Moorunde Wildlife Reserve

Land Management Plan

2014 – …

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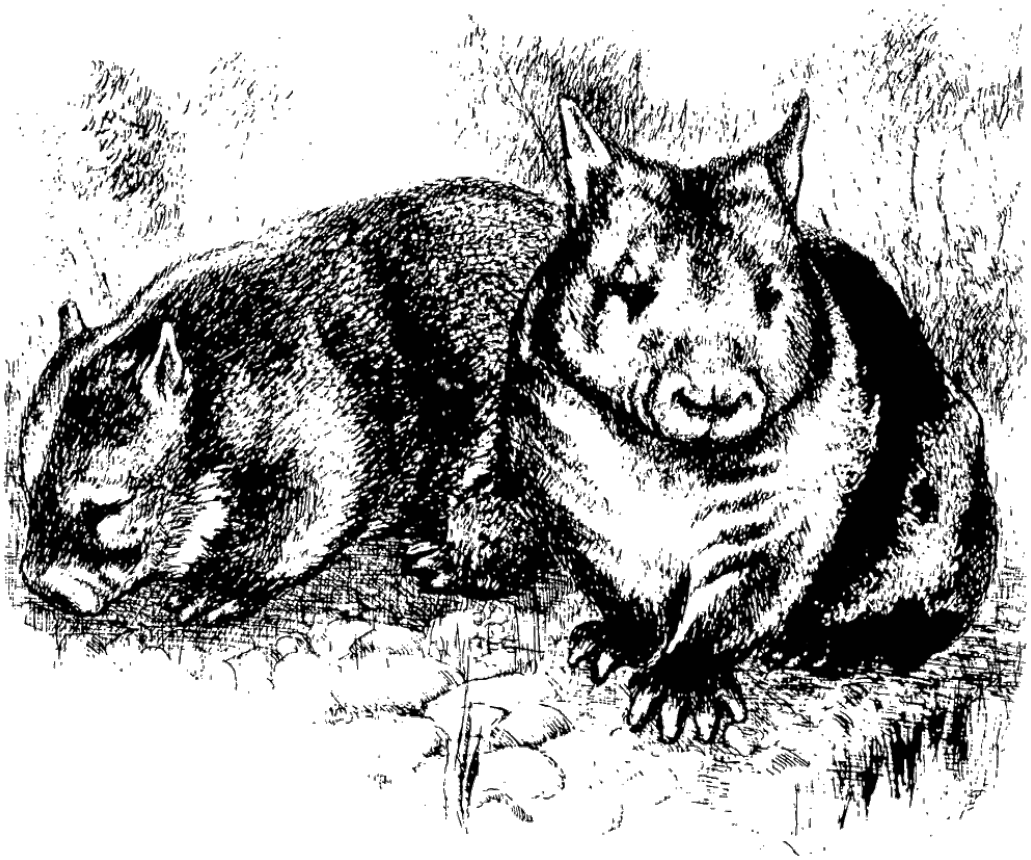

Developed by John Endersby with contributions by Graham Nye & Al Smith

Based on **Discussion Paper for the Management Plan of Moorunde and the Twelve Mile Plain Wildlife Reserve** submitted 24/7/2014 to committee → Management Committee meeting August 2014, written by John Endersby

The development of the Rhine Villa (Cambrai) and adjacent communities on the Murray Plains appears to have progressed very slowly, for several years, after captain Charles Sturt and his men rowed down the Murray River in 1830.

Eight years after this exploratory journey 'The Overlanders' brought the first cattle to travel overland from Sydney to Adelaide through this area. Joseph Hawdon, one of 'The Overlanders' wrote in his diary:-

"They crossed the Murray River on the 23rd March 1838" (near where Swan Reach stands today.) He also noted when travelling west "They were approaching hills without timber covering." After passing the future site of Sedan they moved towards a water course known as the Marne, and "Because they found plentiful grass and water they decided to rest the cattle before moving on to the eastern side of Mt. Barker"

"History of Cambrai – The Early Years"

Foreword

The Natural History Society of South Australia (NHSSA) is developing and implementing a Management Plan to oversee the management, maintenance and restoration of the Moorunde Wildlife Reserve. The current Moorunde Wildlife Reserve covers 7000 hectares of Mallee country in the Murraylands district of South Australia. From a property management perspective, the reserve consists of two main sections: the original 2,000-hectare Moorunde Wildlife Reserve established in 1968 on land purchased from Portee Station and a 5,000-hectare section that was acquired from Portee in 2007. This larger section is historically known as the Twelve Mile Plain. Together these two sections form the present 7,000-hectare Moorunde Wildlife Reserve. From here on the name "Moorunde" will refer only to the original 2,000 hectares, and Twelve Mile Plain referred to in the latter manner. The map (Figure 1) below shows these two sections comprising the reserve, and the location of the property in the Murraylands.

