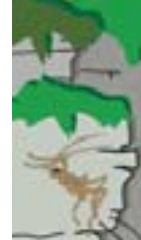


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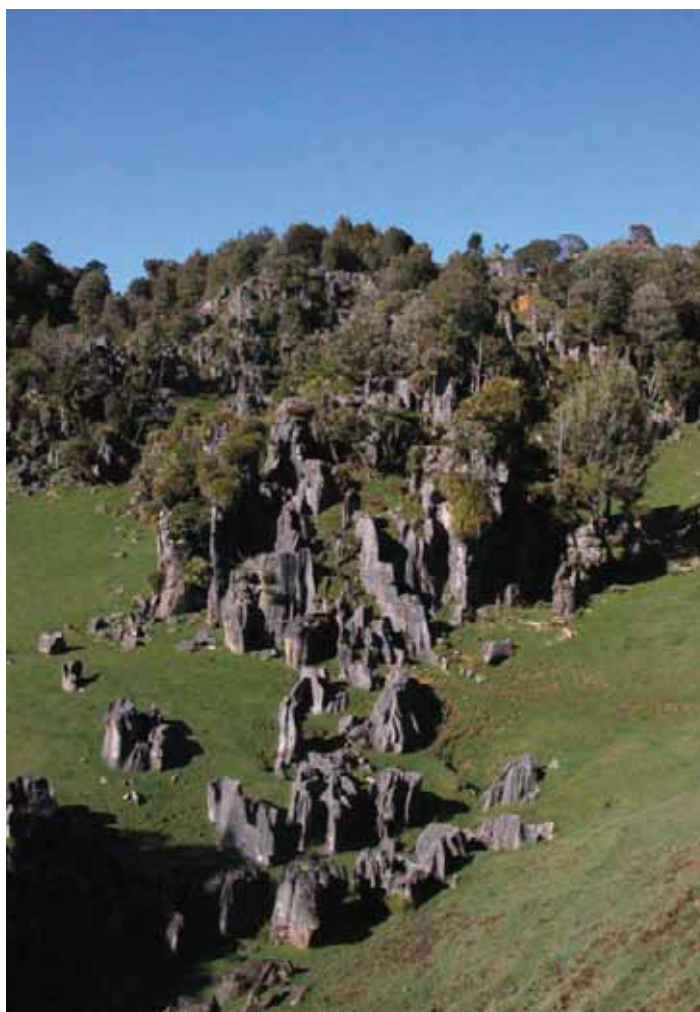


Karst ecosystems

The hill country of the western Waikato is home to many karst ecosystems and landscapes. These karst landscapes are formed when water dissolves carbonate containing rocks such as limestone. They are scattered from Port Waikato to Mokau, and include the Waitomo glowworm caves and a variety of sculpted pools, caves, arches, gorges, disappearing streams, springs and unusual rock formations. This geodiversity creates some unique ecosystems and species.

There are particular plant species found only on limestone outcrops or in cave entrances, such as *Hebe scopulorum* which is confined to exposed limestone bluffs south of Kawhia Harbour and *Asplenium cimmeriorum* which is found in cave entrances, while many other plants have strongholds on the limestone, such as the spleenwort fern *Asplenium lyallii* and the climbing rata *Metrosideros colensoi*.

Eyeless cave beetles and other species are found deep in the caves while cave weta prefer the cave entrances. Glowworms need a steady supply of flying food to get caught in their sticky 'fishing lines', a humid habitat (hence they prefer living in moist caves, along stream banks and in tunnels) and a still atmosphere so their lines don't get tangled. Bats seem to favour the karst landscapes which provide a range of roosting and breeding sites. Even native fish have been found in cave streams and recently several new species of snails with very limited distribution have been found in Waikato karst areas.



Karst landscape
Image courtesy of the Department of Conservation

Threats to karst ecosystems

Over the last century vegetation clearance has had the greatest impact on karst ecosystems. The invasion of exotic weeds continues to degrade these ecosystems. Forest cover over karst is important for a range of processes such as:

- controlling the amount of sediment entering caves
- influencing the food chain for cave species
- affecting the micro-climate of cave entrances and the whole cave system
- affecting the growth rate of speleothems*
- affecting cave hydrology.

