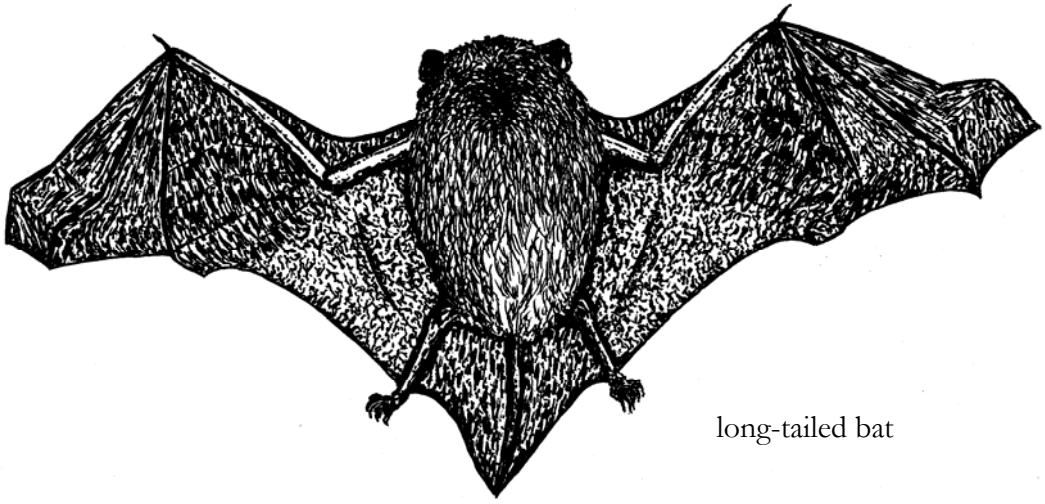
Native Long-tailed Bats / Pekapeka

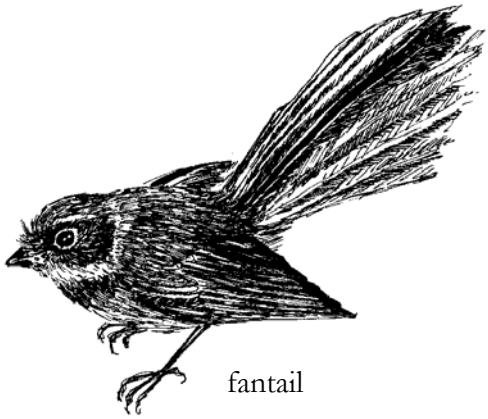
The Ruakuri natural bridge tunnel is home to a colony of native long-tailed bats. Populations of these mammals are under threat in many localities through habitat loss. The accessibility of this colony provides an opportunity to study the bats without disturbing them.



long-tailed bat

Birds

Keep a look out for fantails, grey warblers and wax-eyes in the forest, with kereru and falcons displaying in the air above.



fantail

Threats

Threats to the native forest and wildlife in the Ruakuri Caves & Bush Scenic Reserve include:

- Grazing and browsing by goats, pigs, possums and rats.
- Predation by mustelids (stoats etc), rats and possums.
- Infestations around the boundaries of the reserve from introduced weeds and grasses.
- Human impacts on the environment, for example, tourism and farming.

Management of Ruakuri Caves and Bush Scenic Reserve

The Department of Conservation manages this reserve for:

- Maintaining and improving the health of the forest ecosystem.
- Public enjoyment.
- Tourism.
- Educating visitors about 'karst' landscapes.

There is a real opportunity for schools to help with future management decisions by collecting and recording information about the Ruakuri environment.

Management includes:

- ❖ Maintaining and improving forest health.
- ❖ Minimising erosion and improving water quality.
- ❖ Controlling weeds.
- ❖ Maintaining and upgrading recreational facilities.
- ❖ Providing interpretation and publications.
- ❖ Minimising tourist impacts.
- ❖ Maintaining the *waahi tapu* significance of the area.
- ❖ Operating Aranui Cave for tourism.

Management Objectives for Karst Landscapes

To maintain and improve the resource for:

- ❖ Association with Maori culture
- ❖ Uniqueness of the karst landscape
- ❖ Importance for natural history
- ❖ Utility for recreation and tourism
- ❖ Role in the control of erosion and water quality

NEW ZEALAND ENVIRONMENTAL CARE CODE

Protect plants and animals

Remove rubbish

Bury toilet waste

Keep streams and lakes clean

Take care with fires

Camp carefully

Keep to the track

Consider others

Enjoy your visit

Toitu te whenua
(leave the land undisturbed

Stalactite formation in a limestone cave.

