# VEGETATION AND FLORA OF PART OF THE

# F O R T E S C U E  S A M P H I R E  F L A T

# PILBARA REGION, WESTERN AUSTRALIA.

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TABLE 1

MONTHLY MAXIMUM AND MINIMUM TEMPERATURES (°C) RECORDED AT REDMONT (15 years) AND WITTENOON (28 years)

Upper line of data is Redmont, lower Wittenoon.

| | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Av. maximum | 39.6 | 38.5 | 37.1 | 33.5 | 28.6 | 24.8 | 24.7 | 27.3 | 31.6 | 35.4 | 38.4 | 39.9 |
| Av. " | 39.5 | 37.8 | 36.9 | 33.0 | 27.6 | 24.5 | 24.0 | 26.6 | 30.8 | 35.0 | 37.7 | 39.5 |
| Av. minimum | 25.0 | 24.5 | 23.4 | 20.4 | 16.0 | 12.7 | 11.7 | 13.0 | 15.3 | 18.2 | 21.3 | 24.0 |
| Av. " | 26.0 | 25.2 | 24.4 | 21.0 | 16.0 | 12.8 | 11.2 | 13.2 | 16.6 | 20.4 | 23.5 | 25.4 |
| Highest | 46.0 | 46.1 | 43.1 | 40.0 | 35.2 | 30.6 | 31.9 | 35.0 | 38.8 | 41.6 | 45.0 | 47.0 |
| Highest | 46.7 | 47.5 | 43.9 | 41.3 | 36.1 | 32.2 | 31.1 | 34.4 | 38.0 | 42.8 | 44.7 | 46.2 |
| Lowest | 15.2 | 18.1 | 15.8 | 12.6 | 7.3 | 4.7 | 5.6 | 3.5 | 6.4 | 7.0 | 11.8 | 16.0 |
| Lowest | 17.2 | 15.0 | 12.8 | 11.0 | 5.6 | 1.4 | 1.6 | 3.4 | 6.7 | 6.7 | 12.2 | 6.7 |

TABLE 2

AVERAGE RAINFALL (mm) AND NUMBER OF RAINDAYS RECORDED AT REDMONT (35 years) AND WITTENOON (36 years)

Upper line of data is Redmont; lower Wittenoon.

| | J | F | M | A | M | J | J | A | S | O | N | D | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Av. rainfall | 65 | 62 | 70 | 25 | 13 | 16 | 9 | 6 | 1 | 5 | 9 | 29 | 310 |
| Av. " | 96 | 90 | 63 | 21 | 30 | 27 | 14 | 10 | 3 | 3 | 9 | 39 | 405 |
| Av. raindays | 6 | 5 | 5 | 2 | 2 | 2 | 1 | 1 | 0 | 1 | 1 | 4 | 30 |
| Av. " | 8 | 8 | 5 | 3 | 4 | 2 | 2 | 2 | 1 | 1 | 2 | 4 | 42 |

Cyclones frequently cause physical damage to the vegetation.

## 4. GEOLOGY

The geology of the general area has been described and mapped at the scale of 1:250,000 (MacLeod & de la Hunty 1965). The Fortescue River runs along a narrow, down-faulted block. In some places the rift valley has been filled with Quaternary sediments. Scattered along the margin of the flat are outcrops of the Tertiary Oakover Formation of limestone and calcareous gravels. The latter were not sampled for vegetation and flora. Other materials in the Quaternary sediments have been derived from the flanking plateaux of Banded Ironstone Formation.

## 5. LANDFORMS

The flat is level with less than 30 cm internal relief in most places. One site, (F4), appeared to be a few cms above the general plain level and has poorly developed gilgai.

## 6. SOILS

Soils of the general area have not been described. Halophytic vegetation indicates saline to sub-saline soils. They are generally well-drained and red. Two reasonably distinct types were present:

(a) Most of the flat consisted of a multi-strata alluvial soil with a loamy sand A-horizon. Gypsum crystals, up to 3 mm long, were usually present in the various lenses of the B horizon.
(b) A crumbly soil was present in the gilgai areas. Its vegetation suggested a lower salinity level than in the other soil type. Annuals may survive by heavy falls of rain depressing the saline water-table.