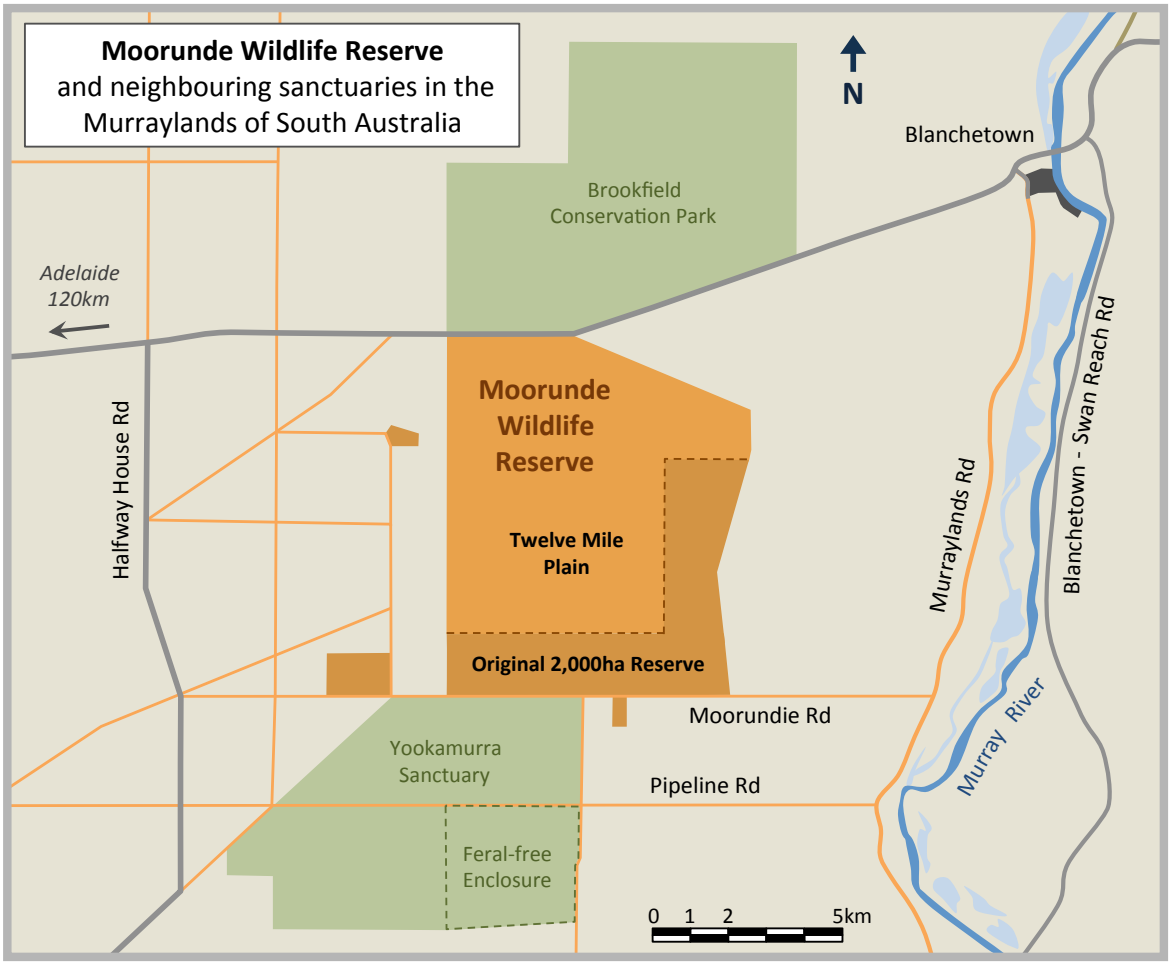

Figure 1: Map showing location of the two sections of Moorunde Wildlife Reserve.

Given the significant period of almost 40 years between acquiring the two sections for restoration and protection as sanctuaries for native species, the NHSSA is developing very different management approaches for the two areas. The original section (Moorunde) has been free of sheep grazing since 1967 and is relatively weed free, although Wards Weed and Thread Iris present an ongoing difficult challenge, and onion weed infestation is under way. The Twelve Mile Plain has had an extended period of over-grazing by stock and rabbits and has experienced significant invasion of Onion Weed in addition to Wards Weed and Thread Iris.

In the past, the Society generally adopted a minimal intervention policy on Moorunde, the original section. The section was fenced to exclude sheep and a regular weed patrol was conducted in an attempt to eliminate weeds and resist the influx of new weeds. This approach has had some success in almost eliminating many of the weed species such as Horehound, and Stemless Thistle but has not prevented the incursion of Wards Weed, Thread Iris and, recently, Onion Weed.

Despite this however, the original eucalypt-dominated areas of Mallee woodland, comprising approximately two-thirds of Moorunde, are good examples of this vegetation type. In contrast, invasion by exotic weeds on the Twelve Mile Plain has been left largely unchecked to the present date. Fortunately, there are large areas of this section that appear to be in a relatively good state of native vegetation diversity typical of Mallee woodlands, Myoporum woodland and tall open shrub-land. However, there are also extensive large areas of the Twelve Mile Plain, particularly in the north-east of the property that were once, most likely, large areas of native grassland, but are now heavily infested with Onion Weed, together with Wards Weed and Thread Iris.

The soil is severely "hard-panned" from excessive dry season digging over several years by wombats in search of Thread Iris corms. This hard-panning is a serious secondary problem response by the wombats to heavy grazing pressure from kangaroos. Hard-panning shortens the growing season for herbaceous plants in wet years and reduces the number of suitable years for any spear grass growth that may be present or re-established. It is within these areas of the property that the management plan is being focussed for more active intervention in the suppression of the exotic weeds and to re-establish the native grasses – grasses that provide an important food source for the Southern Hairy-nosed Wombats that this reserve was originally established to protect.

Moorunde Wildlife Reserve – History, Significance and Purpose

The original Moorunde Wildlife Reserve was established in 1968 by the Natural History Society of South Australia Incorporated, being approximately 2,000 hectares of roughly equal proportions of (1) Tall Open Shrubland with Scattered Myoporum Trees, (2) Mallee Scrubland, and 3) Grasslands, in the semi-arid region of the North-East pastoral district, southwest of Blanchetown, and once part of Portee Station. In 2007, the Society purchased an additional 5,000 hectares of Portee Station (now referred to as the Twelve Mile Plain) on the northern boundary of Moorunde, comprising similar vegetation with the addition of areas of Chenopod Shrub-land (Saltbush/Bluebush) and more extensive areas of Grasslands. However, this extra land, having been grazed by sheep for an additional 40 years was also rabbit-infested and in a more advanced state of degradation.

Moorunde was fenced and water was provided via tanks and ponds. The re-establishment of native vegetation on Moorunde (denuded by sheep and rabbit grazing) did not occur in a substantial manner until the commencement of rabbit baiting in 1994. This was too late to save the native grasses and their seed-bank. However, as the native grasses diminished in the 1970's, the exotic Ward's Weed took its place in providing grazing fodder for the wombats and kangaroos. Since then (due to the absence of the sheep and the baiting of the rabbits) the tall shrubs have invaded the Grassland areas and closed-up in the "Open" Shrubland. It is estimated that, in 1968, there were approximately 150 wombats [Taylor, unpublished data], on Moorunde (after the population was decimated from the 1967 drought). While current estimates are 500-600 southern hairy-nosed wombats on this original section of the reserve [Taylor, unpublished data]. It

is anticipated that the tall shrub intrusion will ultimately suppress even the Ward's Weed, and expectations are that wombat breeding will be suppressed, and, as a result, these numbers (500-600) will decline.

On the Twelve Mile Plain during the late 1970's attempts were made by the Portee Station owner to reverse the encroachment of native "woody weeds" (tall shrubs), by bulldozing, for the purpose of encouraging native grass growth for sheep fodder. This proved unsuccessful as by that time the local native grass seed bank was depleted and the introduced Wards Weed and Thread Iris became the dominant herbaceous plants in place of the native grasses. Encroachment by the introduced and unpalatable Onion Weed followed and invasion by the latter continues to advance. It has spread across approximately two-thirds of the Twelve Mile Plain and *dominates* roughly one quarter of it and continues to encroach with varying degrees of density depending on soil type.

