THE SELECTION AND ASSESSMENT OF SITES OF GEOLOGICAL AND GEOMORPHOLOGICAL SIGNIFICANCE IN KARST TERRAIN.

Neville Rosengren and Michael McRae-Williams
Department of Geography,
University of Melbourne

During 1979–80, the authors undertook a research programme for the Victorian Ministry for Conservation to identify sites of geological and geomorphological significance in East Gippsland. These sites are considered to be of importance in defining the characteristics of the region, and are therefore of particular or broad interest in research and teaching activities in earth sciences. The purpose of the study was to allow management strategies to be developed for each site that are compatible with the preservation of its scientific properties. The data was required in a form that could be utilised by planning agencies and local government authorities and a high reliance was placed on the presentation of maps, diagrams and photographs (including vertical and oblique aerial photographs).
In writing the report a balance had therefore to be maintained between scientific accuracy and the need to make the data readily interpretable by the above bodies. Justification of site selection was on scientific, not scenic qualities, and qualitative landscape evaluation was not attempted.
The study area (Fig. 1) extended from the Latrobe Valley eastwards to the New South Wales border, and from the coast to the alpine areas of North Eastern Victoria. It included a wide variety of geology and terrain types and because of this diversity, a number of problems were manifest in the early part of the study. The size of the area prevented detailed analysis of little–known localities and this problem was compounded by the uneven quality of existing geological mapping — very little of the area had been geologically mapped at scales larger than 1:250,000 — and geomorphological analysis of any substance was confined almost entirely to the coastal zone. Difficulties were presented by the steep and rugged nature of the highland zone, the presence of seasonal snow cover and the need to negotiate access to private property.
The starting point for the study was a file maintained by the Victorian Branch of the Geological Society of Australia, which recorded sites of geological and geomorphological significance in this State nominated by geologists and others, as of conservation significance. This list was supplemented by extensive consultation with individuals and organisations (such as the V.S.A.) and by thorough literature review. Stereoscopic study of vertical aerial photographs of the entire region (at scales usually 1:30,000) was made to detect unusual patterns or unrecorded features that were subsequently checked in the field. With the exception of most of the underground sites, localities were visited so that exact location data could be given and the principal features recorded by photography. Extensive aerial reconnaissance surveys were made to obtain oblique aerial photographs where these could best illustrate the characteristics of the site (Plates 1, 2). The basis of site identification was the 1:100,000 National Topographic Map Series sheets — each site was defined by one or more six figure grid references and the site boundaries

