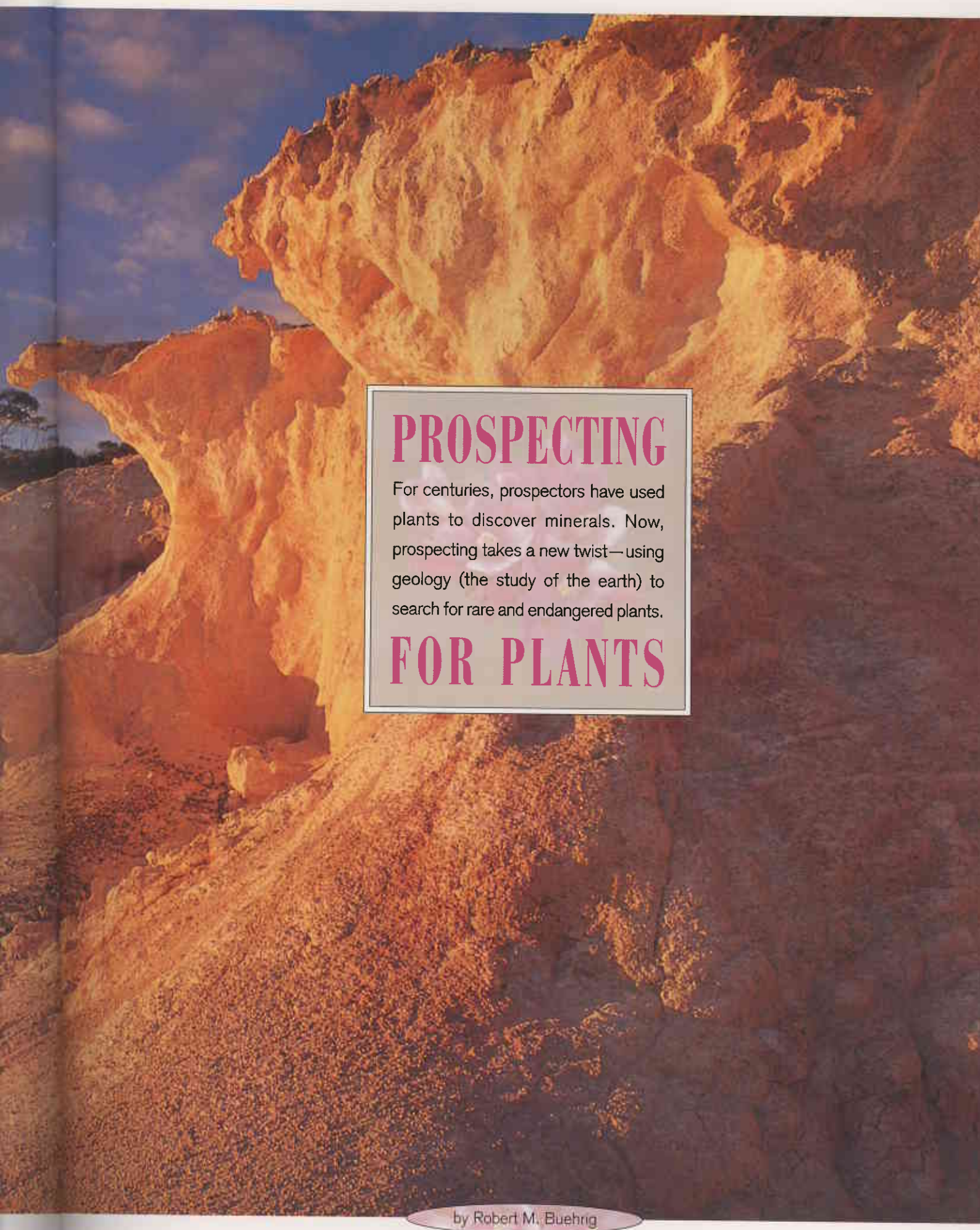


PROSPECTING FOR PLANTS

For centuries, prospectors have used plants to discover minerals. Now, prospecting takes a new twist—using geology (the study of the earth) to search for rare and endangered plants.

by Robert M. Buehrig

Prospecting for plants originated with work by the Department of Conservation and Land Management (CALM) on rare and endangered flora in the Wheatbelt district of Narrogin. Here, CALM staff are responsible for an important resource of more than 240 nature reserves, covering about 130 000 hectares of land. More than 190 species of rare or threatened flora have been recorded scattered over the area. However, the habitat and plant content in some reserves, particularly in the east, are little known. To date, the use of geological maps, in conjunction with existing botanical information, to predict likely locations of rare or endangered plants has produced astonishing success.

