

# METHODS

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## SITE SELECTION AND NOMENCLATURE

The fundamental concept behind all the regional surveys conducted as part of the Biological Survey of South Australia to date has been that they are based on intensive sampling at a series of SITES selected to represent the biological and geographical diversity of the study area. As the Kangaroo Island survey was the first to be carried out in the agricultural rather than the pastoral lands of South Australia some changes were made to the site selection process. In 1989 a series of 47 sites were selected throughout the island for vegetation sampling. There are eight Environmental Associations (Laut *et al* 1977) recognised for Kangaroo Island and within these there are 14 land units namely: Beach, Cliff, Dune, Interdune Low, Tidal Flat, Undulating Plain, Plain, Lake, Lunette, Floodplain, Hillslope, Crest, Hill and Footslope. Natural vegetation has been cleared to different degrees in each of these Environmental Associations but, within these constraints the sites were selected to include representative natural vegetation proportional in each Environmental Association and covering as many of the Land Units where vegetated sites were still available. Sites were also spaced to give as wide a geographic coverage of the island as possible. Adjustments were made to ensure that there were sample sites located in all the islands National and Conservation Parks and the majority of the Heritage Agreement Areas on private land. All landowners were contacted before the survey to obtain permission to sample and find out details of access and eventually from the 47 sites chosen, 340 quadrats were sampled during the vegetation survey carried out from 6 to 20 November 1989. An additional 29 vegetation quadrats were sampled using the same methods during the Sooty Dunnart survey in February and March 1995 (Herbert 1996).

The survey sampling sites were classified in a systematic manner and the best way to illustrate this is to provide an actual example. SITES are named after

towns or geographical features in the vicinity and are referred to with two letter abbreviations. Within a particular Environmental Region (and on a given regional survey) site codes are never duplicated so that by using the hierarchical numbering system developed by Laut *et al* (1977) the complete and unique code for the Kelly Hill site becomes 3.1.1 KH. All the sites in this biological survey are within the Kangaroo Island Environmental Region and so in this publication sites are simply referred to by their letter codes alone. The 47 sites are shown on Fig. 1.

At each of the sites a series of sample QUADRATS were selected. Unlike previous surveys where quadrat sizes of 1 km x 1 km were used, quadrat size in agricultural district surveys was reduced to 30 x 30 m. At each site quadrats were selected to represent the range of habitat variation in the area. The third QUADRAT at the Kelly Hill SITE therefore becomes KH 03. The final level of discrimination is the PATCH TYPE. In the case of agricultural district surveys with 30 x 30 m quadrats the quadrats were generally chosen to fall completely within one habitat PATCH. In coastal foreshore environments and along lagoon and river fringes however even these relatively small sample quadrats were sometimes divided into patches. In the case of KH 03 on the edge of Grassdale Lagoon three patch types were being sampled, the vegetation fringing the lagoon, the emergent water plants and the floodplain woodland. The full designation for the sample site at Kelly Hill Quadrat Three would therefore be:  
KH 03 01 Lagoon edge, KH 03 02 Emergent vegetation, KH 03 03 Floodplain woodland

The increased time and effort needed to sample the vertebrate fauna to the standards developed for the Biological Survey of South Australia meant that only a sub-set of 120 of the 340 vegetation quadrats could be sampled. They were selected on the following basis:  
i) They provided a roughly even proportion of the number of quadrats within each of the 14 floristic

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groups indicated by a preliminary analysis of the vegetation survey data (Robinson 1990)

ii) They were distributed so as to achieve unbiased representation across the eight Environmental Associations on Kangaroo Island (Laut *et al* 1977)

iii) At least one quadrat was located within the boundaries of all National and Conservation Parks on the island.

An additional 29 quadrats were sampled for vertebrates during the Sooty Dunnart survey in February and March 1995.

The distribution of the vertebrate survey sample quadrats is shown in Fig. 2.

