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PLANT SPECIES LISTS FROM FOUR EXCLOSURE SITES IN THE HAY DISTRICT OF SOUTH-WESTERN NEW SOUTH WALES

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ABSTRACT

Semple, W.S. (Soil Conservation Service of New South Wales, Hay, New South Wales, Australia 2711) 1986. Plant species lists from four exclosure sites in the Hay district of south-western New South Wales. Cunninghamia 1 (4): 000–000. In the early 1950s four exclosure sites were established on the Riverine Plain near Hay to study scald reclamation. The principal vegetation type in the four exclosures is an *Atriplex vesicaria* association. In this paper 269 vascular plant taxa present in the exclosures are listed. A number of these were not included in previously published species lists for the Riverine Plain.

INTRODUCTION

Since the early 1950s a number of exclosures have been established in western New South Wales by the Soil Conservation Service. Plant species lists have been published for five of the 13 exclosures currently being maintained (Cunningham & Milthorpe, 1981).

The exclosures were originally established to study reclamation of degraded lands. The main reason for establishing the four exclosures or Experimental Areas ("Jim Barren", "One Tree", "Paradise", "Tchelery") in the Hay district (Figure 1), was to evaluate and demonstrate techniques for reclaiming scalded soils.

Scalding is the name given to an erosion process that removes topsoil and exposes a smooth, compact, clayey subsoil. The resulting surface is referred to as a "scald" or colloquially, a "claypan" (a term that more accurately refers to a dry and often small lakebed (after Beadle, 1948)). Scalding, which has been attributed by many (e.g., Beadle, 1948) to wind erosion and by some (e.g., Warren, 1965) to water erosion, was the main problem facing soil conservationists in the Hay district during the 1950s. As a result of mechanical treatments (contour furrowing, waterponding and checkerboard furrowing), reseeding (commonly with *Atriplex* spp.) and natural regeneration during the good seasons of the 1950s and the early 1960s (Jones, 1966), scalds now occupy only a small proportion of each of the Experimental Areas. A brief account of the scald reclamation treatments and results has been prepared by Cunningham & Milthorpe (1976).

A variety of other studies, including run-off (Alchin, 1983), plant phenology (Alchin, unpublished data), plant-water relations (Gates & Muirhead, 1967), plant introduction (Alchin, 1974), topographic, vegetation and erosion mapping (Soil Conservation Service, unpublished data) have also been carried out in the Areas. Most of these studies had been terminated by the early 1970s.

The exclosure sites are located on or adjacent to Travelling Stock Reserves and all were originally severely eroded by scalding. The Areas are not fully representative of all soil types and plant communities in the Hay district, nor can they be regarded as examples of pristine vegetation of the land types represented in them. It should be appreciated, however, that these four Areas, together with another at Trida, 170 km to the north of Hay, are the only sizable Riverine Plain saltbush sites known to have remained ungrazed or only slightly grazed by domestic livestock for over 30 years.

