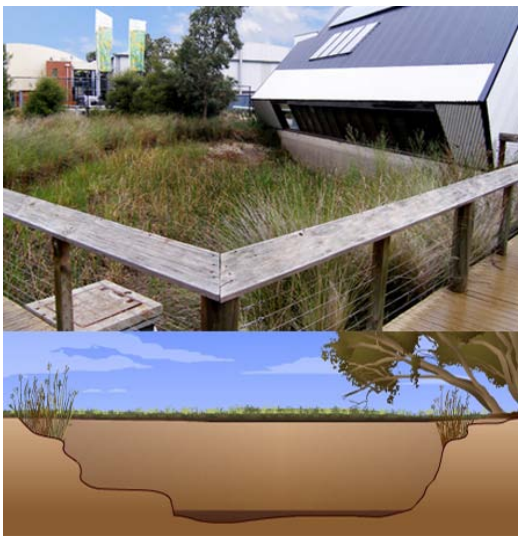
Wetlands through the seasons

Summer: dry year

Little rain and high evaporation

With little rain and high evaporation during a drought, the wetland dries out.

1. Water level: decreasing until the wetland is empty.
2. Water temperature: very high.
3. Oxygen level: decreasing to zero.
4. Nutrient level: extremely high.
5. Pollution: extremely high.
6. Health of invertebrates: many becoming dormant, some only surviving as eggs, others flying away while some may be having difficulty surviving.
7. Tadpoles and frogs: tadpoles dying, remaining frogs digging deep into the mud.
8. Plant growth: dying or dormant.



Water levels decrease during the dry season.
Image: reproduced courtesy of Ecolinc.

Nardoo has clover-like leaflets that float on the water's surface: reproduced courtesy of Bob Winters.

Nardoo

Nardoo is an aquatic fern with two pairs of leaflets arranged in a four-leaf clover pattern. The fronds are erect when growing in mud and floating when growing in water. The flexible stems allow the plant to adapt to changes in water level.

Nardoo grows from a creeping rhizome. This is an underground stem capable of producing the shoot and root systems of a new plant. This enables the plant to propagate asexually and also to survive harsh conditions underground.

As water recedes, nardoo turns brown and forms sporocarps (capsules containing spores). These were used by Indigenous people for food.

The pobblebonk burrows into the mud during the dry season: reproduced courtesy of Bob Winters.

Pobblebonks

Frogs such as pobblebonks cannot breed when wetlands dry up. During droughts the males do not call to attract females.

Pobblebonks dig themselves into the soil near the edge of the wetland or at the bottom before it dries out. They can retain enough water in their bodies to prevent drying out while they wait for the drought to break.

A white-faced heron searching for food: reproduced courtesy of Bob Winters.

White-faced herons

White-faced herons visit the drying pools. They use their long pointed bills to feed on any small aquatic animals remaining in the pools.

The last remaining small animals are easy for herons and other birds to catch in the shallow water.

Wetlands through the seasons

Autumn: dry year

Little rain and moderate evaporation

With little rain and moderate evaporation during a drought, the wetland has only a few pools of water.

1. Water level: shallow pools of water.
2. Water temperature: high.
3. Oxygen level: close to zero.
4. Nutrient level: extremely high.
5. Pollution: high.
6. Health of invertebrates: very poor.
7. Tadpoles and frogs: no tadpoles, frogs digging deep into the mud.
8. Plant growth: dying, dormant or very slow.

A wetland during a long drought.
Image: reproduced courtesy of Ecolinc.

The dry bed of a wetland: reproduced courtesy of Bob Winters.

Invading weeds

Clay dries out and becomes very hard. During the next few months aquatic plants will not grow in the wetland.

Areas in wetlands where soil sediment remains may become a fertile bed for weeds. These weeds are fast growing and set seeds within months.

Pobblebonks spend most of the time buried in the soil during droughts: reproduced courtesy of Bob Winters.

