THE VEGETATION OF THE LAKE PEDDER AREA PRIOR TO FLOODING

J. Balmer[1] and E. Corbett[1]

BALMER, J., & CORBETT, E., 2001: The vegetation of the Lake Pedder area prior to flooding; in: Sharples, C., (ed.), *Lake Pedder: Values and Restoration*, Occasional Paper No. 27, Centre for Environmental Studies, University of Tasmania, p. 67 - 86.

The vegetation in the area now flooded by the Huon - Serpentine Impoundment was never comprehensively described. The description and map of the vegetation presented in this paper incorporates such records as exist but relies heavily on interpretation of air photos flown just before the flooding and correlation with the plant communities that remain exposed around the lake margins. The vegetation ranged from wetland and swamp communities, to blanket moorlands, wet scrub, eucalypt forest and thamnic rainforest communities. The impoundment area had at least 160 higher plant species from 55 families. Fifty-nine of the known plant species were endemic.

It is apparent that much of the broad plain in which the lake was centred was covered by a mosaic of vegetation types, some of which are now very poorly represented in the vegetation that remains exposed above the present lake level. Those now poorly represented in the area include the beach sands, wetland and swamp communities. Rare plant species known to have occurred in the area were Centrolepis paludicola, Centrolepis pedderensis, Hydatella filamentosa, Leptomeria glomerata, Liparophyllum gunnii, Milligania johnstonii *and* Ranunculus acaulis. *Three of these species* (Milligania johnstonii, C. pedderensis, *and* C. paludicola) *were not known from anywhere else at the time the lake was flooded.* C. pedderensis *is now known from only one location on the Frankland Range and is listed as endangered.* Ranunculus acaulis *is now likely to be locally extinct in the Lake Pedder catchment area.*

The vegetation ecology is described in relation to the natural revegetation and successional processes that may be expected should the impoundment ever be drained. Few weeds exist in the area surrounding the impoundment but these are listed and their invasion threat to the drained lake environment is described.

Key Words: Australia, Southwest Tasmania, Lake Pedder, moorland vegetation, restoration, succession

METHODOLOGY

Despite the fact that it has been more than 20 years since the Lake Pedder area was flooded it is possible to tie many strands of information together to allow us to describe the vegetation that once occurred there. Perhaps the most relevant published information is the description by Macphail & Shepherd (1973) of the vegetation surrounding Lake Edgar prior to it being flooded as part of the south-eastern end of the Huon - Serpentine Impoundment.

The University of Tasmania Botany Department conducted a survey of the area and collected plant material and plant community data. The community data could not be found, however the plant material lodged with the Tasmanian Herbarium was still contained largely within a single collection. The plant material was used to compile a species lists for the area, prior to flooding. Species recorded in Macphail & Shepherd (1973) and other plant records from the area contained within the Parks and Wildlife Service computer data base 'WILDLIFE ATLAS' were also added to the species list. Taxonomic nomenclature follows Buchanan (1995).

Corbett (1994a,b) has mapped the extant vegetation on the 1:25,000 map sheets Scotts and Anne which include the eastern half of the impoundment. This vegetation shares some similarities with the drowned vegetation due to the proximity and similarity in geology and hydrology but the Pedder Plains contained communities now poorly represented. However, the authors were able to study a sequence of low-lying, poorly drained plant communities near Condominium Creek which photo-interpretation suggests show strong similarities with some of the drowned communities. A vegetation map (Figure 1) for the area surrounding the original Lake Pedder has been prepared from photo-interpretation of black and white aerial photographs (1:33,000 scale) flown in 1972 as the new impoundment waters advanced up

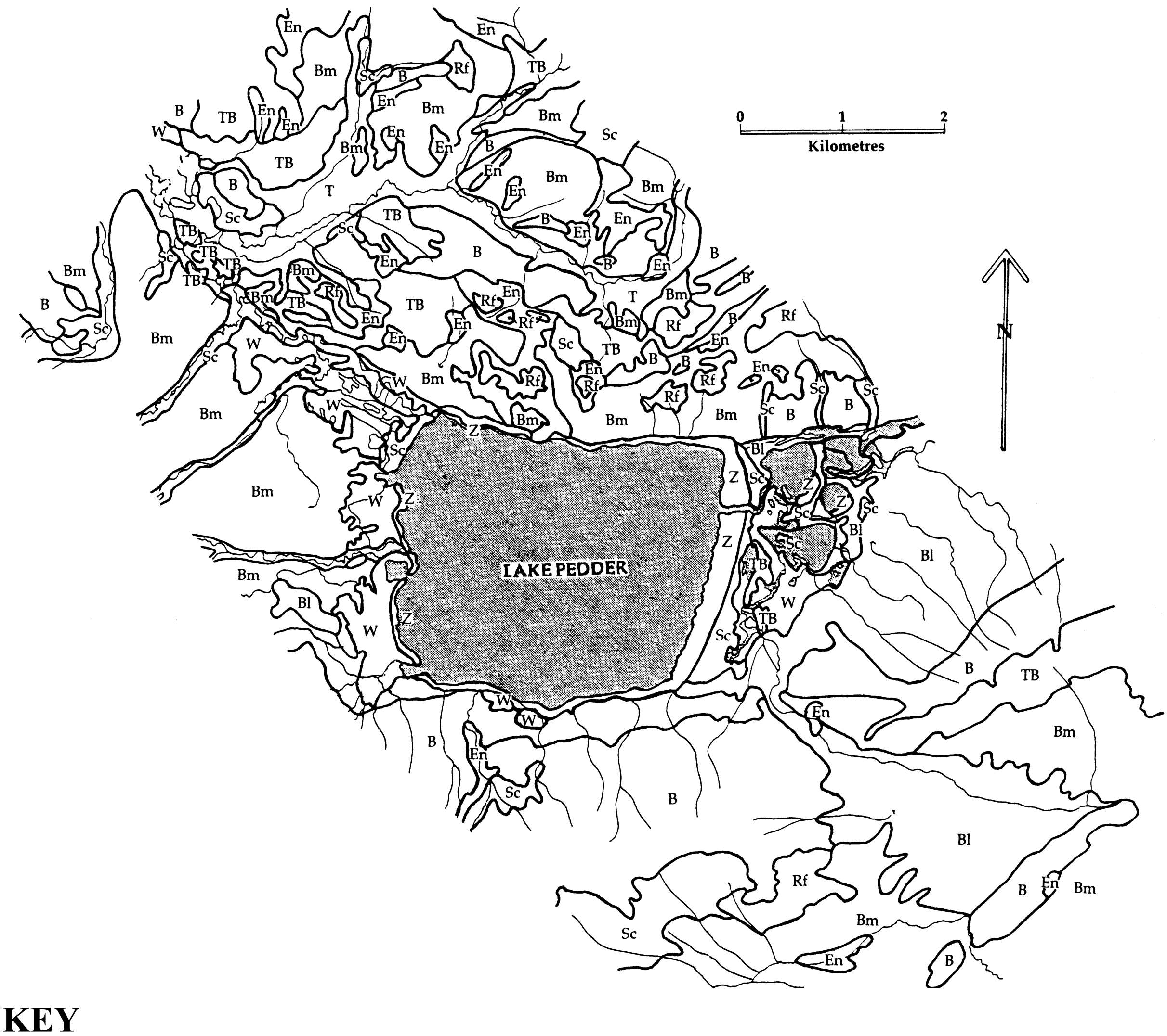
[1] Nature Conservation Branch, Department of Primary Industries, Water and Environment, Tasmania.

the Serpentine River. The mapping was undertaken in accordance with the standard methodology described by Kirkpatrick (1987) and adopted in Kirkpatrick & Balmer (1991).

Descriptions of each mapped unit are based on survey work on the vegetation within the Mt Anne/Lake Pedder area, the description of the vegetation of Lake Edgar by Macphail & Shepherd (1973) and the species records in the Herbarium, and from the Parks and Wildlife Service's computer data base, the Wildlife Atlas. The classification of the vegetation follows that adopted for the World Heritage Area vegetation mapping program which is adapted from Jarman *et al.* (1984, 1988), and Duncan & Brown (1985).

