Growing Native Grasses in the Semi-Arid Murraylands of South Australia

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December 2016

On Wednesday 9th December 2015 at the Waite Campus of the University of Adelaide, the Natural Resources Management Board of the South Australian Murray-Darling Basin (NRM SAMDB) held a forum on Native Grasses. I was one of the speakers, introduced as a "Local Farmer" and allocated ten minutes to speak on "Sowing native grasses: a farmers experience".

Unfortunately this was not enough time to impart knowledge and experience that dates back to 1989—some 26 years. Where does one start speaking with just ten minutes to explain the following?

- Harvesting equipment that I had made
- Homemade sowing machinery designed specifically for Spear Grass
- Harvesting and seeding time
- Soils, soil preparation and soil salinity
- Locations for growing- where to sow
- Rainfall, seasons, germination and seedling survival
- Best sowing methods and times, seed quality and optimal seeding quantities
- Weeds, problems or benefits
- Grazing, pasture management practices and stocking rates
- Advantages and disadvantages over introduced pasture species
- My own trials and the data on them collected over twenty five years

Ten minutes when I needed three to five hours and there were eight other speakers for the night!

The frustrating thing is I couldn't do any of this. All I had time for was to flash a few pictures onto the screen of my pastures and some soil preparation, that left "a lot to be desired", my harvesting and sowing machinery, left unexplained and then… my time was up!. As the Forum facilitator was telling me to step down I put up a graph that illustrates the relationship between rainfall, rainfall events, germination and seedling survival; from 2007 to 2015. I could have taken the graph back to 1992, but didn't have enough room on the graph I had drawn it on (see below).

Basically the graph means that once you have learnt to read it, one can look at anybody's yearly rainfall chart from any semi-arid area in south eastern Australian and tell the following:

- When (approximately the day and certainly the week) certain Spear Grass species (such as *Austrostipa nodosa* and *A. eremophila*) would or could have germinated.
- If after germination seedlings survived either through the next month or next three months.
- If seedlings would have survived to a stage when they could set viable seeds.
- If the seedlings could survive three to four months into the following year, then continue to grow over the next year, if the right amount and combination of rainfall events occurred.

In other words, once the right rainfall events occur (for any season) one can predict the future for up to one, three or twelve months in relation to Spear Grass germination, seedling survival, plants seeding and survival into and beyond the following year. One can not only tell what could have happened in past years (in a paddock of Spear Grass pasture) but, if you know how to read the graph, you can predict the future!

The graph also shows that regardless of the yearly accumulated total rainfall, the grass will (or could) germinate, grow, seed down and survive into the following year with as little as 120–150 mm of rain in any given year, provided the rain and rainfall events are within the criteria set out in the graph are met.

Yet as interesting or useful the graph may or may not be and regardless of what any data anybody collects on the subject, it's all of little value in terms of broad area establishment (or re-establishment) without cheap, reliable and efficient sowing machinery. And that is what I consider to be my greatest achievement, making a machine that can quickly and easily

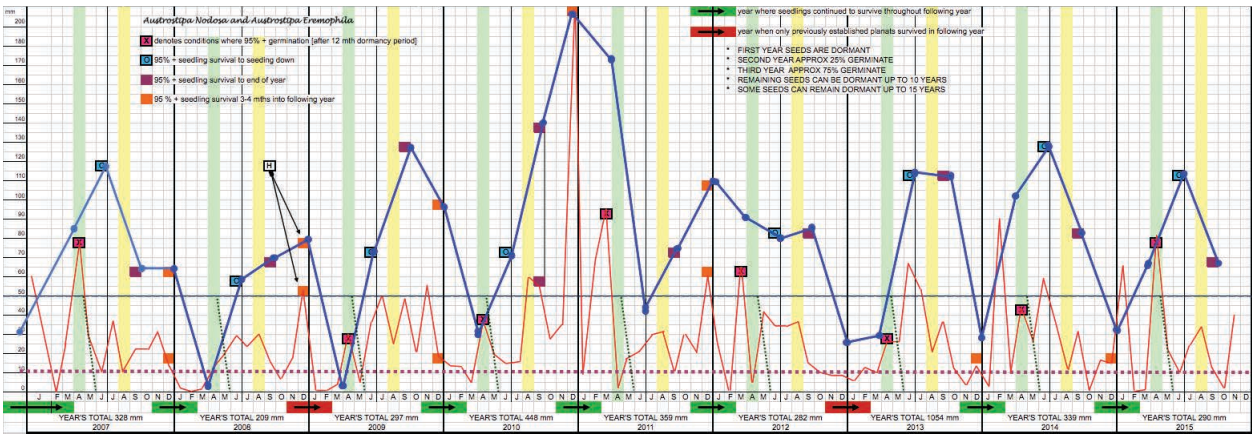


Figure 1: Graph of rainfall, rainfall events, germination and seeding survival presented at Native Grasses Forum. Enlarged later!

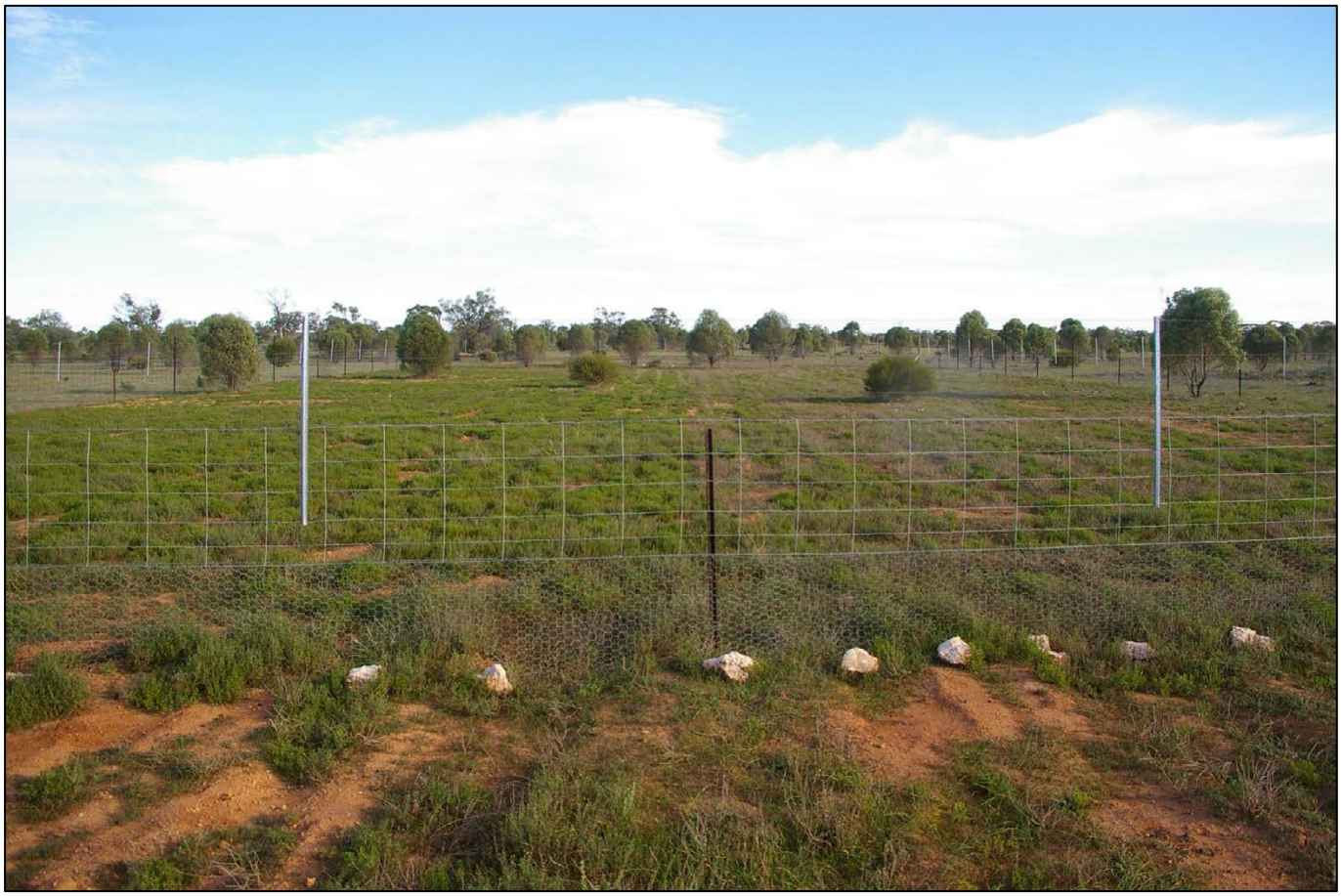


Figure 2: (27th July 2015) Arrangement Enclosure, 70 m x 30 m (2,100 m^2). 700 m^2 of the enclosure, from the galvanised wire spacer in the left foreground of the photo to the fence at the far left, was sown with seed. The remaining 1,400 m^2, from the left galvanised wire spacer to the fence at the far right, was planted out with "tube stock" Spear Grass and Wallaby Grass. The reason for this tube stock planting was to demonstrate to NHSSA Committee members the amount of work required and impracticality of trying to re-establish Spear Grass over several thousand hectares of Moorunde Wildlife Reserve using that method. This demonstration worked! The ground to the left of the dark steel "dropper" in the centre of the photo had two additional cultivations to ensure no "natural" grass survived. This encouraged the growth of an annual native Zygophyllum.

sow Spear Grass seed (or any other native grass species) over any ground while leaving the awns on the seeds still attached—Capable of sowing the seed straight from harvesting without any prior cleaning of trash and other impurities, and without "blocking up".

Yet for those people that were interested in what I had to say over those ten minutes it was the graph that most caught the attention of the Botanists/Ecologists present. The graph I drew up for the Forum covers seven years and was compiled from years of experience and the data came from my memory, using my own collection of rainfall charts. It was sufficiently interesting to prompt a number of Ecologists to come to my property to look in more detail. They also took the opportunity to see my sowing and harvesting equipment and inspect my native grass pastures, which had as it turned out, seven different species of native grasses and two species of native forbs.

However I suspect my visitors had hoped to see records and notes to support up my memorised information and in that they were a little disappointed. This omission I have since corrected with trials in two enclosures that I have been (and still am) collecting data from on Moorunde Wildlife Reserve—this time with written notes! For reasons that need not be explained, I have named these two enclosures:

- The Arrangement Enclosure
  70 m x 30 m (area 2,100 m^2)
- The Forgotten Enclosure
  60 m x 25 m (of 1,500 m^2)

Note: Moorunde Wildlife Reserve, located in the Murraylands is a 7,000ha property "held in trust for the people of South Australia" by the Natural History Society of South Australia, NHSSA.

For example, Figure 2 above shows the Arrangement Enclosure. The seeding trial was conducted on an area of 700 m^2 of the total 2,100 m^2 within the enclosure fence. The seeded section is on the left side of the photograph, between the left galvanised wire spacer and the fence at the far left.

So now I have three graphs and explanations on how to read them. The remainder of this article aims to provide an explanation for interpreting the "Forum Graph" and describes the grass seeding, germination and survival trials conducted in the two enclosures located on Moorunde Wildlife Reserve.

Rainfall Graphs, calculations and discussions of the two enclosures are presented later. First of all, the "Forum Graph", Graph 1.

