Survey of Assemblages of the wetlands with organic mound springs on the tidal mudflats of the Victoria-Bonaparte bioregion Priority 1 ecological community

A report to the Kimberley Region - August 2017 survey of Victoria-Bonaparte wetlands.

Funded by Kimberley Science Conservation Strategy (KSCS)

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GOVERNMENT OF WESTERN AUSTRALIA

Department of **Biodiversity, Conservation and Attractions**

Current description:

Assemblages of the wetlands associated with the organic mound springs on the tidal mudflats of the Victoria-Bonaparte Bioregion East Kimberley on Carlton Hill Station. Large wetlands with *Melaleuca* forest with small patches of rainforest on central mounds. Rainforest and paperbark forest associated with mound springs and seepage areas of the Victoria Bonaparte coastal lands. The rainforest canopy height at Long Swamp is 30m, and the dominant tree species include *Nauclea orientalis, Terminalia microcarpa* and *Melicope elleryana*; the periphery of the patch is permanently moist and supports a *Melaleuca leucadendra* forest (McKenzie *et al*. 1991). Species richness at Long Swamp is 52 and perennial plant species richness is 20. Silty clay soil type at this swamp. Plants with very restricted distributions within the State include *Mucuna gigantea* (vine) and *Sterculia holtzei* P1 (tree). The lithology at Long Swamp is quaternary alluvium and the soil is a black soil plain.

View over the black cracking clay tidal flats – photo Kirsty Quinlan

1. Introduction:

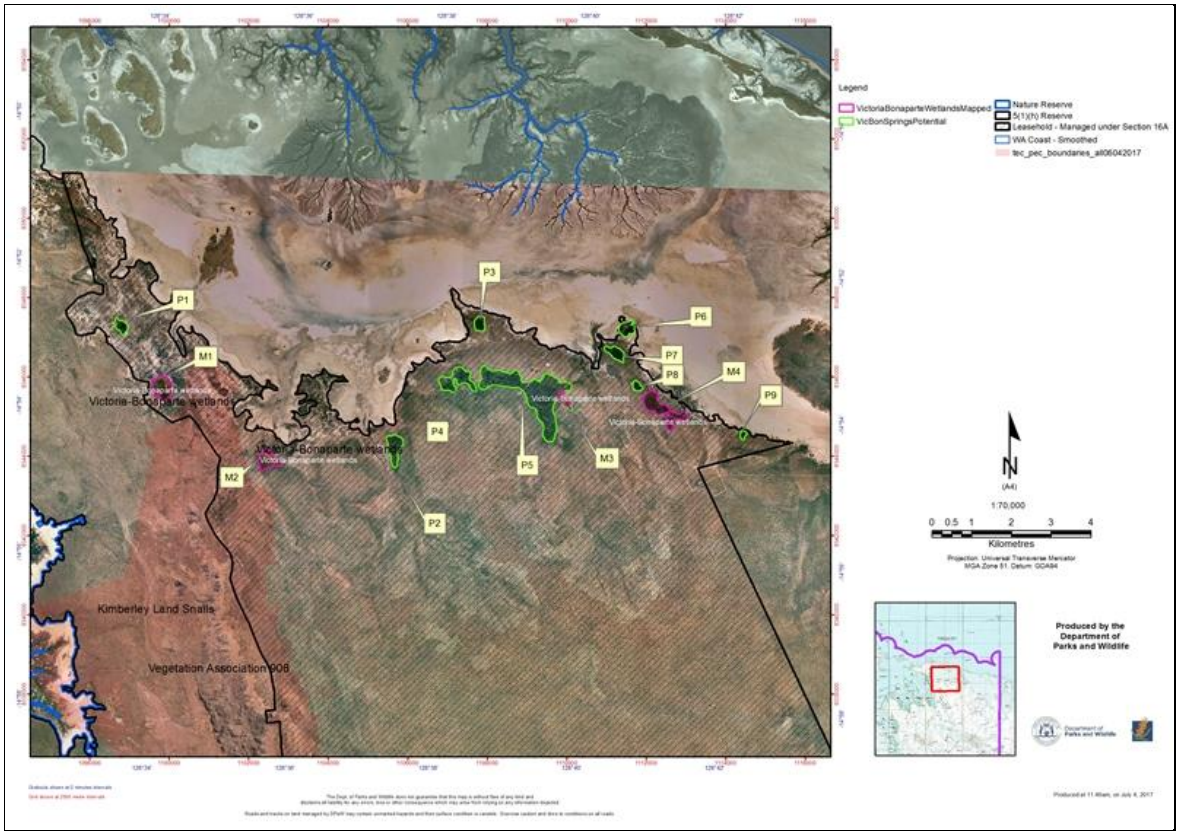
Individual mound springs have generally not been accurately mapped on the tidal flats of the Victoria-Bonaparte Bioregion with the exception of Brolga Spring. The Assemblages of wetlands associated with the organic mound springs were identified following the Kimberley Rainforests Australia survey in 1987 by McKenzie *et al.* (1991). In 2000 S. Black nominated Point Spring and Long Swamp together as one community type however later discussions specified that the two springs and their individual cohorts of assemblages should be split into two types (G.K. Keighery and N.L. McKenzie *pers comm*.). Other survey data includes Halse *et al*. (1996) who undertook a waterbirds and aquatic invertebrate survey at selected sites including two sites at Long Spring, one at Brolga Spring and one at “grassed pool” located on the north-western extent of the wetlands. Other survey included one to monitor change in condition at Long Swamp (G. Graham 1994-1995) and S. Black visit selected sites across the northern Kimberley to evaluate mound springs for their