THE VEGETATION

The vegetation immediately surrounding the original Lake Pedder is illustrated in Figure 1. This figure is a simplified version of a more complex map which uses a multi-layered structural classification (too complex for reproduction on an



KEY

Z Beach Sand
W *Restio tetraphyllus* Swamp
Bl *Lepyrodia* Sedgeland
B Short Buttongrass Moorland
Bm Buttongrass / *Melaleuca squamea* Moorland
TB Scrubby Tea-tree / Buttongrass
T Tea-tree Swamp
Sc *Banksia* Wet Scrub, usually with *Eucalyptus nitida*
En *Eucalyptus nitida* on Tea-tree and / or Wet Forest
Rf Rainforest, often with emergent *Eucalyptus nitida*

Figure 1: Map of the vegetation surrounding Lake Pedder in 1972.

A4 page). The more complex map may be obtained from the Parks and Wildlife Service.

The vegetation that occurred in and around the lake ranged from wetlands, moorlands and scrub to forest vegetation. Wetlands, flat-lying moorlands and tea-tree swamps were the most extensive of the vegetation types flooded. Most of the forests occurred on elevated slopes and escaped inundation. Nevertheless the forests are described here since they formed part of the vegetation surrounding Lake Pedder and add to the diversity of the area. The map distinguishes 10 mapping units which are described below.

The impoundment area had a rich flora having at least 160 higher plant species from 55 families (Appendix 1). Of the plant species recorded 59 were endemic to Tasmania. Of the species listed about 17 (12 of which are endemic), largely occur in rainforest or wet eucalypt forests and would have been uncommon in the area flooded. The lowland plain vegetation captures only a small part of the diversity known to exist in the greater region, which has extensive alpine and subalpine areas and vegetation on diverse substrates, each with a distinctive flora.

Lake Flora

Baumea rubiginosa occurred sparsely near lake margins in water greater than 50 cm deep. Other species in the lakes included *Myriophyllum simulans* floating on the surface and *Isoetes* sp. which grew on the lake bottom. The *Isoetes* has been assumed to be *Isoetes gunnii* although no particular attention has been given to studying the specimens. Michael Garrett (*pers. comm.*) believes the specimens are unusual in having recurved leaves distinctive from those typical of *Isoetes gunnii*. The other unusual aspect of this record is that Lake Pedder was less than 300 m above sea level and *Isoetes gunnii* is an alpine and subalpine species and occurs nowhere else at such a low elevation (Garrett & Kantvilas 1992). Several other *Isoetes* species exist in Tasmania including one recently found in the alkaline pans of the far South West which has so far not been described. All but *Isoetes gunnii* and *I. muelleri* are listed as rare (Kirkpatrick *et al.* 1991, Flora Advisory Committee 1994).

Beach Sands

Sparse vegetation cover was provided by species colonising the sandy shores of Lake Pedder and other smaller sandy areas on the margins of streams and pools. *Centrolepis pedderensis*, *C. paludicola, Ranunculus acaulis* and *Milligania johnstonii* were largely restricted to this habitat. The species composition of these sparse herbfields may have resembled that of the alkaline pans of the far southwest (Brown *et al.* 1982) but no detailed account of the species associations of the 'Beach Sands' was located. Other higher plant species contributed sparse cover, for example, *Restio hookeri* (Morris 1991), *Restio complanatus*, *Melaleuca squamea* and *Drosera pygmaea*.

Restio tetraphyllus *Swamp*

The swamps were seasonally inundated to varying depths and were characterised by the widespread domination of *Restio tetraphyllus*. This community is not described by Jarman *et al.* (1988). *Restio tetraphyllus* Swamps appear to have fringed the margins of the smaller lakes and dominated the wetlands to the east and west of the original Lake Pedder. A patch of this vegetation is associated with a small lake on the plains east of the Huon Inlet shore of the impoundment, just south of Condominium Creek. Other species co-occurring or sometimes replacing *Restio tetraphyllus* include *Baumea rubiginosa* in deep water, *Lepidosperma longitudinale* in shallow water and *Leptocarpus tenax* in drier situations.

In some situations *Lepidosperma longitudinale* dominates shallow water areas with *Chorizandra cymbaria* (Macphail & Shepherd 1973). This vegetation is classified as 'Southwestern Sword Sedgeland' within the moorland classification (Jarman *et al.* 1988).

Photo-interpretation suggests that the area mapped as '*Restio tetraphyllus* Swamp' vegetation was likely to have been a mosaic dominated by '*Restio tetraphyllus* Swamp' but including *Melaleuca squamea* swamp vegetation and '*Lepyrodia* Sedgeland', possibly also *Lepidosperma longitudinale* sedgeland, but this has not been observed in the presently exposed area.

Lepyrodia *Sedgeland*

The mapping unit '*Lepyrodia* Sedgeland' corresponds to 'Southwestern Sedgy' in Jarman *et al.*'s moorland classification (1988). This vegetation is likely to have been dominated by *Lepyrodia tasmanica*, *Leptocarpus tenax* and *Xyris marginata* with *Gymnoschoenus* forming a cover of less than 20%. *Lepyrodia* typifies this vegetation but many other species may have been present including *Empodisma minus*, *Lepidosperma filiforme*, *Diplarrena* spp. and *Sprengelia incarnata*. *Leptospermum lanigerum* and *Leptospermum scoparium* form a sparse emergent cover. *Lepidosperma longitudinale* occurs in the wetter areas while *Gleichenia dicarpa* and the herbs *Mitrasacme montana* and *Ehrharta tasmanica* are ground layer species.

This community is likely to have occurred extensively on the plains to the east and southeast of Lake Pedder, with small patches west of the lake. Areas mapped as '*Lepyrodia* Sedgeland' were probably a mosaic with 'Short Buttongrass Moorland'. The '*Lepyrodia* Sedgeland' would have occurred in the wetter depressions while the 'Short Buttongrass Moorland' was characteristic of areas with slightly improved drainage. Also occurring in this vegetation were 'Peat Pools', now known in this region only from the plain south of Condominium Creek.

'Peat Pools' are small water filled depressions in the moorland that range in size from 10 cm to 5 m across. They are generally around 15 to 30 cm deep and usually have only a sparse vegetation cover of one or two species. The species that may occupy these habitats include *Baumea tetragona*, *Baumea rubiginosa, Carex* species, *Isolepis* species, *Utricularia* spp., and *Eleocharis* spp. Characteristically 'Peat Pools' occur clustered together, but their origin has not been studied. They are known to occur elsewhere in southwest Tasmania but are not common.

Buttongrass / Melaleuca squamea *Moorland*
The 'Buttongrass/*Melaleuca squamea* Moorland' mapping unit would fit into the moorland classification of Jarman *et al.* (1988) as 'Wet Standard'. It is distinguished by the abundance of *Melaleuca squamea* which makes up to 35% of the vegetation cover. This community tends to be taller and denser than 'Short Buttongrass Moorland' described below but has otherwise a very similar species composition with *Melaleuca squamea*, *Bauera rubioides, Sprengelia incarnata*, *Boronia pilosa*, *Gymnoschoenus*, *Lepidosperma filiforme* and *Restio hookeri* forming a single layer of shrubs and sedges. A sparse ground cover is provided by herbs such as *Oschatzia saxifraga*, *Actinotus suffocata* and *Actinotus bellidioides*. This vegetation was probably most extensive on the western plains adjacent to Lake Pedder and the buttongrass slopes north of Lake Pedder.

Along the drainage lines through this vegetation, *Melaleuca* formed a tall shrubbery which may sometimes have had associated patches of pure buttongrass forming large tussock vegetation. Occasional species in the shrubbery may have been *Oxylobium ellipticum*, *Olearia persoonioides*, *Hakea epiglottis* and *Leptospermum lanigerum*.

Short Buttongrass Moorland
The mapping unit 'Short Buttongrass Moorland' fits best in the moorland classification as 'Standard Blanket Moor' and is distinguished in the Lake Pedder area by the low abundance of *Melaleuca squamea*. *Gymnoschoenus* provides about 30% cover while the remaining vegetation cover is provided by a mixture of *Leptospermum nitidum*, *Baeckea leptocaulis*, *Bauera rubioides, Sprengelia incarnata*, *Boronia pilosa*, *Lepidosperma filiforme* and *Restio hookeri* in a single-layered mixture of shrubs and sedges. A sparse ground cover is provided by herbs such as *Oschatzia saxifraga*, *Actinotus suffocata* and *Actinotus bellidioides*. On the better drained slopes *Restio complanatus*, *Epacris corymbiflora* and *Dillwynia glaberrima* are more common members of the community.

