

**THE DISTRIBUTION OF BORAGINACEAE IN WESTERN AUSTRALIA IN
RELATION TO THE BIOLOGICAL CONTROL OF *ECHIMUM PLANTAGINEUM* L.**

By John K. Scott¹ and Kevin F. Kenneally²

1. Entomology Branch, Department of Agriculture, Jarrah Road, South Perth, W.A. 6151.
2. Western Australian Herbarium, George Street, South Perth, W.A. 6151

ABSTRACT

*Distribution maps based on 1° lat. x 1.5° long. grid are given for the 55 described species of native and introduced Boraginaceae in Western Australia. The species are also listed for each of the 181 grid cells covering the State. Nine of the species are introduced, including *Echium plantagineum* L. which is the subject of biological control by insects. Native species of Boraginaceae could provide alternative host plants and a mechanism for the spread of insects between western and eastern Australia.*

INTRODUCTION

The pasture weed, *Echium plantagineum* L. (Paterson's Curse, also known as Salvation Jane) is the subject of biological control by insects. All the four species of insect that are intended for release are possibly not specific to members of the genus *Echium* but thought to be restricted to a small group of the Boraginaceae (Kirk and Wapshere 1979; Wapshere and Kirk 1977). Consequently it is desirable to know whether possible alternative host plants in the same family of plants (Boraginaceae) occur in Western Australia.

There has been little research on the native Boraginaceae of Western Australia. The names used in this paper are based on present taxonomic knowledge of the family except in *Halgania* where one of us (KFK) has carried out a preliminary taxonomic investigation. Several undescribed taxa require naming and only one distribution map, for *Heliotropium undulatum* Vahl., has been published (Rye *et al.* 1980). Piggin (1977) gives a distribution map of *Echium plantagineum* for Australia. The intention of this paper is to list those described species of Boraginaceae occurring in Western Australia and to give their distribution based on herbarium specimens. This information is considered in relation to the known distribution of *Echium plantagineum* and the biological control of this weed.

METHODS

The methods used to map the Boraginaceae follow those of Hnatiuk and Maslin (1980a and b). Species distributions have been recorded using a 1° latitude by 1.5° longitude grid system based on the 1:250,000 topographical survey maps produced by the Division of National Mapping, Canberra. The numbering of each grid cell follows that of Brook (1977). We used 181 grid cells. Figure 1 of Hnatiuk and Maslin (1980a) gives the grid cell numbers. To their 179 grid cells we have added two, Houtman Abrolhos (grid cell number 223) and the islets of the Ashmore Reef, Timor Sea (no grid cell number allocated).

The 55 species mapped are arranged alphabetically and the occurrence in a grid cell is indicated by a "quadrangle". The number of occurrences in each grid are summed to provide the maps of all species, native species only and introduced species only per grid cell (Figure 1). The grid cells with their lists of species are arranged in ascending numerical order of map number beginning with Ashmore Reef. Introduced species are indicated on both the maps and list by an asterisk. The specimens upon which the maps are based are annotated as voucher specimens and housed in the Western Australian Herbarium (PERTH).

RESULTS

The species found in Western Australia are listed in Table 1. Also indicated are those that are introduced and/or overlap with the distribution of *E. plantagineum*. There is a total of 55 species from 18 genera of which nine species are introduced. There are 11 genera containing only native species and six genera containing only introduced species with one genus, *Heliotropium*, represented by both native and introduced species. The largest genus is *Heliotropium* with 20 species, followed by *Halgania* with 16 species. Twenty three species overlap the distribution of *E. plantagineum*. Six of these are introduced. Figure 1A gives the total species number per grid cell while Figure 1B lists the native species per grid cell and Figure 1C the introduced species per grid cell. Figure 1D gives the corresponding grid cell numbers. More native species are found in the northern half of Western Australia when compared with the southern half while the introduced species occur in the south west. Species of Boraginaceae are found more or less throughout Western Australia, the greatest number being 11 species for grid cell numbers 110, 117 and 255. The greatest total of introduced species per grid cell is five and this occurs in the Perth grid cell. In Table 2 the species are listed for each grid cell number and following Figure 1 the distribution of each species is presented alphabetically.

DISCUSSION

Table 1 indicates those species of native Boraginaceae that overlap the distribution of *E. plantagineum*. Some native species may become alternative hosts for introduced biological control agents particularly as one of the insects, the *Echium* leaf miner, *Dialectica scalarisella* (Zeller), attacks genera of Boraginaceae other than *Echium* (Wapshere and Kirk 1977). The other genera attacked by this insect include *Anchusa*, *Borago*, *Cynoglossum*, *Heliotropium*, *Myosotis* and *Symphytum*. All six genera are present in Western Australia and three, *Cynoglossum*, *Heliotropium* and *Myosotis* contain native

Table 1. Species of Boraginaceae recorded from Western Australia.

Species	Introduced (I)	Overlapping <i>Echium</i> (E)
<i>Amsinckia calycina</i> (Moris) Chater	I	E
<i>Amsinckia lycopsoides</i> (Lehm.) Lehm.	I	-
<i>Anchusa capensis</i> Thunb.	I	E
<i>Borago officinalis</i> L.	I	E
<i>Buglossoides arvensis</i> (L.) I.M. Johnston	I	E
<i>Coldenia procumbens</i> L.	-	-
<i>Cordia subcordata</i> Lam.	-	-
<i>Cynoglossum australe</i> R.Br.	-	-
<i>Echium plantagineum</i> L.	I	-
<i>Ehretia saligna</i> R.Br.	-	-
<i>Ehretia urceolata</i> W.V. Fitzg.	-	-
<i>Halgania andromedifolia</i> Behr & F. Muell.	-	E
<i>Halgania argyrophylla</i> Diels	-	-
<i>Halgania bebrana</i> Oldfield & F. Muell.	-	E
<i>Halgania corymbosa</i> Lindl.	-	E
<i>Halgania cyanea</i> Lindl.	-	E
<i>Halgania erecta</i> Ewart & Rees	-	-
<i>Halgania glabra</i> J.M. Black	-	-
<i>Halgania gustafsenii</i> F. Muell.	-	-
<i>Halgania lavandulacea</i> Endl.	-	E
<i>Halgania littoralis</i> Gaud.	-	E
<i>Halgania preissiana</i> Lehm.	-	E
<i>Halgania rigida</i> S. Moore	-	E
<i>Halgania sericiflora</i> Benth.	-	E
<i>Halgania solanacea</i> F. Muell.	-	-
<i>Halgania tomentosa</i> (R. Helms) Ewart & J. White	-	E
<i>Halgania viscosa</i> S. Moore	-	E
<i>Heliotropium asperrimum</i> R.Br.	-	-
<i>Heliotropium bacciferum</i> Forsk.	-	-
<i>Heliotropium bracteatum</i> R.Br.	-	-
<i>Heliotropium conocarpum</i> F. Muell. ex Benth.	-	-
<i>Heliotropium crispatum</i> F. Muell. ex Benth.	-	-
<i>Heliotropium cunninghamii</i> Benth.	-	-
<i>Heliotropium curassavicum</i> L.	-	E
<i>Heliotropium diversifolium</i> F. Muell. ex Benth.	-	-
<i>Heliotropium epacrideum</i> F. Muell. ex Benth.	-	-
<i>Heliotropium europaeum</i> L.	I	E
<i>Heliotropium flaviflorum</i> W.V. Fitzg.	-	-
<i>Heliotropium heteranthum</i> (F. Muell.) Ewart & O.B. Davies	-	-
<i>Heliotropium ovalifolium</i> Forsk.	-	-
<i>Heliotropium paniculatum</i> R.Br.	-	-
<i>Heliotropium pleiopterum</i> F. Muell.	-	-
<i>Heliotropium strigosum</i> Willd.	-	-
<i>Heliotropium supinum</i> L.	I	-
<i>Heliotropium tenuifolium</i> R.Br.	-	-
<i>Heliotropium undulatum</i> Vahl.	-	E
<i>Heliotropium ventricosum</i> R.Br.	-	-
<i>Messerschmidia argentea</i> (L.f.) I.M. Johnston	-	-
<i>Myosotis australis</i> R.Br.	-	E
<i>Omphalolappula concava</i> (F. Muell.) Brand	-	E

Table 1 (cont.)

Species	Introduced (I)	Overlapping <i>Echium</i> (E)
<i>Plagiobothrys australasicus</i> (DC.) I.M. Johnston	-	-
<i>Symphytum officinale</i> L.	I	E
<i>Tournefortia mollis</i> F. Muell.	-	-
<i>Trichodesma zeylanicum</i> (Burm.f.) R.Br.	-	-
var. <i>latisepalum</i> F. Muell.	-	-
<i>Trichodesma zeylanicum</i> (Burm.f.) R.Br.	-	-
var. <i>zeylanicum</i>	-	E

species. A similar situation exists for the *Echium* borer, *Phytoecia coerulescens* (Kirk and Wapshere 1979). Thus it could be possible for insects to spread, via native species, to the eastern half of Australia or vice versa. The native species are mostly perennial shrubs as opposed to the introduced annual species. The presence of these native shrubs could provide alternative food for insects during summer when most plants of *E. plantagineum* die.

Some native species of Boraginaceae occur on both nearshore (Abrolhos Islands) and offshore islands (Ashmore Reef) where they may constitute, as in the latter example, an important component of the island flora (e.g. *Messerschmidia argentea*). The effect of insect damage on populations of these plants is unknown.

The maps, being based on herbarium specimens, suggest a lack of collecting of species of Boraginaceae, e.g. *Cynoglossum australe*. Taxonomic uncertainty about species is also suggested by the maps, e.g. *Halgania glabra*. The greatest abundance of species is associated with towns or major roads while grid cells where no species occur suggests a lack of collecting in these remote areas. An interesting area for the centre of Australia is grid cell 186, centred on the Rawlinson Range. Here the greater species abundance compared with surrounding areas probably reflects the presence of the Giles Weather Station, the Rawlinson Ranges and the major central Australian road for the area. The number of species given for this area is possibly a better indication of the actual numbers near the border of Western Australia than the numbers given in Figure 1.

ACKNOWLEDGEMENTS

We are grateful to R.J. Hnatiuk and B.R. Maslin for providing the base maps used in this survey. Karen Barker and Cheryl Lynch assisted with the mapping and Janis Rooke and Vicki Hamley typed the manuscript. We are grateful for comments on the manuscript from E.S. Del Fosse, J.W. Green, S.D. Hopper, B.R. Maslin and J. Sandow. An opportunity to examine *Halgania* type specimens and collections in overseas institutions was provided by a Churchill Fellowship awarded to K.F. Kenneally. The Winston Churchill Memorial Trust is gratefully acknowledged.

REFERENCES

- Brook, A.J. (1977). *ABIGS Technical Manual*. Dept. Zoology, University of Melbourne, 57 pp.
- Hnatiuk, R.J. and Maslin, B.R. (1980a). The distribution of *Acacia* (Leguminosae-Mimosoideae) in Western Australia, Part 1. Individual species distribution. *Western Australian Herbarium Research Notes* 4: 1-103.
- Hnatiuk, R.J. and Maslin, B.R. (1980b). The distribution of *Acacia* (Leguminosae-Mimosoideae) in Western Australia, Part 2. Lists of species occurring in 1° x 1.5° grid cells. *Western Australian Herbarium Research Notes* 4: 105-144.
- Kirk, A.A. and Wapshere, A.J. (1979). The life history and host specificity of the *Echium* borer, *Phytoecia coerulescens* (Col: Cerambycidae). *Entomophaga* 24: 423-430.
- Piggin, C.M. (1977). The herbaceous species of *Echium* (Boraginaceae) naturalised in Australia. *Muelleria* 3: 215-244.
- Rye, B.L., Hopper, S.D. and Watson, L.E. (1980). Commercially exploited vascular plants native in Western Australia: census, atlas and preliminary assessment of conservation status. *Western Australian Department of Fisheries and Wildlife. Report No. 40*.
- Wapshere, A.J. and Kirk, A.A. (1977). The biology and host specificity of the *Echium* leaf miner *Dialectica scaeariella* (Zeller) (Lepidoptera: Gracillariidae). *Bulletin of Entomological Research* 67: 627-633.

Table 2. Lists of species occurring in 1° x 1.5° grid cells. (* indicates introduced species).

NO GRID CELL NUMBER ASHMORE REEF <i>Messerschmidia argentea</i>	GRID CELL 107 CAMDEN SOUND <i>Heliotropium paniculatum</i> <i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i>
GRID CELL 102 LONDONDERRY <i>Heliotropium flaviflorum</i> <i>Heliotropium paniculatum</i> <i>Trichodesma zeylanicum</i> var. <i>latisepalum</i>	GRID CELL 108 PRINCE REGENT <i>Ehretia saligna</i> <i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i>
GRID CELL 103 BROWSE ISLAND No species recorded	GRID CELL 109 ASHTON No species recorded
GRID CELL 104 MONTAGUE SOUND <i>Heliotropium strigosum</i>	GRID CELL 110 CAMBRIDGE GULF <i>Coldenia procumbens</i> <i>Cordia subcordata</i> <i>Ehretia saligna</i> <i>Heliotropium conocarpum</i> <i>Heliotropium paniculatum</i> <i>Heliotropium strigosum</i> <i>Heliotropium tenuifolium</i> <i>Heliotropium ventricosum</i> <i>Tournefortia mollis</i>
GRID CELL 105 DRYSDALE <i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i>	
GRID CELL 106 MEDUSA BANKS No species recorded	

- GRID CELL 110 (cont.)
Trichodesma zeylanicum
 var. *latisepalum*
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 111 PENDER
 No species recorded
- GRID CELL 112 YAMPI
 No species recorded
- GRID CELL 113 CHARNLEY
Heliotropium conocarpum
Heliotropium ventricosum
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 114 MT. ELIZABETH
Heliotropium ovalifolium
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 115 LISSADELL
Heliotropium paniculatum
Heliotropium tenuifolium
- GRID CELL 116 BROOME
Ehretia saligna
Heliotropium paniculatum
- GRID CELL 117 DERBY
Ehretia saligna
Ehretia urceolata
Heliotropium bacciferum
Heliotropium cunninghamii
Heliotropium diversifolium
Heliotropium paniculatum
Heliotropium strigosum
Heliotropium tenuifolium
Heliotropium ventricosum
Trichodesma zeylanicum
 var. *latisepalum*
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 118 LENNARD RIVER
Ehretia saligna
Heliotropium ovalifolium
Heliotropium paniculatum
- GRID CELL 118 (cont.)
Heliotropium tenuifolium
Trichodesma zeylanicum
 var. *latisepalum*
- GRID CELL 119 LANSDOWNE
Heliotropium paniculatum
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 120 DIXON RANGE
Heliotropium conocarpum
Trichodesma zeylanicum
 var. *latisepalum*
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 121 LAGRANGE
Halgania glabra
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 122 MT. ANDERSON
Halgania solanacea
Heliotropium ovalifolium
Heliotropium paniculatum
Heliotropium tenuifolium
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 123 NOONKANBAH
Halgania solanacea
Heliotropium conocarpum
Heliotropium paniculatum
Heliotropium tenuifolium
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 124 MT. RAMSAY
Halgania solanacea
Heliotropium epacrideum
Heliotropium flaviflorum
Heliotropium paniculatum
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 125 GORDON DOWNS
Halgania solanacea
Heliotropium conocarpum
Heliotropium curassavicum
Heliotropium tenuifolium

