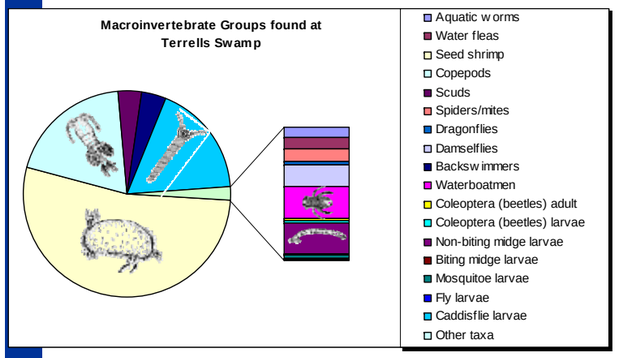
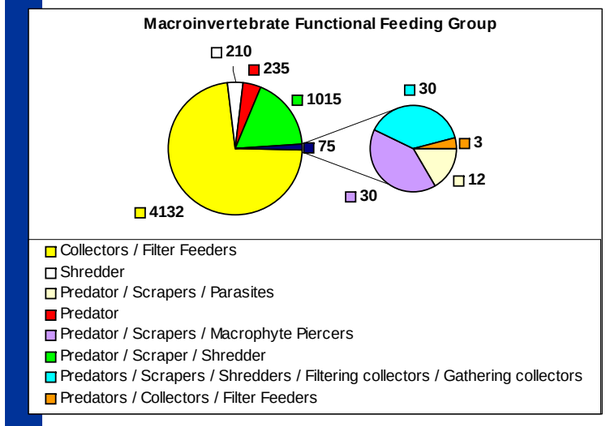
Terrells Lake

plants and algae fluids. These groups are called Functional Feeding Groups (FFG). Some macroinvertebrates fit into more than one of these groups, for example the Water Boatman is a Predator, a Scraper and a Macrophyte piercer.



A healthy wetland should have a representative of each functional feeding group. A loss or dominance in a particular group may indicate a change in ecology of the wetland. The composition of these groups at Terrell's Lake are displayed in the below graph. There appears to be a high number of collectors / filter feeders which could relate to high amount of suspended decomposing fine particulate organic matter in the wetland.



Conclusion

Terrell's Lake was brackish to moderately saline. The swamp is fed by surface runoff sub surface flow and via the creek line to the north east that drains during high rainfall events through a series of lakes and the upper catchment which is partially affected by secondary salinisation. Groundwater monitoring indicates there is no connection between the wetland and the regional groundwater table which is currently at a depth of 6m. At the current rate of groundwater rise there will be no connection in the near future. In contrast there is a groundwater connected wetland close to Terrell's Lake that is clearly groundwater connected. Total nitrogen levels are sometimes high although the available forms are low. Total phosphorus and the available form of phosphorus are both high which may result in high primary productivity.

Some knowledge gaps were identified during the investigation, monitoring and data analysis for this wetland which should be addressed to improve understanding of the water quality and biodiversity and to detect changes over time. The monitoring period was relatively short and some effects of previous and current land use change and management may not yet be evident.

Macroinvertebrates would need to be identified to family or species level to allow more detailed analysis of ecological condition and relationship to other wetland characteristics. The hydrology of the wetland and its catchment is not fully understood or monitored, particularly the interaction between groundwater and surface water. A future monitoring program should be developed to address these issues.

Acknowledgements

The Department of Water would like to sincerely thank and acknowledge the following people for their assistance and contribution toward the South Coast Wetland Monitoring Program and production of this report.

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- Kevin Hopkinson, Naomi Arrowsmith, Andrew Maughan and others for their support and editing assistance.
- Sherrie Randall and Tracy Calvert for data analysis and report compilation.

For further information please contact Tracy Calvert at the Department of Water Albany (08) 9842 5760.

South Coast Wetland Monitoring Project June 2008

This report card summarises the current state of knowledge of physical, chemical and biological characteristics of Terrell's Lake based on the knowledge gained from investigation and monitoring conducted by the Department of Water through the South Coast Wetland Monitoring Program.

Accompanying this document are appendices that provide more detailed information about the wetland monitoring program, terminology of wetland classification, parameters monitored, methodology and the ANZECC&ARMCANZ guidelines used in this report.

Funding for this program has been provided through South Coast Natural Resource Management Inc. - supported by the Australian Government and the Government of Western Australia.

About Terrell's Lake

Terrell's Lake is located approximately 35km north east of Esperance, Western Australia, within the Lake Warden Wetland System catchment and the smaller sub-catchment of the Neridup Creek. The wetland lies at approximately 120m AHD (Australian Height Datum). The area receives an annual average rainfall of 540mm.

Terrell's Lake is located on privately owned land within a small catchment of approximately 157km^2. The wetland lies within a fenced wetland vegetation buffer zone that ranges between approximately 20-250m from the wetland edge.