The original motivation by the Society, to obtain and protect these areas, was to ensure the survival of the Southern Hairy-nosed Wombat, which is becoming a vulnerable species in the region - due originally to overgrazing by sheep, rabbits and kangaroos on station properties in the past. The invasion of kangaroos when sheep and rabbits were removed has increased and is exacerbating the advancement of weed-dominance into the Grasslands.

The combination of the cessation of managed burning practices by the original Aboriginal land owners (practices conducted for maintenance of grasslands and food supply) and the removal of sheep grazing has also resulted in the increasing dominance of "woody weeds" (tall native shrubs) over the grasslands that were present at the time of European settlement. During the 1940's the Mallee Scrub areas were adversely affected by the widespread cutting and harvesting of the Mallee Eucalyptus species for the production of charcoal, resulting in (at the time) the local extinction of the Bush Stone-curlew and the Mallee Fowl. Today the Mallee trees are in a fairly advanced stage of recovery and the signs of the two above bird species becoming re-established (although tenuous) are encouraging.

Volunteer rangers regularly patrol the fences. Volunteer working bees during our Visitor & Volunteer Days also maintain the reserve, removing weeds and repairing tracks and damaged fences. Research projects are ongoing such as monitoring wombat populations, DNA analysis of wombat scat to determine the species of plants they eat, erection of enclosures to monitor grazing pressure, and bird surveys.

Fauna

The **Southern Hairy-nosed Wombat** (Lasiorhinus latifrons) is one of three living species of wombat. It is found mainly in South Australia: in the Murraylands, scattered in Yorke Peninsula, the Gawler Ranges and in the Nullarbor Plains, in the west of the state, crossing over into Western Australia. The other two species are the Bare-nosed Wombat found in cooler areas of New South Wales, Victoria, Tasmanian and southeast South Australia and the highly endangered Northern-hairy Nosed Wombat of Queensland.

The Southern Hairy-Nosed Wombat is the faunal emblem of South Australia. It has been a focus animal for the Society since the establishment of the Moorunde Wildlife Reserve in 1968. Wombats are the largest burrowing marsupial. Southern Hairy-nosed wombats usually rest in burrows during hot dry days and emerge at night to feed on a range of herbaceous plants. Wombats have a strong sturdy body. Southern Hairy-nosed Wombats grow to about 30cm tall, 75-95cm long and weigh up to about 32kg. All species of wombat have suffered population fragmentation since European settlement of Australia through hunting, culling, land clearing, introduction of toxic weeds and competition from other native and feral grazers.

Moorunde was established at a time of major drought (1967) and many native animals were suffering the exaggerated conditions of this. The reserve was established to provide a sanctuary for Southern Hairy-Nosed Wombats with the hope that their populations would remain viable in this region. During periods of drought many wombats at Moorunde and the surrounding areas have been suffering severe malnutrition, leading to numerous ailments including skin lesions, fur loss and liver damage, often leading to premature death. (However, the author has noticed numerous wombats displaying these symptoms and death, during the flush of early Autumn and Winter growth.)

Brookfield Conservation Park, Swan Reach Conservation Park, Ridley Conservation Park and Moorunde (Twelve Mile Plain) Wildlife Reserve also support wombat populations. Current wombat populations in all parks and reserves are small. A high drought frequency makes these small populations particularly vulnerable to the detrimental effects of recurring poor seasons ... the occurrence of preferred wombat habitat (Grasslands) and drought refuge (Chenopod Shrublands) is limited and it is unlikely that Brookfield Conservation Park and (Moorunde/Twelve Mile Plain) as presently constituted, is capable of maintaining viable wombat populations. The areas set aside for wombats in this region are considered inadequate to ensure their long-term conservation [B.J. St John and J.M. Saunders – Plan of Management for the Hairy-Nosed Wombat in South Australia].

Current Management

- Currently Moorunde is being managed by "spot weeded" (by hand-spraying and hand-hoeing), annual rabbit and fox baiting and regular wombat population monitoring. Full scale rabbit baiting has ceased as of 2014 due to the ground being too rough to tow a bait layer.
- The thrust of the original management approach has been to 1) remove the sheep 2) "leave nature to take its course" 3) employ only "non-invasive" policies and practices.
- The main activities have been "spot weeding" and a yearly rabbit-baiting program (which only commenced in 1994). While two artificial "watering points" were also installed, that resulted in an influx of kangaroos and significant "desertification" around those areas. These artificial water points were disconnected in 2010 resulting in some recovery within these two specific locations.
- The rabbit-baiting program on Moorunde has been spectacularly successful in achieving more than 95% reduction in the local rabbit population and a rapid response in new shrub and Myoporum tree regrowth that is now replacing the existing older dying shrubs and trees. However, its success is now being overshadowed somewhat by the shrub regrowth becoming too dense. With a corresponding decline in the areas that were once grassland, while the grass density, now already critically low, continues to decline at an alarming rate and the "seed bank" heading towards complete depletion in most areas.
- The "spot weeding" on Moorunde has, to this date, been in the main successful with the weeds that are largely location specific. However, Wards Weed and Thread Iris now blanket all of the areas outside of the Mallee Scrub. Onion Weed is now present on Moorunde and the fact that it has invaded (despite vigilance) indicates that its spread is inevitable.
- Rabbit baiting on the Twelve Mile Plain commenced in 2008 and in terms of population control has largely been consistent with that on Moorunde. Its commencement *roughly* coincided with the removal of sheep in 2006. The combination of these two events has resulted in a dramatic recovery of Myoporum Tree and Tall Shrub regrowth. However, the depleted understory and ground cover recovery within the Mallee Scrub areas has been (and still is) much slower.

Paradoxically it has been observed that while in some locations the Tall Shrub regrowth is trending towards that of Moorunde in the form of becoming a "woody weed" problem over former grasslands, other areas have displayed an almost complete resistance to recovery. Or at best a recovery only in the less palatable shrub species. Without intervention, large to vast areas of once grassland will simply remain as Onion Weed infested wasteland or as bare duricrust with dying Myoporums, which is probably due to a rising salinity problem.

