

Surveying Western Australia's Land Edge 2

Reference transects in coastal vegetation at Kalbarri, Mandurah and Albany,
Western Australia



C.Tauss 2005

The Western Australian Herbarium (W.A. Department of Conservation & Land Management)
Volunteers of the WA Herbarium's Regional Herbaria and
Coastwest (W.A. Department of Planning & Infrastructure)

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“The summer air is white with blowing sand. We live morning and night the way I did as a boy in Greenough. Thank God we don’t outlive all of our childhood fancies.”

Tim Winton (1993). *Land’s Edge*.

1. Introduction

This project is the second in a series entitled Surveying Western Australia’s Land Edge (SWALE) that was carried out as a collaboration between the volunteers of the WA Herbarium’s Regional Herbarium network, the Western Australian Herbarium (W.A. Department of Conservation and Land Management) and Coastwest (W.A. Department of Planning and Infrastructure). The primary aim of these projects was to record baseline data of flora and vegetation in permanent representative transects at selected areas along the south-west Western Australian coastline. The methods developed in the original SWALE project (Tauss, 2002) were extended in the current project to include transects at Kalbarri, Mandurah and Albany. In SWALE 2, Coastwest specifically requested that some transects be established in areas where there was significant environmental degradation. The data collected from the latter transects will be very useful in planning community rehabilitation efforts for these degraded areas. As in the original SWALE project, fully annotated voucher specimens were collected for most of the flora species recorded in SWALE 2. The voucher specimens were lodged in the WA Herbarium (with duplicates remaining with the respective Regional Herbaria). All the specimen data was captured electronically and is available on the WA Herbarium’s website Florabase (<http://florabase.calm.wa.gov.au>). The vegetation and floristic data collected in the SWALE 2 transects will be valuable to monitor changes over time and inform future environmental management.

There have been a number of previous vegetation and flora studies of the coastal areas chosen for the SWALE 2 project. A vegetation reconnaissance study of the Western Australian coast (Sauer, 1965) included transects at the Blowholes in Torndirrup National Park (Albany), Point Grey at Geraldton and at Rockingham. The SWALE transects were modelled on methods used in the Sauer (1965) study. Keighery *et al.* (1995) compiled floristic data of the limestone flora at the Zuytdorf National Park, north of Kalbarri. Extensive collections of the Kalbarri region have been made by volunteers Don and Barbara Bellairs at Kalbarri and these collections are now incorporated into the Kalbarri Regional Herbarium. The relationships between the coastal vegetation and landforms of the Quindalup Dunes were described by Semeniuk *et al.* (1989). The Peel-Harvey Inlet flora and vegetation was studied by Backshall and

Bridgewater (1981) and a geographic information systems study of the vegetation of the area was conducted by Glasson *et al.* (1995). In the Yalgorup National Park, previous flora studies include those of Fox (1980) and Bridgewater and Zammitt (1979). More recently, the study of Trudgen (1991) and collections by Peg Foreman and Jack Kelly for the Mandurah Regional Herbarium have greatly extended the knowledge of the flora in this area. The quadrat-based study of the Albany area by Sandiford (2000) and general collections by Eileen Croxford, Coralie Hortin and other volunteers have contributed to the largest regional herbarium in Western Australia at Albany.

The SWALE projects were not intended as a comprehensive survey of the coastal flora and vegetation of the South West Western Australian region. Such a survey has yet to be accomplished and would require extensive sampling from representative sites selected on the basis of a rigorous classification of coastal types (in terms of climatic, geological and geomorphic features). Only the latter would allow an adequate overall assessment of the conservation values and management needs of our coastal biodiversity and geoheritage. The SWALE transects were simply cameos that focussed on discrete areas of high conservation value chosen largely on the basis of availability of willing and capable volunteers. Despite this very limited approach, the data collected has highlighted the species richness and variety that is expressed over the climatic range encompassed by coastal south west Western Australia.

