1. “Birds Australia Gluepot Reserve”

Map 1. Gluepot Reserve, situated 60 km north of the Murray River, near the junction of Victoria, New South Wales and South Australia.
1.1 Location and regional context

Gluepot Reserve is 3.5 hours drive north-east of Adelaide. The nearest town, Waikerie, is situated 64 km north of the Murray river in South Australia’s Riverland District. Access is along sandy tracks, through mallee vegetation. The reserve is 54,390 ha in size and measures 37 x 14 km. It is bounded on the east and the south by former old large sheep stations-Calperum and Taylorville Stations- which are now conservation lands. To the north and west of Gluepot are pastoral leases, Parcoola, Balah and Bunyung Stations, which are stocked with sheep. Gluepot Station is part of the largest block of intact mallee left in Australia.

1.2 Land tenure

A large part of Australia is covered by immense fragments (from 50,000 to 100,000 ha) which has been leased to run domestic stock for many years. Gluepot Reserve is one of these pastoral leases owned and operated by Birds Australia. Pastoral leases in South Australia initially run for 99 years and vegetation is assessed regularly by the Pastoral Management Branch of the Department of Environment and Heritage and Aboriginal Affairs (DEHAA). Birds Australia has received approval from DEHAA for its decision not to run domestic stock on the pastoral lease and to use the land as conservation land.

In 1997, Birds Australia applied to have a Heritage Agreement placed on the Reserve. This was approved by the South Australian Native Vegetation Council, and the Minister for the Environment and Heritage signed the Agreement. Now all of Gluepot Reserve is covered by a South Australian Heritage Agreement under the Native Vegetation Act 1991. It is the largest area of land under a Heritage Agreement in South Australia. No new buildings or other infrastructure can be built except in the small area of the Homestead.
Map 2. Gluepot Reserve within the Riverland Biosphere Reserve (formally known as the Bookmark Biosphere)
1.3 Biosphere status

In 1998, Gluepot Reserve became a land partner of the Bookmark Biosphere Reserve. World-wide, there are around 350 areas designated as Biosphere Reserves under the UNESCO Man and Biosphere Program and twelve such areas exist in Australia.

Birth and management of the Bookmark Biosphere Reserve

In 1977 Danggali Conservation Park (253,380 ha) was dedicated a Biosphere Reserve. Following the purchase of Calperum Station in 1993, the Commonwealth and South Australian Governments nominated a major extension to this area to be renamed the Bookmark Biosphere Reserve. With the addition of Gluepot Reserve and Taylorville Station, it now covers approximately 900,000 ha and stretches about 150 km north-south and 100 km east-west.

1.4 Infrastructures

1.4.1 Buildings

The Homestead, built in 1957, where the sheep grazier used to live, is now the Rangers house, the office and the library of the reserve. Around the Homestead there are several other buildings which provide accommodation for the researchers and other volunteers. The Visitor Information and Registration Center opened in 2003, and following this, the shearing shed was converted into an Environmental Education Center. Other storage sheds have been built to store all the tools, machinery and equipments.
1.4.2 Energy supply

The house had an old 32 Volt generator and battery system which failed in 1998. Funds were obtained to enable the installation of a 240 Volt solar power system which provides enough power to the entire homestead area (19 KWh). A backup generator is installed to provide power in the event of 11 continuous days of cloud cover. The Gluepot solar power system is the largest stand-alone in the Riverland. By using renewable energy, Gluepot has moved another step towards sustainable development. Gluepot Reserve is now carbon neutral.

1.4.3 Water supplies

**Drinkable water**: The homestead water supply was inadequate for the reserve’s needs at the time of purchase. By 1999 the installation of a 114,000 litres rainwater collection and storage system provided sufficient water for an average of five people per year during years of average rainfall. Later, many more rainwater tanks has been installed in the Reserve.

**Non drinkable water**: There were formerly 18 earth dams distributed throughout the reserve, which provided water for sheep. However, kangaroos and goats also drank the dam water and their numbers increased dramatically. Hence, a management initiative saw all of the dams decommissioned by 2002 with the exception of the two at the homestead. The two homestead dams (which now have a 2m high fence around them to exclude all herbivores) supply water to an elevated 45,500 litres storage tank which supplies this dam water to three outdoor fire hydrants, the researchers’ bathroom, the toilets and water for the garden.

**Fire fighting**: There are four 91,000 litres concrete tanks which were formerly connected to nearby dams. They were built in late 1965 and 1966, and are now known as Grasswren, Whistler, Emu and Froggy tanks. Pumps and pipelines were installed to fill them from nearby dams and drinking troughs were provided for the sheep. With the decommissioning of dams the tanks were capped to catch rainwater. In the west of the Reserve four other tanks (22,000 litres) were installed. The primary role of these tanks is to provide water at strategic localities for fire fighting.
1.4.4 Fences

By 1997 all fences on Gluepot Reserve, including the boundary fences, were in poor condition. Boundary fences with Calperum and Taylorville Stations do not need to be replaced because these properties have been destocked and are managed as a part of the Riverland Biosphere Reserve. Over 30 km of boundary fence with Parcoola Station in the north has been replaced to keep their sheep stock out of the reserve. Internal fences were no longer needed on Gluepot Reserve and about 50 km of old fence have been removed. In some cases, old fence posts have been left standing to guide walkers. The remaining thousands of fence posts have been recycled to be used to delineate road edges and camping ground areas.

1.5 Natural resources

1.5.1 Climate

The climate at Gluepot Reserve is warm to hot in summer and cool to cold in winter. The nature of the climate in South Australia has led to the area being considered the southern-most extension of the arid zone. Annual rainfall within the region is low and irregular, with averages of 225 mm.

Gluepot Reserve’s rainfall has been measured at the homestead for the past 30 years. It has averaged 215 mm, varying between 35 mm and 560 mm. The early 1970s were particularly dry with two whole years (1970 and 1973) virtually without rain, followed by widespread flooding in 1974. Most of the 25 years since then have been within 10% of the annual average, except for 1982 and 1994 which recorded only one and two-thirds of the average respectively, and for 1991 and 1992 which both produced nearly double the average annual rainfall.

Winds are most often from the south-east during summer and south-west during winter. Wind speeds are generally less than 30 km/h.

1.5.2 Geology and landform

The landscape on Gluepot Reserve is dominated by sand flats, sand dunes, calcrete and dry gypsum lakes. They are the latest in a succession of sediments (about 200 metres thick) which have been deposited during the last 60 million years in the Murray Basin. The Murray-Darling Depression in which Gluepot Reserve lies initially received river and lake sediments (60-30 million years ago), then the sea flooded in after the separation of Australia from Antarctica (about 43 million years ago) and deposited marine limestone with fossils (33-10 million years ago).
The region was then gently uplifted and so the sea retreated and the limestone was overlain by lake clay and gypsum (4 million-700,000 years ago). The gypsum is exposed in a number of dry ‘lakes’ on the eastern section of the Reserve.

During the last 2.5 million years the world has been affected by a series of cold ice ages and warmer interglacial periods. During glaciations the climate was cold, dry and windy. These winds have blown shell grit dust (calcium carbonate) in from the coast and this has formed limestone (calcrete) in the soil. Excellent exposures of nodular calcrete can be seen in the ‘cellar’ at the Old Gluepot Homestead ruins. The winds also blew sand in from the west to form sand dunes, and in the present wetter interglacial period, these dunes have become fixed by vegetation such as spinifex and mallee. All those very fine sediments have formed some clay. Now, when it is raining on the reserve, the soil is very sticky. That is why this station is called “Gluepot”.

1.5.3 Native vegetation

**Plant communities:** “Mallee” is a word used to designate some species of Eucalypts, but also the name of the habitat itself where the trees occur. Those trees are not very tall (between 4 and 8m). The multi-stems are rising from a lignotuber which can be huge when very old. “Mallee” is, by the way, an aboriginal word meaning “multi-stemmed”. Moreover, in the center of the Gluepot Reserve logo is a silhouette of a mallee tree. There are ten different species of mallee within the several hundred species of eucalyptus present in Australia.
- **Mallee Trees over shrubby understorey vegetation.**

The most widespread vegetation types on Gluepot Reserve consist of a mix of the multi-stemmed Yorrell (*Eucalyptus gracilis*), Red Mallee (*Eucalyptus oleosa*) and Summer Red Mallee (*Eucalyptus socialis*). The canopy is mostly open, and the understorey comprises shrubs such as Shrubby twinleaf (*Zygophyllum aurantiacum*), Ruby saltbush (*Enchylaena tomentosa*), Comb Grevillea (*Grevillea huegleii*), Mueller's daisy-bush (*Olearia muelleri*), Silver Senna (*Senna artemisoides*), Stiff Rosemary (*Westringia rigida*), chenopod shrubs (*Chenopodiaceae*), and some Spinifex hummocks (*Triodia scariosa*).