conservation value and proposed listing as threatened ecological communities (TECs).

View over black soil plains with *Melaleuca* forest in background, Victoria-Bonaparte wetlands – photo Mike Lyons

A total of four occurrences are recorded on the TEC database including Brolga Spring, King Gordon Spring, Attack Spring and Long Swamp occupying a total of ~82.2ha and ranging over 13.5km east-west. Prior to the August 2017 survey, a desk top study identified an additional seven wetlands as potential mound springs that could align with the priority ecological community (PEC) (Appendix 1).

Assemblages of the wetlands with the organic mound springs on the tidal mudflats of the Victoria- Bonaparte bioregion have not been formally assessed by the WA Threatened Ecological Communities Scientific Committee (TECSC). The community is listed Priority 1 ecological community (PEC), recorded on the TEC database in 2008.



Appendix 1. Currently mapped mound springs and potential springs

2. Background:

A survey of the Victoria-Bonaparte organic mound springs including an additional suite of potential mound spring sites was undertaken between 1-4 August 2017 by a team with expertise in TEC identification and inventory, biological survey including flora and vegetation, aquatic invertebrate fauna identification and WA wetland inventory. The survey was coordinated by the East Kimberley District Nature Conservation Coordinator, with cooperation and assistance of Traditional Owners Miriuwung Gajerrong.

The vegetated peat mounds of numerous sizes, occur over ephemeral freshwater springs and pools. The mound springs are generally surrounded by inundated moats containing typha, sedges and grasses. The mound springs are distributed along the landward boundary on the coastal saline tidal flats. Smaller springs, (~0.02ha), manifest along the adjacent coastal flats, however many have become degraded. The coastal flats occur as a ~2km wide band alongside the coast of Joseph Bonaparte Gulf, ~90km north of Kununurra. The greater wetland area is occasionally inundated by fresh or saline water (Halse *et al*. 1996). The vegetation consists of dense forests of *M. leucadendra* with other tree species and rainforest patches that contain 50% or more of the crown cover including vines and climbing ferns over scattered-dense layers of ferns, sedges and grasses over leaf litter coverage of various depth. The springs and pools at each location vary in number, size and

depth. The majority contained a thick cover of aquatic ferns and herbs, typha, rushes and sedges with fallen logs and leaf litter.

The key threats identified for the mound springs are pastoralism (impacts of cattle) including trampling of vegetation, soils and spring pools, and nutrient enrichment; altered fire regimes - too high intensity, and potential hydrological change. The springs are on aquifers that have operating bores on them and are potentially threatened by water abstraction (DEC 2008).