- GRID CELL 125 (cont.)
Trichodesma zeylanicum
 var. *latisepalum*
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 126 BEDOUT ISLAND
Heliotropium tenuifolium
- GRID CELL 127 MANDORA
Halgania solanacea
Heliotropium ovalifolium
Heliotropium paniculatum
Heliotropium tenuifolium
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 128 MUNRO
 No species recorded
- GRID CELL 129 MCLARTY HILLS
Halgania solanacea
Heliotropium paniculatum
Heliotropium tenuifolium
- GRID CELL 130 CROSSLAND
 No species recorded
- GRID CELL 131 MT. BANNERMAN
Heliotropium tenuifolium
- GRID CELL 132 BILLILUNA
Halgania solanacea
Heliotropium diversifolium
- GRID CELL 133 BARROW ISLAND
Heliotropium ovalifolium
Heliotropium undulatum
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 134 DAMPIER
Heliotropium ovalifolium
Heliotropium paniculatum
Heliotropium tenuifolium
Heliotropium undulatum
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 135 ROEBOURNE
Ehretia saligna
Heliotropium crispatum
Heliotropium curassavicum
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 136 PORT HEDLAND
Ehretia saligna
Heliotropium crispatum
Heliotropium curassavicum
Heliotropium heteranthum
Heliotropium ovalifolium
Heliotropium paniculatum
Heliotropium tenuifolium
Heliotropium undulatum
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 137 YARRIE
Halgania solanacea
Heliotropium asperrimum
Heliotropium epacrideum
Heliotropium ovalifolium
Heliotropium paniculatum
Heliotropium undulatum
- GRID CELL 138 ANKETELL
Halgania solanacea
Heliotropium epacrideum
- GRID CELL 139 JOANNA SPRING
Halgania solanacea
- GRID CELL 140 DUMMER
 No species recorded
- GRID CELL 141 CORNISH
Heliotropium ovalifolium
Heliotropium tenuifolium
- GRID CELL 142 LUCAS
Halgania solanacea
Heliotropium epacrideum
Heliotropium paniculatum
- GRID CELL 144 ONSLOW
Cordia subcordata
Ehretia saligna
Halgania cyanea

- GRID CELL 144 (cont.)
Heliotropium crispatum
Heliotropium curassavicum
Heliotropium tenuifolium
Heliotropium undulatum
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 145 YARRALOOLA
Cordia subcordata
Heliotropium curassavicum
- GRID CELL 146 PYRAMID
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 147 MARBLE BAR
Heliotropium crispatum
Heliotropium ovalifolium
Heliotropium paniculatum
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 148 NULLAGINE
Heliotropium cunninghamii
Heliotropium flaviflorum
Heliotropium ovalifolium
Heliotropium tenuifolium
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 149 PATERSON RANGE
 No species recorded
- GRID CELL 150 SAHARA
 No species recorded
- GRID CELL 151 PERCIVAL
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 152 HELENA
 No species recorded
- GRID CELL 153 STANSMORE
 No species recorded
- GRID CELL 154 NINGALOO
 No species recorded
- GRID CELL 155 YANREY
Halgania viscosa
Heliotropium crispatum
Heliotropium ovalifolium
Heliotropium undulatum
- GRID CELL 156 WYLOO
Heliotropium heteranthum
- GRID CELL 157 MT. BRUCE
Heliotropium cunninghamii
Heliotropium ovalifolium
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 158 ROY HILL
Heliotropium undulatum
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 159 BALFOUR DOWNS
Halgania solanacea
Heliotropium ovalifolium
- GRID CELL 160 RUDALL
Halgania solanacea
Heliotropium ovalifolium
Heliotropium paniculatum
Heliotropium strigosum
Heliotropium tenuifolium
- GRID CELL 161 TABLETOP
Heliotropium epacrideum
- GRID CELL 162 URAL
 No species recorded
- GRID CELL 163 WILSON
 No species recorded
- GRID CELL 164 WEBB
Halgania solanacea
- GRID CELL 165 MINILYA
Heliotropium undulatum
- GRID CELL 166 WINNING POOL
Halgania viscosa

- GRID CELL 167 EDMUND
Heliotropium crispatum
Heliotropium cunninghamii
Heliotropium curassavicum
Heliotropium heteranthum
Heliotropium undulatum
- GRID CELL 168 TUREE CREEK
 No species recorded
- GRID CELL 169 NEWMAN
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 170 ROBERTSON
Halgania solanacea
Heliotropium ovalifolium
- GRID CELL 171 GUNANYA
 No species recorded
- GRID CELL 172 RUNTON
Heliotropium bacciferum
- GRID CELL 173 MORRIS
 No species recorded
- GRID CELL 174 RYAN
 No species recorded
- GRID CELL 175 MACDONALD
Heliotropium epacrideum
- GRID CELL 176 QUOBBA
Heliotropium curassavicum
Heliotropium undulatum
- GRID CELL 177 KENNEDY RANGE
Halgania sericiflora
Heliotropium curassavicum
Heliotropium undulatum
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 178 MT. PHILLIPS
Heliotropium conocarpum
Heliotropium heteranthum
- GRID CELL 178 (cont.)
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 179 MT. EGERTON
Halgania gustafsenii
- GRID CELL 180 COLLIER
Halgania glabra
Halgania gustafsenii
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 181 BULLEN
 No species recorded
- GRID CELL 182 TRAINOR
 No species recorded
- GRID CELL 183 MADLEY
 No species recorded
- GRID CELL 184 WARRI
 No species recorded
- GRID CELL 185 COBB
 No species recorded
- GRID CELL 186 RAWLINSON
Halgania glabra
Halgania gustafsenii
Halgania solanacea
Heliotropium epacrideum
Heliotropium ovalifolium
Heliotropium paniculatum
Heliotropium pleiopterum
Heliotropium tenuifolium
- GRID CELL 187 SHARK BAY
Halgania littoralis
Heliotropium undulatum
- GRID CELL 188 WOORAMEL
Heliotropium undulatum
Trichodesma zeylanicum
 var. *zeylanicum*

- GRID CELL 189 GLENBURGH
Halgania glabra
- GRID CELL 190 ROBINSON RANGE
Trichodesma zeylanicum
var. *zeylanicum*
- GRID CELL 191 PEAK HILL
Heliotropium heteranthum
- GRID CELL 192 NABBERU
No species recorded
- GRID CELL 193 STANLEY
No species recorded
- GRID CELL 194 HERBERT
Halgania glabra
Trichodesma zeylanicum
var. *zeylanicum*
- GRID CELL 195 BROWNE
Halgania solanacea
Heliotropium heteranthum
- GRID CELL 196 BENTLEY
Halgania glabra
Halgania solanacea
- GRID CELL 197 SCOTT
Halgania erecta
Omphalolappula concava
Trichodesma zeylanicum
var. *zeylanicum*
- GRID CELL 201 EDEL
Halgania littoralis
Halgania viscosa
- GRID CELL 202 YARINGA
No species recorded
- GRID CELL 203 BYRO
Trichodesma zeylanicum
var. *zeylanicum*
- GRID CELL 204 BELELE
Halgania glabra
Heliotropium heteranthum
Heliotropium ovalifolium
Plagiobothrys australasicus
Trichodesma zeylanicum
var. *zeylanicum*
- GRID CELL 205 GLENGARRY
Halgania cyanea
Halgania gustafsenii
Heliotropium ovalifolium
- GRID CELL 206 WILUNA
Halgania cyanea
Heliotropium curassavicum
Heliotropium heteranthum
Trichodesma zeylanicum
var. *zeylanicum*
- GRID CELL 207 KINGSTON
Heliotropium heteranthum
- GRID CELL 208 ROBERT
No species recorded
- GRID CELL 209 YOWALGA
Halgania gustafsenii
Halgania solanacea
- GRID CELL 210 TALBOT
Halgania glabra
Halgania solanacea
Heliotropium ovalifolium
Omphalolappula concava
- GRID CELL 211 COOPER
Cynoglossum australe
Heliotropium asperrimum
Heliotropium paniculatum
Omphalolappula concava
- GRID CELL 213 AJANA
**Echium plantagineum*
Halgania argyrophylla
Halgania bebrana
Halgania preissiana
Halgania sericiflora

- GRID CELL 214 MURGOO
Heliotropium curassavicum
Plagiobothrys australasicus
- GRID CELL 215 CUE
Halgania preissiana
Heliotropium undulatum
Omphalolappula concava
- GRID CELL 216 SANDSTONE
Halgania cyanea
Halgania viscosa
- GRID CELL 217 SIR SAMUEL
Halgania preissiana
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 218 DUKETON
Halgania cyanea
- GRID CELL 219 THROSSELL
 No species recorded
- GRID CELL 220 WESTWOOD
 No species recorded
- GRID CELL 221 LENNIS
 No species recorded
- GRID CELL 222 WAIGEN
 No species recorded
- GRID CELL 223 HOUTMAN ABROLHOS
Cynoglossum australe
- GRID CELL 224 GERALDTON
**Buglossoides arvensis*
Halgania argyrophylla
Halgania bebrana
Halgania preissiana
Halgania sericiflora
Heliotropium curassavicum
Heliotropium undulatum
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 225 YALGOO
Halgania argyrophylla
Halgania preissiana
Halgania sericiflora
Halgania solanacea
Heliotropium curassavicum
Omphalolappula concava
- GRID CELL 226 KIRKALOCKA
 No species recorded
- GRID CELL 227 YOUANMI
Halgania viscosa
- GRID CELL 228 LEONORA
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 229 LAVERTON
Trichodesma zeylanicum
 var. *zeylanicum*
- GRID CELL 230 RASON
 No species recorded
- GRID CELL 231 NEALE
 No species recorded
- GRID CELL 232 VERNON
 No species recorded
- GRID CELL 233 WANNA
 No species recorded
- GRID CELL 234 DONGARA
**Echium plantagineum*
Halgania preissiana
Heliotropium undulatum
- GRID CELL 235 PERENJORI
Halgania cyanea
Halgania preissiana
Halgania solanacea
Omphalolappula concava
- GRID CELL 236 NINGHAN
Halgania solanacea

- GRID CELL 237 BARLEE
No species recorded
- GRID CELL 238 MENZIES
Halgania cyanea
Plagiobothrys australasicus
- GRID CELL 239 EDJUDINA
No species recorded
- GRID CELL 240 MINIGWAL
No species recorded
- GRID CELL 241 PLUMRIDGE
No species recorded
- GRID CELL 242 JUBILEE
No species recorded
- GRID CELL 243 MASON
No species recorded
- GRID CELL 244 HILL RIVER
No species recorded
- GRID CELL 245 MOORA
**Echium plantagineum*
Halgania lavandulacea
Halgania littoralis
Halgania preissiana
- GRID CELL 246 BENCUBBIN
Halgania cyanea
Halgania lavandulacea
Halgania preissiana
Halgania viscosa
Trichodesma zeylanicum
var. *zeylanicum*
- GRID CELL 247 JACKSON
No species recorded
- GRID CELL 248 KALGOORLIE
**Buglossoides arvensis*
**Echium plantagineum*
Halgania andromedifolia
Halgania cyanea
- GRID CELL 248 (cont.)
Halgania rigida
Halgania viscosa
Omphalolappula concava
Trichodesma zeylanicum
var. *zeylanicum*
- GRID CELL 249 KURNALPI
Halgania cyanea
Halgania rigida
Heliotropium asperrimum
**Heliotropium europaeum*
**Heliotropium supinum*
- GRID CELL 250 CUNDEELEE
Halgania cyanea
- GRID CELL 251 SEEMORE
Halgania viscosa
Omphalolappula concava
- GRID CELL 252 LOONGANA
No species recorded
- GRID CELL 253 FORREST
Omphalolappula concava
- GRID CELL 255 PERTH
**Amsinckia calycina*
**Buglossoides arvensis*
**Echium plantagineum*
Halgania andromedifolia
Halgania corymbosa
Halgania lavandulacea
Halgania preissiana
Heliotropium curassavicum
**Heliotropium europaeum*
Myosotis australis
**Symphytum officinale*
- GRID CELL 256 KELLERBERRIN
**Amsinckia lycopsoides*
**Buglossoides arvensis*
Halgania andromedifolia
Halgania cyanea
Halgania lavandulacea
Halgania preissiana
Halgania rigida

- GRID CELL 257 SOUTHERN CROSS
**Echium plantagineum*
Halgania andromedifolia
Halgania cyanea
Halgania lavandulacea
Halgania preissiana
Halgania tomentosa
Halgania viscosa
**Heliotropium europaeum*
- GRID CELL 258 BOORABBIN
Halgania andromedifolia
Halgania cyanea
Halgania lavandulacea
Halgania viscosa
- GRID CELL 259 WIDGIEMOOLTHA
Halgania cyanea
Halgania preissiana
Halgania rigida
- GRID CELL 260 ZANTHUS
 No species recorded
- GRID CELL 261 NARETHA
Omphalolappula concava
- GRID CELL 262 MADURA
Halgania andromedifolia
- GRID CELL 263 EUCLA
Omphalolappula concava
- GRID CELL 264 PINJARRA
**Anchusa capensis*
**Buglossoides arvensis*
**Echium plantagineum*
Halgania preissiana
Myosotis australis
- GRID CELL 265 CORRIGIN
**Buglossoides arvensis*
Halgania lavandulacea
Halgania preissiana
Heliotropium curassavicum
- GRID CELL 266 HYDEN
Halgania andromedifolia
Halgania lavandulacea
- GRID CELL 266 (cont.)
Halgania preissiana
Halgania tomentosa
Halgania viscosa
- GRID CELL 267 LAKE JOHNSTON
Halgania andromedifolia
Halgania lavandulacea
Halgania preissiana
- GRID CELL 268 NORSEMAN
Halgania andromedifolia
Halgania cyanea
Halgania preissiana
Halgania rigida
- GRID CELL 269 BALLADONIA
 No species recorded
- GRID CELL 270 CULVER
Halgania andromedifolia
- GRID CELL 271 BURNABBIE
Halgania andromedifolia
- GRID CELL 272 NOONAERA
 No species recorded
- GRID CELL 273 BUSSELTON
**Buglossoides arvensis*
**Echium plantagineum*
Myosotis australis
- GRID CELL 274 COLLIE
**Borago officinalis*
- GRID CELL 275 DUMBLEYUNG
**Buglossoides arvensis*
**Echium plantagineum*
Halgania cyanea
Halgania lavandulacea
Halgania preissiana
**Heliotropium europaeum*
- GRID CELL 276 NEWDEGATE
**Echium plantagineum*
Halgania andromedifolia
Halgania preissiana

GRID CELL 277 RAVENSTHORPE
Halgania andromedifolia
Halgania preissiana
Heliotropium asperrimum

GRID CELL 278 ESPERANCE
Halgania andromedifolia
Halgania preissiana

GRID CELL 279 MALCOLM
Halgania andromedifolia
Halgania preissiana

GRID CELL 280 AUGUSTA
No species recorded

GRID CELL 281 PEMBERTON
No species recorded

GRID CELL 282 MOUNT BARKER
**Borago officinalis*
**Echium plantagineum*
**Heliotropium europaeum*