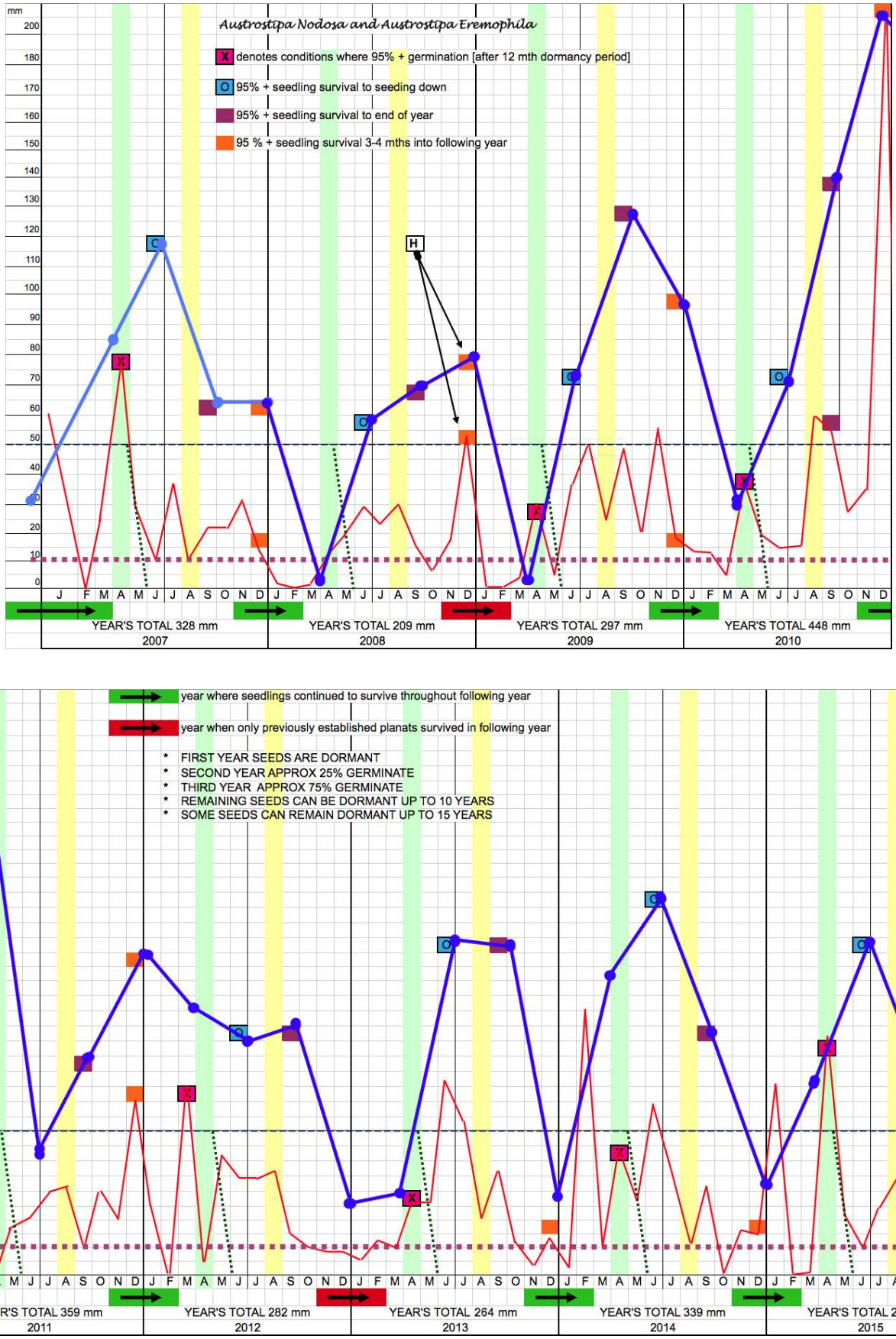
Rainfall, Rainfall Events, Germination and Seedling Survival, 2007-2015

Graph 1 on the next page is the enlarged graph shown in Figure 1, split into two parts to fit the page.

The graph provides a summary of:

- Accumulated rain fall over each quarter or season (blue line).
- Accumulated rainfall over each month (red line).
- Rainfall "thresholds" relevant to germination and seedling survival (purple dotted and black/blue dashed horizontal lines).
- The purple dotted line is a threshold of 10 mm of rain for any given month.
- The black/blue dashed line is a threshold of 50 mm of rain for each season of three months (although I consider this type of country really having only two seasons—spring and summer).

Graph 1. Rainfall, Rainfall Events, Germination and Seedling Survival, 2007-2015



Rainfall data, seed germination and plant survival observations from 2007 to 2015, collected at Endersby property, Cambrai, approximately 30 km southwest of Moorunde Wildlife Reserve.

The graph is divided vertically with heavier black lines for each year, then vertically with coloured lines for each three month season—or it's meant to be. The broad green line was meant to mark the end of March. The heavier black line is placed correctly at the end of June. The yellow line was meant to mark the end of September (not the beginning). My *"sechetary"* was in a hurry and made these mistakes!

You will also notice short green sloping lines running from the 50 mm threshold down zero. These represent the ability of *Austrostipa nodosa* to germinate from the beginning of May to the beginning of June, decreasing as the soil becomes colder—although "emergence" through to the surface (as opposed to sprouting at the seed) may occur into June. Other Spear Grass species (and other native grasses) may germinate in winter.

Interpretation – Part A

Note: there are a number of conditions and exceptions that can have adverse or advantageous effects that can alter actual events (these will be listed later).

The Black/Blue 50 mm Rainfall Threshold

- If the three monthly accumulated rainfall is at or above 50 mm the germination of grass can (as opposed to will) occur over the months of January, February, March, April and May. Then again over October, November and December.
- If the three monthly accumulated rainfall is at or above 50 mm then seedlings can survive through the following three months (generally regardless of the amount of rain over those following months).

The Purple 10 mm Rainfall Threshold line

- If the monthly accumulated rainfall reaches the 10mm threshold or more the germination of grass can (as opposed to will) occur over the months of January, February March, April and May. Then again over October, November and December.
- If the monthly accumulated rainfall is at or above the 10 mm threshold then seedlings can survive through the following months (generally regardless of the amount of rainfall in the following month).
- This means that this species of Spear Grass (*Austrostipa nodosa*) can potentially germinate and survive to seed down and survive into the following year with as little as 120–150 mm of rainfall in that year.

Other Factors

Below are listed a number of factors that can either enhance or otherwise influence germination, growth and mortality that cannot be represented on a graph.

Soil

- Moisture content at a "local" level (immediate topography and seed depth)
- Depth above calcrete layer
- Salinity
- Friability
- Type; e.g. clay, sand, etc.
- Temperature

Weather

- Total rainfall
- Rainfall events (e.g. drizzle/thunderstorm)
- Event clusters (e.g. over how many days) and duration
- Temperature
- Humidity and evaporation
- Wind velocity and temperature

Miscellaneous

- Seed viability, harvesting time, storage time
- Competence of operators (harvesting and sowing)
- Observation skills in collection of data

Interpretation – Part B

It is assumed that none of the above factors or conditions is too extreme to influence results in an adverse way. With that in mind, here are useful conclusions that one can draw from the graphed data.

Germination
January, February, March

Over the first three months of the year germination and emergence will occur if:

- The accumulated rainfall for the three months is 50 mm or more and …
- The accumulated rainfall for that month (In which germination occurs) is also 10 mm or more and…
- The rainfall events and clusters of rainfall days keep the top soil damp (at approximately 10% moisture to soil by weight) for at least one week at a depth of 10mm to 30 mm.
- This usually requires a cluster of rain days for a period of 3–4 days over that week, or in the case of a single rainfall event that day, high humidity and low surface evaporation.

Generally for January, February and March, all four of the immediately above requirements have to be met. In the case of the nine years over 2007 to 2015, this was the case for the years 2011 and 2012.

Seedling Survival/Mortality
January, February, March

- If the above conditions are met seeds will germinate and seedlings will emerge above ground. Survival through the following month generally requires an accumulated rainfall of 10mm or more for that following month or if…
- The 50 mm three months or more rainfalls within just the month of germination and the soil remains damp below and between at least the top 30–60 mm (at approximately 10% water to soil by weight) for two weeks.
- For the majority of seedlings to survive over the following three month period each of those following months requires an accumulated rainfall of 10 mm or more. However this is on a declining time scale – should the 50 mm accumulated rainfall for January, February and March come only over March then provided the soil moisture content below and between 50 mm and 100 mm is 10% (moisture to soil by weight) then a majority of seedlings will survive to June on little or no rain over April and May. Hot dry winds will however increase mortality.
- For March, in the event of germination and emergence occurring due to an accumulated one monthly rainfall of 10 mm and the soil surface from 5 to 20 or 30 mm remaining damp (at approximately 10% moisture too soil by weight) over one week; then for survival of the majority of seedlings only depends on the following month of April having an accumulated rainfall of 10 mm until June. Mortality will however be higher under this low rainfall, and soil types dictate the moisture holding capacity to the required levels.

Germination
April, May, June

- The minimum rainfall requirement for germination and emergence over these three months is for any given month to receive at least an accumulation of 10 mm rainfall or for the top 20–30 mm of soil to remain damp (at 10% moisture to soil by weight) for one week. This usually means a cluster of rainfall events of 3–4 days to occur over that week.
- However although emergence may continue to occur into mid-June and for other species into July germination (i.e. seeds sprouting) generally ceases by the end of May.
- Note: the graph for the Forgotten Enclosure indicates some emergence of grass up to mid-July; however this appears (at time of writing, August/September 2016) to be a species of annual grass, or Wallaby Grass or a winter germinating Spear Grass.
- In the case of the nine years from 2007 to 2015, germination conditions were met for every year except 2008.

Seedling Survival/Mortality
April, May, June

- Over April and May high mortality of seedlings occurs if the respective preceding monthly accumulated rainfall is below 10 mm but is markedly less for June.
- High mortality also occurs in May and April if each of these months does not receive at

least 10 mm of accumulated rain or moisture in the soil layer between 50–100 mm drops below 10%.
- However by June seedling survival over June and into July is virtually assured when conditions or criteria are met in April or May.

Seedling Survival/Mortality
July, August, September

Note: soil temperature is too low for germination in July, August and first half of September.

- Initial requirements are either a 50 mm accumulated rainfall over the previous three months or a monthly accumulation of 10 mm for each preceding month (for *Austrostipa nodosa*).
- In either case seedling mortality is minimal regardless of the rainfall amounts over July, August and September.
- However survival into October, November or December from September depends on either an accumulation of 50 mm of rainfall over these three months or a monthly accumulation of 10 mm for each of these months if the rainfall over July, August or September does not meet requirements.
- For the eight years over 2007–2015, had grass germinated hypothetically in 2008 (in the Murraylands District it didn't) conditions were acceptable for survival of seedlings into 2009. However, although seedlings did germinate in 2012, criteria for survival into 2013 (for seedlings) were not met; and mortality was > 95%.

Germination and Survival of Seedlings
October, November, December

- Work with tube stock and particularly in tubes that had no germination over autumn or winter shows that seeds will germinate and emerge over these months.
- "In field" observations also shows this does occur and growth rates are extremely rapid compared to autumn growth, provided enough rain falls to ensure survival.
- If the soil has been fallowed (i.e.: cultivated and weeds eliminated) the year previous to germination, rainfall requirements are relatively low.
- However I hold no notes or records of these events, except some photographs from two small 2.5 m x 2.5 m enclosures on Moorunde Wildlife Reserve, in an area I dubbed "The Badlands".

Discussion

I began establishing a native grass pasture on my property at Cambrai in 1989 and seeded some twenty hectares using various forms of machinery to achieve this over a period of five years. I finally settled on using a common garden leaf blower vacuum with various modifications and adapters attached as arguably the best method of seeding. As this method leaves the awn still attached to the seed head yet still separates most seeds into individual items. This enables seeding to be done on unworked ground and is quite successful provided the soil has not sustained too much damage (e.g. hard-pan or salinity).

Hence by December 2015, I had had some 26 years in not just seeding native grasses (particular Spear Grass species), but in establishing a native pasture, managing the grass as a "pasture" and observing plants germinate/emerge, grow, set seed and survive into later years, while using the pasture as an asset to graze livestock on it.

This was done without asking for advice, conducting no preliminary research and before I found out it was considered by others to be something difficult to achieve. Therefore I made no notes and except for rainfall charts and a few photographs kept no records. Hence the 2007–2015 graph which I could produce from memories of observations. As such, this was automatically branded by scientists as "*subjecture*" work! And of "limited value".

