Mulga ant nest and mallee fowl mound

THE UNIQUE VEGETATION COMPLEXES ON ROCKY HILLS IN THE WHEATBELT

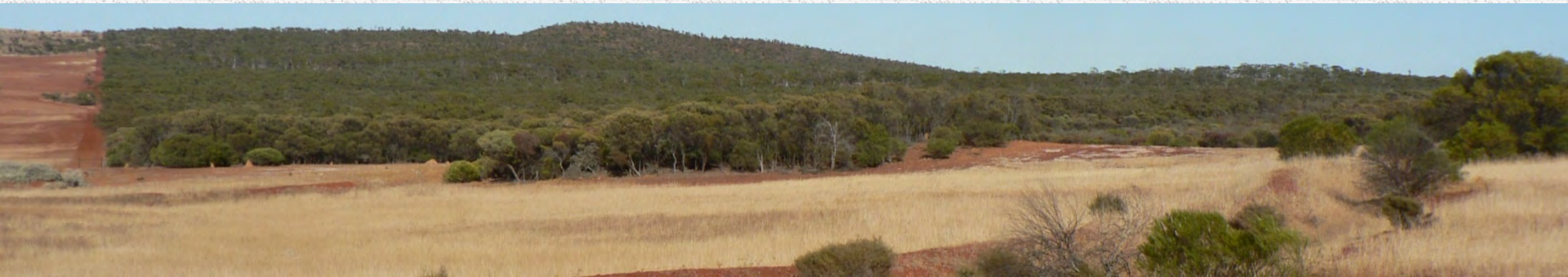
Description, Management and Restoration

Why are they unique?

- Geology → Formation of Soils and Landforms
- Climate → Reducing rainfall from west to east and south to north; ranges of temperature
- Fauna → Interactions between fauna and flora; grazing, pollination, disturbance (e.g. mallee fowl)
- Hydrology → Surface and groundwater; catchment area
- Isolation → Rocky outcrops were isolated by erosion and weathering, but still linked by vegetation. At present many are also isolated through broad scale clearing for agricultural purposes

Types of rocky hills occurring in the wheatbelt

- Granitic/ gneissic outcrops and monoliths
- Banded ironstone formations
- Sandstone, conglomerate, siltstone other sedimentary rocks
- Chert
- Laterite
- Volcanic

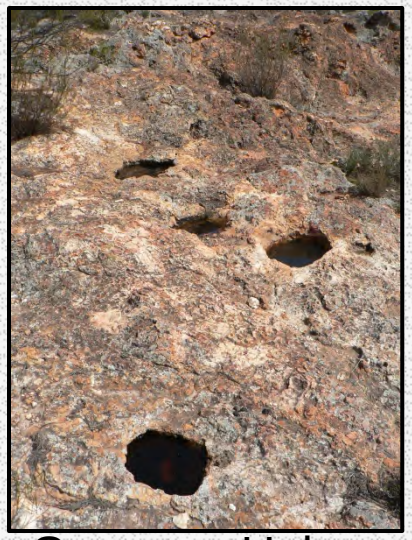


Geological History

- The wheatbelt region is underlain by the Archaean Yilgarn Craton which is chiefly composed of granitoid rock. (Yilgarn –aboriginal word meaning quartz) The craton (stable portion of the continental crust) is ~ 2700 million years old. Over that period of time to the present, the climate has changed many times with glacial and interglacial periods with wetter and drier climates. At present we are in an interglacial period. The earlier landscape would have had mountains which have been eroded down with the ancient drainage system still present as a series of interconnected salt lakes.

- As the plateau eroded the ancient rocks have been exposed and present today as granite and gneiss outcrops and monoliths. Sediments laid down became lithified (rock) and include the sandstones, siltstones, conglomerates and dolomite in shallow marine and freshwater environments. Some metamorphism occurred from pressure and heat resulting in the formation of chert and other metamorphic rocks. The craton has been intruded by igneous rocks such as dolerite. A minor area of volcanism occurs near Morawa (Morawa lava).

