANB, MEL, NSW, PERTH); W. Grocock's property, Sth Stirlings, 17 June 1963, *F. Lullfitz* L1287 (PERTH).

Eucalyptus incrassata Labill. x ***E. pluricaulis*** Brooker & Hopper subsp. ***porphyrea*** Brooker & Hopper

Specimen examined. WESTERN AUSTRALIA: 3.8 km S along Norman road from Cowalellup road, 34° 14'S 118° 43'E, 21 Feb. 1985, *M.I.H. Brooker* 8865 (CANB, NSW, PERTH).

Interseries hybrids

Eucalyptus accedens W. Fitzg. x ***E. pluricaulis*** Brooker & Hoppcr subsp. ***pluricaulis***

The buds on the single specimen of this putative hybrid are shorter, fatter and more obtuse than those of *E. pluricaulis*. Both presumptive parents occur in the Mt Pcron area on lateritic breakaways.

Specimen examined. WESTERN AUSTRALIA: below southern scarp of Mt Peron, 30° 08'S 115° 08'E, 2 March 1983, *M.I.H. Brooker* 7991 (CANB, NSW, PERTH).

Eucalyptus grossa F. Muell. ex Benth. x ***E. histophylla*** Brooker & Hopper

Specimen examined. WESTERN AUSTRALIA: Mt Buraminya, 23 Aug. 1989, *S.D. Hopper* 7445 (PERTH).

Eucalyptus loxophleba Bcnth. x ***E. wandoo*** Blakely subsp. ***wandoo***

Specimens examined. WESTERN AUSTRALIA: Reserve 12109, Shire of Wickepin, Wickepin-Corrigin Rd, 32° 44'S 117° 36'E, 31 March 1987, *M.I.H. Brooker* 9577 (AD, CANB, MEL, NSW, PERTH); 5.6 km from Irishtown Hall on Dumbarton Rd, 31° 34'S 116° 34'E, 23 April 1987, *M.I.H. Brooker* 9584, 9585 (AD, CANB, MEL, NSW, PERTH); Clackline, 31° 43'S 116° 31'E, 23 April 1987, *M.I.H. Brooker* 9586 (AD, CANB, MEL, NSW, PERTH); 15 km W of Quairading, 50 m E of turn-off to Dulbelling on S side of York Rd, 32° 01'30"S 117° 16'E, 13 June 1985, *S.D. Hopper* 4395 (PERTH); 2.8 km W of Dangin North Road along York-Quairading Road, 20 June 1986, *S.D. Hopper* 4888 (PERTH).

Eucalyptus phaenophylla Brooker & Hopper subsp. ***phaenophylla*** x ***E. spathulata*** Hook. var. ***spathulata***

Specimen examined. WESTERN AUSTRALIA: 0.3 km N of Beaufort River, Albany Highway, 31 Oct. 1975, *J.W. Green* 4625 (PERTH).

Eucalyptus phaenophylla Brooker & Hopper subsp. ***phaenophylla*** x ***E. uncinata*** Turcz.

Specimen examined. WESTERN AUSTRALIA: 13 km ENE of Amelup, interscetion of Sandalwood Road and Salisbury Road, 5 Oct. 1987, *S.D. Hopper* 6185 (PERTH).

Eucalyptus recondita Brooker & Hopper ined. x ***E. xanthonema*** Turez. subsp. ***apposita*** Brooker & Hopper

Specimen examined. WESTERN AUSTRALIA: Stirling Range National Park, adjacent to caravan park, N boundary of NP, 34° 20'S 118° 12'E, 23 Nov. 1983, *S.D. Hopper* 3588, 3589, 3590 (PERTH).

Eucalyptus spathulata Hook. var. ***spathulata*** x ***E. wandoo*** Blakely subsp. ***wandoo***

Specimen examined. WESTERN AUSTRALIA: 3.7 km from highway on road to Woodanilling, 33° 33'S 117° 07'E, 8 March 1988, *M.I.H. Brooker* 9898 (AD, CANB, MEL, NSW, PERTH).