This also applies to management of the pastures and in particular grazing practices and pressures. However! I still have grass (planted in 1990) that is alive and thriving! And the grass is now rapidly spreading into unsown areas. So one can't claim I don't know how to manage native pastures. Since about 2010–2012 I have heard terms such as "rotational grazing", "set stocking", "pulse grazing" etc. used in relation to Native Grasses—grasses that have always been grazed since there were animals evolved to eat it. With regards to burning, I hear talk of "Fire Intensity", "Target Burning", "Fire Frequency and Direction", "Seasonal Burns" "When to Burn, When Not to", "Time of Day for Burning" and so on and so on. Yet in all of the reading and research I have done I find that nobody agrees on anything (in relation to Grazing or Burning) and they say that more research and trials need to be done.

While others are busy wondering, thinking and planning what type of research and trials they should be doing, I still have my grass; I have never burnt it; I know that it must be grazed or it dies out; and I manage it according to observable requirements and needs. I play it by ear as the saying goes; and that is how it always has to be managed.

Also note:

- I have never used chemical sprays.
- Burning would be necessary if (a) the grass is not grazed or cut or (b) if the pasture is being invaded by tall woody shrubs or trees—usually native and referred to as "Woody Weeds" or "Native Invader Species".

Germination & Seedling Survivability
Moorunde Wildlife Reserve
2015-2016

- **The Arrangement Enclosure**
- **The Forgotten Enclosure**

The demonstration trials performed within these two enclosures were conducted with appropriate documentation, note-taking, records-keeping, additional measurements and observations.

Figure 2 on page 2 shows the Arrangement Enclosure. Figures 3a and 3b (next page) show the Forgotten Enclosure.

"Rainfall Events", "Clusters of Rain Days", "Rainfall Clusters", "Evaporation"…

Moorunde Wildlife Reserve has five rain gauges placed at intervals around the perimeter of the reserve; these are read once per week by a volunteer ranger. The data is collected by the Volunteer Ranger Coordinator and from time to time monthly and yearly accumulations and graphs are published in the NHSSA newsletter. These records are about as useful as a tear in the top of a billiard table! For the following reasons:

- During the late spring, summer and early autumn evaporation from the gauges can be as high as 2 mm per day and up to 14 mm by the following week.
- The number of "Rain Days" are not recorded
- The "Cluster of Rain Days" and "Event Types" are unknown e.g. did the rain fall over 2,3,4 or 5 days or for say 2 days with a 1, 2 or 3 day gap then fall again for another 1, 2 or 3 days and so on. These "Cluster of Rain Days" are important for maintaining the duration of surface soil moisture and are therefore a key factor in germination and seedling survival. Of importance easily surpassing that of total monthly and yearly accumulated rainfall. Rainfall "Event Types" e.g. Thunderstorm, Light Rain, Heavy Rain, Prolonged Drizzle etc. are also key factors.

For this reason and on the first year (2015) of recording germination in the Arrangement Enclosure, I used my own Rainfall Records

Definition: "Cluster of Rain Days"

Two days of consecutive rainfall or three or more rain days over a seven day period.

from Cambrai, which is approximately 30 km southwest of Moorunde. While not ideal, as it happened the total "Yearly Accumulated Rainfall" for Moorunde was slightly higher and "Rainfall Events" and "Clusters" were similar. Although on average yearly rainfall for Moorunde is 275 mm and for Cambrai is 300 mm.

During 2016 I installed my own rain gauge at the Arrangement Enclosure to monitor rainfall

Figure 3a: (8th July 2015) Forgotten Enclosure, just after sowing Spear Grass seed. 60 m x 25 m (1,500 m2). Deep ripped (after rain) on 9th April 2015. The "worked ground" in front of the enclosure (in the foreground) is due to having to resort to towing the ripper and cultivator with my 4x4 Toyota Hilux (as I had no tractor) and the ute requires a large turning circle—unlike tractors that have turning breaks. Once again the "cultivation" (not the ripping) was for trial purposes only and to eliminate "natural grass" from affecting count results. Weed elimination is neither essential nor desirable for broad area pasture establishment in these semi-arid areas that can be so easily affected by strong wind if the year of expected germination turns out to be a drought year.

Figure 3b: (29th December 2016) Forgotten Enclosure, from east end looking west. Cultivated on 20th April and 24th May 2016 to eliminate "natural grass" from affecting results. Seeded on 8th July 2016 at 0.01 g/m², ten times less seed than practical broad scale rate of 1 kg/ha. Two sample strips each one metre wide running north-south and east-west totalling 84 m² monitored for germination and plant mortality. Final seedling count conducted 16th December 2016, 201 seedlings in 84 m² = 2.39 plants/m². Equivalent to 23.9 plants/m² for a sowing rate of 1 kg/ha. Mortality in 2017 was still to be assessed. However during a site inspection on 4th February 2017 we found the marker stakes had been pulled out and the gate left open by the NHSSA Committee—effectively vandalising an enclosure set up with an NRM grant.

in the immediate vicinity of both enclosures.

Rainfall quantities were thus measured at the trial sites during 2016, but "Events" were recorded based on those at Cambrai. Totals were recorded at Moorunde on the day after the last "Rain Day Event".

Evaporation

Initially I installed my own rain gauge in January 2016, to measure evaporation against the weekly readings from the gauges already on the Reserve by noting the difference between my "immediately after the event" readings and the weekly ranger readings. At the same time I also set up a small open top tank near the Moorunde enclosures to measure "Free Surface Evaporation".

This effort showed that the average evaporation from the five rain gauges over the months of January, February and March 2016 was 1.60 mm/day.

[Note, the tank evaporation gauge indicated an unrealistic "Free water surface" evaporation of 73.3 mm/day! More than ten times the average monthly evaporation in the district—suggesting that the equipment was being tampered with and therefore of no value.]

Evaporation of water from the soil surface was not tested. However during soil salinity tests, soil moisture content as a percentage by weight was measured at emergence (grass in early first leaf stage) and again when the grass was established to the third or fourth leaf stage. Results were 10% and 6% (moisture to soil by weight) respectively down to a depth of 100 mm, using a soil core/extractor.

Moisture content in the soil as it soaked down from the surface to 100 mm and the duration of soil moisture at increasing depths was not recorded.

Rainfall, Rainfall Events, Germination and Seedling Survival, 2015-2016

Graph 2 (four six month parts) and Graph 3 (two six month parts) show rainfall and observations for the Arrangement Enclosure and the Forgotten Enclosure respectively. The Arrangement Enclosure was erected and seeded in 2014, so Graph 2 covers two years 2015 and 2016. The forgotten enclosure was erected and seeded in 2015, so Graph 3 shows results for one year 2016.

The graphs contain the following information:

- Accumulated Weekly Rainfall.
- Accumulated Monthly Rainfall.
- Accumulated Quarterly Rainfall ("traditional seasons").
- "Rainfall Event Days", any week with two or more days of rain is a "Rainfall Event Cluster".
- The day and date when the Enclosures were inspected.
- The day when any grass plant is seen to have emerged through the top soil.
- The estimated day the seed sprouted in the ground.
- Some seedlings die, leaving (for a short time) one or more dead leaves—usually very difficult to detect.
- When seedlings (sometimes already seen emerged in first leaf stage) are seen with two leaves (and or occasionally the third leaf is just appearing).
- Seedlings marked that later turned out to be a different species.
- Various stages of emergence growth and "running up to head" and setting seed were photographed and the dates. recorded.
- The date seedlings were counted (which didn't commence until late September in the Arrangement Enclosure) On each "Count Day" they were marked with a stake. "One Pass" counts can have up to a 30% error, so to reduce this, counts were repeated 2-3 times depending on size of seedling and extent of weed cover. All counts were done "on hands and knees" and using x2 spectacles until the seedlings reach a multi leaf stage and can be detected (with ease) while standing.
- Day (approximately) seed heads appeared/observed.

Notes

- Graph 2(d) Arrangement Enclosure July–December 2016 shows rainfall only. Detailed observations during this period were conducted in the Forgotten Enclosure.
- Generally no seed germinates until the second autumn/winter period after sowing! Therefore a distinction has to be made between "year of sowing" and "first year of germination"
- Generally only approximately 20–30% of seed (that will germinate) does so on the "first year of germination" with about another 40–60% germinating on the "second year of germination" (which is the next suitable year) with remaining viable seed staying dormant for up to 10 years. The ranges (20–30% and 40–60%) are dictated by the type or combination of rainfall "Events" and "Clusters" on the year the grass germinates.

Discussion and Description of Methods in Enclosures

Once the seedlings reach the second leaf stage (which occurs within a few days of emergence) they are amazingly resilient at surviving on almost unbelievably low amounts of rainfall. However first year growth is very slow in comparison to year two.

After year two grazing becomes almost essential for good growth and health of the plants. By year three the plants become inhibited in their growth and vigour if there is a predominance of "dead leaf". Figures 4a—4e are included to illustrate this issue.

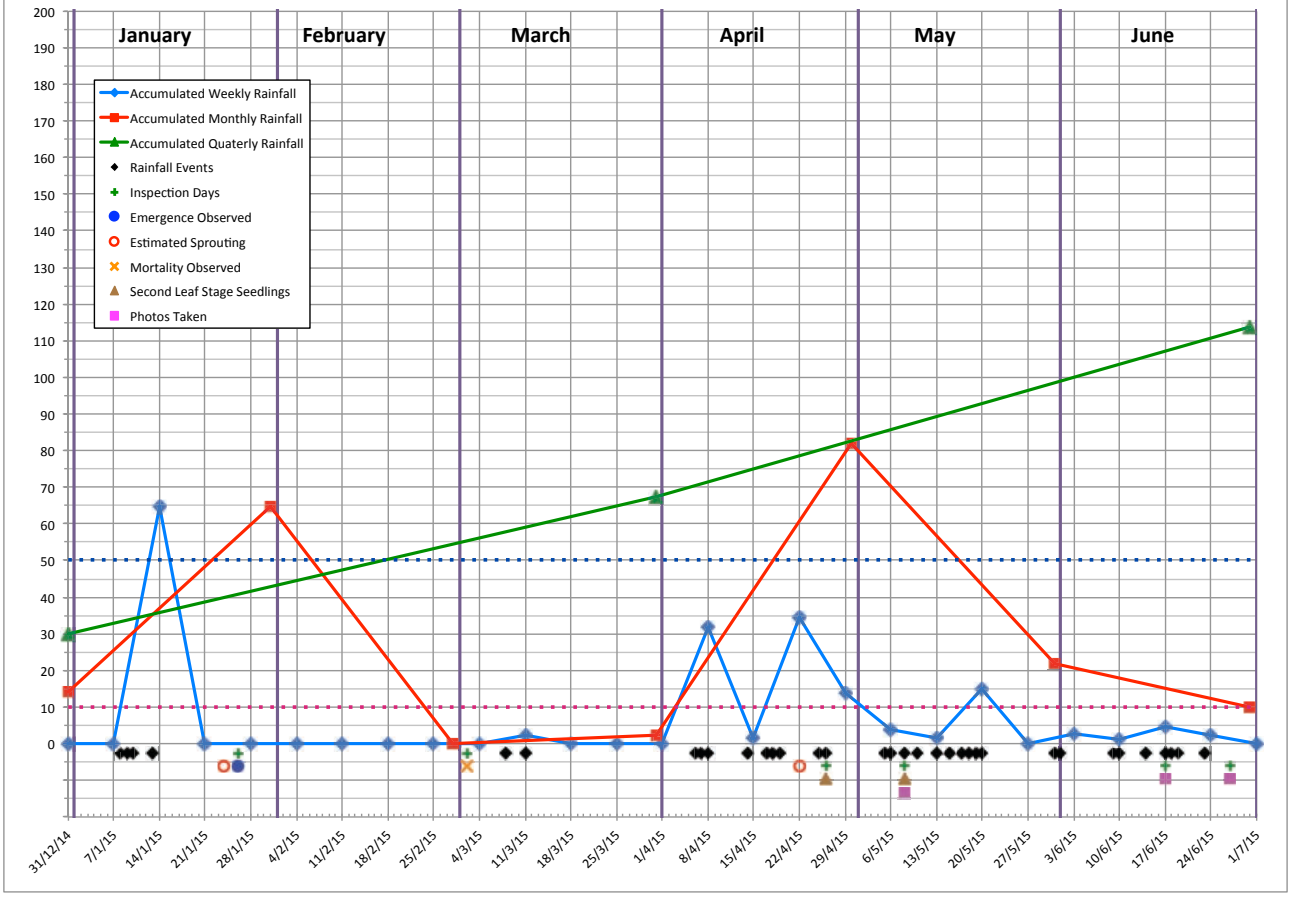
As a "rule of thumb" essentially no grass (Spear Grass) germinates on the year of sowing. However observations and experience with tube stock shows that some spring germination does occur. Photographs of grass plants growing in a third set of enclosures (setup for alternative purposes) show this does occur as the area (1) was cultivated over two seasons (2014 and 2015) to eliminate Onion Weed and then sown in May 2015 and area (2) was cultivated over Autumn, winter and Spring of 2014 and residual Onion Weed was sprayed in May 2015 prior to sowing with Spear Grass. This extended period of fallowing enabled Spear Grass to germinate (and survive) in late September 2015, and demonstrate startling growth rates in 2016 (see Figures 5a—5c).

