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Managing tourism and recreation on Wheatbelt granite outcrops

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Abstract

The conservation estate in the Western Australian wheatbelt is largely biased toward small remnants featuring either granite outcrops or salt lakes. Due to the high level of clearing for agriculture, these areas provide the primary resource for recreation in the natural environment. Although few sites receive more than 1 000 visitors per year, recreation impacts on natural and cultural values can be considerable. Potential recreational impacts on granite outcrop reserves include changes to soil structure, hydrology, vegetation, fauna, heritage and aesthetic values. These may be exacerbated by factors external to the reserve and the small buffer areas surrounding many granite outcrops.

Impacts associated with low level but widespread use of remnant vegetation were the subject of a study in CALM's Merredin District. Sixty sites managed by various agencies were surveyed with the aim of (a) identifying those most appropriate for recreation and tourism and (b) liaising with the relevant agencies over future development and management. Each site was ranked for recreation / tourism suitability by assigning numeric values to physical attributes, threats and uses, and current and future management. The study recommends concentrating development and management effort within the top 21 sites, and restricting recreation on the remainder. Several authorities have used the results of the study to support funding applications for recreation development.

Keywords: granite outcrops, recreation impacts, wheatbelt, management, habitat alteration, assessment

Introduction

The Western Australian wheatbelt is typical of other agricultural regions throughout the world, in that it has been largely cleared (93% in the central wheatbelt; Beard & Sprenger 1984) and flora and fauna persist primarily within small Crown reserves. The Wheatbelt Region of the Department of Conservation and Land Management (CALM) encompasses much of this area; the 'Wheatbelt', 'Wheatbelt Region' or 'Region' refer to CALM's Wheatbelt Region. Forty-three local government authorities (LGAs) have their administrative boundaries wholly or partly within the Region.

There are over 6 300 Crown reserves within the Wheatbelt. Fifty-five per cent are under five hectares, and 72 per cent less than 20 hectares. Approximately 2 500 are unvested (*i.e.* they have no managing authority), the Water Corporation, the Waters and Rivers Commission and LGAs manage approximately 3 100, and CALM manages 625. Most CALM-managed reserves are vested in the National Parks and Nature Conservation Authority (NPNCA) as nature reserves with a purpose of conservation of flora and fauna. The *Wildlife Conservation Act* (1950) and *Wildlife Conservation Regulations* (1970) provide the enabling legislation for the management and control of nature reserves. The legislation excludes most recreation activities, including camping and lighting fires in other than designated fireplaces. CALM's Recreation and Tourism Policy Statement provides further guidelines on the appropriateness of recreational activities on nature reserves.

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Nature reserves in the Wheatbelt Region are heavily biased towards granite outcrops, lateritic breakaways, and salt lakes and associated habitats. Median reserve size is only 114 hectares, which exposes remnants to external influences such as increased radiation, wind and water fluxes, and chemical drift from farmland (Saunders et al. 1991). These impacts are exacerbated by the use of the reserves for recreation. Local people, who have little opportunity for 'natural' recreation experiences on private property, are the main users (Plate 1), although some tourism also exists. Recreation and tourism are often used synonymously to describe leisure activities taken for pleasure and personal satisfaction (Pigram 1983). A commonly used definition to distinguish between them is that a tourist is a recreationist who has traveled more than 40 kilometres and stayed overnight away from his or her normal place of residence. In terms of environmental impact, there is very little difference

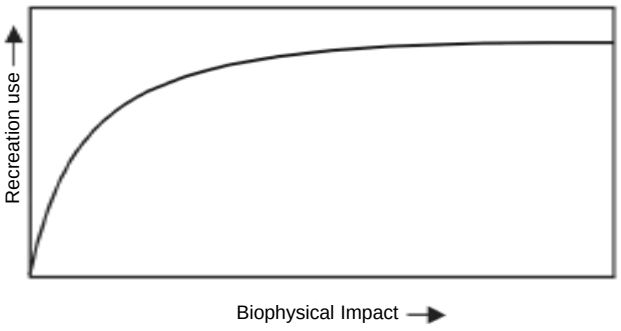

Figure 1. Visitor use *vs* level of impact (modified from Hammit & Cole 1987, and Cole 1993).

between the two. The main tourism attraction in the Wheatbelt is Wave Rock near Hyden, which attracts in excess of 100 000 visitors per year to view the unusual rock formation. CALM is also supporting a feasibility study of a tourism attraction based on black-footed rock wallabies (*Petrogale lateralis*) in the Wheatbelt. Although most reserves are subject to only low levels of recreation (mainly picnicking), the fragility of granite outcrop ecosystems in particular has led to significant degradation at many sites.

The effects of recreation on natural areas

Relatively few sites in the Wheatbelt receive more than 1 000 visitors per year (Moncrieff 1996). However, the level of impact upon natural, cultural and aesthetic values is not necessarily proportional to visitor numbers or the length of time a site has been used. Hammitt & Cole (1987) and Cole (1993) described the biophysical impacts of increasing visitor numbers over time, and found that even small increases in use could have a pronounced effect when visitation rates were low (see Fig 1). This should not, however, be considered in isolation; the timing, location, and type of use are also critical (Lindberg *et al*. 1996).