E. ser. *Levispermae* hybrids

Eucalyptus abdita Brooker & Hopper x ***E. arachnaea*** Brooker & Hopper subsp. ***arachnaea***

Specimen examined. WESTERN AUSTRALIA: Mt Misery, 18 August 1988, *M.I.H. Brooker* 10031 (CANB).

Eucalyptus arachnaea Brooker & Hopper subsp. ***arachnaea*** x ***E. capillosa*** Brooker & Hopper subsp. ***capillosa***

Specimens examined. WESTERN AUSTRALIA: 4 km W of Mt Bebb, 32° 05'S 117° 47'E, 13 June 1985, *S.D. Hopper* 4398 (PERTH); Sorenson's Nature Reserve, 8.7 km W of Babakin, 32° 07'30"S 117° 55'E, 13 June 1985, *S.D. Hopper* 4403 (PERTH).

Eucalyptus arachnaea Brooker & Hopper subsp. ***arachnaea*** x ***E. wandoo*** Blakely subsp. ***wandoo***

Specimens examined. WESTERN AUSTRALIA: 12.6 km E of rail crossing at Carani, 30° 59'S 116° 31'E, 26 Aug. 1982, *M.I.H. Brooker* 7589 (AD, CANB, NSW, PERTH).

Eucalyptus capillosa Brooker & Hopper subsp. ***capillosa*** x ***E. subangusta*** (Blakely) Brooker & Hopper subsp. ***cerina*** Brooker & Hopper

Specimens examined. WESTERN AUSTRALIA: Chiddarcooping Nature Reserve, 30° 51'S 118° 42'E, 17 Feb. 1983, *M.I.H. Brooker* 7971 (CANB, NSW, PERTH); Trayning, *s. dat., M. Barnes* s.n. (PERTH).

Eucalyptus capillosa Brooker & Hopper subsp. ***capillosa*** x ***E. phaenophylla*** Brooker & Hopper subsp. ***phaenophylla*** Brooker & Hopper

Specimen examined. WESTERN AUSTRALIA: Dragon Rocks Reserve, between rock and Pingaring-Holt Rock road, 32° 47'S 119° 04'E, 21 Oct. 1986, *M.I.H. Brooker* 9480 (AD, CANB, MEL, NSW, PERTH).

Eucalyptus capillosa Brooker & Hopper subsp. ***capillosa x E. wandoo*** Blakely subsp. ***wandoo***

Specimen examined. WESTERN AUSTRALIA: 3.8 km S of Kokardine on Cadoux road, 30° 43'S 117° 10'E, 2 July 1986, *M.I.H. Brooker* 9383 (AD, CANB, MEL, NSW, PERTH).

Eucalyptus pluricaulis Brooker & Hopper subsp. ***pluricaulis x E. wandoo*** Blakely subsp. ***wandoo***

Specimens examined. WESTERN AUSTRALIA: 3 km from hwy on road to Woodanilling, 33° 33'S 117° 07'E, 8 March 1988, *M.I.H. Brooker* 9896 (AD, CANB, MEL, NSW, PERTH); 2.9 km E of Albany Highway along road to Woodanilling, 33° 33'S 117° 08'E, 24 July 1984, *S.D. Hopper* 3830 (PERTH).

Eucalyptus gardneri Maiden x ***E. pluricaulis*** Brooker & Hopper subsp. ***pluricaulis***

No specimens of these hybrids are known. However, a population of both parental species and hybrids was observed and photographed by S.D.H. on 11 March 1988 in the Tarin Rock area 0.3 km south of Tarin Rock Road along Hills Road.

Eucalyptus hebetifolia Brooker & Hopper x ***E. sparsicoma*** Brooker & Hopper

Specimen examined. WESTERN AUSTRALIA: 0.9 km E of Tincurrin Nth road on Stock Route 3, 32° 56'S 117° 48'E, 12 Dec. 1988, *M.I.H. Brooker* 10143 (AD, CANB, MEL, NSW, PERTH).