TEACHERS' BACKGROUND READING

KARST LANDSCAPE

Limestone formation
The beginnings of the distinctive Waitomo landscape occurred over 25 million years ago, when the area was covered by a shallow sea. Shell fragments, coral and skeletons of other sea creatures that were buried on the sea floor gradually compacted and cemented together forming **limestone**. The limestone in this area rose out of the sea about 10 million years ago.

The forming of a karst landscape
The Ruakuri Caves and Bush Scenic Reserve is set in what is known as a 'karst' landscape. Karst landscapes are areas of rock (usually limestone) that have well-developed internal drainage systems, whereby water flows and carves its way through the rock as well as along the surface. The resulting features usually include the formation of caves, natural arches, tunnels, gorges, depressions and sculptured rock outcrops.

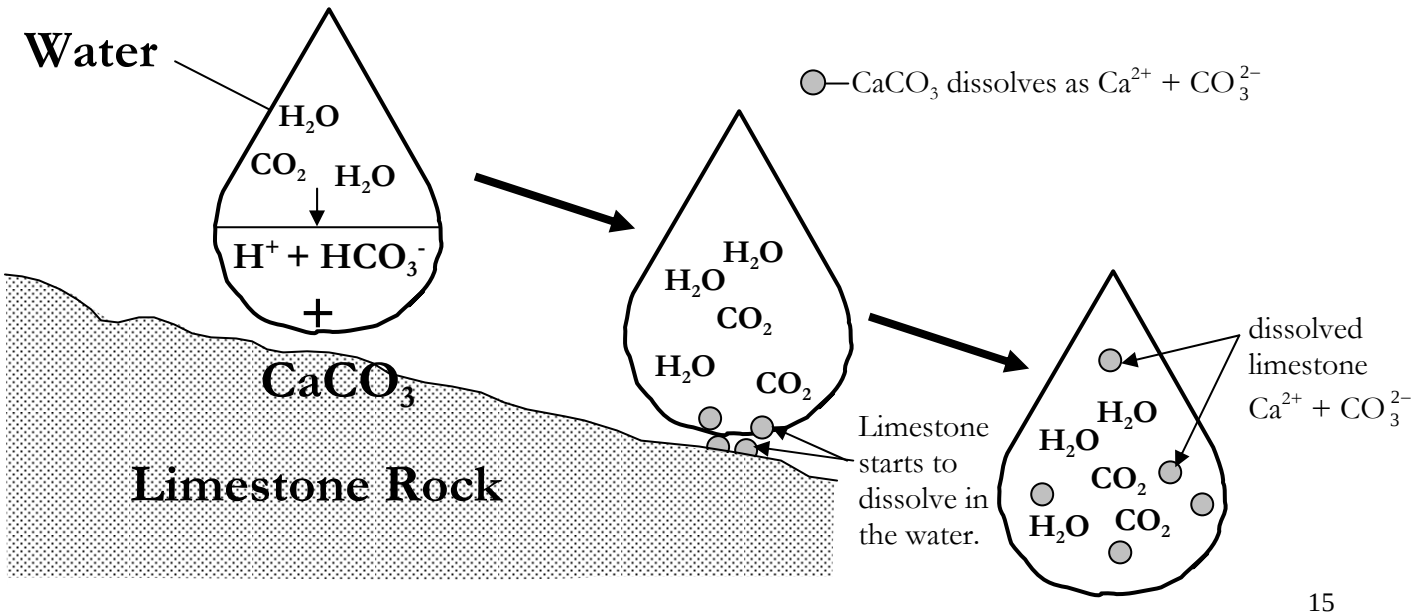
All of these features involve the powerful action of water on limestone.