Seedling survival and growth rate are enhanced with some form of preparation that loosens the soil (compare Figures 4a and 6).

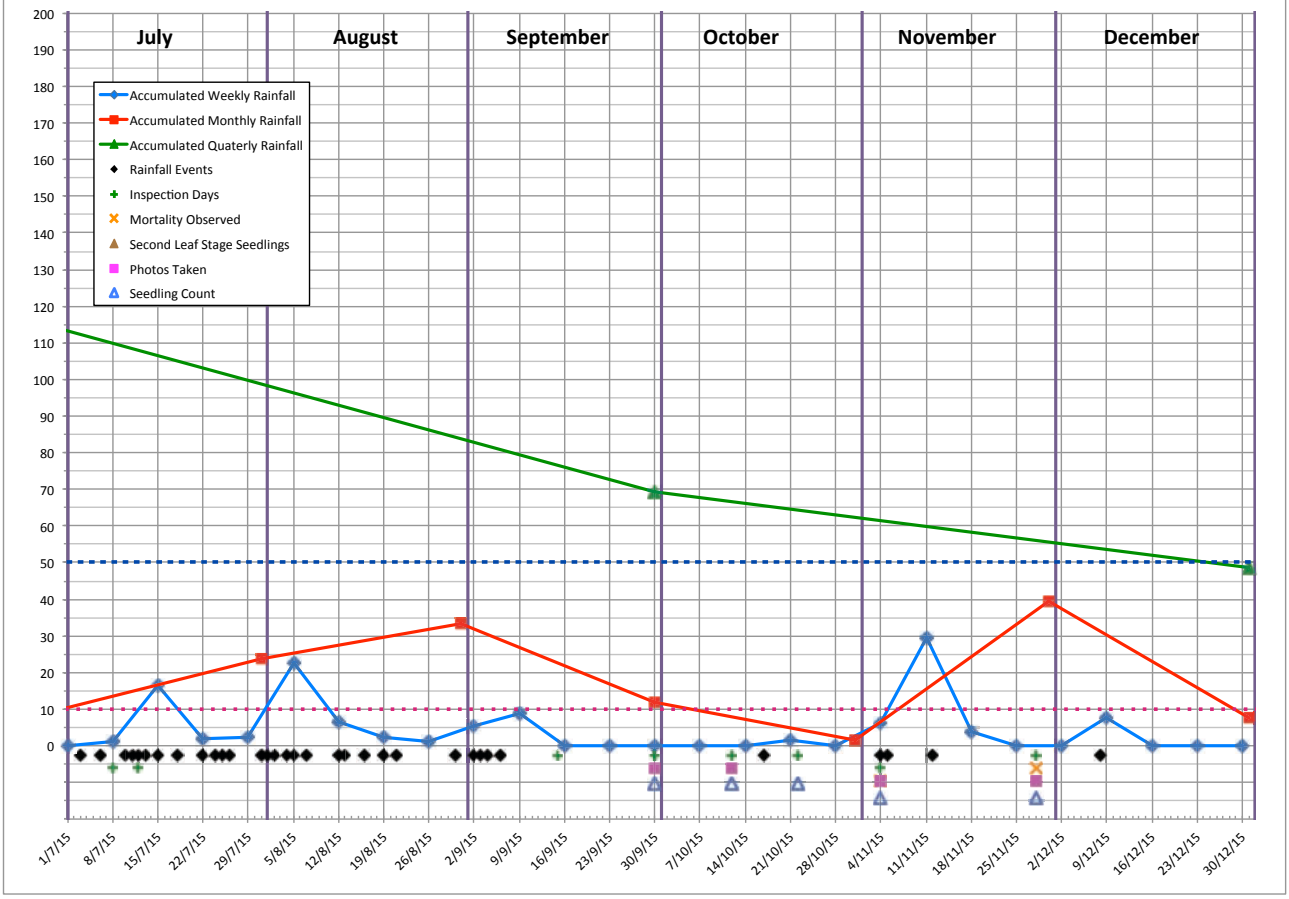
The Arrangement Enclosure Seeded 2014

- This enclosure was deep cultivated five times in 2014 prior to seeding at a rate of 0.01 g/m^2 (equivalent to 100 g/ha)
- Seeding was done over 700 m^2 (the remaining 1,400 m^2 of the enclosure was planted with tube stock separate from this study)
- Seed was broadcast using a garden leaf blower with "an attachment" on the suction pipe that separates "clotted" or "matted" seed and the seed from "trash" or parts of the seed head stems.
- Date of seed broadcasting was 17th May 2014
- A second seeding was done at 0.01 g/m^2 on 9th November 2014 (meaning none of this germinated until 2016)
- The reason for the cultivation and the number of cultivations were:
  - To break up the hard-pan created by years of dry digging (over summers and early autumn months) by wombats searching for Thread Iris corms to eat.
  - To level the ground- as it was "pock marked" by the wombats; with holes up 15 cm deep and each hole was immediately adjacent to surrounding holes.
  - To enhance drainage of soil and reduce top soil salinity levels, which fell from 20 dS/m to 8 dS/m 12 months after cultivation (while immediately outside the enclosure salinity remained at 20 dS/m).

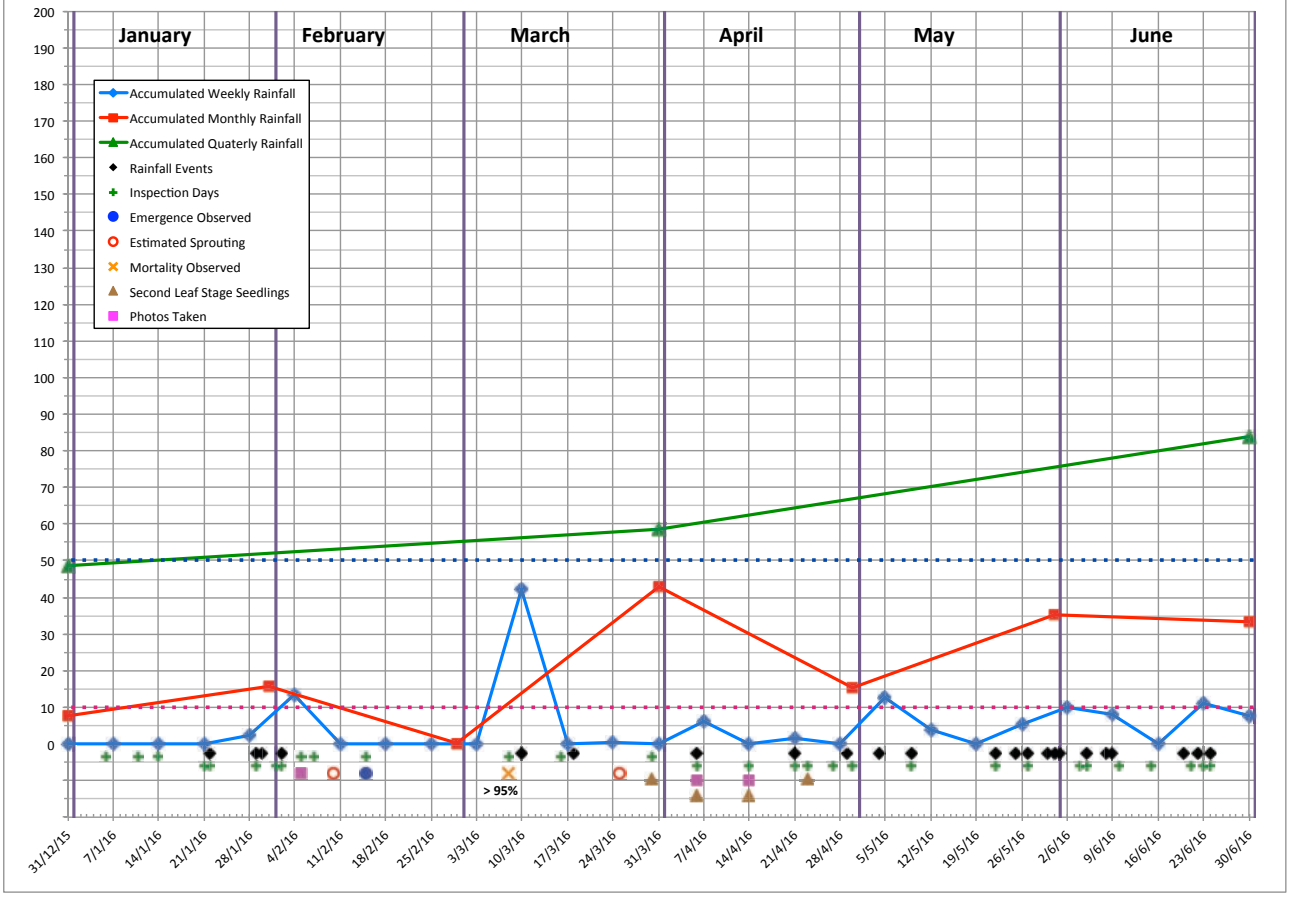
Graph 2(a) Arrangement Enclosure January to June 2015