- The current policy for weeds on the Twelve Mile Plain is to "spot weed" a one-kilometre buffer zone against the boundary of Moorunde. However, this has not prevented Onion Weed from making patch invasions into Moorunde. Efforts at spraying Onion Weed between the wheel grooves and along the edges of access tracks on the Twelve Mile Plain, to reduce spread by vehicle movement, have resulted in more vigorous regrowth of germinating dormant Onion Weed seed, not having to compete with older established plants. While "spot weeding" of the other (generally location specific) weeds has never been complete enough to remove "those last one or two overlooked plants" that produce enough seed to ensure persistence.
- The kangaroo population (both Red and Grey species) has increased dramatically over the past 5-6 years for both Moorunde and the Twelve Mile Plain; to the extent that they have reached "pest/plague species" proportions. Culling is seen as an undesirable option (due to the reluctance or complete aversion by some members of the Society and public sentiment opposing it). Consequently, the plan below seeks to explore (at least in the short to medium term) a proactive management program that may in part address the issue. Nevertheless, long term carrying capacity of grazing animals will ultimately have to be addressed. Part of this plan is to create an **illustration**, to the conservation community as a whole, the importance of "population management" to sway opinion by means of **displaying an extreme contrast**. While at the same time exhibiting an effort to accommodate the kangaroo population by alternative non-destructive methods.
- The procedure will also adopt methods that are not conventional (in conservation terms) towards managing (as opposed to attempting to control or eradicate) the Onion Weed. To illustrate methods of accepting a "learn to live with it" philosophy.

Overall Key Goal

1. To, ***as far as possible***, return the landscape of Moorunde and the Twelve Mile Plain to that of pre-European settlement.
2. To actively develop and maintain a habitat suitable for, and of adequate size, to ensure the survival of a viable population of native fauna and flora found within the reserve.
3. In particular to ensure the survival of the Southern Hairy-Nosed Wombat in the Murraylands region.

Objectives

- To establish the Reserve as a "show-case" of what is possible to achieve in restoration work;
- To illustrate, with the application of a range of techniques, examples of methods to restore and manage degraded semi-arid areas (that were formerly sheep stations);
- To use these examples to instruct people interested in conservation in the methods employed;
- To educate people with a vested interest in wildlife protection, the importance of the principles of **"biomass carrying capacity"** and the **consequences of exceeding it**;
- To develop a program that encourages people to get involved;
- Liaise with other landholders and "stakeholders" interested in the Murraylands region
- Assess stocking rates of native species;
- Scientific value – Set up for research;
- Control of feral flora and fauna;
- Conserve biodiversity;
- Facilitating community involvement in conservation programs (in particular the indigenous community);
- Maintaining landscape connectivity with surrounding properties;
- Enhancing species resilience to the effects of climate change.
- Ensure that management decisions are based on the best available knowledge and information;
- Implementing management regimes that respond to flora and fauna population dynamics;
- Reduce the ecological impact of pest plants and animals;

Management

The following activities outlined below depend on a range of factors and variables where success is determined on regular monitoring and evaluation of progress. This necessitates a degree of flexibility in when and how projects are rolled-out and may be subject to change and whether or not a given activity has available finance for it to commence. Changes in technology may also have to be considered.

To a large extent the progress of the plan is dependent on obtaining funds from outside the society. Notwithstanding this, however, it would be negligent on the part of the Society to not commence until all the money required is raised. As a considerable amount of preliminary work is required to be completed before the core statements in the plan can commence.

Work such as:

- Harvesting/collecting available seed
- Surveying and staking-out the focus zones and fence lines
- Preliminary counts and GPS mapping of wombat warrens in the focus zones
- Extrapolating wombat population in the focus zones to establish a before and after result
- Mapping and monitoring the rising salinity problem
- Setting-up photo points
- And so on

Zoning of Moorunde Wildlife Reserve for Management Efforts

The Management Plan is being developed with different restoration methods to be trialled in different zones on the property. The zones have been selected based on the current degradation or otherwise of the local vegetation communities. Three different approaches (refer to map below) are proposed to be applied on the Twelve Mile Plain; each in accordance to the degree of degradation of the soil and Onion Weed infestation/invasion and the corresponding likelihood of recovery without intervention and address the "woody weed incursion". These three approaches fortuitously (in terms of levels of intervention effort) fall into three separate sections of the reserve. From worst to best they are the 1) the North East Section, 2) the Chained Section and the, 3) Lake and North West Sections. The following discusses the management methods for each of these Sections. The map (Figure 2) on the next page shows the property divided into the zones: A, B, C, D, E, F. Zones A, D, E and F are discussed first, followed by zones B and C.