Cole (1993) described the impacts of recreation on four elements of natural systems, soils, vegetation, fauna and water. To this must be added cultural values, including Aboriginal and non-Aboriginal heritage, aesthetic quality and recreation itself. Impacts to these elements are described in general terms below, with specific reference to Wheatbelt granite outcrops.

Natural values

Soils

Soil can be affected by pedestrian, vehicular and animal traffic (*e.g.* horse-riding). Trampling causes soil compaction and loss of the organic surface layer, necessary for biological activity and water absorption (Cole 1993). Preservation of the organic layer is extremely important for a number of reasons, *viz*;

- the role it plays in biological activity;
- it increases the absorptive capacity of the soil;
- it provides a source of nutrients for plant growth; and
- it is more resilient to erosion than underlying mineral soils.

Loss of the organic layer allows soil compaction which reduces the air spaces between soil particles and hence infiltration capacity (Monti & Mackintosh 1979). This, in turn, leads to reduced access to water and nutrients by plant roots, reduced seed germination, and loss of soil-dwelling biota (Cole 1993). The latter play an important role in the development of soil structure and nutrient cycling. Vegetation loss, soil compaction and loss of infiltration also increase surface water runoff and hence erosion potential. This is a particular problem on thin, poorly structured soils found around the base of granite outcrops (Plate 2).

Vegetation

The vegetation of a typical Wheatbelt granite outcrop has been described by Piggot & Sage (1997) for Yilliminning Rock. They described seven vegetation associations, including Low Woodland and Woodland supporting wandoo (*Eucalyptus wandoo*) and salmon gum (*E. salmonophloia*). These vegetation types are typical of better soils and have been extensively cleared for agriculture. Remnant patches of woodland associated with granite outcrops therefore contribute significantly to nature conservation (Withers & Edward 1997). However, woodland sites also tend to be favoured as sites for recreation, providing shade, scenic beauty, and firewood for barbecues (Plate 3). The small size of these remnants, the dominance of the granite massif within many reserves, and an often large perimeter to area ratio lead to woodland remnants being even more susceptible to external influences, such as weed invasion on soils disturbed by recreation.

Loss of vegetation is one of the most obvious signs of unsustainable site use. Informal access, firewood collection and wanton vandalism can all lead to decreased plant vigour, expressed through changes to plant biomass, composition, cover and structure (Plate 4). Visitors, vehicles and horses can also spread weed seeds (Buckley & Pannell 1990; Lonsdale & Lane 1991; St John Sweeting & Morris 1991) although in the Wheatbelt this is likely to be of minor consequence in comparison to weeds invading from adjoining agricultural land. Of greater concern is dieback, a soil-borne fungus (*Phytopthora* spp) spread by water, pedestrians and vehicles. Pedestrian and vehicle bans have been instigated in many sites in the wetter parts of the Western Australia (*e.g.* Stirling Ranges). The low rainfall in the Wheatbelt is generally not conducive to dieback, although granite outcrops may be susceptible due to their water-gaining capacity. For example, dieback has been recorded at Moorine Rock, 80 kilometres east of Merredin (Hussey 1997).

The diversity of microhabitats on granite outcrops has led to a high level of floristic endemism. Hopper *et al.* (1997) found 16% of orchids and 24% of eucalypts on south-western granites were endemic. Granites also contribute 32 taxa (9.8%) to the State's threatened flora list (Brown *et al.* 1998).

Fauna

Cole (1993) described the manner of impacts on wildlife as either consumptive (*e.g.* hunting or fishing) or non-consumptive. Non-consumptive impacts include;

- habitat modification
- pollution / littering; and
- direct disturbance when recreationists approach too close to wildlife.

In a review of 166 cases of non-consumptive human-wildlife interactions, Boyle & Samson (1985) determined 82 per cent of impacts were negative. The most damaging pursuits were off road vehicle use (95% of studies), hiking and camping (79%) and wildlife observation and photography (74%). The latter result is interesting, as wildlife observation and photography are commonly thought of as relatively benign pursuits. Knight & Cole

Plate 1. Farmhouse adjacent to granite outcrop. Rocks such as this provide the main natural recreation areas for many wheatbelt families.

Plate 2. Erosion caused by vehicle traffic, Yorkrakine Rock.

Plate 3. Picnic site typical of many granite outcrops throughout the wheatbelt. Yilliminning Rock.

Plate 4. A carpark at Yorkrakine Rock, an area once covered by Jam (*Acacia acuminata*) woodland.

Plate 5. Exfoliated granite sheets smashed by visitors, Yilliminning Rock.

Plate 6. Rock-covered gnamma near Narrogin.

Plate 7. Rock catchment wall at Wave Rock, a common sight on many wheatbelt granites.

Plate 8. Graffiti at Yorkrakine Rock.