## 7. VEGETATION

The vegetation has been described and mapped at the scale of 1:1,000,000 (Beard 1975). Vegetation of the samphire flat was classified as "Unwooded succulent steppe; saltbush, bluebush, samphire - dominated by various halophytes". My single traverse indicated two distinct vegetation types: samphire, and perennial woody shrubs over bunchgrass. The samphire was further divided into three plant associations (Table 3). Detailed descriptions of plant associations are presented in Appendix I.

TABLE 3

PROPORTION OF PLANT ASSOCIATION COVER OF FORTESCUE FLAT
(Subjectively assessed from single field traverse)

| Plant Association | % |
|---|---|
| Halosarcia indica ssp. bidens Low Heath D | 70 |
| Halosarcia auriculata Dwarf Scrub C | 9 |
| Muellerolimon salicorniaceum Low Scrub B | 5 |
| Sida fibulifera Open Dwarf Scrub D | 1 |
| Ecotone | 15 |

### 7.1 Conservation

Samphire flats cover only a small proportion (ca 0.3%) of the Pilbara sheet (Beard 1975). Most patches are coastal being within the area covered by tidal movement of the sea. The Fortescue flat is the only inland patch of samphire. Being large in area, conservation of some of the flat should be investigated.

## 8. FLORA

The Fortescue flat is within the Fortescue Botanical District of the Eremaean Botanical Province (Beard 1980). Plant species recorded on the field traverse are listed in Appendix II, together with life form and a subjective assessment of frequency and cover/abundance. Vascular plants consisted of 56 species and 2 subspecies of flowering plants. One of the species was introduced. Families with the most taxa were Chenopodiaceae (13), Poaceae (12), Amaranthaceae (5) and Papilionaceae (5). Genera with most taxa were Maireana (5), Ptilotus (5) and Swainsona (4).

Annuals (AG and AS) were the main life form present with 23 taxa, or 39.0% of taxa recorded. Following were dwarf shrubs (DS) with 12 taxa (20.3%), perennial grasses (PG) with 6 taxa (10.2%) and small shrubs (SS) with 3 taxa (5.1%).

### 8.1 Conservation

No species of Gazetted Rare Flora (Anon 1991) was recorded. One taxon was represented by a single specimen in the Western Australian Herbarium (PERTH) and should be surveyed as potential Rare Flora: Eremophila sp. (KRN 10210). The specimen in PERTH was without a locality (R.J. Chinnock pers. comm.). One taxon appeared to be new to science: Halosarcia sp. (KRN 10243) (P.G. Wilson pers. comm.). Only scattered plants of Eremophila sp. (KRN 10210) were observed, but Halosarcia sp. (KRN 10243) was common in two of the three halophytic plant associations. These populations are on pastoral leases and their conservation needs assessment.

## 9. ACKNOWLEDGEMENTS

Partial financial assistance was provided by the Australian Biological Resources Study, administered by PERTH. Funds were provided for contract collection of plant specimens in the Pilbara. While collecting plants, KRN undertook the recording of site data in his own time.

Assistance with the identification of difficult plants by is gratefully acknowledged: N.S. Lander (Streptoglossa) and P.G. Wilson (Asteraceae and Chenopodiaceae) of the Western Australian Herbarium; A.S. Weston (general) of 8 Pitt St, Victoria Park, Perth; R.J. Chinnock (Eremophila) of South Australian Herbarium; and R. Carolin (Goodeniacae) of University of Sydney. The Bureau of Meteorology, Perth, made available climatic data.

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# APPENDIX I

## Descriptions of Plant Associations

Listed below are descriptions of typical sites for each plant association, including data on geology, landform, soils, vegetation structure and species compositon. The classification of vegetation structure is based on Muir (1977). The plant associations are ordered firstly by tallest to shortest vegetation, and secondly from densest to scarcest upper stratum. If more than plant association has the same density class, then they are order alphabetically by dominant species in upper stratum.