Frogs

Frogs are generally not heard or seen. During droughts the males do not call to attract females.

The remaining frogs are hidden to avoid drying out. They can be found under logs and rocks, tucked deep inside grass tussocks or buried in the soil.

During times of drought, some birds may not survive: reproduced courtesy of Bob Winters.

Drought affects animals

Many species of birds escape the wetlands and fly to other locations that are not affected by drought.

Many young and weakened birds have low energy levels and are not strong enough to fly long distances. These birds may not survive the drought or may be preyed upon by predators.

Wetlands through the seasons

Winter: dry year

Little rain and low evaporation

With little rain and low evaporation during a drought, there are a few shallow pools. The wetland does not overflow.

1. Water level: increasing.
2. Water temperature: cool.
3. Oxygen level: moderate.
4. Nutrient level: very high.
5. Pollution: very high.
6. Health of invertebrates: low.
7. Tadpoles and frogs: struggling to survive.
8. Plant growth: low, some dormant.

Water levels rise slightly in winter.
Image: reproduced courtesy of Ecolinc.

Eucalypt leaves eaten by insects: reproduced courtesy of Bob Winters.

Eucalypts

During winter insects are less active or no longer feeding on eucalypt leaves. This allows eucalypts to replace damaged leaves with new ones.

However, eucalypts growing close to wetlands are under stress during a long dry period. This makes it harder for them to recover from insect attack.

A common froglet is one of the smallest frogs: reproduced courtesy of Bob Winters.

Frogs

Only a few common froglets can be heard among the plants surrounding the wetland. They generally stay buried in the soil where they are kept moist.

Most of the other frogs remain hidden in damp places where they can retain moisture.

A mosquito larva wriggling in the water: reproduced courtesy of Bob Winters.

Mosquitoes

In the few pools of water hundreds of mosquito larvae are swimming about. They breathe air from the surface so they are not affected by low oxygen levels in the water.

Mosquito larvae numbers are much higher than usual because there are very few predators in the wetland. The predators may have left the wetland or their eggs may be lying dormant in the wetland sediment and vegetation.

Wetlands through the seasons

Spring: dry year

Little rain and moderate evaporation

With little rain and moderate evaporation in a drought, the wetland remains low in water.

1. Water level: decreasing.
2. Water temperature: increasing.
3. Oxygen level: decreasing.
4. Nutrient level: increasing.
5. Pollution: increasing.
6. Health of invertebrates: decreasing.
7. Tadpoles and frogs: tadpoles not found, decreasing frog breeding activity.
8. Plant growth: increasing.

A shallow pool of water in a wetland.
Image: reproduced courtesy of Ecolinc.

Floating duckweed can cover the surface of a wetland: reproduced courtesy of Bob Winters.

Duckweed

These tiny flowering plants float on top of the water.

During a dry year the nutrients in the water are concentrated. This may result in a dense growth of duckweed, which may eventually cover the water surface. When duckweed covers a wetland, surface-feeding animals like ducks may find it difficult to feed.

Pobblebonks remain buried while it is very dry: reproduced courtesy of Bob Winters.

Pobblebonks

Pobblebonks dig themselves into the soil and under rocks and logs in or near the wetland before it dries out. They are able to retain sufficient water in their bodies and wait for the drought to break.

In spring, after heavy rain, male pobblebonks generally call to attract females. Female pobblebonks are generally breeding. However, low rainfall means there may be a smaller number of tadpoles.

Polluted water may contain thousands of bloodworms: reproduced courtesy of Bob Winters.

Bloodworms

These long worm-like larvae are a type of fly. The adult body looks a little like a mosquito.

Bloodworms are often the most common animals in polluted water. They are red because their blood contains haemoglobin, which helps them obtain oxygen in the polluted environment.

Wetlands through the seasons

Summer: wet year

Regular rain and high evaporation

With regular rain and high evaporation, the water level in the wetland does not increase markedly.

