

LAND CLASSIFICATION & TASMANIA'S KARST ESTATE

– A GIS-based Review

– Rolan Eberhard

The development of a network of protected areas clearly plays a critical role in karst conservation, as recognised in the IUCN *Guidelines for Cave and Karst Protection*, which stress the need for declaration of areas 'under legislation which provides secure tenure and active management' (Watson *et al.* 1997). The proportion of karst within protected areas is therefore a potentially useful measure of the conservation status of the karst estate within a given region or State. However, it is crude measure because some protected areas are poorly managed or because important sites are excluded.

Tasmania's karst estate is scattered across some 300 areas of carbonate rock, occupying in the order of 400,000 ha or about 6% of the State (Figure 1). The host rocks are dominated by Precambrian dolomites (178,300 ha) and Ordovician limestones (135,400 ha), together accounting for about 75% of carbonate rocks on the island and most of its karst. There are also sizeable areas of karstic Pleistocene aeolian calcarenite (29,000 ha) and Tertiary marine limestone (15,600 ha). Karstic magnesite is present but limited in extent (385 ha). Permo-Carboniferous limestones (21,700 ha) and Siluro-Devonian limestones (30,700 ha) are reasonably extensive but, with a few exceptions, rarely karstified.

These totals, and much of the content of this article, are based on information derived from a digital map known as the Tasmanian Karst Atlas v3.0. This is a more recent version of earlier paper maps prepared by Kiernan (1995) for his report *An Atlas of Tasmanian Karst*. Kiernan's maps were based on the latest geological maps available at that time and a variety of other sources. The karst layer was digitised by Forestry Tasmania in the mid 1990s and later updated by Sharples (2003).

Kiernan (1995) classified the degree of karstification of carbonate rocks and strata containing carbonate rocks into four categories:

Category A: Intensely karstified or probably intensely karstified

Carbonate rock formations known to be highly susceptible to karstification; on the basis of existing knowledge well developed karst is to be anticipated.

Category B: Substantially karstified or probably substantially karstified

Carbonate rock formations known to be susceptible to karstification; on the basis of present knowledge karst is more likely to occur than not.

Category C: Partially karstified or potentially partly karstified

Carbonate rock formations that may be susceptible to some forms of karstification or within which some karst may be present within specified horizons, topographic situations or in response to other environmental factors.

Category D: Possibly partially karstified

Rock formations that are not predominantly carbonate but which contain subordinate carbonates within which karst may have evolved; in cases where there is a high likelihood that carbonates occur within more extensive formations that have not been sufficiently differentiated in geological mapping to allow the specific localities to be indicated, the whole area of undifferentiated rocks has been recorded as Category D pending clarification.

Applied at the karst area level, this system necessarily involves generalising about degrees of karstification, which may vary considerably within a given area. Some karst areas have been surveyed in sufficient detail to map these variations, but this is only true in a limited number of cases.

Tasmania's best developed karst and the majority of caves occur within Category A karst areas, mostly Ordovician limestones and Precambrian dolomites. Category A karst accounts for about 31% of all carbonate rocks on the island. Category B karst areas are known to be cavernous at some sites, although karst development may be relatively subdued and is yet to be confirmed in some instances. Category B karst areas comprise about 42% of carbonate rocks. The partially and possibly karstified Category C and D karst areas contribute 6% and 20% respectively.

Table 1 summarises current land classification arrangements for the different karst categories. Some 70% (290,500 ha) of Tasmania's carbonate rocks are on public land, the lion's share in reserves managed by the Parks & Wildlife Service. The PWS is responsible for 44% of all carbonate rocks, including 69% of Category A karst. Excluding the Tasmanian Wilderness World Heritage Area (WHA), key reserves for karst include the Gunns Plains Cave State Reserve, Leven Canyon Regional Reserve, Vale of Belvoir Conservation Area, Trowutta Caves State Reserve, Mole Creek Karst National Park, Great Western Tiers Conservation Area, Reynold Falls Conservation Area, Lake Beatrice Conservation Area, Mt Field National Park and Hastings Caves State Reserve.