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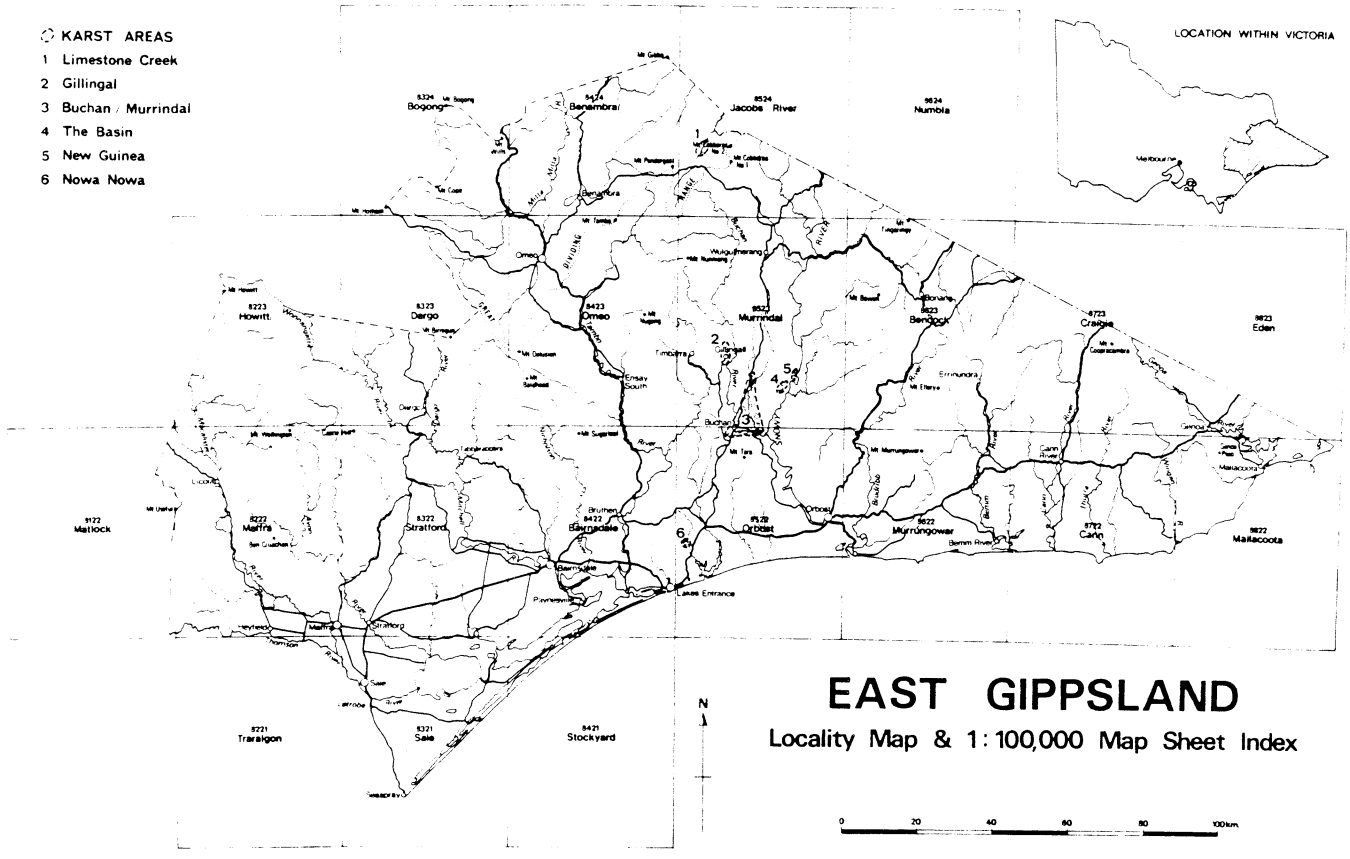

delineated at that scale or at a scale photographically enlarged from those maps.

Site descriptions ranged from a minimum of half a page for minor or unknown sites, to four or five pages for better documented or very important sites. An example of a site description is included as Appendix 1.

The concept of significance of a site is difficult to quantify satisfactorily, as the term 'significance' can be assigned various meanings. The authors' view is that the purpose of this task is to select sites that will display the array of materials, land form, and land-forming processes that comprise the present landscape. Sites may be of interest in that they contain features which are relict from geological processes that are no longer active at that site, while others may be subject to change at a rate that may be measured and analysed over short periods. The specific criteria that were used to select sites (with reference examples from limestone areas) are outlined below.

GEOLOGICAL CRITERIA

(a) An outcrop or exposure which has been used as the type locality of a geological formation, e.g. Buchan Caves Reserve: type site for Buchan Caves Limestone.

(b) A site which displays a contact between geological formations, e.g. Pyramids area: contact between Snowy River Volcanics and Buchan Caves Limestone.

(c) An area with extensive outcrop that displays the lithology or distinctive structures of a geological formation, e g. Buchan–Gelantipy Road 1 kilometre south of Murrindal: Coates Property area.

(d) A site that displays clearly an example of a geological structure, e.g. Anticline Cave: East Buchan Thrust Fault.

(e) Beds containing fossil deposits, e.g. A.P.M. Quarry, Rocky Camp.

(f) Outcrops with mineral deposits from which collectors specimens may be obtained, e.g. W. Tree Opal deposits.

Plate 1: Limestone outcrop — Murrindal (N. Rosengren)

GEOMORPHOLOGICAL CRITERIA

(a) Sites which show the relationship between lithology, structure and landform, e.g. Anticline Cave, Exponential Pot.

