

APPENDIX 1: SUMMARY OF WILDLIFE SURVEY METHODS

Wildlife sampling with associated habitat and environmental description in the southern region of the Northern Territory, is based on quadrat-based transects (i.e. transects linked to representative habitat / vegetation quadrats). Some incidental observations are made outside of survey sites, and some special methodologies may be adopted in particular projects.

All fauna trapping is consistent with the guidelines set out in the *Animal Welfare Act 2000*.

Quadrat-based Transects

In the southern region, fauna trapping is based on a linear transect 250 metres in length which is linked to a representative habitat / vegetation quadrat 50 x 50 metres in size. Rectangular quadrats, with an equivalent area, may be used to sample narrow patches (e.g. riparian strips).

Quadrat-based transects (otherwise known as sites) should be located within substantial areas of relatively homogeneous vegetation and landform, and not near boundaries, fences, roads etc. The exception is when a deliberate decision is made to sample a small patch, edge or ecotone. Sites should be well separated (i.e. 500 metres or more apart) except where sampling adjacent contrasting land units.

Sites should be selected to be representative of the land units, vegetation types and land condition in the study area, along with a geographic spread. The number of habitats sampled and the number of sites per habitat will depend on the size and diversity of the study area, accessibility, and the time and resources available, as well as the aims of the study. In a general biological survey, it is desirable to have at least two sites in each habitat type present (widely spaced if possible to ensure spatial independence) with more sites in more heterogeneous or more widespread habitats. There are various methods to objectively stratify a study area for sampling but some on-ground experience and pragmatism is always required.

The location of each site should be determined as precisely as possible, preferably using averaged GPS reading. If revisiting the site is necessary (e.g. separate botanical visit, repeat trapping), mark a corner of the 50 x 50 metre quadrat with a star picket and record the orientation of the boundaries. In addition, record the orientation of the 250 metre transect in relation to the 50 x 50 metre quadrat.

Traps

The layout of traps at the site and trapping protocol is as follows:

- 25 Elliott traps spaced at 10 metre intervals along a 250 metre transect running through a 50 x 50 metre representative habitat / vegetation quadrat (i.e. transect extends beyond the boundary of the habitat / vegetation quadrat but does not extend beyond the homogenous habitat being sampled unless deliberately sampling ecotones etc.).
- Four pitfall traps (2 white and 2 black) scattered within the habitat / site being sampled (pitfall traps are not confined to the 50 X 50 metre habitat / vegetation quadrat nor located beyond the 250 metre transect). Each pitfall trap consists of a 20 litre plastic bucket and a 10 metre drift-fence. Pitfall traps are located in different micro-habitats in the habitat (e.g. in open ground; in dense grass; close to trees; in rocky areas). Where there is insufficient soil, or where the soil is too hard to sink 20 litre buckets, smaller buckets may be used.
- Traps locations are clearly marked with flagging tape so they can be easily located.
- Traps are opened for three consecutive nights.
- Traps must be checked early each morning, at midday and in the afternoon. During winter, the Elliott traps may be left open during the day. During summer,

the Elliott traps should be closed in the morning and re-opened in the afternoon. Elliott traps (and cage traps if used) should be re-baited each afternoon.

- Bait consists of a mixture of oats and peanut butter. Vanilla essence, cat biscuits and tuna etc., can be added.
- Trapped animals are identified and released near the point of capture, or retained for as short a time as possible for identification, measurement etc. Mammals may be marked by fur clipping and reptiles using 'whiteout' if information is required on re-captures during a particular trapping event.
- Hair tubes and cage traps may be used in some surveys to target particular species.

Bird Counts

Each site is censused for birds in the morning and evening on three consecutive days. Birds are counted for 15 minutes by slowly walking through the site, recording birds seen and/or heard within 50 metres either side of the line walked. The line walked is confined to the homogenous habitat in which the site has been established, but not necessarily to the transect used to trap fauna. In addition, birds are recorded during nocturnal visits. Avoid visiting the sites in the same order every day. The number of individuals of each species is recorded for each count. Only birds using the habitat are counted (i.e. birds merely flying across or overhead are not included but are noted as incidental records). Raptors etc., are included if they are hunting overhead.