Figures in brackets following plant names are per cent canopy cover (CC) of Muir (1977). Taxa with less than 0.1% CC are indicated by a (+). "Misc." (miscellaneous) plants includes annuals, aquatics, climbers, ferns, geophytes, parasitic climbers, perennial grasses, sedges and sedge-like (plants). "KRN" numbers are K.R. Newbey collecting numbers and a reference specimen is lodged in the Western Australian Herbarium (PERTH). An asterisk indicates an introduced species. The period since the last fire ("last burnt") was estimated from observations in nearby areas where the year of the last fire is known.

"Bedrock" refers to major rock type. "Geological surface" is that shown on the Roy Hill 1:250,000 geological map (MacLeod & de la Hunty 1965).

The surface cover of rock, stone, pavement and litter was visually estimated. For explanation of litter see Muir (1977). Note that the present study divides leaves into broad, narrow and terete; Muir (1977) separates them only into broad or terete.

To sample the soil profile, a hole, 62 mm in diameter, was augered to a depth of 1 m where possible. Soil colour was determined in a moist condition using Fujihira Standard Soil Colour Charts. Munsell colour names are listed for most colours and used whenever possible. Where Munsell names are not listed, P.C.C.S colour names listed on the charts are used and enclosed in " ". The degree of calcareousness is according to the system of Northcote (1971), but is only listed if pH is 8.0 or higher. pH is estimated to nearest 0.25 using Soil pH Testing Kit (Inoculo Laboratories, Melbourne). Soil nomenclature generally follows Northcote (1971). Comments on soil profiles more than 1 metre thick are based on observations nearby where similar profiles were exposed e.g. trenches for mineral exploration.

The first site description (F1) is presented in full. The other three do not list attributes which have the same class as (F1). Some attributes are missing for all sites: AMG (Australian Map Grid co-ordinates), elevation, air photo data, sub-province and infiltration.

SITE DATA

LOW SCRUB B (SBi)

(F1) Muellerolimon salicorniaceum Low Scrub B

STUDY: Fortescue Samphire Flat Survey SITE No: PL001 SURVEYOR: NEWK
LOCATION: 22.5 km NE of Mt. Marsh
Lat. 22°24'50" Long. 119°25'20" 28/06/1984
MAP SCALE: 1:250,000 SERIES: Geol. Surv. TITLE: Roy Hill
No: SF 50 - 12 SITE AREA: Plotless, 0.4 ha ASPECT: Level
1:250,000 SHEET: Roy Hill ZONE: 50 ELEVATION: -
AIR PHOTO RUN: - FRAMES: - DATE: - SCALE: -
LAND TENURE: Pastoral Lease LAST BURNT: No evidence of burning
DISTURBANCE: Moderately grazed
ADMINISTRATION: - AREA NAME: Fortescue Flat

LAND REGION: Northwestern PROVINCE: Pilbara
SUB-PROVINCE: - SYSTEM: Not documented

GEOL. REGION: Province LOCAL: Down-faulted block
BEDROCK: ? Limestone SURFACE: Qa

LANDFORM
PATTERN TYPE: Level Plain PATTERN: Saline flat
UNIT: Whole pattern ELEMENT: Whole pattern
DRAINAGE PATTERN: Absent SPACING: Absent
SLOPE LENGTH: 1-8 km INCLINATION: Level
EXPOSURE: Inland, moderate AGENT: Particle fall

LAND SURFACE
EROSION: Absent WIND: Absent SHEET: Absent
RILL: Absent GULLY: Absent GULLY DEPTH: Absent
STREAM BANK: Absent TUNNEL: Absent WAVE: Absent
MASS MOVEMENT: Absent ACTIVITY: Aggraded
FREQUENCY: Seldom MICRORELIEF: None
SOIL: Surface crust INUNDATION FREQUENCY: Greater than 1 per year
DEPTH: Less than 5 cm DURATION: 1-20 days
RUN-OFF VELOCITY: Low INFILTRATION: ?
ROCK: No exposure STONE: Absent
PAVEMENT: Absent
LOGS: Absent BRANCHES: Absent
LEAVES: Absent
SOIL PROFILE
OBSERVATION: No other THICKNESS: Deep (greater than 1 m)
MAIN ORIGIN: Alluvial MINOR: Colluvial
ATTRIBUTE: Salinity DRAINAGE: Poor
SRT: Alkaline SALINITY: High
NORTHCOTE: Um4.41-3/0/18/8 SOIL GROUP: Solonack
NAME: Salina - Damp Phase