GEOLOGY AND HABITATS

Most plants have habitats in which they prefer to live. Of 76 threatened plants studied in the district, nearly 90 per cent showed some degree of habitat preference. The rest probably have preferences too, but there is so little known about them that their habitats are not yet evident.

Plant habitats of the Narrogin landscape can be categorised in seven ways: unweathered material such as granite outcrops or dolerite dykes; undisturbed but weathered products of these rocks; laterite; reworked sand-plain derived from laterite; colluvium and alluvium derived from all the above; lake deposits; and dunes originating from lakes and drainage systems.

Previous page
Main: Sunset at Buckley's Breakway near Hyden. In the Wheatbelt, the plants that inhabit this environment are quite predicable.
Inset: Scientists classify *Boronia capitata* subsp. *capitata* as a 'priority plant'—a plant about which little is known.

Left: Boronia revoluta and *Banksia sphaerocarpa* var. *dolichostyla* are rare plants that grow together on an ancient ironstone formation.

Below: Acacia coweniana lives only in soil-filled crevices of a few granite outcrops in the Wheatbelt.

On geological maps, each of these habitats is a clearly defined unit. Since plant habitats and geological units correspond to a significant degree, it is possible to prospect for habitats using 'geological units' on maps. All one need determine is a plant's preferred habitat (geology) and location (climate) and match it with the geology and location of nature reserves. By matching habitats and locations, a portable computer, armed with a database, can easily produce an inventory of possible plant habitation for all reserves. Moreover, the method can provide CALM with an inventory of habitats occurring on its reserves. Prospecting for plants in this manner does not always work, but it can considerably enhance our chances of success.

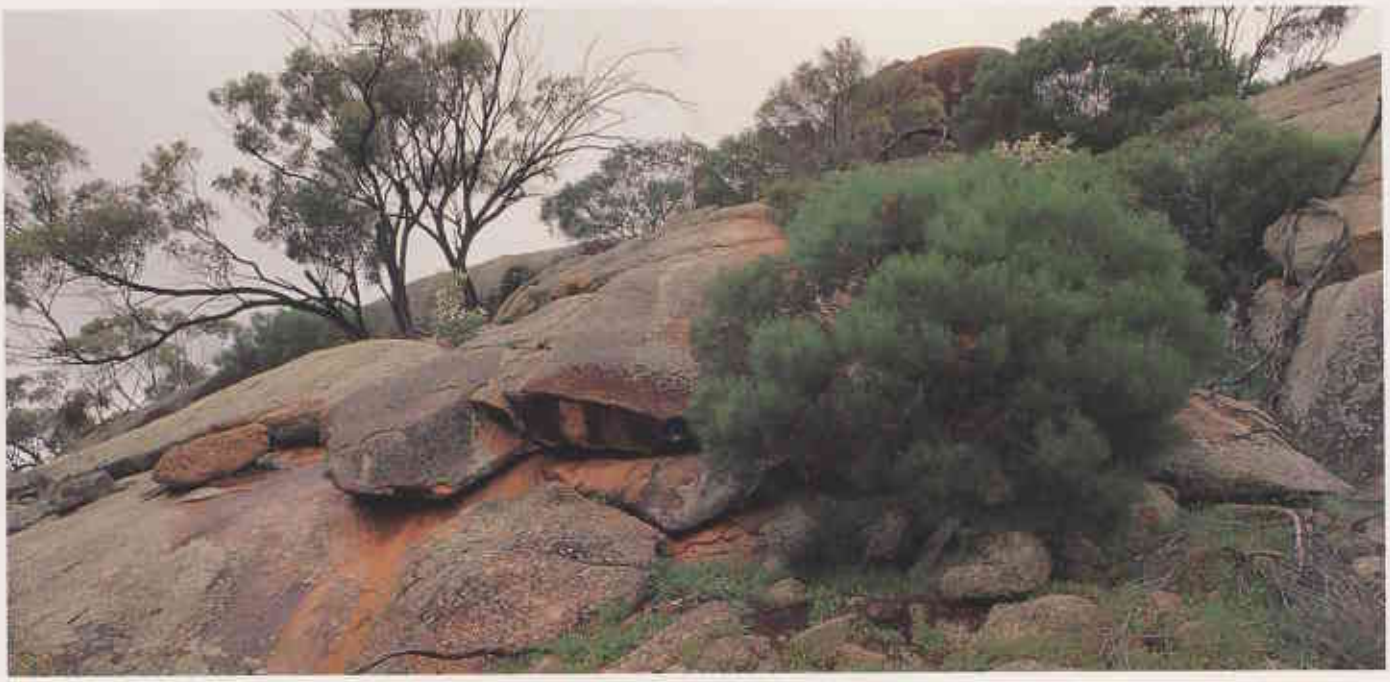
Using maps can help field personnel visualise the landscape while still in the office. This improves efficiency in the field, where the real search begins.