GRID CELL 283 BREMER BAY
**Anchusa capensis*
Halgania andromedifolia

GRID CELL 284 MONDRAIN ISLAND
No species recorded

GRID CELL 285 CAPE ARID
No species recorded

GRID CELL 286 IRWIN INLET
No species recorded

GRID CELL 287 ALBANY
**Borago officinalis*

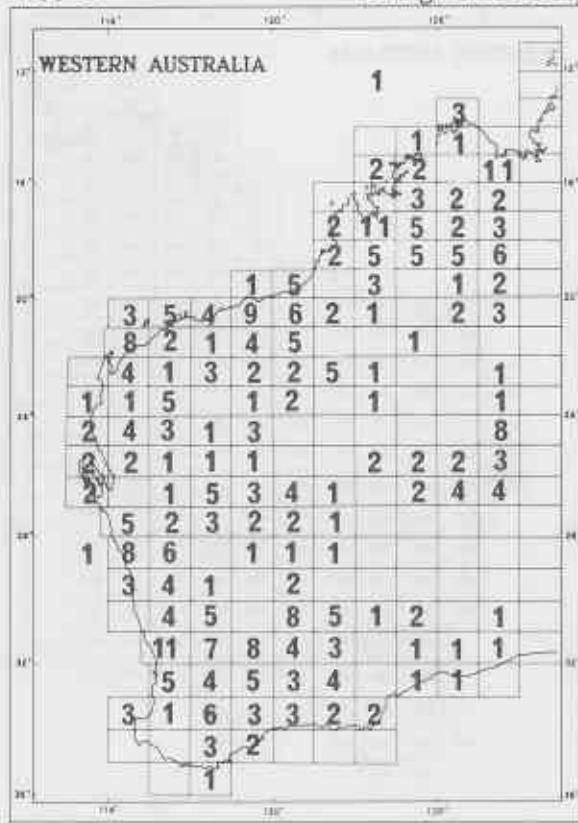


Figure 1A. Total species of Boraginaceae

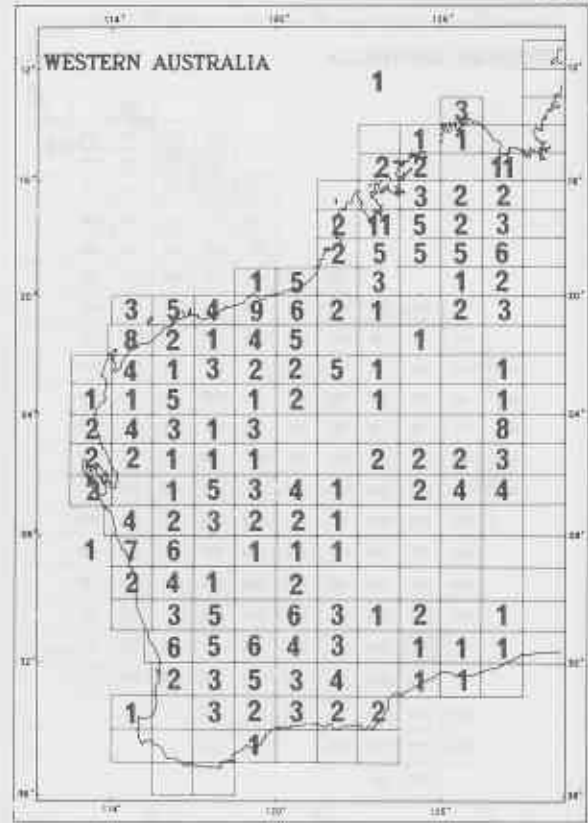


Figure 1B. Total native species of Boraginaceae

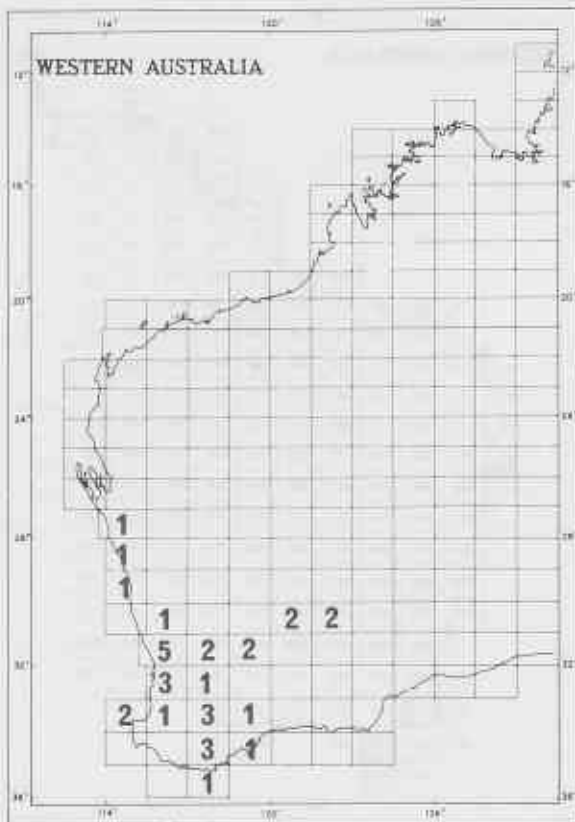


Figure 1C. Total introduced species of Boraginaceae

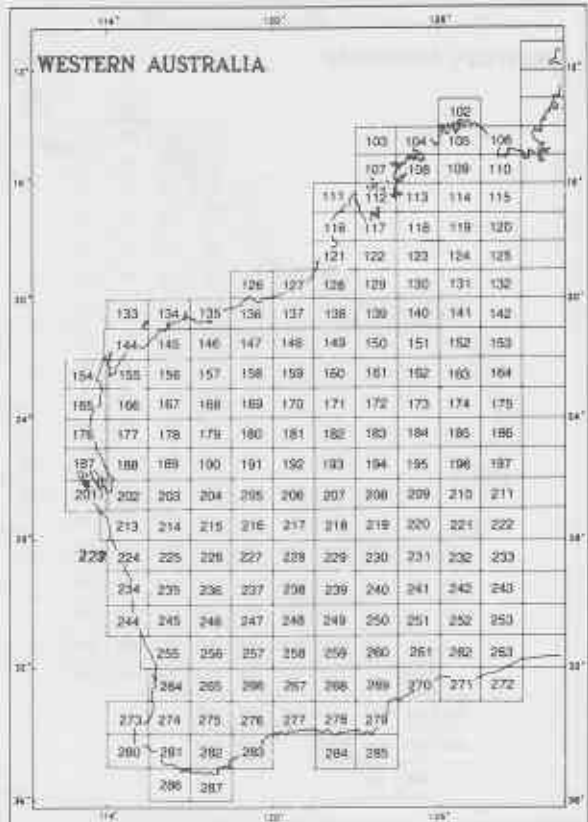
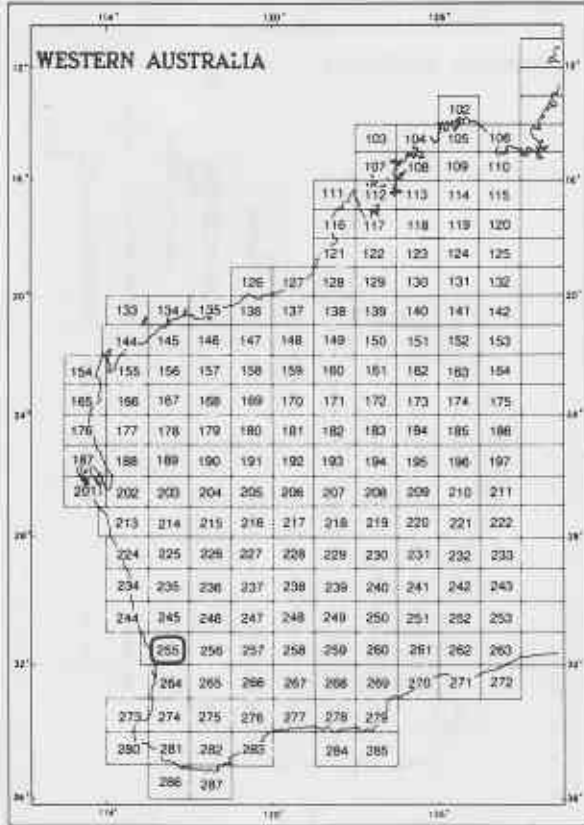
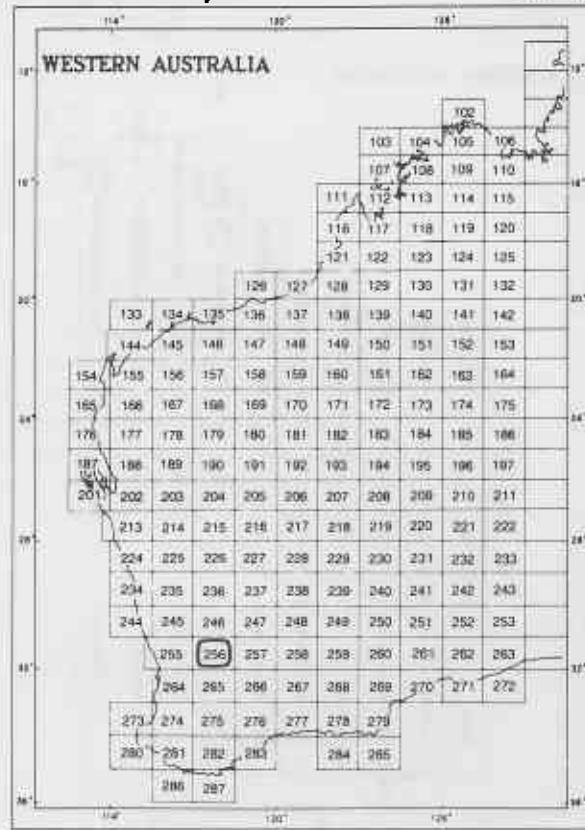