Granite/ gneiss outcrops



Gnamma Holes

Billeranga Hills – Morawa area

Rock types

- Morawa Lava
- Oxley chert
- Jaspilite
- Siltstone
- Red chert breccia
- Feldspathic sandstone (Arkose)

Grevillea asparagoides P3 – gravelly outwash slopes

Eremophila serrulata – western edge of range

Scree slope of chert and sandstone

Acacia pterocaulon P1 – restricted to a few rocky hills including Billeranga Hills

Yandanooka Hills (west of Three Springs to Mingenew)

- The geology of the Yandanooka (Aboriginal for “Water in the hills”) is complex and includes the Mullingarra gneiss of Precambrian age ~ 3000 million years old) which is overlain by younger rocks (Proterozoic ~ 1500 mya) of sandstone, siltstone and wacke (a muddy sandstone) which is further overlain by a series of Permian rocks (~ 280 mya) such as tillite (sedimentary rock of glacial origin), shale, sandstone and conglomerate. Later, during the early Tertiary period (60 mya), a combination of high rainfall and temperatures caused deep weathering of the surface layers and with subsequent erosion and weathering processes the present day soils were formed.

Rocky outcrops of Yandanooka area

Wacke

Weathered and eroded mesa with sandstone cap under which small caves are present

Melaleuca sclerophylla P3 on sandstone

Leucopogon stokesii P1

L. Stokesii low shrubland on slopes below breakaway

Banded Ironstone Formation (BIF)

Ancient sedimentary rocks of alternating bands of chert and iron oxide mostly occur on the eastern side of the wheatbelt into the rangelands. Some of these rock formations have been metamorphosed.

- Koolanooka Hills (Place of plenty wild turkeys)
- Perenjori Hills (Perangery – water hole)
- Minor areas of the Moonagin – Milhun Ranges north east of Morawa
- Mt Gibson Range

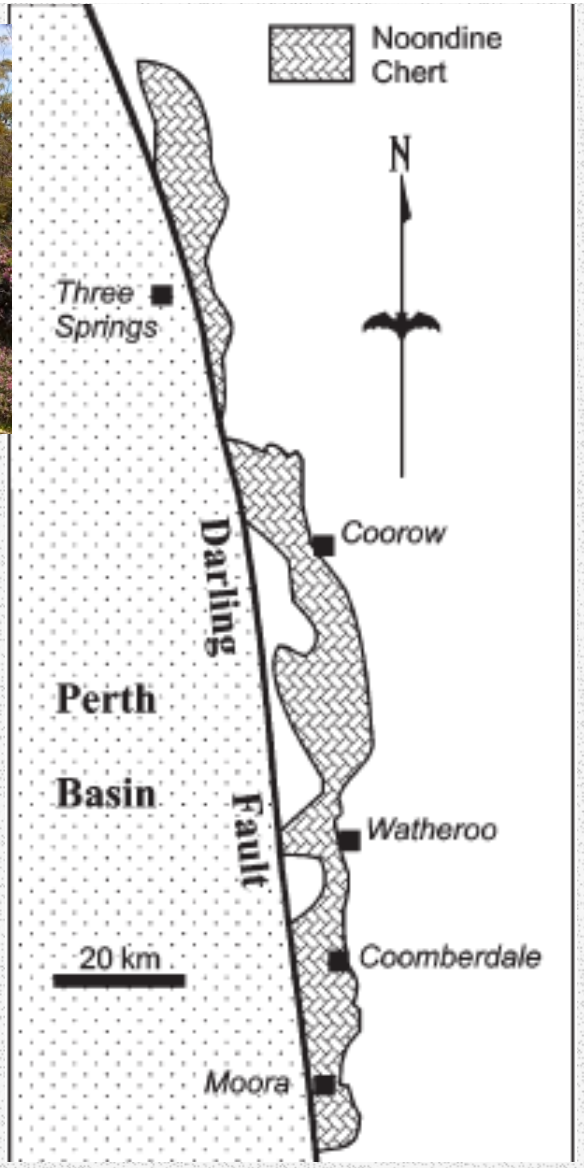
BIF

Chert Hills

Moora, Coomberdale, Watheroo

Jingemia Cave in Chert

Images ^ v Rachel Walmsley



Talc is also associated with the chert deposits. E.g. Talc Mine near Three Springs, and other deposits near Coorow.