This community was most extensive on the mountain slopes south of Lake Pedder. With increasing altitude the community grades into 'Mountain Blanket Moor' (Jarman *et al.* 1988) which is characterised by the addition of *Actinotus moorei*, *Isophysis tasmanica*, *Anemone crassifolia*, *Dracophyllum milliganii* and the replacement of *Epacris corymbiflora* with *Epacris heteronema*, *Epacris serpyllifolia* and *Eucalyptus vernicosa*. These communities have not been distinguished separately on the vegetation map.

Tea-tree Swamp
The 'Tea-tree Swamp' map unit has some similarities with 'Wet Copse' vegetation in the moorland classification (Jarman *et al.* 1988). It occurs in the upper reaches of the Huon, west of Sandfly Creek. Sections of the tributary flowing into the Serpentine northeast of Lake Pedder which were dominated by Tea-tree swamp are now flooded in the impoundment. This community is dominated by *Melaleuca squarrosa,* in almost pure stands or growing with *Leptospermum lanigerum*, *L. scoparium*, *Melaleuca squamea, Hakea epiglottis* and sometimes *Banksia marginata* and *Acacia melanoxylon* near the edges. Understorey species may include a tangled layer of *Gahnia grandis*, *Bauera rubioides* and *Empodisma minus* or *Calorophus elongatus*. This scrub rarely exceeds 3 m in height in this region. The lack of higher plant species diversity, the low stature and the high level of the water table help to distinguish this community from the '*Banksia* Wet Scrub' community.

Scrubby Tea-tree over Buttongrass
This map unit fits within the community description of 'Layered Blanket Moor' described by Jarman *et al.* (1988). It is vegetation which consists of a scrubby 2-3m tall canopy dominated by *Leptospermum nitidum*, *L. scoparium*, *Melaleuca squamea* and sometimes *M. squarrosa* over a tangled and dense layer of monocots and shrubs including *Gymnoschoenus*, *Boronia citriodora*, *Sprengelia incarnata, Empodisma minus* and *Bauera rubioides*. Many other species are present but less conspicuous in this middle stratum, and the ground layer is sparse. Woody shrubs can include *Agastachys*, *Cenarrhenes*, *Banksia*, *Leptospermum glaucescens* and sometimes *Hakea lissosperma* and *Telopea*.

This community seems to be a transitional stage in the succession from moorland to wet eucalypt forest. It occurs on the southeastern slopes in areas topographically protected from fire and in situations where drainage is not a limiting factor for tree establishment.

Banksia *Wet Scrub*
'*Banksia* Wet Scrub' is related to Jarman's 'Dry Copse' vegetation (Jarman *et al*. 1988). Typically it shows gradation in height, increasing to 3-6 m in height in the centre of each thicket, where it is overtopped by a canopy of *Eucalyptus nitida*. The scrub is dominated by *Banksia marginata* and/or *Acacia mucronata* (in wetter situations) which overtop a dense tangled shrub layer of *Leptospermum scoparium*, *Melaleuca squarrosa* and sometimes *Leptospermum glaucescens*. *Bauera rubioides*, *Blandfordia*, tall *Sprengelia incarnata*, *Empodisma minus, Diplarrena latifolia*, *Gahnia grandis* and sometimes *Melaleuca squamea* co-occur in the thick and tangled ground layer. *Allocasuarina monilifera*, *Acacia verticillata*, *Callistemon viridiflorus*, *Leptospermum lanigerum* are also occasional species in the scrub layer.

The ecotone between wet scrub and adjacent moorland often has a higher species diversity with species which are uncommon elsewhere, for example: *Boronia citriodora*, *Pimelea lindleyana*, *Oxylobium ellipticum*, *Lomatia polymorpha, Allocasuarina monilifera*, *Epacris impressa* and at higher altitudes *Epacris heteronema*.

Eucalyptus nitida *Forest*
Only small patches of '*Eucalyptus nitida* Forest' occur in the vicinity of the impoundment and little, if any, was flooded. It is probably best classified as 'Sedgy *E. nitida* Forest' (Duncan & Brown 1985). It occurs in fire-protected sites, generally on the steep southeastern slopes, where the vegetation becomes taller with a more open understorey. The eucalypts may be 10 - 20m tall and are emergent over an understorey of tea trees and other sclerophyllous trees up to 8m in height. The main understorey species are *Leptospermum lanigerum* and those characteristic of the *Banksia* wet scrub with additional species such as *Acacia melanoxylon*, *Phebalium squameum*, *Pittosporum bicolor*, *Lomatia polymorpha*, *Monotoca glauca*, *Anopterus glandulosa* and *Cenarrhenes nitida*. The open ground layer may contain species such as *Dianella revoluta*, *Pteridium esculentum*, *Pultenaea juniperina*, *Gahnia grandis*, *Bauera rubioides*, *Epacris impressa*, *Cyathodes juniperina*, *Coprosma nitida*, *Empodisma minus*, and *Stylidium graminifolium*.

Throughout southwest Tasmania this community is usually fringed by the *Banksia* Wet Scrub.

Rainforest
Rainforest and mixed forest, with a canopy dominated by *E. nitida,* occur in small patches in the Lake Pedder area in places that are well protected from fire. *Nothofagus cunninghamii* is the dominant tree species which co-occurs with *Phyllocladus aspleniifolius* and *Eucryphia lucida*. On soils of higher nutrient status *Atherosperma moschatum* is an important species, and the fern *Polystichum proliferum* may be common. In areas of lower fertility or in younger forests such as the forest immediately north of the original Lake Pedder, *Cenarrhenes nitida*, *Anopterus glandulosus, Anodopetalum biglandulosum* are common. Shrubs in the understorey include *Trochocarpa cunninghamii* and *Trochocarpa gunnii*, *Cyathodes juniperina*, *Monotoca glauca*, *Tasmannia lanceolata* and *Prionotes cerinthoides*. Fern species on the ground include *Blechnum wattsii* and epiphytes included *Grammitis billardieri* and *Hymenophyllum rarum*. Where canopy disturbance occurs *Histiopteris incisa* and *Hypolepis rugosula* may be common.

The area mapped as rainforest in Figure 1 is likely to have been classified as 'Thamnic Rainforest with *Anopterus glandulosus* and/or *Cenarrhenes nitida* understoreys' (T3. in Jarman *et al.* 1984) although no field inspection has been made of the rainforest sites above the impoundment level.

Fire History
The fire history of the Lake Pedder area has not been documented, but it appears from HEC records and the memory of individuals working for the HEC and Lands Department that there was no deliberate or accidental burning immediately prior to the flooding.

Aerial photography from 1949 provides strong evidence that the last major fire in the area was well before the flooding, probably in the early 1930's, possibly coinciding with major wildfires which swept southwest Tasmania in 1934 and 1939. Fire caused extensive damage in the area west of the lake - both on the plains and the north-facing slopes. East of the lake fire affected parts of the Frankland Range slopes but did little damage on the plains.

The fire to the west of the lake created a sharp boundary along the southern edge of the tea tree swamp (at that time short *Melaleuca* with a lot of interstitial buttongrass and possibly other monocots) suggesting the fire was rather low intensity on the wet plains. On the north-facing slopes the fire must have been intense, burning to the tops of the ranges and leaving up to 50% of the surface as gravel almost without vegetation. A small hill in the Serpentine Plain 4 km northwest of the lake was very severely burnt, and a remnant forest at its southeastern end was penetrated, with some of the mixed forest destroyed. More extensive rainforests further west showed very sharp boundaries against moorland, probably indicating the destruction of fringing wet forest.

At the southwest corner of Lake Pedder dune sand was exposed over an area of about 50 hectares, probably as the result of fire. By 1972 this area had recovered as wetlands and moorland shrubbery.

In the northwest corner of Lake Pedder, near the Serpentine outflow, dune sand was exposed around the northern fringes of the wetlands but the foredune vegetation and that of the NW/SE dune system was undamaged, and changed remarkably little between 1949 and 1972.

The burnt plains west of the lake had lost nearly all tall vegetation by 1949, although some remnants are visible along the watercourses. The plains were largely covered by wet sedgelands, with an intricate network of pale areas suggesting sparse recolonisation. Whether the growth occurred on terrace edges or small eroded channels is difficult to say.

