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Identifying water sources that sustain mound springs in the Walyarta Conservation Park

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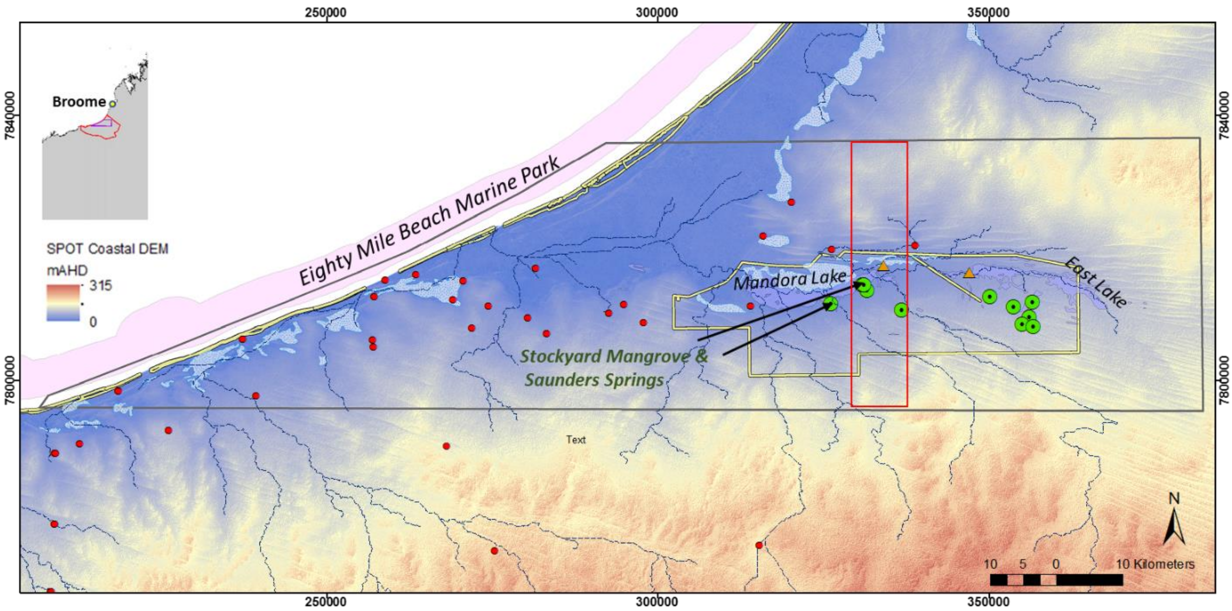
Background

The Mandora Marsh mound spring and wetland system are part of the Eighty Mile Beach Ramsar site, located in the Walyarta Conservation Park, within the Great Sandy Desert in north-west Western Australia. The mound spring system has high ecological and heritage values, hosting unusual groundwater dependent vegetation, peat mounds and seasonal moats inhabited by unique invertebrate communities. The perennial springs are small, between 20 and 250 metres in diameter, and located on low rises south of the main river that drains into Mandora Lake. Aerial photographs and remote sensing imagery show these springs have maintained a consistent areal extent for at least the past 30 years, which means they receive a supply of reliable groundwater that is unaffected by short term changes in climate. Potential spring water sources are the relatively deeper 'older' artesian groundwater, or shallower 'younger' groundwater from unconfined aquifers that perpetually intersect the water table. Understanding the relative contribution of these is required to inform management of groundwater to maintain the spring's biodiversity. To investigate this knowledge gap field water sampling programs were carried out in September 2015 and November 2016.