- **Mallee Trees over Spinifex Grass** (*Triodia scariosa*)

Another major vegetation unit is Summer Red Mallee (*Eucalyptus socialis*) and Yorrell (*Eucalyptus gracilis*) on sand dunes, with an understorey dominated by Spinifex (*Triodia scariosa*). Yorell and Summer Red Mallee dominate the upper storey, with Narrow-leaf Red Mallee (*Eucalyptus leptophylla*) and Ridge-fruit (*Eucalyptus incrassate*) mallee occurring as understorey species. Other understorey species include Turpentine bush (*Eremophila sturtii*), Tar bush (*Eremophila glabra*) and mixed shrubs, but few chenopods.
- **Black Oak woodland habitat**

  Black Oak (*Casuarina pauper*) woodland occurs mainly in the north and west of Gluepot Reserve. This low woodland is characterised by denser Black Oak which stand with individual trees generally being a slender upright shape. The understorey is more open comprising mainly Ruby saltbush (*Enchylaena tomentosa*), Limestone Bindyi (*Sclerolaena patenticuspis*), Pearl Bluebush (*Maireanna sedifolia*), Silver Senna (*Senna artemisoides*), and various other shrubs.

- **Shrubland in open Black Oak woodland habitat.**

  Where the *Casuarina pauper* woodland is more open, various shrubs such as Chenopods (Chenopodiaceae), Silver Senna (*Senna artemisoides*), daisy-bushes (*Olearia sp.*), Emubushes (*Eremophila sp.*) and hop bushes (*Dodonaea sp.*) are common. Other tree species, particularly Bullock bush (*Alectryon oleifolius*) and Sugarwood (*Myoporum platycarpum*) are also present in those opened areas.
- **Austrostipa grassland habitat.**

Some areas of the Reserve are devoid of canopy or upper storey vegetation. This habitat is found on well drained soils. Those areas are dryer. Only small bushes like the Thorny Lawrenecia (*Lawrenecia squamata*) and some Chenopodiaceae like the Limestone Bindyi (*Sclerolaena patenticuspis*) or the Ball Bindyi (*Disocarpus paradoxus*) can be found. But those areas are mostly covered by Speargrass (*Austrostipa sp.*) and Wallaby Grass (*Danthonia sp.*).

Those five plant communities are the most common, but some others have been described on the reserve.

**Plant species**: Nearly 300 species of vascular plants have been recorded at Gluepot so far. Of these, approximately 240 are native and 35 introduced. The numbers are very fluid because new species are steadily being collected. Of the cryptogams, 45 Lichen species have been recorded, but no Fungi, Liverworts or Mosses have yet been collected at all. Approximately half of the vascular plant species have been lodged at the State Herbarium of South Australia.

A reference herbarium is being compiled at Gluepot and presently contains about half of the recorded species. This is a continuing program.

### 1.5.4 Native fauna

Gluepot Reserve has a diversity of vegetation communities which support important wildlife other than birds. In spite of the different fires which occurred in the Reserve, many areas were not burnt, leaving substantial areas of Mallee and Casuarina woodland with trees that are hundreds of years old. These old trees have numerous hollows for nesting birds and reptiles.
**Mammals**

In 1857, the Blandowski expedition recorded 29 species of mammals (excluding bats) based at the junction of the Murray and Darling Rivers. This junction is situated at 250 km from the Reserve and is in the same bio-region as Gluepot. Thus we can have a better idea of the mammal’s diversity at that time.

Nowadays, 17 species no longer occur in this region and five of these species are now extinct throughout Australia. In 150 years, the mammalian biodiversity of the Riverland region has been reduced to a mere shadow of its former significance.

The causes of the extinctions of these mammals in the mallee are not clear, but they have probably been caused by overgrazing (by introduced sheep *Ovis aries*, rabbits *Oryctolagus cuniculus* and goat) and the destruction of the mallee habitat by man. Predation from introduced foxes *Vulpes vulpes* and cats *Felis catus* have also been a major cause of decline.

Fortunately, not all mammal species have declined. The Western Grey Kangaroo *Macropus fuliginosus* and Red Kangaroo *M. rufus* have increased because of reduced predation pressure from Dingoes *Canis familiaris* and increased water availability at dams. Both of these species are common on Gluepot Reserve and 1,630 were shot there during 1995-96 when the property was managed for sheep production.

Presently, there are 8 species of mammals on Gluepot including the widespread Short-beaked Echidna *Tachyglossus aculeatus*, and 11 bat species have been recorded.
**Birds**

Since 1997, 197 bird species have been recorded on Gluepot Reserve – of these, 18 are nationally threatened. Four species are considered nationally endangered or vulnerable, and 33 further species are listed as endangered, threatened or vulnerable in one or more of the three Murray Mallee States. Gluepot Reserve and neighbouring parts of Riverland Biosphere Reserve contain the largest remaining population of the critically endangered Black-eared Miner (*Manorina melanotis*), one of Australia’s rarest birds. Much of the field research and monitoring about this species is centred on the Reserve.

Other nationally significant species breeding on Gluepot are the Malleefowl (*Leipoa ocellata*) and the Red-lored Whistler (*Pachycephala rufogularis*). Of the 33 regionally significant species, at least 13 are likely to be breeding residents, and 20 probably non-breeding are visitors or vagrants. Only one introduced species, the Common Starling (*Sturnus vulgaris*), has been recorded breeding on Gluepot Reserve – this species no longer exists on the Reserve.

**Herpetofauna**

The biodiversity of the reptile fauna is high in the Bookmark Biosphere Reserve with over 53 species recorded.

Reptiles are abundant on Gluepot Reserve and 49 species have been recorded since mid-1997, including the nationally threatened Bandy-bandy *Vermicella annulata*. Four species of amphibians have also been recorded on Gluepot.
**Invertebrates**

As in other areas, invertebrates dominate both the terrestrial and aquatic faunas of the mallee in terms of numbers of individuals, numbers of species and biomass. For example, over 150 species of ant were found, in a 50 x 50m square over one year in north-west Victoria.

Invertebrates have an essential role in ecosystem structure and function; they are involved in feeding on plants, nutrient recycling, parasitism, predation, scavenging, pollination, and by occupying the lower levels of the food chain, they are the main food of many species of reptiles, birds and mammals.

14. The red back ant

15. One common spider on Gluepot
1.5.5 Feral animals

**Goats** (*Capra hircus*)

Gluepot Reserve has been destocked since March 1997, and Feral Goats (*Capra hircus*) are now the introduced species that pose the greatest conservation threat to the reserve’s vegetation. Feral goats are a major environmental pest and contribute significantly to total grazing pressure. Feral goats compete with native animals for resources. They deplete the soils protective cover of vegetation, break up the soil crust with their hooves and over-graze grasses and herbs when alternative food is scarce. So, they slow down considerably the regeneration of the reserve which has been stocked for approximately 90 years.

16. From the left to the right, the old and the new fence between Gluepot and Parcoola, still a stocked station. Unfortunately the new fence is sheep proof, but not goat proof.
Goat numbers in the region has been high for several decades. Between 1977 and 1975, 45,000 goats were killed or removed from Danggali Conservation Park. Twenty-thousand more were removed from Bookmark between 1993 and 1995. Moreover, about 7,000 were removed from Gluepot between 1988 and 1996. Over 400 were killed or removed from Gluepot Reserve in 12 months between 1998 and 1999. Furthermore, with the decommissioning (by 2002) of all artificial watering points on Gluepot and some on Calperum Station to the east, goat numbers have declined markedly on Gluepot.

The pastoral properties to the north and west of Gluepot remain a significant source of feral goats because water is retained there for sheep. The problem is that they can easily go through the fences which are sheep proof, but not goat proof. Regularly, Gluepot attracts additional goats which graze on the lush Gluepot vegetation -thus, they are often shot.
**Rabbits** (*Oryctolagus cuniculus*)

Due to a largely unsuitable habitat, Rabbit *Oryctolagus cuniculus* number has always been low at Gluepot. During searches of 30 km$^2$ of mallee for Malleefowl mounds, volunteers recorded 14 rabbit warrens, about half of which were active, which supports the notion that densities on Gluepot are low.

This contrasts with the Murray River floodplain and associated terraces where rabbit numbers have been very high when not controlled.

**Foxes** (*Vulpes vulpes*) and **Cats** (*Felis catus*)

Because Rabbit numbers have been historically low in the mallee, Fox and Feral Cat numbers have been low there too. However, foxes are present on Gluepot and they are a significant threat, particularly for the Mallefowl. Since 1998, a Fox-baiting program (using 1080 baits) has been conducted 3-4 times per year on Gluepot, in conjunction with neighbouring Calperum and Taylorville Stations. Cats are also a significant threat for all the birds, thus they are trapped or shot on the reserve.

**Honey bees** (*Apis mellifera*)

Apiarists have placed honey bees near dams on Gluepot in the recent past, but this no longer occurs. In fact, Australian Apiarists work only with introduced European bees, because they live in large colonies and collect more honey than the natives bee; thus they are more commercially productive.

A big argument exists in Australia: Should we destroy European bee hives that become “wild” after they have left Apiarists’ hives? Of course, Apiarists say no because the bees which became wild can be used as a reservoir and are essential not only for the pollination of wild flowers, but also for agriculture. On the other side of the argument, conservationists have a differing outlook, and Gluepot Reserve Management Committee is included. Their point of view is that bees may deplete nectar supplies for native fauna, increase hybridisation of native plants, and compete for tree-hollows with other birds and animals.