| | | |
|---|---|---|
| A | 0-18 cm | Weak red (10R 4/4) loam; humus not obvious; roots absent; consistence very firm; pH 8.0; not calcareous; not water repellent; boundary clear, smooth. |
| B21 | 18-32 cm | Red (10R 4/6) sandy light clay; consistence moderately |

| | | |
|---|---|---|
| | | strong; pH 7.75; boundary gradual, smooth. |
| B22 | 32-50 cm | Red (10R 4/6) sandy loam; consistence moderately strong; pH 7.75; boundary gradual, smooth. |
| B23 | 50-100 cm | Dark red (10R 3/6) light clay; clay content increasing slightly with depth; inclusions 3-5% gypsum crystals 1-3 mm long; consistence moderately strong; pH 8.0; not calcareous. |

VEGETATION
PROVINCE: Eremaean DISTRICT: Fortescue SYSTEM: Not defined
MUIR: SBr.SCi.SDi.Jr No of TAXA: 10

STRATUM 1: Shrubs 1.1-1.5 m, CC = 2, clumping none Muellerolimon salicorniaceum (2).
STRATUM 2: Shrubs 0.6-1.0 m, CC = 10, clumping none Muellerolimon salicorniaceum (10).
STRATUM 3a: Shrubs 0.0-0.5 m, CC = 22, clumping none Halosarcia indica ssp. bidens (10), H. auriculata (7), H. sp. (KRN 10243) (3), Frankenia sp. (KRN 10214) (2), Enchylaena tomentosa var. tomentosa (+).
STRATUM 3b: Misc. plants, CC = 2.5, clumping none ANNUALS: Cressa cretica (1), Eragrostis falcata (1), Nicotiana rosulata (0.5), Swainsona sp. (KRN 10191) (+).

DWARF SCRUB C (SCi)

(F2) Halosarcia auriculata Dwarf Scrub C

STUDY: Fortescue Samphire Flat Survey SITE No: PL002 SURVEYOR: NEWK
LOCATION: 22 km NE of Mt. Marsh
Lat. 22°25'00" Long. 119°25'00" AMG: ? E ? N 28/06/1984

SOIL PROFILE
ATTRIBUTE: Salinity DRAINAGE: Poor
SRT: Alkaline SALINITY: High
NORTHCOTE: Um4.41-3/0/18/8 SOIL GROUP: Solonack
NAME: Salina - Damp Phase

| | | |
|---|---|---|
| A | 0-18 cm | Red (10R 4/6) sandy loam; humus not obvious; roots absent; consistence very firm; pH 8.5; not calcareous; not water repellent; boundary clear, smooth. |
| B21 | 18-32 cm | Red (10R 4/6) clayey sand; inclusions 5-10% gypsum crystals 1-3 mm long; consistence very firm; pH 8.25; slightly calcareous; boundary clear, smooth. |
| B22 | 32-51 cm | Red (10R 4/6) sandy loam; inclusions 5-10% gypsum crystals less than 1 mm long; consistence very firm; pH 8.75; slightly clacareous; boundary clear, smooth. |
| C | 51-?? cm | Hardpan - too hard to auger deeper. |

VEGETATION
MUIR: SCi.SDr.Jr No of TAXA: 11

STRATUM 1: Shrubs 0.6-1.0 m, CC = 12, clumping none Halosarcia auriculata (12), Muellerolimon salicorniaceum (2), Eremophila sp. (KRN 10210) (+).
STRATUM 2a: Shrubs 0.0-0.5 m, CC = 7, clumping none Halosarcia indica ssp. bidens (3), Enchylaena tomentosa var. tomentosa (2), H. sp. (KRN 10243) (1), Maireana luehmannii (1).
STRATUM 2b: Misc. plants, CC = 7.1, clumping none ANNUALS: Eragrostis falcata (4), Nicotiana rosulata (3), Ptilotus exaltatus var. exaltatus (+). GEOPHYTES: Cyperus bulbosus (0.1).