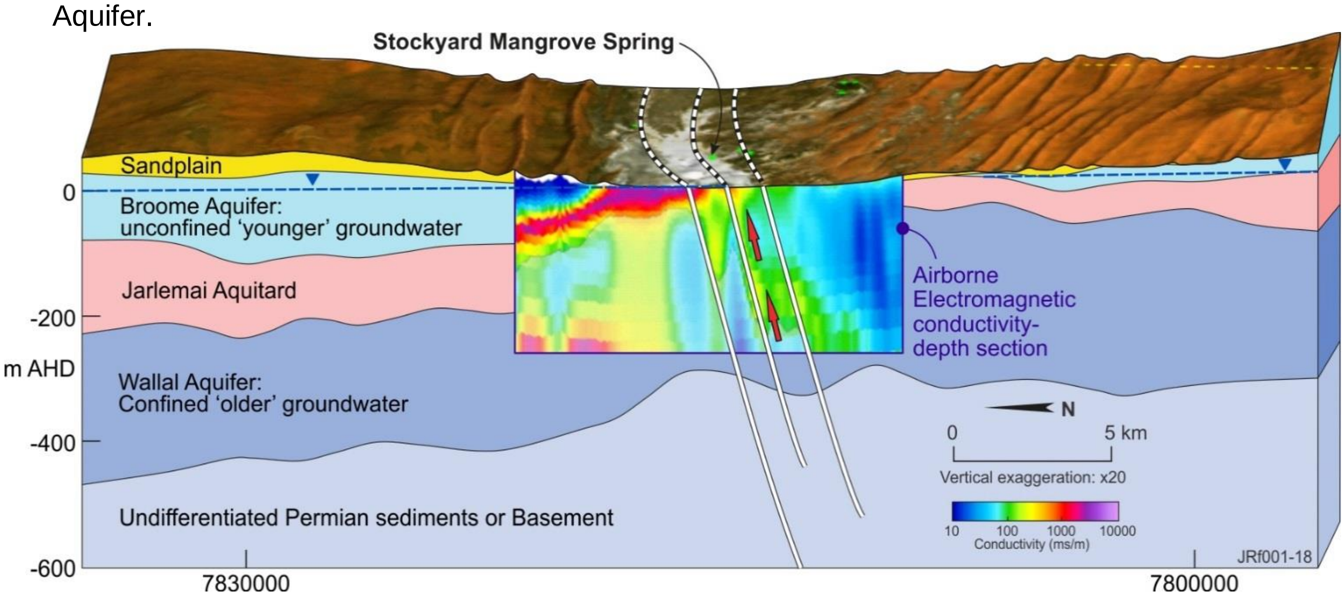
Above: Map of the Walyarta study area (grey boundary) overlain on the SPOT Coastal Digital Elevation Model (DEM), with samplings sites in green (springs), red (groundwater) and orange (surface water). Seasonal river water courses and wetlands are outlined in blue and shaded in light blue and purple, Conservation Estate boundaries are outlined in yellow. The red polygon is the location of the 3D model – see next page.

Above: Photographs of a. Saunders Spring (view to the east) showing fenced boundary and tracks, bare ground where seasonal spring moats form with fringing vegetation and a peat mound to the north-east, b. Stockyard Mangrove (view to the north) with sparse, heavily grazed vegetation, and c. sampling of spring groundwater discharge at Saunders Spring peat mound.

Findings

The investigations involved the collection of twenty-three near-surface water samples across eleven springs. Water was sampled either via a shallow excavation (~10cm) or a micro piezometer and was analysed for major ions, nutrients, metals, rare earth elements and stable water, strontium and carbon-14 isotopes. A number of samples were collected across spring mounds to identify the location of spring vents, and five sites characterised by 'older' water in 2015 were resampled in 2016. Spring locations and water chemistry results were examined in a three-dimensional hydrogeological model constructed from drill hole and airborne geophysical (e.g. magnetic and electromagnetic) data to identify geological controls on spring flow. The main findings are:

- Repeat sampling showed consistent chemical and isotopic signatures, which indicates the same aquifer sustained spring discharge in the consecutive dry seasons sampled.
- Groundwater from three spring vent samples was older (uncorrected radiocarbon ages >5,000 years) when compared to other parts of the mound, which indicates a deeper groundwater source (e.g. Wallal Aquifer) and potentially higher discharge rate at the central vent.
- Perennial springs are aligned with geological faults.
- The observations above, combined with the discrete and uniform extent of perennial springs point toward ascending springs (controlled by artesian pressures in the Wallal Aquifer) being the dominant spring discharge mechanism rather than descending (gravity supported) spring flow from the Broome Aquifer.



Above: Three dimensional model of the hydrogeology (location outlined as red polygon in map on previous page), white line work (solid and dashed) are major east-west trending geological faults, red arrows represent the direction of groundwater flow in the Wallal Aquifer (along fault zones), approximate water table is dashed blue line.

Management implications

Research findings confirm that in the Walyarta Conservation Park discrete perennial springs with near-surface dry season discharge receive older, steady artesian groundwater flow. This implies that:

- Maintaining the spring's conservation values requires management of the deeper confined Wallal Aquifer in order to maintain this discharge.
- Monitoring is required to continually measure spring discharge and aquifer pressures in closer proximity to the springs than is currently available.
- Management of the springs would benefit from a greater understanding of how surface water and groundwater move along geological faults and contributes to springs and wetlands.

Further information

Rutherford, J.L., Cendón, D.I., Soerensen, C., Batty, S., Huntley, B., Bourke L., Pinder, A., Quinlan, K., English, V. and Coote, M. (2018). *Hydrological conceptualisation of the Walyarta mound springs*. Department of Biodiversity, Conservation and Attractions, Perth, Western Australia.

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