The reduction of the number of permanent watering points on the Reserve has probably reduced honey bee density as their swarm efficiency is reduced once hives are more than 2 or 3 km from water. Feral honey bees still have access to water in the elevated bird troughs. At this stage, each new wild hive is destroyed.
1.6 Cultural resources

1.6.1 Aboriginal history

There is a very long Aboriginal history in the Riverland Biosphere Reserve with archaeological sites from 12,000 years ago in the Chowilla area. Moreover, in the north of Bookmark at Karolta, rock engravings reveal a largely continuous occupation from about 30,000 years ago. The Australian Heritage Commission interviewed local Aborigines and noted that until the recent past the Bookmark mallee country was owned and managed by the Paakantji tribe in the north and the Meru tribe in the south around the Murray River. Aboriginal people have strong social and cultural associations with the Bookmark Biosphere Reserve. This association is documented through oral history and through law creation.

Ethno history records indicate that during winter, when resources associated with the Murray River were hard to obtain, the mallee country was an important resource for food. Today mallee resources continue to be an economic and a social value to local Aboriginal people for food, medicine and the manufacture of saleable craft and artefacts.

European disease such as smallpox and influenza spread down the River Murray and caused significant loss of Aboriginal lives, even before they had direct contact with Europeans. Later, conflicts with drovers and settlers led to even more deaths.

Gluepot Reserve contains several artifact scatters along drainage lines, and a scarred tree has been documented near the Old Gluepot homestead site. South Australian Museum staffs have commenced an archaeological study of Aboriginal culture on the Reserve.
1.6.2 European history

The European history of the Bookmark Biosphere Reserve began in 1830 when Charles Sturt travelled down the Murray River. In 1838 the next Europeans passed through the area droving cattle from New South Wales to Adelaide and Bookmark Biosphere Reserve. European pastoral occupation of the Bookmark area began in 1851. Soon after, the name Bookmark was given to the area by the Robertson brothers who in 1896 divided Bookmark into Calperum and Chowilla Stations. The name “Bookmark”, originally applying to a quite small landholding was used for the entire and very large biosphere Reserve – now changed to Riverland Biosphere.

Pastoral development on the Bookmark was slow. In this area the ground water is approximately 150 m below the surface and it is salty, making the construction of numerous dams difficult.

The most tangible evidence of past pastoral activities is found in tracks, buildings, fences, dams and old equipment.
Excavation of the dam

In 1934, Reg Warnes purchased the Gluepot lease and held it with members of his family, for 28 years until 1962. A major period of development began. Nearly all Gluepot’s 18 dams were built during 1936-39 providing water for people and sheep. Dams had to be maintained constantly by deepening them and clearing the drains leading into them. The dams and tanks allowed the increase of the number of goats and kangaroos in the area. These animals competed with the sheep for food and broke through fences so considerable energy was put into culling them. Furthermore, the Warnes built the new house at Gluepot in 1957 and it is still in use.
**Birth of the reserve:**

Birds Australia purchased Gluepot Station on 30 July 1997 with a view to managing it as part of the National Reserve System. From the outset, Birds Australia placed particular emphasis on the long-term conservation of the reserve’s nationally threatened species of birds.

In recent times, Gluepot’s neighbours (Calpirum and Taylorville) have been managed for conservation, and the area protected under the Riverland Biosphere Reserve is 900 000 ha. With the advent of conservation organisations like Birds Australia and the development of conservation lands such as the Riverland Biosphere Reserve, we are seeing the mallee and its wildlife inhabitants revert to the situation as it was prior to European settlement.

![Gluepot Reserve](image)
1.7 Management

1.7.1 Management context

**Birds Australia:**

Birds Australia (Royal Australasian Ornithologists Union) was founded in 1901. It works to conserve native birds and biological diversity in Australia and Antarctica, through the study and management of birds and their habitats, and the education and involvement of the community. Birds Australia is the nation’s largest scientific society concerned with wildlife, with over 7,000 members and the ability to inspire the involvement of thousands of volunteers in its conservation projects. It relies on the financial support of trusts and foundations, private individuals, government agencies and companies to help it study and protect birds and their habitats. Birds Australia is an independent, non-profit organisation whose affairs are controlled by an elected Council. The Gluepot Management Committee is a sub-committee of the Birds Australia Council.

Since the 1970s, Birds Australia has conducted about 30 conservation-related projects annually. These have ranged from nationwide surveys, wildlife monitoring programs and studies of endangered species, to the production of some of the most authoritative publications on birds and the environment. Birds Australia has also established three field study centres called observatories where researches are undertaken and educational courses are held (opened to everyone).

Birds Australia is giving $30,000 per year to help Gluepot to run.

1.7.2 Management philosophy

The management objectives at Gluepot Reserve are to:

- Manage effectively a large and internationally significant protected area, for biodiversity conservation as an addition to Australia’s National Reserve System;
- Develop and implement high quality management, monitoring and business plans;
- Implement and monitor management actions aimed at improving the quality of native vegetation and enhancing populations of threatened species;
- Reduce the threats from wildfire, feral animals and weeds;
- Initiate and support high quality research, particularly on nationally threatened species;
- Contribute as a partner to the Bookmark Biosphere program;
- Increase public awareness of measures to conserve biodiversity through on-site education programs and by involving volunteers in all aspects of the Reserve’s programs;
1.7.3 Staffing and volunteer resources

Volunteer Management Committee

The Birds Australia Council has vested management of the reserve in a Management Committee. The Committee, which has 15 members, has been selected on the basis of their enthusiasm and skills in areas such as business management, land management, wildlife survey, research, conservation, and community involvement. The Management Committee has a chairman, secretary, treasurer and a number of sub-committees. It meets approximately every six weeks and most major decisions are made by a consensus of members. Outside of that meeting, sub-committees or individual members work on specific projects. The Committee is also responsible for the Research and monitoring projects on Gluepot.

Volunteer rangers and assistant rangers

The reserve is operated and managed on a continuous basis by volunteer Rangers and assistant Rangers who stay for a minimum of two months. All Reserve Rangers are volunteers and while at the Reserve they have the full use of the homestead, a 4WD vehicle (for Reserve business) and are paid a monthly food allowance.

Volunteer rangers are expected to undertake tasks similar to those of a National Park ranger. A member of the Management Committee inducts rangers when they arrive at the reserve, and this is described in a comprehensive Ranger Manual that is up-dated regularly. Because of the reserve’s isolation, preference is given to couples, those who are comfortable in the bush, able to communicate with the public, and have a strong interest in natural history.

Placements are also available for volunteer Assistant Rangers, who stay for an undefined period, and are often environmental management graduates and undergraduates seeking appropriate experience. Volunteer rangers and assistant rangers are encouraged to use their initiative, and when time permits, work with research personnel on their projects.

The volunteer Management Committee and first volunteer rangers took up office in July 1997. Since 1999, by placing some unpaid advertisements and through ‘word of mouth’, the reserve’s volunteer ranger positions have been fully booked 1-2 years in advance. At present, Ranger positions are booked for the next two years.
« Friends of gluepot »

A « Friends of Gluepot » group has been formed and presently has approximately 100 members. Members of this group are volunteers who undertake a large number and variety of projects on the Reserve. This includes the Reserve upkeep, maintenance, building construction, track maintenance, feral species and weed eradication. Since July 1997, Volunteers have donated over 5 million dollars worth of time and kilometers. As an example, in 2008, volunteers donated 26,750 hours to the Reserve.

Financial support

Gluepot reserve not only runs with the generous time donated by volunteers, but also with funds and donations. At the beginning, it was the donations of more than 2 400 people and organisations which allowed it to buy the $350 000 property –this sum was raised in 10 weeks.

Presently Gluepot requires approximately $60,000 to $80 000 a year for its Operating Budget. $10 000 is received from the Bureau of Meteorology for recording the daily weather data at the meteorological station; $30 000 by Birds Australia, and the remaining funds come from visitor fees and donations.
2. Bushfires

2.1 Understanding bushfire

2.1.1 Ingredients needed for bushfires

- fuel
- heat
- oxygen
- dryness

\[ \text{vegetation} \]

- high air temperature
- wind
- dry air

2.1.2 Ingredients that increase bushfire danger

1. vegetation
2. temperature above 30°C
3. wind over 20 Kph
4. dry air less than 30 % relative humidity
5. atmosphere unstable
6. terrain features slopes, ruggedness
7. buildings features complex shapes, exposed windows, etc.

1. Vegetation

Bushfires require vegetation to burn and the more widely spaced the vegetation, the less danger of it spreading. There are different types of vegetation, that burn differently:

- Spinifex and litter ignite easily and burn fast and hot.
- Eucalyptus leaves ignite more easily than branches and trunks.
- Trunks catch fire more slowly than shrubs but their flames last longer.
- Trees are hard to ignite without grass, spinifex, shrubs, or litter beneath them.
- Fire that rises into tree tops moves fastest.
- Fire that runs along tree tops is the most dangerous.
2. **Temperature of the day**

When the air temperature is below 20°C, a bushfire is unlikely but if it is 37°C or higher, we must be prepared for bushfire.

3. **Wind**

Wind has several consequences. It dries out vegetation making it more combustible, it supplies oxygen to stimulate burning and fans flames. Also, it blows burning debris ahead to start fresh ignitions.

