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Quadrats, a means to justify your conclusions

In a recent forum I was surprised by the resistance, even by other botanists, to collect quadrat data as part of a flora survey. Quadrats are an important means by which botanists or ecologists are able to quantify their observations and justify their conclusions. Without quadrats or something equivalent, it is impossible for outcomes of a survey to be verified and consequently for a reviewer to have confidence in them.

In the simplest form, a quadrat consists of a list of plants that occur within a defined area with some sort of quantitative measure of abundance.

Representative quadrats should be collected for all vegetation types occurring within a study area. This includes indigenous and non-indigenous vegetation. Remember it is just as important to quantify the quality and biodiversity within indigenous vegetation, as it is to show the lack of it in areas excluded from further analysis and/or protection.

Plant lists should at least include all vascular species, although on occasion some ecologists also list non-vascular plants like mosses, liverworts and fungi. Both native plants and weeds should be documented as this provides an indicator of the biodiversity and level of degradation, respectively. Effort should be taken to ensure enough plants are documented from the various lifeform groups present to subsequently identify the vegetation type sampled.

Throughout Australia the most common quantitative measure used to document species cover is the Braun-Blanquet Scale of Projective Foliage Cover (PFC), or a variation of this scale, although other indices are used depending on the objective of the study. The scale in its simplest form ranges between 1 and 5, with '1' being allocated to plants with <5% Projective Foliage Cover, '2' to plants with 5 - 25% PFC, '3' to plants with 25 - 50% PFC, '4' to plants with 50 - 75% PFC and 5 to plants with 75 - 100% PFC. Projective Foliage Cover is a fancy way of saying the percentage of the quadrat covered by the plant if viewed from above. In Victoria, uncommon or rare plants that are sparsely or very sparsely present are allocated '+'. In New South Wales, the same categories are used but are ascribed values between 1 and 6 (i.e. '1' instead of '+', '2' instead of '1', etc).

An important factor controlling the outcome of a quadrat assessment is the size of the quadrat, the shape of the quadrat, the homogeneity of the vegetation being sampled and the time spent searching for plants. All these parameters should be specified and discussed in the methodology section of a report. Some government agencies, suggest minimum quadrat sizes for different vegetation types, but in general it is left up to the ecologist to suggest and justify appropriate sampling strategies.

Quadrats have been collected throughout Australia by a variety of ecologists. Early studies were primarily published in journals and raw data was rarely made available. In recent times however government agencies have started collating results of ecological studies as a foundation for vegetation mapping and other biodiversity studies. These databases are readily accessible and form a foundation for botanical assessments (e.g. Victoria - Flora Information System; New South Wales - BioNet; South Australia - Environmental Data Base of South Australia). In addition to quadrat data, these biological

Articles Inside

Quadrats, a means to justify your conclusions, cont'd…

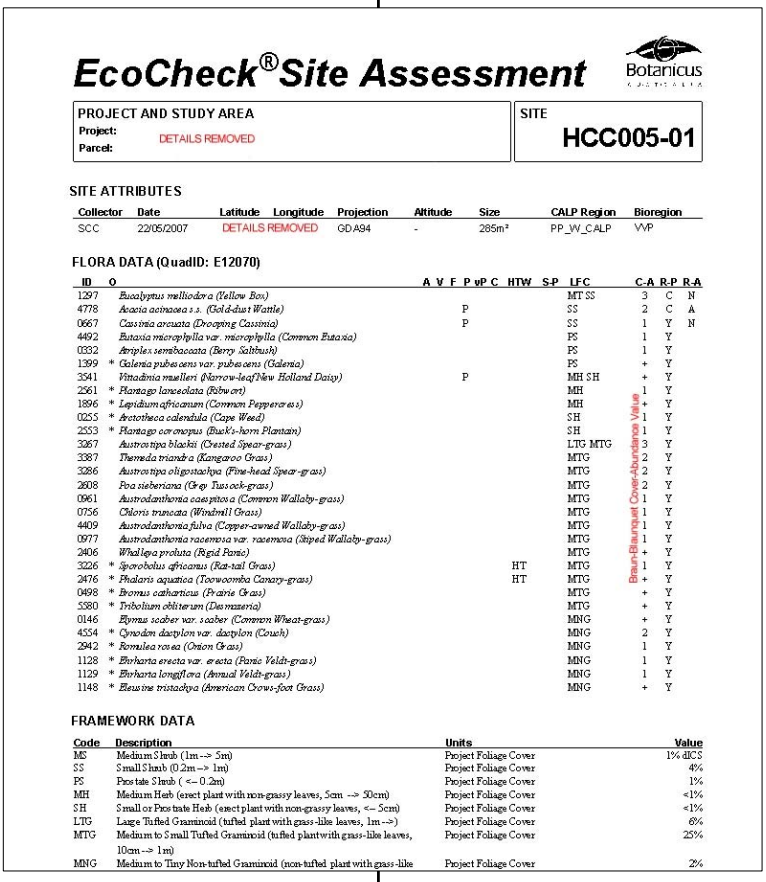
databases contain site lists, incidental records, herbarium records and grid lists.