LOW HEATH D (SDc)

(F3) Halosarcia indica ssp. bidens Low Heath D

STUDY: Fortescue Samphire Flat Survey SITE No: PL003 SURVEYOR: NEWK
LOCATION: 21.5 km NE of Mt. Marsh
Lat. 22°24'45" Long. 119°24'50" AMG: ? E ? N 28/06/1984

SOIL PROFILE
ATTRIBUTE: Salinity DRAINAGE: Poor
SRT: Alkaline SALINITY: High
NORTHCOTE: Um4.41-2/0/16/8 SOIL GROUP: Solonack
NAME: Salina - Damp Phase

A 0-16 cm Dark red (10R 3/6) sandy loam; humus not obvious; roots absent; consistence moderately weak; pH 8.0; not calcareous; not water repellent; boundary clear, smooth.
B 16-36 cm Red (10R 4/6) loamy sand; inclusions 5-10% gypsum crystals less than 1 mm long; consistence moderately weak; pH 8.5; not calcareous; too hard to auger deeper.

VEGETATION
MUIR: SDc No of TAXA: 12

STRATUM 1: Shrubs 0.6-0.7 m, CC = 1, clumping none Muellerolimon salcorniaceum (1).
STRATUM 2a: Shrubs 0.0-0.5 m, CC = 32, clumping none Halosarcia indica ssp. bidens (25), H. auriculata (5), Enchylaena tomentosa var. tomentosa (1), Maireana luehmannii (1), Frankenia sp. (KRN 10214) (0.5).
STRATUM 2b: Misc. plants, CC = 1.8, clumping slight ANNUAL: Eragrostis falcata (1), Swainsona sp. (KRN 10191) (0.5), Flaveria australasica (0.1), Nicotiana rosulata (0.1), Dactyloctenium radulans (+), Trianthema triquetre var. triquetre (+).

OPEN DWARF SCRUB D (SDr)

(F4) Sida fibulifera Open Dwarf Scrub D

STUDY: Fortescue Samphire Flat Survey SITE No: PL004 SURVEYOR: NEWK
LOCATION: 18 km NE of Mt. Marsh
Lat. 22°26'35" Long. 119°22'50" AMG: - E - N 28/06/1984

SOIL PROFILE
ATTRIBUTE: None evident DRAINAGE: Poor
SRT: Alkaline SALINITY: None
NORTHCOTE: Um4.41-4/1/23/2 SOIL GROUP: Red Clay
NAME: Not named

| | | |
|---|---|---|
| A | 0-23 cm | Red (10R 3/6) clay loam; humus not obvious; roots absent; consistence moderately weak; pH 8.5; not calcareous; not water repellent; boundary clear, smooth. |
| B21 | 23-44 cm | Red (10R 3/6) sandy light sand; consistence very strong; pH 8.0; slightly calcareous; boundary gradual, smooth. |
| B22 | 32-51 cm | Red (10R 3/6) clayey sand; mottles common, fine, distinct, very pale brown (10YR 8/3); consistence very firm; pH 8.25; slightly calcareous; too hard to auger deeper. |

VEGETATION
MUIR: SDr.GLi.Ji No of TAXA: 39

STRATUM 1: Shrubs 0.6-0.7 m, CC = 0.6, clumping none Solanum sturtianum (0.5), Eremophila sp. (KRN 10210) (0.1).
STRATUM 2a: Shrubs 0.0-0.5 m, CC = 3.5, clumping none Sida fibulifera (2), Dissocarpus paradoxa (1), Enchylaena tomentosa var. tomentosa (0.5), Maireana integra (+).
STRATUM 2b: Misc. plants, CC = 48, clumping slight ANNUALS: Dichanthium affine (5), Psoralea cinerea (5), Swainsona sp. (KRN 10191) (5), Dactyloctenum radulans (3), Calotis multicaulis (1), Streptoglossa cylindriceps (1), Flaveria australasica (0.5) Lawrencia densiflora (0.5), Portulaca oleracea (0.3), Boerhavia burbidgeana (0.2), Euphorbia australis (0.2), Goodenia prostrata (KRN 10233)(0.2), Tragus australianus (0.2), Goodenia sp. (KRN 10227) (0.1), Lepidium phlebopetalum (0.1), L. platypetalum (0.1), Sporobolus australasicus (0.1), Zygophyllym ovatum (0.1), Atriplex flabelliformis (+),
Gomphrena canescens (+), Polygala chinensis (+), Ptilotus polystachyus var. polystachyus (+), Swainsona sp. (KRN 10288) (+), S. sp. (KRN 10237) (+), S. sp. (KRN 10238), Tribulus occidentalis (+). GEOPHYTES: Ptilotus gaudichaudii var. gaudichaudii (+). PERENNIAL GRASSES: Eragrostis setifolia (25), Aristida contorta (+), Bothriochloa ewartiana (+), *Cenchrus ciliaris (+), Chloris barbata (+), Enneapogon caerulescens (+).