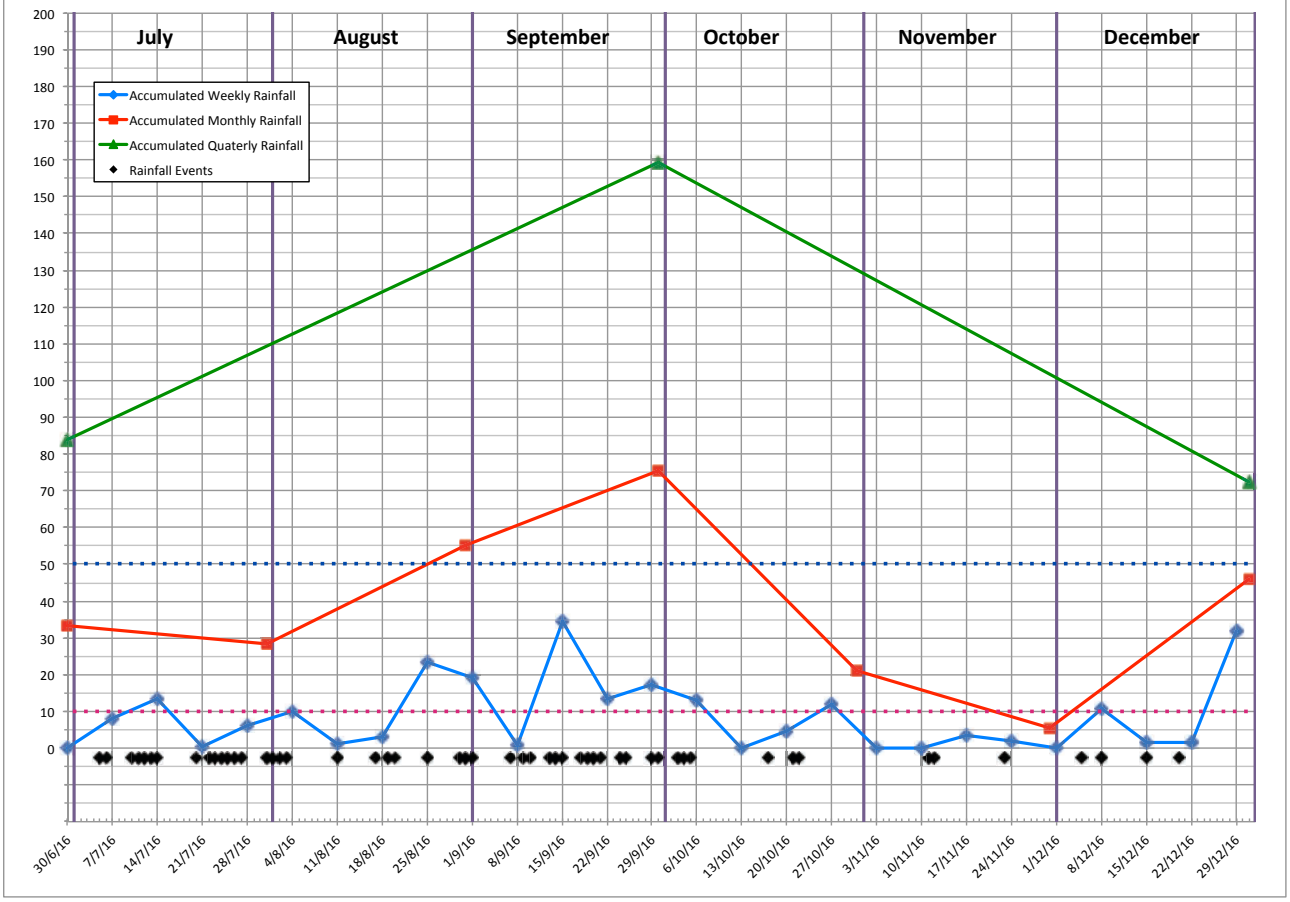
Graph 2(b) Arrangement Enclosure July to December 2015



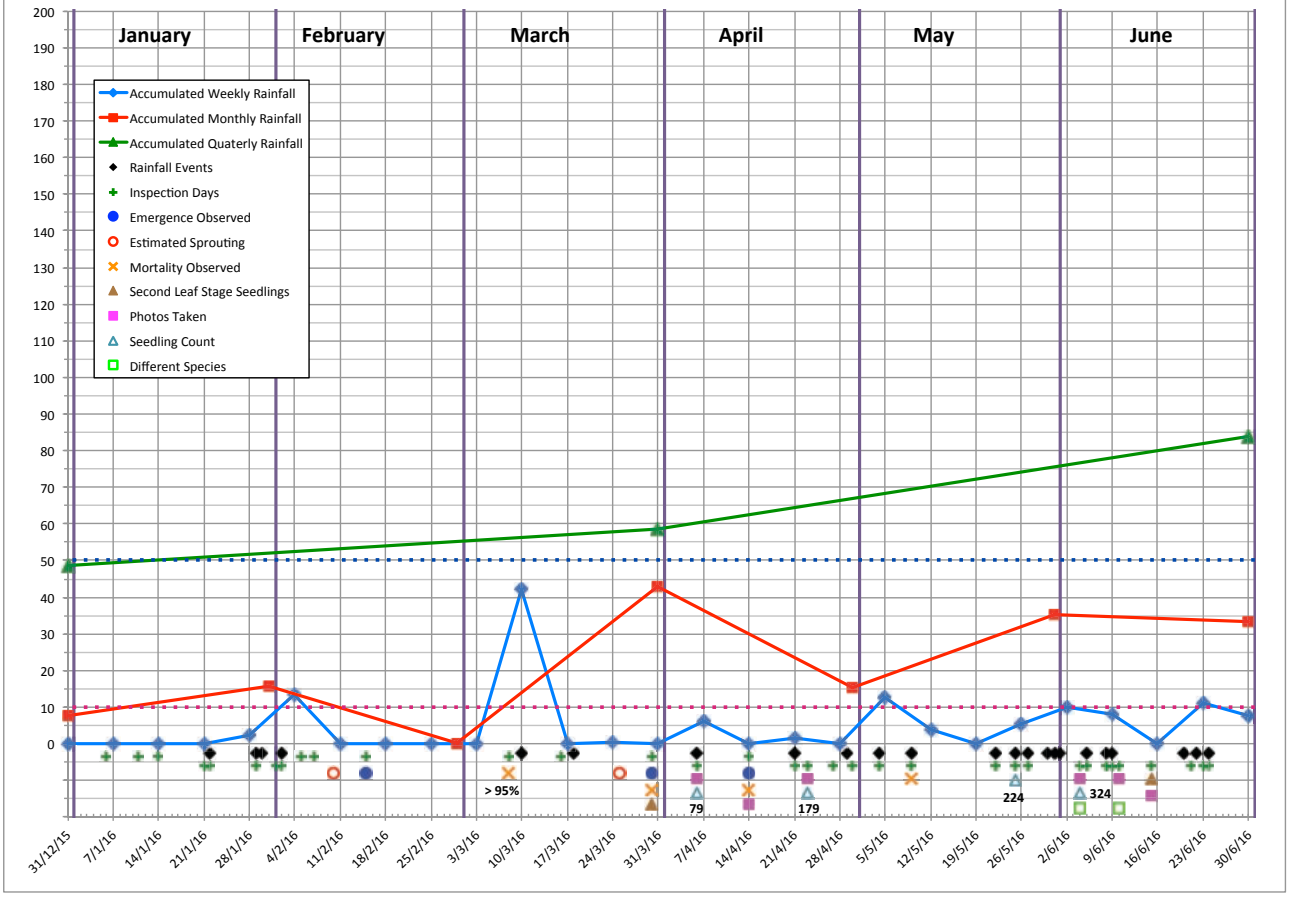
Graph 2(c) Arrangement Enclosure January to June 2016



Graph 2(d) Arrangement Enclosure July to December 2016



Graph 3(a) Forgotten Enclosure January to June 2016



Graph 3(b) Forgotten Enclosure July to December 2016

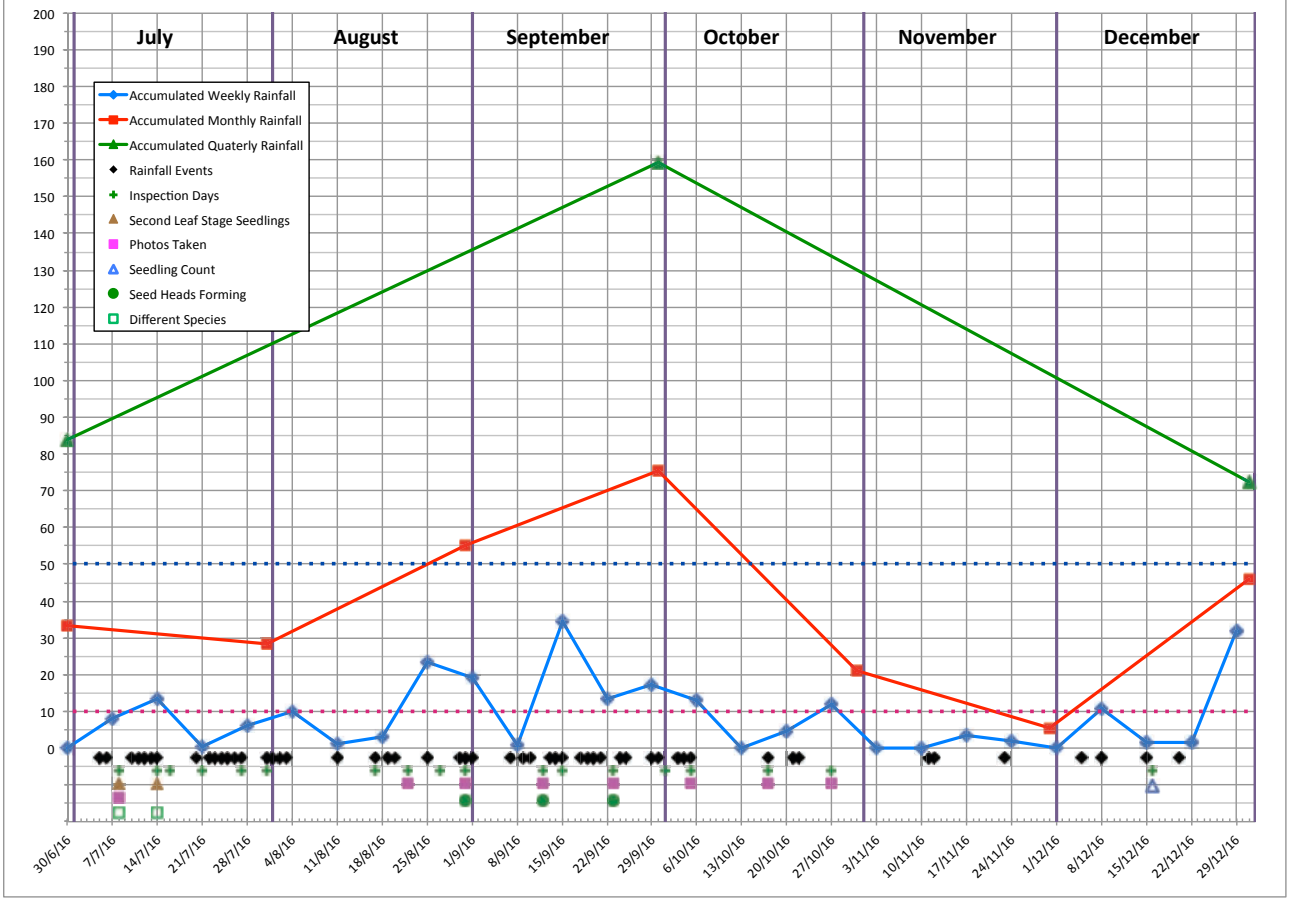


Figure 4a: (28th September 2016) These are of seedlings in the Badlands Enclosure; some having germinated in September/October 2015 (and survived) others germinated in February 2016 (and survived). However size is no indicator for distinguishing which is which. They survived harsh periods after germination due to well-prepared soil; as this trial was run for purposes not discussed here that required soil preparation. They are though, healthy examples of plants less than one year old and by November 2016 were over one metre tall. This health and vigour will not last unless the plants are grazed off and the progression of deterioration is illustrated in the Figures 4b—4d.

Figure 4b: (23rd September 2016) This plant was germinated in tube stock in March 2014 and planted in the Arrangement Enclosure (and therefore un-grazed). It shows two seasons of dead leaf and stem which is already starting to inhibit this year growth vigour.

Figure 4c: (27th October 2015) This is Spear Grass growing in an enclosure that was erected in November 1995 (on Moorunde Wildlife Reserve). For the first few years the grass was dense and as healthy as that shown in Figure 4a; and 2013 was the last year this occurred, but now the "thatch" of dead leaf and stem is making the soil too fertile! Which…

Figure 4d: (28th September 2016) …by September 2016, and even after very good autumn, winter and spring rain, the lack of grazing has been detrimental. Burning a year or two prior, would have helped; but that wasn't the objective of the trial/enclosure. Demonstrating this was the point.

Figure 5a: (17th October 2017) Somehow the Badlands Enclosure (and trial) got into this discussion, An area 40 m x 40 m was worked up to test different methods of establishing Spear Grass after suppressing this Onion Weed infested site. Note the Onion Weed in the foreground. There are three weld mesh enclosures set up here after seeding Spear Grass (quantity seed not measured) on 16th May 2015. The largest enclosure 9 m x 3m is in the foreground. The second enclosure 6 m x 3m is on the other side to the right and the third enclosure 3 m x 3m is roughly in the centre of the picture. The extended cultivation resulted in germination and survival of Spear Grass seedlings in both late September, early October of 2015 and a second period of germination and survival in February 2016. Hence this advanced growth due to 1) little or no weed competition, 2) Softened soil enhancing root growth, 3) Moisture retention due to fallowing and 4) additional growth time. Yet even so seedlings that didn't germinate until April/May 2016 have done far better here than the other two enclosures (the Arrangement and Forgotten Enclosures).