East of Lake Pedder the fire appears to have affected parts of the north-facing Frankland Range slopes, which were reduced to almost bare gravel. The fire seems not to have extended into the valley, as indicated by the unburnt scattered 'sand humps' carrying *Eucalyptus nitida.*

Comparison between photography in 1949 and 1972 shows almost complete recovery and stabilisation of moorland and scrub communities and very little change to vegetation on the forested slopes north of the lake, the open valley east of the lake or the main dune systems. By 1972 the tea tree swamp along the tributary of the Serpentine had matured and expanded to fill most of the valley as a mosaic of dense *Melaleuca squarrosa* and more varied tea tree; little short moorland vegetation remained. On the hill in the Serpentine Plains, burnt rainforest and mixed forest was replaced by *Eucalyptus nitida* over a wet forest understorey.

By 1972 the severely burnt western valley had well-developed *Eucalyptus nitida* forest along the creek lines and a number of small trees, probably *Banksia*, appeared in the moorland 1-2 km west of the lake. The area of peat pools was apparently unchanged, but the plains show a general increase in the height and shrub content of the moorland vegetation. The ravaged mountain slopes had recovered, with a good cover of graminoid heath and buttongrass moorland plants.

Almost the only reduction in vegetation between 1949 and 1972 occurs on the foredunes at the northwest corner of the lake. Here the front line of tea tree has been lost, possibly through spot burning but more likely through blow-out dune erosion.

Few changes are evident in the areas above the present lake level between the 1972 and 1988 airphotos apart from a gradual expansion of wet scrub on the forest fringes. *Melaleuca* scrub in a valley northwest of the lake provided a barrier to the fire, and by 1972 had fully developed to mature tea tree swamp.

East of Lake Pedder an area of about 300 ha of moorland near Harlequin Hill was burnt in 1980 when an experimental fuel reduction burn escaped, but there is no evidence of any other recent low-altitude fires in the area.

Conservation Status of Plant Communities and Species

Appendix 1 lists the species and their conservation status. Of those listed as Rare or Threatened at least four occurred on the beach of Lake Pedder. These were *Centrolepis paludicola* (V r2), *Centrolepis pedderensis* (E e), *Milligania johnstonii* (R r2) and *Ranunculus acaulis*. Three of these species were not known to occur elsewhere at the time of flooding yet there were no measures taken to secure their conservation. Since the flooding *Milligania johnstonii* has been found to occur extensively in the alkaline pans of the Maxwell, Olga and Hardwood valleys (Brown *et al.* 1982). *Centrolepis paludicola* is known from around the shores of the new impoundment in gravel outwashes, as well as near Queenstown and Melaleuca (Balmer & Harris 1994). *Centrolepis pedderensis* has been recorded from a lake shore in the Frankland Range, an alkaline pan in the Giblin River valley, and the Gordon River valley at sites now flooded (Gilfedder 1989). *Ranunculus acaulis* is recorded by Curtis & Morris (1975) as having occurred in the wet sands of Lake Pedder prior to its flooding, as well as on sand dunes of the west coast. It is presumed to be locally extinct from the Lake Pedder area now.

Plant specimens of *Leptomeria glomerata* (r2) which were recorded to have come from the dunes behind Lake Pedder are lodged in the Tasmanian Herbarium. Specimens of *Liparophyllum gunnii* (r2) and *Hydatella filamentosa* (R r2) are also lodged in the Tasmanian Herbarium but their collection locality was not more specific than Lake Pedder. Typical habitats for these species include alkaline pans, 'Southwestern Sword Sedgeland' and other swampland habitats (Jarman *et al.* 1984 and Curtis & Morris 1994). The *Isoetes* in Lake Pedder was very likely not to have been *I. gunnii* but rather one of the other Tasmanian *Isoetes*, all of which are listed as R1 or R2. It occurred in Lake Pedder itself and to the best of our knowledge is not known from the new impoundment.

Appendix 2 lists the communities and their conservation status. The table lists the communities by their published classification names as well as by the mapping units which contain them. All those that have been classified in the published literature are listed as well-reserved (Kirkpatrick *et al.* 1994). The abundance of these communities is not indicated but most are widespread in southwest Tasmania. The beach sands and *Restio tetraphyllus* swamps are the most significant communities due to their relative rarity and because they provided habitat for several rare plant species.

Vegetation Dynamics
Macphail & Shepherd (1973) proposed a successional sequence as lakes infill. They suggested that a hydrosere of sedges developed - *Baumea rubiginosa*, *Lepidosperma longitudinale*, *Chorizandra cymbaria* - as shoaling occured. Following the succession of sedges, *Restio tetraphyllus* becomes established. On the root mat (sometimes partially floating) created by the *Restio*, woody species can then invade, including *Melaleuca squamea*, *Leptospermum lanigerum, Bauera rubioides* and *Sprengelia incarnata*. The scrub prevents wave erosion and the lake begins to infill further. With time rainforest species can invade, and indeed Macphail & Shepherd observed an abundance of *Tasmannia lanceolata* and sporadic individuals of *Gaultheria* and *Phyllocladus* (all bird-dispersed species). If these areas are burnt and the shrubs are killed *Gymnoschoenus* and other moorland monocots may invade on the accumulated peats resulting in the conversion of the community to a 'Blanket Moorland' (Macphail & Shepherd 1973). The moorlands are well adapted to fire, and recover using a variety of mechanisms including vegetative recovery, seed released from aerial seed banks and soil-stored seed.

The moorlands in the absence of fire may develop into 'Layered Blanket Moor' and eventually to 'Wet Scrub', eucalypt forest and rainforest (Jackson 1968). The process is likely to be extremely slow due to the extreme waterlogging and low nutrient status of the soils. The chances of a fire free interval long enough to achieve such a succession are small indeed. Nevertheless, there are examples of scrub and forest communities that contain suppressed and non-reproductive *Gymnoschoenus* individuals on tall pedestals, which appear very old, along the Scotts Peak and Gordon Roads and in the scrubby ecotones between moorland and rainforest on the track up the northeast ridge of Mt Anne. These communities look very much as though they have at some stage been dominated by buttongrass but have been engulfed by forest as the forest boundary has expanded. Such boundary movements have been described by Balmer (1990). Very good evidence supporting conversion of rainforest to moorland has been presented by Podger *et al.* (1988) for the Hogs Back Plain (lower Huon catchment area), and other examples of both transitions exist elsewhere in western Tasmania (Brown & Podger 1982, Dr Frank Podger, *pers. comm.*).

Weeds
The weeds known from the region are listed in Appendix 3. Despite extensive surveys along the Scotts Peak Road, few weeds were located except in the vicinity of the Strathgordon township and the quarry at Red Knoll lookout. Here the weed problem is of a manageable size (Tim Rudman *pers. comm.*). The species of particular concern if the impoundment were to be drained are the Pampas grasses, *Cortaderia* spp. These species are able to colonise low nutrient soils and can disperse over great distances. They favour wet and boggy areas and lake shores, and would have no difficulty invading the freshly-drained shores of Lake Pedder. Fortunately Pampas grass populations in the area are presently small and it would be relatively easy to eradicate these if a commitment was given.

REVEGETATION OF LAKE PEDDER IF IT IS DRAINED

Background to the Tasmanian Experience
Most buttongrass peatland revegetation experience in Tasmania follows mechanical disturbance of peats, for example road construction and mining operations. In these situations the peat is usually recovered from stockpiles or deep peats and replaced over the scarred areas. Soil stored seed is still present in the peats and seed dispersal from adjacent vegetation is readily achieved. The replaced peats are invariably better drained and less compacted than the undisturbed peatlands. The recovery of vegetation in these situations is highly variable. At Melaleuca the revegetation following mining has resulted in the recovery of most species present in the undisturbed vegetation, but scrub has replaced what was buttongrass moorland as a result of the improved drainage. Revegetation of the mechanically disturbed peats tends to be very patchy but can be achieved within about 5 years (Michael Cooper *pers. comm.*) In the absence of soil, the revegetation is a very long process unless treatments of fertiliser and direct seeding are applied. Even with treatment an effective cover would not be achieved for at least 15 years (Michael Cooper *pers. comm.*).

The Huon Plains east of the present lake were bulldozed in a number of places to provide temporary access to the lake from the Scotts Peak road. In some instances soil was removed down to the C-horizon or bedrock and here revegetation (unassisted) has been very slow. Moss, *Centrolepis* and *Drosera* species manage to establish in fine sand and *Restio tetraphyllus* grows where some soil has accumulated in ponds, but there is very little recolonisation by larger plants. This is in contrast to road verges, where the pile-up of soil has favoured rapid shrub growth. Also in marked contrast is the abundant regrowth in areas where the peat has not been completely destroyed or some soil deposition has been possible. Tracks showing on 1988 aerial photographs are in many places untraceable in 1994 under a heavy cover of cutting grass, tea tree, *Bauera* and *Restio tetraphyllus.* Thus impressive regrowth can occur on small mechanically disturbed sites in some areas over a rather short time but this seems to be strongly dependent on the extent to which the peat layer has been destroyed.