Much of the karst managed by the PWS is in the WHA, which takes in all or part of some 84 areas of carbonate rock. More than half of these areas are Category A karsts, accounting for 92% of Category A karst managed by the PWS (63% of Category A karst for the State as a whole). The WHA includes high profile karst areas and popular caving venues, such as Marble Hill (Ida Bay) and parts of the Mole Creek karst. It also includes other large and important karst areas too numerous to name. Karst and karst-related values were a cornerstone in the recognition of this part of Tasmania as a World Heritage property, being cited under six of the seven World Heritage criteria addressed in the Australian government's nomination to UNESCO.

State forest (including Forest Reserves) also contains sizeable areas of karst – 15% of Category A karst and 20% of carbonate rocks in all categories. Category A karsts partly under State forest occur at Gunns Plains, Loongana and Mole Creek in the north, and Junee-Florentine, Riveaux, Cockle Creek, Hastings and Marble Hill in the south. Nearly half of the area of carbonate rock in State forest is Category B karst. The extensive dolomite karstlands of northwest Tasmania account for much of the category B karst on State forest, in addition to numerous smaller areas of karstified dolomite and to a lesser extent limestone in the south and west.

A meagre 5% of Category A karst on State forest is classified as Forest Reserves – a surprising result given the presence of some outstanding elements of karst geodiversity on State forest. Forest Reserves on Category A karst include two in the Mole Creek area, where approximately 550 ha of karst is reserved at Tailender Cave and Dogs Head Hill-Standard Tier, and the Lady Binney Reserve, which takes in ~350 ha of the Junee-Florentine karst. Category B karsts are more adequately represented in Forest Reserves – about

20% of Category B karst in State forest is reserved in this way, mostly in north-west Tasmania and including some important features such as Lake Chisholm and the Julius River caves.

Some 13% of Category A karst is on private land (part of circa 30% of carbonate rocks in all categories on private land). This is a significant result when one considers that the conservation status of these areas is strongly dependent on the attitude of the landowner (notwithstanding various statutory and administrative arrangements that apply on private land). The areas involved are virtually all in northern Tasmania: Mole Creek, Vale of Belvoir, Loongana, Gunns Plains and Flowery Gully. Private land contains by far the largest proportion of Category B karst of the various tenure classes – 48%. This reflects the existence of large private holdings on aeolian calcarenite on King Island and Flinders Island, Precambrian dolomite in northwest Tasmania and Ordovician limestone around Dairy Plains in northern Tasmania. These karstlands are associated with subdued terrain and deep soils favoured for agriculture – they are poorly represented within the reserve system.

Land Classification	Karst Category (ha)				TOTAL
	A	B	C	D	
PWS Reserves	89,063	31,537	7,133	53,178	180,912
Forest Reserves	949	7,547	1,987	4,867	19,353
State forest	18,914	30,851	3,611	11,349	64,725
Private land	17,339	83,320	11,917	10,029	122,605
Other	3,172	19,241	858	4725	23,992
TOTAL	129,437	172,496	25,506	84,149	411,588

Table 1: Land classification and karst categories in Tasmania as at February 2007. Other = public reserves, unallocated Crown Land, land vested in HEC, etc. Karst areas from Tasmanian Karst Atlas v3.0 (Sharples 2003). Land classification based on theLIST data (DPIW).