Laterite

During the Tertiary period, from about 60 – 10 million years ago, WA had a moist temperate to tropical climate which led to high rates of rock weathering and soil formation. The deep soils that formed had accumulations of iron, aluminium and quartz in the upper parts of the profile, and intense leaching of other constituents from the rest of the profile. The resulting soils or lateritic profiles were sometimes tens of metres deep. The ironstone caprock (duricrust) formed near the top of the profile, and was exposed during a period of erosion 2 million years – 10,000 years ago, when sea levels had dropped and/ or uplift of the south west of WA occurred.

Types of habitat in rocky landscapes – microclimates

- Exposed rock (very limited water storage; long periods of dry – supports mainly short lived plants)
- Depressions with shallow sediments (long periods of dry; limited water storage; arid and semi-arid adapted plants)
- Depressions with deeper sediments (greater moisture holding capacity)
- Gnamma holes/ rock pools (aquatic plants)
- Water storage areas at the base of rock outcrops (deep sediments) which are moister and cooler
- Caves, rock shelters

Soil types associated with rocky outcrops

- This will depend on the substrate – the rock/s from the soil has formed
- Soil depths will vary along the slope – usually shallow soils near the top of the slope, becoming deeper towards the base.
- High amounts of organic matter can build up in pockets on the rock outcrop and at the base of slopes which result in loams or organic loams/ peat, particularly where there is a lot of moisture.
- Different types of soil will support different suites of plants.
- Rocky soils can provide a lot of surface protection against erosion.

Changing climates

- The wheatbelt has had varying climates with cycles of wetter and drier times, usually associated with worldwide glacial and interglacial periods. South Western Australia has had minor direct glacial impacts. The changing climate has resulted in the expansion and contraction of different types of plants adapted to wetter and drier climates. As the climate has dried species adapted to wetter climates have contracted to the south west (e.g. Perth, Margaret River). Small pockets of suitable moist habitat present within the rocky hills in the drier wheatbelt provide refuge for these species (refugia).

The outcrops became more isolated as further erosion of the area continued, and the interspaces became more hostile for wetter adapted plants, leading to some species being isolated for long periods of time, which has led to further speciation. Species which occur more frequently in the wetter south west are sometimes present as isolated populations on granite or other rocky outcrops in the wheatbelt and separated by several hundred kilometres. These wheatbelt populations are called outliers. Arid or semi-arid species are also present on some the rocky outcrops (e.g. *Cymbopogon ambiguus* – scented grass) in shallow pockets of soil. Due to isolation, many of the rocky habitats in the wheatbelt have developed their own unique floras.

Unique assemblages of plants

These are comprised of a variety of species including both rare and common. For example common species such as Acacia acuminata (Jam), Allocasuarina campestris (Tammar) and A. acutivalvis; and Eucalyptus species with a suite of understorey species which may be unique to an area which may or may not include rare or endemic plants. These unique assemblages are often described as Threatened or priority ecological communities. Many of the wheatbelt occurrences on granite have not been described as TECs or PECs at this stage, but are often unique or restricted to a geographical area. There may be several vegetation types included within one ecological community.

TEC 55. Coomberdale chert hills -Heath dominated by one or more of *Regelia megacephala*, *Kunzea praestans* and *Allocasuarina campestris* on ridges and slopes of the chert hills of the Coomberdale floristic region.

TEC 56. Billeranga system - Plant assemblages of the Billeranga System (Beard 1976):

Melaleuca filifolia – Allocasuarina campestris thicket on clay sands over laterite on slopes and ridges; open mallee over mixed scrub on yellow sand over gravel on western slopes; *Eucalyptus loxophleba* woodland over sandy clay loam or rocky clay on lower slopes and creeklines; and mixed scrub or scrub dominated by *Dodonaea inaequifolia* over red/brown loamy soils on the slopes and ridges.