Searches

Each site is actively searched five times for reptiles, amphibians, mammals, scats and other sign etc.

- Three searches during the day (morning, midday and late afternoon).
- Two searches at night using spotlights.
- Each search should take approximately 10 minutes involving turning rocks and logs, raking through leaf litter, looking under bark, looking in crevices etc. (all rocks, logs etc., should be put back in the same position).
- The number of individuals of each species seen is recorded.
- Scats, bones and other sign should be recorded where these can confidently be attributed to a species.
- Carnivore scats should be collected for hair analysis and labelled with the quadrat-based transect number and date.

Incidental Records

Species that are seen in the same habitat but are not attributable to a survey site, should be recorded as incidental records for that habitat with an appropriate abundance code to indicate they were not within the quadrat-based transect.

Other species seen in the general area that are not attributable to a survey site or surveyed habitat (opportunistic sightings), should be recorded separately on a list for the general area. Where possible, note the exact location and brief habitat details for the species. This is most important for species that have some conservation significance (e.g. rare, restricted, range extension).

Data Recording

Fauna records are entered onto a VisualCE database on a palmtop computer. Each species from the quadrat-based transect is recorded, along with a total abundance (the sum of all records from captures, searches, bird counts). Incidental records adjacent to the site are also recorded. Habitat and vegetation attributes within the 50 x 50 metre quadrat at each site are recorded on a separate palmtop database which has been designed to meet the needs of the southern region of the Northern Territory (a hardcopy proforma is given in Table A1.1). All bioregional resource assessment data is transferred from palmtops to an appropriate project database (e.g. ACCESS database), but data can be stored in other databases or species x site spreadsheets (e.g. Excel spreadsheets).

All fauna data is submitted to the Northern Territory Fauna Atlas. Plant voucher specimens are submitted to the Alice Springs Herbarium and entered into the Herbarium Holtze Database once processed.

Specimens

An example specimen should be collected for all captures that cannot be positively identified. Example specimens should also be collected for species which have not previously been reported from the area or have been very infrequently collected. This is particularly important if there can be any doubt about their identification.

- Vertebrates are killed by an injection of Nembutal directly into the heart (preferable) or into the abdominal cavity. For small lizards, a drop of Nembutal into the mouth is sufficient.
- Once the animal is dead, it should be fixed in 10% formalin. For most reptiles and small mammals, formalin should be injected at several points into the body cavity. Reptiles should be laid out neatly in a setting tray with Wettex soaked with formalin beneath and over the specimens. Small mammals should be fixed in jars of formalin. Larger mammals should have their abdominal and thoracic cavity opened with a short incision.
- After fixing (approximately three days), specimens should be transferred to 70% alcohol.
- Specimens should be labelled with a jeweller's tag with the quadrat-based transect number, date and collector. This information should also be recorded on a specimen sheet (which may also include some body measurements).

Bat Sampling

Bats are sampled once at each site using Anabat detectors for a period of 12 consecutive hours (i.e. over one night from 6.00 pm until 6.00 am). Bat calls are identified at a later stage with the aid of a catalogue of recorded reference calls.

Bats may also be opportunistically sampled using harp traps and mist nets, by sightings, captures in caves, and through the identification of audible calls (for a few species). For each, record details of location and brief habitat notes. For trapping, also record trapping time. It is usually appropriate to take basic measurements of all bats trapped. Reference calls on Anabat may be recorded from captured individuals.

Mist netting and harp trapping for bats in central Australia depends very much on the presence of suitable areas such as waterholes, creeks and rivers (wet and dry), and other flyways (J. Cole NRETA, pers. comm.).

Other Methods

Other methods may be adopted in particular surveys for certain taxa. These are not described here, but consideration should be given to:

- turtles;
- freshwater fish;
- freshwater invertebrates;
- aerial survey;
- macropods; and
- large goannas and snakes.

Consultation with locals, particularly Aboriginal people, may also be a very important source of information.

Table A1.1 Biodiversity Conservation (South) habitat and vegetation attribute proforma.