The springs are located on unallocated Crown land (UCL), within the ex-Carlton Hill Pastoral Lease, which is awaiting outcome of S16 negotiations. Access to the springs is recommended during low tide.

3. Objective:

The Kimberley Region is seeking to address knowledge gaps utilising funding from the Kimberley Science Conservation Strategy (KSCS). The aim of the survey is to update PEC baseline information, including description, condition and threats to the PEC, to establish permanent quadrats to record flora and vegetation, inventory aquatic invertebrates, soils and water chemistry, and to identify new occurrences and update boundaries of the wetland community as required. Over time it will be valuable to build up a uniform dataset for springs for a broader regional analysis.

This report covers the ecological community aspect of the survey and will assist with the development of a formal nomination of the community to the TECSC, with recommendations for management and future research.

4. Methods

A total of eleven sites were surveyed, including all recorded occurrences and five additional sites, and the following recorded:

- general vegetation description, condition and structure across the mapped community;
- Flora list (Appendix 2) for vegetation within the quadrat and at random locations throughout the mound spring community;
- threatening processes; and
- management recommendations compiled.

In conjunction with the above six sites were selected in tall dense rainforest community and in a woodland community. Permanent 50x50^{2}m quadrat were installed. Each quadrat was marked with one 1.6m star picket at NE corner site. This will enable future scoring and analysis of change, for monitoring purposes. Quadrat data (held by M. Lyons) for site include:

- GPS location;
- vegetation description, stratum and structure;
- soil and landform;

- flora specimens were collected from the mound springs seepage areas and damplands surrounding the springs. The flora specimens will be provided for lodging where suitable to the WA Herbarium. Mike Lyons and Jill Pryde (DRF Permit no. 22-1718); Additional flora collected by M. Coote and A. Turnbull.
  Aquatic invertebrate survey, peat core and water chemistry in an area of standing water by A. Pinder and K. Quinlan.
- Assessment and mapping by the wetlands group (M. Coote and A. Turnbull) using a handheld GPS in conjunction with aerial photography.
- Photographs of occurrences and surrounding landscape.

These data will be added to the corporate TEC/PEC database when available

5. Limitations:

Four days were allocated to survey the Victoria-Bonaparte wetlands and this limited the capacity to conduct a full assessment on status and condition across the suite of wetlands.

6. Results:

Survey of the Victoria-Bonaparte wetlands PEC was undertaken between 1-4 August 2016 to coincide with low tide. The PEC comprise four mapped occurrences that occur over a range of 14 km bordering the edge of the saline coastal flats. All recorded occurrences and the majority of potential sites sampled are located on a raised central mound that contained a mix of peaty organic black soils and/or decayed organic material. Internal moats and pools occur at various depth and contained aquatic ferns and submerged herbs at various densities. The canopy vegetation comprised tall *Melaleuca* forest with other trees, including rainforest species of various stratum and density including thickets of vines, including climbing ferns over *Pandanus spiralis*, typha, creepers, rushes, sedges, grasses and ferns. The surrounding alluvial flats and black soil plains support dense to scattered stands of *Melaleuca* spp., *Acacia* spp. and other shrubs and trees over *Cyperus* spp., *Sporobolus ?virginicus* grasslands and patches of *Adansonia gregorii* (boab) and *Pandanus* thickets with scattered samphires over the outer saline areas. No Declared rare flora (DRF) were identified, however two priority flora species were recoded including *Sterculia holtzei* (P1) and *Utricularia ?aurea* (P2). This information may change once all flora taxa has been processed

Brolga Spring (Occurrence 01)

(M1 Appendix 1)

Brolga Spring occupies 23.3ha. A *Melaleuca* woodland surrounded by *Typha domingensis* with emergent *Ficus* spp. is a small permanent freshwater spring which lies on the margin of open coastal grassland plain towards the west and the red soils plains of open eucalypt woodlands to the east and south. The spring occurs at the extreme northern end of the Ningbing Range on the sandy margin flanked by tidal limit 3km east and 4km west. Brolga Spring lies directly adjacent Mijing Conservation Park (Crown reserve 49691).