- When the average summer wind speed is 55 Kph or faster, we must be prepared.
- When the average speed is below 20 Kph, bushfire is unlikely.
- The most hazardous wind gust is in an unstable upper atmosphere and makes the bushfires hard to control.

4. **Low relative air humidity (dry air)**

*Relative humidity*: degree of dampness in the air.

Dry air evaporates moisture from vegetation and buildings making ignition easier. When relative humidity of the air is above 60%, bushfire is unlikely but if it is 30% or less, we must be prepared.

5. **Unstable atmosphere**

When the atmosphere is unstable, winds at ground level become violent and the bushfire hard to manage. Also, the flames can rise extremely high and burning debris sucked up, can be blown for kilometres and fall still alight.

- On a still day with hazy sky and high air pressure, bushfire danger is low.
- When the wind is hot, strong and gusty, we must be prepared.

6. **Terrain features**

*Slopes*

- A fire travelling uphill doubles its speed for each 10% increase in slope.
  
  Up a 20° slope, fire moves four times faster than on a flat ground.
- A fire travelling downhill goes slower.
7. **Buildings features**

The three vulnerable areas of buildings are the ceiling space, the windows and the subfloor. The bushfire can attack them with direct flames, flying sparks, embers or burning debris. The direct flames can ignite walls only when vegetation grows, or burning debris piles up, against them. Sparks and embers can get inside the ceiling space, blow through broken windows and under doors, lodge in vents and crevices; and blow under the building.

2.1.3 **How bushfires behave**

**Ground fire**

Burning litter can carry a fire a long way on the ground and can set alight to spinifex, which is the main fuel load in a mallee fire. This type of fire is very hot and can quickly kill trees because it burns the roots through the soil.

**Under storey fire**

Spinifex burns quickly and carries fire to surrounding spinifex. Moreover, their combustion spreads to the closest trees and litter.

**Crown fire**

The eucalyptus wood is not really combustible. However its leaves contain eucalyptus oil which is very flammable. Once the fire has reached the leaves on the top of the tree, the entire canopy burns. Furthermore, hanging bark spreads the fire to the surrounding vegetation.

2.2 **November 2006**

In November 2006, Gluepot experienced its first fire for over 50 years. Severe lightning storms caused spot fires over a large area of the Riverland Biosphere, and Gluepot was hit in 12 locations. All the fires were quickly extinguished except one on the southern portion of the Birdseye Block burnt approximately 8,000 ha. Luckily, rain fell a few days after the fires and re-growth of burnt mallee trees, spinifex and understorey is well underway.

2.3 Controlled burning: a bushfire prevention

Controlled burning consists of burning all the flammable spinifex which is the main source of fuel in mallee fires. This is a good way to create firebreaks (areas without fuel) on the reserve and thus prevent the spread of future fires. On gluepot, a firebreak must be greater than 100 metres to avoid the fire and less than 150 meters to preserve the environment.

Gluepot utilises firebreaks to divide the reserve up into 44 separate areas. Thus, if a bushfire occurs in one area, firebreaks should prevent the fire moving into adjacent areas. Controlled burning also provides a safe access throughout the reserve to visitors and fire fighters.

In 2007, a fire management plan was devised for spinifex controlled burning. Now, each year, from 2007, approved areas are burnt during May or June, the best months for weather conditions. The different aims of the fire management plan are the follows:

- Reduce the effects of large wildfires
- Maintain old age Mallee communities
- Attempt to restrict wildfires to 1 or 2 days with little or no fire suppression
- Provide a safe access for CFS to assist in fire suppression
- Provide a safe access throughout the reserve during wildfires
- Reduce the need for invasive CFS suppression techniques during wildfires
Map 3. **SEPARATE AREAS**

The dark blue lines demarcate each of the future 44 separate areas of the reserve. These lines represent natural fire breaks as well as the burnt breaks.

Map 4. **NATURAL FIREBREAKS**

Not all the lines require to be burnt; some are already natural fire breaks. The light blue areas stand for all the natural firebreaks and these can be special vegetation which does not burn or different roads of the reserve.
The burning plan is obtained by taking the natural firebreaks from the different separate areas (Map3: Fire management 2007). The total length required to be burnt for wildfire protection is 96kms. This represents burning 10 sq kms or 1.7% of the reserve.
Legend:
- Approval required: an approval from the management committee is required before burning areas.
- Approved: areas approved by the management committee, in way to be burnt.
- Finished: areas already burnt.
Burning plan 2010

From 2007 to 2009, 90 kms were completed. This year, about 6 more km will be burnt and this will complete the Gluepot Reserve burning program for 10 years.

During my placement, I had the chance to be involved in the burning plan 2010. For three hours, one morning we burnt each spinifex in the following red square area:

Burning must be done early in the morning when the weather conditions are best. At that time: the temperature is low, the humidity is high, the vegetation is cool and moist, and generally wind is calm.
**Equipment**

Gas flame throwers are the safest and cleanest ignition method for burning. To ensure the safety, everybody who takes part in the burning must wear overalls (safety combination), gloves and boots. Furthermore, goggles and smoke masks can be used if necessary.

Finally, water and food are required because most of the controlled burning is away from the vehicles.

**Conclusion**

Since 2006, fire is qualified as the largest threat for the Gluepot Management committee. Furthermore, climate changes tend to announce an increase of bushfire; this is why a good prevention like controlled burning is required.
2.4 Studies undertaken about the consequences of fire

2.4.1 Ant survey

Introduction

Ants are not cuddly or cute, and some can sting. But ants are fascinating. They are the most numerous types of animals in the world, have the largest brains of all insects and can carry 10 or 20 times their own body weight. They live in highly organized and socially structured colonies that can range from a few individuals to tens of thousands, and they are very busy creatures. They are found everywhere except in Antarctica and high mountains where it is too cold and some isolated islands.
In Australia there are some 103 genera and approximately 1350 described species. They are the most highly social of all insects, and have been around for millions of years long before the dinosaurs existed.
Ants can eat other ants, dead animals, larvae, caterpillars and need water that they often find in dew.

Ants as indicators of environmental changes

Early in the morning, as the sun starts to rise and the temperature increases, so does the ant activity from the nest. Some ant species have narrow tolerances and will respond quickly to temperature or humidity change.
Some ant colonies are long lived and have permanent nests that can be marked and revisited. These long lived species will allow us to monitor the health of their colony as the environment changes around it. In contrary, short lived ant species immediately respond to sudden weather changes.
Ants and environmental monitoring

Ants are especially common in Australia. They occur in large numbers in all habitats throughout Australia. Ant communities change significantly when environmental conditions are altered. As a consequence, the monitoring of ant communities has become an important component of environmental inventories. A wide range of government and non-government agencies and private companies use the monitoring of ant communities to assist them in making decisions about managing the environment.

It is well known that bushfires can cause significant damage to the environment, but properly managed fire can actually improve conditions for many plants and animals. To determine optimal fire regimes and thus protect the environment, extensive studies have been completed to determine the effects of different burning practices. Ants have proven very useful in determining the effects of fire and thus in developing management strategies which optimise its impact.

Survey

The survey is led at Gluepot by Annette Vincent who is a volunteer; and the different ant samples are studied in the South Australian Museum in Adelaide.

First of all, the original idea (beginning 2007) was to study the different effects of the bushfire that occurred in 2006 on ant populations. To achieve this, the two goals were:

- Realize a survey of the bushfire area every year from 2007 in order to compare them and study the evolution each year.
- Realize a survey of normal bush area to compare with the bushfire area surveys.

Then, in the end of 2007 the burning of spinifex (fuel controlled) started. So, the management committee suggested a study of these controlled burning areas in order to compare them to the bushfire survey of 2007, and also compare these two last surveys to normal bush area survey of 2007. The fuel controlled survey started in 2008.
**Collecting method: micropits**

These are small collecting tubes, 8 cm tall and 2.5 cm diameter with screw top lids, ¾ filled with 100% ethanol solution placed into a hole dug in the ground, the lid is then removed. The soil is then filled back and packed down, up to the level of the top of the tube but not into the tube.

Usually, tubes are placed on Monday morning, left for 4 days and collected on Friday morning. For the bushfire area, each site measures 100m and there is 1 micropit every 10m. We chose to follow the controlled burning area and the normal bush area (100m controlled burning/100m no controlled burning) in order to know if there are two different territories or if ants move. So, these two areas are side by side and so each site is 200m and there is still 1 micropit every 10m. At the end of the collecting day, we had 120 micropits filled with ants.
Characteristics

Map 9. Localization of the different areas and sites
There are 3 different areas: normal bush area, bushfire area (fire 2006) and controlled burning area. For each area, there are 4 sites differentiated by several variables (dry, wet, level, height, slope, vegetation, spinifex…).

The survey is repeated each season (except summer) of each year to also study the weather variations.