TEC 59. Koolanooka system -Plant assemblages of the Koolanooka System (Beard 1976):

Allocasuarina campestris scrub over red loam on hill slopes; Shrubs and emergent mallees on shallow loam red over massive ironstone on steep rocky slopes; *Eucalyptus ebbanoensis* subsp. *ebbanoensis* mallee and *Acacia* sp. scrub with scattered *Allocasuarina huegeliana* over red loam and ironstone on the upper slopes and summits; *Eucalyptus loxophleba* woodland over scrub on the footslopes; and mixed *Acacia* sp. scrub on granite.

TEC 60. Moonagin system - Plant assemblages of the Moonagin System (Beard 1976): Acacia scrub on red soil on hills; Acacia scrub with scattered *Eucalyptus loxophleba* and *Eucalyptus oleosa* on red loam flats on the foothills.

TEC 75. Inering system - *Allocasuarina campestris* scrub over chert and granite; *Allocasuarina campestris* thicket with scattered *Acacia acuminata* and *Allocasuarina huegeliana* over brown sandy loam over stony and lateritic summits and slopes; *Acacia* sp. mixed low woodland on red/brown sandy loam over granite on summits and slopes; *Melaleuca cardiophylla* thicket with scattered *Eucalyptus loxophleba* and *Eucalyptus salmonophloia* over granite on the lower slopes and foothills; and *Eucalyptus loxophleba* woodland over clay loam on the foothills.

Plants with restricted ranges on rocky outcrops

Acacia pterocaulon
Billeranga Hills on Chert

Acacia muriculata
Koolanooka Hills BIF

Acacia woodmaniorum
Blue Hills BIF

Drummondita rubroviridis
Koolanooka Hills on BIF

Drummondita fulva
Blue Hills on BIF

Darwinia polychroma
Carnamah area on granite

Plants with restricted ranges on rocky outcrops - Chert Hills near Moora

Synaphea quartzitica

Acacia aristulata

Regelia megacephala

Granitic outcrops Coorow – Carnamah area

Thryptomene shirleyae

Verticordia dasystylis subsp. oestopoia

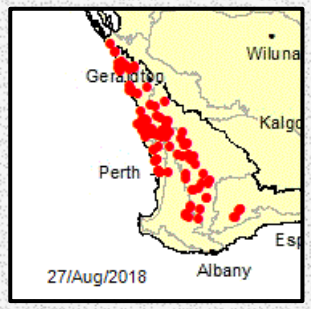
Mt Caroline – Central Wheatbelt

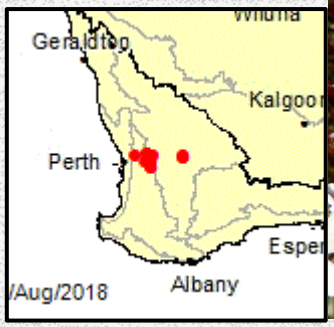
Black flanked rock wallaby (Image: Phil Lewis)

Lasiopetalum moullean – Mt. Caroline and Kokerbin NR

Eremophila brevifolia – outlier with other populations near Gidgegannup and Geraldton

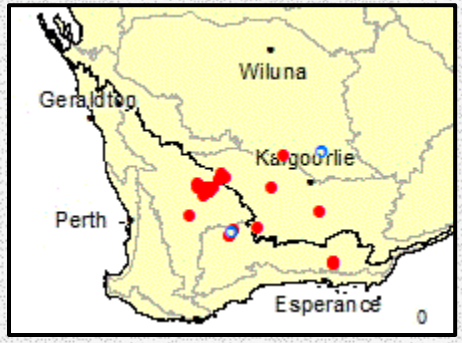
Banksia prionotes – not rare but at eastern edge of range which is reducing with climate change





Stylidium asteroideum – outlier with other popns ~ 150 west in the Jarrah Forest

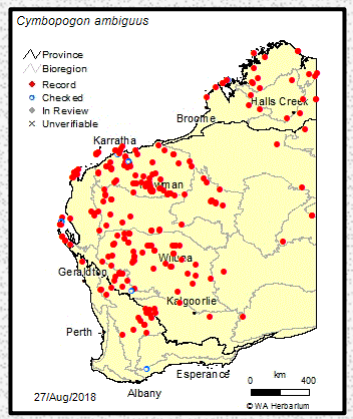
Plants adapted to dry conditions on rocky outcrops in the wheatbelt