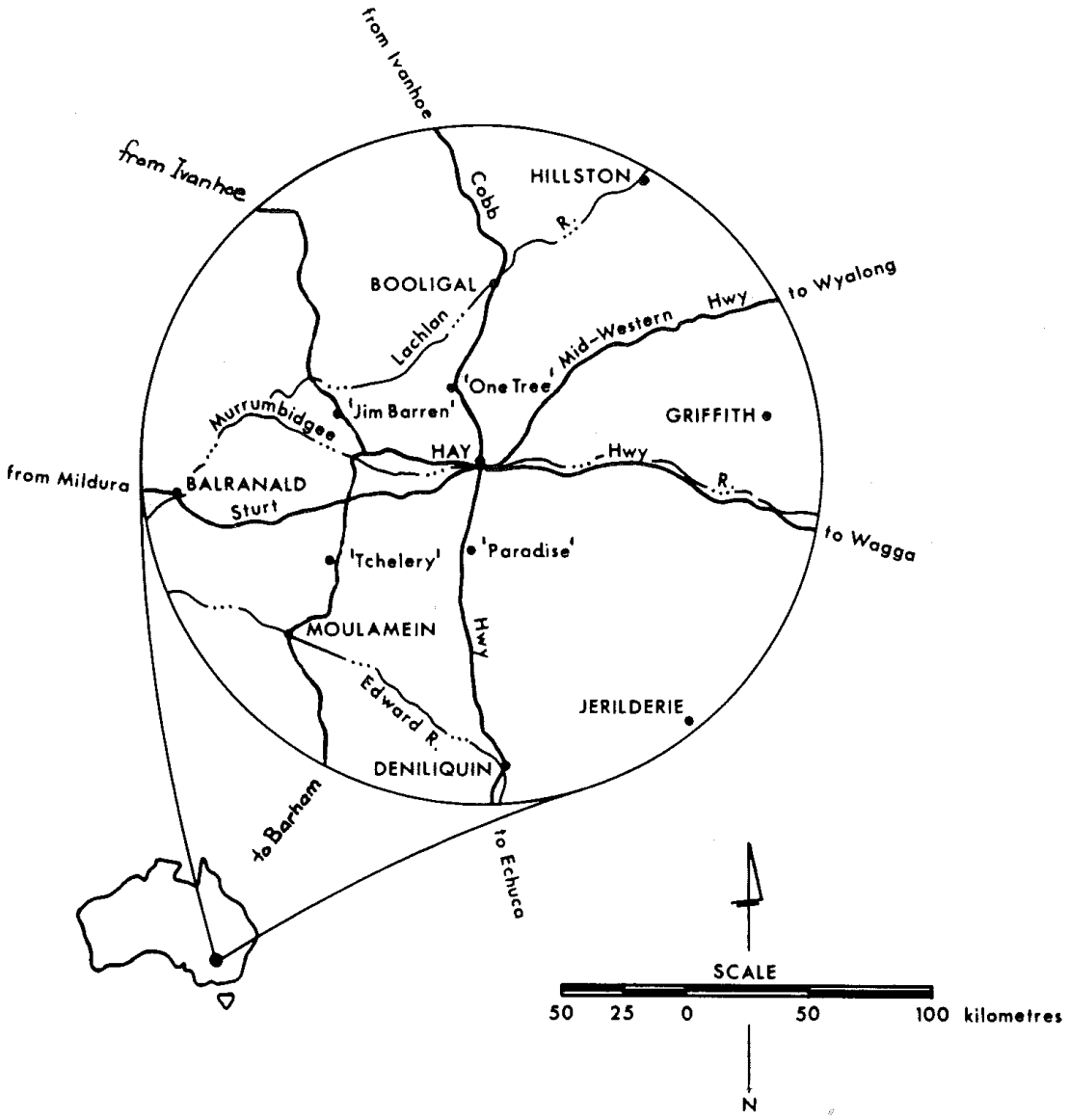

Figure 1. Location of the four exclosures: *"Jim Barren", "One Tree", "Paradise" and "Tchelery".*

DESCRIPTION OF THE AREAS

Brief descriptions of the Experimental Areas are given in Table 1. All Areas are located on the Riverine Plain of southeastern Australia, a depositional landform built up by a system of prior streams that issued from gaps in highlands to the east and south. (Butler, 1950). The long period of alluvial deposition is thought to have ceased under arid conditions during the late Pleistocene. Landform features represented on the Experimental Areas include alluvial plain, the margin of a prior stream, lunette, canegrass depression and aeolian sandhill.

The region in which the Experimental Areas are located is commonly referred to as the "Hay Plain", which comprises the well-known "One Tree Plain" to the north of Hay and the "Old Man Plain" to the south.

The principal vegetation formation on all four Areas is shrub steppe with *Atriplex vesicaria* (bladder saltbush) being the main association (Figure 2). Communities of *Maireana aphylla, M. pyramidata, Eragrostis australasica* and *Acacia homalophylla* (Figure 3) also occur on one or more of the Areas.

Figure 2. Stock have been excluded from this bladder saltbush (*Atriplex vesicaria*) community for over 30 years but scalds are still quite evident. Paradise Experimental Area, August 1982.

Figure 3. *Acacia homalophylla* community. Note the lack of regeneration outside the exclosure. Tchelery Experimental Area, September 1982.