Personally I believe it is important for a consultant to collect original data, document their findings and justify any recommendations they make. It is not adequate, just to list plants extracted from statewide databases and say whether you think they may or may not be present. It is imperative that adequate survey is conducted to document the biodiversity present, the level of degradation that has occurred, find any significant species, classify the vegetation and establish its quality. The primary way this is achieved is by collecting quadrat data, yet progressively less and less companies, and government agencies, are collecting this data to support their decisions.

In Victoria, where once it was standard practice to collect quadrat data, consultants now only list the vegetation believed to be on site and its habitat score (quality rating). In most cases, no data is provided to support any of the primary assumptions. Is the vegetation actually what has been mapped or modeled by the Department of Sustainability & Environment? What plants did they actually see and how abundant were they? Without this type of data it is impossible for anyone to verify someone's conclusions, short of going out on site and reassessing the vegetation again!

I suppose it is appropriate that I now explain how I do things, as it is one thing to espouse certain standards but another to attempt to implement them. The overriding principle controlling my actions has always been to justify, with sound scientific data, any recommendation made in a report.

The first thing that I do when starting a flora survey is to stratify the site by splitting it up into homogeneous blocks of vegetation. As mentioned previously in Issue 1 of EcoRamblings, an average 3.3 hectare site is usually broken up into about 15 strata - some dominated by indigenous vegetation and some by non-indigenous vegetation. Each stratum is then sampled. If the block is really large a smaller representative block is sampled, but in most cases the entire stratum is assessed. I then make a list of plants seen, their lifeform, whether their reproducing and using the Braun-Blanquet Scale, provide an estimate of their cover. After collecting the underlying biodiversity data I collect any other data required to calculate the habitat score of the area (e.g. the percentage cover of certain lifeforms), ensuring at all times that the raw data is recorded. The time taken to complete an assessment varies depending on the vegetation type and number of plants present. In general, a treeless site can take between 30-45 minutes and a treed site 45-75 minutes. The above insert shows part of a completed site assessment sheet now included as a standard in all my reports. The objective with these sheets is to provide a clear sequence from my original observations to the habitat score value used to substantiate my conclusions.



EcoCheck® Site Assessment — Botanicus

PROJECT AND STUDY AREA	SITE
Project: DETAILS REMOVED Parcel:	HCC005-01

SITE ATTRIBUTES

Collector	Date	Latitude	Longitude	Projection	Altitude	Size	CALP Region	Bioregion
SCC	22/05/2007	DETAILS REMOVED		GDA94	-	285m²	PP_W_CALP	VVP

FLORA DATA (QuadID: E12070)