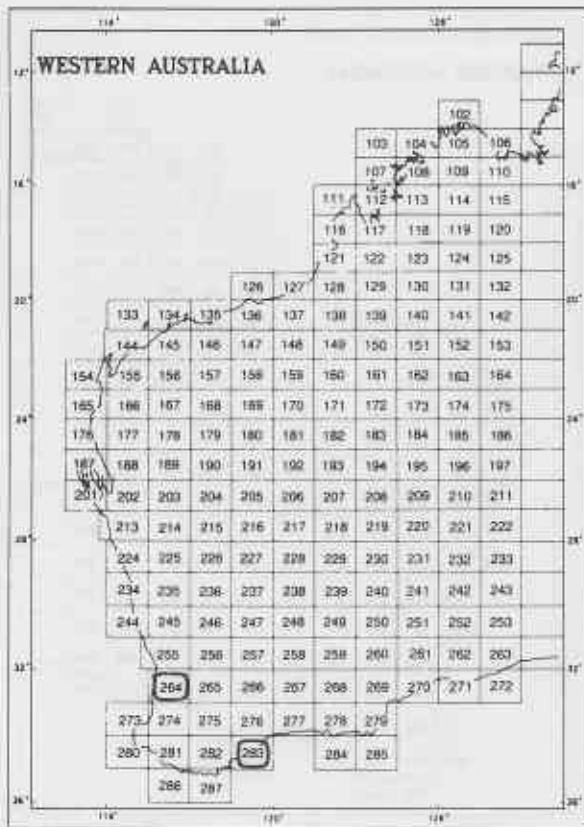
Figure 1D. Guide to grid cell numbers



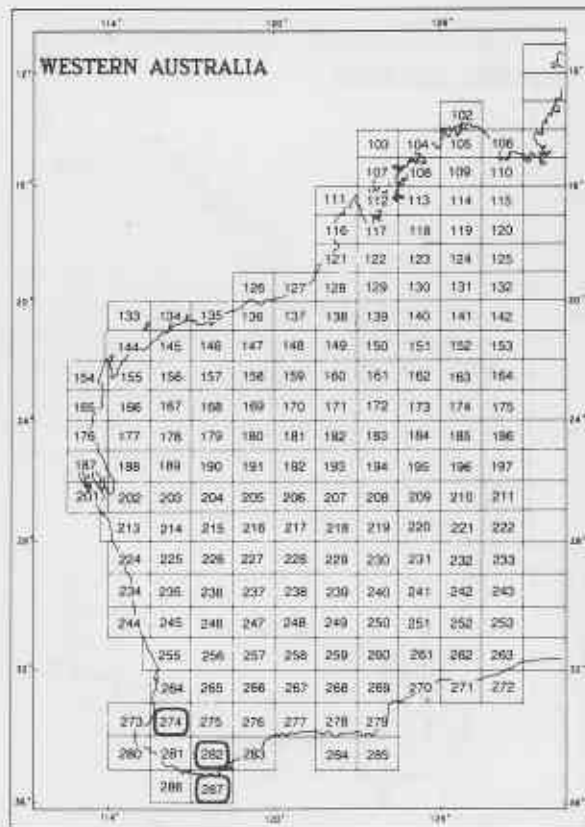
**Amsinckia calycina*



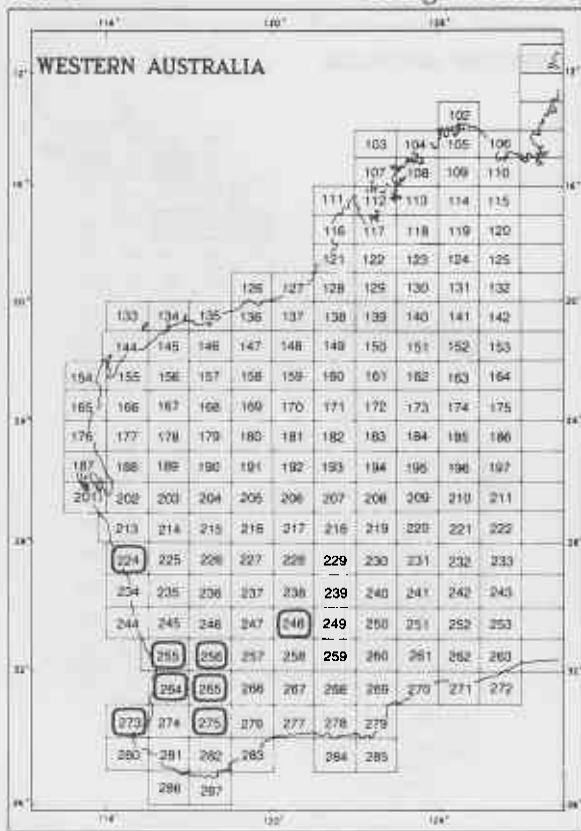
**Amsinckia lycopsoides*



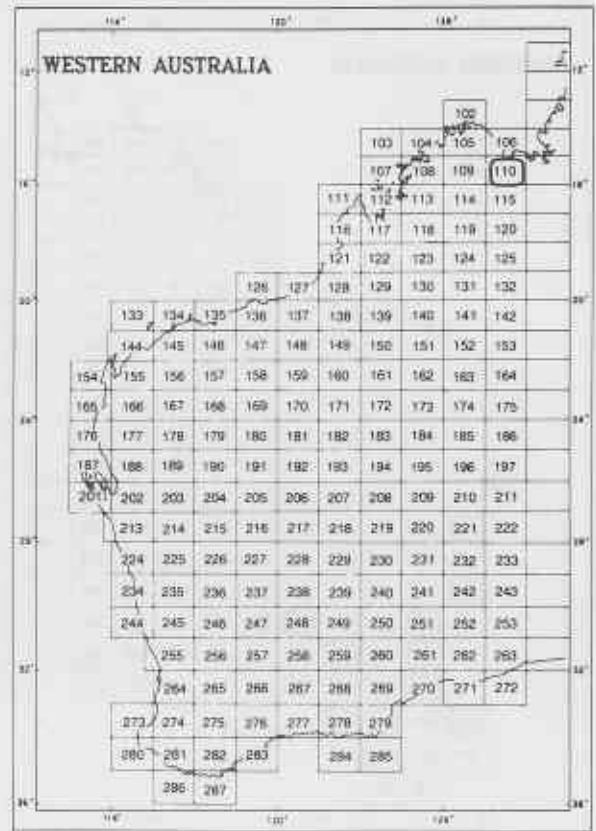
**Anchusa capensis*



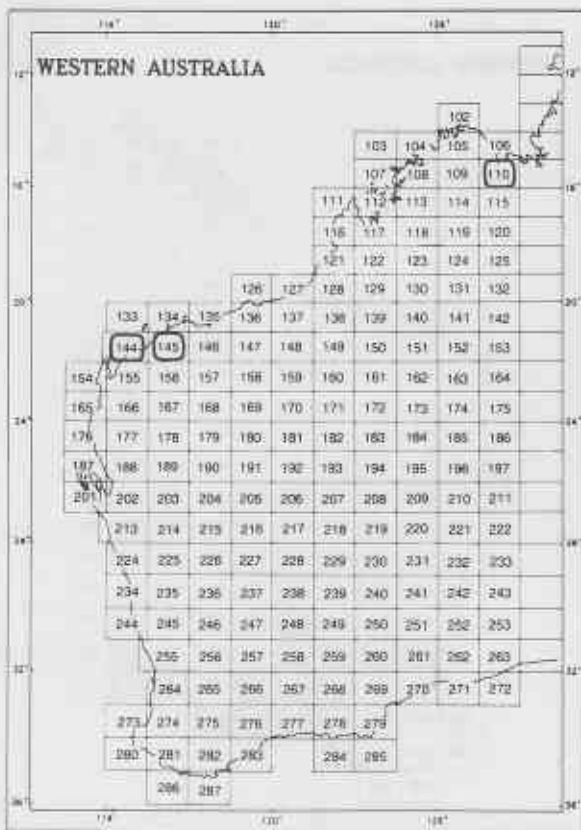
**Borago officinalis*



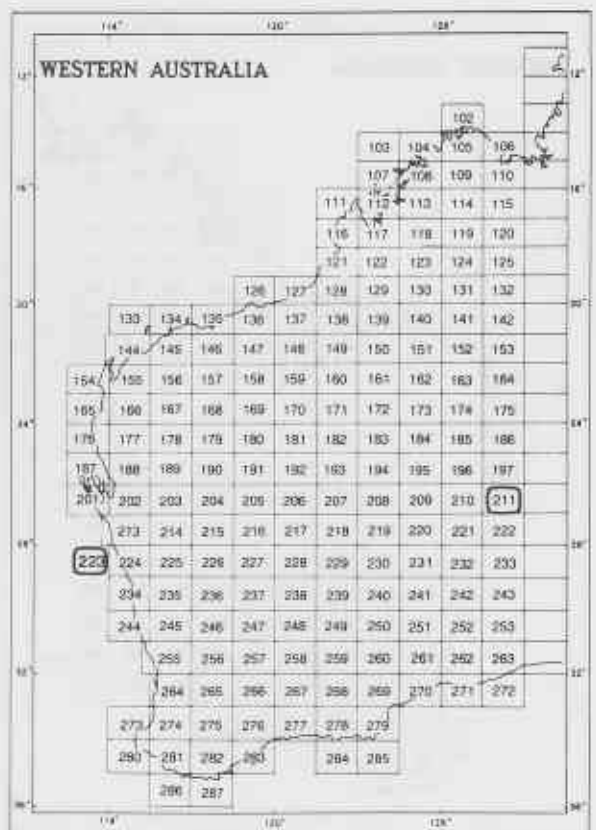
**Buglossoides arvensis*



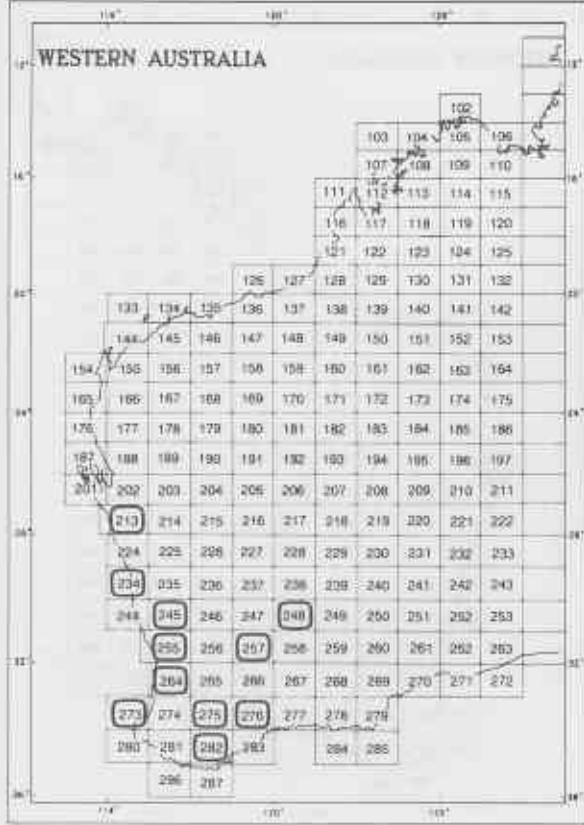
Coldenia procumbens



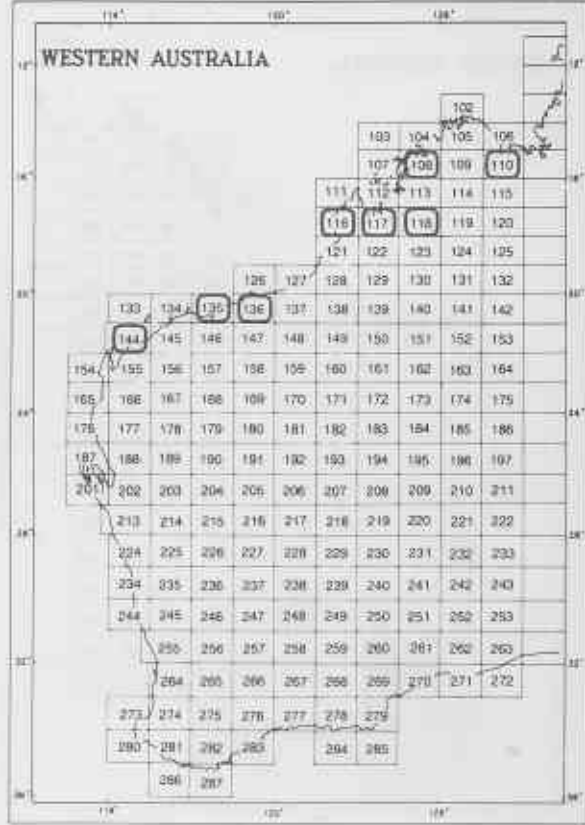
Cordia subcordata



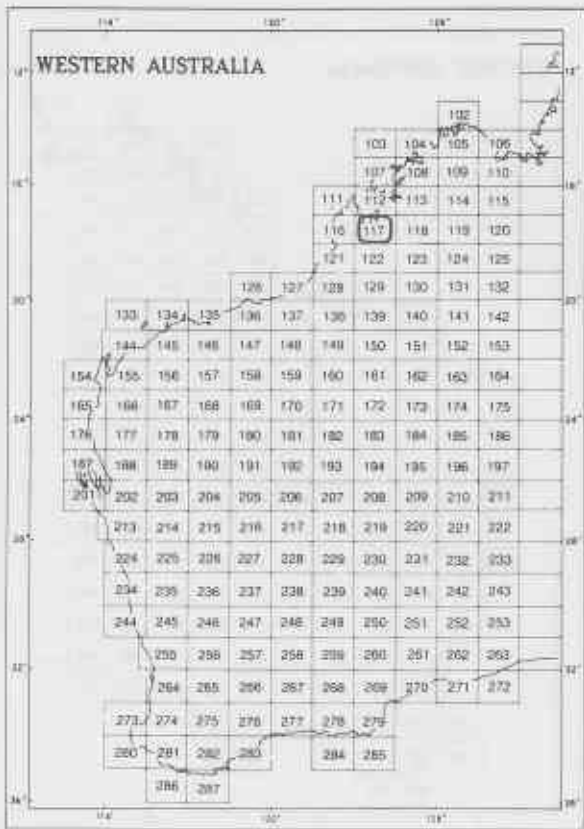