1. Water level: fluctuating.
2. Water temperature: warming.
3. Oxygen level: moderate to low.
4. Nutrient level: increasing.
5. Pollution: increasing slightly.
6. Health of invertebrates: mostly good.
7. Tadpoles and frogs: tadpoles growing quickly, frogs looking for cover as water level falls.
8. Plant growth: increasing.

Water levels are the lowest in summer.
Image: reproduced courtesy of Ecolinc.

 Flower spikes of Water ribbons: reproduced courtesy of Bob Winters.	**Water ribbons** These are aquatic plants. The large green strap-like leaves either float or stand erect out of the water. Water ribbons develop tall flowering spikes. The seeds germinate readily in shallow water. These plants provide habitat and food for wetland birds and fish.
 A tadpole starting to grow back legs: reproduced courtesy of Bob Winters.	**Tadpoles** Pobblebonk tadpoles can be found throughout the year. Many are growing larger and starting to develop back and then front legs. Growling grass frog tadpoles do not finish their life cycle until the middle of autumn. Tadpoles eat wetland plants and frogs catch smaller animals such as insects and worms.
 A male dragonfly patrolling his territory: reproduced courtesy of Bob Winters.	**Dragonflies** Male dragonflies are territorial. Each male patrols a small area of a wetland and chases other males of the same species out of their area. After mating, the different species of dragonflies use varied methods for depositing their eggs. Some dragonflies just drop them in the water.

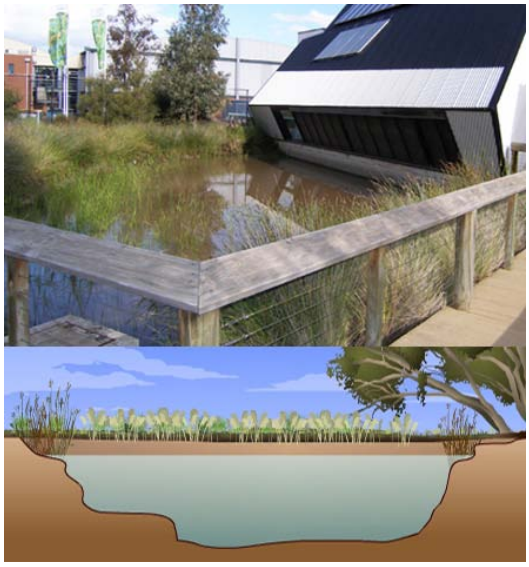
Wetlands through the seasons

Autumn: wet year

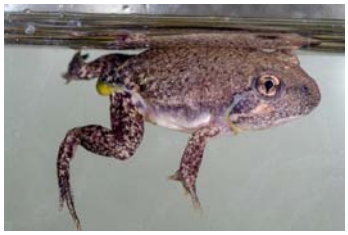
Regular rain and moderate evaporation

With regular rain and moderate evaporation, the water level in the wetland slowly increases.

1. Water level: increasing.
2. Water temperature: becoming cooler.
3. Oxygen level: increasing.
4. Nutrient level: decreasing.
5. Pollution: decreasing.
6. Health of invertebrates: very good.
7. Tadpoles and frogs: most tadpoles are eaten, those remaining growing larger, frogs commence breeding again.
8. Plant growth: slowing down and some becoming dormant.



Wetlands provide valuable habitat for wildlife.
Image: reproduced courtesy of Ecolinc.