(1995) identified the very nature of the activity as potentially damaging; avid wildlife watchers and photographers seek out rare or charismatic species, often at sensitive times of the year (*e.g.* breeding), and actively approach animals for better photographs.

Habitat modification includes loss of vegetation required by animals for food, shelter or nesting, or the creation of artificial barriers to small wildlife (*e.g.* walking tracks). An excellent example of the problems associated with littering is provided by the former black-footed rock wallaby colony on Kokerbin Rock near Kellerberrin (WA). Kinnear (CALM, pers comm) found that captured animals invariably had cut feet from broken glass.

Direct disturbance to wildlife is usually only temporary, and animals return within several hours. However, there may be a major impact when animals are living under stressful conditions. Permanent relocation of large mammals has been documented for some North American species (Geist 1978, cited by Cole 1993), and could potentially happen to the isolated rock wallaby colonies on central wheatbelt granite outcrops if visitors are allowed random access.

The two main existing recreational impacts on Wheatbelt granite outcrop fauna are;

- the wanton destruction by visitors of exfoliated granite sheets around granite outcrops (Plate 5). These are often smashed into smaller pieces, and occasionally used to construct cairns on outcrop summits. Intact sheets provide habitat for numerous reptiles; and
- habitat loss through the combined effects of soil compaction, shrub loss and firewood collection in woodlands.

Withers & Edward (1997) described the terrestrial fauna of granite outcrops in Western Australia. Although few species were restricted to granite outcrop habitats, many species were found to use them. They reasoned that granite outcrops were important as seasonal resources or temporary refuges for the fauna of surrounding habitats, and urged the conservation of the ecotone between the granite outcrop itself and the surrounding habitats

Water

The distribution and quality of water can be impacted by recreation, most commonly by addition of pollutants / nutrients through toilet wastes and washing, increased runoff and erosion from compacted soils, and deposition of sediments into waterways (Anderdeck 1994; Buckley & Pannell 1990). While the impacts of the latter two processes tend to occur as part of a process over time, pollution or fouling of gnammas can be instantaneous. Particularly susceptible is the aquatic vegetation and invertebrates found in gnammas, including one taxa of Declared Rare Flora. For example, Bayly (1992) attributed the high pH of one gnamma to the cement mortar used in rock wall construction to raise the level of the pool. A simple act such as bathing with soap could have a profound impact by altering nutrient balances.

Cultural values

Aboriginal Heritage

Bindon (1997) provided an excellent summary of the significance of granite outcrops to Aboriginal people. Granite outcrops provided hunting and gathering opportunities, religious and ceremonial use, and art sites. Gnammas provided an indispensable source of water, permitting occupation of otherwise inhabitable country. Covering gnammas with flat sheets of exfoliated granite protected water from evaporation (Plate 6; Mountford 1976, in Bindon 1997)

Outcrops also provided opportunities for hunting and gathering unavailable elsewhere. One of the most obvious examples is the lizard fauna common to outcrops. Bindon (1997) mentions evidence of 'lizard traps' on a number of south-west granites, although he concedes the function of these traps cannot be confirmed.

The significance of granite outcrops to Aboriginal religious beliefs and art can be demonstrated by using the example of Wave Rock. A dreaming story tells of an evil spirit woman who stole Aboriginal children to feed to her husband, Mulka. Mulka lived in what is now called Mulkas Cave near Wave Rock, leaving evidence of his existence through the handprints found on the ceiling of the cave. When the spirit people tried to stop the evil spirit woman from stealing the children, she leapt into the sky with the help of Hyden Rock, which was soft and acted as a trampoline (Morrison *et al.* 1993).

The significance of granite sites in dreaming stories led to their frequent use for ceremonial purposes. Stone arrangements, utilising slabs of exfoliated granite or other weathered products, often mark the sites. Unfortunately, they are very prone to vandalism and can be destroyed by simply shifting the stones. The integrity of lizard traps and rock-covered gnammas can similarly be destroyed. Aboriginal artwork can suffer a similar fate through carelessness or deliberate vandalism. In Hippos Yawn near Wave Rock, artwork on the ceiling of shelter was vandalised by graffiti. In removing the offending graffiti, Aboriginal hand stencils were also sandblasted off. Some of the hand stencils in Mulkas Cave are close enough for visitors to touch and, despite interpretive and warning signs, could easily be vandalised.

Non-Aboriginal heritage

Many Wheatbelt granite outcrops have been used as a source of water by explorers and for agricultural settlement. These take the form of wells and rock-walled catchments that channel rainfall runoff from the bare rock surface into catchment dams. Wells dug at the base of granite outcrops along natural drainage lines are common throughout the Wheatbelt (*e.g.* at Kokerbin Rock, Totagin, and Korrelocking). These features were often covered to reduce evaporation and fouling by animals. However, their integrity is often threatened by vandalism from visitors; invariably rubbish and timber is thrown in, and the fabric around the top of the wells, including the covers, is damaged.