### SAMPLING TEAMS

The vegetation survey was carried out over two weeks in November 1989 using eight teams each of two field botanists. Different teams stayed in accommodation throughout the island (Table 7) to reduce the distance to quadrats and provide a place where plant specimens could be processed and data sheets completed each evening.

**Table 6.**  
**Location of base camps for the Kangaroo Island vegetation survey.**

GROUPS	WEEK 1	WEEK 2	WEEK 3	WEEK 4
A	Cape Borda	Cape Borda		
B	Cape du Couedic	Vivonne Bay		
C	Cape du Couedic	Vivonne Bay		
D	Rocky River	Rocky River		
E			Pelican Lagoon	Pelican Lagoon
F			Pelican Lagoon	Pelican Lagoon
G			Murrays Lagoon	Murrays Lagoon
H			Kingscote	Kingscote

The vertebrate survey was carried out over two consecutive two week blocks in October - November 1990. Each of ten quadrats per week were sampled over four days and four nights. During each fortnight there were three teams of three specialist biologists, a

mammalogist, an ornithologist and a herpetologist. Two vehicles were available for each team to enable the ten quadrats to be visited as early as possible each morning. As with the vegetation survey the teams stayed in accommodation spread over the island. (Table 8)

**Table 7.**  
**Location of base camps for the Kangaroo Island vertebrate survey.**

GROUPS	WEEK 1 21-26 Oct	WEEK 2 27 Oct- 3 Nov	WEEK 3 4-9 Nov	WEEK 4 10-16 Nov
1 + 4	Rocky River	Rocky River	Rocky River	Rocky River
2 + 5	Cape Borda	American River	American River	American River
3 + 6	Stokes Bay	Stokes Bay	Murrays Lagoon	Murrays Lagoon

Examples of sampling techniques in use in the field are shown in Figs 52-55

### DATA COLLECTION

On the vegetation survey, standard data sheets were filled out which included a standard description of the location and physical environment and the vegetation within the area of each quadrat. All vascular plants present in the quadrat were recorded and each survey team collected a herbarium specimen of each species encountered during their week of sampling. All specimens were lodged with the State Herbarium for identification or checking of field identifications and, depending on specimen quality, as many specimens as possible were incorporated into the Herbarium collection. Soil sampling and description was carried

out at the majority of the sample quadrats selected for the vertebrate survey. On the vertebrate survey each quadrat was sampled using a 50 m long line of six fenced pitfall traps. Traps used consisted of 455 mm x 380 mm sheet of white high impact polystyrene sheet joined into a cylinder using a slotted H section plastic strip (HM12). This resulted in a pitfall trap 125 mm in diameter and 380 mm deep. Using this system the hole depth could be cut when impenetrable rock was encountered. At only six quadrats (LI0401, CC0401, NB0201, LL0201, CD0701 and CG0801) on coastal sheet limestone or waterlogged ground was it not possible to establish a line of pitfall traps.



**Figure 50.**  
Setting up a harp trap for collecting bats at Emu Bay.  
Photo: D. Armstrong.



**Figure 51.**  
David Peake-Jones examining a tiny skink.  
Photo: B. St John.



**Figure 52.**  
**Cath Kemper wading in Larrikan Lagoon.**  
**Photo: G. Carpenter.**



**Figure 53.**  
**One of the numerous Brushtail Possums caught in cage traps during the vertebrate survey.**  
**Photo: D. Armstrong.**

A separate line of 15 Elliott traps was run in association with each pitfall line sampling the same habitat within the quadrat, and a possum/cat size trap was placed at each end. Reptiles and mammals were also sampled by searching each of the ten quadrats at least once during the sampling period.