(b) Sites which display the action of geomorphological processes, e.g. weathering, erosion, deposition. In some cases the landform may be due to an active and observable process, e.g. tufa terraces on Scrubby Creek Cave Stream, but in others the process may be representative of climatic conditions in previous geological times, e.g. the travertine formations at the Pyramids.

(c) Sites were chosen to be representative of the landforms that occur in East Gippsland. The limestone areas, though small in extent, represent the best example of surface karst and cave development in Victoria, and the Devonian limestone at Buchan is the largest outcrop of karst–forming carbonate rocks in Eastern Australia south of Chillagoe in Queensland.

Plate 2: The Potholes karst area (N. Rosengren)

Sites have been assigned a significance rating as either National, State, Regional, Local or Unknown. The latter category is used when there is insufficient detailed information about the site to allow a significance assessment to be made.
Factors considered in determining the significance rating of a site were:

(a) Frequency of replication, i.e. the site is unique, rare or an unusual example of a geological formation or of surface morphology.

(b) Degree of disturbance and/or quality of outcrop, structure or landform.

(c) Value as a reference and research site which displays classic characteristics of a geological formation and/or a relict or active geomorphological process.

(d) Need for further investigation — where there is doubt as to the nature or origin of the feature, or where little detailed investigation has been undertaken.

(e) Where landforms and/or outcrops provide spectacular landscape.

The actual rating assigned to a site is determined by evaluating the degree to which the five criteria outlined above are fulfilled. For example, a site rated as being of National significance such as Anticline Cave is unique in Victoria, and possibly in Australia as an example of cave form determined by a geological structure. The nature of the site can be readily appreciated by field inspection, and although other aspects of the cave have deteriorated due to visitor pressure, the essential structure of the cave remains undamaged. A site rated as of local significance is simply a clear example of a more common feature, e.g. the outcrop of Buchan Caves Limestones at Butterworths, or South Buchan.

MANAGEMENT

The scientific value of the cave areas will be diminished if:

(a) Infilling or collapse of caves or blocking of cave entrances occurs;

(b) Cave decoration is destroyed through ground vibration, overuse or vandalism;

(c) Changes are made to the hydrological regime or quality of water entering the cave systems;

(d) The function of the caves as habitats for unique and important species of plants and animals is destroyed by changes in the above–mentioned factors;

(e) The important archaeological and palaeontological deposits are destroyed by changes in the above factors.

There has been little scientific investigation of the geomorphology of the East Gippsland limestones and in particular, insufficient work has been completed to establish the extent and quality of caves and the hydrological associations of the cave systems.
Our investigations are not of sufficient detail to allow complete management prescriptions to be formulated for each cave locality. We emphasise that any development that will cause surface or subsurface ground vibrations, or interfere with the air or water flow through caverns or passages, may degrade the cave resource.

APPENDIX. Site 8523-23

8523 (8522) — 23 THE BUCHAN CAVES AREA

LOCALITY:

026497. One kilometre south-west of Buchan township.

ABSTRACT:

Type site for Buchan Caves Limestone. Best known and well decorated passage caves.

ACCESS:

Caves Reserve Road.

OWNERSHIP:

Crown Land Reserve and some private land.

GEOLOGY:

The limestone outcrop which includes the Buchan Caves exhibits the full range of sediment types in the Buchan Caves Limestone, a formation which in this area reaches a thickness of 370 metres. The limestone in general conformably overlies the Snowy River Volcanics, and is separated from the latter by transition beds consisting of sandstone, grits and limestones interbedded with tuffaceous layers. These transition beds (the Spring Creek Member) are exposed in Spring Creek and Eighty Acre Creek. The Spring Creek Member is followed by 30–40 metres of dolomite and dolomitic limestone which are generally poorly fossiliferous. The dolomitic beds are followed by mid–grey to black, fine to medium grained calcarenite, with a high proportion of black calcirudite in the upper part of the formation. Above the dolomitised sediments the limestone becomes increasingly fossiliferous. *Acrospirifer yassensis* occurs lowest down in the sequence and is often found concentrated in well–defined limestone beds. Slightly higher up the sequence, *Campophyllum recessum* appears and occurs in alternating beds with *Acrospirifer*. These two fossil species are characteristic of the middle part of the Buchan Caves Limestone. Within this middle zone some 3 metres above the lowest *Acrospirifer* horizon is a bed unusually rich in ostracod outcrops in Fairy Creek, just south of the Caves Reserve boundary. This bed contains *Aparchites regularis, A. buchanensis, Schmidtella subfabiformis, Sulcella australis* and *Kloedenalla indistincta*. Ostracods are generally more characteristic of the upper part of the limestone sequence where they occur in association with pelecypods and nautiloids. The uppermost 30–40 metres of the limestone sequence is richly fossiliferous with over 30 species of brachiopods, molluscs and corals.

