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Groundwater dependent ecosystem pictorial conceptual model 'cave ecosystems'

Version 1.5

Cave ecosystems

Subterranean wetlands include all underground areas containing water, including caves and aquifers. Subterranean cave systems are groundwater dependent ecosystems. Subterranean cave systems with large void sizes are part of 'karst landscapes' often characterised by sinkholes and springs. Karst landscapes are commonly found in regions where carbonate rocks are abundant. Carbonate rock may be fractured and/or dissolved by mechanical weathering and chemical weathering from contract with water (e.g. rain and soil water naturally containing weak acids). Subterranean cave ecosystems can be divided into four zones (shown as focal circles in the conceptual model):

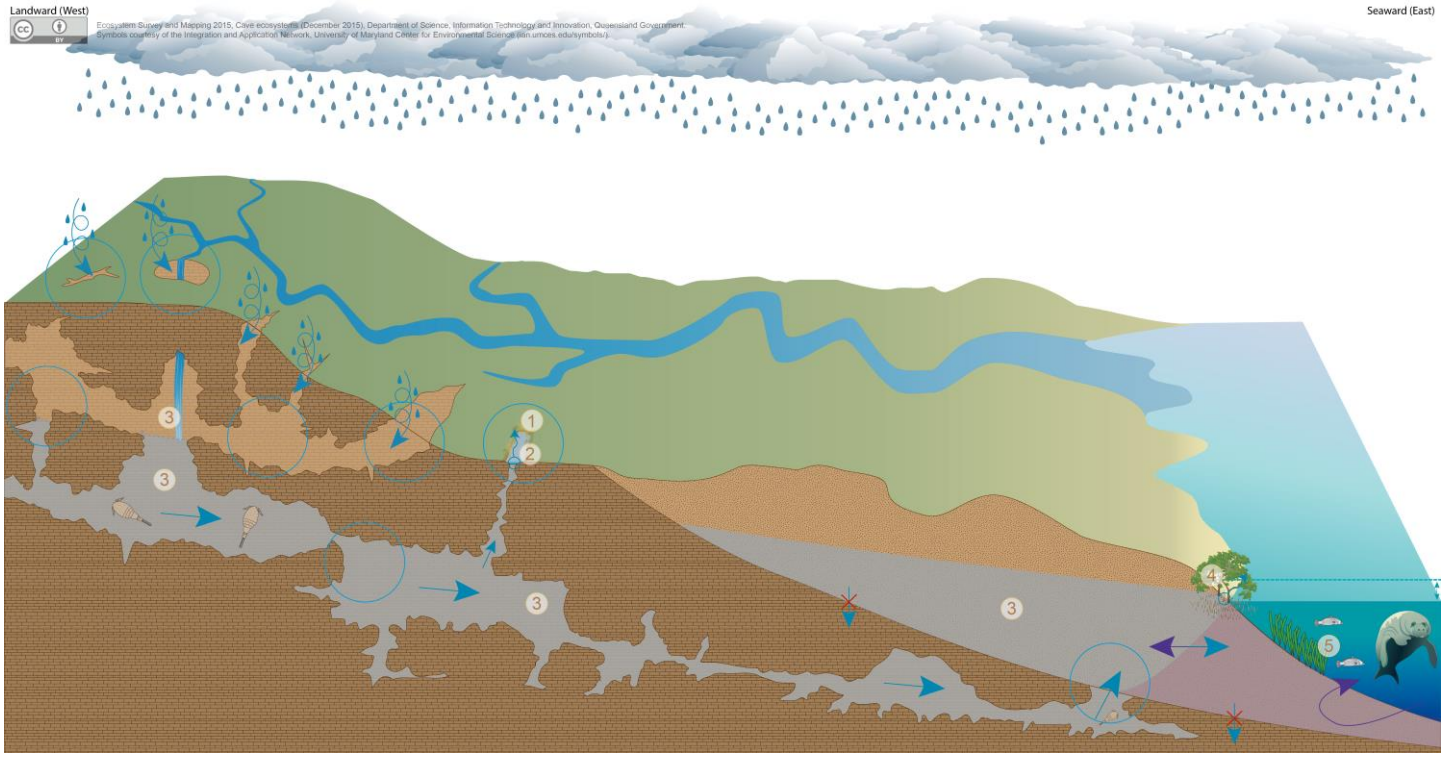
- Entrance zone – this is where the surface and subterranean environments connect.
- Twilight zone – in this zone light from the surface progressively diminishes. Flora (e.g. ferns, mosses and algae) can grow in areas of this zone where light from the surface is able to penetrate.
- Transition zone – in this zone light is unable to penetrate from the surface. However other surface environmental conditions, including temperature fluctuations and moisture content, influence the conditions in the transition zone.
- Deep zone – in this zone light is unable to penetrate from the surface. Relative humidity is high and evaporation is low. Temperature is relatively constant throughout the year. Fauna found in the deep zone (i.e. stygofauna and troglofauna) are adapted to the subterranean environment.