Cynoglossum australe



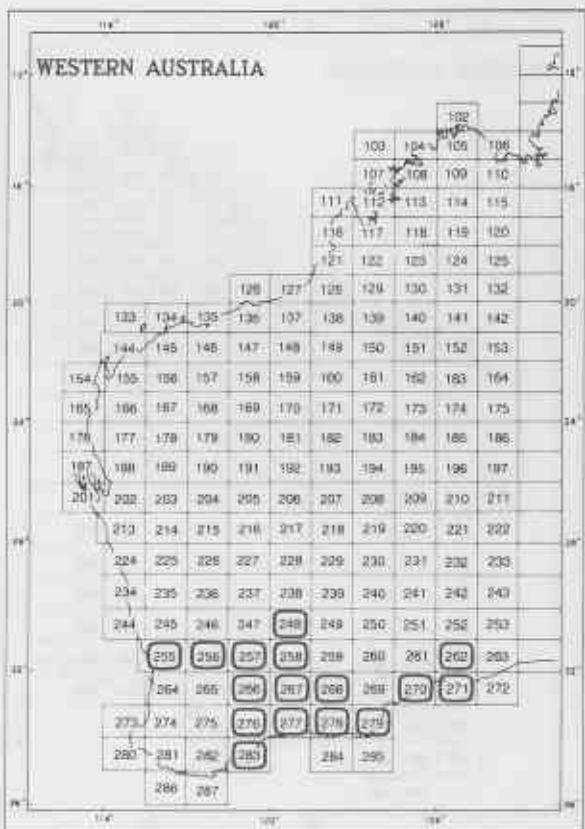
**Echium plantagineum*



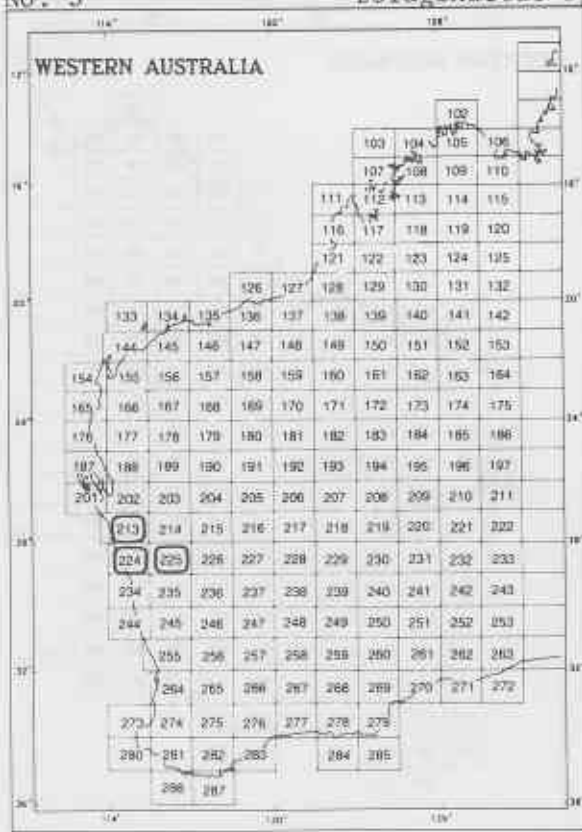
Ehretia saligna



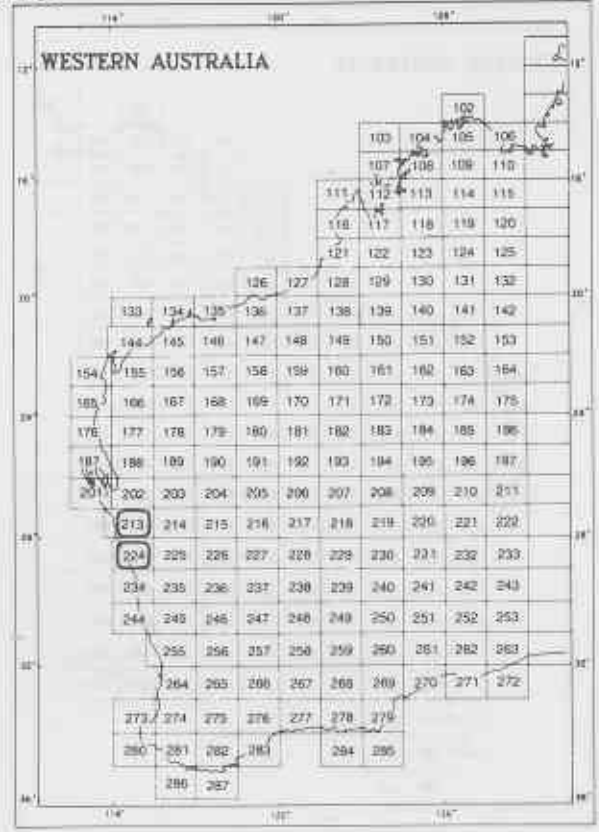
Ehretia urceolata



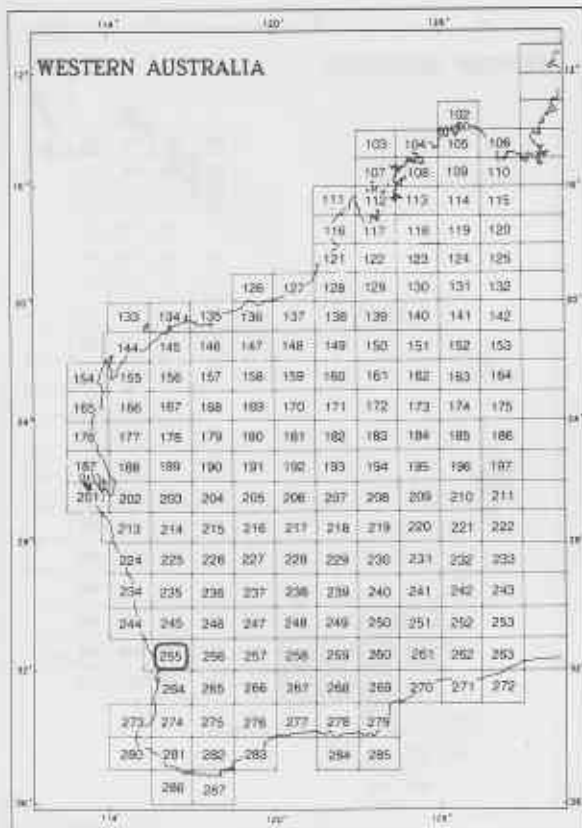
Halgania andromedifolia



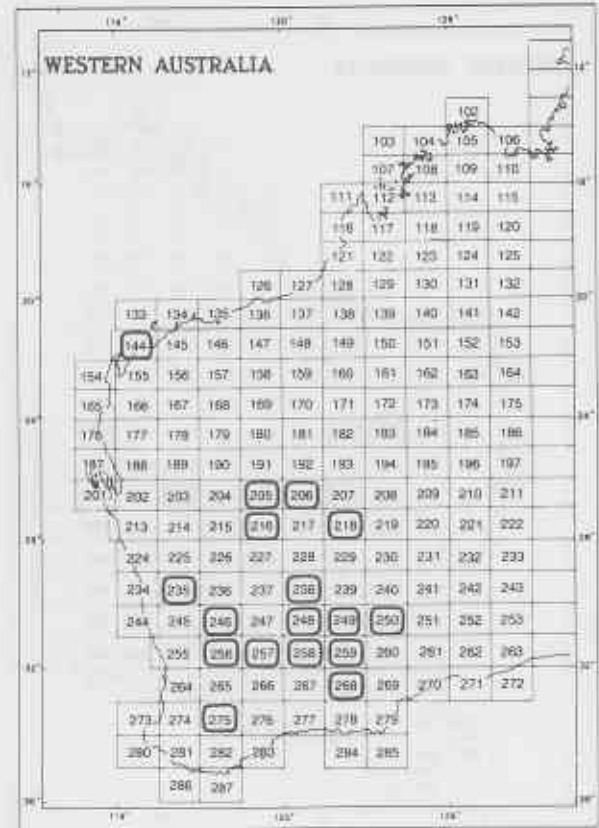
Halgania argyrophylla



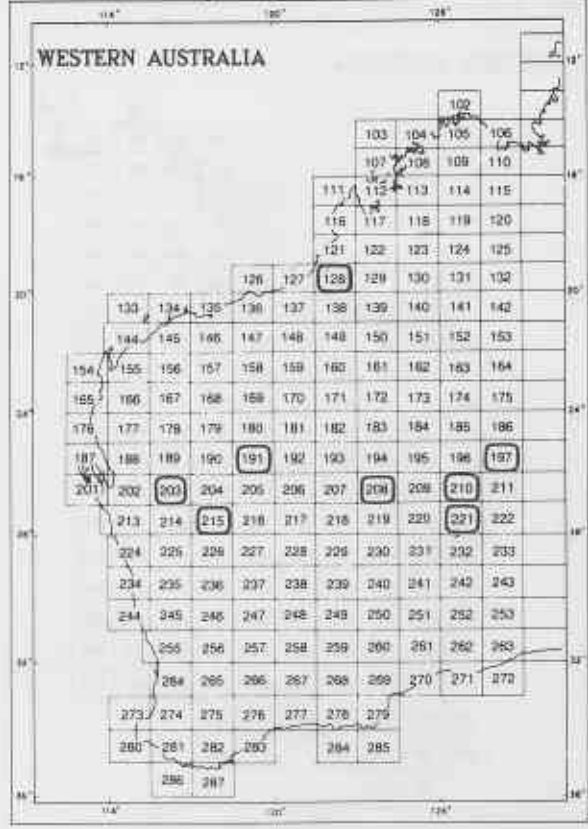
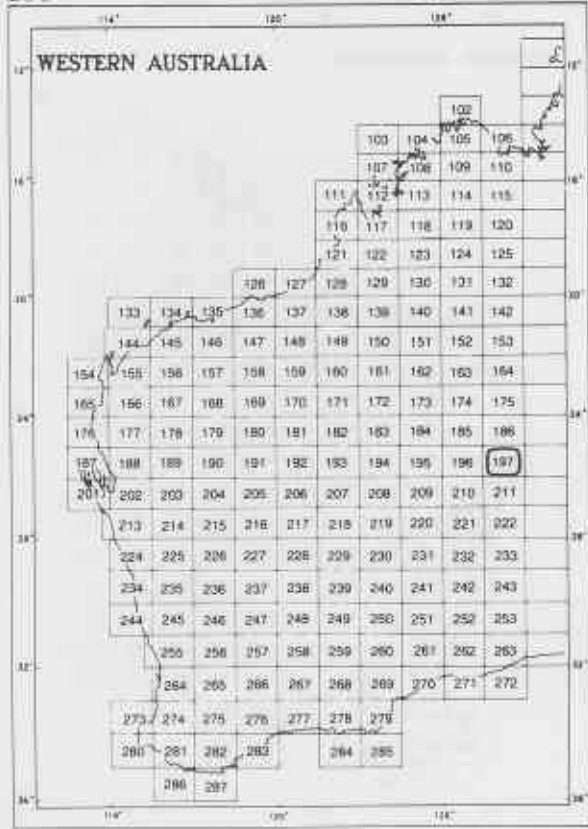
Halgania bebrana



Halgania corymbosa

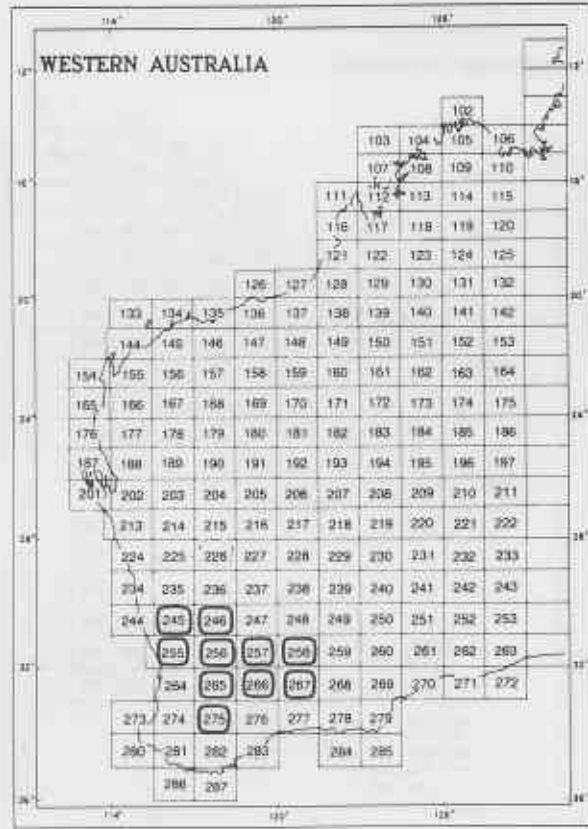
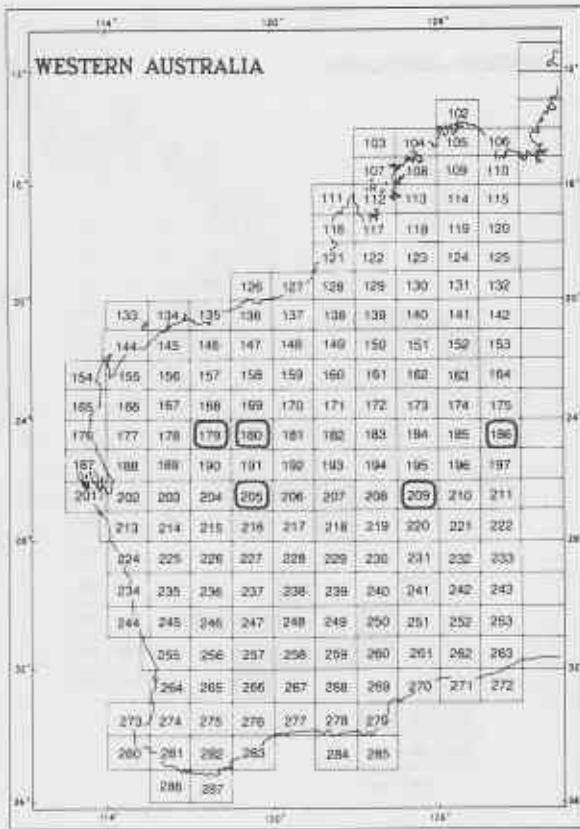