Brolga Spring – photo Adam Turnbull

No comprehensive survey of Brolga Springs was undertaken in August 2017, however boundary reconnaissance and a brief edge survey to observe status and condition was conducted. Vegetation comprised a *Melaleuca* sp. forest within the central mound and open water with patches of duckweed *Lemna aequinoctialis*. Species co-occurring included *Cyperus javanicus*, sedges and *T. domingensis*. The outer perimeter of the larger seepage area in the surrounding moat contained *T. domingensis* forming a dense barrier. The south and western peripheries were more open and comprised *M. viridiflora, Sesbania cannabina*, and occasional *Ficus* spp. with vines and creepers, including *Thespia* sp. Based on records of previous survey and current survey, the degraded stands of *M. ?leucadendra* found on the southern side of the wetland, are in poor condition and the vegetation surrounding the trees has become degraded, transitioning into a grassland. Along the western periphery, upland of the moat, soils are red-brown sandy-loam covered with deep litter of *P. spiralis*, dense *M. viridiflora* shrubs, *S. cannabina* and *A. gregorii* over *Cyperus* spp. and grasses. Although the brief survey limited the flora inventory, the flora taxa present in this occurrence appeared to be diverse.

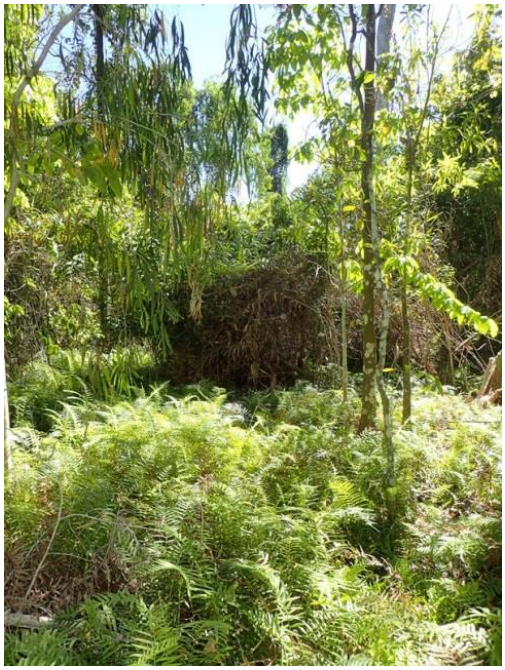
Previous observations by S. Black *et al*. (2000) noted the destructive impacts caused by cattle, particularly at the south east corner, which appears to be a major entry point into the wetland. McKenzie (*pers comm*. 2013) noted that a fence installed prior to visitation in 2013, appeared to have assisted in improving vegetation condition of the community. However in August 2017 the fence was breached and cattle were again causing significant damage to the community and resulted in trampling of vegetation, damaging soil structure and adding to the accumulation of nutrients. Some weeds in this area have potential of becoming a serious threat, including **Mesosphaerum suaveolens* located on the southern side. The community was

partially burnt in the previous 12 months. Vegetation condition Good-Very Good (Bush Forever scales).

The key threats identified for the mound springs are trampling of vegetation, soils and springs by cattle, nutrient enrichment, high intensity fires and potential hydrological change.

Long Springs (Occurrence 04)

(M3 Appendix 1)



***Cyclosorus interruptus* patch with scattered rainforest trees, vines and creepers - photo Mike Lyons**

Long Spring is a large wetland with scattered pools and a mosaic of vegetation occupying ~110 ha. The combination of *Melaleuca* forest and *T. domingensis* occurring in the moat and internal pools in the northern portion of the wetland is distinct from the internal rainforest and vine thicket patches with canopy height (>30m) occupying the southern portion of the spring. The south eastern periphery is permanently moist and supports a *M. leucadendra* forest transitioning to rainforest patches with groves of tall *P. spiralis* and dense cover of *Cyclosorus interruptus* with scattered rainforest trees, vines and creepers. The inner quaking mounds contain pools at variable depth (>50 cm) containing dense leaf litter and thick layers of decayed vegetated matter suspended in fresh-brackish water. The pools and moats contain ferns, sedges, aquatic herbs and flowering *Nymphaea* sp.