Chemical processes involved in karst formation

It is not water itself that dissolves limestone, but rather the **carbonic acid** present in water - which forms when water molecules (H_2O) combine with dissolved carbon dioxide (CO_2):

$$H_2O + CO_2 \rightleftharpoons H^+ + HCO_3^- \text{ (carbonic acid)}$$

Limestone rock (mainly calcium carbonate) has a pH higher than 7 (neutral) making it alkaline. When an alkaline substance comes into contact with an acid, a chemical reaction will occur. The same process applies to limestone when water flows over it containing carbonic acid:



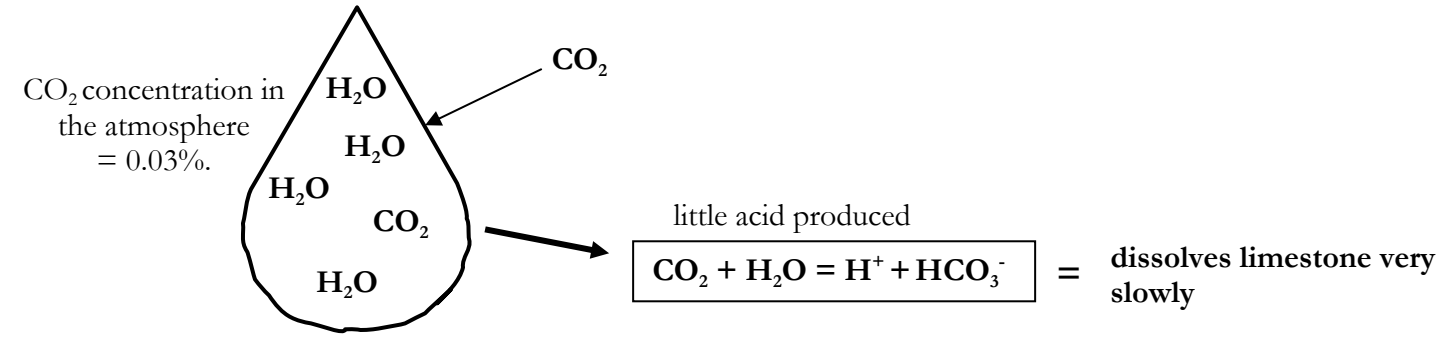
The karst at Waitomo is well formed because of the relative purity and thickness of the limestone (calcium carbonate), the relatively high rainfall and the high relief and dissected nature of the land which facilitates water flow.

CO_2 levels in water
As more CO_2 dissolves in water, more acid is produced and the greater the dissolving 'power' of the water on limestone.

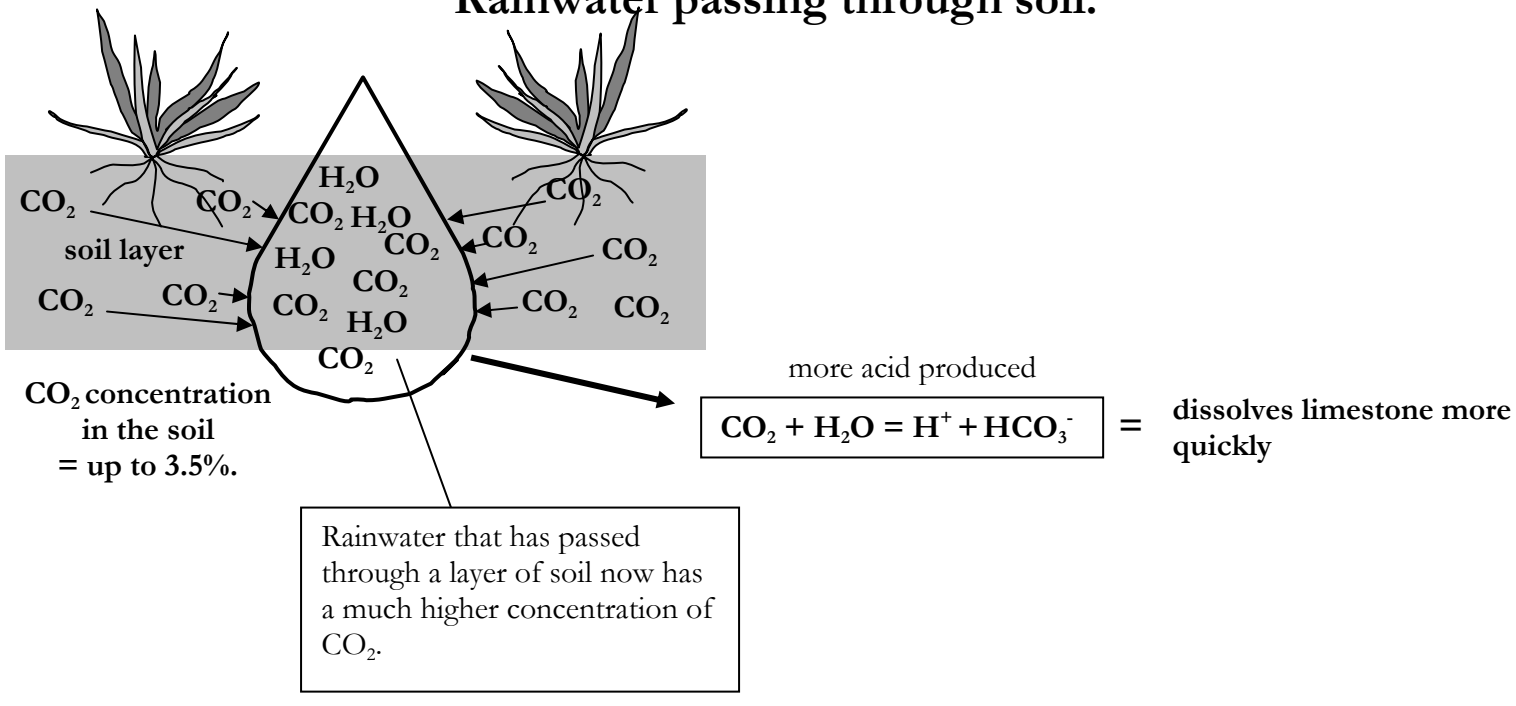
Pure rainwater dissolves limestone very slowly as it contains relatively little dissolved CO_2. This is because CO_2 makes up only around 0.03% of atmospheric gases.