Halgania cyanea



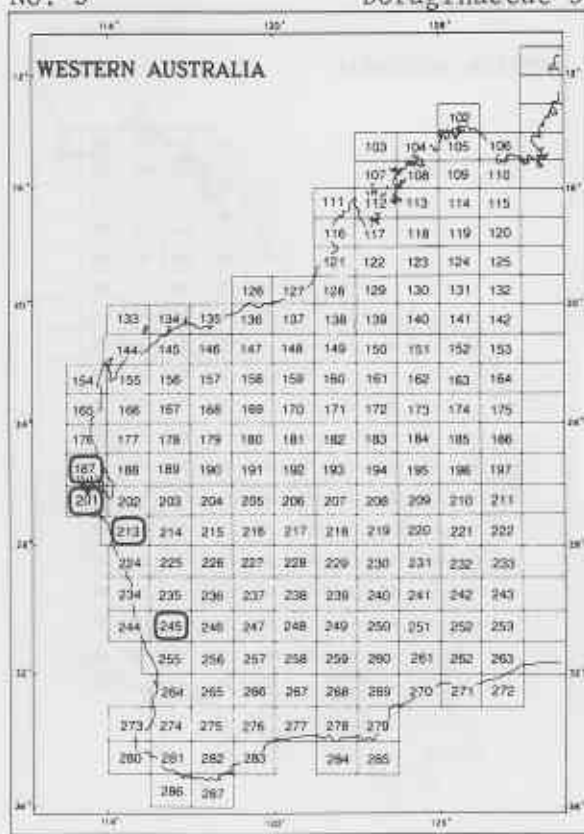
Halgania erecta

Halgania glabra

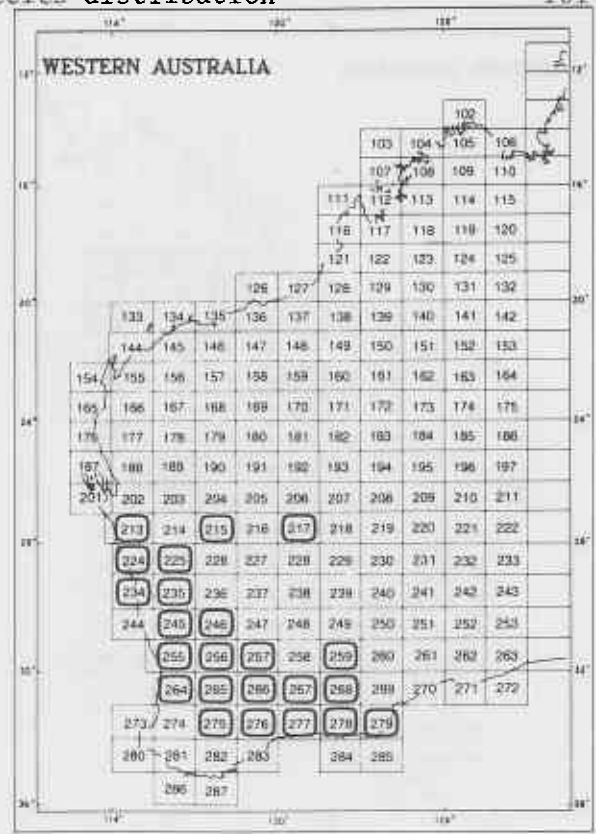


Halgania gustafsenii

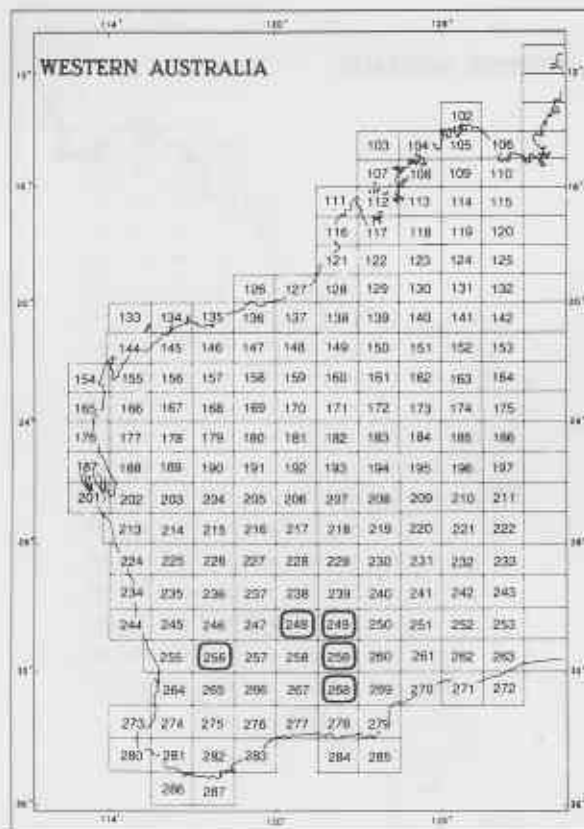
Halgania lavandulacea



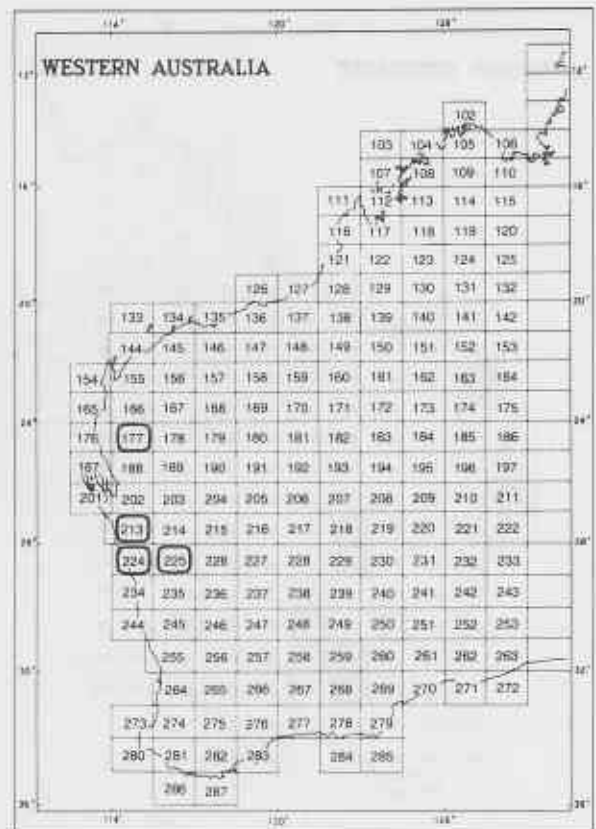
Halgania littoralis



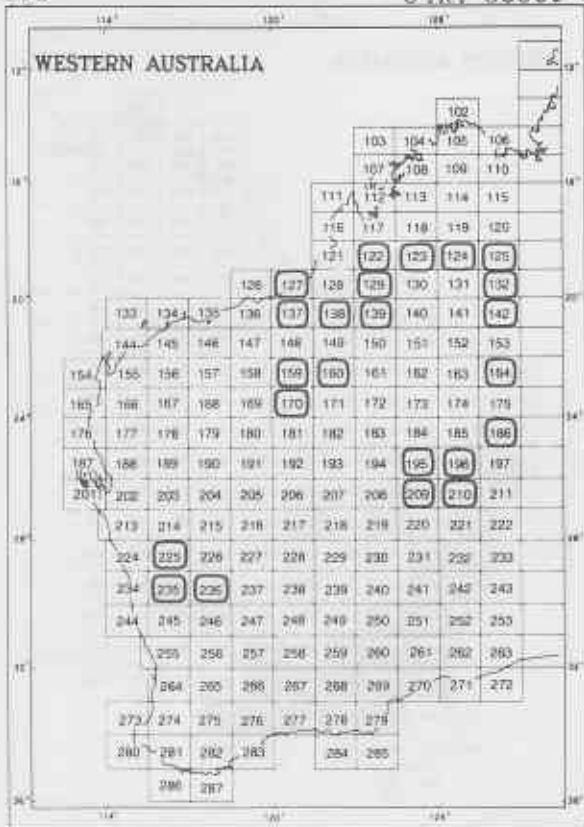
Halgania preissiana



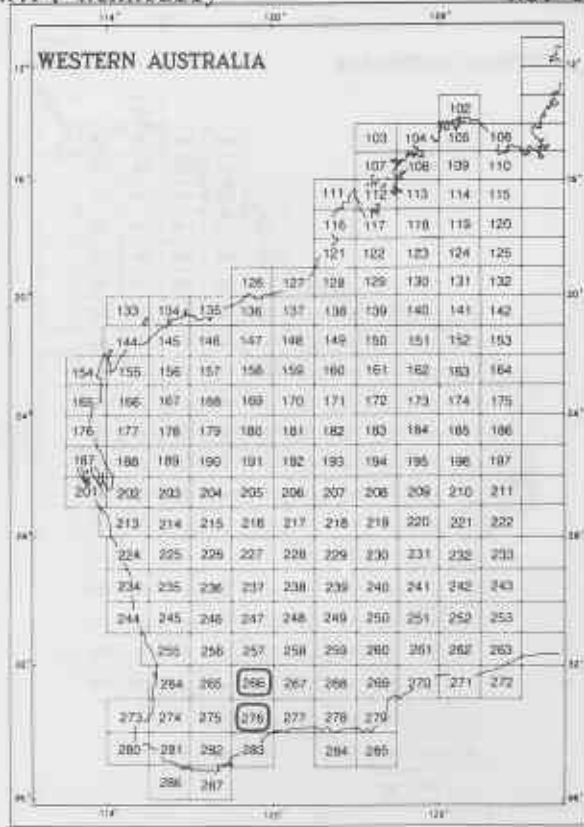
Halgania rigida



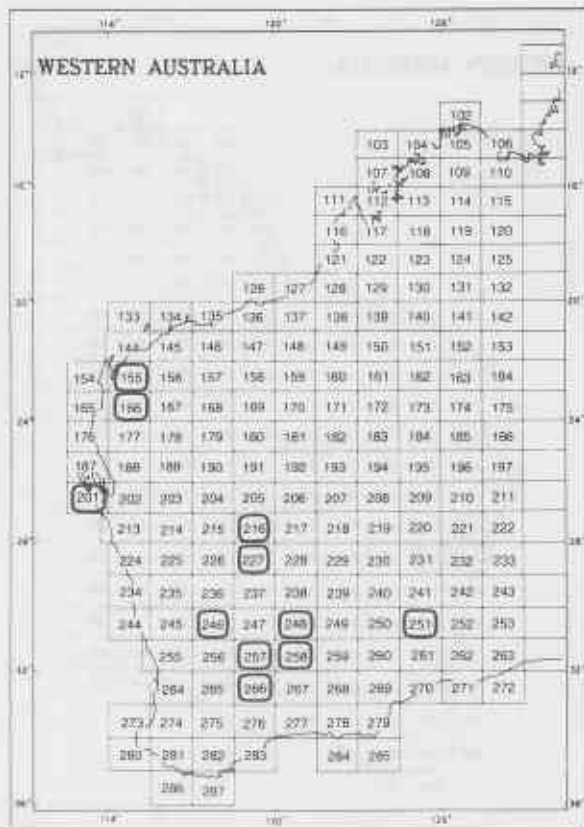
Halgania sericifolia



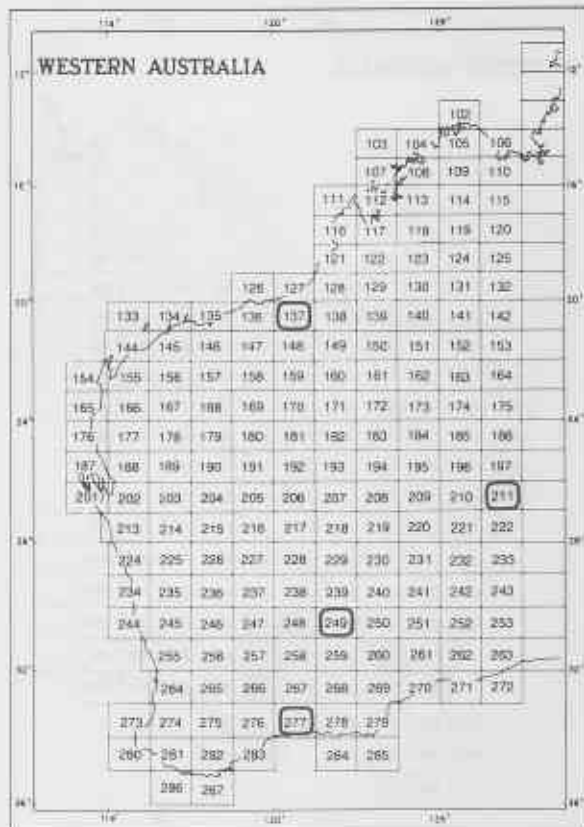
Halgania solanacea



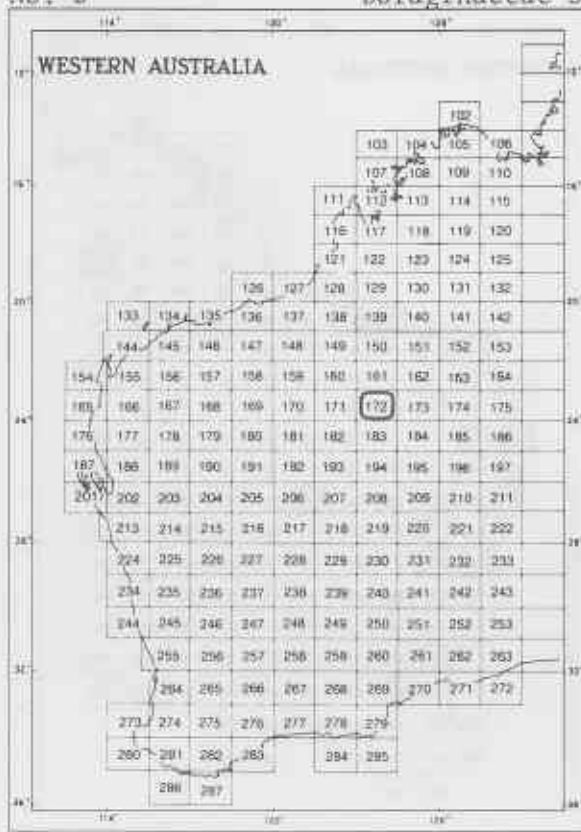
Halgania tomentosa



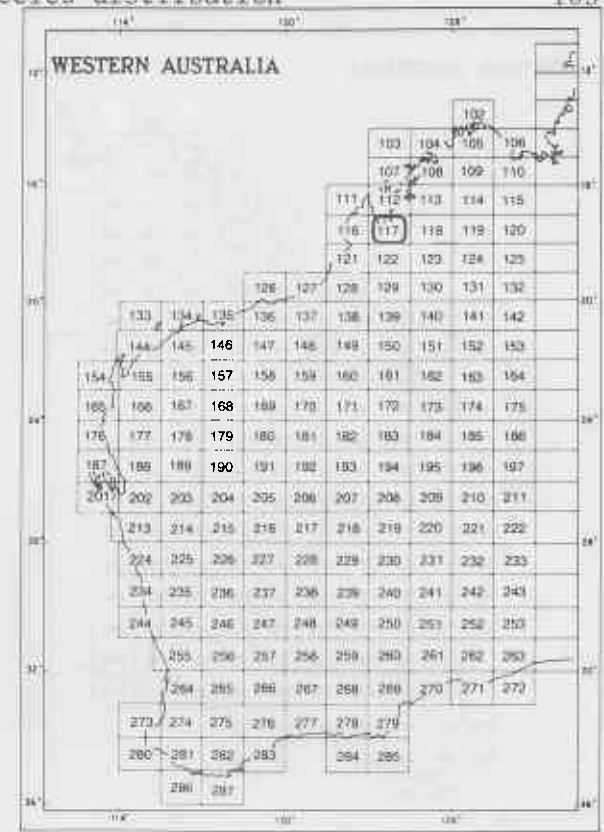
Halgania viscosa



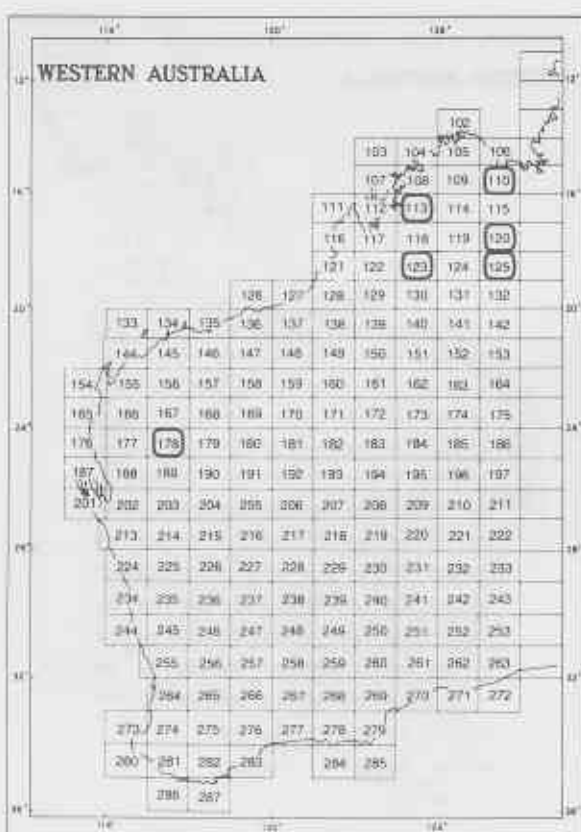
Heliotropium asperrimum



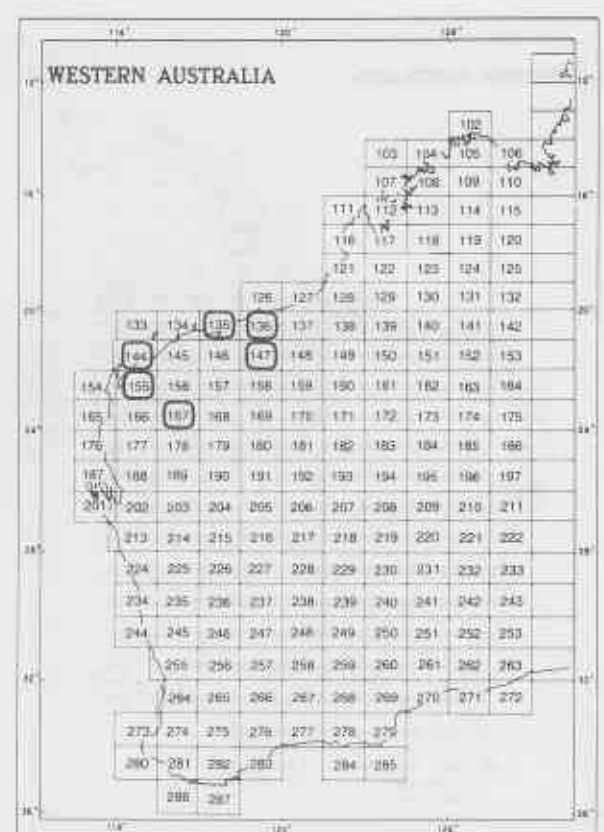
Heliotropium bacciferum



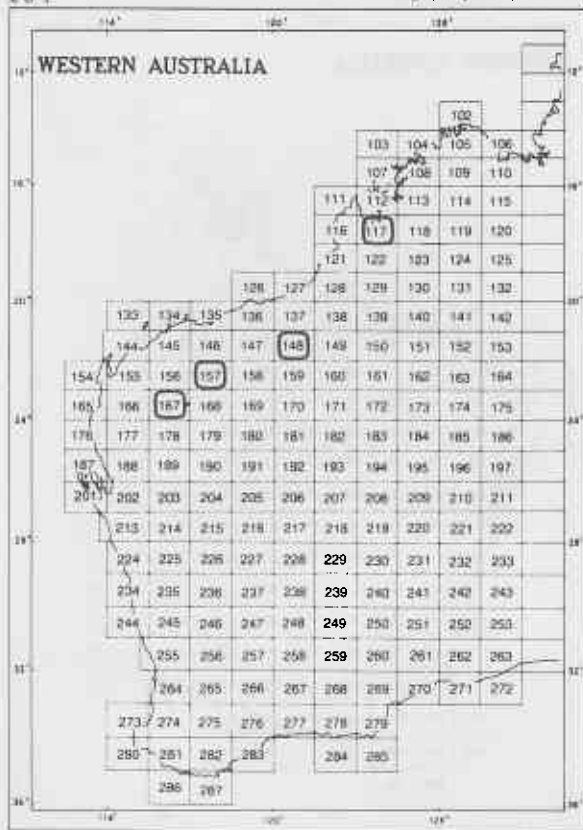