Figure 5b: (16th May 2015) The Badlands trial site after the final cultivation (foreground) and sowing, half the area was recultivated in 2016 (20 m x 40 m). The other half was divided into two areas with the far side (of 10 m x 40 m) being sprayed with a small boom spray towed behind a quad-cycle. The middle 10 m x 40 m was left "unworked" in 2016 and weed growth did inhibit much of the grass. Ultimately no area had the Onion Weed completely eliminated; however the two-year cultivated area proved to be much more effective than the "cultivate and spray" area—in terms of Onion Weed suppression. However this extent of soil preparation for weed control is not recommended. Despite the Onion Weed the Spear Grass growth here contrasts markedly with that of the un-grazed plants shown in Figure 6, growing in untreated hard-panned soil.

Figure 6: (23rd September 2016) Compare these plants that germinated "naturally" from the in-ground seed bank in hard-panned soil, with those in Figure 4a. These are "extreme examples" from each end of the scale, illustrate the difference in plant growth and seed production between no soil restoration work and restored soil, where hard-panning and salinity problems have been dealt with.

(The Arrangement Enclosure continued)

- To eliminate the existence of existing Spear Grass and dormant seeds from contaminating the results.

Note: dS/m = deciSiemens per metre, unit of salinity, based on electric conductivity

Each cultivation was performed after rainfall events that left the soil in optimal moisture working conditions. However for the first two cultivations this "optimal" was far from ideal; as the top soil hard-pan prevented most of the rain from entering deeper into the top 30–50mm (see Figure 7a, 7b, 7c, 7d and 7e) germination/emergence and seedling survival was considerably less than that achieved in the Forgotten Enclosure (of 2016 the following year).

One possible reason for this is the existence of some young Myoporum trees in the seeded area (see Figure 8a and 8b) which have had a marked effect. Other reasons for reduced results may be:

- A much higher soil salinity level at the time of germination in the Arrangement Enclosure (initially 20dS/m then dropping to 8dS/m) compared to only 1.04dS/m in the Forgotten Enclosure.
- A different "batch" of seed sown, harvested at an earlier "seed set" period (perhaps?).
- Possibly less favourable "Rainfall Event Types" or higher humidity.
- A combination of all of the above.

On 10th March 2016 all seedlings that had been found to have germinated and survived from the May sowing of 2014 were counted using string lines 2 m apart across the 70 m x 10 m area and a total of 344 plants were recorded (see Figure 9).

However prior to this count and from 29th September 2015 to 28th November 2015 any seedlings seen (amongst the thick Zygophyllum) were marked with a stake. By 28th November 2015 a total of 172 Spear Grass seedlings had been marked, and staking was discontinued due to the density of the Zygophyllum and Wards Weed making the effort no longer practical (see Figure 10). This "staking" then represented approximately one half of the total seedlings found on 10th March 2016.

Then on 27th April 2016 (once again using string lines, see Figure 9) the first 172 plants that had been marked with stakes were inspected for mortality. 33 plants were found dead, representing a mortality rate of 19.2% of the seedlings that germinated in 2015.

Calculations for the Arrangement Enclosure

- Total of 7 g of seed sown over 700 m^2.
- Seeding rate = 7/700 = 0.01 g/m^2, equivalent to 100 g/ha
- While 100 g/ha is useful for demonstration trials when seedlings have to be counted…
- …a more practical sowing rate would be 1 kg/ha = 10 x 100 g/ha
- 344 plants germinated and survived to 10th March 2016 after sowing on 17th May 2014 with a calculated mortality of 19.2%.
- 344/700 m^2 = 0.49 plants/m^2 germinated and survived.
- Therefore had the seeding rate been 1 kg/ha, 4.9 plants/m^2 would have been established.
- Which is well below an expected 20–40 plants/m^2 and probably due to the reasons given above?

Counting was later conducted in December 2016 which included seedlings germinated from the seeding done on 9th November 2014. As this November seeding missed the 2014 autumn/winter season none was expected to germinate in the 2015 autumn/winter; but was expected to have germinated by winter 2016.

A final count of the Spear Grass seedlings was conducted on 29th December 2016, with a total of 2,856 plants, which includes the original 344 seedlings (now adult plants) counted on 10th March 2016; being the seedlings germinated over 2015.

However one must remember that this enclosure was seeded twice in 2014—first on 17th May 2014 and again on 9th November 2014. As mentioned above, I knew that none of the seed from the sowing on 9th November would germinate in 2015 as it didn't experience a winter/spring wet period in 2014 to break its dormancy.

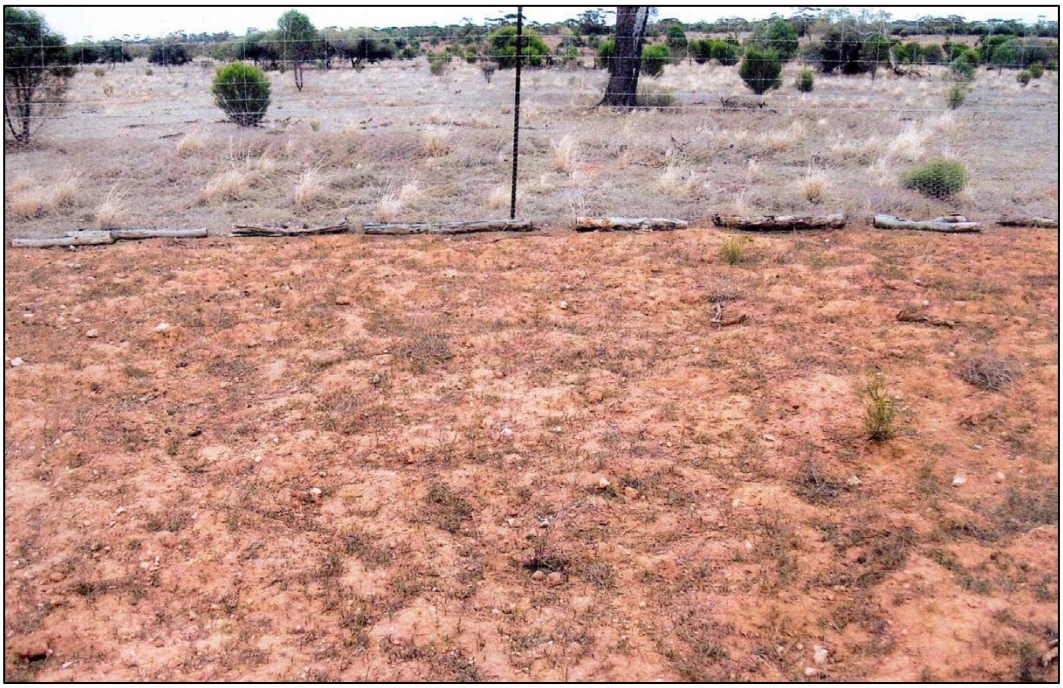


Figure 7a: (4th May 2016) The background of this photo beyond the fence is inside the Peter Collins Enclosure that was erected by March 2013; and even after four years/growing seasons the ground isn't recovered with native grasses, despite all grazing being excluded. The grey vegetation being dead Wards Weed and the lighter coloured tuffs are the Spear Grass. This illustrates the severely depleted "in-ground seed bank" on Moorunde Wildlife Reserve to the point where even if lightly grazed the Reserve cannot recover without intervention. Outside the enclosure (in the foreground) is ground that has been dug over by wombats in their desperate search for something to eat—Thread Iris corms. This "ploughing" by the wombats is done when the soil is dry (over summer and before autumn rains arrive). This is the cause of the soil becoming hard-panned on the Reserve. The vast over population of kangaroos now present since 2007 leave little else for the wombats; and now over 90-95% of the soil suitable for growing native grass on this Reserve has been damaged and is becoming destroyed in this way. Meanwhile, the NHSSA Committee who are responsible for managing the Reserve, are not only doing nothing about this…

Figure 7b: (10th March 2016) …situation, but refusing to recognize and acknowledge that it is a problem. Most of these areas have been excavated this way to a depth of 10–15 cm, for several years, which has resulted in the breakdown of the duri-crust or cryptogamic crust of mosses, lichens, fungi and algae. These non-vascular plants form intimate associations with surface soils as they regulate moisture infiltration, moisture retention and alter the soils chemistry that makes nutrients available to plant roots. The breakdown of soil particle aggregates caused by this `dry ploughing` is because the soil algae that creates a binding gel around the particles is killed by the disturbance and the gel is exposed to sunlight. This leads to hard-panning of the soil, which can be seen in this illustration, restricts rainfall moisture infiltration were the rain water drains and collects in the multitude of pot holes left by the wombats and…

Figure 7c: (4th May 2016) …eventually dries out! Leaving a "sealing stick" of fine clay particles behind. Paradoxically this breakdown of the soil to its finest particles increases the rise of any moisture in the soil and the subsoil due to "capillary action" which is enhanced as the soil aggregates breakdown to fine particles. This ultimately leads to…

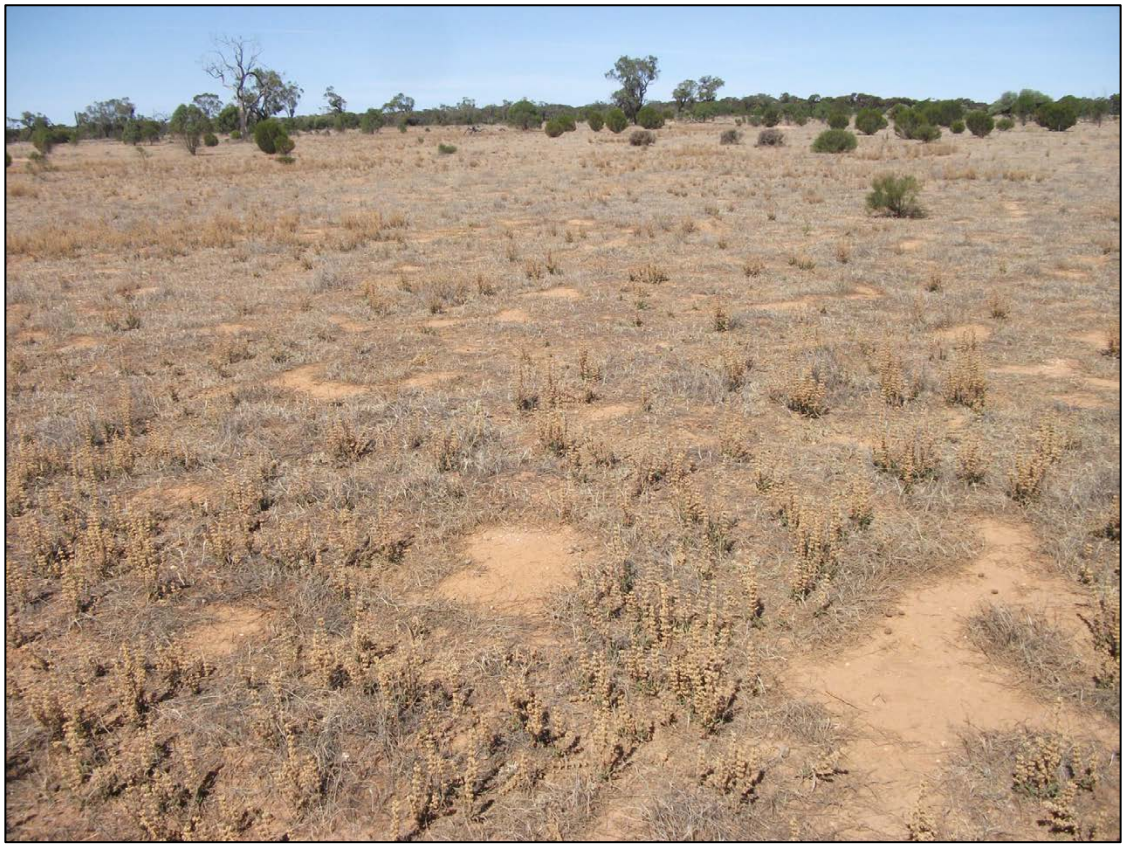


Figure 7d: (12th December 2015) …salts that are naturally in all soils rising to the surface and becoming so concentrated they literally poison the surface. The smattering of bare patches in this photo is a typical example of this process. The bare spots test up to 40 dS/m while the ground in between is only moderately saline (as a guide sea water averages 55 dS/m and any soil that tests 16 dS/m or above is considered "highly or extremely" saline). Gradually these bare areas increase in size and number until they join together to form…