ID	O		A	V	F	P	vP	C	HTW	S-P	LFC	C-A	R-P	R-A
1297		*Eucalyptus melliodora (Yellow Box)*									MT SS	3	C	N
4778		*Acacia acinacea s.s. (Gold-dust Wattle)*				P					SS	2	C	A
0667		*Cassinia arcuata (Drooping Cassinia)*				P					SS	1	Y	N
4492		*Eutaxia microphylla var. microphylla (Common Eutaxia)*									PS	1	Y	
0332		*Atriplex semibaccata (Berry Saltbush)*									PS	1	Y	
1399	*	*Galenia pubescens var. pubescens (Galenia)*									PS	+	Y	
3541		*Vittadinia muelleri (Narrow-leaf New Holland Daisy)*				P					MH SH	+	Y	
2561	*	*Plantago lanceolata (Ribwort)*									MH	1	Y	
1896	*	*Lepidium africanum (Common Peppercress)*									MH	+	Y	
0255	*	*Arctotheca calendula (Cape Weed)*									SH	1	Y	
2553	*	*Plantago coronopus (Buck's-horn Plantain)*									SH	1	Y	
3267		*Austrostipa blackii (Crested Spear-grass)*									LTG MTG	3	Y	
3387		*Themeda triandra (Kangaroo Grass)*									MTG	2	Y	
3286		*Austrostipa oligostachya (Fine-head Spear-grass)*									MTG	2	Y	
2608		*Poa sieberiana (Grey Tussock-grass)*									MTG	2	Y	
0961		*Austrodanthonia caespitosa (Common Wallaby-grass)*									MTG	1	Y	
0756		*Chloris truncata (Windmill Grass)*									MTG	1	Y	
4409		*Austrodanthonia fulva (Copper-awned Wallaby-grass)*									MTG	1	Y	
0977		*Austrodanthonia racemosa var. racemosa (Striped Wallaby-grass)*									MTG	1	Y	
2406		*Whalleya prolata (Rigid Panic)*									MTG	+	Y	
3226	*	*Sporobolus africanus (Rat-tail Grass)*							HT		MTG	1	Y	
2476	*	*Phalaris aquatica (Toowoomba Canary-grass)*							HT		MTG	+	Y	
0498	*	*Bromus catharticus (Prairie Grass)*									MTG	+	Y	
5580	*	*Tribolium obliterum (Dwarsaria)*									MTG	+	Y	
0146		*Elymus scaber var. scaber (Common Wheat-grass)*									MNG	+	Y	
4554	*	*Cynodon dactylon var. dactylon (Couch)*									MNG	2	Y	
2942	*	*Romulea rosea (Onion Grass)*									MNG	1	Y	
1128	*	*Ehrharta erecta var. erecta (Panic Veldt-grass)*									MNG	1	Y	
1129	*	*Ehrharta longiflora (Annual Veldt-grass)*									MNG	1	Y	
1148	*	*Eleusine tristachya (American Crows-foot Grass)*									MNG	+	Y	

Braun-Blanquet Cover-Abundance Value

FRAMEWORK DATA

Code	Description	Units	Value
MS	Medium Shrub (1m --> 5m)	Project Foliage Cover	1% dICS
SS	Small Shrub (0.2m --> 1m)	Project Foliage Cover	4%
PS	Prostate Shrub (<-- 0.2m)	Project Foliage Cover	1%
MH	Medium Herb (erect plant with non-grassy leaves, 5cm --> 50cm)	Project Foliage Cover	<1%
SH	Small or Prostrate Herb (erect plant with non-grassy leaves, <-- 5cm)	Project Foliage Cover	<1%
LTG	Large Tufted Graminoid (tufted plant with grass-like leaves, 1m -->)	Project Foliage Cover	6%
MTG	Medium to Small Tufted Graminoid (tufted plant with grass-like leaves, 10cm --> 1m)	Project Foliage Cover	25%
MNG	Medium to Tiny Non-tufted Graminoid (non-tufted plant with grass-like	Project Foliage Cover	2%

As a scientist, I consider it essential to justify all my conclusions and recommendations. As a community concerned with the conservation of natural resources, you should expect no less.

As experts, consultants are generally paid reasonable fees to conduct a survey, yet most are providing information that is substandard, unable to withstand peer review and will not stand up in court if required.