TABLE 1

Brief description of the four Experimental Areas

	JIM BARREN	ONE TREE	PARADISE	TCHELERY
Approximate area (ha)	70	75	50	71
Tenure	60 ha leased from an adjoining holding, the balance occupied by agreement with the Hay Pastures Protection (P.P.) Board.	By agreement with the Hay P.P. Board.	By agreement with the Hay P.P. Board.	Reserve No. 88068 for Soil Conservation purposes.
First fenced	1952	1952	1951	1952
Landforms	* Alluvial plain with slopes commonly <0.5 per cent * Scattered low rises including small part of a lunette * Depressions	* Alluvial plain with slopes commonly <0.5 per cent * Sandy ridge up to 1.5 m above the level of the plain * Depressions	* Alluvial plain with slopes commonly <0.5 per cent * Scattered low rises (probably associated with prior stream) * Small depressions	* Alluvial plain with slopes commonly <0.5 per cent * Scattered low sandy rises and part of a larger sandy ridge about 1 m above the level of the plain
Soils (including Northcote (1971) codings where profiles have been described)	Red-brown and grey clays (e.g. Ug 5.24) and duplex soils (e.g. scalded Dy 4.13)	Red-brown and grey clays (e.g. Uf 3.1) and duplex soils	Red-brown and grey clays and duplex soils (including Dr 4.13 and scalded Db 3.13)	Red-brown and grey clays (e.g. Ug 5.38) and duplex soils (e.g. Dr 2.13)
Vegetation communities	* *Atriplex vesicaria* * *Maireana* spp. * *Eragrostis australasica*	* *Atriplex vesicaria* * *Eragrostis australasica*	* *Atriplex vesicaria* * *Maireana aphylla*	* *Atriplex vesicaria* * *Maireana aphylla* * *Acacia homalophylla*

The Experimental Areas are currently surrounded by a relatively new, conventional stock-proof fence, and each contains a recently constructed rabbit-proof exclosure of about 0.5 ha. Despite their location on well used roads and the presence of signs requesting co-operation in keeping the Areas stock-free, forced entry and subsequent grazing by domestic livestock does occasionally occur, though only for short periods, as none of the Areas contains a permanent water supply.

Efforts have been made to prevent use of the Experimental Areas by domestic and feral animals. Native animals are not deliberately excluded, but some may be hindered by the surrounding fences. Rabbits, which are a problem in only one of the Areas (Tchelery) at present, are controlled at regular intervals, usually in co-operation with the adjoining landholder. Feral pigs have been sighted on one Area (Jim Barren) only and do not currently present a problem.

Noxious plants, including *Lycium ferocissimum*, *Marrubium vulgare* and *Xanthium spinosum*, are removed or poisoned at irregular intervals.

Deliberate introductions of plants into the Areas appears to be minimal. The only successful pasture introductions were those species that were already native to the region (such as *Atriplex* spp.) or had already become naturalized (such as *Medicago truncatula*). Despite many early attempts, only a few introduced trees and tall shrubs have persisted. For completeness, these species are included, with appropriate annotation, in the species lists that follow.

The Areas have now fulfilled their original purpose of evaluating and demonstrating scald reclamation techniques. As they contain a wide variety of species in a small area, the Areas are currently used as a training ground for persons requiring knowledge of plant species in the district. As exclosures, the Areas have also been of value in the study of the widespread dieback of bladder saltbush during the late 1970s and early 1980s (Clift, Semple & Prior, unpubl. data).

THE SPECIES LISTS AND THEIR COMPILATION

Plant collections from the Areas during the 1950s and 1960s were few, but increased during the 1970s. From 1978, species were regularly recorded by the author, and many specimens were submitted to the National Herbarium of New South Wales for identification or confirmation. Duplicate specimens of all those submitted are held at the Hay office of the Soil Conservation Service.

Existing unpublished species lists for each of the Experimental Areas were examined and all observations not supported by herbarium specimens or subsequent observation were deleted. This procedure has undoubtedly resulted in the omission of some valid observations from the lists presented in Table 2. Further deletions resulted from a re-examination of herbarium specimens, many of which were later redetermined by the National Herbarium of New South Wales. It is not claimed that the species lists are complete, but it is hoped that they will provide a sound basis for subsequent additions, particularly in years of abnormally high or unseasonal rainfall.