### 5th > 9th April 2010 AUTUMN survey

<table>
<thead>
<tr>
<th>AREAS</th>
<th>Bushfire area</th>
<th>Fuel controlled burning area / Normal bush area</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITES</td>
<td>1st site</td>
<td>1st site</td>
</tr>
<tr>
<td></td>
<td>2nd site</td>
<td>2nd site</td>
</tr>
<tr>
<td></td>
<td>3rd site</td>
<td>3rd site</td>
</tr>
<tr>
<td></td>
<td>4th site</td>
<td>4th site</td>
</tr>
</tbody>
</table>

For each site, we study the number of ants and the number of genera. Then we compare the 4 different sites of the same area to each others in order to know if we can find one genus on different sites or different genera on one site. Moreover, we want to find out if characteristics like the dry, the wet, the presence of spinifex or the slope etc have direct effects on ants.

Then, we compare the 3 different survey areas to each other to determine the effects and consequences of bush fire and controlled burning on ant populations and the potential differences between bushfire and controlled burning.
ANT SURVEY

1st survey area: Bush fire (November 06)
   ➢ Beginning of the survey - November 07

1st site
   - Base of the south facing sand ridge
   - Wetter (rain from South)

2nd site
   - Top of the sandy dune
   - Very dry, most exposed to the sun
   - Highest point

3rd site
   - Bottom of the swale
   - Wettest (the rain drains)
   - Lowest part

4th site
   - Level sandy plan
   - Average rainfall
   - Well drained
**2\textsuperscript{nd} survey area**: 2 areas: Controlled burning/Normal area
- Beginning of controlled burning – July 2008

**1\textsuperscript{st} site**
- Level sandy plan
- Average rainfall
- No controlled burning because no spinifex

**2\textsuperscript{nd} site**
- Level plan (very gentle North facing slope)
- Average rainfall
- 100m controlled burning: no spinifex (burnt)
- 100m no controlled burning: spinifex

**3\textsuperscript{rd} site**
- Top of sandy ridge
- Very dry
- 100m controlled burning: no spinifex (burnt)
- 100m no controlled burning: spinifex

**4\textsuperscript{th} site**
- Bottom of the south facing slope
- Wetter
- 100m controlled burning
- 100m no controlled burning: spinifex
Conclusion

Being at Gluepot allowed me to be involved in a large environmental survey which asked a great scientific rigour because of its scope. Indeed, the study takes into account many characteristics and variables and compares everything.

Thanks to this survey, I learnt a lot about all the different sites in Gluepot and the different characteristics of the bush. Furthermore, I took part in a two days course about ants led by Annette Vincent. She taught us how to draw ants, how to classify them and how to catch them.
2.4.2 Vegetation survey

Introduction

In order to complete Annette Vincent’s work, a survey about vegetation has been undertaken on the same sites. The survey could determine if the vegetation has a link with ant populations.

The best time for the vegetation survey to be done is in spring (September to November), this is why it has not been completed yet. However, a pilot study of the bushfire area has been done. During the pilot study, we went on the 4 different sites and established a statement of every type of vegetation.

We will try to determine if the different variables have consequences on the vegetation.

Site 1
Base of the south facing sand ridge
Wetter (rain from South)

43. Mallee dragoon
Species

- Triodia scariosa
- Purplelaqua chenopod
- Halgania cyanea
- Eremophila glabra murray
- Sclerolaena parviflora
- Sclerolaena obliquicuspis
- Beyeria opaca
- Grevillea huegelii
- Austrostipa
- Eucalyptus socialis
- Acacia rigens
- Myoporum platycarpum
- Eucalyptus leptophylla
- Acacia curved tip
- Maireana pentatropis
- Prostanthera aspalathoides
- Sclerolaena diacantha
- Eucalyptus gracilis
- Solanum coactiliferum
- Eremophila crassifolia
- Grammosolen dixonii
Site 2
Top of the sandy dune
Very dry, most exposed to the sun
Highest point

Species

- Eucalyptus leptophylla
- Eucalyptus socialis
- Triodia scariosa scariosa
- Eremophila glabra murray
- Halgania cyanea
- Scleroleana parviflora
- Scleroleana obliquuspsis
- Beyeria opaca
- Solanum coactiliferum
- Austrostipa sp
- Purplelaqua chenopod
48. *Solanum coactiliferum*

49. *Eucalyptus leptophylla*

50. *Triodia scariosa scariosa*
Site 3
Bottom of the swale
Wettest (the rain drains)
Lowest part

Species

- Grammosolen dixonii
- Solanum coactiliferum
- Triodia scariosa scariosa
- Sclerolaena diacantha
- Sclerolaena paviflora
- Eremophila glabra glabra
- Beyeria opaca
- Eremophila glabra murray
- Podolepis capillaris
- Eucalyptus dumosa
- Myoporum platycarpum
- Eucalyptus socialis
- Maireana pentatropis
- Mealy chenopod
- Maireana appressa
- Austrostipa sp
- Halgania cyanea
- Grevillea huegelii
- Lomandra leucocephala ssp. robusta
- Callitris verrucosa
- Purpleaqua chenopod

52. Callitris verrucosa

53. Beyeria opaca

54. Grammosolen dixonii

55. Solanum coactiliferum

56. Lomandra leucocephala ssp. robusta
Site 4
Level sandy plan
Average rainfall
Well drained

Species

- Eremophila glabra murray
- Triodia scariosa scariosa
- Eucalyptus dumosa
- Sclerolanea parviflora
- Maireana pentatropis
- Sclerolanea diacantha
- Mealy chenopod
- Purplelawaqua chenopod
- Eucalyptus oleosa
- Eremophila glabra glabra
- Marieana appressa
- Senna artemisioides petiolaris
58. *Sclerolanea dicantha*

59. *Eremophila glabra murray*

60. *Sclerolanea parviflora*

61. *Eucalyptus dumosa*
Results

Number of species

<table>
<thead>
<tr>
<th>Site</th>
<th>Number of species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 species</td>
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<tr>
<td>2</td>
<td>11 species</td>
</tr>
<tr>
<td>3</td>
<td>21 species</td>
</tr>
<tr>
<td>4</td>
<td>12 species</td>
</tr>
</tbody>
</table>

Number of common species

<table>
<thead>
<tr>
<th></th>
<th>Site 1</th>
<th>Site 2</th>
<th>Site 3</th>
<th>Site 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1</td>
<td>8</td>
<td></td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Site 2</td>
<td></td>
<td>6</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Site 3</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Site 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Percentage of common species

<table>
<thead>
<tr>
<th></th>
<th>Site 1</th>
<th>Site 2</th>
<th>Site 3</th>
<th>Site 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1</td>
<td>33%</td>
<td>35%</td>
<td>32%</td>
<td></td>
</tr>
<tr>
<td>Site 2</td>
<td></td>
<td>23%</td>
<td>27%</td>
<td></td>
</tr>
<tr>
<td>Site 3</td>
<td></td>
<td></td>
<td>43%</td>
<td></td>
</tr>
<tr>
<td>Site 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Observations & interpretations

Being interested in the number of species, we can see that the sites 1&3 have a wide variety of species with 21 each; whereas the sites 2&4 have only 11 and 12 species.

The sites 1&3 are situated in the South whereas the site 2&4 are situated in the North. It seems that the geographic situation has an impact on the number of species.

Looking at the number of common species, we can see that the sites 3&4 are 43% similar; whereas the sites 2&3 are the most different sites with only 23% similarity.

The sites 3&4 are situated at the two lowest levels (level sandy plane & bottom of swale); whereas the sites 2&3 differ the most in height (highest point, bottom of swale).

It seems that the level has an impact on the kind of species.
Conclusion

All these observations seem to conclude that the variety and the type of vegetation are linked to the topography of the Reserve. Each site is different and so, is submitted to a particular microclimate. We can imagine that ant populations can be affected in the same way.

Because of the fire, it will be interesting to study the complete survey to understand how ants survive compared to the normal bush area.

With already 21 species on two sites we can say that, 4 years after the bushfire, the re-vegetation is in a good way.
3. Occupational health and safety projects

3.1 Feral goat project

Introduction

Feral goats in the Riverland and at Gluepot

Gluepot Reserve has been destocked since March 1997, and Feral Goats *Capra Hircus* are now the introduced pest species that pose the greatest conservation threat to the Reserve’s vegetation. There are between two and three million Feral Goats in Australia. Since 1998, Goats have been removed from Gluepot by trained shooters and in more recent times groups of conservation shooters have been coming to Gluepot 3 or 4 times per year. In 2002, the management committee decided to fill in all artificial watering points to reduce grazing pressure, thus increasing biodiversity. Feral Goat numbers have since reduced markedly on Gluepot. Pastoral properties to the north and west of Gluepot remain a significant source of Feral Goat numbers because watering points are maintained for livestock, and goats are also harvested for profit.

Grazing pressure on vegetation

Goats have a highly variable diet and will eat almost anything. They tend to favour browsing from trees or shrubs rather than grasses and can graze anything from ground cover up to about 1.8m off the ground. They have also been known to climb trees in an attempt to access higher foliage. In essence, Goats are highly mobile, notoriously disrespectful to fences, thriving in rugged and inaccessible terrain.