However, when rainwater passes through soil, where the CO_2 concentration can be as high as 3.5%, it is able to absorb much higher levels of CO_2 and is therefore much more acid. It is then able to dissolve limestone much more quickly.

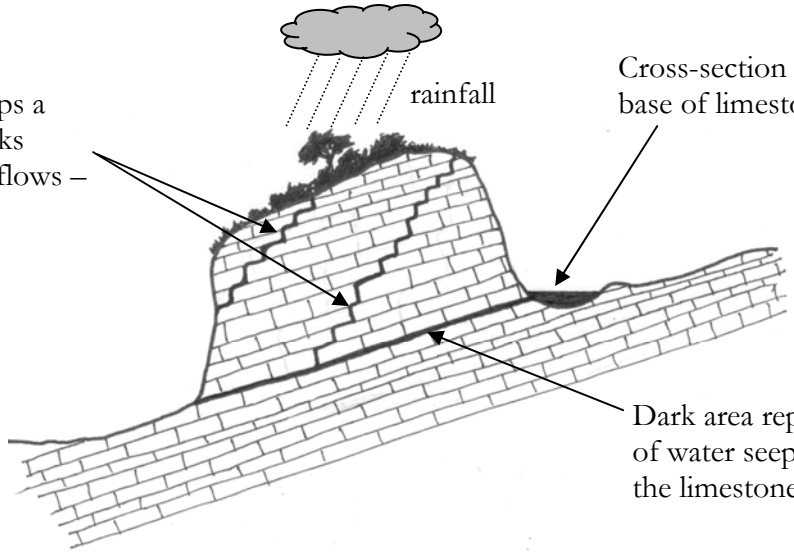
Rainwater:



Rainwater passing through soil:



The forming of tomos, caves and other karst features from the action of rainfall and stream erosion on limestone:

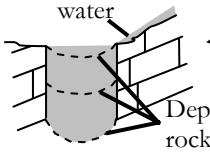


The limestone develops a network of small cracks through which water flows – called 'epikarst'.

Cross-section of a stream flowing at base of limestone outcrop.

Dark area represents the pathway of water seeping through cracks in the limestone.