All transects at Kalbarri and Albany were located in National Parks in areas with conservation values of national significance (Table 1). Similarly in the Mandurah area, the Seal Rock transect was established in an area of high conservation values in the Yalgorup National Park. The other two Mandurah transects were established in relatively degraded areas. The second Mandurah SWALE 2 transect was located in the Creery Wetlands that are experiencing the adverse impacts of large scale anthropogenic environmental changes. Although this area is within the internationally significant and Ramsar-listed conservation area, much of the estuarine wetlands surrounding it have been recently decimated by canal and urban development. The purpose of this transect was to survey in detail the floristics of one of the transects that was originally established by Glasson *et al.* (1995) in their digital mapping of the vegetation of the Peel – Harvey Inlet subsequent to Dawesville Cut. The third Mandurah transect was located in a degraded, narrow coastal strip reserved subsequent to the development of the Florida Beach housing estate. It illustrates the fate of much of the Western Australian coastline where real estate development overrides the natural environment.

Table 1: Conservation values of SWALE transect areas

Conservation values	
Kalbarri	
Jakes Point	National significance as part of Kalbarri National Park in terms of biodiversity, geology and landforms. Jakes Point also has cultural significance, being listed as one of the 10 best surf breaks in Australia.
Red Bluff	
Goat Gulch	
Mandurah	
Seal Rock area	National significance as part of Yalgorup National Park due to biodiversity and geoheritage conservation values.
Creery Island	Part of the globally significant, Ramsar-listed Creery Wetlands.
Florida Beach	Landforms, flora and vegetation highly modified. Coastal vegetation important in reducing erosion risk to adjacent houses.
Albany	
Sharp Point,	National significance as part of Torndirrup National Park, Vancouver Peninsular National Park and Two Peoples Bay National Park with regard to biodiversity and landforms.
Goode Beach,	
Little Beach	

2. METHODS

Location of transects

The transects were designed to include a selection of typical coastal vegetation in each of the project areas as well as some areas that highlighted unusual or unique features of each region (Table 2). As in the original SWALE project, the practical constraints of the project largely determined the length of transect established in each case.

Vegetation and flora

Colour aerial photographs (from the Department of Land Administration, flown in 2000) at a scale of 1:5000 were used to map vegetation units and select sites for transects. These aerial photos will be useful to assess (in a general way) the vegetation changes over time that occur in the future adjacent to the transects.

Vegetation structure terms used for describing vegetation mapping units in this study (Table 3) were modified from Specht (1981). The transects were marked out using a 50m tape measure, aluminium pegs and flagging tape. The number of permanent markers was kept to a minimum for aesthetic and safety

reasons. Geographic positioning system (GPS) readings were taken to provide location information for the voucher specimen database and as the main method of permanently locating transects.

Table 2: Transect locations and lengths

Transect Name & Code	Location	Length (m)
Jakes Point JP	Kalbarri National Park, Kalbarri Lat: 27° 44' 6.300" S Long: 114° 8' 46.800" E	50
Red Bluff RB	Kalbarri National Park, Kalbarri Lat: 27° 44' 40.100" S Long: 114° 8' 37.400" E	105
Goat Gulch GG	Kalbarri National Park, Kalbarri Lat: 27° 47' 15.000" S Long: 114° 7' 13.000" E	156
Creery Island (Long Island) LI	Creery Wetlands, Mandurah Lat: 32° 33' 22.000" S Long: 115° 43' 55.000" E	100
Florida Beach FB	The transect is located just south of golf course at Florida Beach, a southern suburb of Mandurah	85
Seal Rock SR	Yalgorup National Park (south of Tim's Thicket) Lat: 32° 40' 29.100" S Long: 115° 36' 28.700" E	295
Sharp Point SP	Torndirrup National Park, Albany Lat: 35° 6' 21.600" S Long: 117° 52' 0.500" E	156
Mistaken Island MI	Goode Beach (near Mistaken Island), Albany Lat: 35° 3' 40.600" S Long: 117° 56' 16.500" E	161
Little Beach LB	Two People's Bay National Park, east of Albany Lat: 34° 58' 17.600" S Long: 118° 11' 39.500" E	86

Table 3: Vegetation structure classifications (modified from Specht 1981).