ANIMAL, VEGETABLE OR MINERAL

The occurrence of plants and animals in particular habitats is not haphazard, but rather it is based on climate, soil, and landforms.

Soil and landforms also do not occur haphazardly. They evolve because the regional and local climate is working on the chemical and structural geology over a great period of time. One might say that geology and climate, united by time, are the parents of a site; soil and topography are their children; and plants and animals are the grandchildren, and even great grandchildren.

Keeping in mind that plant habitats do not commonly occur as distinct



Above left: Conostylis rogeri is a rare plant found growing in two nature reserves on reworked sandplain.

Above: Little is known about *Boronia capitata* subsp. *capitata*. The plant exists as a sole population growing in an area of sand over laterite.

entities (laterite, for example, may grade into sand, then colluvium, alluvium and, perhaps, lake deposits or dunes), it is possible to interpret plant habitats in the landscape on a geological basis.

Overall, the landscape of the Narrogin District is gently undulating and underlain by deeply weathered granitic rock. Scattered throughout are granitic knolls that protrude above the landscape. Laterite caps hills, spurs and ridges, while colluvium covers the steeper slopes. An ancient river system, marked by salt lakes, passes near Hyden, Kondinin and Corrigin on its way to the Swan-Avon River drainage, while another passes near Quairading. In places, wind has swept these valleys and deposited low sand dunes.

ROCK OUTCROPS

In the Wheatbelt, rock outcrops occur in sheet form, or tower above the surrounding plains as picturesque granite domes. These granite rocks have come to project through a cover of debris and soil because, compared with surrounding areas, they contain relatively few cracks or joints. Without cracks or joints for water to seep into, weathering slows and erosion outstrips soil formation to expose bare rock.

GEOLOGICAL FORMATIONS AND ENDANGERED PLANTS THAT INHABIT THEM

Geological unit	* Geological rock code	Plants
Granitic rock outcrops	Agv, Agl, Age, etc.	Besides *Isoetes brevicula*, there are other endangered plants that live around granite. *Myriophyllum petraeum* grows in a habitat similar to quillwort; *Acacia coweniana* grows where soil has gathered in rock crevices; *Acacia cuneifoli* occupies drainage lines at the base of granite; *Andersonia bifida* seems to favour shallow granitic soil (actually colluvium) near outcrops; *Acacia tuberculata* seems to prefer disturbed soil near sheet-like rock outcrops; and both *Stylidium neglectum* and *Pimelea graniticola* live in shallow soil pockets of gritty, loamy sand over granite.
Laterite and duricrust	Czl	Along with the Narrogin bell (*Darwinea carnea*), other endangered plants partial to laterite are: *Grevillea lullfitzii*, *Beaufortia* sp. (undescribed), *Petrophil crispata*, *Acacia heterocroa* subsp. *robertii*, *A. insolita* subsp. *recurva*, *Persoonia hakeiformis* and *Grevillea crawleyae*.
Quartz 'breakaways'		Quartz 'breakaways' are more easily identified on aerial photographs than on geological maps. Both a smokebush— which is the focus of research into a more efficient treatment for AIDS— and *Acrotriche patula* appear to occupy a similar quartzite environment as *Monotoca Leucantha*.
Sandplain	Czs	In addition to *Melaleuca arenaria*, other endangered plants that grow on sand or in sand near laterite are: *Grevillea spinosissima*, *Verticordia gracilis*, *Daviesia rhizomata*, *Dryandra ynaroides*, *Logania exilis* and *Boronia capitata* subsp. *capitata*. Regarding the Boronia, only one population exists; it grows on sand near a sand-laterite contact in the Tutanning Nature Reserve.
Alluvium and colluvium	Qa, Cza Qc	Many endangered plants other than the 'underground orchid' favour various sorts of alluvium and colluvium. Some are: *Acacia lanei*, *Jacksonia* sp. Quairading, *Eucalyptus loxophlebax* x *wandoo*, *Microcorys tenuifolia*, *Stylidium rhipidium*, *Andersonia carinata*, *Gastrolobium densifolium*, *Triglochin stowardii*, *Conospermum scaposum* and *Andersonia bifida*.
Lakes salt flats, and dunes	Ql, Qd	The endangered plant *Phyllota gracilia* was first collected by Drummond in 1845. This plant has not been collected near Narrogin since 1959. If it is relocated there, the probability is that it will grow on a dune or a small rise near drainage lines or playa lakes. CALM's WA Herbarium records indicate *Grevillea wittweri* may occur on sand dunes or sandplain and that *Acacia asepala* grows on rises along old drainage lines.