Granite outcrops and their rock-walled catchments were the primary source of water almost all Wheatbelt towns. Perhaps the best known of these in Wave Rock, where the wall runs along the top of the 'wave' itself

(Plate 7). Although damage from recreationists at such a public site is unlikely, a small disused catchment at nearby Graham Rock has been largely destroyed. Other disused catchments have been similarly treated.

Aesthetic values

Limited research is available on the attractiveness of Wheatbelt landscape features. Stuart-Street & Kirkpatrick (1994) described the Wheatbelt landscape as being characterised by pastoral fields, expanses of cereal crops and wide open views, often unobstructed by remnant vegetation. Areas of highest scenic quality included;

- major rock outcrops;
- vegetation with a diversity of species, height and density;
- strong form, colour and texture contrasts with surrounding landscape (*e.g.* clumped remnant vegetation);
- distinctive stands of vegetation with strongly defined growth habits, texture and colour (*e.g.* Salmon Gum and other woodlands); and
- dramatic displays of seasonal colour.

All of these landscape components are common features of granite outcrops and their surrounds, reinforcing the importance of granite reserves as a major contributor to aesthetic quality in the Wheatbelt. However, their prominence, fragility, common use for recreation, and the familiarity of local people to site detail mean that visual quality can be easily diminished. For example, a yellow rubbish bin on top of one granite outcrop near Bruce Rock is visible from the surrounding countryside for over a kilometre. Vehicle tracks on moist soil on outcrop aprons can leave a visual scar lasting for decades. Graffiti is even longer lasting, as evidenced by that accumulated over many years at Yorkrakine Rock near Kellerberrin (Plate 8).

The retaining walls built to divert water for storage are common visual scars on many Wheatbelt granite outcrops. The best known of these is at Wave Rock. The impacts of such walls are threefold;

- they reduce visual quality;
- walls are typically constructed using exfoliated granite, reducing animal habitat; and
- the hydrological systems on granites are altered, potentially impacting on vegetation associations and animal habitats.

Conversely, the water catchment systems have played a vital part in the development of the Wheatbelt and even where no longer functional, retain heritage value.

Reducing the impacts

It is acknowledged that, apart from the tourism industry associated with Wave Rock, most sites are used by local people. This poses a particular problem for managers in determining whether sites are used primarily because of their proximity, or their features. Herbert & Schmidt (1982), in a survey of visitors to the Darling Plateau forest to the immediate west of the Wheatbelt, found that;

- 46% of those surveyed chose a particular site due to its landscape amenity and site features;
- 9% for the activities they could undertake;
- 17% for psychological or social reasons; and
- 22% for the facilities present.

The last category was further subdivided into seven criteria, including accessibility and availability and type of facilities present. Of responses in this group, 61% (or 13.6% of the total surveyed) considered the availability of facilities to be paramount, whereas only 20% (4.4% of the total surveyed) rated access as most important. If these findings apply to the Wheatbelt, it is possible that although current use may be due to a site's proximity to the local population, use would decrease if additional facilities were provided elsewhere. For example, providing picnic facilities and a greater level of visual amenity may attract visitors to a centralised location. Such sites could be 'hardened' and managed to prevent further deterioration. However, consideration must be given also to the 'friction of distance' concept: that is, sites at a greater distance, or perceived as involving more time, effort or cost to get to, are patronised less (Pigram 1983).

Site hardening and management techniques include;

- using barriers to restrict access;
- banning campfires, or alternatively providing firewood and fire rings, or gas / electric barbecues;
- interpretation and information on recreation impacts and site features;
- provision of toilets;
- forming, surfacing and maintaining roads and pedestrian tracks to prevent erosion; and
- seasonal site closures.

McArthur & Hall (1996) recognised that hardening could compromise the heritage values of sites by failing to blend with the surrounding environment. Sensitive design can help to overcome the obtrusiveness of many hardening and management techniques. For example, the use of site topography and natural vegetation as visual screens, and using appropriate local materials and colours for facilities and signage can reduce visual impacts.

One management response: targeted development

The distribution and number of reserves, and the low-level recreation associated with most, has proven problematical for managers and has led to varying degrees of degradation. In 1995 the Wheatbelt Region of CALM initiated the preparation of a recreation and tourism plan for the Merredin District with the following goals;

- to maximise the diversity of recreation opportunities whilst rationalising recreation use of reserves, and hence preventing further degradation of conservation, cultural and aesthetic values;
- to provide a focus for provision of tourist and recreation services and information;

- to provide additional tourist income to the region by attracting transient traffic, and encouraging current visitors to stay longer; and
- to initiate mutually beneficial partnerships with LGAs in regard to recreation and tourism activities.

Although it is acknowledged there are many techniques available to managers to reduce impacts (including education, enforcement, temporal and spatial zoning), it was reasoned that these goals could be best achieved by concentrating use and management at selected, hardened sites. The reasons for choosing this management response was twofold; (1) due to the lack of resources needed to implement other strategies, and (2) to involve LGAs in determining priorities for development, and their ongoing management. An integral part of the planning process was the consideration of recreation resources on all Crown Reserves, including sites managed by CALM as well as other authorities such as LGAs. Consequently, collaboration with LGAs to identify potential sites, and ensure satisfaction with the process of ranking sites for development, was a high priority.