# APPENDIX II

## Flora List

Taxa are listed systematically by family, and then alphabetically within families. The system and nomenclature follows that of the Western Australian Herbarium (PERTH) (Green 1985). Unnamed taxa are reference by my collections lodged in PERTH. * indicates and introduced taxon. Taxa were subjectively assessed for frequency and cover/abundance in each plant association.

LF (Life form) follows the system of Newbey (1979).

Plant association refers to numbers in Appendix I.

| Frequency | Cover/abundance |
|---|---|
| A = 1 or 2 populations | 1 = 1 or 2 plants |
| B = Few " | 2 = Few plants |
| C = Scattered " | 3 = Few plants to 1% canopy cover |
| D = Frequent " | 4 = 1-5% canopy cover |
| E = Common " | 5 = 6-30% " " |
| | 6 = 31-70% " " |

| LF | Taxon | Plant association F1 | F2 | F3 | F4 |
|---|---|---|---|---|---|
| POACEAE (31) | | | | | |
| PG | Aristida contorta F. Muell. .. .. | | | | A1 |
| PG | Bothriochloa ewartiana (Domin) C.E. Hubb. | | | | A1 |
| PG | *Cenchrus ciliaris L. .. .. .. | | | | A1 |
| PG | Chloris barbata (L.)Sw. .. .. .. | | | | A1 |
| AG | Dactyloctenium radulans (R. Br.) P. Beauv. | | | A2 | D4 |
| AG | Dichanthium affine (R. Br.)A. Camus .. | | | | E4 |
| PG | Enneapogon caerulescens (Gaudich.) N. Burb. | | | | A2 |
| AG | Eragrostis falcata (Gaudich.)Benth. .. | E4 | E5 | E4 | |
| PG | Eragrostis setifolia Nees .. .. | | | | E5 |
| AG | Sporobolus australasicus Domin .. | | | | B2 |
| AG | Tragus australianus S.T. Blake .. | | | | B2 |
| CYPERACEAE (32) | | | | | |
| AB | Cyperus bulbosa M. Vahl .. .. .. | | B3 | | |
| CHENOPODIACEAE (105) | | | | | |
| AS | Atriplex codonocarpa Paul G. Wilson .. | | | A3 | |
| DS | Atriplex flabelliformis Paul G. Wilson | | | A1 | A1 |
| DS | Dissocarpus paradoxus (R. Br.) F. Muell. ex Ulbr. | | | | B3 |
| DS | Enchylaena tomentosa R. Br. var. tomentosa | B1 | D4 | D3 | C3 |
| DS | Halosarcia auriculata Paul G. Wilson | E5 | E5 | E4 | |