New Edition of Weed Control Handbook

The New South Wales Department of Primary Industries have recently published Edition 3 of the *Noxious and Environmental Weed Control Handbook – A guide to weed control in non-crop, aquatic and bushland situations*. The guide can be downloaded from the NSW-DPI Website (PDF).

The guide covers a broad range of important topics, each written by a different author. Subjects relevant to the broader audience include integrated weed management, use and calibration of application equipment, application techniques, herbicide resistance and common control techniques. The section on herbicide drift was a welcome sight, considering the number of times I have encountered off target damage to significant species in recent years. Non-chemical control techniques discussed include mulching, flame cultivation, hot water application and slashing.

The bulk of the guide is dedicated to specific recommendations for a variety of weeds found throughout the state. For most species detailed notes are provided of about herbicides suitable for control of the species, appropriate application rates and comments on their application. Unfortunately, this section has some failings that detract from the obvious efforts of the editors.

1. Recommendations are not provided for all weeds appearing on the Schedule of Noxious Weeds reproduced on Page 26 and 27. Notable exceptions are Water Caltrop, Yellow Burrhead, Hymenachne and Eurasian Water Milfoil that were important enough to have an identification photo on the back cover but not to have control measures listed in the book. Other Class 1 Weeds not discussed in detail in the book were Anchored Water Hyacinth, East Indian Hygrophila, Mexican Feather Grass and Pond Apple.
2. Common names used throughout the book vary making it difficult to find plants. For example, the Schedule lists *Acroptilon repens* as Creeping Knapweed but the control measures are listed under Hardhead Thistle (Creeping/Russian Knapweed).
3. Plants listed in the control section are not alphabetically listed and coupled with the variation in the plant names used, makes it very hard to find the data on some species. I suggest you keep the PDF and use the search facility in your PDF Reader.
4. Control measures were provided for 20+ extra species but it is unclear what criteria were used for their inclusion as non appear to be obvious bushland weeds.
5. The comments regarding non-chemical control are of little value and appear primarily to be applicable to an agricultural context or a place to insert random comments.
6. Despite providing detailed notes on herbicide use in aquatic environments to control infestations of Alligator Weed, Black Knapweed and Hygrophila no warnings were provided about the potential impact these chemicals could have on susceptible aquatic fauna (e.g. frogs and fish).

In summary, this guide consolidates valuable information on a wide variety of common noxious weeds and their control, primarily – contrary to the title – in the agricultural context. Although these techniques are applicable to degraded bushland environments the absence of alternative techniques for use in high-quality indigenous vegetation detracts from the text.

Questions & Answers

A Friends Group says, "I'm wondering if other groups have noticed a difference in the survival of naturally regenerating plants due to climate change. We have had rain over winter with plenty of regeneration occurring but as soon as we had some hot days, plants seem to be struggling. We also lost several native plants last summer that had been planted the previous year even though seed and cuttings were obtained from local indigenous stock. This loss appeared to be greater than previous years."

Attributing *failure of a plant to establish following rains* to climate change might be a long stretch. Climate is just one of the many factors controlling plant survival – plant competition, too little or too much nutrients, pathogens, etc might all have contributed to the outcome. Without specifics it is difficult to guess at what is occurring. To illustrate the point, in some recent surveys I noticed a significant increase in the germination of the native herb, *Veronica gracilis* (Slender Speedwell). Most of the plants however were struggling and are unlikely to survive summer. On careful inspection I noted that the underneath of the leaves were heavily infested with fungi, which was significantly impacting on the vigour of the plant. Apparently the recent rains and warm weather had not just simulated the germination of the species but promoted the growth of this fungus.

Another point I would like to pick up is use of local stock in revegetation programs. Yes, the use of local stock increases the likelihood of plants being adapted to the peculiarities of the local area BUT this assumes that the local environment is currently in the condition you would expect this plant to occur and that all the natural ecological processes are operating. Without sounding condescending, it is not uncommon for people to put a wetland species back into a wetland without reinstating the natural inundation regime. Revegetation sites, compared to restoration sites, rarely consider the ecological process of the recipient area, and so only a few extremely tolerant species are able to survive.