Revegetation Processes

The revegetation of the impoundment with higher plants will require a seed source. Moorland and scrub communities typically rely on vegetative regeneration following major disturbance events but in this case vegetative regeneration of the drowned vegetation will not be possible. Soil stored seed, and seed dispersal from the vegetation around the lakeside are therefore required to achieve revegetation naturally.

The process of revegetation may well be one of primary succession commencing with the rotting of the remains of the dead vegetation. There is likely to be a flush of algae as fungi, bacteria and invertebrates assist in the process of decomposition of the dead vegetation and nutrients are released. The bryophytes and lichens will be next in the progression as the peats become exposed. Many of the bryophytes have good wind dispersal and will be able to colonise these areas rapidly. The bryophytes will therefore provide a barrier to erosion even if the invasion of higher plants takes a long time. The water dispersed species are likely to begin colonising the stream banks and areas of overland water flow and then spread out from these situations. Soil stored seed may be triggered to germinate with the increase in oxygen levels but may also require some kind of disturbance. Any plants that do germinate from soil stored seed will then be a source of seed for surrounding areas in later years but most will take 3 to 10 years to reach reproductive maturity.

Soil-Stored Seed

There have been no studies of the soil stored seed bank of buttongrass moorlands in Tasmania, and the importance of the soil seed bank in the likely regeneration processes if the lake were to be drained is not clear. Nevertheless the literature reports that in general wetlands and peatlands do have soil stored seed (McIntyre *et al.*, 1988, McGraw 1987, Nicholson & Keddy 1983, and Leck 1989) suggesting that Tasmania's moorlands will too. Taxa reported to have viable stocks of seed in the soil include *Juncus*, *Carex*, *Drosera*, *Hypericum*, *Agrostis*, *Viola*, *Scirpus*, Ericaceae (Nicholson & Keddy 1983, McGraw 1987, Putwain & Gillham 1990). *Juncus planifolius* and *Restio tetraphyllus* are often found pioneering in revegetation sites in Tasmania.

The most relevant soil-stored seed bank study conducted in Tasmania was one of a high altitude sedgy-grassland with peat soils at Cradle Valley. Results showed massive germination of *Poa*, a few *Empodisma minus* seedlings and some herb species (Dr. Jennie Whinam *pers. comm.*). The presence of *Empodisma*, a common moorland species, in the seed bank suggests that it and other Restionaceae may also have viable seed in moorland soils. No species germinated that were not already present in the vegetation and so the age of the seed bank is not known and may be quite recent. No woody species germinated at all in the Cradle grassland soil seed bank trial, a characteristic that is noted in the literature (Howard & Ashton 1967, Schneider & Sharitz 1986). Fewer woody species seem to make use of a soil-stored seed bank as a regeneration strategy due to their typically longer life span, since the success of an individual breeding year is less important to their long-term persistence than it would be for a short-lived species (Schneider & Sharitz 1986). Early successional tree and shrub species are an exception to this general trend. *Acacia* and Fabaceae genera are well known for their hard-coated seeds that can survive in the soil seed bank for decades (Gilbert 1959, Priestley, 1986). Cremer & Mount (1964) report that *Pomaderris*, *Zieria*, and *Phebalium* regenerate after fire from soil-stored seed and can be absent from the pre-fire vegetation for several decades and still regenerate in abundance after fire. Regeneration of species not found in the standing vegetation may be due to long-lived seeds in some taxa (Fyles 1989), or long distance seed dispersal in some cases (Leck & Simpson 1987).

Seed longevity is affected by the environment and studies have shown that cold acidic wet sites preserve the seed banks well (Harper 1977). The anaerobic conditions of peat are ideal for long term conservation of biological material (Priestley 1986). Age estimates of 127 years for germinable seeds of *Juncus* and *Carex* were obtained from *Sphagnum* peatlands in West Virginia (McGraw 1987). Ancient germinable *Lotus* seeds were dated from a peat deposit in China as being around 530 years old while seeds older than this in the deposit were no longer viable (Priestley 1986). Reports of extraordinarily long lived seeds from Egyptian tombs are hoaxes and such long lived seed is unlikely (Priestley 1986). Priestley (1986) summarises what is known from the literature on the longevity of a range of species and concludes most are short lived, lasting less than a decade. Nevertheless there are many that last several decades but few remain viable for longer than 40 years.

Tasmanian tree species that are known to have long-lived soil-stored seed are *Acacia melanoxylon*, *Zieria arborescens*, *Pomaderris apetala*, and *Phebalium squameum*. All of these wet forest taxa require fire for their regeneration due to their inability to germinate and grow in low light conditions. Germination opportunities do not always occur in the wet forests which have unpredictable firing frequencies and succeed to mixed forest communities (Gilbert 1959) when the fire-free interval is longer than their life span of less than 130 years. In contrast the rainforest species *Atherosperma* and *Nothofagus* do not have a soil-stored seed bank but are able to regenerate without disturbance (Cremer & Mount 1964). It is possible that some moorland species may have long-lived seed to ensure that should succession to forest occur, a fire could allow them an opportunity to re-enter the vegetation from the soil-stored seed bank. However, although there is evidence of rainforest converting to moorlands, as for example at the Hogs Back Plain (Podger *et al.* 1988), a number of studies of single fire events in rainforest have failed to observe moorland species in the post-fire regeneration (Barker 1991, Hill & Reid 1984, Jordan *et al.* 1992). *Gymnoschoenus* seeds are relatively large and do not have a flight appendage (Curtis & Morris 1994) and are therefore not likely to disperse by wind over long distances. It seems likely therefore that for moorland species to replace rainforest, invasion must happen over time after frequent firing by incremental lateral dispersal via wind and water. The soil-stored seed bank may well be important in the first few decades, but evidence from rainforest fires suggests that it does not last centuries.

Research is needed to determine if a viable seed bank does still exist. There seems to be enough evidence in the literature that moorland plants do have soil-stored seed and that the wet peat environment is one that prolongs the preservation of seed suggesting that some seed may well still be viable. Two decades after flooding the soil-stored seed bank is very likely to have become impoverished given that many species have seeds that remain viable for less than a decade. Viable seed is reported to occur in the top few cm of the soil with few studies reporting viable seed at depths greater than 5 cm. Surface samples of peats from the impoundment bottom need to be collected and subjected to various treatments to induce germination.

If a soil-stored seed bank is found to exist it may be difficult to trigger the germination of this seed. Experimentation as to how this may be achieved on a large scale would be needed as well as determining whether a viable soil-stored seed bank is present. If a fire is needed to trigger this germination then it will come with the risk of increasing the chances of major peat erosion. The speed of colonisation by lower plants will be critical to prevent this.

Long Distance Dispersal of Seed

Dispersal of seed from existing vegetation around the lake shore is another important source of seeds for revegetation if the lake were to be drained. Mechanisms for this process are wind dispersal, water dispersal and dispersal by animals, including humans.

There are few if any places within the impoundment that are more than 2 km from the nearest source of vegetation. However, given that the prevailing wind direction is westerly the effective distance from vegetation sources for areas on the eastern edges of the lake may well be greater than 2 km and this distance is likely to be a barrier for the dispersal of many plant species.

Little information could be found on the seed dispersal distances of Tasmanian taxa. *Eucalyptus* is reported to have a dispersal distance of much less than 250m (Cremer 1966) and since *Melaleuca*, and *Baeckea* seed are of a similar size and shape these taxa may also have short dispersal distances. In a study in Finland (Salonen 1987), 99% of seed travelling the comparatively short distances of 250 m from the nearest vegetation edge had flight appendages. Thus one would expect that the only species likely to be able to naturally provide a source of seed to much of the drained impoundment area will be those that are able to disperse over great distances by wind or which are transported by water or animals. *Leptospermum* is an example of a species which although it has no flight appendage has relatively long, narrow seeds that are well dispersed at least after fire. Many of the moorland monocotyledons have relatively heavy seed without any flight appendage. They will therefore rely on water dispersal and animal dispersal which is likely to result in a slow and patchy revegetation process. To rely on natural dispersal may result in very slow and incremental revegetation with a low diversity of species for many years.