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* Speleothems are cave formations which are formed by the chemical precipitation of compounds previously dissolved in ground waters. The most common examples are stalactites and stalagmites.

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Image courtesy of the Department of Conservation

Karst ecosystems hot tips

- Visit the New Zealand Speleological Society web site: www.caves.org.nz
- Visit the Waitomo Museum of Caves for information, or for educational visits, contact the Museum's education service, phone 07 878 7640. Visit their website: www.waitomocaves.co.nz
- Visit the Weedbusters website: www.weedbusters.org.nz
- Visit the Landcare Research website and read their factsheet on how to prioritise weeds: www.landcareresearch.co.nz/research/biodiversity/landscapesprog/workshops/Stanley_WeedSheet.pdf
- Visit the New Zealand Landcare Trust website for the Biodiversity Restoring the Balance self-help kit and for community group information and resources: www.landcare.org.nz/action/groups
- Visit the New Zealand Ecological Restoration Network for information on ecological restoration: www.bush.org.nz/nzern
- Call Environment Waikato's Freephone 0800 800 401 or visit their website: www.ew.govt.nz
- Contact the Department of Conservation Maniapoto Area Office in Te Kuiti, phone 07 878 1050, for information on the Maniapoto Karst Plan.
- Visit Department of Conservation website for information on karst ecosystems: www.doc.govt.nz

Other threats to karst features:

- Human use, for example through breakage and souvenir collection.
- Human activity in some high use caves increases the carbon dioxide content of the air. The acid in carbon dioxide will start to dissolve the limestone especially in the tourist caves. The oil in human skin is also acidic and will dissolve limestone.
- Changes to the regional water table and increased sedimentation.
- Changes to the water quality entering the caves. High nutrient content which may encourage "undesirables" to establish in the area.
- Animal and plant pests.
- Human use as holes for rubbish disposal.
- Roothing, quarrying and other such surface activities.
- Recreational use, particularly by groups with little knowledge of cave conservation.
- Changes to the volume and variability of flows entering the cave system.

Which type of karst are the most depleted in our region?

Very few of the major karst systems in the Waikato have intact forest overlying the caves. Because this ecosystem is so rare and special we need to protect as much as possible. Many significant karst features remain on unprotected private land.

How do I know what to do, and when?

Use the table overleaf to help you prioritise your management actions. Managing threats to karst systems must take into account both the significance and vulnerability of a feature or process. Each site is different and will require its own assessment.



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Choosing Actions: Karst ecosystems

Assess needs/plan

Do this before anything else! Seek professional advice if you need to identify the management issues for your site. Write up a plan of action. Get a copy of the bush restoration plan template from the Department of Conservation or 0800 BIODIV (246 348).

Seek funding

Complete this table to determine what actions are needed and how much each will cost before you apply for funding. You may need to obtain funding before you can start on the work. Call 0800 BIODIV for advice.