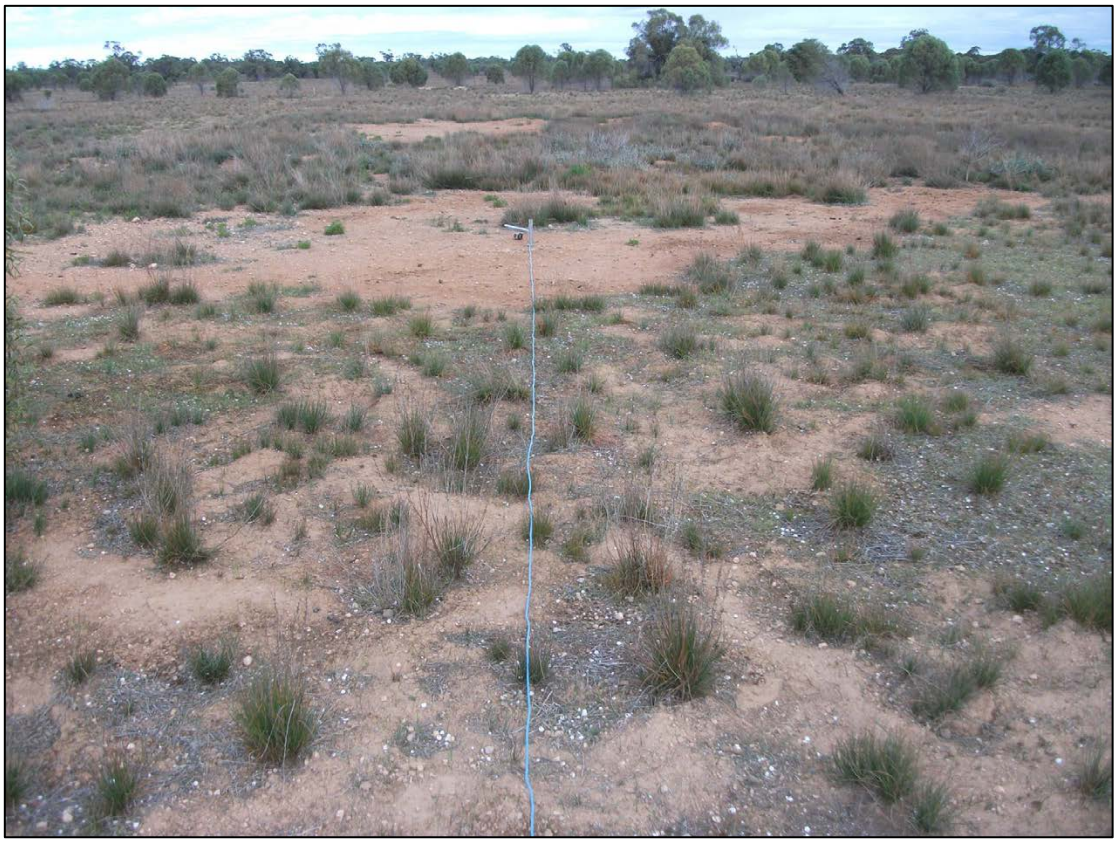


Figure 7e: (23rd July 2015) …salt pans! These also inevitably expand. It is also worth noting that the predominant "ground" cover vegetation here is Onion Weed. A plant that researchers have found capable of geminating and growing while being irrigated by sea water (with only a 30% reduction in growth vigour). So if it wasn't for these clumps of Onion Weed this salt pan would be bare ground filling the whole picture. Meanwhile the NHSSA Management Committee view the Onion Weed as something to be eradicated and seem to expend considerable effort trying to do so, which will effectively increase the areas affected by salinity.

Figure 8a: (27th October 2016) The Myoporum trees in these two photos (8a and 8b) germinated in 2007 after sheep were removed in from Moorunde in 2006 and as can be seen in the background they are becoming quite dense. While it is good to see some new trees coming on to replace the old and dying ones it must be remembered that this land was managed ever since the environment and climate changed at the end of the last ice-age some 10,000-12,000 years ago. The purpose of this management by the First People, who were here prior to the ice-age, was to retain the environment as it was during the ice-age—predominately grassland! This management (by means of the judicious use of burning areas off at specific times) preserved much of the Murraylands (and Australia generally) as an environment that ordinarily could only have existed during ice-age conditions. When the First People were replaced by European settlers, their sheep and cattle by default, took the place of management by fire and this worked quite well, and continued to preserve this ice-age environment along with the fauna that had evolved to live on it. Then around 1880 the rabbits came and it was these animals that changed everything—not the grazing of sheep and cattle.

Figure 8b: (27th October 2016) On those areas that are not being effected by rising salinity; and now that there is no burning, no livestock, rabbits are controlled and kangaroos have reached pest plaque numbers, trees and shrubs are taking over these ancient grasslands; the area in the foreground was seeded with Spear Grass just as that in the other end of this enclosure. Wombats that evolved to live on grassland and open Myoporum woodland and tall open shrub land (which is why they are in the Murraylands) are looking at a bleak future! Paradoxically their future is even more threatened on Reserves and Conversation Parks in the district and on `Bushland Properties` than on land that is still held by farmers/graziers who control the kangaroo population. All because people believed, that Australia was (since first European Settlers arrival) a "wilderness" when it never has been for the past 50,000 years. This mistaken belief has led to the most predominate environment in Australia (grasslands) becoming the most threatened environment in the country, and the very people who should know better simply refuse to.

Figure 9: (27th April 2016) Scrutiniser Geoff Weller re-checking my seedling counts in the Arrangement Enclosure; using "string lines" two metres apart to count germinated grass plants and also to assess mortality. Even with relatively "thin sowing" and therefore few plants, two metres is the maximum practical distance between the two ropes for counting. This has to be reduced as plant density increase. However when we calculated native grass plant density across the entire 7,000 hectares of Moorunde Wildlife Reserve, plants were so sparse, the lines (with two people counting) were expanded to 10 metres apart. Walking one kilometre along a 10 m strip represented a one hectare sample area (1000 m x 10 m). After counting 50 such sample areas the native grass density on the reserve was estimated to be 0.00056 plants/m^2.

Figure 10: (17th June 2015) By mid-winter or spring, and even though seedlings are in the multi-leaf stage, it becomes virtually impossible to make accurate counts of seedlings due to weed cover—the bright green plants surrounding the Spear Grass seedling are Zygophyllum and Wards Weed. Hence the absence of notes and records for germination over October, November and December.

(The Arrangement Enclosure continued)

One would expect then, that as the sowing rate on 9th November (0.01 g/m^2) was equal to that on17th May the possibility existed for the count to be approximately twice that of the 2015 germination (counted on 10th March 2016).

The count for germinated seedlings of 2015 was: 344 plants over 700 m^2 = 0.49 plants/m^2. The count for all plants (2016 seedlings plus 2015 plants) was: 2,856 plants over 700 m^2 = 4.08 plants/m^2. Therefore the number of seedlings from the 2016 germination is 2856 – 344 = 2,512 plants. 2,512 ÷ 700 m^2 = 3.59 plants/m^2, equivalent to 35.9 plants/m^2 at a sowing rate of 1 kg/ha. That is 7.3 times the germination rate of 2015.

So what has happened here? The answer to that was also mentioned earlier! Observational experience supported by some trial work indicted that only "approximately 20–30% of seed will germinate on the first year of germination with about another 40–60% germinating on the second year of germination (which is the next suitable year) with the remaining viable seed staying dormant for up to 10 years".

This has to be taken into account! To do this we will presume that 30% of the seed sown on 17th May 2014 germinated in 2015 with the remainder, germinating in 2016. Which would give a count (for this sowing) of 344 x 3 = 1,032. Now! The count (for seed sown on 9th November) of seedlings for 2016 germination is 2,512 – 1,032 = 1,480 plants.

1,480 seedlings over 700 m^2 = 2.11 plants/m^2, thus if the sowing rate had been 1 kg/ha the seedling density for 2016 would be 21.1 plants/m^2. This is 4.3 times the germination rate of 2015. Now this requires some speculation to explain, but once again we go back to an earlier issue already mentioned.

At the time immediately prior to preparing the enclosure for sowing the salinity in the soil tested at 20 dS/m (anything above 16 dS/m is Class 4, highly saline). After soil preparation (i.e. deep cultivation and immediately prior to the suitable rainfall events to start germination in 2015 this salinity level had dropped to 8 dS/m then again immediately prior to the "suitable rainfall events" to start germination in 2016 the salinity levels had dropped to 1.98 dS/m.

I will return to this issue of salinity later, but first, results from the Forgotten Enclosure.

The Forgotten Enclosure
Seeded 2015

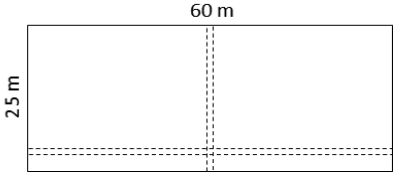
See Figures 3a and 3b.

- 60 m x 25 m (1,500 m^2).
- Sown with 15 g of seed on 8th July 2015.
- Sowing rate 0.01 g/m^2.

This enclosure was deep ripped on 9th April 2015, and then cultivated on 20th April 2015 and 24th May 2015. The cultivation was done to eliminate any existing grass. It was seeded on 8th July with 15 g (i.e. seeding rate of 100 g/ha). However thirteen (13) Spear Grass seeds subsequently germinated from the natural seed bank; due to the minimal cultivation compared to the Arrangement Enclosure. These plants were identified with a stake.

With this enclosure all rainfall measurements were taken from the gauge set up approximately 2 km northwest at the Arrangement Enclosure. Measurements were taken as "Weekly Accumulations" from the site however "Rainfall Event Days" were noted (and assumed to be the same) from Cambrai.

In this Enclosure, instead of attempting to count the emerging seedlings from the whole 1,500 m^2, two 1 m wide strips were marked out, regularly inspected and seedlings marked with stakes within the strips only. One strip runs along the 60 m length (approximately 3 m in from the south boundary), the other strip runs across the 25 m width approximately in the centre of the enclosure.



Thus marking a sample area of 84 m^2 with seedlings counted and samples regularly photographed from early emergence to the time of setting seed (see Figures 11a and 11b).

Figure 11a: (4th May 2016) At this stage of counting one has to crawl on hands and knees and I use 2x spectacles as well. Even then (and on relatively bare ground) a "one pass count" has at least 30% error. So the 60 m x 1 m and 25 m x 1 m strips had to be crawled over at least three times to get within a reasonable boundary of "error". Note: some plants outside the metre strip have also been staked as no "string" was used for initial identification and the distance was guessed. On the final count, using string, these outsiders were discounted.

Figure 11b: (6th October 2016) When the grass gets larger so too does the weed density and the "first pass" error actually measures to about 40%. Eventually counting has to stop and wait until the weeds die and dry off. Then comes the risk of counting seedlings that germinated in the spring, luckily this year (2016) this is unlikely to be a problem as it's been too dry over October/November for any significant number to have survived. Also by November/December grass plants that are not Spear Grass can be identified.