Site No.:	Survey type:	Quad. size: 30x30 50x50 other:	
Region:		Date:	Observer:
Site description & location details:		Landform pattern:	
Landform element:		Photo ref. no.:	
Co-ordinates (decimal degrees):		Datum: WGS84	
Run: Water run-on Water run-off Plain	Patch size: Small Medium Large		
Edge: Ecotone <u>or</u> Closest distance:	Adjacent land unit:		
Slope (°):	Aspect (° from north):		Altitude: metres asl
Climate (circle): 1 = Dry, plant stress; 2 = Dry, no plant stress; 3 = Recent rain, no vegetation response; 4 = Recent rain, noticeable vegetation response			
Disturbance impact categories: None Low Moderate High			
Fire impact:	Last fire: this year last year 2+ years ago long unburnt		
Rabbit damage:	introduced herbivores:		Pigs:
Weeds:	Other (describe):		
Substrate type (circle):			
Aeolian Sand	Clay	Laterite	Quartz Gravels
Alluvial Red Earth	Dolomite/Limestone/Marble	Leached mottled weathered rock	Quartz-arenites
Alluvial Sand	Felsic Volcanics	Limestone/Siltstone	Quartzite
Alluvium/Colluvium	Granitoids/Gneisses	Litharenites	Silcrete
Calcrete	Intermediate Metamorphics	Mafic Metamorphics & Intrusives	
% Bare ground:	%	% Outcrop:	% Rock / Stone: %
% Pebbles / Small stones (<0.6–2 cm):	0 <2 2-10 10-20 20-50 50-70 70-90 >90		
% Stones / Small rocks (>2–20 cm):	0 <2 2-10 10-20 20-50 50-70 70-90 >90		
% Rocks / Big rocks (>20–200 cm):	0 <2 2-10 10-20 20-50 50-70 70-90 >90		
% Boulders (>200 cm):	0 <2 2-10 10-20 20-50 50-70 70-90 >90		
Soil, soil crust, litter and log habitat:			
Soil (circle): Sand Sandy loam Loam Clay loam Clay Cracking clay Peat Rock Other:			
% Crust cover (of bare ground): %		% Litter cover (fixed & loose): %	
Number of fallen logs (>15 cm diameter in the quadrat):			
Vegetation structure:			
Vegetation strata	Dominant taxa (record in order of dominance)	Average ht. of strata (m)	% Cover of strata (circle)
Tree layer:			<10 10-30 30-70 >70
Upper shrub layer:			<10 10-30 30-70 >70
Lower shrub layer:			<10 10-30 30-70 >70
Ground layer:			<10 10-30 30-70 >70

Vegetation profile (% cover in height classes)		Notes:				
>10m:	0 <5 5-10 10-25 25-50 50-75 >75					
>5– 0m:	0 <5 5-10 10-25 25-50 50-75 >75					
>3–5m:	0 <5 5-10 10-25 25-50 50-75 >75					
>1–3m:	0 <5 5-10 10-25 25-50 50-75 >75					
>0.5–1m:	0 <5 5-10 10-25 25-50 50-75 >75					
0–0.5m:	0 <5 5-10 10-25 25-50 50-75 >75					

Floristics, % cover / abundance, phenology and fire response				
Cover / abundance classes:		Phenology (flowering / fruiting) at the population level:		
1 = <10% cover, very few individuals (1 – 5)		None Low Moderate High		
2 = <10% cover, occasional (6 – 50)		Fire Response at the population level:		
3 = <10% cover, common to abundant (>50)		K = Population killed		
4 = 10–30% cover, any number of individuals		R = Population resprouting		
5 = >30–70% cover, any number of individuals		V (K > R) = variable, more plants killed than resprouting		
6 = >70% cover, any number of individuals		V (R > K) = variable, more plants resprouting than killed		
		V (K = R) = variable, equal proportion killed and resprouting		
Plant taxa	% Cover	Flowering	Fruiting	Fire response
1.				
2.				
3.				
4.				
5.				
6.				
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22.				

Plant taxa	Phenology (flowering / fruiting) at the population level: None Low Moderate High			
	% Cover	Flowering	Fruiting	Fire response
23.				
24.				
25.				
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Plant taxa	Phenology (flowering / fruiting) at the population level: None Low Moderate High			
	% Cover	Flowering	Fruiting	Fire response
52.				
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An explanation of habitat and vegetation attributes in this proforma is given below.