* *Code letters that appear on geological maps and identify geological formations.*

Granite habitats are unique and include the rock itself, weathered joints or crevices, rock pools and colluvial quartz outwash. Outcrops have their own characteristic vegetation that includes lichens, mosses, shrubs and stunted trees. At the base of some outcrops, like deep pockmarks in the surrounding granite, are unusual water-filled holes, known as a 'gnamma holes.' For millennia during drought, Aboriginal people have turned to these for water.

The threatened species *Isoetes brevicula,* a quillwort, is an interesting inhabitant of granite domes. Because its preferred habitat is so clear-cut, this plant serves as a good example of how geological prospecting works.

Using a database that contains the geology (including rock outcrops) and a location of all nature reserves, one can easily acquire a list of all exposed rocks in an area. The plant may not occur where predicted, but it will definitely occur nowhere else.

Four new quillwort populations that were predicted in this way have been found, bringing to five the number of known populations.

LATERITE AND DURICRUST

Laterite ridges, breakaways and spurs occur throughout the Wheatbelt. Some resist weathering because they are underlain by dolerite dykes. Because the iron content of dolerite dykes in the Wheatbelt is high, they weather to duricrust (cap rocks), ironstone boulders and heavy clays. These products behave like armour in the landscape, causing these features to stand out as surrounding soils are stripped away by erosion.

Laterite soil, on the other hand, is most commonly found in more western regions of the district. The soil is infertile and composed mainly of orange-brown rounded gravel and sands. These remain when granite and other rocks have been weathered and leached for long periods of time. Their lateritic soil profile consists of surface rounded gravels and sands over duricrust, a hardened area of the same material. Under this may be more sand and gravel, grading into mottled white clays. At the bottom of the profile, freshly weathered rock merges into bedrock.

Dryandra spp. in association with certain *Adenanthos, Banksia, Beaufortia,* and *Calothamnus* dominate laterite heath, while blue mallet (*Eucalyptus gardneri*) and *E. argyphea* may grow on heavier clays around breakaways.

The sole population of the rare and beautiful Narrogin Bell (*Darwinea carnea)* grows on top of a harsh laterite spur. Fenced to prevent grazing by livestock, this lone population leads a vulnerable existence in the middle of a farmer's paddock.

QUARTZ 'BREAKAWAYS'

Monotoca leucantha's habitat has been described as 'quartzite' or, as botanist Charles Gardner stated in 1934, 'a quartz soil'. This localised quartz soil and accompanying breakaway is not described on geology maps.

Two of three new populations of *M. leucantha* found near Narrogin were first discovered by identifying their distinctive habitat in the office. Once its environment is recognised, the plant is relatively simple to find because, although the habitat is uncommon, the plant's occupancy seems not to be. Complications may result, however, if the quartzite occurs in a farmer's paddock that is subject to grazing.

SANDPLAIN

Sandplains commonly form an undulating topography over duricrust. They consist of reworked yellow or white sand with sometimes abundant limonite pebbles. Deposits are thinnest on hills, and increase in thickness down-slope where they may merge with colluvium and alluvium. Geologists believe the sand originated from nearby degraded laterite and duricrust.

Many threatened plants grow in the scrub-heath and thicket of dry, leached sandplains. Charles Gardner first collected *Melaleuca arenaria* at

Left (top to bottom): Boronia revoluta has only been found east of the Number 1 Rabbit Proof Fence in the mining areas of Hatters Hill and the Ironcaps.

New populations of *Podotheca pritzelii* were 'discovered' by identifying sand dunes on geology maps.