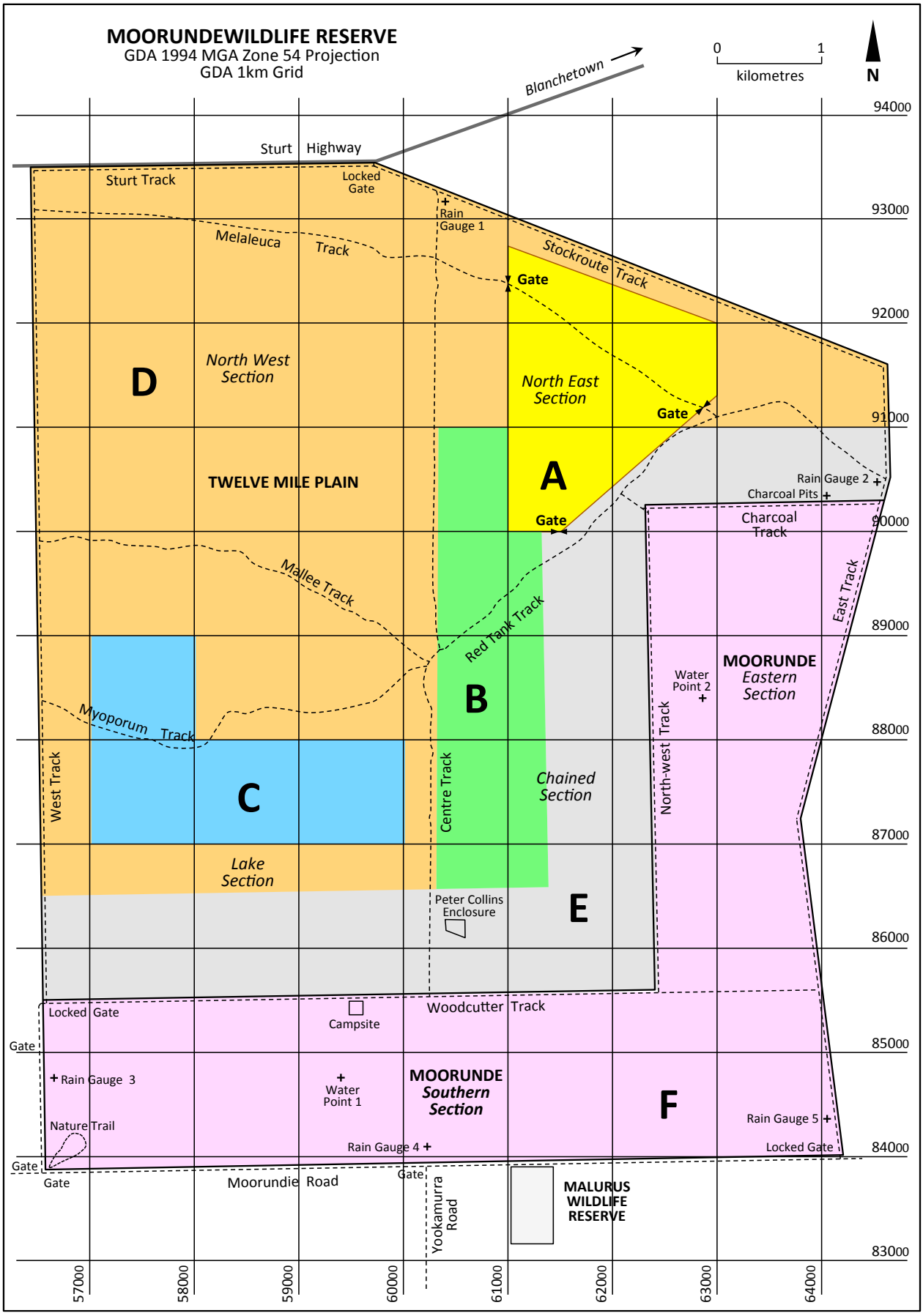

Figure 2: Zoning of Moorunde Wildlife Reserve for Management Efforts

Methods - Zone A: (North-East Section Twelve Mile Plain)

- There is no likelihood of acceptable recovery over almost all of this section and it will require intervention [McDonald, J, Willoughby et al]. This will involve the erection of a kangaroo proof fence to enclose a specific 4 square-kilometre (400 hectare) area – see attached map. Sub-surface wombat tunnels in the form of galvanised steel arches are to be installed in locations where the wombats subsequently burrow under the fence. These tunnels prevent kangaroos making use of the undermined fence. See Figure 3, an example of a kangaroo and goat proof fence.
- With some minor exceptions, this area is currently, in effect, a wasteland in terms of conservation value; where no further damage can be done [McDonald, J, Willoughby et al]. It is the area most heavily infested with onion weed, with most of it "hard-panned" caused by the dry soil summer digging of wombats looking for thread iris bulbs; and now displaying bare salt pan areas. Even with *all* grazing animals removed it will not recover and, in fact, is still in the process of decline [McDonald, J, Willoughby et al]. With exception of some Myoporum trees regrowth replacing the old dead and dying trees. Shrub growth recovery is in the process of developing over what was once a grassland area, into a combination of "woody weed" and onion weed infested scrub. The remainder has degenerated to bare duricrust in the dry season and Ward's Weed, Thread Iris and Onion Weed, with the rising salinity problem. It is also the area that has displayed the majority of sick, starved and dying wombats in the past, and the localised population has crashed to a minimum of a few individuals. In the event of a "hypothetical worst-case scenario outcome" intervention management of this land would simply revert to its current condition over time, ie even if nothing works the area would be left no worse off for the attempt.
- The proposed plan (once the enclosure fence is erected) is to systematically, over a number of years, suppress (as opposed to attempting to control or eradicate) the Onion Weed by using a range of various specific and targeted cultivation techniques. With a view to returning the soil to a condition that will enable native grasses to be re-established and out compete the weeds. This soil treatment will also address "hard-panning" and the rising salinity problems.
- The soil treatment will require techniques developed by the author from experience in dealing with the diversity in the topography and soil types in semi-arid regions. See Appendix: ***Equipment Required***. However, the appendix only deals with the hard panning and salinity issues. A decision may have to be arrived at on whether or not it is necessary to level the ground that the wombats have "moguled" in their search for thread iris bulbs. In that event the author recommends the use of what is known as *off-set discs* followed by light harrowing.
- It is envisaged that opportunities to train other, and preferably younger, machine operators to assist and continue the task into the future.
- It is assumed that the general reader does not have the land and soil management background, and or the local experience specific to the topography, soil conditions and weather/climate to the region. Nor any extensive knowledge of cultivation machinery and their various uses and applications for treating hard-panned and saline soil in a semi-arid environment. As this expertise is quite detailed and wide-ranging, it is outside the scope of this plan to go into further details on what implements are to be used, and when and how to use them.
- A staged approach, as opposed to a one-year coverage is proposed, for the following reasons:
    1. To spread the total workload for the machinery operators and other ancillary participants – who will play a vital role ensuring that research and monitoring of progress does not lag behind the activity.
    2. To increase the opportunity to train as wide a variety of people in all facets of the recovery programme, and to ensure effective liaison with other parties.

3. To accommodate the vagaries in the semi-arid weather/climate conditions.
4. To leave some areas temporarily unworked to provide grazing ground for those wombats still within the enclosure.
5. With all ventures that have some "novelty" aspect to them a step-by-step approach can provide increased learning benefit, facilitating subsequent improvement in technique in following years.

- As all of the kangaroos and almost all of the rabbits will be removed from within the 400-hectare enclosure, and only a minimum number of wombats still exist in this particular location, it is envisaged that native grass re-introduction will be a relatively easy process, as the author has extensive mechanical and broad-acre experience in sowing and establishing native grasses and has the necessary sowing equipment. See article "Growing Native Grasses in the Semi-Arid Murraylands of South Australia – December 2016", *trials, observations, data and results from growing native grasses on Moorunde Wildlife Reserve between 2014 and 2016.*
- In terms of time, in five years it may be possible to return the 400-hectare area from what is illustrated in Figure 4 (an Onion Weed infested claypan) and Figure 5 (a bare summer/autumn duricrust area dug over by wombats in the middle ground and dying Myoporum trees in the background) into what is displayed in Figure 6 (a blanket of seeding spear grass living amongst a tall open shrub-land with Myoporum trees) and/or what is illustrated in Figure 7. Figure 8 is an illustration of a commercially grown spear and wallaby grass field established using mechanical seeding methods for the purpose of providing grazing pasture for sheep on a property near Cambrai owned by the author.
- It would be possible to achieve the desired result in less time; however, reasons for not doing so are mentioned above. Conversely, a longer period of (say) up to 10 years may prove to be desirable for the sake of flexibility, further training or demonstration purposes, or from financial restraints, plus the availability of suitable seed.