| LF | Taxon | Plant association F1 | F2 | F3 | F4 |
|---|---|---|---|---|---|
| DS | Halosarcia halocnemoides (Nees) Paul G. Wilson ssp. tenuis Paul G. Wilson | | | B5 | |
| SS | Halosarcia indica (Willd.)P.G. Wilson ssp. bidens (Nees)Paul G. Wilson | E5 | E4 | E5 | |
| DS | Halosarcia sp. (KRN 10243) .. .. | E5 | D4 | | |
| DS | Maireana carnosa (Miq.)Paul G. Wilson | | | A1 | |
| DS | Maireana integra (Paul G. Wilson) Paul G. Wilson | | | A2 | A2 |
| DS | Maireana luehmanii (F. Muell.) Paul G. Wilson | | C3 | C3 | |
| DS | Maireana pyramidata (Benth.) Paul G. Wilson | | | A2 | |
| AS | Salsola kali L. .. .. .. .. | | B2 | B2 | |
| AMARANTHACEAE (106) | | | | | |
| AS | Gomphrena canescens R. Br. .. .. | | | | A1 |
| AS | Ptilotus exaltatus Nees var. exaltatus | | A1 | | |
| RP | Ptilotus gaudichaudii (Steudel) J. Black var. gaudichaudii | | | | A1 |
| DS | Ptilotus obovatus (Gaudich.)F. Muell. | | | A1 | |
| AS | Ptilotus polystachyus (Gaudich.) F. Muell. var. polystachyus | | | | A1 |
| NYCTAGINACEAE (107) | | | | | |
| AS | Boerhavia burbidgeana H.J. Hewson .. | | | | B2 |
| AIZOACEAE (110) | | | | | |
| AS | Trianthema triquetra Willd. var. triquetra | | | B2 | |
| PORTULACACEAE (111) | | | | | |
| AS | Portulaca oleracea L. .. .. .. | | | | B3 |
| BRASSICACEAE (138) | | | | | |
| AS | Lepidium phlebopetalum (F. Muell.) F. Muell. | | | | A3 |
| AS | Lepidium platypetalum H.J. Hewson .. | | | | B2 |
| PAPILIONACEAE (165) | | | | | |
| AS | Psoralea cinera Lindley .. .. .. | | | | D4 |
| AS | Swainsona sp. (KRN 10228) .. .. | | | | A1 |
| AS | Swainsona sp. (KRN 10191) .. .. | A2 | | C3 | E4 |
| AS | Swainsona sp. (KRN 10237) .. .. | | | | A1 |
| AS | Swainsona sp. (KRN 10238) .. .. | | | | A1 |
| ZYGOPHYLLACEAE (173) | | | | | |
| AS | Tribulus occidentalis R. Br. .. .. | | | | A1 |
| AS | Zygophyllum ovatum Ewart & J. White .. | | | | A2 |
| POLYGALACEAE (183) | | | | | |
| AS | Polygala chinensis L. .. .. .. | | | | A1 |
| EUPHORBIACEAE (185) | | | | | |
| AS | Euphorbia australis Boiss. .. .. | | | | B3 |
| MALVACEAE (221) | | | | | |
| AS | Lawrencia densiflora (E.G. Baker) Melville | | | | D3 |
| HP | Sida fibulifera Lindley .. .. .. | | | | D4 |

| LF | Taxon | Plant association F1 | F2 | F3 | F4 |
|---|---|---|---|---|---|
| FRANKENIACEAE (236) | | | | | |
| DS | Frankenia sp. (KRN 10214) .. .. | E4 | | D3 | |
| PLUMBAGINACEAE (294) | | | | | |
| MS | Muellerolimon salicorniaceum (F. Muell.)Lincz. | E5 | D4 | D3 | |
| CONVOLVULACEAE (307) | | | | | |
| AS | Cressa cretica L. .. .. .. .. | B3 | | | |
| SOLANACEAE (315) | | | | | |
| AS | Nicotiana rosulata (S. Moore)Domin .. | E3 | E4 | E3 | |
| SS | Solanum sturtianum F. Muell. .. .. | | | | A2 |
| MYOPORACEAE (326) | | | | | |
| SS | Eremophila sp. (KRN 10210) .. .. | | B2 | C3 | B2 |
| GOODENIACEAE (341) | | | | | |
| AS | Goodenia sp. (KRN 10227) .. .. | | | | B2 |
| AS | Goodenia prostrata .. .. | | | | B3 |
| ASTERACEAE (345) | | | | | |
| AS | Calotis multicaulis (Turcz.)Druce .. | | | | C3 |
| AS | Flaveria australasica Hook. .. .. | | | D3 | D3 |
| AS | Streptoglossa cylindriceps (J. Black) C.R. Dunlop | | | | C3 |