Eucalyptus subangusta (Blakely) Brooker & Hopper subsp. ***subangusta x E. wandoo*** Blakely subsp. ***wandoo***

Specimens examined. WESTERN AUSTRALIA: Wongan Hills ridgetop, c. 1 km W of road to gap, 30° 52'S 116° 40'E, 26 Aug. 1982, *M.I.H. Brooker* 7596 (CANB, NSW, PERTH); 15.3 km NE of Calingiri towards Wongan Hills, 30° 59'S 116° 33'E, 16 Feb. 1983, *M.I.H. Brooker* 7967 (CANB, NSW, PERTH); 8 km NW of Wongan Hills township, 9 km NE of Mortlock Flats, 30° 51'S 116° 40'E, 26 Aug. 1982, *S.D. Hopper* 2481 (PERTH).

Eucalyptus wandoo Blakely subsp. ***wandoo x E. xanthonema*** Turez. subsp. ***xanthonema***

Specimens examined. WESTERN AUSTRALIA: Beaufort River Crossing, Albany Highway, 33° 30'S 117° 04'E, 21 Nov. 1983, *M.I.H. Brooker* 8368 (CANB, NSW, PERTH); 3.7 km E of Albany Hwy on Woodanilling Rd, 33° 33'S 117° 08'E, 26 Nov. 1987, *M.I.H. Brooker* 9828 (AD, CANB, MEL, NSW, PERTH).

Eucalyptus wandoo Blakely subsp. ***wandoo x E. xanthonema*** Turcz. subsp. ***apposita*** Brooker & Hopper

Specimens examined. WESTERN AUSTRALIA: 2.2 km along N boundary firetrail from Bluff Knoll Rd, Stirling Range, 7 Oct. 1982, *M.I.H. Brooker* 7694 (CANB, NSW, PERTH); 2.5 km along N boundary fire trail (Stirling Range National Park) from Bluff Knoll Road, 7 Oct. 1982, *M.I.H. Brooker* 7697 (CANB, NSW, PERTH); 0.4 km SE of Chester Pass road on Bluff Knoll road, Stirling Range, 34° 21'S 118° 13'E, 21 March 1983, *M.I.H. Brooker* 8030 (CANB, NSW, PERTH); Salt River Road, N of Stirling Range N.P., 22 Feb. 1985, *M.I.H. Brooker* 8868 (CANB, MEL, NSW, PERTH); Stirling Range National Park, 100 km S of Bluff Knoll Ranger's residence, 34° 19'30"S 118° 11'15'E, 21 May 1989, *A. Rose* 1063 (PERTH).

Intergrades between species of *E.* ser. *Levispermae*

The following case is an instance of discrete, morphologically uniform populations that are intermediate between wheatbelt wandoo and desert wandoo.

Eucalyptus capillosa Brooker & Hopper subsp. ***capillosa - E. nigrifunda*** Brooker & Hopper ***intergrades***

Specimens examined. WESTERN AUSTRALIA: 2 km E of Die Hardy Range road on Diemals-Menzies road, 29° 43'S 119° 34'E, 16 Oct. 1984, *M.I.H. Brooker* 8694 (CANB, MEL, NSW, PERTH); 23.8 km SE of Perrin Vale on Menzies road, 29° 14'S 120° 14'E, 23 June 1987, *M.I.H. Brooker* 9662, 9662a (AD, CANB, MEL, NSW, PERTH); 30 km SE of Peron Vale Station, 29° 13'S 120° 16'E, 13 June 1988, *R.J. Cranfield* 6999 (PERTH); Lake Barlee, 18 Oct. 1966, *C.A. Gardner* 19032 (PERTH).

Acknowledgements

We are grateful to B. Rockel, C. Sounness and C. Ranford for growing specimens of all taxa in the glasshouse at CSIRO, Perth, to Susan Patrick and John Rainbird for line drawings, to Jan Rayner and Raelene Hick for word processing, to Andrew Brown for cartography and other technical assistance, and to our colleages L.A.S. Johnson, K. Hill and D.F. Blaxell for discussions. The late K.R. Newbey alerted SDH to the existence of several undescribed taxa of the *Levispermae* in the Ongerup and Jerramungup districts on a field trip in 1982.

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Index to new species and subspecies of *Eucalyptus* ser. *Levispermae* (page number for main description in **bold**)

Publication date of Nuytsia Volume 7 Number 3: 30 June 1991

0919-1291-600

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ISSN 0085-4417