Heliotropium bracteatum



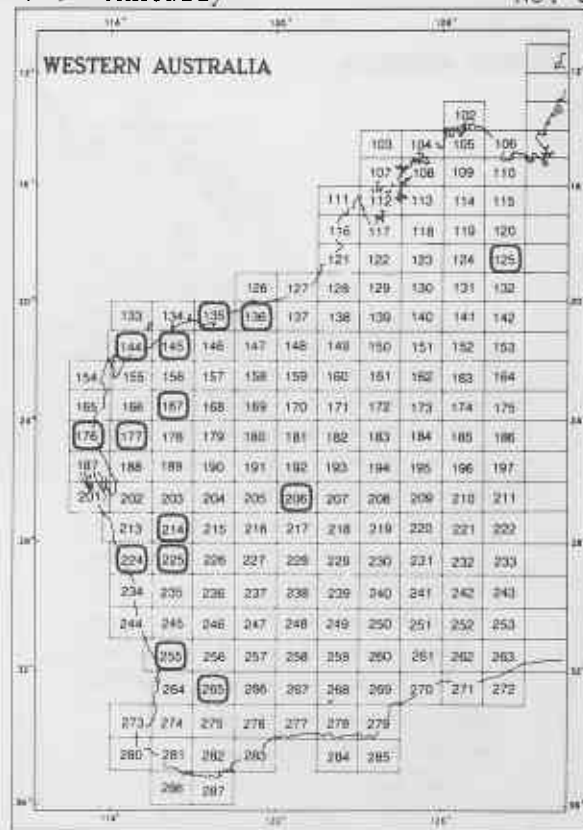
Heliotropium conocarpum



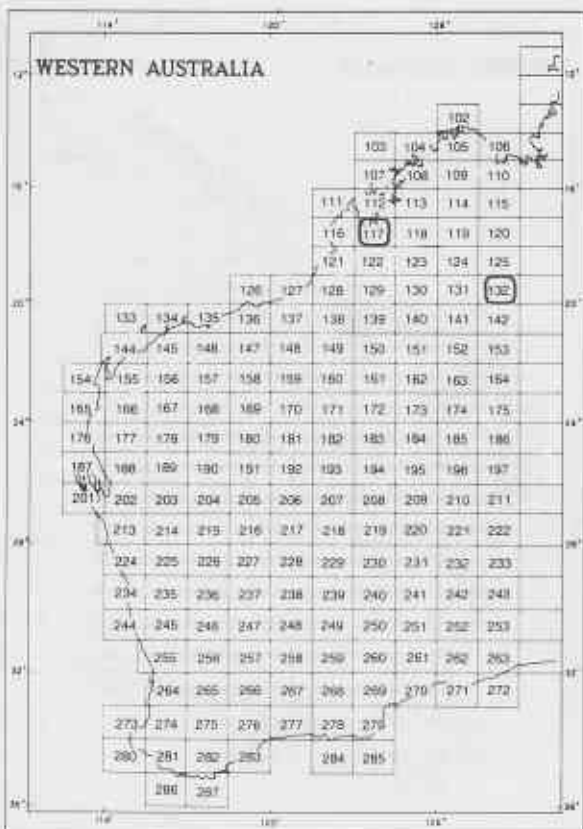
Heliotropium crispatum



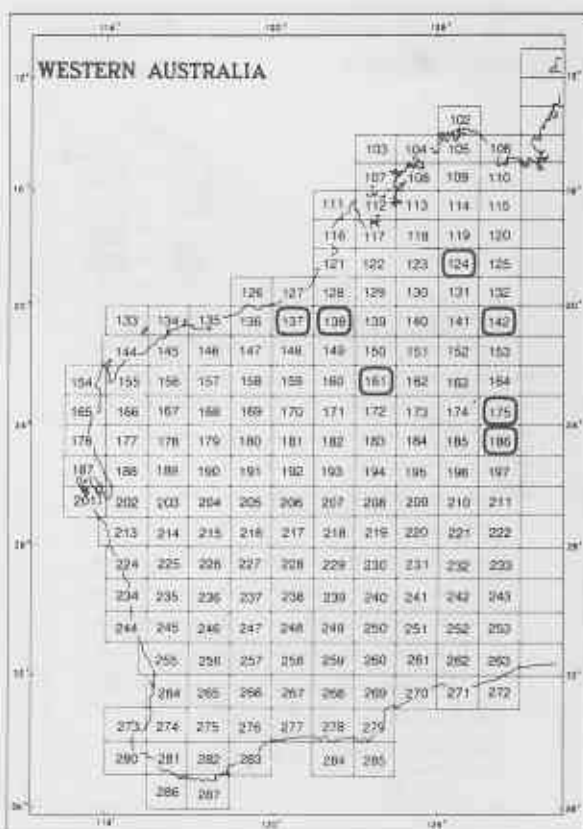
Heliotropium cunninghamii



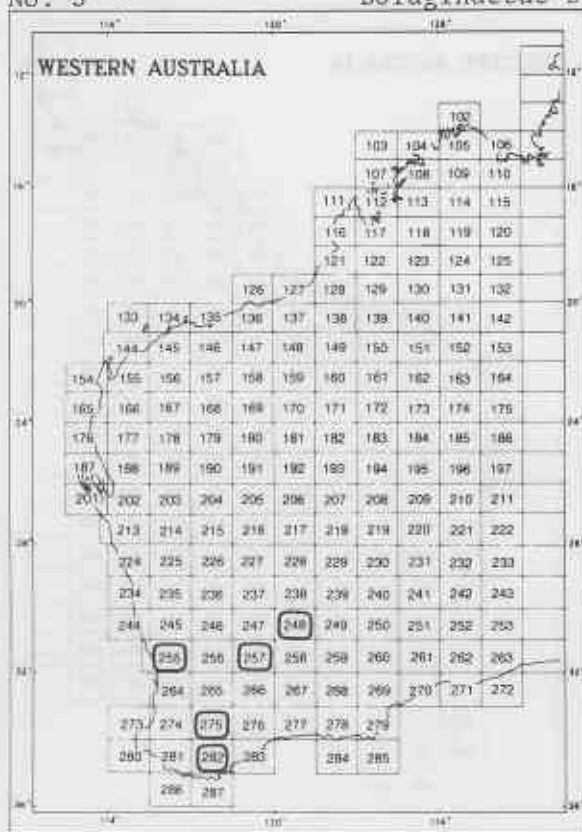
Heliotropium curassavicum



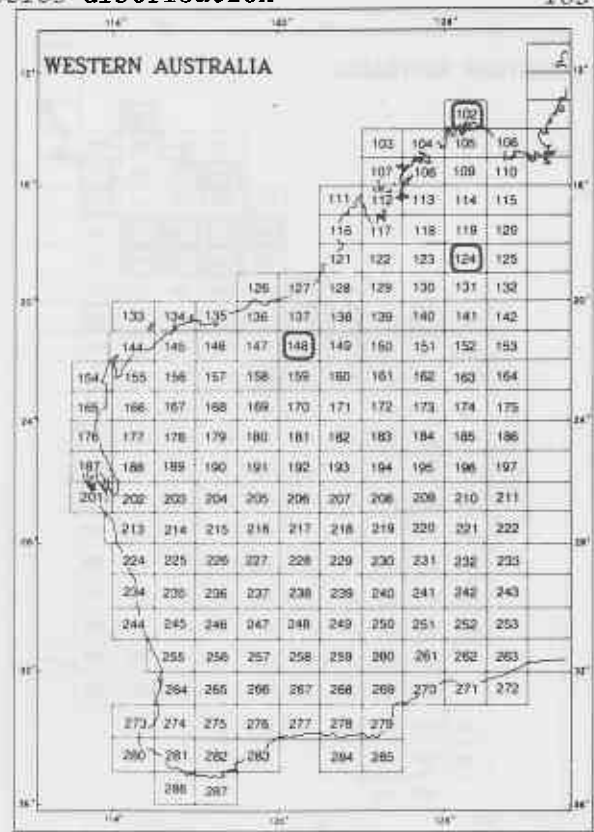
Heliotropium diversifolium



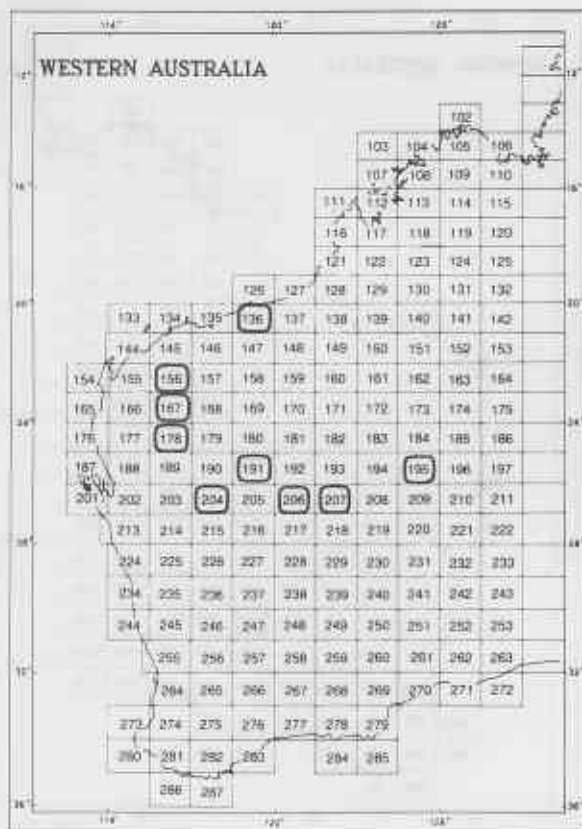
Heliotropium epacrideum



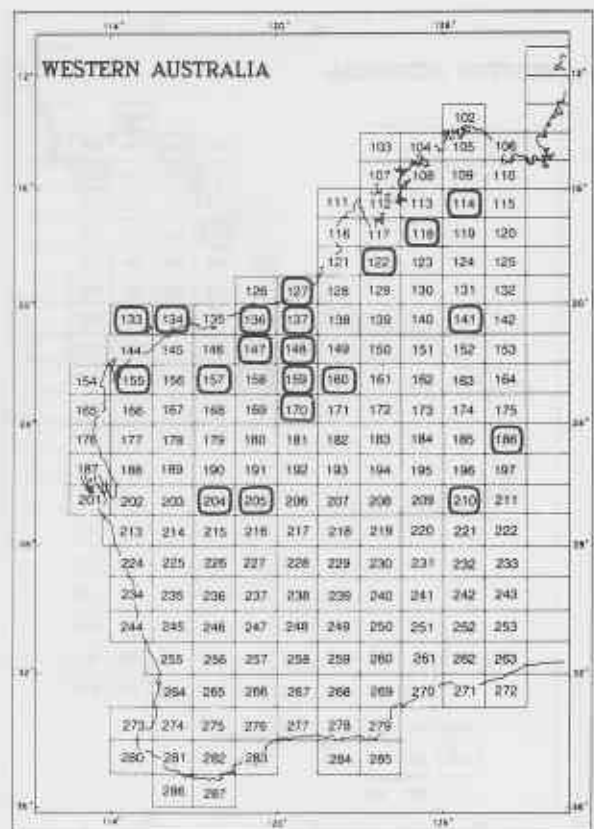
**Heliotropium europaeum*



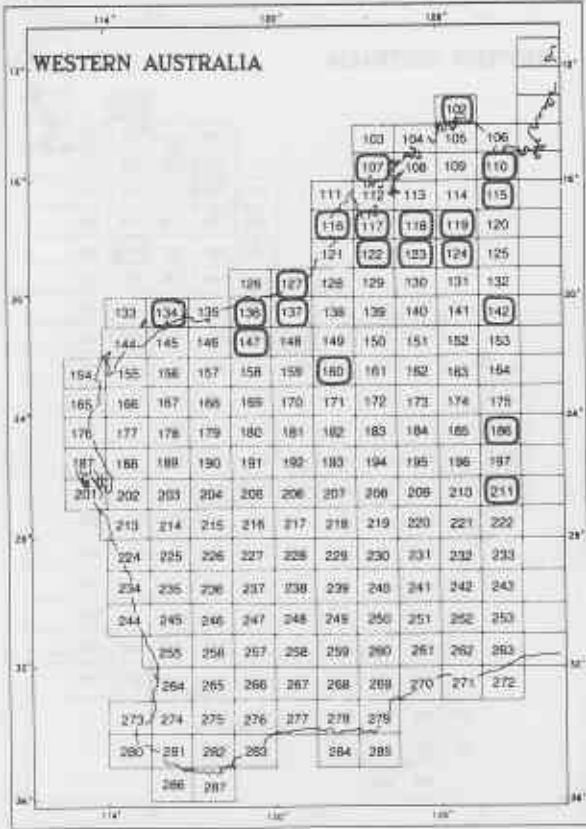
Heliotropium flaviflorum



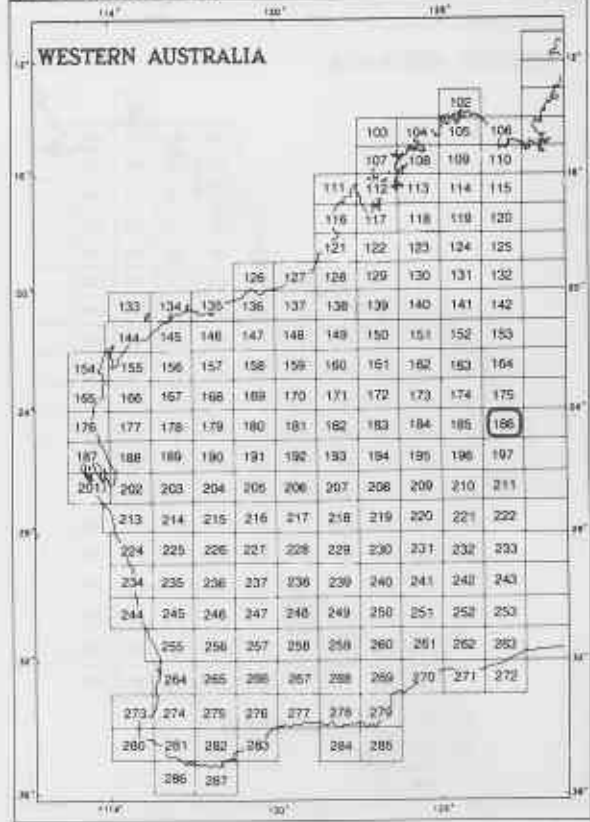
Heliotropium heteranthum



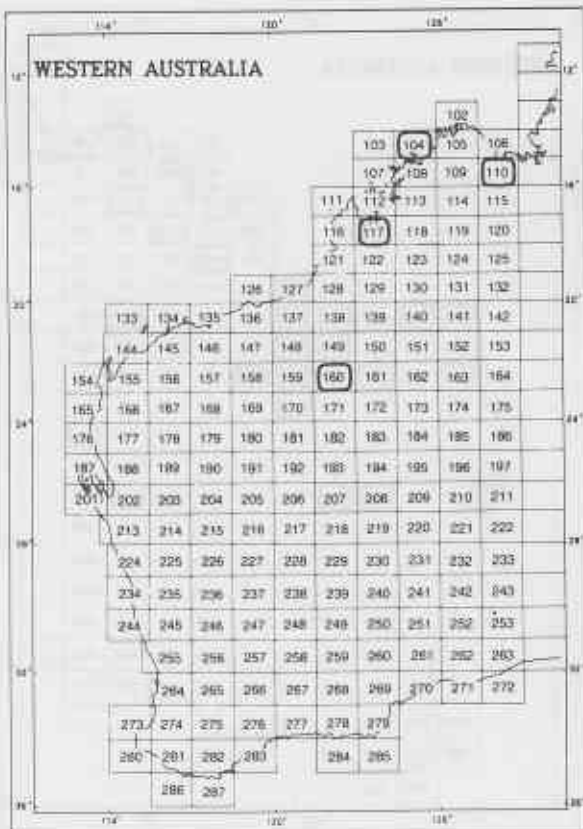
Heliotropium ovalifolium



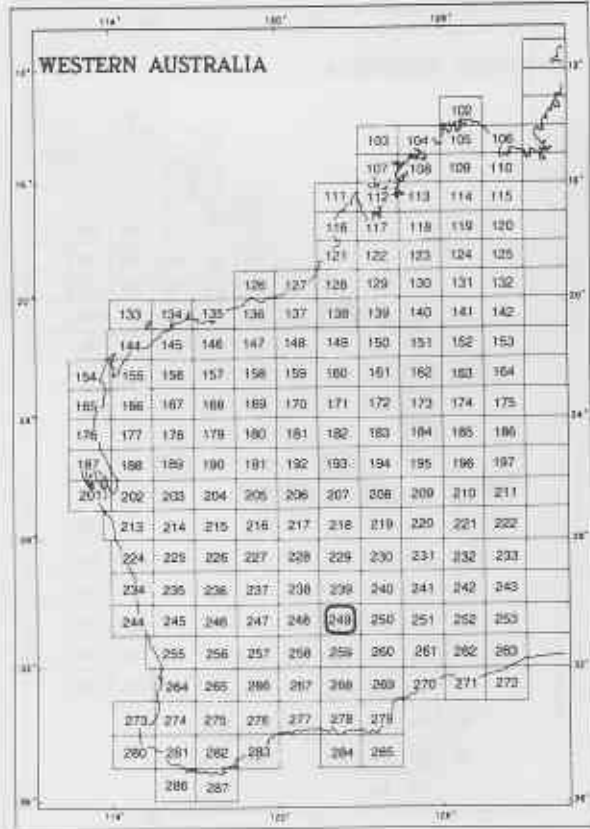
Heliotropium paniculatum



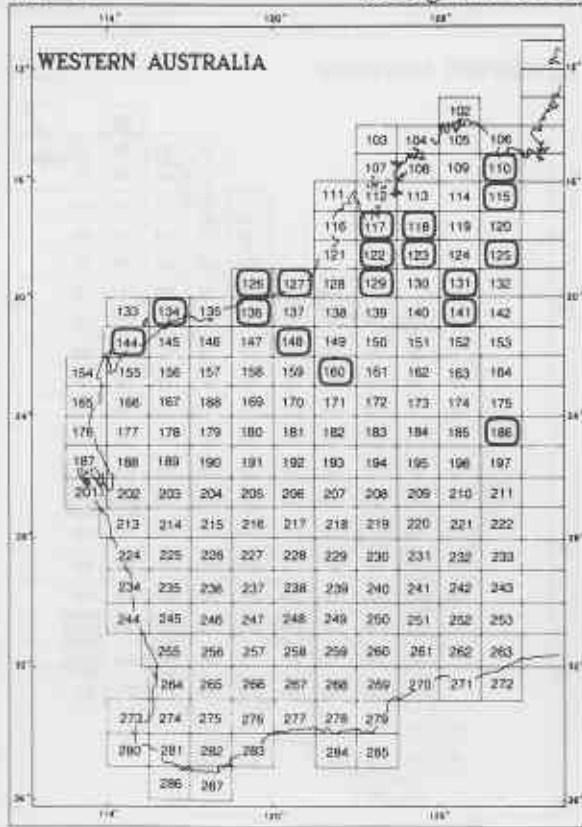