Issues affecting Vegetation Establishment

Other factors besides seed availability will also affect the speed of vegetation establishment. Edaphic factors have been shown to greatly influence the speed of vegetation recovery - in particular the presence of soil is very important for plant establishment. Peats were 30 cm deep in most parts of the valley and are still likely to be in good condition and not decomposed as a result of the flooding (Michael Cooper *pers. comm.*).

The peats are of low fertility and so the recovery from seeds may well be expected to be slow compared with re-establishment of plants by vegetative means after fire. The addition of fertiliser may well be advocated to assist species recovery but this carries with it the increased chances of weed establishment if a weed source is available. The issue of weeds would therefore require more serious attention.

Salonen (1990) showed that peat particle size appeared to correlate strongly with plant establishment. On peats with larger particle size the soils were more aerated and better drained and vegetation establishment was rapid. Areas with fine particle peats that were saturated for prolonged periods had only sparse vegetation cover after more than ten years. Some of the Huon - Serpentine Impoundment area was composed of poorly drained and frequently inundated wetlands and moorlands which have very fine textured muck peats, and revegetation by local species adapted to wet conditions is expected to be very slow.

The regeneration of *Calluna* from the soil seed bank in an English moorland was shown to be inhibited by the presence of a lichen-alga film which formed over the organic peat surface after a severe fire (Legg *et al.* 1992). Algae are often found across the peat surface in Tasmanian moorlands but their impact on seedling establishment has never been studied here.

CONCLUSION

The original vegetation of the Lake Pedder area was diverse and rich in species. It contained rare and threatened species and habitats which are elsewhere restricted and rare. It was therefore of special significance.

It is expected that following the draining of the lake the area would be rapidly colonised by fungi and bacteria which will decompose the dead vegetation, after which there is likely to be a flush of algae and colonisation by bryophytes. The plants best adapted to the newly drained lake environment are likely to be those that can cope with wet conditions. The problems posed to successful natural regeneration of the higher plant vegetation are potentially many but the presence of soil will certainly reduce the establishment time if a seed source is available. The soil-stored seed bank is likely to be impoverished and few species are likely to be able to disperse over distances longer than 250m by wind.

It is not possible to give a clear indication of how quickly the revegetation might take place without further research. It will be necessary to determine the viability of the soil-stored seed bank under the impoundment, the mechanisms required to trigger any viable seed in the soil and the number of species capable of long distance dispersal in the vicinity of the lake.

To ensure a rapid revegetation, active seeding is likely to be needed and should include a range of plants known from the original environment. Common species in the area included *Restio tetraphyllus*, *Lepidosperma longitudinale*, *Melaleuca squamea*, *Leptospermum lanigerum*, *Leptospermum nitidum*, *Gymnoschoenus sphaerocephalus*, *Leptocarpus tenax*, *Lepyrodia tasmanica*, *Empodisma minus* and *Lepidosperma filiforme*. The collection of such species might be achieved by slashing moorlands in nearby areas following the maturation of seed and spreading the slash over the drained impoundment area. The practical issues of this process are addressed elsewhere in this symposium volume (Duckett 2001).

A weed eradication program would also be required prior to and following the draining of the lake to prevent major weed invasions.

ACKNOWLEDGMENTS

The authors would like to express their thanks for valuable assistance and advice from Dr Michael Brown, Bill Brown, Dr Jennifer Whinam, Michael Cooper, Dr David Keith, Barbara Abbott, Stephen Harris, Michael Garrett, Tim Rudman, Peter Cinquini, Dr Michael Battaglia, Alex Buchanan and Ian Higginbottom.

REFERENCES

BALMER, J., 1990: Two moorland boundaries; *Tasforests*, Vol. 2 (2), p. 133-141, Forestry Commission, Tasmania.

BALMER, J., & HARRIS, S., 1994: *A Search for* Centrolepis paludicola *in Western Tasmania*; Parks & Wildlife Service, Hobart.

BARKER, M., 1991: The effect of fire on West Coast lowland rainforest; *Tasmanian NRCP Report No. 7*, Forestry Commission, Tasmania.

BRIGGS, J.D., & LEIGH, J.H., 1988: *Rare or Threatened Australian Plants*; Australian National Parks & Wildlife Service, Canberra.

BROWN, M. J., CROWDEN, R.K., & JARMAN, S.J., 1982: Vegetation of an alkaline pan - acidic peat mosaic in the Hardwood River Valley, Tasmania; *Australian Journal of Ecology* , Vol. 7, p. 3-12.

BROWN, M. J., & PODGER, F., 1982: Floristics and fire regimes of a vegetation sequence from sedgeland-heath to rainforest at Bathurst Harbour, Tasmania; *Australian Journal of Botany*, Vol. 30, p. 659-676.

BUCHANAN, A. M., 1995: *The Vascular Plants of Tasmania & Index to The Students Flora of Tasmania*; Tasmanian Herbarium Occasional Publication No. 5.

CORBETT, E., 1994a: *Anne*; Unpublished 1:25,000 Vegetation Map, Parks & Wildlife Service, Tasmania.

CORBETT, E., 1994b: *Scotts*; Unpublished 1:25,000 Vegetation Map, Parks & Wildlife Service, Tasmania.

CREMER, K.W., 1966: Dissemination of seed from *Eucalyptus regnans*; *Australian Journal of Forestry*, Vol. 30, p. 33-37.

CREMER, K.W. & MOUNT, A.B., 1964: Early stages of succession following the complete felling and burning of *Eucalyptus regnans* forest in the Florentine Valley, Tasmania; *Australian Journal of Botany*, Vol. 13, p. 303-322.

CURTIS, W. M. & MORRIS, D.J., 1975: *The Students Flora of Tasmania Part 1*; Second Edition, Government Printer, Tasmania.

CURTIS, W.M. & MORRIS, D.I., 1994: *The Students Flora of Tasmania Part 4B*; St David's Park Publishing, Tasmania.

DUCKETT, T., 2001: Practical cost effective rehabilitation of the current Lake Pedder impoundment; in: Sharples, C., (ed.), *Lake Pedder: Values and Restoration*, Occasional Paper No. 27, Centre for Environmental Studies, University of Tasmania, p. 117-124.

DUNCAN, F. & BROWN, M.J., 1985: *Dry Sclerophyll Vegetation in Tasmania. Extent and Conservation Status of the Communities*; Wildlife Division Technical Report No. 85/1, National Parks & Wildlife Service, Tasmania.

FLORA ADVISORY COMMITTEE, 1994: *Native Higher Plant Taxa which are Threatened in Tasmania*; Unpublished Report, Parks & Wildlife Service, Tasmania.

FYLES, J.W., 1989: Seed bank populations in upland coniferous forests in Central Alberta, Canada; *Canadian Journal of Botany*, Vol. 67(1), p. 274-278.

GARRETT, M. & KANTVILAS, G., 1992: Morphology, ecology and distribution of *Isoetes L.* in Tasmania; *Papers and Proceedings of the Royal Society of Tasmania*, Vol. 126, p. 115-122.

GILBERT, J.M., 1959: Forest succession in the Florentine Valley, Tasmania; *Papers and Proceedings of the Royal Society of Tasmania*, Vol. 93, p. 129-151.

GILFEDDER, L., 1989: *Five Rare Southwest Tasmanian Endemic Plant Species*; Unpublished Report for the World Wildlife Fund and the Tasmanian Department of Lands, Parks & Wildlife .

HARPER, J.L., 1977: *Population Biology of Plants*; Academic Press, London.

HILL, R.S. & READ, J., 1984: Post fire regeneration in mixed forest in western Tasmania. *Australian Journal of Botany*, Vol. 32, p. 481-493.

HOWARD, T. & ASHTON, D.H., 1967: Studies of soil stored seed in Snow Gum woodland; *Victorian Naturalist*, Vol. 84, p. 331-335.

JACKSON, W.D, 1968: Fire, air, water and earth - an elemental ecology of Tasmania. *Proceedings of the Ecological Society of Australia,* Vol. 3, p. 9-16.

JARMAN, S.J., BROWN, M.J. & KANTVILAS, G., 1984: *Rainforest in Tasmania*; National Parks & Wildlife Service, Hobart.