Tallest Layer	Foliage 100-50%	projective cover 50-30%	of tallest 30-10%	layer <10%
trees < 10m	low closed forest	low open forest	low woodland	low open woodland
shrubs > 2m	closed scrub	scrub	open scrub	tall open shrubs
shrubs < 2m	closed heath	heath	open heath	low open shrubs
Perennial sedges & rushes	closed sedges	sedges	open sedges	sparse sedges

Small specimens of all species (both mature and seedling specimens) occurring in the vicinity of the marked out transect were collected to make temporary field herbaria on site. Each specimen was labelled with a standard field name that was decided upon by the group. (Note: many of these field names were simply abbreviated descriptions of the most obvious distinguishing features of the plant e.g. "tiny herb

with grey hairy leaves” not scientific names). The field herbarium activity served as informal botanical training to familiarize participants with the flora of each area prior to commencing the survey. It also enabled consensus to be reached about standard field names for each taxon so all participants recorded the same field names as they matched the plants included in their field herbaria with plants occurring in their quadrats during the survey. The transects were surveyed as a 1m wide belt recording flora from a continuous series of 1m² quadrats over a 50m measuring tape (Fig 3b), (after Sauer,1965). Presence of all flora taxa in the quadrats was recorded using field names from field herbaria, projected foliage cover class and height of plant. A modified Braun-Blanquet (1951) system was used to group projected foliage cover of each taxon encountered in the quadrat in the following classes.

Cover Class: **1.** < 5%

2. > 5% and <25%

3. >25% and <75%

4. > 75%

Both adult and juvenile forms of the entire flora were recorded and notes were kept about the state of maturity of the plants observed (eg. seedling, flowering or fruiting states).

Standard protocols developed by the WA Herbarium for the Regional Herbarium Program were used for collection of flora voucher specimens, recording collection notes and specimen processing, curation, databasing and incorporation. Collecting notes accompanying each specimen included: collectors name and number, date, field identification name, habit, size, flower colour, landform, soils, vegetation structure, associated taxa, condition of vegetation, locality statement and GPS coordinates. Specimens were labelled with the collector’s name and number and then pressed, dried and delivered to the WA Herbarium with labelled duplicate specimens and collecting notes retained at the respective Regional Herbarium. Each batch of specimens received by the WA Herbarium was frozen to destroy any insect contamination. The specimens were identified by Herbarium botanists, mounted by volunteers of the WA Herbarium on standard sheets and databased. The databasing process assigned each specimen with a unique database number and all the relevant data about the specimen from the collecting notes was incorporated into the electronic database and onto a printed label to be affixed to the specimen sheet. Duplicate labels were sent to the respective Regional Herbarium. The specimens were then incorporated into the Western Australian Herbarium collection and stored under controlled atmospheric conditions.

Landforms and sediments

Topographic survey of landforms for each transect was undertaken using a laser level.

Stratigraphy at selected sites was investigated by shallow digging and materials were subsequently examined using a stereoscopic microscope. Surface sediments were described directly in terms of grain size, texture, colour and presence of organic matter without resort to soil classification systems. The terms used to describe sediments (Table 4) were based on grain size as per the Wentworth scale (Krumbein & Pettijohn, 1938). Sediment fabric was defined by the size particles forming the framework and the size of interstitial particles (Table 5).

The types of wetlands in or near the transects were classified using terms from the geomorphic classification of wetlands (Semeniuk & Semeniuk, 1995).

Table 4: Sediment definitions: grain size

Term used in this study	Size class of grains (mm)
gravel	>2
very coarse sand	1-2
coarse sand	0.5-1
medium sand	0.25-0.5
fine sand	0.125-0.25
very fine sand	0.063-0.125
mud or peat	<0.063

Table 5: Sediment definitions: fabric

Descriptor	Definition
sand	Sand-sized particles dominant (>90%).
humic sand	Sand grains coated with a thin layer of fine organic particles dominant (>90%).
muddy (or peaty) sand	Sand particles form the frame (>60%) with some interstitial mud-sized particles (or peat) also present.
sandy mud (or peat)	Mud (or peat) sized grains dominant (>60%) and support some sand grains.
mud (or peat)	Mud sized grains dominant (>90%).

3. THE SWALE 2 TRANSECTS

The SWALE 2 transects were described in the context of the physical setting of each region with regard to climate, geology and landforms (Table 6). Definitions of the terms used are listed in the glossary (Appendix 1).