Action and Priority	Comments
Protect water table Avoid damming/ diverting water	Karst ecosystems are created by the erosive effects of water. Changes in water supply can damage cave systems. Major dams, in-cave dams and major water takes could create an issue. Talk to Environment Waikato if you are concerned about possible damming or diverting.
Reduce pollution 1 st Sediment 2 nd Nutrient run-off	If your cave system has a stream flowing into it, consider retiring the riparian margin and providing a planted swale to absorb excess nutrients out of the water. See planting below to deal with run-off.
Reduce human damage 1 st Limit exposure to human breath 2 nd Use electric lights 3 rd Don't take 'trophies' 4 th Limit trampling 5 th Take all rubbish from cave	<ul style="list-style-type: none"> • Cave formations can be damaged by touching. Leave some caves 'untouched' and use well visited caves to reduce the number damaged by humans. • Use electric lights rather than carbide, as carbide lights emit heat, carbon dioxide and soots and can leave marks on rock when moving through a cave. • Never touch, break off or damage cave formations. Leave them for others to enjoy. Take only photos. Even broken bits of stalactite should always be left in the cave. • Use designated tracks where marked to reduce trampling damage in caves. Avoid bone deposits and untrampled cave floor surfaces. • Take out all rubbish and human waste and dispose appropriately. • Go caving with a leader who understands cave conservation and cave safety.
Control stock	If grazing animals can enter your site they will trample the soil and eat the plants, and their dung and urine will pollute the site. Heavier animals, such as cattle are generally more damaging. Even a hot wire will be a good start to keep cattle out. A more robust type of fence will be required to keep out deer, pigs and goats. Priorities for fencing include bush margins, stream margins, spring heads and cave entrances. Be ready to tackle weeds as soon as the last stock are out, you may find the weeds 'take off' when grazing stops.
Control weeds 1 st Regional plant pests 2 nd Limestone specialists 3 rd Other weeds	<ul style="list-style-type: none"> • While weeds won't grow in the dark of underground karst ecosystems, they can reduce the natural value of the landscape on the surface and around cave entrances. • Deal with weeds you are legally obliged to. See the plant and animal pests section in Environment Waikato's website. Be vigilant for weeds in nearby sites that are not in your site - yet! • Weed control may need to be targeted in relation to karst-reliant native plants. A particular weed of karstscapes is <i>Geranium robertianum</i> - the common herb robert - which grows in limestone rock cracks that could be habitat to rare ferns. • Note also that getting rid of some weeds can just encourage others! Get good advice on weed management.

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Action and Priority	Comments
<p>Control pests</p> <p>1st Hoofed animals 2nd Possums, rodents, mustelids, cats 3rd Rabbits/hares (if planting)</p>	<ul style="list-style-type: none"> • Pests cause damage to the special forest systems that grow on the surface in karst landscapes. Pests include deer, pigs, goats, rodents, possums, mustelids, rabbits, hares and feral cats. It is also likely that rats impact on cave ecosystems. • Target the large animals first - they will be easier to find and if the site is well fenced may be able to be eliminated. Use a trained hunter to shoot deer, goats and pigs. Other pests will need on-going control using traps or poisons. Seek advice from the Department of Conservation regarding control methods and best practice.
<p>Planting</p> <p>1st Buffer 2nd Enhance 3rd Connections 4th Maintain</p>	<ul style="list-style-type: none"> • Firstly, you should consider planting the edges of streams, springs and cave entrances to trap sediment and run-off. Also consider planting to buffer existing native bush remnants. • If the site is of unnaturally low diversity and isolated from natural seed sources, consider enhancement plantings. Make sure they are appropriate to the site - get advice. If you have to remove a lot of weeds, consider enhancement planting of natives as soon as possible to reduce the chance of another weed filling the space • If your site is isolated from other natural areas, consider planting corridors of vegetation to encourage birds to move between them. Retirement and planting of streams will provide for this. • Keep your plantings weed free until the plants are well established. Small plants can be smothered by rank grass. Protect from rabbits, hares, and stock. • Retiring areas around cave entrances, including shaft entrances, will help the caves.
<p>Enhance native fauna</p> <p>1st Cave species 2nd Surface fauna</p>	<ul style="list-style-type: none"> • Cave fauna are often present in low numbers and are vulnerable to impacts. Help protect them by reducing pollution and human damage (see previous page). • Surface fauna such as forest birds and/or bats will benefit from the actions noted above (particularly pest control and fencing).
<p>Monitoring</p> <p>Measure change</p>	<p>It is important to be able to measure the effect of any management activities on karst features. Having baseline data is important. Take photos of your site prior to any action. Undertake photo monitoring at set intervals. Visual inspections and biological surveys may also be useful. In terms of any restoration planting, keep records of which plants survived and those that didn't so you can learn for next time. If the project is large and needs a lot of funding get a professional monitoring programme in place, to justify the next round of grants.</p>
<p>Legal protection</p>	<p>If a site is not legally protected as a reserve or private covenant, it's generally best to seek legal protection when the site is in good condition. However, if you are planning to protect the site and you need to fence it, it pays to contact QEII National Trust first, as they usually pay a share of the fencing costs. Talk to the Department of Conservation about other options for protecting karst and cave features.</p>