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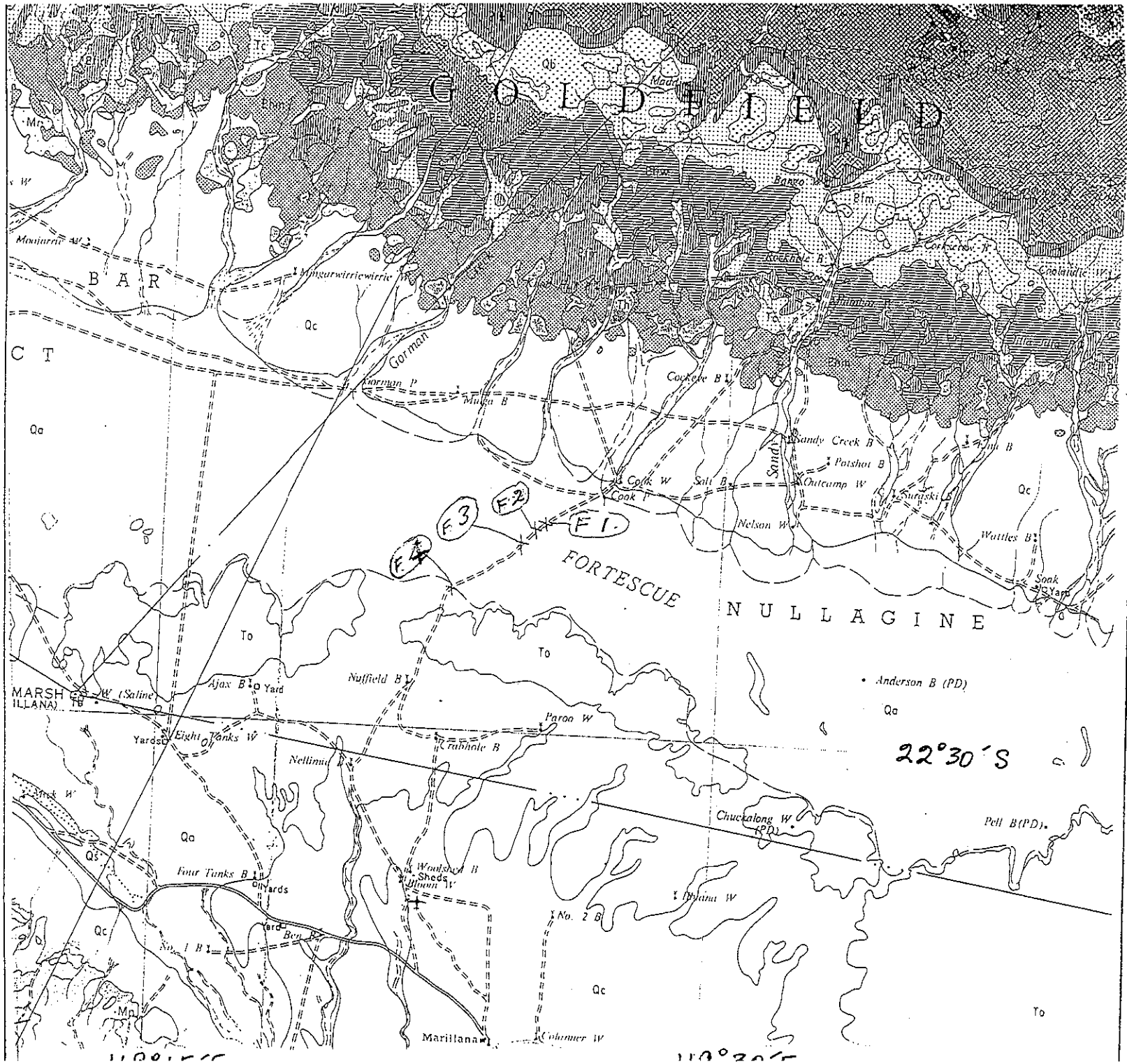


N

Scale 1: 250 000

0 5 10

Kilometers

Fig. 1
Location of sites 1, 2, 3, 4, on Fortescue River flat.

Map is taken from ROY HILL geological survey of Western Australia (Sheet SF 50-12).

Figure 2

Sites 1 (above) and 2.

Figure 3

Sites 3 (above) and 4.

Figure 4

Frankenia sp. (KRN 10214)