Nomenclature in the species list is based on usage at the National Herbarium of New South Wales and largely follows Jacobs & Pickard (1981); authorities are as cited in that publication. The plants are listed in alphabetical order of families and of genera within each family.

A total of 269 species, subspecies and varieties (including one hybrid and three complexes) of native and naturalized vascular plants has been listed for the Experimental Areas. Of these, 67 (25% of the total number) are recorded as being naturalized in New South Wales (Jacobs & Pickard, 1981). Naturalized taxa are mainly from Poaceae (16 taxa), Asteraceae (19 taxa), Brassicaceae (6 taxa) and Fabaceae (8 taxa).

The listed taxa include 30% of the 876 so far published for the Riverine Plain (Leigh & Mulham, 1977; Mulham & Jones, 1981). There are 30 taxa additional to those already in published lists of native and naturalized plants; some of the additions are the result of recent generic revisions. One species, *Urospermum picroides* (L.) Desf. (Asteraceae), had not previously been recorded in New South Wales. Previous distributional data for taxa on the Riverine Plain have been extended in a number of cases.

Though all Areas consist largely of the *Atriplex vesicaria* association, there is much floristic variation between them (Table 2). Only 79 taxa, out of a total of 269, are common to all Areas. The presence of different landform features and small localized habitats on each Area would account for much of this variation; however, more frequent observations on the more accessible Areas such as "Paradise", is another probable contributor.

ACKNOWLEDGMENTS

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TABLE 2

Vascular plants recorded from four exclosures in the Hay district

X = observed in Experimental Area (without voucher)
V = voucher specimen from Experimental Area held at Hay S.C.S. office
\+ = species deliberately planted in Experimental Area
* = species naturalized in New South Wales (after Jacobs & Pickard, 1981)
\# = not included in previously published lists for the Riverine Plain (Leigh & Mulham, 1977; Mulham & Jones, 1981)

Botanical Name	Jim Barren	One Tree	Paradise	Tchelery
PTERIDOPHYTES				
Adiantaceae				
Cheilanthes sp.	—	—	X	—
Marsileaceae				
Marsilea drummondii	X	X	X	X
GYMNOSPERMS				
Cupressaceae				
Callitris glaucophylla	—	—	—	X
ANGIOSPERMS				
Aizoaceae				
Disphyma clavellatum	X	V	—	—
Sarcozona praecox	—	V	V	X
Tetragonia tetragonioides	X	X	X	X
Zaleya galericulata	—	V	—	—
Amaranthaceae				
#**Alternanthera angustifolia*	—	V	V	V
A. denticulata	—	—	—	V
Amaranthus macrocarpus	—	V	V	V
Ptilotus spathulatus	—	—	V	—
Apiaceae				
Daucus glochidiatus	V	V	V	X
Asteraceae				
Actinobole uliginosum	—	—	—	V
**Arctotheca calendula*	—	X	X	X
Brachycome campylocarpa	V	V	V	X
#*B. ciliaris* var. *ciliaris*	V	—	—	—
#*B.* sp. aff. *ciliocarpa*	V	—	—	—
B. curvicarpa	—	—	—	V
B. linearifoba	V	V	V	V
B. papillosa	V	—	—	—
Calocephalus sonderi	X	X	V	X
Calotis hispidula	V	V	X	V
C. scabiosifolia	—	V	V	—
**Carduus tenuiflorus* (complex)	V	—	—	—
**Carthamus lanatus*	X	X	X	—
**Centaurea melitensis*	V	X	X	X
Centipeda cunninghamii	X	V	—	—
C. thespidioides	—	V	—	V
**Chondrilla juncea*	—	—	V	—
**Cirsium vulgare*	X	X	X	X
**Conyza albida*	—	—	—	V
**C. bonariensis*	—	—	V	X
**Cotula bipinnata*	—	V	V	—
C. coronopifolia	—	V	—	—
Craspedia pleiocephala	V	—	—	V
C. globosa	—	—	V	—
Eriochlamys behrii	—	—	—	V
#*Gnaphalium sphaericum*	—	—	V	—
**Hedypnois rhagodioloides* ssp. *cretica*	V	X	V	V
Helipterum corymbiflorum	X	X	V	V
#*H. diffusum*	—	—	V	—
H. floribundum	V	V	V	V
H. hyalospermum	—	—	—	V
H. jessenii	—	—	V	—
H. moschatum	—	V	—	V