Figure 3: Example of one design of a kangaroo and goat proof fence erected for land recovery on a property located in semi-arid land between Wilcannia and Cobar, NSW.

Figure 4: A typical example of an Onion Weed infested clay pan in the North East Section.

Figure 5: Bare duricrust. Wombats have dug over much of this and dying Myoporum trees are beyond.

Figure 6: A blanket of seeding Spear Grass growing amongst a Tall Open Shrubland with Myoporum trees.

Figure 7: "After establishing Moorunde Wildlife Reserve, rain fell in 1970. Photo of Berna on Moorunde amongst the Spear Grass (Stipa species), 1970" – Alwin Clements.

Figure 8: An illustration of a commercially–grown spear and wallaby grass field established using mechanical seeding methods for the purpose of providing grazing pasture for sheep on a property near Cambrai owned by a Society member (September 2014)

Methods - Zone D: Remainder of Lake and North-West Sections

2,500 hectares "Recent Recovery" Control Site, Minimum Intervention – Spot Weeding
As most of this area is Mallee Scrub or Mallee Woodland of varying degrees of density and Chenopod Shrubland and already dense tall shrubland (and not originally grassland) it should be left "as is" to act as a recent (since 2007) control site. The only intervention suggested is to undertake spot weeding as required (hand or spray), to control minor outbreaks of weeds, plus rabbit and fox baiting when necessary.

Methods - Zone E: East and Southern Half of Chain Section and Lower Third of Lake Section Sections

- 1,200 hectares "Buffer Zone", Continue Hand Hoeing, Spot and Boom Spraying
- Shortly after the acquisition of the Twelve Mile Plain, this area was designated to be a "weed free buffer zone" for the original L-shaped Moorunde Reserve – and so it is proposed to remain. The management methods of the weeds (as was originally decided) will continue to be hand hoeing, spot and boom spraying. As these methods do not directly attack the problem of the weed's "dormant seed bank" (in particular, Onion Weed), this area will provide a useful comparison to the effectiveness of the methods employed in Zones A and B (i.e. cultivation versus spraying)
- Note that this zone covers an equal area to the total area of those zones proposed for more active intervention, namely zones A, B and C.

Methods - Zone F: The Original 1968 Wildlife Reserve

- 2,000 hectares "Early Recovery" Control Site, Minimum Intervention as in original Management Plan – Spot Weeding
- The original Moorunde Wildlife Reserve was established in 1968 after the worst drought on record for South Australia (1967). Although significant areas here were once "grassland", since the commencement of the rabbit-baiting program in 1994, these areas have disappeared under an increasing density of native "woody weeds" (the tall shrubs in particular and, to a lesser degree, areas of chenopod shrubs). It is no longer practical to recover these Grasslands without taking measures that would be unacceptable (i.e. mechanical clearing) and they should now be left untouched to respect the sentiments of those early members who saw the advance of shrubs and Myoporum trees alone, as a measure of their success. Nonetheless, it must be understood that although this type of recovery provides a pleasant aesthetic and a habitat for certain creatures, it is not totally representative of the vegetation communities that once existed here – which definitely included Grasslands. It must also be noted that this change in vegetation communities has largely been a result of the rabbit control program since 1994 and not the exclusion of sheep in 1968. With this in mind, it is proposed to leave this zone to act as an "early (since 1968 or 1994) recovery" control site. As with Zone D, the only intervention suggested is to undertake spot weeding as required (hand or spray), to control minor outbreaks of weeds. However, the increase in kangaroo numbers which equates in an increase in kangaroo movement across the Reserve to and from areas heavily infested with Onion Weed the belief that the invasion of this weed, which is now well established, can be brought back under control is somewhat misguided.
- Mature Onion Weed plants set between 1,000 and 2,000 seeds per plant and the seeds are roughly the size of a metal pin head. When the pod bursts open the three ripe seeds are held in a cup like structure with the seeds covered in a moist glue-like film. This readily adheres to animal fur as they pass through and the seeds shake out of the pod cups. When the glue-like film dries the seed loses it adhesive ability and the seeds fall onto the ground. Therefore, during the seed ripening periods of the year kangaroo and wombat movement will constantly deposit seeds into new areas. Some seeds can remain viably

dormant for up to ten years. Soil disturbance such as hoeing established plants tends to stimulated germination and increase infestation. By far the best policy to handle this weed is to leave it alone, minimise grazing pressure, encourage native plant competition and learn to live with it.

Methods - Zone B: (Chained Section Twelve Mile Plain)

- This area was once largely grassland that was being invaded by "woody weeds" and a previous station owner attempted to remedy this situation by mechanical means – i.e. bulldozing the tall shrubs to remove them with a view to encouraging the grassland area last seen there in the early 1970s. However, overstocking with sheep plus neglecting to control the rabbits defeated this effort; with Wards Weed taking the place of the hoped-for grasses.

- Since the removal of the sheep in 2006 and the commencement of 1080 rabbit-baiting in 2008, the "woody weed" invasion has recommenced. With the addition of Onion Weed advancing into the more favourable grass growing locations. 1974 and 1985 being the last years in which Spear Grass grew at desirable quantities; [Taylor, Natural History Journal] although the "seed bank" was still sufficient up until 1995 to produce recovery (see Figure 9 and 10, illustrating Spear Grass on Lake Short; an area still within Portee Station until then). Since that time however, the Spear Grass "seed bank" is no longer capable of producing recovery without intervention and shrubs have taken over (see Figures 11 and 12).