The main impacts of Feral Goats on the biodiversity of Gluepot are as follows:

- They are generalist feeders with a highly variable diet. This means they can intensively graze areas which would usually be only grazed lightly by native herbivores.
- Goats increase the total grazing pressure in a given area, reducing the productivity of vegetation and thereby decreasing the amount of food and habitat available for native species.
- Goats increase erosion when they travel across long distances with their hard hooves.
- Seedlings and suckers are grazed by goats, limiting the ability for recruitment by native plants.
- Long term vegetation community change, with species resistant to grazing becoming dominant and species susceptible to grazing disappearing.
Monitoring of Goats at Gluepot

The aim of the project is to stop the goats coming to graze in Gluepot, or at least reduce their numbers. To achieve this, the management committee decided first to put up a trial electrical fence section of 10km as a test before full electrification. To assess its effectiveness, monitoring is required for 3 months before the installation and 3 months after. The number of goat in the area is estimated by “4 days monitoring” once a month.

Purpose of Risk assessment

Until now, there was no risk assessment for this project. The project was deemed to be dangerous as the work was located next to an electrical fence. The work also included subtle risks such as dust inhalation and muscles strains. Furthermore, different people were to carry out the project every month. Therefore, it was extremely important to identify each risk so new people can implement controlled measures; this is why the management committee have requested the goat project risk assessment.

Goat Project Methods
In preparation for monitoring, on the first morning 45 sand-pads are prepared. Each sand-pad needs to be raked smooth (red square) using the back of a rake or other suitable tool, and if necessary, more soil can be added from the side of the road. The surface must be smooth and it is much easier to see animal tracks the following morning if the rocks, sticks and bark are removed from the sand-pad. The dimensions of each sand-pad are the width of the road by the distance between two fences posts which is about 5m*5m. Monitoring of each sand-pad is done on three consecutive days and is required every month until the electric fence has been constructed and then for three months after this.

![Example of goat’s prints](image)

The three following mornings, goat’s prints are counted for each site (see tracks in the red circle). Animal tracks are best observed early in the morning, before being disturbed by wind and dried by the sun and are also easier to see in the slanting light.
Assistant rangers’ tasks:

- First morning: establish each of the sand-pads

- Next mornings
  1- Drive the car out to the site
  2- Get out of the car
  3- Check for tracks
  4- Walk around on the edge*
  5- Look for prints

- If prints:
  6- Go back to the car
  7- Take the rake out of the car
  8- Record the number of sets of tracks on a data sheet
  9- Rake the ground to erase the prints
  10- Put the rake back in the car
  11- Get back in the car and drive to the next site
## Risk Assessment

<table>
<thead>
<tr>
<th>Task</th>
<th>Hazard</th>
<th>Risk situation</th>
<th>Risk</th>
<th>Wounds location</th>
<th>Safety measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check for tracks</td>
<td>vegetation, spinifex</td>
<td>walking close to the vegetation</td>
<td>wounds</td>
<td>legs</td>
<td>long trousers, good shoes</td>
</tr>
<tr>
<td>Check for tracks</td>
<td>uneven surfaces, holes</td>
<td>walking on the edge of the road</td>
<td>fall, twist the ankle</td>
<td>extremities</td>
<td>good shoes that keep ankles safe, walk around the edge, not on the edge</td>
</tr>
<tr>
<td>Take the rake out of the car</td>
<td>heavy, awkward-shaped rake</td>
<td>taking the rake with a stretched arm*</td>
<td>injuries</td>
<td>arms, shoulders, back</td>
<td>slide the rake carefully out of the car</td>
</tr>
<tr>
<td>Walk with the rake</td>
<td>rake</td>
<td>walking on the rake</td>
<td>wounds</td>
<td>body</td>
<td>walking with the rake by the side, the head at the bottom; with teeth pointed outwards</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>maintain a good body position or use a back harness, alternate with left and right, alternate with partner, use a plastic broom</td>
</tr>
<tr>
<td>Rake the ground to erase prints</td>
<td>wrong body position</td>
<td>raking</td>
<td>back issues</td>
<td>back</td>
<td>double fence (electrified wires situated on other side of fence), protective rake with plastic arm</td>
</tr>
<tr>
<td>Rake the ground to erase prints</td>
<td>electrical fences</td>
<td>raking (metal rake), touching the fence</td>
<td>electrocution</td>
<td>body</td>
<td></td>
</tr>
<tr>
<td>Rake the ground to erase prints</td>
<td>dust</td>
<td>raking</td>
<td>breathing issues, irritation</td>
<td>airways, eyes</td>
<td>breathing masks, glasses</td>
</tr>
<tr>
<td>Rake the ground to erase prints</td>
<td>sun, heat</td>
<td>raking</td>
<td>dehydration</td>
<td>body</td>
<td>drink water, wear hat, use sunscreen and sunglasses</td>
</tr>
<tr>
<td>Put the rake back in the car</td>
<td>heavy, awkward-shaped rake</td>
<td>lifting the rake, put it back with stretched arms</td>
<td>back issues, injuries</td>
<td>arms, shoulders, back</td>
<td>keep back straight and place rake carefully back in the car</td>
</tr>
</tbody>
</table>
Example of Goat Tracks
Data Sheet:

<table>
<thead>
<tr>
<th>Date</th>
<th>Previous 24 hour Weather</th>
<th>Observer/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visit 1</td>
<td>25/03/2010</td>
<td>Luke</td>
</tr>
<tr>
<td>Visit 2</td>
<td>26/03/2010</td>
<td>Luke, Ellen</td>
</tr>
<tr>
<td>Visit 3</td>
<td>27/03/2010</td>
<td>Luke, Ellen</td>
</tr>
</tbody>
</table>

Comments: Sporting shooters came for the weekend (19/3 - 22/3) just gone. This may effect results.

<table>
<thead>
<tr>
<th>Entry Points (x)</th>
<th>Sand Pad</th>
<th>Number of Goat Intrusions Per Sand Pad</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OP01</td>
<td>Visit 1 0</td>
</tr>
<tr>
<td></td>
<td>OP02</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>OP03</td>
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</tr>
</tbody>
</table>

Passive tracking Index (Control): 1.00  3.13  1.07

Passive tracking Index (Test): 0.80  1.47  1.10

The passive tracking Index is the number of goat tracks recorded per day divided by the number of sites.
Edge*: raised and unstable edge of road around the sand-pad.

Stretched arm*: incorrect body position when taking the rake out of the car.
**Electric fence project**

62. This is the actual fence. Behind, there is the old one.

This is the drawing of the future safety electrical fence which will be attached to the actual fence.

**Conclusion**

The risk assessment identified 9 hazards. Among these, we can highlight the 3 following main ones: the electrical fences (electrocution risk), a wrong body position (back issues) and the dust (breathing issues, irritation). Safety measures for the electrical fence hazard include using a safe rake with a plastic arm. This is going to be bought by the Reserve. Similarly, to avoid the dust hazard breathing masks have been bought. Finally, the hazard posed by using the wrong body position could be solved by buying a back harness but Gluepot is a charity Reserve and does not have the funds. However, the other pieces of advice must be followed.

The risk assessment has been checked and validated by the management committee and Duncan Mackenzie, Gluepot’s chairman. It is now part of the Goat monitoring project’s manual.
3.2 Climate change risk assessment workshop on Gluepot Reserve

The following part leans on Luke Ireland’s work who led the workshop.

Gluepot Reserve is situated in South Australia in the arid zone; the climate is warm to hot in summer, cool to cold in winter and the rainfall average low.

Now, and more than never, the world is facing a large issue: climate change. Global warming is clearly evident and many researches show the correlation with phenomena like melting of glaciers, earlier flowering and changes in migratory patterns of animals. This is a real threat towards the reserve.

To ensure that Gluepot Reserve is aware of the risks associated with climate change impacts, a study was undertaken by Luke Ireland. A brainstorming was realized with the Rangers and Volunteer rangers to identify the different risks for each variable (increased number of hot days, increased bushfire danger etc.) of each key element (people, environment, assets). After the risk identification, the different existing controls were examined, and for each scenario a priority was assigned based on likelihood and consequence scales.

This analysis will be incorporated into processes for management and strategic planning over the next 25 years.