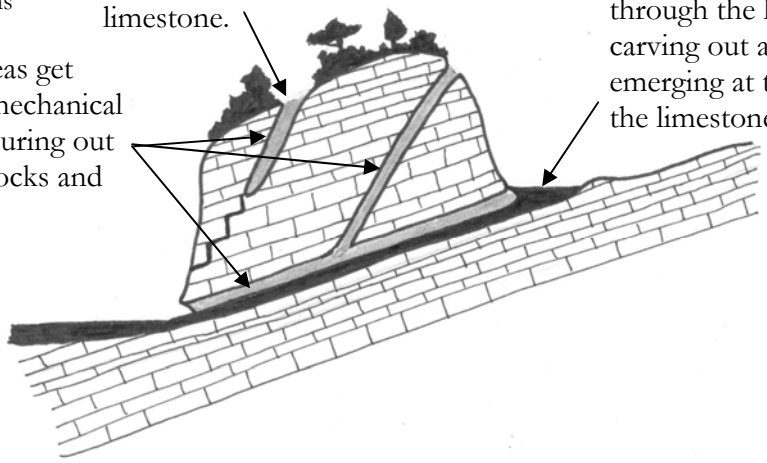
1



Tomos form when water flow concentrates at a point and erodes a shaft vertically (or near to) into the limestone.

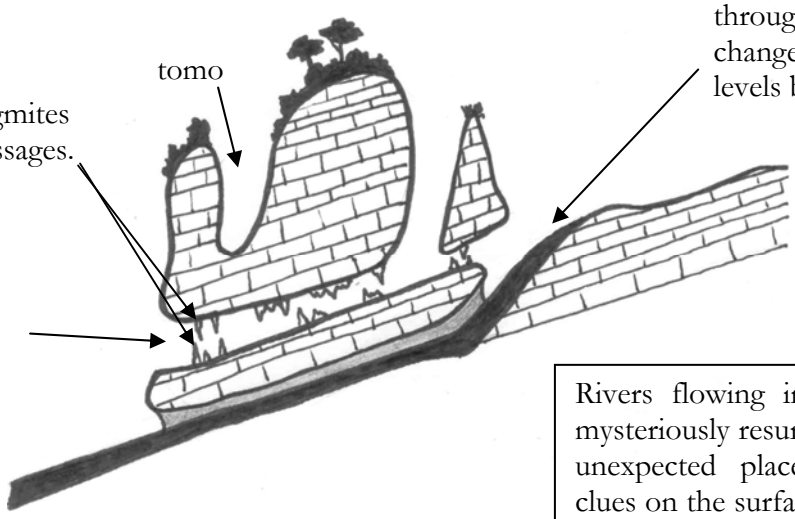
Dissolved areas get enlarged by mechanical erosion – scouring out by pebbles, rocks and water.

The stream now flows through the limestone, carving out a channel and emerging at the other side of the limestone outcrop.



2

As a stream carves its way through the rock it will often change course – leaving dry upper levels behind.

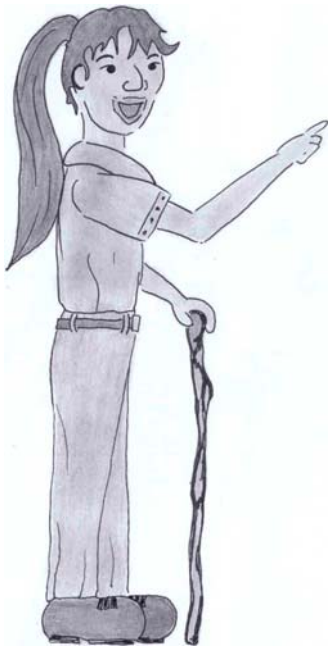


Stalactites and stalagmites form in the cave passages.

3

Dry passagess - no longer have a streams flowing through them.