Methodology and site assessment

A four part process was devised to meet project goals. Firstly, letters were sent to the 16 LGAs within CALM's Merredin District in November 1994, requesting information on any nature-based recreation / tourism sites managed by authorities other than CALM. A standardised format for recreation site assessment was then developed. Due to the large number of sites throughout the District and the distances between them, it was considered improbable that a single officer would be able to assess all sites. Standardising assessment procedures would allow results to be compared sites were assessed by different officers. The third step was to determine the most important criteria for assessing recreation and tourism potential. A scoring system was developed that divided the assessment into three categories, physical attributes (possible 100 points, or 57% of the total), threats and uses (possible 30 points, 17%), and current and future management (45 points, 26%). The proportion of the total score of each category was considered to represent their relative importance to future recreation and tourism activities, and although the category scores are somewhat arbitrary, the method still allowed a comparative analysis of sites. Lastly, a system was devised that enabled reserves to be ranked according to objective criteria.

Physical attributes

This category was divided into five criteria;

- proximity to a recognised travel route (maximum 20 points);
- proximity to services, such as fuel and food (maximum 10 points);
- site accessibility (8 points for 2WD, maximum 10 points for caravans)
- proximity to another type of feature (maximum 10 points); and
- natural attributes, including eight sub-criteria (maximum total 50 points).

The points assigned for the first two criteria acknowledge the importance of major travel routes and town services to site development. It was felt that these criteria provided the bases for recreation / tourism infrastructure in the study area. Subsidiary to this was the need to provide 2WD access, and to a lesser extent access for caravans.

Proximity to another type of site was also considered important. The majority of reserves in the Wheatbelt are based around granite outcrops or waterbodies. The provision of a diversity of site types was considered critical in maximising visitor interest. For example, a site consisting solely of a granite outcrop but with an area of waterbody within 10 km was awarded additional points.

Natural attributes contributed up to 50 of the 100 points allowable in the Physical Attributes category, and 29% of the total score. This acknowledges that the physical attractions of the Wheatbelt generally lack the scenic grandeur of other regions (*e.g.* the national parks to the south, the tall forests of the south and west, and the Pinnacles to the north), and cannot be solely relied upon to attract visitors. Instead, natural attributes must be considered within the pre-established framework based on infrastructure and management. Within these constraints, the landscape features described by Stuart-Street & Kirkpatrick (1994) and water bodies were assigned maximum points.

Threats and uses

Seven threats to the recreation use of sites were identified. These were assigned values from -5 (for a high threat) to 0 (no threat). Only four could be considered to be threats caused by recreation directly, dieback, vandalism, erosion and fire (possible increased incidence), although the latter also accounted for destruction of scenic amenity. The others (land claims, weed invasions and salinity) are primarily external threats. Land claims are not necessarily a threat to recreation, but its inclusion as a criterion recognises that liaison may need to be undertaken with Aboriginal interests prior to site development

The diversity of recreation opportunities was considered to be quite important in maximising visitor interest. The abundance of sites with singular features generally restricted the number of opportunities offered, hence sites featuring a range of opportunities were rewarded by the scoring system. The period of use and interpretive potential was similarly considered. Sites offering year-round use and interpretive opportunities were considered to be a more efficient use of development and management funds, and hence scored more points than seasonally-used sites, or those with limited interpretive opportunities.

Current and future management

Current management was considered an indicator of the commitment of LGAs to cater for recreation. Criteria included the general cleanliness of sites, and the level and quality of facilities provided. However, the other two criteria in this category (cost to establish infrastructure and the cost of serviceability / maintenance) contributed a

possible 17% of the total score compared to 8.5% for current management. It was considered that the production of a regional framework for recreation / tourism, and the identification of key sites, might provide the incentive for LGAs to establish sites and maintain them to the desired standard. The scores reflected this assumption.

Despite the systematic process used in assigning numeric values to criteria, the process has several inherent faults. Firstly, it could be argued that scores for each category are not representative of their relative importance. For example, natural attributes (within the physical attributes category) were assigned a maximum possible value of 50 out of a possible total score of 175. It could be argued that because natural attributes are the main attractions to visitors they should be rated higher. Conversely, threatening processes (*e.g.* fire) and problems with managing sites may lead to continuing degradation, despite high quality natural attributes. Further, it was accepted that LGAs could argue that the assigned values for each criterion might undervalue sites within their area. Discussions with seven shires following the assessment process indicated that this was not a problem within the Merredin District, but the assessment procedure should be able to accommodate such concerns when the situation arises.