Acacia heterochroa subsp. *robertii* is a priority plant that likes laterite or an ironstone envirommment.

Herbarium records show that *Monotoca leucantha* grows on a particular type of quartz soil like that of Buckley's Breakaway.

Bendering, near Tammin in 1922. He labelled it 'yellow sand with some gravel'. Other botanists, Leigh, Briggs and Boden, wrote about this plant: 'Presumed extinct and unknown in cultivation. There seems little hope this species will be rediscovered.' As it turns out, to relocate Gardner's plant in the field, one need only drive to a yellow sand patch in a nature reserve, predetermined on a geological map, and open the car door.

Although in different places, *Grevillea roycei*, *Acacia deflexa* and *Loxocarya eludens* grow on sand. Geology and a computer correctly forecast the existence of new populations of these plants in various locations from north-east of Brookton to the Dragon Rocks Nature Reserve south-east of Hyden.

LAKES, SALT FLATS AND DUNES

Most lakes throughout the Wheatbelt were originally freshwater, but following land clearing, salt became a problem. Evaporation forms brine within the sediments and a salt crust crystallises during dry periods. Salt flats are bare or vegetated with samphires.

Low dunes, consisting of quartz sand, occur on the eastern and south-eastern sides of drainage channels and playa lakes (flat, salt areas, flooded in wet weather). Geologists believe the dunes formed during a dry period about 18 000 years ago and were deposited by prevailing winds that blew roughly from the north-west. A mosaic of woodland and shrubland, of eucalypts and melaleucas, grow on dunes.

From CALM's WA Herbarium records, it is evident that *Podotheca pritzelii* grows on sand dunes. Two new populations of this plant were discovered during one field trip, simply by consulting geological maps to locate dunes before visiting the area.

COLLUVIUM AND ALLUVIUM

Colluvium and alluvium form the more clayey soil of slopes and valley floors. Colluvium is a loose deposit, usually found on lower slopes and around breakaways, and deposited there mainly by gravity. Alluvium is a sediment occurring on valley floors, deposited by water in rivers, flood plains and lakes.

Topographic position plays a role in vegetation distribution as colluvium grades into alluvium. Mallee and patches of woodland grow on upper valley colluvium, and woodlands occupy lower, seasonally wet valley loams.

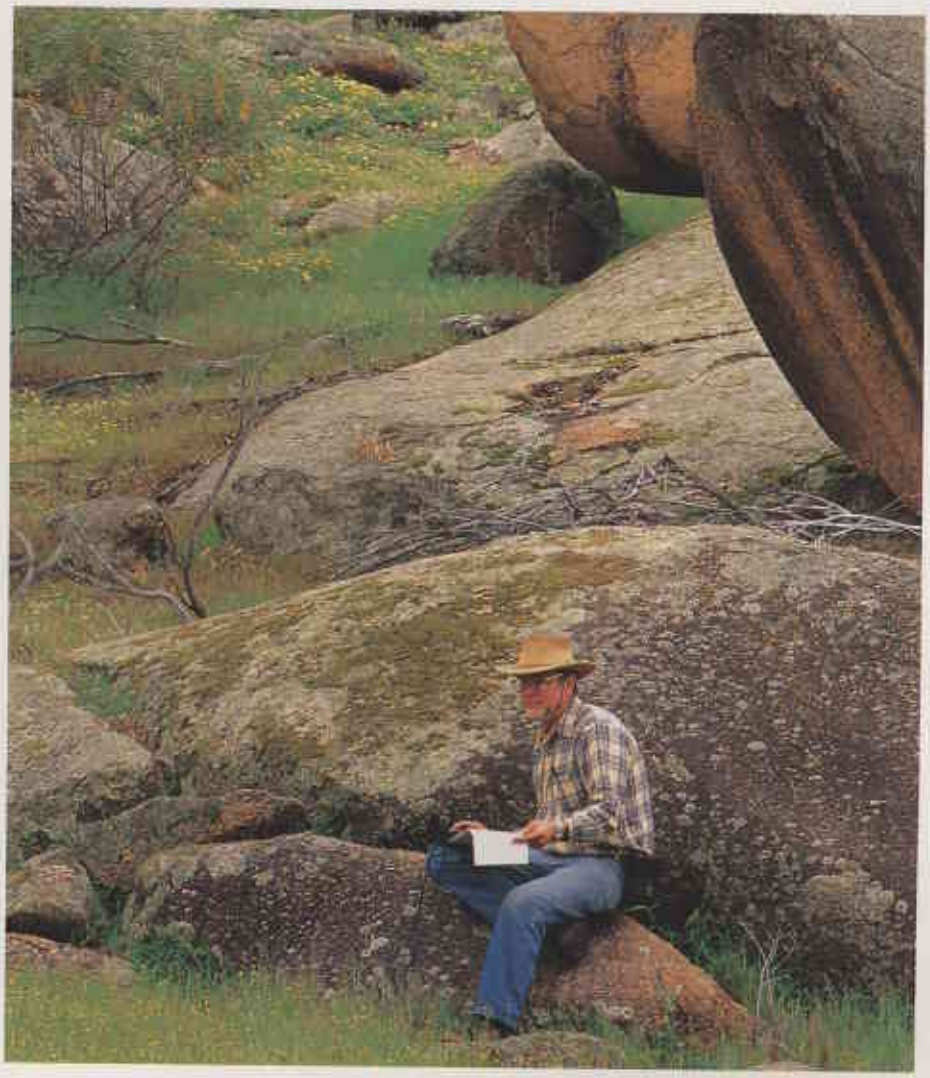
Depending on the parent material, different colluvium and alluvium may exist. For instance, colluvium derived from laterite will be unlike that which forms from granite and will support different plants.