Botanical Name	Jim Barren	One Tree	Paradise	Tchelery
H. praecox	—	—	—	V
H. pygmaeum	X	—	V	V
**Hypochoeris glabra*	V	V	—	X
**H. radicata*	—	—	V	—
Ixiolaena leptolepis	V	V	V	V
**Lactuca serriola*	X	V	V	—
Leptorhynchos panaetioides	V	V	V	V
Microseris lanceolata	—	V	V	—
Minuria cunninghamii	V	V	V	V
M. denticulata	V	V	V	V
M. integerrima	—	—	V	—
M. leptophylla	X	V	V	V
Myriocephalus rhizocephalus var. *rhizocephalus*	—	—	—	V
#*M. stuartii*	V	—	—	—
**Onopordum acaulon*	V	—	—	—
**Picris echioides*	—	—	V	V
Podolepis muelleri	—	—	V	X
**Podospermum resedifolium*	V	—	V	—
Pogonolepis stricta	—	—	V	V
Senecio cunninghamii	X	X	—	—
S. glossanthus	V	V	V	V
#*S. lautus* ssp. *dissectifolius*	—	V	—	—
S. quadridentatus	—	V	—	—
S. runcinifolius	X	V	X	V
**Sonchus oleraceus*	V	V	X	X
#**Urospermum picroides*	V	—	—	—
Vittadinia pterochaeta	—	—	—	V
V. sp. *B* (*V. conydyloides*)	—	V	—	—
#*V.* sp. *E* (*V. gracilis*)	—	—	V	—
**Xanthium spinosum*	X	X	—	X
Boraginaceae				
**Echium plantagineum*	X	X	X	X
**Heliotropium europaeum*	V	—	V	V
Plagiobothrys plurisepaleus	—	—	—	V
Brassicaceae				
Arabidella nasturtium	V	—	V	X
**Brassica tournefortii*	—	X	X	X
**Capsella bursa-pastoris*	—	X	X	—
#*Cuphonotus humistratus*	—	—	—	V
#*Harmsiodoxa brevipes* var. *brevipes*	—	V	—	V
**Lepidium africanum*	—	V	V	—
L. fasciculatum	V	V	—	X
L. papillosum	V	—	—	—
#*L. pseudohyssopifolium* (*L.* sp. *A*)	—	—	V	—
#*L. sagittulatum*	—	V	V	—
Menkea australis	—	—	V	—
**Sisymbrium erysimoides*	X	X	V	V
**S. irio*	X	X	X	—
**S. orientale*	V	V	V	X
Caesalpiniaceae				
Cassia eremophila var. *eremophila*	—	—	—	X
Campanulaceae				
Wahlenbergia communis	—	—	—	V
W. fluminalis	—	—	V	V
#*W. gracilenta*	—	—	V	—
#*W. gracilis*	—	—	—	V
Caryophyllaceae				
**Spergularia diandra*	—	—	—	V
**S. rubra*	V	V	V	X
Chenopodiaceae				
Atriplex conduplicata	X	V	—	—
A. eardleyi	—	—	—	V
A. holocarpa	V	V	—	—