JARMAN, S.J., KANTVILAS, G. & BROWN, M.J., 1988: *Buttongrass Moorland in Tasmania*; Research Report No. 2, Tasmanian Forest Research Council Inc., Hobart, Tasmania.

JORDAN, G., PATMORE, C., DUNCAN, F., LUTTRELL, S., 1992: The effects of fire intensity on the regeneration of mixed forest tree species in the Clear Hill/ Mount Wedge Area; *Tasforests*, Vol. 4, p. 25-38.

KIRKPATRICK, J.B., 1987: *Management Oriented Vegetation Mapping for the Western Tasmanian World Heritage Area*; Unpublished Report for the Directed Wildlife Research Program, Department of Lands, Parks & Wildlife, Hobart.

KIRKPATRICK, J.B. & BALMER, J.B., 1991: The vegetation and higher plant flora of the Cradle Mountain - Pencil Pine area, Northern Tasmania; in: Banks, M.R., Smith, S.J., Orchard, A.E. & Kantvilas, G., (eds), *Aspects of Tasmanian Botany. A Tribute to Winifred Curtis*, p. 119-148.

KIRKPATRICK, J.B., GILFEDDER, L., HICKIE, J. & HARRIS, S., 1991: *Reservation and Conservation Status of Tasmanian Higher Plants*; Wildlife Division Scientific Report No. 91/2, Department of Parks, Wildlife & Heritage, Tasmania.

KIRKPATRICK, J.B., BARKER, P., BROWN, M.J., HARRIS, S., & MACKIE, R., 1994: *The Reservation Status of Tasmanian Vascular Plant Communities*; Tasmanian Conservation Trust, Hobart.

LECK, M. A., 1989: Wetland Seedbanks; in: Leck, M.A., Parker, T.V., & Simpson, R.L., (eds), *Ecology of Soil Seed Banks.* Academic Press, San Diego, California; Chapter 13, p. 283-305.

LECK, M. A. & SIMPSON, R.L., 1987: Seed bank of a freshwater tidal wetland: turnover and relationship to vegetation change; *American Journal of Botany*, Vol. 74, p. 360-370.

LEGG, C.J., MALTBY, E. & PROCTOR, M.C.F., 1992: The ecology of severe moorland fire on the North York moors; seed distribution and seedling establishment of *Calluna vulgaris*; *Journal of Ecology*, Vol. 80 (4), p. 737-752.

MACPHAIL, M. & SHEPHERD, R., 1973: Vegetation of Lake Edgar; *Tasmanian Naturalist*, No. 34, p. 1-17.

McGRAW, J.B., 1987: Seed bank properties of an Appalachian sphagnum bog and a model of the depth distribution of viable seeds; *Canadian Journal of Botany*, Vol. 65, p. 2028-2035.

McINTYRE, S, LADIGES, P.Y. & ADAMS, G., 1988: Plant species richness and invasion by exotics in relation to disturbance of wetland communities on the riverine plain, New South Wales, Australia. *Australian Journal of Ecology*, Vol. 13 (4), p. 361-374.

MORRIS, D.I., 1991: *Restio hookeri* (Restionaceae), a new name for a familiar Tasmanian species, and reinstatement of *Gahnia rodwayi* F. Muell. ex Rodway (Cyperaceae); in: Banks, M.R., Smith, S.J., Orchard, A.E. & Kantvilas, G., (eds), *Aspects of Tasmanian Botany. A Tribute to Winifred Curtis*, p. 33-34.

NICHOLSON, A. & KEDDY, P.A., 1983: The depth profile of a shoreline seed bank in Matchedash Lake, Ontario; *Canadian Journal of Botany*, Vol. 61, p. 3293-3296.

PODGER, F.D., BIRD, T. & BROWN, M.J., 1988: Human activity, fire and change in the forests at Hogsback Plain, Southern Tasmania; in: Frawley, K. J. & Semple, N. (eds): *Australia's Ever Changing Forests*, Proceedings of the First National Conference on Australian Forest History, Department of Geography and Oceanography, University College, University of New South Wales, Australian Defence Force Academy, Canberra, p. 119-142.

PRIESTLEY, D.A., 1986: *Seed Aging*; Cornell University, New York.

PUTWAIN, P.D. & GILLHAM, D.A., 1990: The significance of the dormant viable seed bank in the restoration of heathlands; *Biological Conservation*, Vol. 52 (1), p. 1-16.

SALONEN, V., 1987: Relationships between the seed rain and the establishment of vegetation in two areas abandoned after peat harvesting; *Holarctic Ecology*, Vol. 10, p. 171-174.

SALONEN, V., 1990: Early plant succession in two abandoned cut-over peatland areas; *Holarctic Ecology*, Vol. 13, p. 217-223.

SCHNEIDER, R.L. & SHARITZ, R.R., 1986: Seed bank dynamics in a Southeastern USA riverine swamp; *American Journal of Botany*, Vol. 73 (7), p. 1022-1030.

ZIEGELER, D., 1990: *A Survey of Weed Infestations within the Tasmanian Wilderness World Heritage Area and Peripheral Areas*; Department of Parks, Wildlife & Heritage, Tasmania.

APPENDIX 1:

HIGHER PLANT SPECIES FOR WHICH THERE ARE HERBARIUM SPECIMENS OR OTHER STRONG EVIDENCE TO SUGGEST THAT THEY OCCURRED IN THE AREA OF THE LAKE PEDDER IMPOUNDMENT.

Conservation Status (Kirkpatrick *et al.* 1991)**:**

EN Tasmanian endemic.
t Within Australia, occurs only in Tasmania.
r2 Taxa that occur in 20 or less 10x10 km National Mapping grid squares in Tasmania.
R Taxa that have limited distributions nationally following Briggs & Leigh (1988).
E Taxa that are likely to become extinct if present land use changes and patterns and other causal factors of decline continue.
e As for E but for Tasmania only.
V Taxa that are likely to become extinct over a longer time period than those classified E.

M Species in the Lake Pedder collection within the Tasmanian Herbarium but likely to have occurred only at high altitudes.

* Species not located in the Tasmanian Herbarium's Lake Pedder collection, but likely to have occurred in the area.

DICOTYLEDONAE

APIACEAE		
Actinotus bellidioides		
Actinotus moorei	EN	
Actinotus suffocata		
Hydrocotyle sibthorpioides		*
Lilaeopsis polyantha		
Oschatzia saxifraga	EN	
ARALIACEAE		
Pseudopanax gunnii	EN	
ASTERACEAE		
Erigeron stellatus	EN	
Helichrysum pumilum	EN	
Olearia persoonioides	EN	
CAMPANULACEAE		
Isotoma fluviatilis		
CASUARINACEAE		
Allocasuarina monilifera	EN	
CUNONIACEAE		
Anodopetalum biglandulosum	EN	
Bauera rubioides		
DILLENIACEAE		
Hibbertia procumbens		
DROSERACEAE		
Drosera arcturi		
Drosera binata		*
Drosera pygmaea		*
ELAEOCARPACEAE		
Aristotelia peduncularis	EN	
EPACRIDACEAE		
Cyathodes juniperina		
Dracophyllum milliganii	EN	M
Epacris corymbiflora	EN	
Epacris heteronema	EN	
Epacris impressa		
Epacris lanuginosa		

Epacris serpyllifolia	EN	M
Leucopogon collinus		
Leucopogon nova-sp.		
Monotoca glauca		
Monotoca submutica	EN	
Pentachondra pumila		M
Prionotes cerinthoides	EN	
Richea scoparia	EN	M
Sprengelia incarnata		
Sprengelia montana		M
Trochocarpa cunninghamii	EN	*
Trochocarpa gunnii	EN	
ERICACEAE		
Gaultheria hispida	EN	
ESCALLONIACEAE		
Anopterus glandulosa	EN	
EUCRYPHIACEAE		
Eucryphia lucida	EN	
Eucryphia milliganii	EN	
EUPHORBIACEAE		
Amperea xiphoclada		
FABACEAE		
Almaleea subumbellata		*
Dillwynia glaberrima		
Oxylobium ellipticum		
Pultenaea juniperina		*
FAGACEAE		
Nothofagus cunninghamii		
HALORAGACEAE		
Gonocarpus serpyllifolius		*
Myriophyllum pedunculatum		
Myriophyllum simulans		*
LAURACEAE		
Cassytha pubescens		
LENTIBULARIACEAE		
Utricularia dichotoma		
Utricularia lateriflora		*
LOGANIACEAE		
Mitrasacme montana		
MENYANTHACEAE		
Liparophyllum gunnii	t	r2
MIMOSACEAE		
Acacia mucronata		
Acacia verticillata		*
MONIMIACEAE		
Atherosperma moschatum		*
MYRTACEAE		
Baeckea leptocaulis	EN	
Callistemon viridiflorus	EN	*
Eucalyptus nitida	EN	
Eucalyptus brookeriana	EN	*
Eucalyptus vernicosa	EN	M
Leptospermum glaucescens	EN	
Leptospermum lanigerum		*
Leptospermum nitidum	EN	
Leptospermum scoparium		
Melaleuca squamea		
Melaleuca squarrosa		
PITTOSPORACEAE		
Billardiera longiflora		