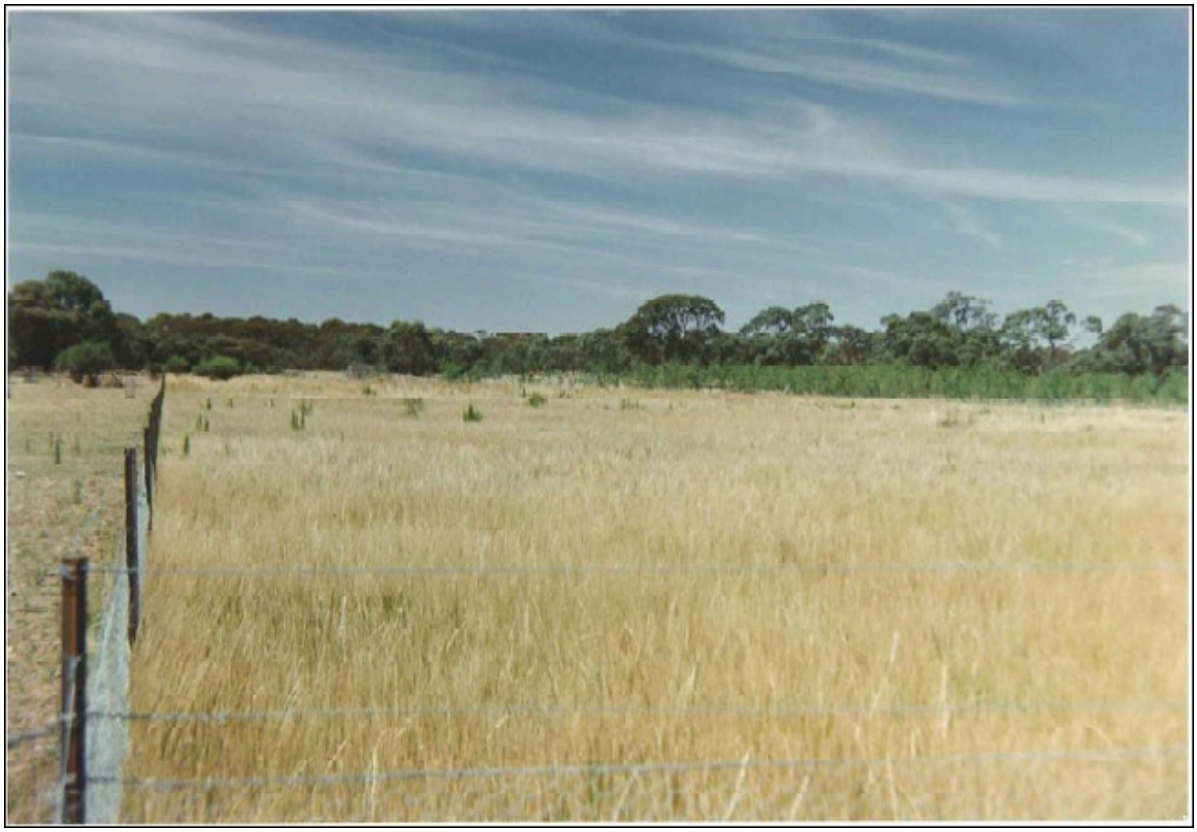

Figure 9: "Large enclosure (Lake Short, formally Portee Station) looking east along the longest extent of the area showing Eucalyptus seedlings beginning to reach above the grasses in the enclosed area" – photo Alwin Clements 1995 – take note of the date.

Figure 10: "Contrast between grazed and ungrazed, Lake Short, 18th November 1995" – photo by Alwin Clements. Note impact of grazing outside of the enclosure due to sheep which were still on the property at that time. The "green belt" in the background is the weed Tobacco Bush that germinated after the lake flooded in 1992—it has since died out.

Figure 11: Same enclosure as Figure 9 but taken from the other end and looking in the other direction. This photo was taken by Alwin Clements on 15th July 2006. Note: there was no advantage in fencing off to save the trees and shrubs and within 11 years they have choked out the grasses within the enclosure

Figure 12: "Lake area looking south, Lake Short, 15th July 2006" – photo by Alwin Clements. Note the growth of chenopod shrubs and the lack of Spear Grass and compare the date of this photo with that of Figure 10, taken a decade earlier.

- The sudden increase in the kangaroo population since the invasion of these animals during the eastern states drought of 2006 to 2010 and the cessation of culling by the former station owner has in effect replaced the grazing pressure (on the grasses) formerly applied by the sheep and rabbits combined.
- The recommencement of kangaroo culling is seen as an undesirable option – at least in the short to medium term. The plan aims to explore other options (or possible alternatives) and exhaust these in deference to those people who hold strongly to a "no destruction of wildlife philosophy". However, the necessity to actively manage the kangaroo problem may, unfortunately, become the only option to save the wombat population.
- Although the topography of the **Chained Section** (in its entirety) lends itself to being completely fenced off against kangaroos (as opposed to the entire **North East Section** that has water runoff gullies at its eastern end), and would be the preferred choice, this is considered impractical because:
  1. The cost is probably prohibitive.
  2. The current Onion Weed infestation is not so widespread and the wombat population is estimated to be somewhat higher due to a greater and more vigorous Ward's Weed pasturage. (Note: however, salinity problems are beginning to appear due to the Ward's Weed being grazed down by kangaroos, leaving the ground bare and increasing dry cultivation by wombats)
  3. It is desirable to explore methods to manage the kangaroos and see/test if it is possible to establish and maintain a "good stand of grass" despite their presence.
  4. The effort in (3) above will, in conjunction with the fenced off "show case" area in the **Zone A - North East Section** provide the **vindication** or **defensible position** for kangaroo population control – should the need still prove to be the only option!
- With the above in mind, it is proposed to systematically treat the soil hardpan and re-seed the grass (in selected areas over a number of years) in a designated four-square kilometre (400 hectares) strip 1 km wide, starting from one kilometre north of the Woodcutter Track, and adjacent to, and 50 metres east of, the Centre Track, and extending north for approximately 4.5 kilometres.
- Much of this area is not as thickly infested with Onion Weed as in that of the **Zone A - North East Section**.
- The main thrust here would be simply to "break" the "hard pan" effect and prepare a favourable

"seedbed" for sewing the grasses. That would increase germination and seedling survival. Areas of Onion Weed infestation will, in all probability, be avoided with regard to treatment, and simply re-seeded without preparation.