Birds were recorded for each quadrat (or within each patch for the few quadrats with multiple patches). Observers spent from one to several hours during the best bird observation times of early morning and late afternoon and recorded all birds within or flying over the quadrat during the search period. An attempt was made to put the same amount of search effort into each quadrat during the best observation times. At each site all species of birds seen or heard were recorded. Each observation was noted separately, taking care not to recount individuals or groups of individuals. Care was also taken to exclude those species not associated with the site (e.g. species calling from adjacent vegetation types). If possible, sites were also visited at night to record nocturnal species. Twelve observers were responsible for ten sites each, at a rate of five sites per week.

Due to logistical difficulties the birds of seven sites were not surveyed during the study, leaving 113 sites to analyse.

A permanent photographic monitoring point was established at each quadrat using two 1.4 m long galvanised steel posts set 10m apart. The standard photographs are in Appendix I.

On both the vegetation and vertebrate surveys plants and vertebrates (especially birds and bats) encountered outside quadrats were recorded on special "opportunistic" data sheets. On Kangaroo Island because of the large amount of driving between widely scattered quadrats a large number of opportunist observations of birds and also road kills were recorded.

These opportunistic records were collected to allow:

- i) A more thorough inventory of the biota between quadrats, taking in habitats not represented by quadrats (particularly cleared farmland) and allowing some assessment of species' habitat utilisation of a greater array of habitats
- ii) Some assessment of variation in biota within habitats beyond that provided by the selected quadrats

iii) Sampling of certain vertebrate groups for which systematic quadrat-based methods are inappropriate, e.g. bats. The limited time for sampling may prevent any exhaustive inventories of bat communities; bats were mostly collected from sites such as pools and dams and other places where they congregate; e.g. flyways. Locations near or within quadrats were favoured. Mist-nets and harp traps were used for bat sampling

At least the first specimen of each small mammal and reptile species recorded in each quadrat was preserved as a museum specimen. In the case of larger species (ie. *Trichosurus vulpecula*, or *Notechis scutatus*) which had been extensively collected in the past and did not present any identification problems only a few road kill specimens were collected. In addition, to minimise the risk of the less easily distinguished species being overlooked, all captured specimens were examined by the appropriate specialist before being released. Larger series of taxonomically or biogeographically interesting species were taken, as required by the relevant curator at the South Australian Museum.

A small amount of vehicle and walking spotlight searching was carried out both on the quadrats and opportunistically, but the demands of quadrat sampling and specimen processing did not allow this to be carried out systematically.

Samples of liver tissue were taken from all specimens collected and stored in liquid nitrogen. The technique of allozyme electrophoresis was used to help identify difficult groups such as *Vespadelus* and *Sminthopsis*. Tissue samples from all mammals and reptiles are permanently stored at the SA Museum.

Invertebrates were collected from pitfall traps or opportunistically around each quadrat. These samples were lodged with the South Australian Museum. Examples of the field work in progress are shown in Figs 52-55. A summary of the sampling effort over the whole survey is given in Table 8.

The total number of observations of plants and vertebrates during the survey are shown in Table 9. It is this data base which forms the basis for the community analyses presented in this report.

**Table 8**  
**Trapping and spotlighting effort during the Kangaroo Island vertebrate survey**

Group	Week	Site	Pit Trap Nights	Elliot Trap Nights	Cage Trap Nights	Vehicle Spotlight Hours	Foot Spotlight Hours	Mistnet Hours	Harp Trap Nights
1	1	Rocky River	294	735	98	2	1	0	0
	2	Rocky River	240	600	80	1.5	0	0	2
2	1	Cape Borda	246	645	73	1.5	2	0	3
	2	American River	300	750	85	1	0	0	5
3	1	Stokes Bay	192	600	80	3.5	0	3	3
	2	Kingscote	192	560	72	0	0	3	4
4	3	Rocky River	240	600	80	2	0	4	1
	4	Rocky River	222	660	88	1.5	1	10	5
5	3	American River	290	750	99	4	0	0	0
	4	American River	300	750	100	1	0	0	4
6	3	Murray Lagoon	318	864	116	0	0	0	3
	4	Vivonne Bay	252	625	84	1.5	0	0	0
TOTAL			3086	8139	1055	19.5	4	20	30