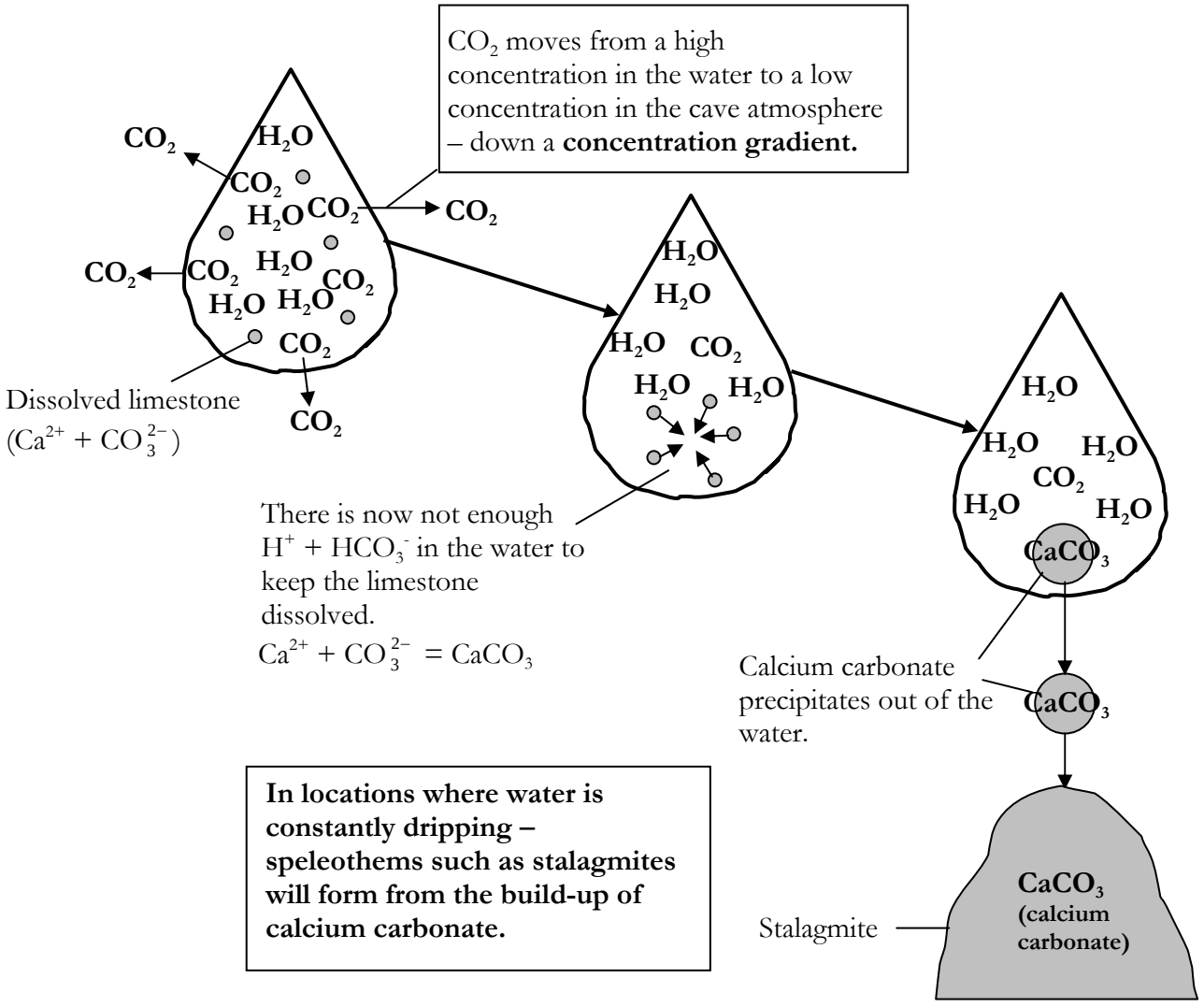
Rivers flowing into caves often mysteriously resurface in the most unexpected places, leaving few clues on the surface as to the path a stream takes on its underground journey.



Activity
Try this. Obtain limestone chips from a garden centre. Drop lemon juice or vinegar onto dry chips. Immediately the acid reacts with the calcium carbonate, dissolving the rock and can be observed as an effervescent liquid bubbling on the rock surface. Examination with a hand lens will make it more dramatic. Contrast this with drops of ordinary water on dry limestone.

Cave Speleothems
Cave speleothems (**speleothem** is a collective term for things like stalactites and stalagmites) are often formed by a reversal of the process that dissolves limestone. Water entering the cave system via percolating through the soil above has high levels of dissolved CO_2. As it enters the cave, CO_2 leaves the water and is lost to the atmosphere (i.e. it moves from a high concentration in the water to a low concentration in the atmosphere).

With the loss of CO_2, the water flowing through karst cave systems becomes less acidic and less able to 'hold' dissolved limestone in solution. The calcium carbonate is able to precipitate out of the water to slowly form structures such as stalactites and stalagmites.



In locations where water is constantly dripping – speleothems such as stalagmites will form from the build-up of calcium carbonate.

- Speleothems can also form from the evaporation of very slow moving water, which leaves behind calcium carbonate.