Results

Sixty sites were assessed and ranked (Table 1). An analysis of the results revealed an abundance of sites with distinctive topographic features (typified by high scores for 'topographic complexity') or waterbodies (51% and 49% of sites respectively). A total of 78% of all sites featured one or both. This is indicative of the reserve selection system in the Wheatbelt, where almost all arable land was cleared and the reserve system based on the remaining non-productive sites. The bias toward waterbodies or distinctive topographic features was also evident in the results of the top 21 ranked sites; the top 21 ranked sites have been used for discussion purposes due to two sites being ranked equal 20th. Only five of the top 21 sites had neither (Kellerberrin–Trayning Road, Korrelocking Nature Reserve, Durokoppin Nature Reserve, Weira Reserve and Meckering Earthquake Fault).

The survey revealed only four sites where there were more than three possible recreation opportunities. All sites were ranked in the top 21 (Mt O'Brien, Mt Matilda NR, Karalee Rock and Sandford Rocks NR). Most sites offered nature study, picnicking or bushwalking on unmarked trails, whilst several lakes provided infrequent opportunities for water-skiing. There was also evidence of horse-riding, and possibly camping, at some sites. Water-skiing, horse-riding and camping are not permitted on nature reserves, but are allowed on LGA reserves at the discretion of the relevant authority.

The distribution of scores is illustrated in Fig 2. The graph shows a distinctive drop in the scores for those reserves ranked equal 15th (score=135) and those ranked equal 23rd (score=129). The location of the top 21 ranked sites is shown on Fig 3. The significance of the weighting for each criterion is demonstrated through the distribution of sites along major travel routes and near towns. Only Sandford Rocks and Billyacatting were further than 10 km from a recognised travel route, but scored highly in the other categories.

CALM is responsible for the management of seven of the top 21 sites; Mt Matilda NR, Baladjie Rock NR, Durokoppin NR, Bulgin Rock NR, Sandford Rock NR, Buntine NR and Korrelocking NR. The remainder are vested in LGAs, the Waters and Rivers Commission or the Water Corporation. The latter two are in the process of rationalising their reserve assets in the Merredin District, and offering those that no longer meet corporate requirements to CALM or LGAs.

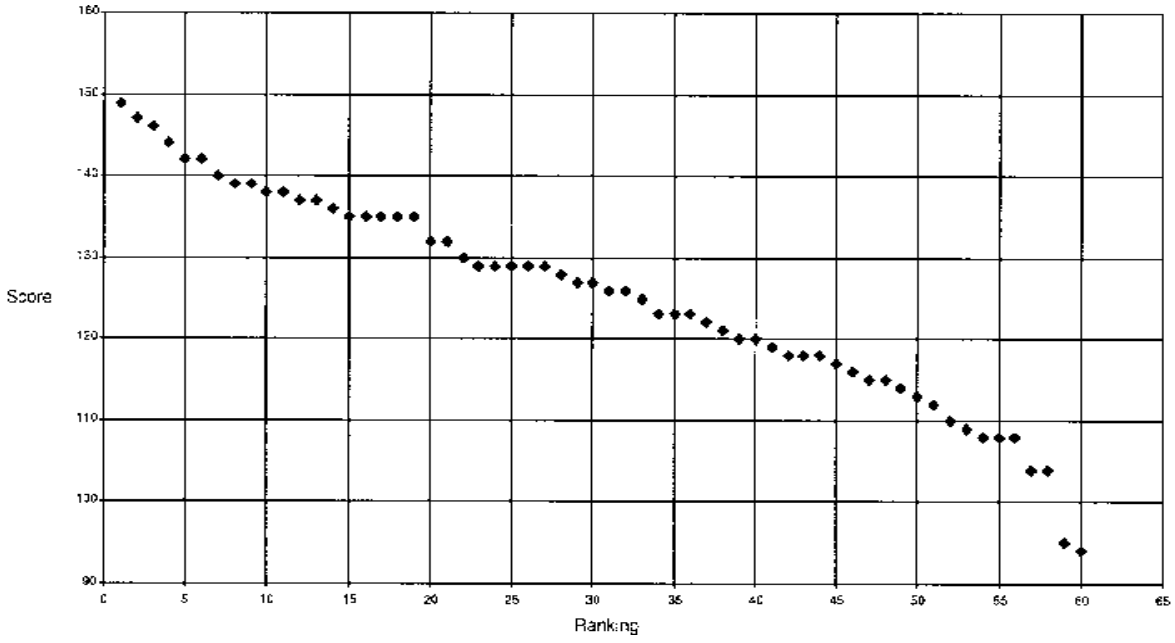

Figure 2. Distribution of scores for assessment and ranking of sixty reserves in the Merredin District (see Table 1).

Table 1.