**Key elements**

Before starting the risk identification process, we had to find key elements which are a set of topics that can be discussed one by one during the process. At the beginning, Gluepot Reserve’s operations were broken down into the following categories:

- Environment
- Staff
- Infrastructure
- Visitors

Then, with the Occupational Health and Safety skills, we revised and updated these topics classifying them and improving the organisation of the table as following:

- People
- Environment
- Assets
<table>
<thead>
<tr>
<th>Key</th>
<th>Climate Change Variable</th>
<th>Change</th>
<th>Effect</th>
<th>Affected Element</th>
<th>Primary Risk Control Measure</th>
<th>Secondary Risk Control Measure</th>
<th>Consequence</th>
<th>Likelihood</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>People</td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Environment</td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>Assets</td>
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</tr>
</tbody>
</table>
### Consequence scale

In order to determine the consequence scales, a set of success criteria was determined by Luke Ireland and Duncan Mackenzie for Gluepot Reserve as follows:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Protection and Enhancement of the Biodiversity</th>
<th>Reserve Infrastructure &amp; Safety</th>
<th>Human Resources &amp; Finances</th>
<th>Public Image</th>
<th>Management, Monitoring and Business Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic</td>
<td>Loss of many species and loss of habitat. Irrecoverable damage to the environment</td>
<td>Large numbers of serious injury or loss of lives. Irrecoverable damage to infrastructure</td>
<td>Severe shortages of volunteers. Reserve no longer financially viable</td>
<td>Widespread concern about Gluepot’s operations and ability to protect biodiversity</td>
<td>Management plans no longer effective. Reserve forced to close</td>
</tr>
<tr>
<td>Major</td>
<td>Loss of key conservation species. Severe loss of environmental amenity and danger of continuing environmental damage</td>
<td>Isolated instances of serious injury or loss of lives. Severe damage to infrastructure</td>
<td>Operations severely affected by volunteer shortages. Poor financial outlook due to increasing costs and lack of grants</td>
<td>Serious expressions of concern about operations and ability to protect biodiversity</td>
<td>Management operations seriously affected. Monitoring projects no longer viable</td>
</tr>
<tr>
<td>Moderate</td>
<td>Increase of key threatening processes and environmental damage. Chance of revival with intensive recovery efforts</td>
<td>Small numbers of injuries. Isolated instances of major damage to infrastructure</td>
<td>Volunteers require increased levels of training/attention. Grants harder to obtain and higher operating costs</td>
<td>Isolated expressions of concern regarding Gluepot’s operations and ability to protect biodiversity</td>
<td>Isolated instances of serious disruptions to management practices and monitoring programs</td>
</tr>
<tr>
<td>Minor</td>
<td>Small, localised areas of environmental damage. Reduction in food and habitat resources. Minimal recovery effort needed for restoration</td>
<td>Serious near misses or minor injuries. Minor damage to infrastructure.</td>
<td>Isolated shortages of volunteers or poor workplace relations easily resolved. Increasing operating costs</td>
<td>Some concern regarding operations and ability to protect biodiversity</td>
<td>Slight disruptions to management and business plans and monitoring projects</td>
</tr>
<tr>
<td>Insignificant</td>
<td>Nil or negligible environmental damage</td>
<td>Appearance of a threat but no actual harm. Negligible damage to infrastructure easily fixed</td>
<td>Minor workplace issues that would pass without special attention. Negligible financial losses</td>
<td>Minor instances of public dissatisfaction, which are easily resolved onsite</td>
<td>Negligible effect on management operations</td>
</tr>
</tbody>
</table>

### Likelihood scales

Likelihood scales are necessary to describe the possibility of a risk arising given a particular climate change scenario. The scales can be used to rate the likelihood of both single and recurrent events.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Recurrent Risks</th>
<th>Single Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost Certain</td>
<td>Could occur several times per year</td>
<td>More likely than not - probability greater than 50%</td>
</tr>
<tr>
<td>Likely</td>
<td>May arise about once per year</td>
<td>As likely as not - 50/50 chance</td>
</tr>
<tr>
<td>Possible</td>
<td>May arise once in ten years</td>
<td>Less likely than not but still appreciable - probability less than 50% but still quite high</td>
</tr>
<tr>
<td>Unlikely</td>
<td>May arise once in 10 - 25 years</td>
<td>Unlikely but not negligible - probability low but noticeably greater than zero</td>
</tr>
<tr>
<td>Rare</td>
<td>Unlikely during the next 25 years</td>
<td>Negligible - probability very small, close to zero</td>
</tr>
</tbody>
</table>
**Risk priority matrix**

The following matrix is used to define the level of priority associated with each combination of consequence and likelihood.

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Insignificant</th>
<th>Minor</th>
<th>Moderate</th>
<th>Major</th>
<th>Catastrophic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost Certain</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
<td>Extreme</td>
<td>Extreme</td>
</tr>
<tr>
<td>Likely</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>Extreme</td>
</tr>
<tr>
<td>Possible</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Unlikely</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Rare</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
</tr>
</tbody>
</table>

**Extreme** risks demand urgent attention at the most senior level and cannot be simply accepted as part of routine operations without executive sanction.

**High** risks are the most severe risks that can be accepted as a part of routine operations without executive sanction but they will be the responsibility of the most senior operational management and reported upon at the executive level.

**Medium** risks can be expected to form part of routine operations but they will be explicitly assigned to relevant managers for action, maintained under review and reported upon at senior management level.

**Low** risks will be maintained under review but it is expected that existing controls will be sufficient and no further action will be required to treat them unless they become more severe.
## Results table

<table>
<thead>
<tr>
<th>Key Element</th>
<th>Climate Change Variable</th>
<th>Effect</th>
<th>Affected Element</th>
<th>Primary Risk Control Measure</th>
<th>Secondary Risk Control Measure</th>
<th>Consequence</th>
<th>Likelihood</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Increased number of hot days, changes in seasonality of rainfall, Increased frequency of extreme events (fire, droughts)</td>
<td>Change in life cycle, behaviour and migratory patterns</td>
<td>Flora and Fauna, including threatened species</td>
<td>Destocking, goat control</td>
<td>Closure of waterpoints, enclosure around homestead dam</td>
<td>Moderate</td>
<td>Almost Certain</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>Increased bushfire danger, average temperature and number of hot days</td>
<td>Loss of habitat</td>
<td>All biodiversity including Mallee ecosystem</td>
<td>Fire management plan, fire breaks</td>
<td></td>
<td>Major</td>
<td>Possible</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>Increased average temperature, droughts, bushfires and decreased rainfall</td>
<td>Local species extinction due to extreme events, changes in distribution or inability to adapt in-situ</td>
<td>Flora and Fauna, including threatened species</td>
<td>Feral animal control, fire management plan</td>
<td>Community/regional involvement</td>
<td>Major</td>
<td>Possible</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>Increased temperature, decreased rainfall, changed seasonality of rainfall</td>
<td>Changed distribution of pests</td>
<td>Biodiversity</td>
<td>Feral animal control</td>
<td>Closure of water points</td>
<td>Minor</td>
<td>Likely</td>
<td>MEDIUM</td>
</tr>
<tr>
<td></td>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Increased instances of stressed animals</td>
<td>Fauna</td>
<td>Closure of water points</td>
<td></td>
<td>Minor</td>
<td>Likely</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>People</td>
<td>Increased average temperature, droughts, bushfires and decreased rainfall</td>
<td>Local species extinction due to extreme events, changes in distribution or inability to adapt in-situ</td>
<td>Visitor numbers</td>
<td>Feral animal control, fire management plan</td>
<td>Biodiversity education through courses</td>
<td>Moderate</td>
<td>Possible</td>
<td>MEDIUM</td>
</tr>
<tr>
<td></td>
<td>Increased evaporation and decreased rainfall</td>
<td>Reduction in water resources</td>
<td>Staffing numbers</td>
<td>Very large storage</td>
<td>Water saving measures</td>
<td>Major</td>
<td>Unlikely</td>
<td>MEDIUM</td>
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<td>Risk</td>
<td>Mitigation</td>
<td>Level of Concern</td>
<td>Impact</td>
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<td>Increased bushfire danger due to bushfire danger</td>
<td>Closure of reserve</td>
<td>Insignificant</td>
<td>Increased bushfire danger</td>
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<td></td>
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</tr>
<tr>
<td>Increased frequency/intensity of electrical storms and extreme events</td>
<td>Risk of electrocution and other injuries</td>
<td>Significant</td>
<td>Closure of reserve - finances, public image</td>
<td></td>
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<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Health and Safety of Staff and Visitors</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
<td></td>
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<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Advice in birdhides re: fire</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
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<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Earth rod for some buildings</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
<td></td>
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<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Health and safety of visitors and staff</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
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<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Advice on walks brochures for visitors, Induction manual for rangers</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
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<td>Increased temperature, heatwaves and number of hot days</td>
<td>Increased UV radiation</td>
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<td>Fire management plan, fire breaks</td>
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<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Health and safety of visitors and staff</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
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<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Advice on walks brochures for visitors, Induction manual for rangers</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
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<td>Increased temperature, heatwaves and number of hot days</td>
<td>Shorter working days</td>
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<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Decreased output/production</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
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<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Flexibility of work</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
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<td>Increased temperature, heatwaves and number of hot days</td>
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<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Gluepot Foundation growth</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
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<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Reduced comfort in education courses</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
<td></td>
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<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Reduction in visitor numbers</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Finance, Publicity</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
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<td>Increased temperature, heatwaves and number of hot days</td>
<td>Gluepot Foundation growth</td>
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<td>Fire management plan, fire breaks</td>
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<td>Increased temperature, heatwaves and number of hot days</td>
<td>Insurance for education centre</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
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<tr>
<td>Increased intensity of rainfall and extreme events</td>
<td>Reduced safety around Homestead area</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
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<tr>
<td>Increased intensity of rainfall and extreme events</td>
<td>Staff and infrastructure</td>
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<td>Fire management plan, fire breaks</td>
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<tr>
<td>Increased intensity of rainfall and extreme events</td>
<td>Gravel pathways, external shade structures</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
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<td>Increased intensity of rainfall and extreme events</td>
<td>Solar lights</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
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<tr>
<td>Decreased rainfall</td>
<td>Increased cost to get water from elsewhere</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
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</tr>
<tr>
<td>Decreased rainfall</td>
<td>Finances</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
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<tr>
<td>Decreased rainfall</td>
<td>Large rainwater capacity</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
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<tr>
<td>Decreased rainfall</td>
<td>Water saving measures</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
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</tr>
<tr>
<td>Increased average temperature, droughts, bushfires and decreased</td>
<td>Increased dependence on Emergency Services</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
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<tr>
<td>rainfall</td>
<td>Closure of reserve - finances, public image</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
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<tr>
<td>Increased intensity of rain, decreased rainfall, change in seasonal</td>
<td>Health of staff</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
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<tr>
<td>rainfall</td>
<td>Education and good hygiene practice</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Increased intensity of rain, decreased rainfall, change in seasonal</td>
<td>Different disease patterns and pests</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>rainfall</td>
<td>Health of staff</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Increased intensity of rain, decreased rainfall, change in seasonal</td>
<td>Education and good hygiene practice</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
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<td></td>
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<tr>
<td>rainfall</td>
<td>Insignificant</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased intensity of rain, decreased rainfall, change in seasonal</td>
<td>Possible</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>rainfall</td>
<td>Possible</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased intensity of rain, decreased rainfall, change in seasonal</td>
<td>Possible</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rainfall</td>
<td>Possible</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased intensity of rain, decreased rainfall, change in seasonal</td>
<td>Possible</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rainfall</td>
<td>Possible</td>
<td>Minor</td>
<td>Fire management plan, fire breaks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assets</td>
<td>Stresses on community, loss of local participation</td>
<td>Labour and time resources</td>
<td>Air-conditioning, Palmer block</td>
<td>Major</td>
<td>Possible</td>
<td>HIGH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------</td>
<td>---------------------------</td>
<td>-------------------------------</td>
<td>-------</td>
<td>----------</td>
<td>------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased average temperature, heatwaves, bushfires and decreased rainfall</td>
<td>Recruitment of volunteers</td>
<td>Managamenet of reserve, finances</td>
<td>Rangers Maintenance Calendar, Big Day Out, RAG team</td>
<td>Major</td>
<td>Possible</td>
<td>HIGH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Increased need for maintenance</td>
<td>Resources, volunteer hours, finances, infrastructure</td>
<td>Gluepot Foundation growth</td>
<td>Minor</td>
<td>Possible</td>
<td>MEDIUM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased bushfire danger</td>
<td>Increased bushfires leading to loss/damage to infrastructure</td>
<td>Infrastructure</td>
<td>Fire management plan, fire breaks</td>
<td>Moderate</td>
<td>Possible</td>
<td>MEDIUM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased temperature, heatwaves and number of hot days</td>
<td>Increased demand for insulation</td>
<td>Finances</td>
<td>Gluepot Foundation growth</td>
<td>Insignificant</td>
<td>Possible</td>
<td>LOW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased number of hot days, intensity of rainfall and extreme events</td>
<td>Depreciation of assets, ‘wear and tear’</td>
<td>Finances</td>
<td>Gluepot Foundation growth</td>
<td>Insignificant</td>
<td>Likely</td>
<td>LOW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased intensity of rainfall and extreme events</td>
<td>Siltation in dams</td>
<td>Time resources</td>
<td>Silt trap (needs fixing)</td>
<td>Insignificant</td>
<td>Possible</td>
<td>LOW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased number of hot days, changes in seasonality of rainfall, Increased frequency of extreme events (fire, droughts)</td>
<td>Government/market response to climate change</td>
<td>Supply of goods, finances</td>
<td>Gluepot Foundation growth</td>
<td>Minor</td>
<td>Unlikely</td>
<td>LOW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased intensity of rainfall and extreme events</td>
<td>Erosion of campsites, dams and roads</td>
<td>Time resources</td>
<td>Insignificant</td>
<td>Likely</td>
<td>LOW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased intensity of rainfall, decreased rain</td>
<td>Reduce efficiency of water</td>
<td>Water resources</td>
<td>Insignificant</td>
<td>Unlikely</td>
<td>LOW</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Observation & interpretation