Table 6: Physical setting of the SWALE 2 transects

Transect	Climate	Geology	Landforms
KALBARRI Jakes Point Red Bluff Goat Gulch	Semi arid	Holocene aeolian deposits over Tumblagooda Sandstone and occasional Pleistocene (Chinaman's Rock) limestone. Tumblagooda Sandstone Pleistocene Tamala Limestone over Tumblagooda Sandstone	Rocky shore and perched dunes Rocky shore with cliffed slope and plateau Cliffs about 70m in height, slopes of steep valley tract and plateau
MANDURAH Long Island Florida Beach Seal Rock	Sub humid	Holocene aeolian and estuarine deposits Aeolian Holocene deposits Aeolian Holocene deposits. Pleistocene Tim's Thicket Limestone. Pleistocene limestone ridge (Bouvard Reefs)	Dune and supratidal flats of shoal in active delta of estuary Low dunes modified by human activity Foredune & parabolic blowout. Inland limestone ridge and dampland in old embayment. Rocky shore and offshore reefs
ALBANY Sharp Point Goode Beach Little Beach	Sub humid	Limestone over Proterozoic gneiss Holocene quartz sand over estuarine & lagoonal deposits and over Proterozoic gneiss. Holocene peat and quartz sand over Proterozoic gneiss	Plateau with low perched dunes truncated at the Southern Ocean by steep cliffs about 170m in height. Tombolo with a foredune on the ocean side and a rocky slope and perched dune towards the harbour side Sheltered beach of rocky bay. Supratidal flat and paluslope seaward of a perched dune.

The SWALE 2 transect locations were deliberately chosen to illustrate some of the large range of the geology, landforms and biodiversity of coastal settings between the semi-arid climate at Kalbarri, the subhumid western coast at Mandurah and the subhumid, southern coast at Albany (Fig 1). At Kalbarri, the Red Bluff (Fig 2) transect illustrated the vegetation of the Tumblagooda Sandstone cliffs adjacent to the Indian Ocean. At the Goat Gulch transect (Fig 3) the Tumblagooda Sandstone formed much taller cliffs and was overlaid by a capping of Tamala Limestone, thus the vegetation of this transect could perhaps be seen as having a closer alliance to that of the coastal cliffs north of Kalbarri than the Red Bluff vegetation. The setting of the Creery Wetlands (Fig 4) in the Holocene estuarine shoals at the Peel-Harvey Inlet at Mandurah was very different to the other SWALE 2 transects. At Jakes Point (Kalbarri), Seal Rock (Fig 5) and Florida Beach (Mandurah) and Goode Beach (Albany) the foredunes of the transects were Holocene dunes. Climatic and edaphic differences between the latter transects however set the stage for variations in vegetation and floristics. The tall cliffs of the Torndirrup National Park at Albany (Fig 6) were in many respects similar to the tall cliffs at Kalbarri however there were major geological and climatic differences between the Sharp Point and Goat Gulch transects. The final transect at Little Beach (Two Peoples Bay near Albany) contrasted sharply with all other transects surveyed in SWALE being a very unusual freshwater wetland immediately adjacent to the high energy Southern Ocean in a subhumid climatic setting. In some aspects, the Holocene dune settings at Kalbarri and Mandurah paralleled the Drummond Cove and Port Kennedy transects respectively in the first SWALE project. Likewise, the Goode Beach transect was somewhat similar in setting to the quartz sand beach at the Hellfire Bay transect and the granite outcrop at the Cape Le Grand transect respectively of the first SWALE project.



Figure 1: SWALE and SWALE 2 transects locations and rainfall



Figure 2: Tumblagooda Sandstone cliffs at Red Bluff Kalbarri National Park



Figure 3: Tamala Limestone over Tumblagooda Sandstone at Goat Gulch, Kalbarri National Park



Figure 4: Creery Wetlands, Peel-Harvey Estuary, Mandurah



Figure 5: Seal Rock, Yalgorup National Park, south of Mandurah



Figure 6: Torndirrup National Park, Albany. Limestone over Proterozoic granite and gneiss cliffs



Figure 7: A fresh water paluslope wetland adjacent to marine embayment at Little Beach, Two People's Bay National Park, Albany.