Site01 located on northeast edge of Long Spring (currently mapped as Occurrence04)

(P5 Appendix 1)

Following a reconnaissance to this location, it became apparent this was not the site of survey by McKenzie *et. al* (1991) which identified the site EK06. Vegetation comprised tall (>30m) forest of M. leucadendra ~75 % cover. Internal moats and pools at various depth (30-75cm) with an external moat dominated by an impenetrable cover of *T. domingensis* (>3 m) with occasional *Acrostichum speciosum* and *Cyperus* sp. Internal pools contained mostly decayed aquatic herbs, sedges and typha. A distance of ~150 m was traversed toward the centre of the spring with *M. leucadendra* and *T. domingensis* continuing to dominate this patch.

Long Spring (NE patch) dominated by *M. leucadendra* forest over *T. domingensis* – photo Mike Lyons

Site02 south east portion of Long Spring

(P5 Appendix 1)

Vegetation over the central mound contained dense *M. leucadendra* with a mixed rainforest canopy to a height (>30m). One permanent 50x50m^2 quadrat (KMS13A) was established in the south-central section with vegetation cover 50-70%. Constituent tree species included the buttressed ?*Carallia brachiata*, ?*Timonius timon*, *?Nauclea orientalis* and *P. spiralis* with vines, including *Flagellaria indica*. Ferns included *C. interruptus, A. speciosum* and *Ceratopteris thalictroides*. *T. domingensis* and *C. ?javanicus* were also present in the understory. The pools of standing water contained decayed organic material, roots, leaves, and aquatic herbs including *U. ?aurea* (P2) and flowering *Nymphaea* sp with soils of dark grey-silty clay. On higher ground, the sandy eastern periphery comprised a scattered woodland of *Melaleuca* sp., *Cochurus* sp. and *Fimbristylis ferruginea*.

KMS13A Long Spring (south) – photo Mike Lyons

General condition was Excellent (Bush Forever scales). Within the central mound, some evidence of cattle activity was noted, and cane toads were present. Impacts of cattle were noted on the periphery of the wetland. D. Chemello noted fauna present.

Potential Spring 01

(unnamed wetland, referred to as Grassed pool (Halse *et al*. 1996))

(P1 Appendix 1)

Grassed pool occurs on the north western extension of the saline coastal tidal flats of the Victoria-Bonaparte wetlands, 4 km north of Brolga Spring. It is a shallow, seasonally inundated open freshwater pool (Halse *et al*. 1996) with dark grey peaty soils. It contains two bodies of open water. The larger wetland is relatively open, surrounded by sedges including *Cyperus conicus* and *C. Javanicus* with grasses and herbs. On the south, western and northern edges of the wetland emergent on higher ground a woodland of trees including *Melaleuca* spp. and mangroves over *Sporobolus ?virginicus* and grasses occurs. A dense stand of *T. domingensis* surround the smaller wetland to the north of the main water body. Grassed pool provides a variety of habitat types for shorebirds, and many bird species were present during the August 2017 visit. An inventory of avian fauna was recorded by D. Chemello.

Open wetland at "Grassed pool" – photo Mike Lyons

One permanent 50 m transect (KMS14A) was established along the northern edge of the central waterbody, 05 m inward of the high water level. This level is likely to rise and fall with tidal movement. The vegetation comprised of *Melaleuca* sp. woodland and mangroves of *Avicennia marina* and *Lumnitzera racemosa* and *Thespesia populneoides*. There was little undergrowth in this location, mostly bare ground with occasional *Fimbristylis* sp., *Sporobolus ?virginicus*, and herbs (?Malvaceae). Vegetation was in condition Good (Bush Forever scales). Plant species considered useful indicators of rainforest communities and associated mound springs were not present at the site sampled or areas surveyed opportunistically. Therefore, based on the August 2017 survey this portion of the wetland may not align with the Victoria-Bonaparte wetlands PEC. However, a higher stand of vegetation which is located on the far western edge of the wetland was not surveyed. This area may contain rainforest indicator vegetation.

KMS14A " Grassed Pool" – photo Mike Lyons

Cattle appear to be a major threat to this wetland. They were present at the time of survey and their impact on the vegetation and soils was evident. An inlet point immediately to the north of the smaller wetland as well as the cleared edge on the eastern flank of the wetland appear be the primary entry points. Other threats include weed invasion, altered fire regimes, feral animals, potential hydrological changes (e.g. groundwater extraction) and tourism development.