Life underground
In a healthy cave, water provides all the things a cave needs to survive and grow. It flows in carrying with it sand, pebbles, plant debris and the occasional insect. Insects and organic debris also enter through tomos and other cave entrances.

Caves are home to unique life-forms – adapted to living in a dark and food-poor environment. Caves have the following characteristics that provide challenges to those species which inhabit them:

- an absence of light and day-night rhythms
- less variation in temperature than outside caves
- higher humidity levels than outside the cave
- decreasing food sources the further from the cave entrance they go.

To cope with these characteristics, cave-adapted species have developed some unusual features, for example:

- reduced or complete loss of eye-sight
- loss of pigmentation (skin is often pale)
- increased use of touch as a sense, e.g. long feelers
- fewer eggs produced less often – but often of greater size with more yolk.

FOREST HEALTH AT RUAKURI

The native forest growing on this unique landscape has never been logged by timber millers but is under attack from several pests. Stock grazing and goat and possum browsing, if not managed, will continue to cause rapid decline in forest health, having serious detrimental effect on the reserve's biodiversity and the whole Ruakuri ecosystem.

A Department of Conservation forest monitoring team annually assesses the amount of damage possums and goats have done to forest health. Information recorded through this monitoring process helps to decide the best times to begin or modify pest control programmes.

To assess possum damage, the team looks at particular trees over a period of time. In this forest, **tawa** and **mahoe** are among the list of species that possums prefer. If the tree is severely damaged it shows that possum numbers in the area are high and the general health of the forest will be deteriorating through the impact of possum browsing.

Schools have a real opportunity to help with future management decisions by collecting and recording information about the Ruakuri environment.

PLANT IDENTIFICATION

A visit to Ruakuri will be more interesting if you are able to recognise some of the following plants:

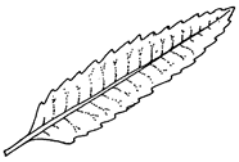
For further information on plant identification refer to Andrew Crowe's book **"Lifesize Guide to Native Trees"** (Penguin Books, 1997).

Tawa: the most dominant canopy tree at lower altitude.

Kohekohe: important as an indicator species monitoring forest health.

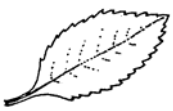
Rimu: towers above other species.

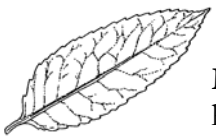
Parataniwha: found in damp, dark conditions around caves and in gorges.



Rewarewa: common along most tracks, large flowers from November to January.

Pukatea: spectacular fluted trunk and splayed root system.





Mahoe: important as an indicator species monitoring forest health.

Mamaku: the largest of our tree ferns.

Miro: large berries are important kereru (pigeon) food in the early winter.

HOW TO START

Before reaching Ruakuri, stop at Opapaka Pa Track (about 1km east of Waitomo Village) and familiarise students with native plants and their traditional Maori uses. Pick up a site investigation kit from the Waitomo Museum of Caves Education Officer and then you are ready to begin.

At Ruakuri, start with the activities for the Pest Control panel at the main car park entrance and use the work-sheets provided to assess forest health between the seat at the top of the first steps and the first cave tunnel. Use the following sheets to help assess possum damage to tawa and mahoe trees:

- Foliar Browse Index (page 39).
- Insect vs Possums Damaged Leaves (page 40).
- Foliage Cover Scale (page 41).
- Record your assessment in the Forest Monitoring Recording Sheet (page 42).

The following investigations can also be conducted while walking around the Ruakuri Caves and Bush Scenic Reserve and activities are included in this kit (see pages 26 to 45):

- **Air temperature**
  Make a record of the temperature outside the forest and among ground cover plants.

- **Waitomo Stream**
  Record the water levels, water temperature and water clarity.

- **Ruakuri Cave Stream Resurgence**
  Record the water level on the gauge at the cave entrance and temperature of the air as it exits the cave.

- **Possum damage to the forest**
  Practise assessing and recording possum damage to two common trees in the reserve; tawa and mahoe.

- **Tourism**
  Record the number and types of vehicles in the car park. Estimate the number of people using the track during your visit.

- **Display panel information**
  Comment on learning points from the interpretation panels.

- **Long-tailed bat monitoring**
  Record information about long-tailed bats.

- **Traditional Maori uses of native plants**
  Record the names and traditional uses of native plants.