First, for the environment key, there are only 5 scenari out of 27 in total. Indeed, in spite of large environmental information sources, it is truly hard to plan what the future climate change effects could be on the vegetation.

<table>
<thead>
<tr>
<th>Key</th>
<th>Scenari</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>5</td>
</tr>
<tr>
<td>People</td>
<td>14</td>
</tr>
<tr>
<td>Assets</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
</tr>
</tbody>
</table>

Priority rate

<table>
<thead>
<tr>
<th>Priority rate</th>
<th>Number of scenari</th>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>High priority</td>
<td>5</td>
<td>Environment (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>People (2)</td>
</tr>
<tr>
<td>Medium priority</td>
<td>8</td>
<td>Environment (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>People (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Assets (2)</td>
</tr>
<tr>
<td>Low priority</td>
<td>14</td>
<td>People (8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Assets (6)</td>
</tr>
</tbody>
</table>

However, most of the high priorities are linked to the environment. So, the main future actions will be related to it.

Then, the people key appears in each priority rate, there is obviously many levels of risks associated with it. This shows that people are very important for the running of gluepot Reserve and so special attention must be paid to this.

Finally, assets are not really affected. Indeed, Gluepot is a conservation Reserve, so assets are more support elements.

Conclusion

These risks are like a guideline which will be presented to the management committee. It will help the committee understand the importance of climate change in their future management decisions.
4. Other task undertaken

Meteorological station data recording

Duncan Mackenzie, Chairman of Gluepot Management Committee succeeded in convincing the Bureau of Meteorology (B.O.M) to operate a synoptic weather station within the grounds of Gluepot Reserve. Rangers undertake observations twice a day, at 9am and again at 3pm. These include temperature, humidity, rainfall, wind speed and direction, cloud cover, visibility and evaporation. (See Appendix 4, p.63: Example of a data sheet)

As a synoptic weather station Gluepot Reserve is an important part of the Bureau’s Observational Network. Enormous care is taken to ensure the quality of the Data, as data from all sites are input for global computer models which are vital tools in modern forecasting techniques. Each day, the data is downloaded on the web (www.bom.gov.au/) by the B.O.M, and all the data from all the stations in Australia is available, Gluepot included.

Gluepot Reserve weather station, commenced operation in April 1999 and in this short time the temperature has ranged from a lowest minimum of -6.5°C in May 2006 to a highest maximum of 46.9°C in January 2001. The highest daily rainfall recorded so far is 50.8mm in February 2000.

The Reserve also operates its own solar powered automatic weather station located in the eastern section of the Reserve. Data is downloaded monthly via a laptop computer and transferred to Gluepot’s main computer at the Homestead. Data from both the Bureau of Meteorology and automatic weather stations are a vital part of many research programs on the Reserve.

$10,000 is given by the B.O.M. to the reserve to operate this weather station.
# Meteorological data sheet

<table>
<thead>
<tr>
<th>Station Name: Gluepot</th>
<th>Station number: 020028</th>
<th>Date: 31/5/10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Observer</strong></td>
<td><strong>Time</strong></td>
<td><strong>Temperature</strong></td>
</tr>
<tr>
<td>Luke</td>
<td>0900</td>
<td>11 3/10 5</td>
</tr>
<tr>
<td>Luke</td>
<td>1500</td>
<td>15 4/12 1</td>
</tr>
</tbody>
</table>

**Max temperature**

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature</th>
<th>As Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900</td>
<td>17.2</td>
<td>11.8 15.8</td>
</tr>
<tr>
<td>1500</td>
<td>15.4</td>
<td></td>
</tr>
</tbody>
</table>

**Min temperature**

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature</th>
<th>As Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900</td>
<td>10.6</td>
<td>11.4</td>
</tr>
<tr>
<td>1500</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Terrestrial Minimum**

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature</th>
<th>As Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900</td>
<td>9.6</td>
<td>15.4</td>
</tr>
</tbody>
</table>

**Phenomena - Midnight to Midnight yesterday**

- Dew Fall
- Snow
- Thunderstorm/Thunder Heard
- Frost
- Dust Storm
- Mist/Haze/Smoke
- Fog
- Strong Wind (mean 22-35Kts)
- Gale (mean 34Kts or more)

- Report any of the above if they have occurred outside obs time or have been reported in an obs.

**Remarks/Plain Language**

- [ ]

**Since last obs**

- Rainfall: 0.4

- Accum. Rainfall: 0

**Read to the nearest whole degree.**

**Transfer to F88 for forwarding at end of month.**

- Rain to 0900

**Annexe with obs time**
Conclusion

Understanding both the historical and ecological evolution of this sheep station which became a natural reserve was very interesting. Even more, the different tasks and studies undertaken like the ant’s survey and the vegetation’s survey allowed me to be involved in the Reserve management.

Moreover, I have been able to help the Reserve with my occupational health and safety skills carrying out the goat project risk assessment.

Furthermore, contact with tourists, volunteers, researchers, whether Australians or from overseas, was one of the best part as it was truly enriching.

The international aspect of this internship at Birds Australia Gluepot Reserve as a Volunteer Assistant Ranger was fascinating in both naturalistic and human terms.

I would like to acknowledge Duncan Mackenzie for his welcome and for all the time he spent to find the best visa.

Moreover, I want to thank the Rangers and the Volunteer Rangers I lived with who made me spend good times and helped me.