Granitites intangendus

Acacia cowaniana (endemic to central wheatbelt)

Cymbopogon ambiguus



Plants on or near granite outcrops at Canna

Darwinia sp. Canna

Androcalva adenothalia

Grevillea tenuiloba

Cheilanthes lasiophylla
(woolly cloak fern)

Prostanthera magnifica – also found at Billeranga Hills, and on BIF hills

Values

- Biodiversity
- May support rare species or species which have not been described
- Potential for future use in pharmaceuticals; insect control;
- Habitats for fauna
- Water catchment and storage
- Aesthetic
- Recreation/ tourism
- Carbon sequestration and storage
- Erosion mitigation
- Potential income – bush walks, camping, seed bank for other remnants in area
- Reduction in Local Government rates
- Refuge for pollinators > pollination of crops
- Refuge for birds > predate on insects which may damage crops

Threats

- Passive clearing through grazing (domestic, goats, rabbits, kangaroos)
- Clearing (e.g. removal of trees for timber (firewood, fence posts; sandalwood harvesting; clearing for access tracks and infrastructure)
- Fire (changes in fire regime – too frequent; lack of fire)
- Weeds
- Climate change (changes in rainfall patterns; reduction in annual rainfall); drought
- Fragmentation and isolation of remnants; edge effects
- Spray drift
- Insect damage – can be linked to climate; vegetation already under stress
- Rubbish
- Mining
- Recreation

Management

- Identify what is present – survey
  - Vegetation – native and weeds; rare and common
  - Fauna (e.g. Mallee fowl, spiny tailed skinks)
  - Aboriginal heritage sites – gnamma holes, scatters, other sites (liaise with local Aboriginal people or experts to identify, record and maintain site (reduce chances of any further damage to site through rehabilitation activities)
  - Threatened or priority ecological communities and species (management may require liaison with DBCA)
  - Erosion, salinity, wind erosion
  - Other threats

Plan

Fencing – protecting against domestic grazing

Seed collecting












Nangeen Hill NR Management for grazing, weeds

2013. Official opening of the predator proof fence. The northern outwash plain has been cleared for agriculture (historic), and impacted heavily by grazing by wallabies, kangaroos and rabbits