Environmental variables

- Site No.** Unique label for each site.
- Survey type** Full or targeted – that is, full species complement or targeted survey for particular species (e.g. only woody taxa recorded; only taxa with >1% cover recorded). Could be a full floristic survey but targeted for a particular fauna species (e.g. full floristics as part of Central Rock-rat survey).
- Quad. size** Size of the survey quadrat (most quadrats in the Southern region will be 50 x 50 metres)
- Region** Usually park name, station name or sample region.
- Date** DDMMYYYY format
- Observer** The person deciding what data values go onto the sheet (not necessarily the scribe); given and surname in full.
- Description & location** Details about the site and its location in relation to roads, tracks, creeks, landscape features etc, sufficient for someone else to relocate it.
- Landform pattern** Choose from the following landform patterns (relief is metres above the plain):

No.	Landform pattern	Relief	Modal slope
1	Level plain	<9 m	<1%
2	Great undulating plains	<9 m	1–3%
3	Undulating plains	<9 m	3–10%
4	Rolling plains	<9 m	10–32%
5	Badlands	<9 m	>32%
6	Gently undulating rises	9–30 m	1–3%
7	Undulating rises	9–30 m	3–10%
8	Rolling rises	9–30 m	10–32%
9	Steep rises	9–30 m	32–56%
10	Badlands	9–30 m	>56%
11	Undulating low hills	30–90 m	3–10%
12	Rolling low hills	30–90 m	56–100%
13	Steep low hills	30–90 m	32–56%
14	Very steep low hills	30–90 m	56–100%
15	Badlands	30–90 m	>100%
16	Undulating hills	90–300 m	3–10%
17	Rolling hills	90–300 m	10–32%
18	Steep hills	90–300 m	32–56%
19	Very steep hills	90–300 m	56–100%
20	Precipitous hills	90–300 m	>100%
21	Rolling mountains	>300 m	10–32%
22	Steep mountains	>300 m	32–56%
23	Very steep mountains	>300 m	56–100%
24	Precipitous mountains	>300 m	>100%
25	Drainage line	variable	variable

- Landform element** Brief description of landscape setting of site (landform element). Choose from the following landform elements listed in the "Yellow Book" (McDonald *et al.*, 1990): crest; hillock; ridge; simple slope; upper slope; mid-slope; lower slope; flat; open depression (vale); closed depression.
- Photo ref. no.** If a photograph of the site is taken, record a photo reference number.
- Co-ordinates** Precise location / geocode (decimal degrees) from GPS.
- Datum** The datum in which geocode was collected (WGS84 is the default).
- Run** Water run-on sites receive run-off (e.g. swamps, base of hills); water run-off sites shed rainfall (e.g. hill crests, upper slopes); plains are extensive flat areas – circle the appropriate category.
- Patch size** Contiguous area of sampled habitat type (most relevant for restricted habitats such as Lancewood, rock outcrop) – circle the appropriate category.
- The following two edge variables are relevant where deliberately sampling ecotones or fragmented landscapes. In most cases however, sampling homogenous habitats / vegetation communities.
- Edge** Indicate if sampling an ecotone (site on the boundary) or the distance to nearest boundary (metres).