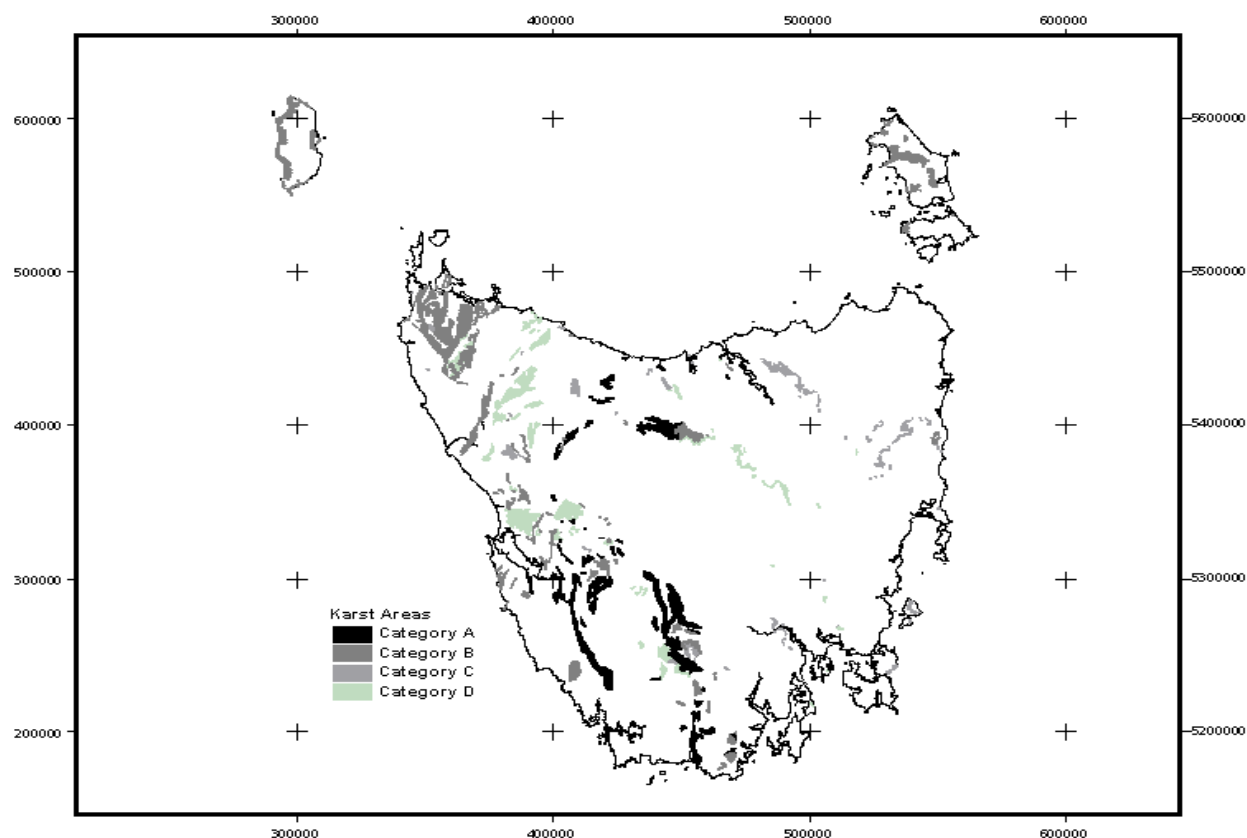


Figure 1: Karst in Tasmania. Karst areas from Tasmanian Karst Atlas v3.0 (Sharples 2003). Base data from theLIST, © State of Tasmania.

Table 2 provides a breakdown of karst categories with respect to Tasmania's CAR Reserve System (Figure 2). The concept of a CAR Reserve System ('Comprehensive, Adequate, Representative') goes back to the National Forest Policy and the State-Commonwealth Regional Forest Agreement (RFA) process of the 1990s. The CAR Reserve System includes areas formally dedicated for conservation, such as National Parks, as well as informal reserves such as Protection Zones on State forest, which are reserved as a matter of policy. Private land under secure management agreement is also considered part of the CAR Reserve System.