Questions & Answers, cont'd...

A school asks how best to manage local grassland to promote the recovery of native grasses compared to exotic grasses with limited time and person power.

Arrange with your local fire authority to burn the grassland in autumn every 2-3 years as part of their training program, hand weed small infestations in the better-quality areas and spray sparingly in lower-quality areas (especially during the post-burn recovery period). Aim to minimize nutrient input and disturbance in the grassland. Continue this for 3-4 cycles and the balance of C_3 and C_4 grasses will normalise and depending on how depleted your herbaceous component is, they will become more abundant throughout the grassland. 'Nutrient control' is an important concept here – remove rubbish, control legumes and avoid overuse of herbicides that breakdown in the soil. Consider establishing a simple monitoring program, as discussed below, to monitor the recovery of the grassland biodiversity.

Good Luck

A LGA Officer comments on the success of removing ****Anthoxanthum odoratum* **(Sweet Vernal-grass) from an indigenous lawn by removal of seed heads over several years and asks whether this would translate into a bushland context?

This technique is an effective control of annuals, biennials and short-lived perennials, as long as they do not actively spread by other means (e.g. bulbuls, rhizomes, adventitious roots, etc). The primary problem is the level of effort required to remove the heads and dispose of them compared to slashing, which results in the flower head being left on the soil to decompose (undesirable addition of nutrients into the soil). I have always thought that a hand-held seed collection machine, if appropriately modified, might be an effective tool for removing unwanted grass heads.

The concept of spring burning in bushland areas, particularly grassy ecosystems, was originally proposed as a method of removing the heads of unwanted C_3 grasses. In theory this works, but a spring burn would also result in the loss of any seed heads of indigenous herbs and has the potential of eliminating annual spring flowering species completely from a grassland.

A LGA Officer asks whether ****Anthoxanthum odoratum* **(Sweet Vernal-grass) or ****Briza maxima* **(Large Quaking-grass) are allelopathic.

Allelopathy is when a plant produces a compound, directly (e.g. root produce chemicals) or indirectly (decomposing leaves result in phytotoxins), that inhibits the growth of another species. Some well-known examples of allelopathy in Australia are the suppressed growth of most species under **Pinus radiata* (Radiata Pine), **Cupressus macrocarpa* (Monterey Cypress) and some natives in the genera *Allocasuarina* (She Oak) and *Eucalyptus* (Gum).

The leaves of **Anthoxanthum odoratum* are scented by a chemical called coumarin. This compound is known to inhibit seeding growth in other species. Although quite a bit of literature exists on the impact of this species on other exotic grasses I was unable to locate any literature on the impacts this species might have on Australian natives. I am unaware of any literature suggesting that **Briza maxima* is allelopathic.

A land manager in Victoria says, "I am particularly interested in the spread of *Leptospermum laevigatum* (Coastal Tea-tree) beyond sand dune systems or on sites that are directly on the coast. I have seen in numerous parts of the state where this species seems to grow away from the dunes. I was wondering what exactly its ecological niche is and how far from the coast dune systems should it be growing? How was it naturally kept in balance, fire? If it has spread out of its natural area then would fire be a way of controlling it?"

Leptospermum laevigatum (Coastal Tea-tree) is a native shrub that is primarily confined to coastal dunes east of the Otways. In the absence of fire this species invades adjacent heathlands and eventually out competes indigenous species and should be treated as an environmental weed in this situation. Although adult plants are readily controlled by fire, the species is an aggressive post-fire/post-disturbance colonizer and will quickly re-establish in an area if frequent burning is not maintained.

FURTHER READING

Molnar C. D., Fletcher D. and Parsons R. F. (1989) Relationships between heath and *Leptospermum laevigatum* scrub at Sandringham, Victoria. *Proceedings of the Royal Society of Victoria* **101**, 77-87.