Heliotropium pleiopterum



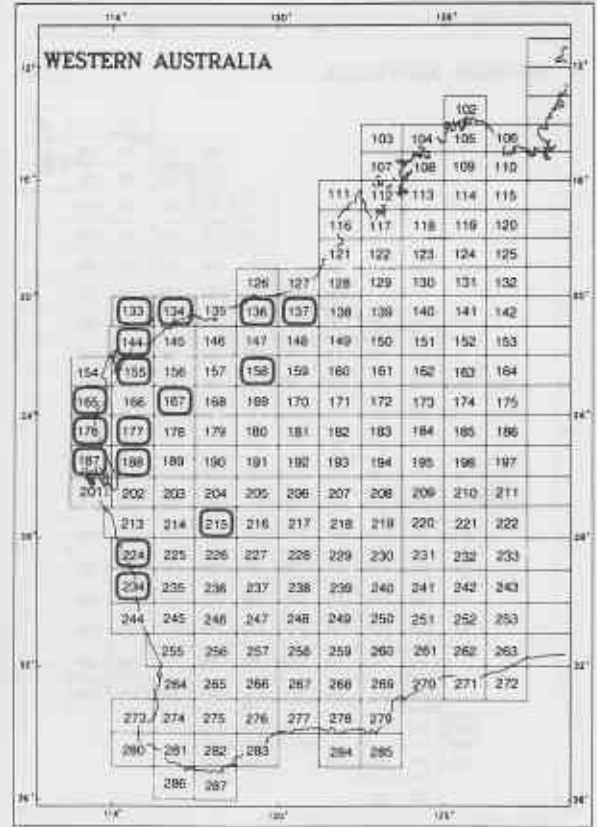
Heliotropium strigosum



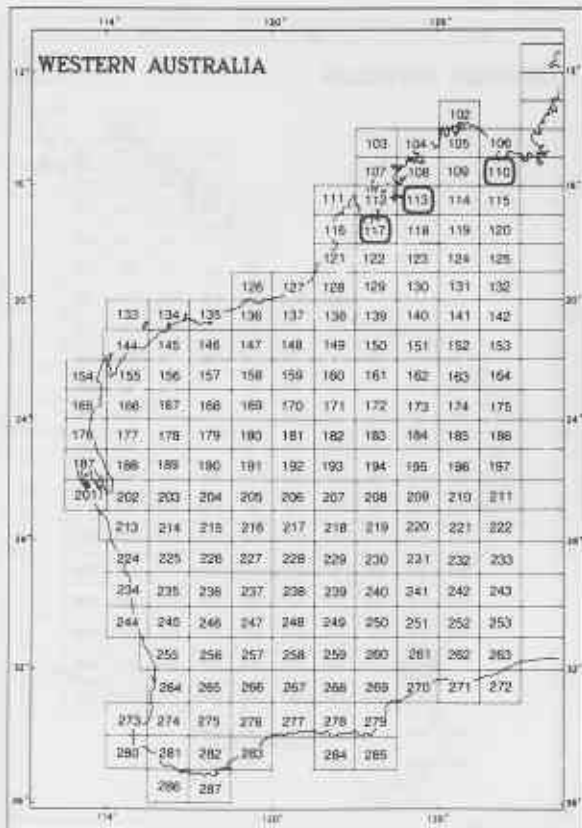
**Heliotropium supinum*



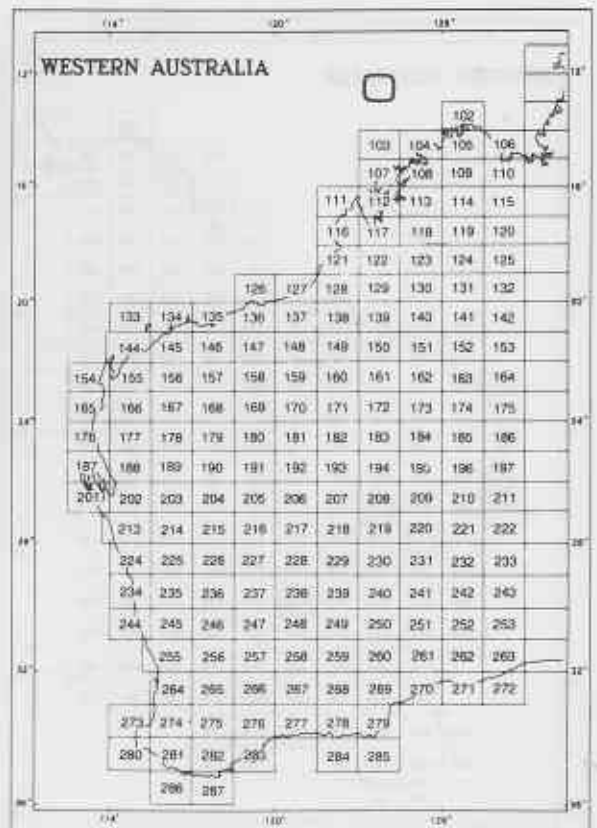
Heliotropium tenuifolium



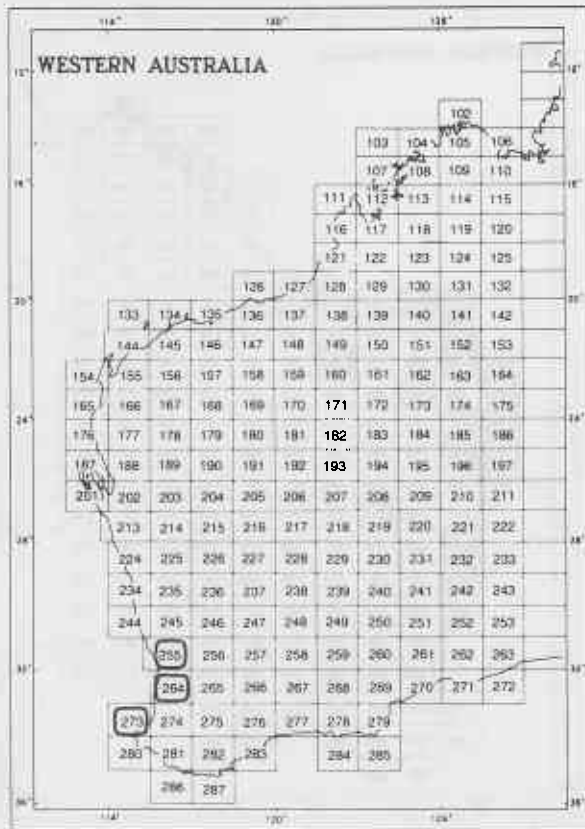
Heliotropium undulatum



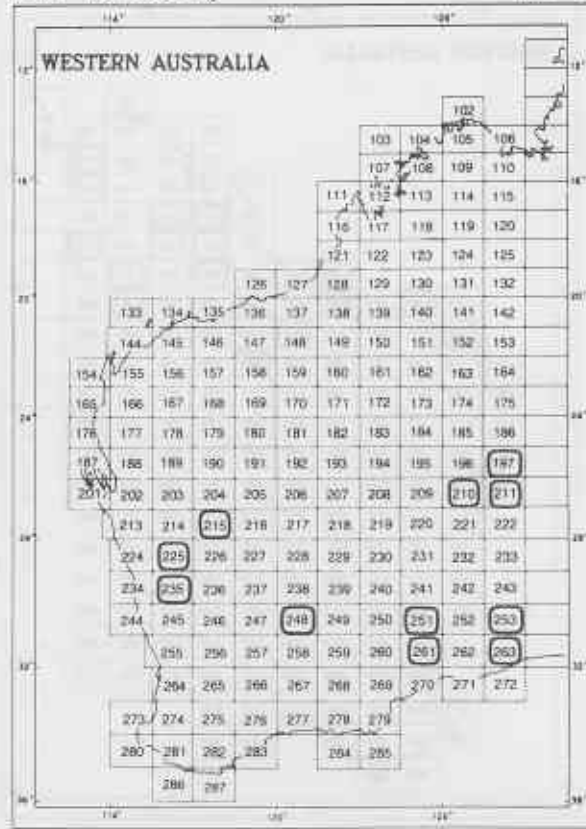
Heliotropium ventricosum



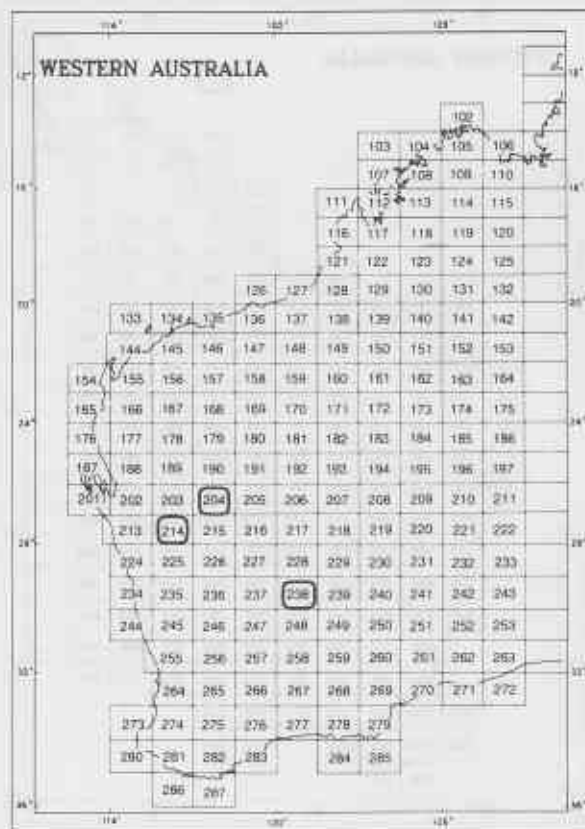
Messerschmidia argentea



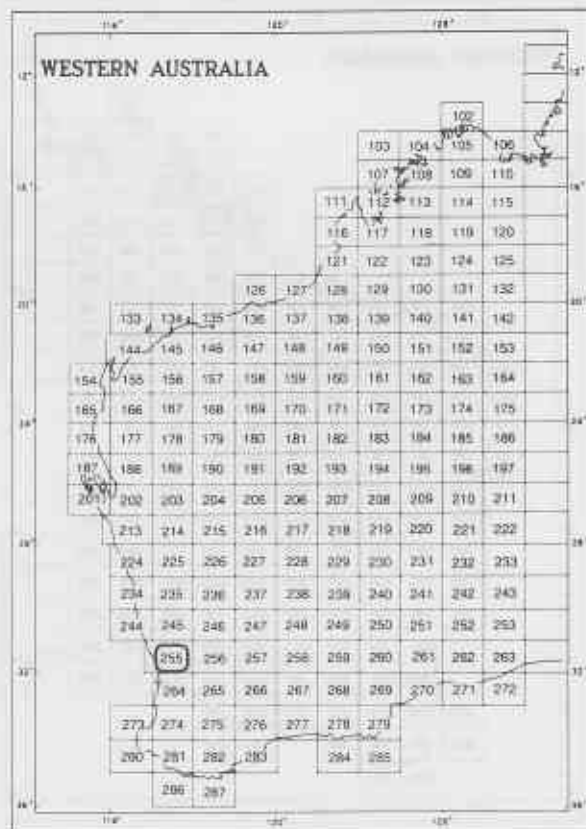
Myosotis australis



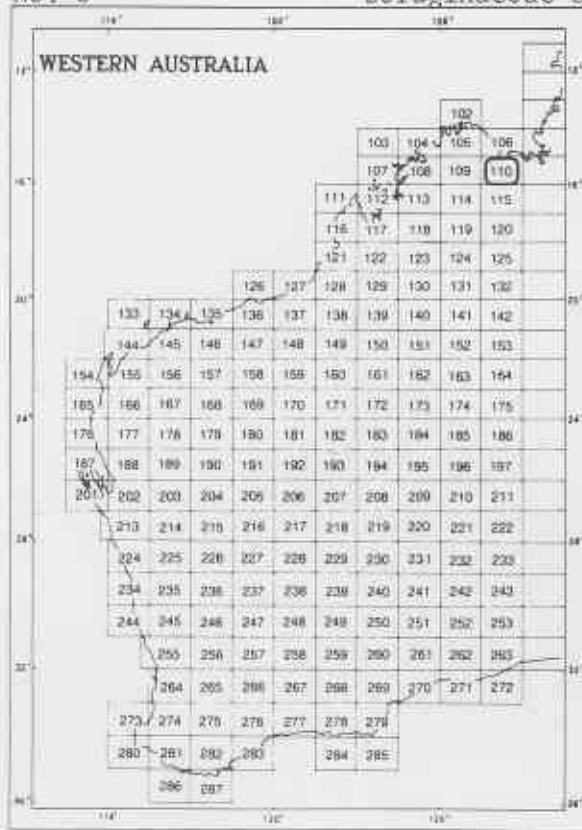
Omphalolappula concava



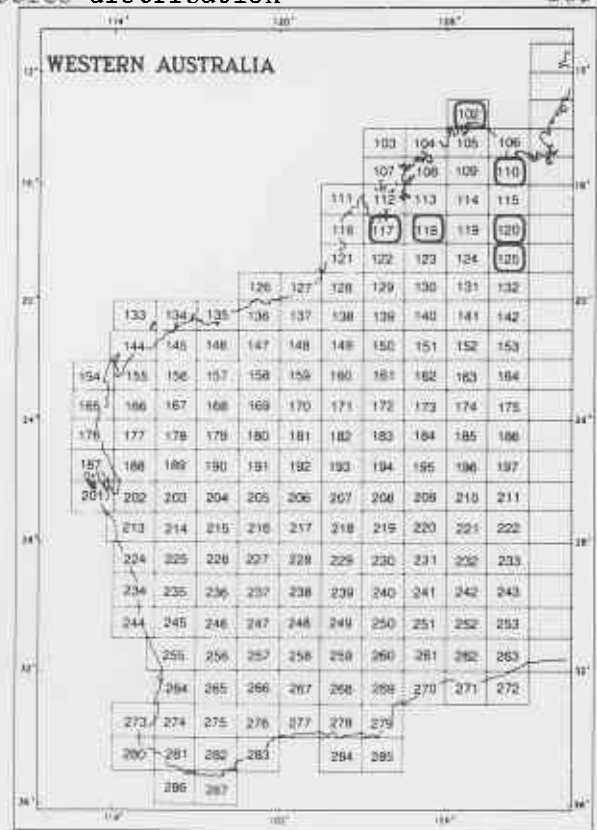
Plagiobothrys australasicus



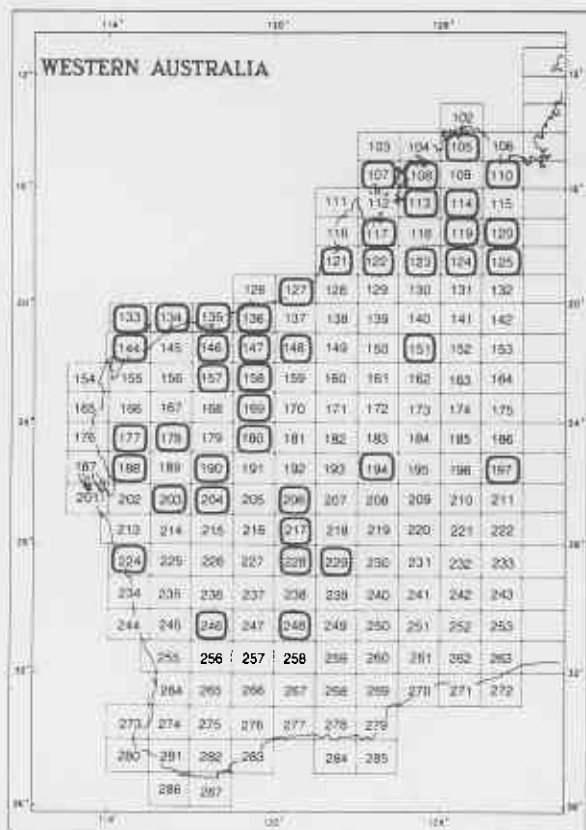
**Symplytum officinale*



Tournefortia mollis



Trichodesma zeylanicum var. *latisepalum*



Trichodesma zeylanicum var. *zeylanicum*