- However (in view of the kangaroo grazing pressure), it is proposed to have multiple "seed bank strip enclosures", fenced off to act as constant seed "resupply areas". These strip enclosures, are proposed to be 45 metres long and constructed out of chicken mesh in form of a long ridgeback tent style with an apron at ground level on both sides. As they will resemble the shape of a packet of Toblerone chocolates they will be (from here on, for the ease of conversation) referred to as Toblerone enclosures. It is proposed that these Toblerone enclosures be placed on a grid at 200m intervals – therefore requiring 25 enclosures per 100 hectares (one square kilometre).
- It is hoped that much of the seed from grass growing within these Toblerone enclosures will be "wind-blown spread" to areas that become grazed out and lose their seedbank. The intention is, therefore, to have these as seedbank resupply areas.
- Should this system prove to be of no or little significance in restoring the seed bank (with comparison made to the Moorunde control and Zone A area), the option is then open and defensible to discourage kangaroo habitation (if not visitation) by obtaining a DEWNR "destruction permit" and periodically have the kangaroos "driven off", for the benefit of the wombats.

Methods - Zone C: (Lake and North-East Sections Twelve Mile Plain)

These two sections are the least degraded and contain most of the Mallee Woodland and Mallee Scrub on the Twelve Mile Plain. Although a large portion of once open shrub-land has now "closed-in" and become too dense for grass to grow.

- However, understory and ground cover recovery within the Mallee has been somewhat slower than that of the "Tall Open Shrubland with Scattered Myoporum Tree" formations. A large strip of land formerly of "Tall Shrubs and Myoporum" was mechanically cleared south of the "Myoporum Track" and it is here that grass re-sowing is to be done. However, even this zone is rapidly being closed-in again by "Woody Weeds".
- With that in mind, it is intended to test a *third* option of grass recovery by simply sowing grass seed directly over the ground by using a modified garden leaf blower with a specially adapted receiver connected to the vacuum pipe (invented by author). A delivery rate could be as high as 8 kilograms of seed per hectare may be used. The seeding delivery rate may have to be reduced depending on financial constraints or seed supply.
- The total area covered per year would depend on time and resources available (including person hours).
- Some of the less dense "Tall Open Shrubland" plus areas of open "Mallee Woodland" could also be "grassed up"
- The aim would be to bring to completion this zone at around the same time as the other two zones.

Discussion

Research into the accounts and diaries of a number of early explorers and 'overlanders' crossing the Murraylands region, show that prior to European settlement (an introduction of sheep, cattle and rabbits) there were thousands of hectares of grasslands (in addition to Mallee Scrub, Chenopod Shrub-land and Tall Open Shrub-land) in the district, including the area that is now Moorunde Wildlife Reserve. Other indicators, such as the clumps of Bullock Bush (as opposed to single plants) created by the Aboriginal people (cutting their roots) to provide shelter spots to lure kangaroos to their shade for hunting purposes, support this conclusion.

To this date conservationists have focussed their efforts and seen as a measure of their success, the regeneration of Chenopod Shrubs and Tall Open Shrub-land, at the expense of these grassland areas. Observations from wombat population studies (Taylor 1997, unpublished data) show that grasslands were still in existence on original Moorunde at the time of writing his report. Further photographic evidence from 1968 to 2006 is available (Clements, unpublished data) which shows that spear grass was still in reasonable abundance up to and including 1985.

The rabbit-baiting program on Moorunde commenced in 1994, at a time when the rabbits were in plague proportions. It is most probable that the depletion of spear grass on the original Moorunde was **largely due to the rabbits and not sheep** (Photographic evidence, A Clements and J Endersby, unpublished data) since at that time kangaroo numbers were relatively low compared to the last 5 to 6 years (2008 – 2014). Surrounding properties where sheep are still run, but kangaroos and rabbits are controlled, still have abundant grasses.

An enclosure erected south west of Moorunde Campsite (in 1995) demonstrated the ability of the native grasses to fully recover within 12 months. However, an additional enclosure erected and connected to this original 1995 enclosure, in 2010 had subsurface Wombat Gates installed under the fence. It took two years for the wombats to learn how to use these gates and during that period no spear grass had germinated indicating depletion in the local seed bank. Despite the occurrence of several favourable years, in terms of rainfall and timing since then, for native grasses to grow. This has been replicated in a number of other smaller enclosures, erected by the author at various locations across the Reserve. Even with the expulsion of rabbits and kangaroos the seed bank for grasses on Moorunde is now insufficient to even tolerate the grazing pressure from the depleting wombat population.

Considering all of the evidence it can be determined that zones A, B and C were once either grasslands or open shrub-land with grass between the shrubs. They developed since the retreat of the last glacial period, some 12 to 15 thousand years ago, being managed and maintained by Aboriginal people who were here for tens of thousands of years prior to this last glacial period; People who played a significant role in manipulating the vegetation landscape that developed across Australia as the ice cover retreated (Gammage et al). It is therefore considered necessary to show respect to these now lost tribes and all off their current descendants by re-instating and/or preserving the country as much as possible as it was first discovered by European settlers.

Moorunde Wildlife Reserve is not our private domain. It was purchased to protect and manage the environment – "to actively promote by example the protection and preservation of the native flora and fauna of Australia as entire ecosystems in their indigenous habitats" (Natural History Society stated purpose). The grasslands were a significant part of that; and an essential component for the long-term survival of the Southern Hairy-nosed Wombat population of the Murraylands region.

Currently there are a number of areas within the Murraylands Region, and some close to Moorunde/Twelve Mile Plain Wildlife Reserves, where landholders have abundant grass growing in suitable years. These properties still run sheep; however, their kangaroo and rabbit numbers are under control. These areas offer far more favourable conditions for wombats to live in; while Moorunde/Twelve Mile Plain Wildlife Reserve and other areas such as adjacent conservation parks and private sanctuaries are rapidly declining in their value as refuges for these animals. However, land holders who run sheep may not always be favourably inclined to protect wombats and some do engage in active destruction of them (see Figure 13). This creates a paradox as the Reserves, parks and private land set aside to protect wombats are becoming less and less favourable for their long-term survival; while the best grassland areas are controlled by people who may be potentially hostile towards these animals. Hence, we have the disturbing position where in reality nobody is currently working towards the best interests of the Southern Hairy-nosed Wombat, unless and until direct manipulation of at least some of the reserved land is undertaken for them; their long-term future prospects are bleak.

The major thrust of this Management Plan is to address that paradox and set an example for other protected areas to follow.

It is hoped that all stakeholders support the Natural History Society in this endeavour; as these animals are unique to only four isolated areas in southern Australia, are vulnerable, and it is to be hoped to stop them becoming endangered.

Figure 13: Private property nearby Moorunde where sheep are run and good native grass grows. Land holder has ripped warrens with a bulldozer in an attempt to eliminate wombats from the property.