Parsons R. F. (1966) The Soils and vegetation at Tidal River, Wilson's Promontory. *Proceedings of the Royal Society of Victoria* **79** (2), 319-354.

A contractor asks, "What impact if any will climatic change have on the relevance of existing EVCs in terms of seed sourcing and selection of species? In other words as temperatures rise and the southern areas of our continent become progressively drier are current EVCs moving south and do we need to look further north to where plants are surviving in drier conditions."

Interesting questions. At present our legislative and policy base in Australia has not factored in the outcome of significant climatic change. Restoration projects are still attempting to recreate ecosystems that predate European settlement. Yet if significant climatic change occurs, resulting in shifts in the climatic zones within Australia, this will be impossible to achieve. Although bracing for the worse I believe that most environmentalists are still hoping that we can pull ourselves back from the brink, because if we can't then it will be like trying to catch a pack of cards.

Personally I believe that ecosystems are just transient expressions of a collection of organisms dispersed spatially and temporally on the earth surface. Trying to conserve a particular snapshot in time is futile, as the factors controlling the distribution and abundance of species are dynamic. It is important in a closed system like earth that ecosystem function is maintained and that in general we avoid the loss of biodiversity as component taxa may shift in their importance in the new environments that will appear as the climate shifts.

For a manager of a local bushland remnant, it is likely that this will be expressed as a shift in species composition, with widely dispersed generalists surviving and a shift in the abundance of specialist taxa. For those specialists poorly adapted to the new conditions, they will migrate if they are able or will become locally extinct. For those specialists that through pure chance are now better adapted to the environment, the local populations will flourish and if able will migrate into adjacent areas.

So coming back to our current legislative and policy base. Maybe we should avoid basing our action on maintaining or recreating pre-European vegetation types but look more at promoting species diversity.

Why conserve?

I was reminded when conducting some fieldwork recently that not all people involved in our industry have really thought about why we should protect the environment. There is a vast amount of literature available covering the philosophical reasons behind the conservation movement, so I don't intend to reiterate all the reasons here. I will however cover some of the common explanations.

Every organism has the right to survive on earth – this is rather self-explanatory, whether you believe in this right or not. I always considered this a fundamental tenet of the conservation movement but was surprised when searching for quotes that very few people actually state this as an objective. The only threatened species legislation I found within Australia, which incorporates similar ideas into its objectives, was the *Flora & Fauna Guarantee Act 1988 (Vic)*. It has as one of its objectives "to guarantee that all taxa of Victoria's flora and fauna other than the taxa listed in the Excluded List can survive, flourish and retain their potential for evolutionary development in the wild".

It is our fault, so we should fix it – this explanation is easy for most people to understand. We are responsible for the decline in a species or ecosystem so we should attempt to protect and manage the last remaining vestiges. This explanation is usually accompanied by an underlying reason why the loss of these species or communities are of concern. A common encountered reason is that we might lose a species that might be of use to us in the future, e.g. a frog that provides a cure for cancer.

'Spaceship Earth' Ehrlich & Ehrlich 1981 – The last explanation put forward here, highlighted by recent understanding and interest in global warming, is that we are all reliant on the environment for food, air and water. If we continue to destroy components of the environment it will eventually collapse – us along with it! There is a famous analogy put forward by Paul and Anne Ehrlich in 1981 in the preface to their book 'Extinction – The causes and consequences of the disappearance of species", which compares the loss of species to the loss of rivets from a plane. Eventually, it will come down with a crash! Global warming is a classic example of how the clearance of large expanses of rainforest throughout the equatorial regions of the world – the earth's lungs, so to speak – reduces the capacity of the environment to reduce global carbon dioxide (CO_2) levels, even if we manage to curb CO_2 production over the next few decades.

Why monitor?