Reserve rankings for the Merredin District

Rank	Reserve / Site	Shire	Physical Attributes (/100)	Threats and uses (/30)	Current and Future Management (/45)	Total (/175)
1	Mt O'Brien	Wongan–Ballidu	98	15	36	149
2	Mt Matilda Nature Reserve	Wongan–Ballidu	98	19	30	147
3	Kellerberrin–Trayning Road	Kellerberrin / Trayning	100	13	33	146
4	Buntine Rock Nature Reserve	Dalwallinu	93	11	40	144
5	Baladjie Lake Nature Reserve	Westonia	97	10	35	142
5	Hunts Soak	Yilgarn	95	12	35	142
7	Durokoppin Nature Reserve	Kellerberrin	95	11	34	140
8	Totagin	Merredin	95	7	37	139
8	Lake Ninan	Wongan–Ballidu	100	9	30	139
8	Weira Reserve	Mukinbudin	87	11	40	138
8	Meckering Earthquake Fault	Cunderdin	84	19	35	138
12	Merredin Peak	Merredin	95	7	35	137
12	Bulgin Rock Nature Reserve	Cunderdin	95	9	33	137
14	Oak Park Reserve	Goomalling	90	8	38	136
15	Xantippe Tank	Dalwallinu	93	9	33	135
15	Sandford Rocks Nature Reserve	Westonia	80	17	38	135
15	Korrelocking Nature Reserve	Wyalkatchem	91	8	35	135
15	Karalee Rock	Yilgarn	93	14	28	135
15	Mt Marshall	Mt Marshall	96	5	34	135
20	Mt Collier	Koorda	90	9	33	132
20	Billyacatting	Trayning	85	11	36	132
22	Culimbin Well	Dowerin	88	9	33	130
23	Kellerberrin Hill	Kellerberrin	88	6	35	129
23	Petrudor Rock	Dalwallinu	80	11	38	129
23	Eaglestone Rock / Lake Brown	Nungarin	83	10	36	129
23	Dingo Rock	Wongan–Ballidu	80	11	38	129
23	Namalcatching Nature Reserve	Dowerin	90	8	31	129
28	Burrocoppin Nature Reserve	Merredin	87	8	33	128
29	Mt Steven	Trayning	87	7	33	127
29	Cunderdin Hill	Cunderdin	86	6	35	127
31	Uberin Rock	Dowerin	80	12	34	126
31	Mt Stirling	Kellerberrin	80	10	36	126
33	Frog Rock Nature Reserve	Yilgarn	88	9	28	125
34	Reynoldsons Reserve	Wongan–Ballidu	86	3	34	123
34	Datjoin Well	Mt Marshall	75	11	37	123
34	Billiburning Rock	Mt Marshall	80	10	33	123
37	Pergandes	Mt Marshall	71	14	37	122
38	Danberrin Hill	Nungarin	78	9	35	121
39	Elachbutting Nature Reserve	Westonia	72	12	36	120
39	Charles Gardiner Nature Reserve	Tammin	80	8	32	120
41	De-erranning Reserve	Mukinbudin	78	8	33	119
42	Yorkrakine Rock Nature Reserve	Tammin	80	6	32	118
42	White Dam	Wyalkatchem	85	6	27	118
42	Mollerin Rock	Koorda	76	8	34	118
45	Waddouring Hill	Mt Marshall	77	7	33	117
46	Wubin Rock	Dalwallinu	77	4	35	116
47	Berringbooding Reserve	Mukinbudin	75	9	31	115
47	Chiddarcooping Nature Reserve	Westonia	73	9	33	115
49	Yannimooning	Westonia	73	9	32	114
50	'Sharks Mouth' (private property)	Kellerberrin	77	3	33	113
51	Gathercole	Wongan–Ballidu	75	3	34	112
52	Gnamma holes, Trayning–Bencubbin Road	Trayning	71	8	31	110
53	Lake MacDermott	Mt Marshall	70	7	32	109
54	Moningarin Tank	Koorda	71	5	32	108
54	Lake Campion (Ski Lake)	Nungarin	72	0	36	108
54	Wattonning Reserve	Mukinbudin	69	2	37	108
57	Trayning Well	Trayning	61	9	34	104
57	Baandee Lake	Kellerberrin	70	-2	36	104
57	Cailbro School Site	Dalwallinu	52	8	35	95
60	Newcalbeon	Koorda	56	5	33	94