PROTEACEAE		
Agastachys odorata	EN	
Banksia marginata		
Cenarrhenes nitida	EN	
Hakea epiglottis	EN	
Hakea lissosperma		*
Lomatia polymorpha	EN	
Persoonia gunnii	EN	
Persoonia juniperina		
Telopea truncata	EN	*
RANUNCULACEAE		
Anemone crassifolia	EN	M
Ranunculus acaulis	t	r2*
RUBIACEAE		
Coprosma nitida		*
Galium australe		*
RUTACEAE		
Boronia citriodora		
Boronia parviflora		
Boronia pilosa		
Phebalium squameum		
SANTALACEAE		
Exocarpos humifusus	EN	*
Leptomeria drupacea		
Leptomeria glomerata	EN	r2
SCROPHULARIACEAE		
Euphrasia gibbsiae ssp. *kingii*	EN	
Euphrasia gibbsiae ssp. *pulvinestris*	EN	*
Euphrasia striata	EN	*
STYLIDIACEAE		
Stylidium graminifolium		
THYMELAEACEAE		
Pimelea linifolia ssp. *linoides*	EN	
URTICACEAE		
Australina pusilla		*
Urtica incisa		*
WINTERACEAE		
Tasmannia lanceolata		

MONOCOTYLEDONAE

CENTROLEPIDACEAE		
Centrolepis monogyna	EN	*
Centrolepis paludicola	EN	r2 V
Centrolepis pedderensis	EN	e E
CYPERACEAE		
Baumea rubiginosa		*
Baumea tetragona		*
Carex appressa		*
Chorizandra australis		
Eleocharis gracilis		
Gahnia grandis		
Gymnoschoenus sphaerocephalus		
Isolepis sp.		
Isolepis subtilissima		
Lepidosperma longitudinale		
Lepidosperma filiforme		
Oreobolus sp.		M
Schoenus lepidosperma subsp. lepidosperma		
Tetraria capillaris		

HYDATELLACEAE		
Hydatella filamentosa	EN	r2 R
IRIDACEAE		
Diplarrena latifolia	EN	
Diplarrena moraea		
Isophysis tasmanica	EN	M
JUNCACEAE		
Juncus planifolius		
JUNCAGINACEAE		
Triglochin striatum		
LILIACEAE		
Blandfordia punicea	EN	
Drymophila cyanocarpa		
Milligania johnstonii	EN	r2 R
POACEAE		
Agrostis aemula		*
Agrostis rudis		*
Deyeuxia monticola		*
Ehrharta oreophila	EN	*
Ehrharta stipoides		
Ehrharta tasmanica	EN	
RESTIONACEAE		
Calorophus elongatus		
Calorophus erostris	EN	
Empodisma minus		
Leptocarpus tenax		
Lepyrodia tasmanica		
Restio complanatus		
Restio hookeri	EN	
Restio tetraphyllus		
XYRIDACEAE		
Xyris marginata	EN	
Xyris muelleri	EN	

GYMNOSPERMAE

PHYLLOCLADACEAE		
Lagarostrobos franklinii	EN	*
Phyllocladus aspleniifolius	EN	

PTERIDIOPHYTA

BLECHNACEAE		
Blechnum wattsii		
DENNSTAEDTIACEAE		
Histiopteris incisa		*
Hypolepis rugosula		*
Pteridium esculentum		
DRYOPTERIDACEAE		
Polystichum proliferum		*
Rumohra adiantiformis		*
GLEICHENIACEAE		
Gleichenia dicarpa		
Gleichenia microphylla		
Sticherus tener		
GRAMMITIDACEAE		
Grammitis billardierei		
HYMENOPHYLLACEAE		
Hymenophyllum australe		*
Hymenophyllum rarum		

ISOETACEAE		
Isoetes gunnii	EN	
LINDSAEACEAE		
Lindsaea linearis		
LYCOPODIACEAE		
Huperzia australiana		M
Lycopodium deuterodensum		
Lycopodiella diffusa	t	
Lycopodiella lateralis		
SELAGINELLACEAE		
Selaginella uliginosa		

APPENDIX 2:

CONSERVATION OF HIGHER PLANT COMMUNITIES THAT OCCURRED IN THE AREA OF THE LAKE PEDDER IMPOUNDMENT.

Conservation status as reported in Kirkpatrick *et al.* (1994), WR = well reserved

Community	Mapping Unit	Reservation Status
***Unclassified*:**		
	Lake Flora	?
	Beach Sands	?
	R. tetraphyllus Swamp	?
	Peat Pools[1]	?
***Classified*:**		
Southwestern Sedgy [1]	*Lepyrodia* Sedgeland	WR
Wet Standard[1]	Buttongrass/*Melaleuca squamea* Moorland	WR
Pure Buttongrass[1]	Buttongrass/*Melaleuca squamea* Moorland	WR
Standard Blanket Moor[1]	Short Buttongrass Moorland	WR
Mountain Blanket Moor[1]	Short Buttongrass Moorland	WR
Layered Blanket Moor[1]	Scrubby Tea-tree over Buttongrass	WR
Wet Copse[1]	Tea-tree Swamp	WR
Dry copse[1]	*Banksia* Wet Scrub	WR
Sedgy *E. nitida* Forest[2]	*Eucalyptus nitida* Forest	WR
Thamnic Rainforest with *Anopterus glandulosus* and/or *Cenarrhenes nitida* understoreys[3]	Rainforest and mixed forest	WR

***References to the Community Classification*:**

1 Jarman *et al.* (1988)

2. Duncan & Brown (1985)

3. Jarman *et al.* (1984)

APPENDIX 3:

EXOTIC HIGHER PLANT SPECIES RECORDED IN THE LAKE PEDDER IMPOUNDMENT AREA
(Source: Ziegeler 1990; see also Duckett 2001, this volume)

***Strathgordon Township*:**

Antirrhinum majus	
Betula pendula	Silver birch
Buddleja davidii	Butterfly bush
Calendula officinalis	Marigold
Cordyline australis	Cabbage tree
Cortaderia jubata	Pink pampas grass
Cortaderia selloana?	Common pampas grass
Crocosmia x *crocosmiiflora*	Montbretia
Cotoneaster horizontalis	Cotoneaster
Cupressus macrocarpa	Monterey cypress
Dahlia sp.	Dahlia
Escallonia rubra	Escallonia
Fuchsia magellanica	Fuchsia
Fuchsia sp.	Fuchsia
Grevillea sp.	Grevillea
Hebe speciosa	Showy hebe
Hebe sp.	Hebe
Hydrangea macrophylla	Big leaf hydrangea
Lepidium sativum	Nasturtium
Leycesteria formosa	Himalayan honeysuckle
Lonicera sp.	Honeysuckle
Ilex aquifolium	Holly
Malus sp.	Apple
Phormium tenax	New Zealand flax
Photinia robusta	Chinese firebush
Pinus radiata	Radiata pine
Polyscias sambucifolia	Elderberry panax
Populus sp.	Poplar
Quercus robar	Oak
Rhododendron sp.	Rhododendron
Ribes sanguineum	Flowering currant
Salix caprea	Pussy willow
Salix matsudana cv. *"Tortuosa"*	Tortured willow
Schizostylis coccinea	Kaffir lily

***Secondary weeds found along the roadsides*:**

Cirsium arvense	Californian thistle
Cirsium vulgare	Spear thistle
Cirsium sp.	Thistle
Cortaderia jubata	Pink pampas grass
Cortaderia sp.	Pampas
Rubus fruticosus	Blackberry
Rumex crispus	Curled dock
Rumex obtusifolius	Broadleaved dock
Senecio jacobaea	Ragwort
Typha latifolia	Cumbungi