Cattle, a major threat across the wetlands – photo Mike Lyons

Potential spring09

(unnamed wetland)

(P9 Appendix 1)

This spring is the most easterly sampled in the survey, located 500 m east of Attack Spring, on the edge of the coastal saline flats. A small (~0.8 ha), heavily vegetated mound, surrounded by a moat and internal pools of water at variable depth occurs. The substrate mostly contained partially decayed vegetated material

KMS10 established in dense vegetation – photo Mike Lyons

One permanent 50x50m^2 quadrat (KMS10) was established within the dense closed-open tall forest with cover ~70% of *M. leucadendra* (>70m) over *Sesbania formosa*, a broadleaf tree emergent. The understory contained *C. interruptus* and other ferns with submerged aquatic, *U. ?aurea* (P2) in standing water. On the periphery, some patches of vegetation were more open. Other patches were dense, containing thickets of *T. domingensis* and *Colocasia esculenta* (taro) with *Marsilea* sp.,

Corchorus sp., *Cyperus* sp and *Sporobolus ?virginicus*. No DRF was located however one Priority flora species was recorded. Plant species considered useful indicators of rainforest communities and associated mound springs were present . The total number of weeds species was low. Vegetation condition was Excellent (Bush Forever scales).

There was evidence of cattle activity. The key threats identified for the wetland include grazing, weed invasion, altered fire regimes, feral animals, potential hydrological changes (e.g. groundwater extraction) and possibly tourism development.

It is considered that this mound spring is likely to align with Victoria-Bonaparte wetlands Priority 1 ecological community.

Attack Spring (Occurrence03)

(M4 Appendix 1)

Attack spring is an elevated quaking mound, which contains a thick layer of decayed vegetated matter suspended over fresh-brackish water. The 36ha mound was encircled by a mosaic of standing pools and moats of water at variable depth (3cm-70cm). Vegetation over the mound comprised a dense closed-open *Melaleuca* forest and other rainforest species canopy to a height of >30m.

Quaking mound, Attack Spring – photo Mike Lyons

One permanent 50x50m^2 quadrat (KMS11A) was established within the central mound containing *M. leucadendra* forest (>30m) 70% cover, over scattered *S. formosa* and vines of *Flagellaria ?indica* and an understory of *T. domingensis*, *C. ?javanicus* and ferns including *A. speciosum*. Contiguous pools contained thick layers of fallen paperbark and decayed vegetated material and a dense coverage of aquatic yellow flowering herb *U. ?aurea* (Priority 2). The moat surrounding the mound contained an almost impenetrable barrier of *Phragmites karka* and *T.*

domingensis. On higher ground, the periphery of the wetland contained occasional *S. formosa* and dense *Melaleuca* spp. woodland. Vegetation condition was Excellent (Bush Forever scales). Within the central mound there was little evidence of cattle activity, however cattle impacts were noted on the outer surrounding *Melaleuca* woodland.

Potential spring06 (unnamed)

(P6 Appendix 1)

A small densely vegetated mound located on the far northern edge of the saline coastal flats. The mound occupies ~6 ha and drained from the north west. A small number of internal pools and moats with water at variable depth were present. Substrate consists mostly decayed organic material with little soil.

Potential Spring06 displaying the dense understory – photo Jill Pryde

One permanent 50x50m^2 quadrat (KMS12A) was established within the densely closed to open *M. leucadendra* forest >70m and *Carallia brachiata*. Additional trees include yellow flowering *Thespesia ?populneoides*, with perennial climber *Flagellaria ?indica* and a climbing fern ?*Stenochlaena palustris*. A dense understory contained *Corchorus* sp., *Cyperus* spp. and ferns including *C. interruptus* and *A. speciosum* and creepers. Around the periphery, thickets of *T. domingensis*, *C. esculenta* over *Marsilea* sp., *Cyperus* sp and *S. ?virginicus*. Restricted to the outer edge were shrubs of *Melaleuca* spp. over grasses. Plant species within the central mound that are considered useful indicators of rainforest communities and associated mound springs were present at the site sampled. Total number of weeds species was low. Vegetation condition was Excellent (Bush Forever scales). There was no sign of recent fire. There was some evidence of cattle entering the community, however impacts appeared to be low.