2017. Fenced grazing exclosures were erected in 2015 and revegetated with shrubs grown from locally collected seed.

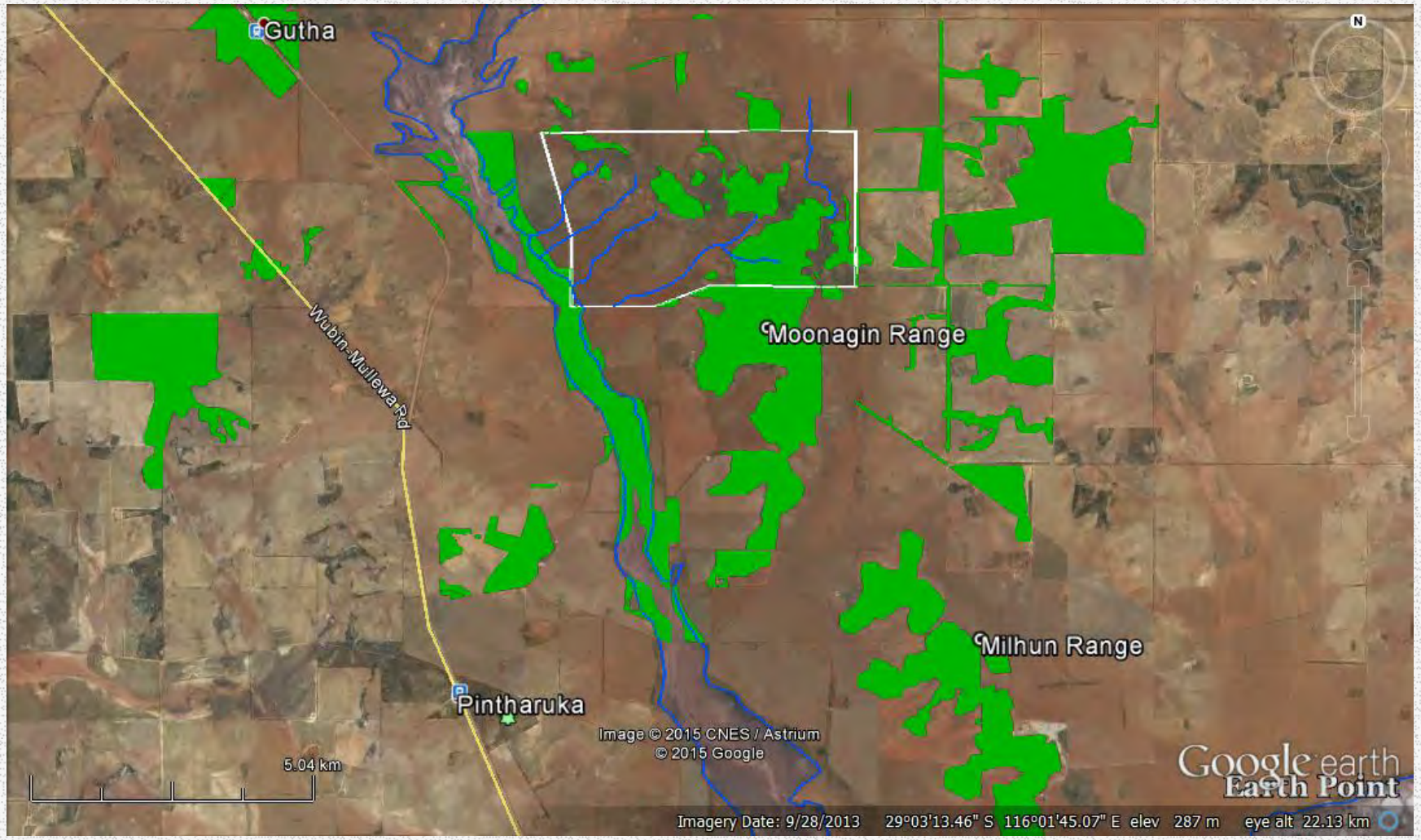
2017. Weed control was undertaken in July (left). This area was heavily impacted by Cleretum papulosum* (related to ice plant). Oct 2017 (right) – successful control; Senna pleurocarpa still present. Soil surface very non-wetting from Cleretum.

Moonagin Hills – Hill View – Carbon Neutral

View from one hill with biodiverse plantings in background

Revegetation between two hills will grow to form a link between the remnant vegetation areas.

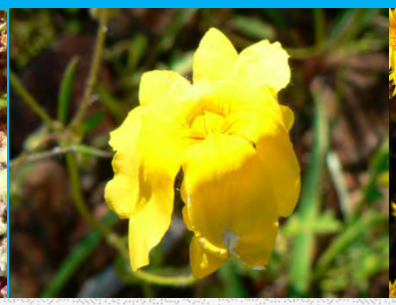
Monitoring vegetation changes, bird and invertebrate presence


Gutha
Wubin-Mullewa Rd
Moonagin Range
Milhun Range
Pintharuka
Image © 2015 CNES / Astrium
© 2015 Google
5.04 km
Google earth
Earth Point
Imagery Date: 9/28/2013 29°03'13.46" S 116°01'45.07" E elev 287 m eye alt 22.13 km

- Link remnant vegetation which is mostly only on the hills by establishing vegetation in the valleys and plains
- Fence the remnants to exclude grazing
- Plant a biodiverse range of species – shrubs and trees
- Improve movement of wildlife between remnants mammals, birds, reptiles and invertebrates
- Reduce recharge to the groundwater system
- Carbon credits
- Reduce erosion









Bushnell


PHIL LEWIS


2012-01-09

Bushnell
2012-01-13 10:41:10