Subterranean cave systems may store and transmit groundwater through the void spaces created through the interaction of carbonate rocks and water over time. Groundwater in these subterranean cave systems may support plant and/or animal communities, ecological processes and delivery of ecosystem services. Subterranean cave systems may support stygofauna (aquatic fauna that depend on groundwater for all or some of their life cycle) and troglofauna (terrestrial, air-breathing fauna for which groundwater provides a humid environment and transmits nutrients from the surface environment).

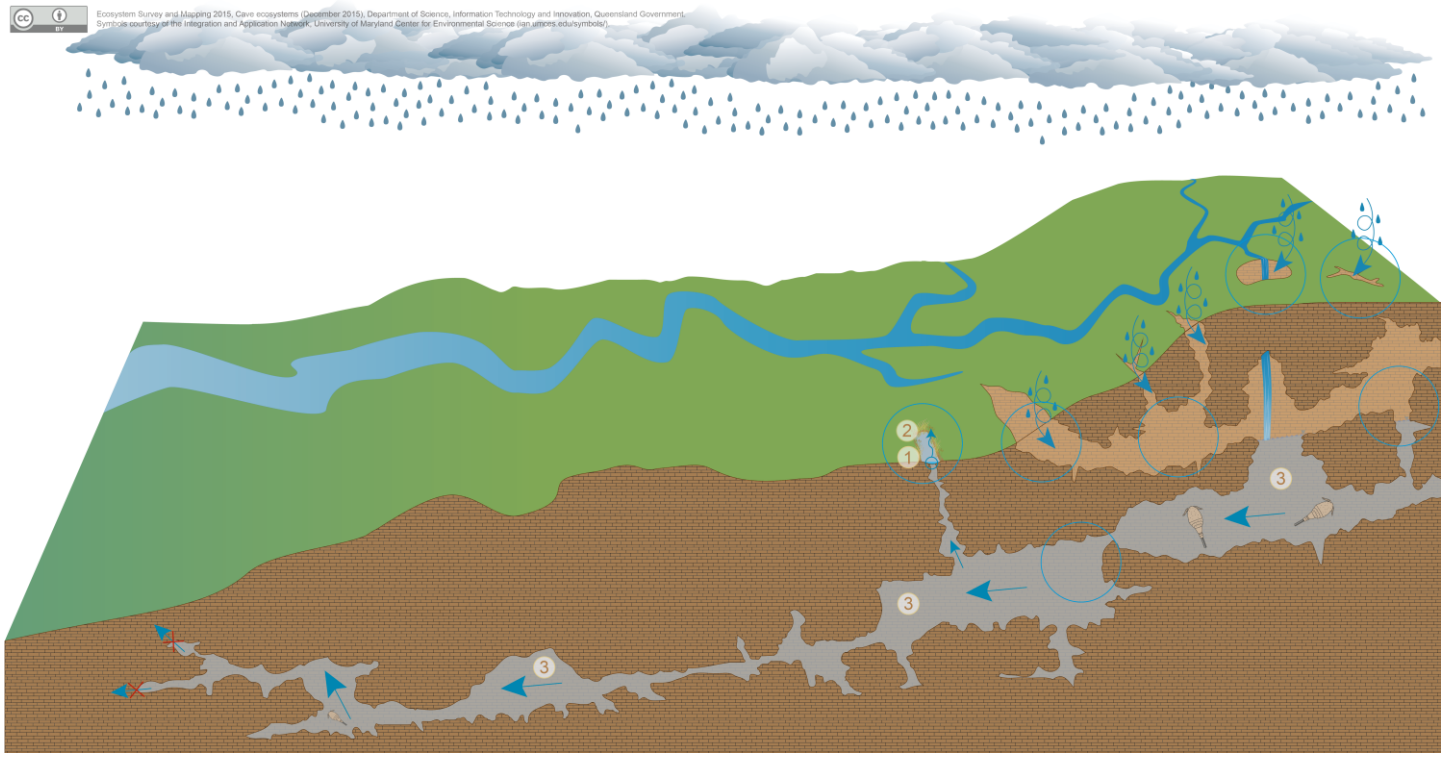
The discharge of groundwater from cave systems may also support:

- Palustrine (e.g. swamps), lacustrine (e.g. lakes) and riverine (e.g. streams and rivers) wetlands located near springs fed by groundwater in cave systems.
- Terrestrial vegetation accessing groundwater from cave systems through their root zone.
- Aquifer ecosystems by recharging overlying aquifers.
- Estuarine ecosystems located at or down-gradient of springs fed by groundwater in cave systems.
- Near-shore marine ecosystems located at or down-gradient of submarine springs fed by groundwater in cave systems, although this is less common in Queensland landscapes.

Coastal example



Inland example



Geology legend

Sand

Limestone

Limestone Cave
Cave formed by the dissolution of limestone by water

Groundwater hydrology legend

Sand (unsaturated)

Sand (saturated with marine water)

Sand (saturated with groundwater)

Limestone cave (unsaturated)

Limestone cave (saturated with groundwater)

Limestone (unsaturated)

Spring
A hydrogeological feature by which groundwater discharges naturally to the land surface or cave

Groundwater table

Direction of groundwater movement

Negligible groundwater movement

Direction of marine water movement

Groundwater and marine water interface
The position of the interface will vary temporally

Tidal range

Infiltration and percolation
Rain infiltrates through the soil to recharge the aquifer below

Flora legend

Cladium spp.

Mangrove

Sedge

Seagrass

Fauna legend

Stygofauna
Aquatic fauna that live in groundwater

Dugong dugon

Fish

Focal circle legend

Formation of limestone caves
Water containing dissolved carbon dioxide is acidic. This acidic water flows into rock cracks and dissolves limestone (calcium carbonate). Carbon dioxide generally originates from decaying organic matter in soil and directly from the atmosphere in rain.

Entrance zone
In the entrance zone, the surface and sub-surface environments interact.

Transition zone
Light from the surface is unable to penetrate into the transition zone. However other surface conditions including temperature fluctuations and moisture content still influence the transition zone. Some fauna reside in the transition zone (e.g. crickets) and venture to the surface to forage for food at night.

Spring
Groundwater discharged from cave ecosystems may support surface ecosystems including palustrine, lacustrine and riverine wetlands.

Stream disappearing into sinkhole
Surface water including streams and runoff can enter caves through sinkholes or other entrances.

Twilight zone
In the twilight zone, light from the surface is progressively diminished. Plants can grow in those areas of the twilight zone where light from the surface is able to penetrate.

Deep zone
Light from the surface is unable to penetrate into the deep zone. In the deep zone, relative humidity is high and evaporation is low. There are minimal temperature fluctuations throughout the year. Fauna residing in the deep zone (called troglobites) are adapted for the dark including reduced body pigment and longer antennae.

Recharge of overlying aquifers
Groundwater discharged from cave ecosystems may support overlying aquifer ecosystems and/or form submarine springs that may support estuarine and near-shore marine groundwater dependent ecosystems.

Groundwater dependent ecosystem legend

Terrestrial GDEs
Regional ecosystems and riverine wetlands may depend on the subsurface presence of groundwater within the capillary zone for some or all of their water requirements.

Subterranean GDEs
Aquifer and cave subterranean wetlands may depend on the subterranean presence or expression of groundwater for some or all of their water requirements.

Surface expression GDEs (near-shore marine systems)
Near-shore marine wetlands may depend on the surface expression of groundwater for some or all of their water requirements. This sub-type of GDE is not currently mapped in the Queensland GDE Mapping.

Surface expression GDEs
Lacustrine wetlands, palustrine wetlands and riverine water bodies may depend on the surface expression of groundwater for some or all of their water requirements.

Surface expression GDEs (estuarine systems)
Estuarine wetlands may depend on the surface expression of groundwater for some or all of their water requirements. This sub-type of GDE is not currently mapped in the Queensland GDE mapping.

Citation

Queensland Government (2017) *Groundwater dependent ecosystem pictorial conceptual model 'cave ecosystems': version 1.5*, Queensland Government, Brisbane.