Two small vegetated patches to the west were briefly surveyed. The most northerly patch was degraded with the second immediately to the south comprised a tall woodland of *Melaleuca* spp. over a dense understory of grasses and herbs. The patches contained few rainforest indicator species, and no peat mounding was evident.

Looking west to small vegetated patches and potential mound springs – photo Jill Pryde

Potential spring07 (Hayley's Spring)

(P7 Appendix 1)

Hayley's spring is located south of Potential Spring06 and 1 km northwest of Attack Spring. No comprehensive survey was undertaken, however a brief edge survey and boundary reconnaissance was undertaken to assess status and condition.

Internal pools covered with *L. aequinoctialis* – photo Jill Pryde

The thickly vegetated mound occupied ~8.6 ha and rises (~2m) above black cracking clays and surrounding saline coastal flats. Soils are peaty grey-black containing mostly organic material. Water appears fresh-brackish. Vegetation on the central mound comprised a tall-medium dense *M. leucadendra* forest with vines including *F. indica* and emergent ?*N. orientalis* and lacking mid-story. A suite of internal moats to various depth (~30-70cm), contain a dense cover of *L. aequinoctialis, U. ?aurea* and *Stenochlaena palustris*. *A. speciosum* typically occurred from the surrounding pools of water to the base of *Melaleuca* trees. Many fallen *Melaleuca* trees lay over the mound. Surrounding the central mound, occasional ?*Cochorus* sp. and dense stands of *Schoenoplectus subulatus, P. karka, T. domingensis* over *Marsilea* sp. and ferns including *C. interruptus* occurred. The outer perimeter contained a woodland of

Melaleuca spp. and *Acacia* spp. shrubs and mistletoe with *T. domingensis* and swathes of mixed sedges, including *C. ?javanicus* sp*. Fimbristylis* sp. and grasses. Vegetation condition was Excellent (Bush Forever scales).

Based on observations from this partial survey, the mound appears to align with the PEC.

The key threats identified to the mound springs are, grazing, weed invasion, altered fire regimes, feral animals and potential hydrological changes (e.g. groundwater extraction) and tourism development.

Potential spring08 (unnamed)

(P8 Appendix 1)

A small vegetated mound which occupies ~5.4ha is located immediately west of Attack Spring. This site was not surveyed.

King Gordon Spring (Occurrence 02)

(M2 Appendix 1)

King Gordon spring is situated 2 km east of Brolga Spring, and occupies ~18ha. This is a large vegetated mound containing rainforest and vine thicket patches surrounded by moats, and standing pools of water at variable depth. The outlier saline mudflats comprise *Melaleuca* shrubland over sedges, vines and grasses.

High water levels within internal moats – photo Jill Pryde

One permanent 50x50m^2 quadrat (KMS15) was established within the central raised mound, containing closed-open rainforest, dominated by *M. leucadendra* and ?*Terminalia* sp. (<30 m) ~60-70% cover*. The understory comprised scattered P. spiralis* and dense layers of vines including *Flagellaria ?indica* and a rampant climbing vine *Luffa aegyptiaca* over *T. domingensis, C. ?javanicus* and ferns over a

dense layer of fallen *Pandanus* branches and litter. Scattered internal pools of water (<75cm deep) contained a thick layer of decayed vegetated material in combination with aquatic herbs *U. ?aurea, L. aequinoctialis* and *Nymphaea* sp., aquatic ferns and vines and creepers. Soils were dark grey clay below a dense leaf layer. General condition was Excellent (Bush Forever scales). Average flora species richness was 10-25 and the number of weeds species was low. *Melaleuca leucadendra* trees showed signs of recent fire. No obvious sign of threats were noted however cattle are likely to utilise the springs.