One of the defining characteristics of the CAR Reserve System is that it does not provide a uniform level of security for the values it contains. Informal reserves such as Protection Zones on State Forest can be created, modified or revoked by the land manager, provided Tasmania's commitments concerning reservation levels for CAR values are not compromised. Some elements of the CAR Reserve System are subject to Tasmania's *Mineral Exploration Development Act 1995*; dedicated formal reserves are an exception

in this regard. Tasmania. Similarly, the *Tasmanian Reserve Management Code of Practice* (PWS *et al.* 2003), which sets out standard practices for reserve management, does not formally apply to all parts of the CAR Reserve System.

The CAR Reserve System is structured around a concept of CAR values, as defined in the 'JANIS Report', which proposed national criteria for the conservation of forest biodiversity, old-growth forests and wilderness. The JANIS Report recommended that the CAR Reserve System should encompass 15% of the pre-1750 distribution of each forest ecosystem, 60% of old-growth forest and 90% or more if practicable of high quality wilderness. These reservation targets underpinned the RFA process and critically influenced the shape of the resultant reserve system. Karst was never a driver in the process, despite having a high profile in forest management in Tasmania. Where karst did get reserved under the RFA – and some important gains were made – this seems to have mostly been incidental to decisions based primarily on CAR values.

	Karst Category (ha)				
	A	B	C	D	TOTAL
Dedicated Formal CAR Reserves					
National Parks	83,157	20,228	4,763	23,344	131,491
State Reserves	153	617	19	3	792
Nature Reserves	40	61	97	0	198
Game Reserves	65	0	0	0	65
Historic Sites	0	493	0	0	493
Wellington Park	0	0	47	0	47
SUBTOTAL	83,415	21,399	4,925	23,346	133,086
Other Formal CAR Reserves					
Conservation Areas	3,650	6,527	16	8,833	19,026
Regional Reserves	364	4,006	1,971	19,711	26,052
Nature Recreation Areas	1,699	1,479	0	0	3,178
Forest Reserves	949	7,547	1,987	4,145	14,629
SUBTOTAL	6,662	19,560	3,974	32,690	62,885
Informal CAR Reserves					
Informal Reserves on State Forest	4,317	10,767	1,052	5,051	21,187
Informal Reserves on Other Public Land	89	1,179	293	1,420	2,981
SUBTOTAL	4,406	11,945	1,345	6,471	24,167
Private CAR Reserves					
Private Nature Reserves & Private Property Conservation Covenants	33	0	0	0	33
Private Sanctuary & Private Property Conservation Covenant	15	0	21	0	36
Private Property Conservation Covenant	282	178	28	55	543
Other Private Land Within the WHA	715	0	0	0	715
Other Private Reserve	57	654	248	96	1,055
SUBTOTAL	1,102	832	298	151	2,382
TOTAL	95,585	53,735	10,542	62,658	222,520

Table 2: Karst and the CAR Reserve System in Tasmania as at February 2007. Karst areas from Tasmanian Karst Atlas v3.0 (Sharpley 2003). CAR Reserve System from theLIST (DPIW).