 Abundant reeds at the edge of a wetland: reproduced courtesy of Bob Winters.	**Reeds** Tall reeds along the edge of the wetland and in shallow water may develop large fluffy seed heads after flowering. In some habitats fertile seeds are produced. However, the spread of this plant is mainly vegetative via stem-like roots called rhizomes, which will sprout new shoots in spring.
 This very young frog still has a stump where its tail once was: reproduced courtesy of Bob Winters.	**Tadpoles and frogs** Frogs call more frequently to attract females after heavy rain. In wet seasons the number of large tadpoles increase. Tadpoles develop back and then front legs. The growling grass frog tadpoles complete their life cycle by developing into adult frogs.
 A reed warbler catching an insect: reproduced courtesy of Bob Winters.	**Reed warblers** As the weather gets cooler, there are fewer insects for birds like the reed warbler to eat. In winter, reed warblers fly north where there is more food. They stop off at wetlands on their journey.

Wetlands through the seasons

Winter: wet year

Regular rain and low evaporation

With regular rain and low evaporation, the wetland fills and overflows.

1. Water level: high.
2. Water temperature: low.
3. Oxygen level: high.
4. Nutrient level: decreasing.
5. Pollution: decreasing.
6. Health of invertebrates: very good.
7. Tadpoles and frogs: tadpoles slowing down in growth, frogs less active.
8. Plant growth: slowing down and some have become dormant.

Wetlands may stay wet all year, or the water may evaporate during the dry season.

Image: reproduced courtesy of Ecolinc.

Some Slender knotweed flowering in a wetland: reproduced courtesy of Bob Winters.

Slender knotweed

Throughout the warmer months Slender knotweed forms a thick mat over the shallowest part of the wetland. It provides habitat for many invertebrates.

During winter Slender knotweed dies back with its stems, leaves and pink flowers slowly disappearing. Its nutrients are returned to the wetland.

Frog eggs: reproduced courtesy of Bob Winters.

Frogs

Growling grass frogs hide under logs, rocks and in crevices during winter. They often choose to be a long way from their closest wetland.

Most frogs are less active in winter. Frog eggs take a lot longer to hatch and tadpole growth is slower. As pobblebonk tadpoles are slow growing, they may still be found in winter.

A water flea magnified 100 times: reproduced courtesy of Bob Winters.

Water fleas

Water fleas may produce sexually or asexually depending on environmental conditions.

During winter fertilised eggs of the water flea lie on the bottom of the wetland waiting to hatch in spring. During spring and summer female water fleas asexually produce female juveniles, which moult to become adults. In autumn the females may asexually produce males. After mating occurs between females and males, fertilised eggs are laid. These are capable of withstanding harsh environmental conditions.

Wetlands through the seasons

Spring: wet year

Regular rain and moderate evaporation

With regular rain and moderate evaporation, the full wetland overflows after each rain.

1. Water level: high and stable.
2. Water temperature: cool.
3. Oxygen level: high.
4. Nutrient level: moderate.
5. Pollution: low to moderate.
6. Health of invertebrates: good.
7. Tadpoles and frogs: many tadpoles, frogs reproducing.
8. Plant growth: moderate.

A wetland after a lot of rain will overflow.
Image: reproduced courtesy of Ecolinc.

In full sun, *Azolla* tends to be red while in the shade it is green: reproduced courtesy of Bob Winters.

Azolla

Small floating ferns called *Azolla* rapidly grow and cover the surface of some wetlands.

The rapid growth is due to high levels of nutrients in the water. In the shade this plant is green. *Azolla* slowly turns red when it is exposed to the sun during summer and autumn.

Most frogs need water in which to lay their eggs: reproduced courtesy of Bob Winters.

Frogs

The wetlands are still full and the water is becoming warmer. At this time reproduction has the best chance of success.

Frog eggs look different depending on the species of frog. Pobblebonk eggs resemble white froth among the wetland plants. Growling grass frog eggs are contained in a jelly mass which sinks soon after the eggs are laid. Common froglets spread their eggs throughout the wetland.

A family of ducks swimming in a wetland: reproduced courtesy of Bob Winters.

Ducklings

Ducks breed when food is readily available. Ducklings are protected by their parents, but must find their own food.

As soon as the ducklings hatch they must leave their nest to feed. Ducklings recognise their parents and follow them.