change in ecology of the wetland. The composition of these groups at Swan Lake are displayed in the below graph.

Macroinvertebrate Functional Feeding Groups

Collectors / Filter Feeders
Predator
Scrapers
Shredders
Predator/Scrapers / Parasites
Predator / Scrapers / Shredders / Filtering collectors / Gathering collectors
Predator / Scrapers / Macrophyte Piercers
Predator / Scrapper / Shredder

Collectors / Filter Feeders and Predators appear to be the most dominant groups yet the groups appear to be fairly evenly represented.

Conclusion

Swan Lake is a brackish to moderately saline wetland receiving water from surface runoff, sub surface flow and via the three drainage lines entering from the north. Despite the lake being perched above the groundwater, saline water enters the lake through sub-surface flow and seeps along the water courses. Nutrient levels are usually reasonably low although the available forms of nitrogen have been high on occasions.

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.

- Ruhi Ferdowsian (Department of Agriculture and Food, Albany) for providing knowledge of the hydrogeology associated with Swan Lake.
- Ania Lorenz, Sherrie Randall, Kevin Hopkinson, and Albany Department of Water team who conducted the monitoring.
- 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.
Nutrients
Total Nitrogen (TN) concentrations ranged between 0.85-2mg/L which exceeded the guidelines developed for ecosystem protection for southwest Australian wetlands for slightly disturbed systems of 1.5mg/L on one of the three sample occasions.

Dissolved inorganic nitrogen fractions of ammonia (NH3-N) ranged between 0.01-0.17mg/L which exceeded the recommended guideline value of 0.04mg/L on two of the five sample occasions. Total oxidised nitrogen (NOx-N) ranged between 0.01-0.13mg/L which exceeded the recommended guideline value of 0.1mg/L on two of the five sample occasions.

Nutrients are recycled naturally through the swamp 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 may enter Swan Lake through surface and sub surface drainage flow from the surrounding land and through the three drainage channels.

The low levels of nutrients may mean they have been readily taken up for growth by plants and algae. During sampling in March 2007 there was a thick scum of Microcystis flos-aquae, a cyanobacterium which can be toxic at high densities to humans and animals. Another bloom was observed after summer 2008 also.

Macroninevertebrates
Twenty one groups of macroinvertebrates were found at Swan Lake during the monitoring period of which the most abundant included; Cladocera (water fleas), Ostracoda (seed shrimp), Copepoda (copepods), Notonectidae (backswimmers), Corixidae (waterboatmen), and Trichoptera (caddisfly larvae).

Other groups of less abundance were found including; Oligochaeta (aquatic worms), Hirudinea (leeches), Gastropoda (snails/limpets), Bivalvia (bivalve molluscs), Amphipoda (scuds), Decapoda (shrimp/prawn/crayfish), Acarina (spiders/mites), Ephemeroptera (mayflies), Epipiptopora (dragonflies), Zygoptera (damselflies), Coleoptera (beetles) adult, Chironomidae (non-biting midge larvae), Ceratopogonidae (biting midge larvae), Other Diptera (fly larvae), and Other taxa.

The diversity of macroinvertebrates found over the sample period ranged between nine to twenty one groups with a median of eleven which rates as average 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 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 Scarper 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

Salinity
Salinity over the sample period ranged between Brackish (3.13mS/cm) and moderately saline (5.97mS/cm). Fluctuations in salinities relate to seasonal fluctuations in rainfall, evaporation and water levels.

Historically the lake would have acted like an estuary and drained to the ocean however it is likely that wind migration of sand dunes and infilling of creek lines has separated the lake from the ocean.

Salt may enter Swan Lake through surface and sub surface drainage and through the three drainage channels entering the lake. Although the lake is perched above and recharges the groundwater, saline groundwater may discharge to the creek lines to the north.

Classification of Swan Lake has been evaluated on the basis of guidelines developed by V & C Semeniuk Research Group. For further explanation please refer to the appendices.

Classification of Swan Lake

<table>
<thead>
<tr>
<th>Wetland type</th>
<th>Water Salinity</th>
<th>Consistency of Salinity</th>
<th>Size (Metres)</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake</td>
<td>Subhaline - Hyp sodaline</td>
<td>Poikilohaline</td>
<td>Mesoscale 980 x 755</td>
<td>Irregular</td>
</tr>
</tbody>
</table>

South Coast Wetland Monitoring Project

June 2008

Macroinvertebrate Groups found at Swan Lake

<table>
<thead>
<tr>
<th>Aquatic worms (leeches)</th>
<th>Snails/limpets</th>
<th>Bivalve molluscs</th>
<th>Water fleas</th>
<th>Seed shrimp</th>
<th>Crayfish (shrimp/prawn/crayfish)</th>
<th>Dragonflies</th>
<th>Damselflies</th>
<th>Waterboatmen</th>
<th>Bivalve molluscs</th>
<th>Shrimp/prawn/crayfish</th>
<th>Fly larvae</th>
<th>Other Diptera (fly larvae)</th>
<th>Other taxa</th>
</tr>
</thead>
</table>

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

No TN analysis for these dates

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

Soluble Reactive Phosphorus (SRP) (form of phosphorus available for uptake by plants) ranged between 0.005-0.01mg/L which did not exceed the recommended water quality guideline value of 0.03mg/L on any sample occasion.