The Buchan Caves Limestone is conformably overlain by the Taravale formation. The latter is well exposed in a road cutting at the entrance to the Caves Reserve. At this locality, the Taravale Formation consists of interbedded mudstones containing various amounts of impure limestone nodules. This formation is particularly susceptible to mass wasting which is well exhibited in the cutting.

GEOMORPHOLOGY:

Well–developed surface karst features do not occur within this area. However, this area is of great significance for its cave development, with seventy–five known caves. It includes the most extensive cave system in Victoria, consisting of Dukes Cave, (B–4), Fairy Cave, (B–5), Royal Cave (B–6), Federal Cave (B–7) and caves B–64 and B–65. This cave system contains between four and five kilometres of stream passage cut at several levels, including areas where it is widened into caverns by block collapse. Some of the best cave decoration known in Victoria is found in these caves. It includes well–developed stalactital and stalagmital forms, pillars, shawls, speleothems, rimpools and helictites together with cave sediments and a permanent flowing stream. Other caves of importance in this area are Moons Cave (B–2), Spring Creek Cave (B–1), Kitsons Cave (B–8 and B–16), Whale Cave (B–20 and B–57), Scrooges Vault and system (B–56, B–67, B–39, B–40 and B–41) and Archivault Cave (unnumbered)

Moons Cave (B–2) was previously used as a tourist cave and consists of a stream passage which is well–decorated in parts and which contains a permanent stream. The water source of the stream is unknown although it is thought that B–32 cave feeds into Moons Cave. It is postulated that additional water enters the system from the Buchan River. Moons Cave is polluted by sewage effluent from the Caravan Park toilet block.

Spring Creek Cave (B–1) consists of a horizontal maze system developed along joint planes, and represents an early phase of cave development. This cave is currently dry and contains bats and vertebrate bone deposits. Kitson Cave (B–8) varies from those described above as its form is controlled by bedding and has developed partially down dip. A similar cave is Whale Cave (B–20 and B–57) which has developed on several levels and contains extensive areas of mudslope and ends in a stream passage. The Scrooges Vault system includes five caves all of which are watercourse–connected. This is a complex system and the lower levels act as a water reservoir collecting water from sources to the south. It is thought that water from this system feeds the Reserve caves. In addition, Scrooges Vault is noteworthy for its excellent cave decoration which includes speleothems and calcite rafts.

REFERENCES:

Stirling (1889), Kitson (1907), Dunn (1907), Swift (1950), Teichert and Talent (1958), Sweeting (1960), Matthews (1968), Nicoll and Brush (1976), White and Davey (1976), O'Shea (1980)

SIGNIFICANCE:

National. Best developed cave system in Victoria. Type area for Buchan Caves Limestone.

MANAGEMENT:

Land use allocation without knowledge of the hydrology of the cave systems has already degraded parts of this important resource. Hydrological studies are in progress on

this system and until these are completed it is not appropriate to recommend detailed management prescriptions for the area. The general recommendations outlined earlier apply to this locality.

The scientific value of the caves is dependent on the maintenance of a stable hydrological system and a high level of water quality. The present Caves Reserve includes only a part of the limestone outcrop in this area and consequently excludes several important caves, and probably the major part of the catchment of the Reserve's cave system. It is thus recommended that the Caves Reserve be extended to include the headwaters of Fairy Creek.