Vegetation predominantly consists of *Eucalyptus occidentalis* (Yates) *Melaleuca cuticularis* (Salt water paperbark), *Nuytsia floribunda* (Christmas tree) in the midstorey and *Anarthra scabra, Billardiera heterophylla* in the understorey. There are a number of dead trees (mostly *Eucalyptus occidentalis*) around and within the wetland with some trees regenerating in the outer wetland zone. The demise of the trees may relate to altered hydrology and potentially changes in salinity over time.

	GPS Location Coordinates		
Wetland Suite	**Easting**	**Northing**	**MGA Zone**
Murra Murra Suite	422323	6275718	51

Terrell's Lake

Approximately 95% of the catchment area has been cleared for agriculture including cropping and livestock.

Water quality monitoring commenced in November 2005 however the lake was dry until the beginning of 2007. Monitoring included physical, chemical and biological parameters as outlined in the appendices.

Yate trees at Terrell's Lake with Anarthra scabra, Billardiera heterophylla in the understorey.

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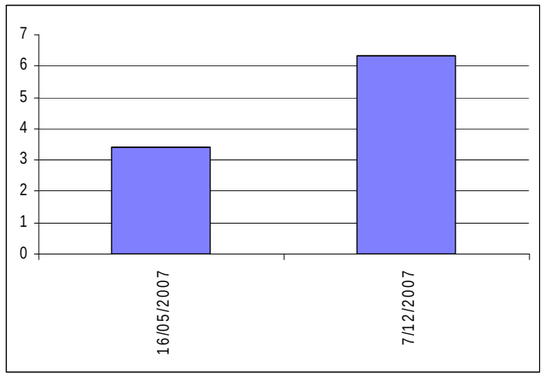
Wetland Classification

Wetland type	*Water Salinity*	*Consistency of Salinity*	*Size (Metres)*	*Shape*
Playa	Subhaline - Hyposaline	Poikilohaline	Macroscale 1450 x 1320	Ovoid

Classification of Terrell's Lake has been evaluated on the basis of guidelines developed by V & C Semeniuk Research Group. Extended dry periods of the lake correspond with the hydro period classification Playa meaning intermittently flooded basin. During 2007, the lake flooded in response to heavy rainfall experienced in February that year. For further explanation please refer to the appendices.

Salinity

Salinity over the sample period was brackish (3.4mS/cm) to moderately saline (6.3mS/cm). Fluctuations in salinities relate to seasonal fluctuations in rainfall which in turn determines the amount of surface runoff generated from the cluster of lakes to the north. During high rainfall events the higher flows may dilute incoming saline water from the upper catchment and reduce salinities in the wetland. Salinities may then increase as lake levels recede due to evaporation and loss through groundwater recharge.



Salinities (mS/cm) over the sample period

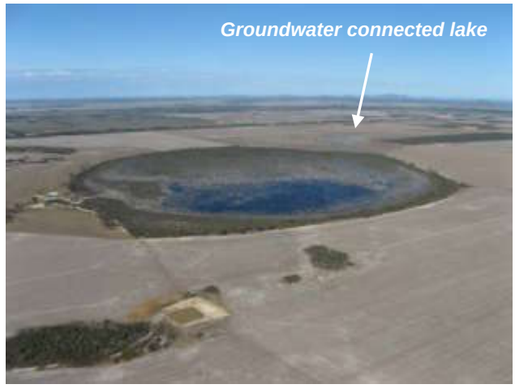
Depth of the groundwater recorded at a Department of Agriculture and Food groundwater monitoring bore (AG2) indicates there is no connectivity between the lake and groundwater. Groundwater level in this bore is 6m below the ground surface (100m AHD) while the lake is 106m AHD which means the lake is 6m above the regional watertable. The current rate of groundwater rise is 25cm per year which indicates there will be no connectivity with the groundwater in the near future unless the rate of rise increases.

Salinities of the groundwater also do not correlate with the lake with salinities measuring 22mS/cm and 29mS/cm.

Salinity measurements taken on the 20th May 2008 from the smaller lake situated about 600m south of Terrell's Lake were nine and half times seawater at 481mS/cm.

Creek line draining from the lakes north into Terrell's Lake

The salinity in this smaller lake is a result of highly saline groundwater and high evaporation rates compared to the brackish to moderately saline waters of Terrell's Lake. The differences in salinity between the two lakes confirm Terrell's Lake is not connected to groundwater.