**Table 9**  
**Total number of individual observations on the survey**

TAXON	Quadrats	Opportune	TOTAL
Plants	10275	95	10370
Mammals	1207	256	1463
Birds	3874	930	4804
Reptiles	851	116	967
Amphibians	245	10	255

#### DATA ANALYSIS

##### i) Vegetation Classification

Vegetation types and trends were determined using classification and ordination techniques described in Robinson et al (1988), Copley and Kemper (1992) and Belbin (1991). These techniques were modified to take advantage of the additional site survey data collected for the Kangaroo Island survey. The digital mapping of all native vegetation remnants also enabled further geometric analyses of patch sizes, fragmentation and distribution of mapped vegetation types within and outside the current reserve system.

The Kangaroo Island vegetation data was analysed using the PATN software package to analyse patterns and trends in the data (Belbin 1987), MINITAB

statistical software package to investigate the probability that observed trends and groupings occur by chance, and ESRI's ARC/INFO Geographical Information System software to display species and group distributions and analyse geographic trends in the data.

For a more comprehensive discussion of PATN procedures refer to Belbin (1987, 1991).

**Table 10**  
**Cover abundance scores from field data and the equivalent weighting used in the PATN analysis.**

Cover Abundance Score	Weighting used in analysis
+	0.1
1	1
2	2
3	3
4	4
5	5

##### ii) Mammals

The mammal community analysis was carried out on the complete quadrat data set with the exception of the few bat observations and those of introduced species encountered inconsistently and largely by sign on quadrats such as goats, cats, pigs and sheep. The introduced House Mouse, which was sampled consistently in the quadrats, was however included.

### iii) Birds

Because birds were sampled by direct observation and often included species such as galahs, corvids and birds of prey flying overhead which could not easily be assigned to a particular habitat, these species were left out of the community analysis. In addition, water birds and shore birds and waders were removed as were species which could only be identified to genus. This reduced the original number of 111 taxa recorded on quadrats to 61 for the final analysis.

### iv) Reptiles

Reptiles were recorded by a combination of pitfall trapping and quadrat searches and although the search effort varied to some extent because of time constraints and observer searching skill, the only reptiles not included in the community analysis were snakes, *Aprasia striolata* and *Varanus rosenbergi*.

## **VEGETATION MAPPING**

The vegetation was mapped from 1991 1:40 000 colour aerial photography. Additional information included the use of vegetation information obtained during DEP's (Department of Environment and Planning) vegetation and fauna surveys on KI in 1989, along with 1994 ground truthing of accessible areas of the island. The smallest mappable unit is approximately one hectare, and this is due to the scale of the aerial photographs used.

As much of the island's vegetation is remote with respect to access, there was a significant reliance placed on aerial photo interpretation. Interpretations are never completely accurate and variations from the descriptions may occur in local areas. A considerable amount of remnant vegetation on KI, particularly that occurring along roadsides and creeklines, was too narrow to map at the 1:40,000 scale and is therefore not represented.

Vegetation units were drafted onto 1:40,000 scale mylar film from the aerial photographs and then digitised and stored in ESRI's Arc/Info GIS software. This vegetation data is stored and maintained as part of the Environmental Database of South Australia in the Information and Data Analysis Branch, Planning SA.

## **COMPILATION OF BIOLOGICAL DATA**

Information from a variety of published and unpublished sources on Kangaroo Island was consulted to prepare the introductory sections of this report. As Kangaroo Island is one of the State Herbarium's plant distribution regions, data on all species recorded up to the time of the survey was

available. Information on distribution of the more interesting species and on potential taxonomic problems however were checked by consulting the Herbarium collections. The mammal and reptile collections at the South Australian Museum are computerised and specimen records for Kangaroo Island were extracted. Distribution data for some bird species was retrieved by hand. The RAOU Australian Bird Atlas computer file was also available as a source of bird records for the island.