Many endangered plants favour alluvium, colluvium, or a combination of both. Perhaps the most famous is the underground orchid (*Rhizanthella gardneri*). When plotting known locations of the orchid on geological maps, its habitat preference becomes apparent. Once established, the strategy is simple. A computer can list nature reserves, in the area that contain the habitat, and a check of the geological maps will confirm where in the reserve to look. As with all prospecting, there are no guarantees—except one, the thrill of the chase!

MAPPING THE FUTURE

The challenge of plant conservation is to locate and preserve nearly 2 200 rare and poorly known Western Australian plants. Since geology and climate (location) are the basis of a site, we can use them to prospect for plants and to provide us with an inventory of land resources held in nature reserves.

Geology can help us to better visualise the landscape, which leads to a more accurate expectation of what we may or may not find there. By expanding our knowledge of the environment, applied geology can help CALM continue managing Western Australia's resources in an effective and innovative manner.



Rob Buehrig uses geological maps, a satellite navigator (GPS) and compass to locate plant habitats.

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All photos by Jiri Lochman

LANDSCOPE

VOLUME TWELVE NUMBER 2, SUMMER 1996–97

Shannon National Park is the home of the Great Forest Trees Drive, another nature-based tourist attraction for the south-west. Read the story on page 17.

The rugged Kimberley coast was the location of the first maritime LANDSCOPE *Expedition. Read all about it on page 10.*

A huge volunteer effort has helped with the renewal of the Montebello Islands and the eradication of feral animals. (See page 47.)

Science has long-known the relationship between plants and habitats. Now we are 'Prospecting for Plants' using landforms as a guide. (See page 23.)

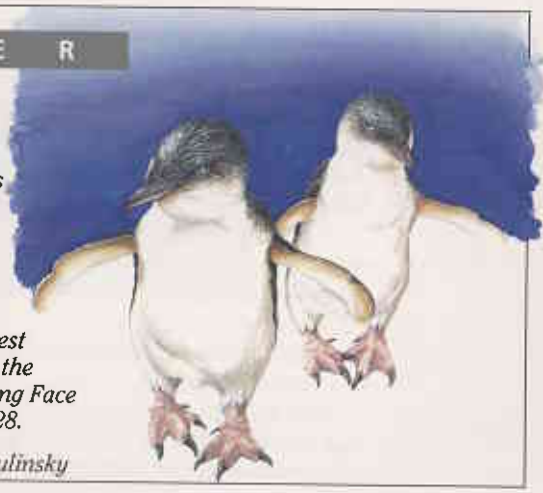
One hundred years ago, two members of an expedition to the Great Sandy Desert became lost. Read what happened to them in 'Land of the Lost' on page 36.

FEATURES

REGULARS

COVER

*The scientific name of the little penguin (*Eudyptula minor*) means 'little diver'. The wings of these flightless seabirds have evolved into flippers for underwater propulsion. The little penguin is the smallest of the 17 penguin species. Penguin Island has the largest colony of little penguins on the west coast. See 'The Changing Face of Penguin Island' on page 28.*



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