Botanical name	Jim Barren	One Tree	Paradise	Tchelery
A. leptocarpa	—	—	X	X
A. lindleyi	V	V	X	X
A. nummularia	X	X	X	X
A. pseudocampanulata	V	V	X	X
A. semibaccata	V	—	X	X
A. vesicaria	X	X	V	X
#*Chenopodium cristatum*	—	—	V	—
**C. murale*	—	—	—	V
C. nitrariaceum	X	X	X	X
#*C. pumilio*	—	—	V	V
Dissocarpus biflorus	V	X	—	X
Einadia nutans	X	X	V	X
Enchylaena tomentosa	V	—	—	X
Maireana aphylla	—	X	X	X
#*M. apressa*	V	V	—	—
M. brevifolia	—	—	—	V
M. cheelii	—	—	V	V
#*M. coronata*	—	—	V	—
M. decalvans	—	—	V	—
M. microcarpa	V	V	—	—
M. pentagona	—	—	V	V
M. pyramidata	X	X	X	X
#*M. tomentosa*	—	—	V	—
#*M. turbinata*	—	V	—	V
Malacocera tricornis	X	X	X	X
Osteocarpum acropterum	V	X	X	V
Rhagodia spinescens	X	X	V	X
Salsola kali	X	X	V	X
Scleroblitum atriplicinum	V	V	—	X
Sclerolaena diacantha	—	—	V	V
S. divaricata	X	V	X	X
S. intricata	X	V	X	X
S. muricata	V	V	V	X
S. tricuspis	X	X	V	X
S. sp. *A* (*Bassia brachyptera*)	X	X	X	V
S. sp. *B* (*Bassia stelligera*)	—	—	V	V
Sclerostegia tenuis	V	X	X	V
Convolvulaceae				
Convolvulus erubescens	X	V	X	V
Cressa cretica	—	—	—	V
Crassulaceae				
#*Crassula colorata* var. *tuberculata*	V	V	—	—
C. sieberiana	X	X	V	V
Cucurbitaceae				
**Citrullus lanatus*	—	X	—	X
**Cucumis myriocarpus*	—	—	—	V
Cyperaceae				
Eleocharis acuta	—	—	—	V
E. pallens	V	X	X	—
Euphorbiaceae				
Chamaesyce drummondii	V	X	V	V
Euphorbia eremophila	—	X	—	—
Fabaceae				
Lotus cruentus	—	V	—	V
**Medicago laciniata*	V	V	—	V
**M. minima*	V	V	V	X
**M. polymorpha* var. *vulgaris*	V	V	V	X
**M. praecox*	V	X	V	—
**M. truncatula*	X	X	V	X
**Trifolium arvense*	—	—	V	—

Botanical name	Jim Barren	One Tree	Paradise	Tchelery
**T. glomeratum*	X	—	X	X
**T. tomentosum*	X	—	X	X
Frankeniaceae				
Frankenia connata	—	V	—	—
Gentianaceae				
Centaurium spicatum	V	V	V	—
Geraniaceae				
Erodium cicutarium	X	V	V	V
E. crinitum	V	X	V	V
**E. moschatum*	—	—	V	V
Goodeniaceae				
Goodenia fascicularis	—	V	—	V
G. glauca	V	—	—	—
G. pinnatifida	—	V	V	—
G. pusilliflora	—	—	V	V
Hypoxidaceae				
#Hypoxis hygrometrica	—	—	—	V
H. hookeri (pusilla)	—	—	V	—
Juncaceae				
Juncus aridicola	V	V	V	—
#J. aridicola x *J. subglaucus*	V	—	—	—
J. bufonius	V	X	V	X
J flavidus	—	—	V	—
J. radula	—	V	V	V
Lamiaceae				
**Marrubium vulgare*	—	X	—	X
Teucrium racemosum	—	—	—	V
Liliaceae				
Wurmbea dioica (Anguillaria dioca)	—	—	—	V
Bulbine semibarbata	V	V	V	X
#Thysanotus baueri	—	—	—	V
Loranthaceae				
Amyema quandang var. *quandang*	—	—	—	V
Lythraceae				
Lythrum hyssopifolia	V	V	—	—
Malvaceae				
Abutilon halophilum	—	—	V	—
#A. otocarpum	—	—	—	V
Hibiscus trionum	—	—	—	V
Lavatera plebeia	X	X	V	X
**Malva parviflora*	V	X	V	V
Sida intricata	—	—	—	V
Sida trichopoda	—	—	V	—
Mimosaceae				
+Acacia brachystachya	—	—	V	V
A. homalophylla	—	—	—	V
A. oswaldii	—	—	—	V
A. salicina	—	—	—	V
Myoporaceae				
+Eremophila bignoniiflora	—	—	—	V
E. longifolia	—	—	—	X
Myrtaceae				
+Eucalyptus camaldulensis	—	V	V	—
+E. dundasii	—	—	V	—
+E. flocktoniae	—	V	—	—
+E. populnea	—	—	—	X
+E. woodwardii	—	V	—	—