Priority 3 aquatic herb *Utricularia ?aurea* found in majority of sites surveyed – photo Mike Lyons

Potential spring02 (Bamboo Spring)

(P2 Appendix 1)

Bamboo Spring is located 3km east of King Gordon Spring and lies adjacent to inlets draining from the north west. The spring was elongated in shape and occupied ~23ha. No comprehensive vegetation survey was undertaken, however peat and water samples were taken along with a partial boundary reconnaissance, that focussed along the western side.

Bamboo Spring – photo D. Chemello

This spring was mostly inundated by water at various depths (20-75cm) and dominated by *M. leucadendra* (~90% cover) perched on pockets of higher ground with the fern *A. speciosum* in combination with *T. domingensis* and *Cyperus* sp. Internal pools contained the violet-white flowering *Nymphaea* sp. and thick mats of decayed aquatic herbs including, *L. aequinoctialis*, *U. ?aurea* and *Cyperus* sp. An open moat (>75cm) occurred on the periphery of the central mound and contained *T. domingensis, Nymphaea* sp. and thick mats of aquatic herbs including, *L. aequinoctialis, U. ?aurea* and an Indian water fern *Ceratopteris ?thalictroides*. Soils were black organic peat. The surrounding shrubland contained *Melaleuca* spp. and *Acacia* spp. over mixed sedges, *Cyperus* sp. and grasses. Vegetation condition was Excellent (Bush Forever scales).

Flowering *Nymphaea* sp. present within internal and external moats – photo Mike Lyons

8. Recommendations

- Determine whether additional springs surveyed align with the Victoria-Bonaparte Wetlands priority 1 ecological community. This would require further hydrological investigation and additional vegetation survey;
- Design and implement a project to determine the hydrological drivers of the mound spring ecosystem;
- Design and implement a monitoring program that utilises quadrats established during the current survey. This will probably require establishment of a more comprehensive network of quadrats, and should be designed to provide information about the success of land management in the sensitive environment of the mound spring ecosystem;
- Seek funds for fencing of the mound springs to restrict cattle access; and
- Determine whether weeds are likely to become a major threat and seek ways to management them.

9. Conclusions:

Based on observations from this partial survey, the majority of mound springs surveyed are likely to align with the Victoria-Bonaparte Wetlands priority 1 ecological community. Once all results of the August 2017 survey are reconciled, it is likely that additional occurrences will be added to the TEC database and boundaries will be delineated. Over time it will be valuable to build up a uniform dataset for springs for a broader regional analysis.

It is recommended that a full nomination be prepared and presented to the W.A. Threatened Species Ecological Communities Scientific Committee for formal assessment.

10. References:

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Appendix 2. Flora of Victoria Bonaparte mound springs and surrounds, compiled from August 2017^ survey and historical survey data (not a comprehensive list)

Flora taxa	*Conservation status*
Acrostichum speciosum	
Adansonia gregorii	
Amyema sp.	
Antidesma ghaesembilla	
Avicennia marina	
Bauhinia cunninghamii	
Carallia brachiata	
Ceratophyllum demersum	
Ceratopteris thalictroides	
Cochurus sp.	
Colocasia esculenta	
Cyclosorus interruptus	
Cyperus conicus	
Cyperus javanicus	
Diospyros maritima	
Eleocharis ?geniculata	
Ficus racemosa	
Ficus virens	
Ficus sp.	
Flagellaria indica	
Fimbristylis caespitosa	
Fimbristylis ferruginea	
Juncus sp.	
Lemna aequinoctialis	
Luffa aegyptiaca	
Lumnitzera racemosa	
Marsilea sp.	
Melaleuca alsophila	
Melaleuca leucadendra	
Melaleuca viridiflora	
Melicope elleryana	
Mesosphaerum suaveolens	
Mucuna gigantea	
Nauclea orientalis	
Nymphaea sp.	
Pandanus spiralis	
Phragmites karka	
Schoenoplectus subulatus	

Sterculia holtzei	*Priority 1*
Sesbania formosa	
Sesbania cannabina	
Sporobolus ?virginicus	
Stenochlaena palustris	
Timonius timon	
Terminalia microcarpa	
Thespia populneoides	
Typha domingensis	
Utricularia aurea	*Priority 2*

^The list of flora will be verified following formal flora identifications.