Why monitor anything? The answer to this question is self evident – to see what happens – yet, most people involved in the natural resource management industry steer away from monitoring anything. To be fair, the primary reason for this is that most projects are funded on a yearly basis, most agencies have a high staff turnover and it is very rare that staff have, as part of their core duties, anything that remotely sounds like monitoring. In my experience, monitoring usually only occurs in areas where there is a proactive conscientious officer – the impetus never originates from senior managers! This last fact is the most puzzling considering most managers are looking for indices to monitor the performance of individuals or groups (e.g. KPI). Why then don't they record indices that monitor the effectiveness of their management programs?

There are two types of ecologists – synecologists and autecologists – and both monitor the environment differently. Putting it simply synecologists (syn-: with, together.) look at groups of organisms (e.g. like plants in vegetation community or birds in a woodland guild), their relationships and how they would change over time, whereas an autecologist (aut-: self) looks at a single organism (e.g. like a rare plant, a rare animal, a pest or a weed), factors that control its distribution or abundance and how it's population numbers or extent would change over time.

Monitoring programs are easy to design as long as you clearly define from the outset your objectives, appropriate indicators and how you intend to monitor those indicators. For example for a rare plant your objective might be *to*

Why monitor? cont'd...

maintain or enhance the condition of the extant population, your indicator might be *plant numbers* or possibly *plant condition* and your monitoring activity might be to *annually count, during peak flowering, the number of plants within a permanent monitoring plot*. By monitoring the population numbers over time you will be able to establish whether you are meeting your objective.

In a recent project, a remnant of *Western Basalt Plains Grassland* was monitored, the objective was *to maintain or enhance the condition of the remnant grassland*, one of the indicators was *plant diversity*, and one of the monitoring activities was to *annually record the number of indigenous plants within a defined area*.

Monitoring *per se* provides valuable input into whether existing programs have met their goal but become even more useful when integrated into a dynamic monitoring-management model. In this situation, the results of annual monitoring is used to feedback into future management programs. For example, in Hume City Council annual monitoring data from 220 sites have been used to prioritise weed and pest control activities in the best-quality reserves within the municipality.

The simpler an indicator is and the easier it is to collect, the greater the chance it will continue to be monitored over time. Despite this tenet, more complex indices can provide valuable input into biodiversity programs. For example, recent monitoring of habitat scores for defined areas over several years by Botanicus Australia Pty Ltd has provided valuable information on potential gains that can be achieved through certain management activities in a range of threatened ecosystems.

FURTHER READING

Cropper S. (1991) 'The Resource Evaluation and Monitoring System - A system for monitoring natural and cultural assets' (Department of Conservation and Environment: Melbourne).

Cropper S. C. (1993) 'Management of endangered plants' (CSIRO Publishing: East Melbourne).

DEWR (2007) 'Monitoring and Evaluation – Resources' (Webpage managed by the Department of the Environment and Water Resources).

Who is Simon Cropper?

Considering you have taken the time to listen to my ramblings I thought it only fair that I let you know a little bit about myself so you can decide for yourself whether my views are legitimate. I have been a professional ecologist since 1985 and have been involved in survey work, the development and implementation of monitoring programs, detailed ecological research and management of both significant species & ecosystems. I also authored the book 'Management of endangered plants' published by CSIRO. In 1993, I established the natural resource consultancy Botanicus, which has since serviced a broad range of government and private sector clients, and has conducted numerous flora & fauna surveys throughout Victoria.

Housekeeping

Please feel free to distribute this publication to anyone interested in Natural Resource Management. If you would like to have future issues automatically sent to you by email, send me an email with SUBSCRIBE ECORAMBLINGS in the subject line to my email address below. If at any stage you wish to discontinue receiving future issues, send me an email with UNSUBSCRIBE ECORAMBLINGS in the subject line.

Please note that numerous links to the Internet have been provided in this document to help direct the reader to supportive documentation or further reading. I have assumed that most people will have broadband and Acrobat® Reader on their system. I apologise if this is not the case. I have marked links pointing to Acrobat® Portable Document Format files with the PDF symbol. The reader can be downloaded from the Adobe Website.

Articles in this document can be cited in the same way as traditional journals, viz. Cropper, S.C. (2006) Heat stress in outdoor workers. *EcoRamblings* **1**: 1-2.

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