Botanical name	Jim Barren	One Tree	Paradise	Tchelery
Nyctaginaceae				
Boerhavia coccinea	—	—	V	V
Onagraceae				
Epilobium billardierianum ssp. *cinereum*	—	—	V	—
Oxalidaceae				
Oxalis corniculata (complex)	X	X	V	V
Plantaginaceae				
Plantago cunninghamii	V	X	V	V
P. drummondii	—	V	V	—
P. turrifera	—	X	—	V
Poaceae				
Agrostis avenacea	V	V	X	X
**Alopecurus geniculatus*	V	V	—	V
Amphibromus nervosus	—	—	V	—
**Avena fatua*	X	X	X	X
Bromus arenarius	X	V	X	X
**B. molliformis*	—	V	V	V
**B. rubens*	V	V	X	V
**B. unioloides*	—	—	—	V
Chloris acicularis	X	X	X	X
C. truncata	X	V	X	X
Dactyloctenium radulans	—	X	V	V
Danthonia auriculata	—	—	V	—
D. caespitosa	X	X	V	V
D. setacea	—	V	V	—
Diplachne fusca	—	V	V	V
Eragrostis australasica	X	X	X	X
#E. molybdea	—	—	—	V
E. parviflora	V	—	V	V
E. setifolia	—	—	—	V
Eriochloa crebra	—	—	V	—
E. pseudoacrotricha	—	—	V	—
**Hordeum leporinum*	V	V	X	X
**H. marinum*	V	V	X	X
**Lamarckia aurea*	X	V	X	X
**Lolium perenne*	—	V	—	—
**L. rigidum*	V	—	X	V
Panicum prolutum	V	—	—	—
P. whitei	—	—	V	—
**Parapholis incurva*	X	X	V	V
**Phalaris minor*	V	V	V	V
**P. paradoxa*	V	V	V	—
Poa fordeana	—	V	—	—
Puccinellia stricta	V	—	—	—
**Schismus barbatus*	V	V	X	X
Sporobolus caroli	V	X	V	X
Stipa elegantissima	V	—	—	—
S. variabilis (complex)	X	X	X	X
Tragus australianus	—	V	V	X
*#*Vulpia bromoides*	—	—	V	—
**V. myuros*	V	V	V	V
Polygonaceae				
Muehlenbeckia cunninghamii	—	—	X	X
M. horrida	—	—	V	—
**Polygonum aviculare*	—	X	X	—
Rumex brownii	—	—	V	—
**R. crispus*	—	—	V	—
R. dumosus	—	—	V	—
R. tenax	—	—	—	V

Botanical name	Jim Barren	One Tree	Paradise	Tchelery
Portulacaceae				
Calandrinia eremaea	—	—	V	X
C. pumila	—	—	—	X
C. volubilis	—	V	V	X
Portulaca oleracea	X	V	V	X
Proteaceae				
Hakea leucoptera	—	—	—	X
Ranunculaceae				
**Myosurus minimus*	V	X	X	X
Ranunculus pentandrus var. *platycarpus*	V	X	X	X
Rubiaceae				
Asperula conferta	—	—	V	—
Santalaceae				
Exocarpos aphyllus	—	—	—	V
Sapindaceae				
Dodonaea viscosa ssp. *angustissima*	—	V	—	X
Scrophulariaceae				
Glossostigma sp.	V	—	—	—
Limosella curdieana	X	X	V	V
Solanaceae				
**Lycium ferocissimum*	X	X	X	X
Solanum esuriale	X	V	V	X
**S. nigrum*	—	—	—	V
Urticaceae				
Urtica incisa	—	—	—	V
**U. urens*	—	—	—	V
Verbenanceae				
**Verbena supina*	—	V	—	—
Zygophyllaceae				
Nitraria billardieri	V	X	X	X
Tribulus terrestris	—	V	V	X
Zygophyllum glaucum	—	—	V	V
Z. iodocarpum	V	V	—	V
#Z. sp. *A.* (aff. *ammophilum*)	V	—	—	—
#Z. sp. *C.* (aff. *billardieri*)	—	—	V	—
Total taxa (excluding deliberate plantings)	130	147	171	181