Inspection of this enclosure was much more rigorous and frequent than for 2015 in the Arrangement Enclosure and commenced on 6th January 2016—after noting some natural seed bank seedlings had germinated in the spring of 2015 (as noted above, and marked with stakes). Seedlings were seen emerging on 15th February 2016 and had not been discovered on an inspection on 7th February 2016; therefore probably having emerged on or about 10th February 2016 as indicated on the graph. However on an inspection on 8th March 2016 all of these seedlings appeared to have died and this is indicated on the graph as > 95%.

A second emergence was observed to have occurred on 30th March 2016 due to a rain event of 42.2 mm on 10th March 2016. Then on inspection (on 30th March 2016) some seedlings were well into the second leaf stage while others (in the second leaf stage) had died. A count was made on 6th April 2016 and 79 seedlings were staked out with some photographed.

Seedlings were still being found to have emerged by 4th June 2016 with a count of 324. However it was suspected that these later emergence were of other species of grass. In fact emergence was still being noted up until 14th July 2016. Due to this probability of a different grass species emerging at this time of year; and also to the increasing density of Wards Weed and Medic making it too difficult to find grass seedlings, counting was discontinued on 4th June 2016 (at 324 seedlings). However counting (and a more accurate identification is intended to recommence some time in either November or December 2016.

Meanwhile if we assume the seedling count of 179 on 23rd April 2016 is made up of only Spear Grass; and the only Spear Grass to germinate for the autumn period of 2016, we can calculate a seedling density of 3.11 plants/m^2 from a seeding rate of 0.01 g/m^2, equivalent to 21 seedlings/m^2 at a seeding rate of 1 kg/ha—as of August 2016.

A final count of the Sear Grass seedlings was done on 16th December 2016 with a total of 201 plants. However some explanation on how this number was arrived at is necessary.

During the counting on 23rd April 2016 I had run out of galvanised fencing spacers used to mark the seedlings, and I finished using 30–40 cm lengths of wire doubled over, which I removed after finalizing the count on December 2016. Then over the 25th May 2016 and 4th June 2016 count I bent the lengths of wire into an L-shape guessing that these seedlings would not be Spear Grass Species; and this turned out to be correct. A total of 67 plants had to then be subtracted from the 324 plants counted 4th June 2016, reducing the count to 257 plants. Also; during the counts prior to 16th December 2016 no string lines defining an exact 1 m wide strip were used. A metre wide strip was estimated as I crawled across the enclosure.

For the 16th December 2016 count, as it would be the last one for the year, accuracy became important and string lines 1 m apart were run out (see Figures 12a and 12b). A total of 66 plants fell outside these strings and had to be subtracted also, further reducing the count to 191 plants. However, an extra 10 plants were found unmarked which increased the final count to 201 plants and indicated an approximate error of 5% for the autumn inspections.

As mentioned earlier all of the wire stakes were removed; mainly due to the difficulty in finding them and their undesirable presence because of this. All galvanised fencing spacers were left in the ground regardless of their location. That being either inside or outside the marked one metre strip; making 132 plants staked to later be inspected as a sample to assess mortality after rain in 2017. These 132 stakes were subsequently removed by members of the NHSSA Committee. This deliberate act of sabotage has prevented the assessment of mortality.

Calculations

201 plants over 84 m^2 = 2.39 plants/m^2 from a seed sowing rate of 0.01 g/m^2, equivalent to a sowing rate of 100 g/ha.

Had the sowing rate been a practical 1 kg/ha, the plant density would have been 23.9 plants/m^2.

This is on the lower scale of expectations of 20-40 plants/m^2. However examination of the graph reveals why this occurred.

- An uncalculated/uncounted germination and subsequent >95% mortality over February and March;
- No "Clusters" of rainfall events during April and May to maintain top soil moisture at an optimum level; once again causing significant mortality*; and
- The lack of rainfall event "Clusters" would have also reduced conditions to less than optimal for germination**.

***Mortality**: it is difficult enough to count seedlings in the one, tow or even three leaf stage to within an acceptable "error factor" and this renders any effort to assess mortality at these early stages a pointless exercise (see Figure 13).

****Germination**: it is worth noting that after the 23rd April 2016 count of 179 only another 20 plants ultimately germinated in May 2016. So, essentially 2016 was not an optimal year for Spear Grass germination. However as mentioned in the preamble probably only one third of the viable seeds sown have germinated this year; and following favourable season could correct this. While this relatively low May germination is consistent with the subjective assessment shown in the "Forum Graph" (Graph 1), of the "drop off" in germination as weather conditions and soil temperature deteriorate over this month.

Reflection on Salinity

Now, as I said the discrepancy between the 2015 germination the salinity readings of 2015–2016 and the 2016 germination is only speculation. However it is worth noting that the germination in the Arrangement Enclosure of 2016 is comparable to that of the Forgotten Enclosure; that had no salinity issues to begin with! And there is one other indicator supporting (to some degree), the idea of suspecting salinity being the cause of the 2015–2016 germination discrepancy to be found in the progression illustrations (see Figures 8a and 8b). Although it's not so easy to pick out in the photographs there is a disproportionate increase in seedling density immediately around and circling the (apparent) dead grass created by the young Myoporum tree. And I suspect this would be due to the tree roots decreasing the soil salinity at the limit of their root extension. While the bare areas closer to the tree is caused by the tree taking too much of the soil moisture, at the root extension limit enough moisture is left for grass to germinate and grow under the benefit of reduced salinity produced by the tree.

I tested for the effects the Myoporum trees were having on the germination. Expecting the trees to produce a significant reduction in the seedling count, I separated the counting into the first 20 m, where the trees were having no visible effect, and the last 50 m where there were circles of bare areas.

The plant count (total) over the first 20 m x 10 m of the enclosure was 993 or 4.97 plants/m^2. The plant count (total) over the southern end of the enclosure (approximately 50 m x 10 m) and affected by circles of bare areas was 1863 or 3.73 plants/m^2. While the count of all plants over the whole 70 m x 10 m area was 2856 or 4.08 plants/m^2, which would indicate the trees were causing a minimal effect.

However! At the edge of the bare areas and for about a metre wide the seedling density was such that in places they were almost uncountable! I am open to other suggestions; but at this point I consider salinity differences in the soil between the two years of germination to account for the increase in germination in 2016. In addition to that, I hold the deep cultivation responsible for the salinity reduction. As outside the Arrangement Enclosure salinity is still at almost 20 dS/m.

A final word of warning though for the people responsible for managing Moorunde Wildlife Reserve. In relation to the recent regeneration of Myoporum trees and tall

Figure 12a: (16th December 2016) Scrutiniser Graham Nye running out two string lines 1 m apart along 60 m length of the Forgotten Enclosure.

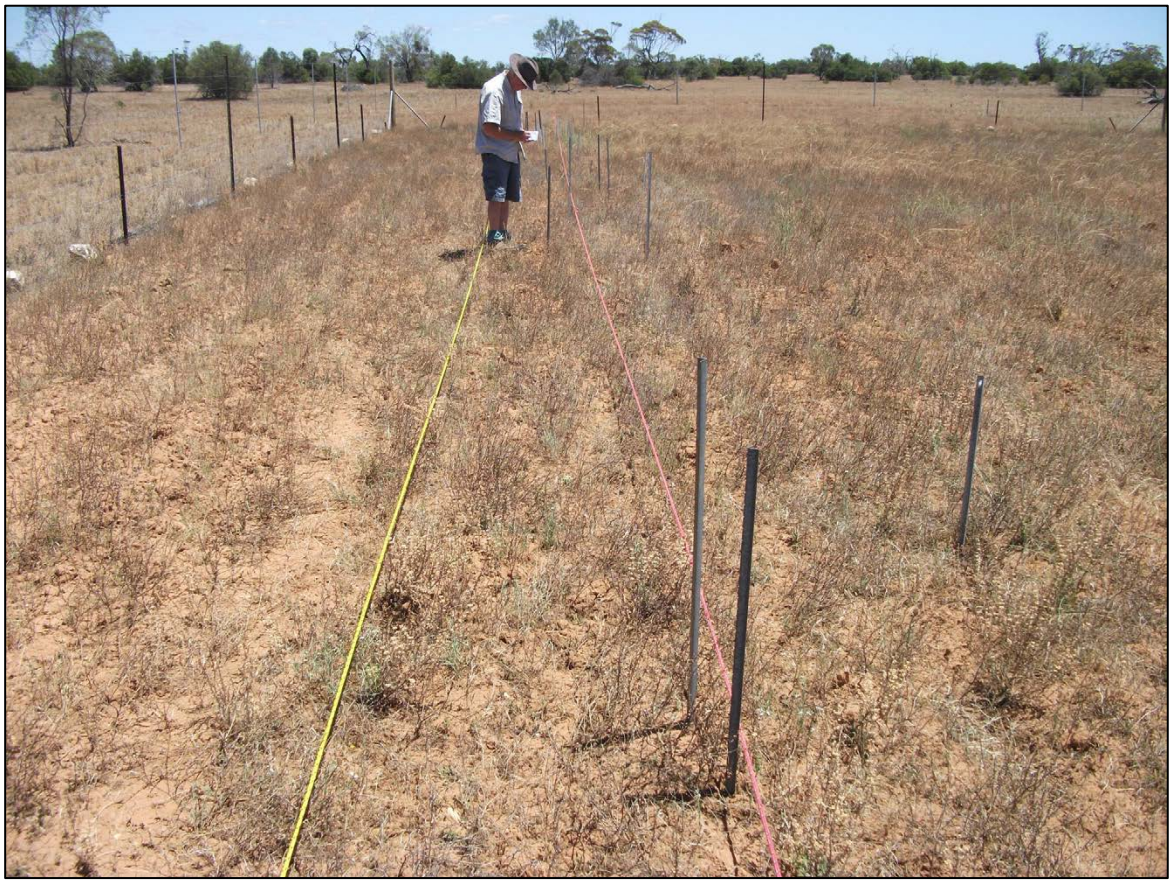


Figure 12b: (16th December 2016) Scrutiniser Graham Nye rechecking my seedling counts within the 60 m x 1 m marked strip. The stakes to the right of the pink string mark plants that germinated from dormant in-ground seed.

Figure 13: (6th April 2016) At the one-leaf stage, the observer has to be on hands and knees to find all of the seedlings, and dead seedlings are extremely difficult to detect. This seedling is not quite dead yet! For scale, the dark blue object pressed into the soil behind the seedling is a "BIC Biro" pen.

shrubs in the background of Figure 2 of the Arrangement Enclosure taken on 27th July 2016 one can see the Myoporum Trees regrowth has become quite dense since the sheep were removed in 2006. Now look at and compare this with the background of Figure 8a where you can see these bare areas overlap!

If the once grassland and open scrubland is to remain a habit for wombats to survive in on Moorunde Wildlife Reserve, this advancing density of Myoporum Trees and tall shrubs must be stopped, or there will not, in the future, be any pasture (even weeds) for wombats to graze on. While where there are no trees and no perennial grasses (or Onion Weed) the soil salinity will eventually take over.

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Acknowledgements

- Money for enclosure fencing materials was obtained via the Natural History Society of South Australia from a government grant applied for by committee member, the late Peter Collins. I find it somewhat surprising and disrespectful to his memory that NHSSA Committee members would then choose to sabotage the last stages of the trial by removing marker stakes within both enclosures. These stakes marked the first seedlings found to germinate and had been left in place to facilitate calculation of mortality rate and plant lifespan.
- The Forgotten Enclosure fence (170 m long x 2 m tall) was erected by the Prisoner Workforce from the Cadell Training Centre.
- The 2007-2015 Graph presented at the 2015 Native Grass Forum was formatted from my hand-drawn original for projection on screen by my "*sechetary*" Barbara Endersby.
- Graham Nye and Geoff Weller assisted by scrutinising my work and in counting seedlings.
- Al Smith edited the handwritten draft report and formatted it together with the enclosure graphs and photo illustrations.
- A generous NHSSA member from Bordertown, who kindly covered printing and postage expenses involved in the publishing of these results from this research.