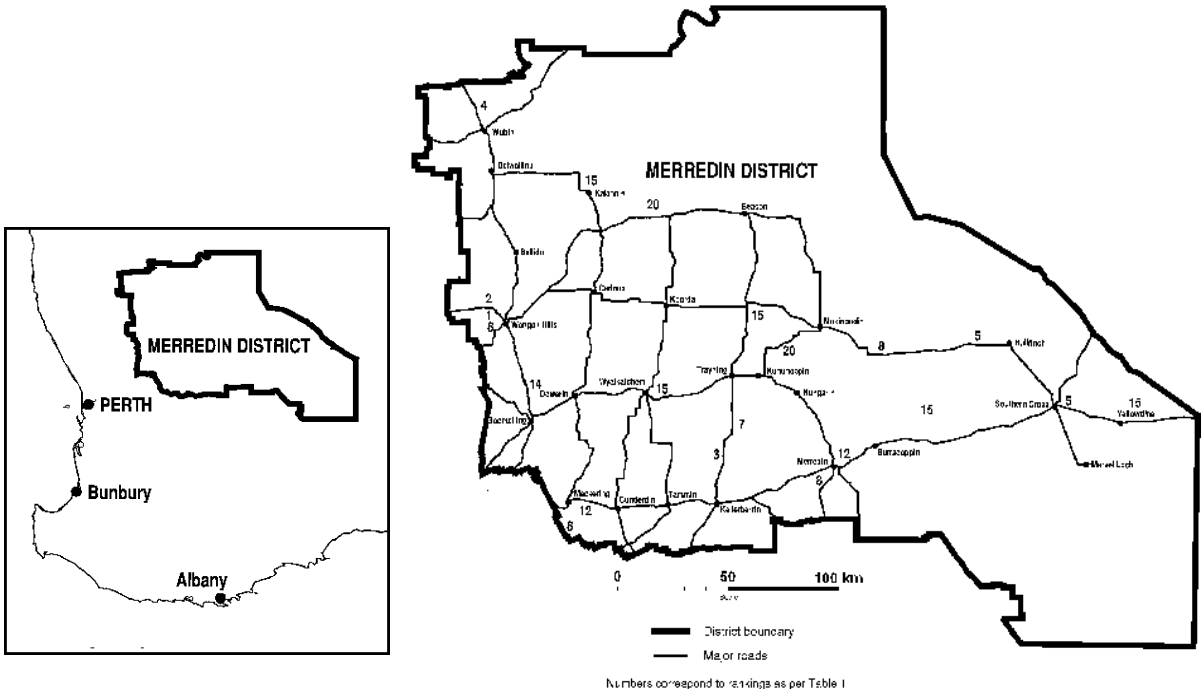

Figure 3. Location of top 21 ranked recreational sites surveyed in the CALM Merridin District (see Table 1).

Discussion

It is clear from site inspections undertaken during the course of the project that almost all sites suffered from varying degrees of degradation due to recreation. Inappropriate siting, poor site design, and lack of active management, all contributed to negative impacts despite low visitor numbers. The most obvious impacts included;

- soil compaction and erosion of picnic sites and access tracks;
- loss of understorey species from picnic sites;
- extensive wanton destruction of exfoliated granite adjacent to visitor sites; and
- removal of timber for firewood.

Several sites were severely degraded, with Yorkrakine Rock probably the worst principally through loss of vegetation, erosion and graffiti. The main factors contributing to the level of degradation at this site were poor site design, the relatively high visitor numbers and long established use patterns. It is probable that many sites in the Wheatbelt will eventually suffer similar degradation unless recreational use of sites is rationalised, and those chosen are properly planned and managed (*e.g.* access to vandal prone sites is restricted, graffiti is removed immediately to discourage further efforts).

The arbitrary nature of the scoring system means that there is a possibility for disagreement over the rankings. Whilst the scoring system was ratified by the North Eastern Wheatbelt Travel (NEWTRAVEL) group of seven shires after brief examination, other shires may disagree. Safstrom (1995) detailed the various technical problems in assessing the conservation value of Wheatbelt reserves. He considered the applicability of scoring systems, iterative selection algorithms, irreplaceability, and multi-criteria analysis before deciding that the last method was most preferable. The main advantage of this method was the ability for different users to select appropriate criteria to suit their needs. The same principles can be applied to this study, enabling shires to agree on the most important criterion, or various combinations of criteria. This is readily achieved by filtering the data in an Excel spreadsheet to select the chosen criteria.

Although most of the discussion has concentrated on the top 21 sites, this is probably in excess of the number that should be considered for development at a District level. Given that the objectives of the strategy include reducing the amount of impacts to natural sites, development of any more would be self-defeating unless a large amount of management input could be ensured, which is unlikely. It is assumed, however, that not all of the top 21 sites would be developed. For example, LGAs may lack development funds, or the purpose of the reserve does not include recreation. Discussion of the top 21 reserves at least enables LGAs to be selective, and discuss options amongst themselves.

Conclusions

The results of the survey have acted as a guide to local authorities to identify and prioritise where efforts could be best directed within the Merredin District. CALM has an ongoing interest in the acceptance of the strategy, even when most of the reserves in the study area are managed by LGAs. As the primary conservation agency in WA, CALM has responsibility for the protection of wildlife on all lands, not just those managed by CALM. Further, some current recreation sites are located on CALM nature reserves that have been degraded due to resource constraints. To overcome these problems and to assist LGA development, CALM has collaborated with the LGAs in planning for future recreation and tourism use of high-ranking reserves. This has taken the form of

informal partnerships where CALM has provided expert advice on site and facility design, and LGAs would maintain the sites. This is possibly a more efficient use of agency funds, rather than actively trying to manage the current number of widely dispersed sites. A corollary of the approach taken has been the use by LGAs of the rankings and CALM's site designs to apply for external grant funding. For example, the Shire of Wongan-Ballidu has obtained over $60 000 in grant funding to develop walking trails, interpretation and a lookout platform at Mt Matilda and Mt O'Brien. This success has led to CALM's Narrogin and Katanning Districts conducting similar ranking exercises within their operational areas, with a view to establishing collaborative recreation management with LGAs.

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