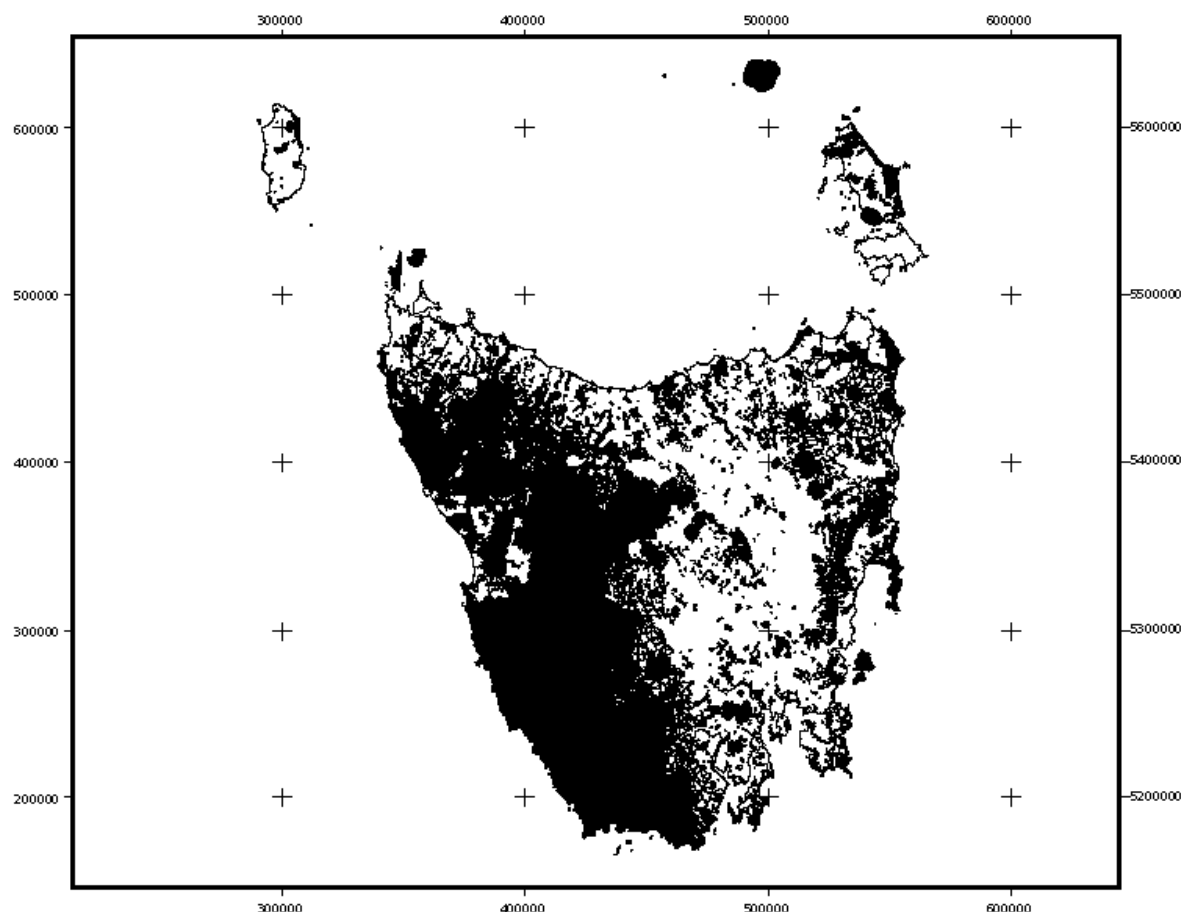


Figure 2: Tasmania's CAR Reserve System. Base data from **theList**, © *State of Tasmania*.

The 10 years since the Tasmanian RFA came into effect have witnessed various initiatives directed at achieving better protection of karst values through reservation, particularly on private land.

Programs to purchase or covenant karst on private land have delivered mostly small but nonetheless important reserves in northern Tasmania.

The government has also purchased a sizeable area of cavernous karst near Montagu in northwest Tasmania. An additional ~135,000 ha of forested public land was reserved under the 2005 Community Forest Agreement (CFA), which revisited aspects of the RFA in response to intense lobbying from various disgruntled stakeholders. The extended CAR Reserve System potentially includes additional areas of karst, although gains appear to be fairly minor.

The CAR Reserve System presently takes in about 54% of carbonate rocks in Tasmania. At this point I should correct an earlier statement that a figure of 70% applied in 2003 – an error due to sloppy maths on my part (Eberhard 2003). However, the CAR Reserve System does include about 74% of Category

A karst, mostly in dedicated formal reserves managed by the Parks & Wildlife Service. About 12,000 ha (13%) of Category A karst is informally reserved in areas available for mineral exploration. Informal reserves such as protection zones on State forest and numerous generally small public reserves on other Crown land cover

approximately 3% of Category A karst. Many of these reserves are Protection Zones on State Forest, the Junee-Florentine karst accounting for the bulk of these (~3620 ha). Less than 1% of Category A karst is located on private land subject to private reserves, conservation covenants and the like.