Aerial shot of Terrell's lake with saline groundwater connected lake to the south

Nutrients

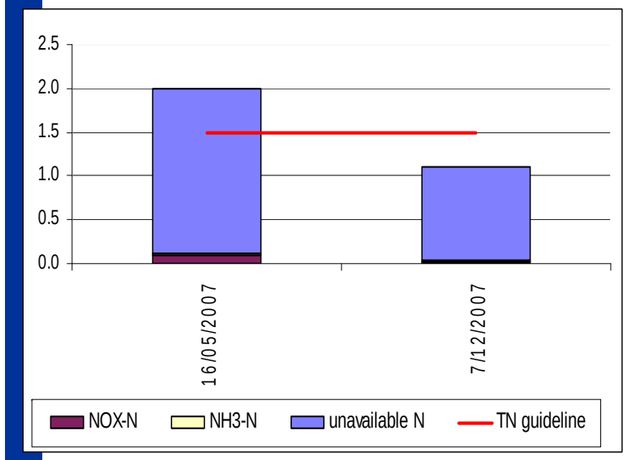
Total Nitrogen (TN) concentrations were high ranging from 0.06-2.0mg/L. TN concentrations on one of the two sampling occasions exceeded the guidelines developed for ecosystem protection for southwest Australian wetlands for slightly disturbed systems of 1.5mg/L.

Dissolved inorganic nitrogen fractions of ammonia (NH_3-N) ranged from 0.01-0.02mg/L and total oxidised nitrogen (NOx-N) ranged between 0.03-0.1mg/L. NH_3-N and NO_X-N

Terrells Lake

South Coast Wetland Monitoring Project June 2008

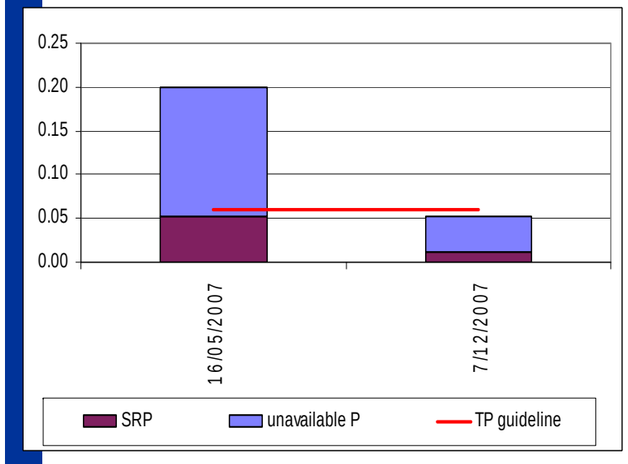
fractions did not exceed the recommended guideline values of 0.04mg/L and 0.1mg/L respectively, on any sample occasion.



Nitrogen fractions in mg/L over the sample period with TN guideline illustrated

Total Phosphorus (TP) concentrations ranged from 0.05-0.2mg/L. TP concentrations exceeded water quality guidelines of 0.06mg/L on one of the two sample occasions.

Soluble Reactive Phosphorus (SRP) (form of phosphorus available for uptake by plants) ranged from 0.01-0.052mg/L. In relation to water quality guidelines SRP exceeded the recommended value of 0.03mg/L on one sample occasion.



Phosphorus fractions in mg/L over the sample period with TP guideline illustrated

Nutrients are recycled naturally through the lake due to uptake and assimilation of nutrients by plants and animals and through release of nutrients for example through microbial breakdown of organic material.

Nutrients stores in the catchment sediments may enter Terrell's Lake through surface and sub surface flow from the surrounding land and via the creek line that receives water from the upper catchment. Higher nutrient levels in April 2007 would have been delivered in high flows during the storm event in February 2007.

Low proportions of available nutrients can indicate the majority is being readily taken up by plants and animals while the remainder may be bound up in organic matter, or as dirt or dead cells or bound to clay soils in the case of phosphorus.

Large amounts on organic material in Terrell's Lake

Macroinvertebrates

Eighteen groups of macroinvertebrates were found at Terrell' s Lake during the monitoring period of which the most abundant included Ostracoda (seed shrimp), Copepoda (copepods), Trichoptera (caddisflie larvae), Notonectidae (backswimmers), and Amphipoda (scuds).

Other groups of less abundance were found including; Chironomidae (non-biting midge larvae), Culicidae (mosquitoe larvae), Coleoptera (beetles) larvae, Coleoptera (beetles) adult, Corixidae (waterboatmen), Zygoptera (damselflies), Epiproctophora (dragonflies), Acarina (spiders/mites), Cladocera (water fleas), Oligochaeta (aquatic worms), Other Diptera (fly larvae), Ceratopogonidae (biting midge larvae) and Other taxa.

The diversity of macroinvertebrates found over the sample period ranged between fourteen to eighteen groups with a median of eighteen, which rates high based on the Ribbons of Blue Wetland Habitat Score.

Each group of Macroinvertebrate play a different role in the food chain, some feed on organic material (Shredders), others feed on fine organic particles (Collectors/filter feeders), others graze on algae (Scrapers), some feed on each other (Predators), others are parasitic (Parasites) and some are Macrophyte piercers that feed off living