Adjacent land unit	The vegetation type or land unit adjacent to habitat being sampled.
Slope	Measured in degrees using a clinometer – estimate a mean slope for heterogeneous sites.
Aspect	The direction the slope faces expressed as degrees from north – leave blank for zero slope.
Altitude (optional)	Most reliably read off a topographic map (metres above sea level).
Climate	Time since rain assessed on a 1 to 4 scale where: 1 = Dry, and there is evidence of plant stress; 2 = Dry, but no evidence of plant stress; 3 = Recent rain but no evidence of vegetation response; or 4 = Recent rain and noticeable vegetation response. Additional notes: Dry – survey conducted during prolonged period in which no rain has fallen. Plants may show signs of stress depending on the length of time since rain. Recent rain (no visible impact on vegetation) – Some rain prior to or during survey, but either insufficient quantity or too recent to have made a visible impression on the plant community, other than some slight greening of shallow-rooted perennials. Recent rain (visible impact on vegetation) – Effective rain prior to survey (may be still raining during survey), sufficient to stimulate germination, especially of ephemeral taxa. With sufficient soil moisture, ephemeral plants will develop to maturity and growth and regeneration of perennials will be evident.
Disturbance	
Disturbance impact	Rate the impact of various disturbances for the quadrat (i.e. fire, rabbits, introduced herbivores (horses / donkeys / camels / cattle), pigs, weeds, other) as: None ; Low ; Moderate ; or High .
Last fire	Estimate from fire scars and regeneration whether the site was burnt during the current year (this year); the previous year (last year); fire scars present but apparently old (2+ years ago); or no sign of fire or its effects (long unburnt) – circle the appropriate category.
Substrate, soils and litter	
Substrate type	Broad classifications of the principal substrate types – circle the appropriate type.
% Bare ground	Estimate % cover of bare ground / soil other than rock for the quadrat that can be seen.
% Outcrop	Estimate % cover of outcropping rock for the quadrat that can be seen.
% Rock / Stone	Estimate % cover of rock / stone for the quadrat that can be seen.
Rock size	For rock / stone cover, estimate cover of rocks in size classes for the quadrat – circle appropriate % cover category for each size class. Rock sizes refer to the longest dimension on the rock. As there can be different sized rocks lying on other rock (e.g. small rocks lying on boulders), the sum of the values given for each size class does not necessarily equal 100% (i.e. may be >100%).
Soil	Broad texture classes relating to the amount of clay in the soil – circle the appropriate category; if other then choose the most appropriate texture class from the following texture classes listed in the "Yellow Book" (McDonald <i>et al.</i> , 1990): sand; loamy sand; clayey sand; sandy loam; fine, sandy loam; light, sandy clay loam; loam; loam, fine sandy; silt loam; sandy clay loam; clay loam; silty clay loam; fine sandy clay loam; sandy clay; silty clay; light clay; light-medium clay; medium clay; heavy clay).
% Crust cover	If biogenic soil crust is present, estimate % of the bare ground in the quadrat covered by crust.
% Litter cover	Estimate % cover of fixed and loose vegetation litter for the quadrat that can be seen (e.g. dead Spinifex attached to living clumps is included as fixed vegetation litter).

No. of fallen logs	Number of fallen logs greater than 15 centimetres in diameter in the quadrat.
Broad vegetation structure	
Vegetation structure	For the tree layer (generally single stemmed trees), upper shrub layer (>2 metres tall multi-stemmed woody plants and single stemmed sapling trees), lower shrub (1–2 metres tall single or multi-stemmed woody and slightly woody plants) and ground layer grasses, other herbaceous plants and slightly woody plants up to 1 metre tall), record the dominant taxa (in order of dominance), the average height (metres) of the strata overall, and % cover of the strata overall (circle the appropriate % cover class).
Vegetation profile	Estimate the cover of vegetation in different height zones – circle the appropriate % cover class in each height zone. The same plant could contribute cover to more than one zone.
Notes	The notes section in the proforma can be used to record additional information relevant to the site (e.g. evidence of feral predators on site).
Floristics, % cover / abundance, phenology and fire response	
Plant taxa	Record all plant taxa present in the quadrat.
% Cover	For each taxon, estimate % cover (projective foliage cover) using the following classes: 1 = <10% cover, very few individuals (1–5 individuals); 2 = <10% cover, occasional (6–50 individuals); 3 = <10% cover, common to abundant (>50 individuals); 4 = 10–30% cover, any number of individuals; 5 = >30–70% cover, any number of individuals; or 6 = >70% cover, any number of individuals. You may also record the actual % cover in brackets.
Flowering	Flowering (open flowers only). For each taxon, record flowering at the population level as: None ; Low ; Moderate ; or High .
Fruiting	Fruiting (mature fruit / seeds but excludes persistent dehisced fruit). For each taxon, record fruiting at the population level as: None ; Low ; Moderate ; or High .
Fire response	For each taxon, record fire response at the population level as: K = Population killed; R = Population resprouting; V (K > R) = variable, more plants killed than resprouting; V (R > K) = variable, more plants resprouting than killed; or V (K = R) = variable, equal proportion of plants killed and resprouting.