This includes reserves in the Mole Creek, Gunns Plains and Loongana areas, as well as privately owned karst in the WHA. The WHA's private karst comprises Gordonvale in the Vale of Rasselas (~76 ha karst) and land vested in the Aboriginal community totalling ~535 ha karst in the Maxwell River, Franklin River and Carcroft areas.

It would be clear by now that this sort of analysis is great for generating statistics of the kind that come in handy in an age that likes reporting on the state of things, quantitatively and often. But are the numbers particularly meaningful?

The fact that nearly three quarters of Category A karst is reserved (albeit under land classifications offering varying degrees of security) is an encouraging result on the face of it.

However, much depends on which areas are reserved and where the boundaries lie. A more useful analysis would incorporate procedures for characterising the diversity of karst systems.

Landform classification for geoconservation entails various practical and conceptual difficulties (Southberg 1990), although some progress has been made. Kiernan (1995)

developed karst 'species lists', an analogue to the Linnaean system for classifying living organisms. Eberhard (2004) used the environmental controls of lithology, topography and climate to classify Tasmania karst areas into 110 'types', an approach that parallels a more sophisticated analysis of environmental variables considered in identifying landscape units that control Tasmanian river geomorphology (Jerie *et al.* 2003).

The development of an agreed classification for karst systems would be a potentially useful tool in identifying conservation priorities. On the other hand efforts to address some glaring omissions in the reservation status of certain karst systems – for example Croesus Cave and Lynds Cave at Mole Creek – require no higher justification, and it is disappointing that opportunities to rectify

this situation were squandered by the RFA and CFA.

The aforementioned caves are only two of about a dozen 'cross-tenure caves' at Mole Creek ie. caves that extend across the boundary between areas managed by the Parks & Wildlife Service and State forest or private land. Similarly, the western margin of the Mt Field National Park overlies passages in at least half a dozen major caves that are partly on adjoining State forest.

Arrangements of this kind are not conducive to consistent management of the caves, particularly as Forestry Tasmania has failed to address cave-based activities in State forest in any systematic way; nor does the situation provide the security of tenure appropriate to the significant karst landforms affected.

REFERENCES

- Eberhard, R., 2003; A few thoughts on some Tasmanian issues; *ACKMA Journal* 52: 13-17.
- Eberhard, R., 2004; *A Desktop Assessment of Groundwater Dependent Ecosystems in Tasmania*, report to Water Development Branch, Department of Primary Industries, Water & Environment, Tasmania.
- Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-committee, 1997; *Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative Reserve System for Forests in Australia*, Environment Australia, Canberra.
- Jerie, K., Houshold, I. & Peters, D., 2003; *Tasmania River Geomorphology: Stream Character and Regional Analysis*, Nature Conservation Report 03/5, Department of Primary Industries, Water & Environment, Tasmania.
- Kiernan, K., 1995; *An Atlas of Tasmanian Karst*, Tasmanian Forest Research Council Inc., Report No. 10.
- Parks & Wildlife Service, Forestry Tasmania and Department of Primary Industries, Water & Environment, 2003; *Tasmanian Reserve Management Code of Practice*, Department of Tourism, Parks, Heritage & the Arts, Hobart.
- Sharples, C., 2003; *Data Dictionary and Metadata for the Tasmanian Karst Atlas V. 3.0 (2003) Digital Dataset*, prepared for Forestry Tasmania and Department of Primary Industries, Water & Environment, Tasmania.
- Southery, T.L., 1990; *Towards a Descriptive Geomorphic Classification System for Nature Conservation Purposes*, Department of Parks, Wildlife & Heritage Occasional Paper No. 23, Tasmania.
- Watson, J., Hamilton-Smith, E., Gillieson, D. & Kiernan, K., (Eds.) 1997; *Guidelines for Cave and Karst Protection*, IUCN, Gland, Switzerland and Cambridge, UK.

