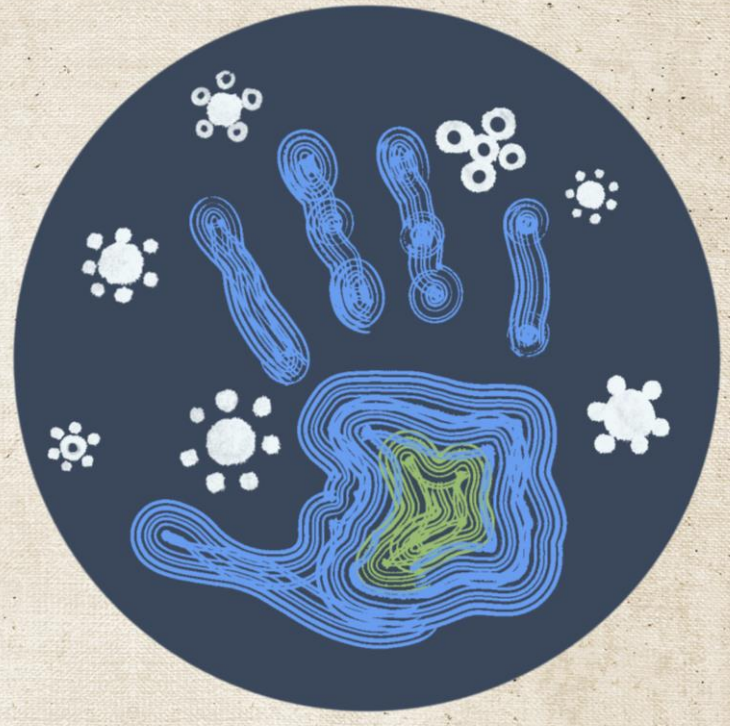


Centre for People, Place & Planet

STRATEGIC RESEARCH CENTRE

AUSTRALIA ECU EDITH COWAN UNIVERSITY

# Empodisma Peatland Mapping – Technical Report

**OUR RESEARCH –**

is responding to global environment change by understanding the interactions of ecosystems, human ecology and social justice.

# Where are we and why?

Southwestern Australia

Four Bioregions – Swan Coastal Plain, Jarrah Forrest, Warren, Esperance Sand Plain

TEC Listing Process

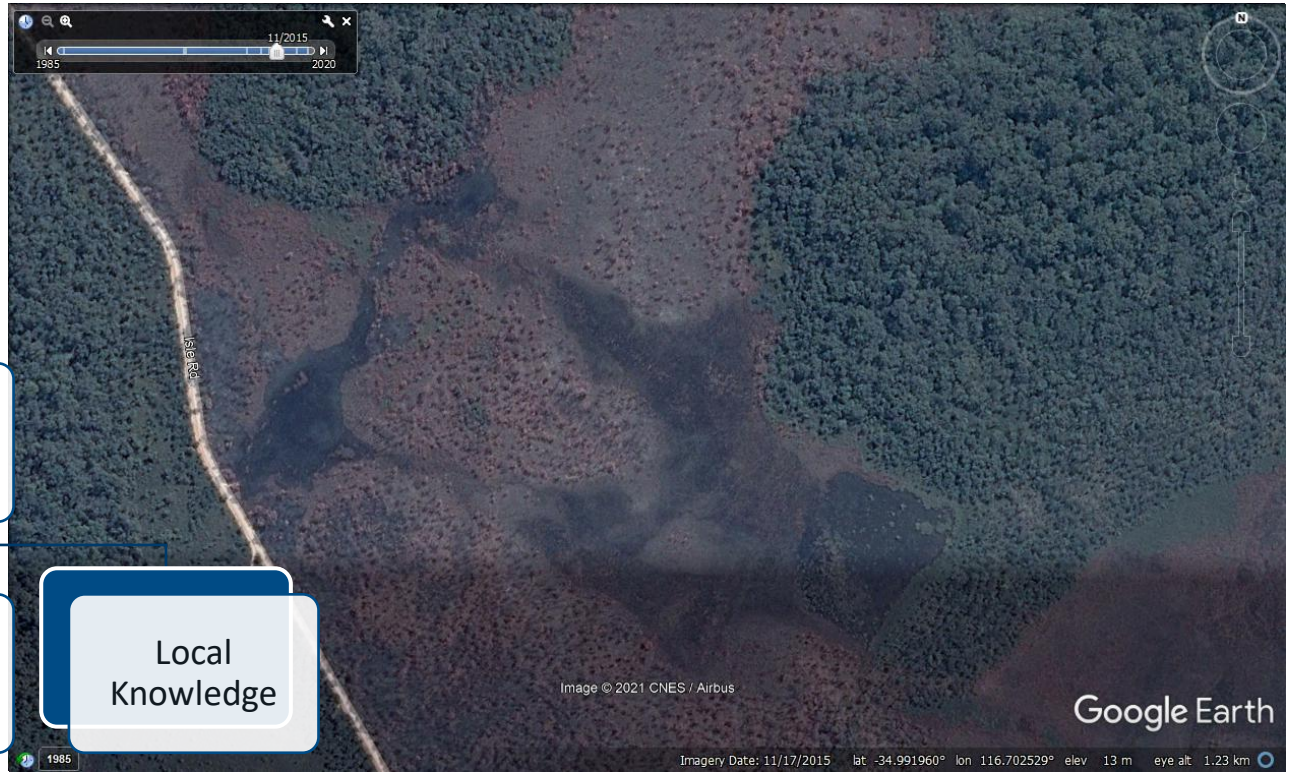
Predict Spatial Distribution of Peatlands

- Empodisma

Peatland systems in the far southwest

# Previous Mapping






Based upon

Interpretation of soil maps

Interpretation of post fire aerial imagery

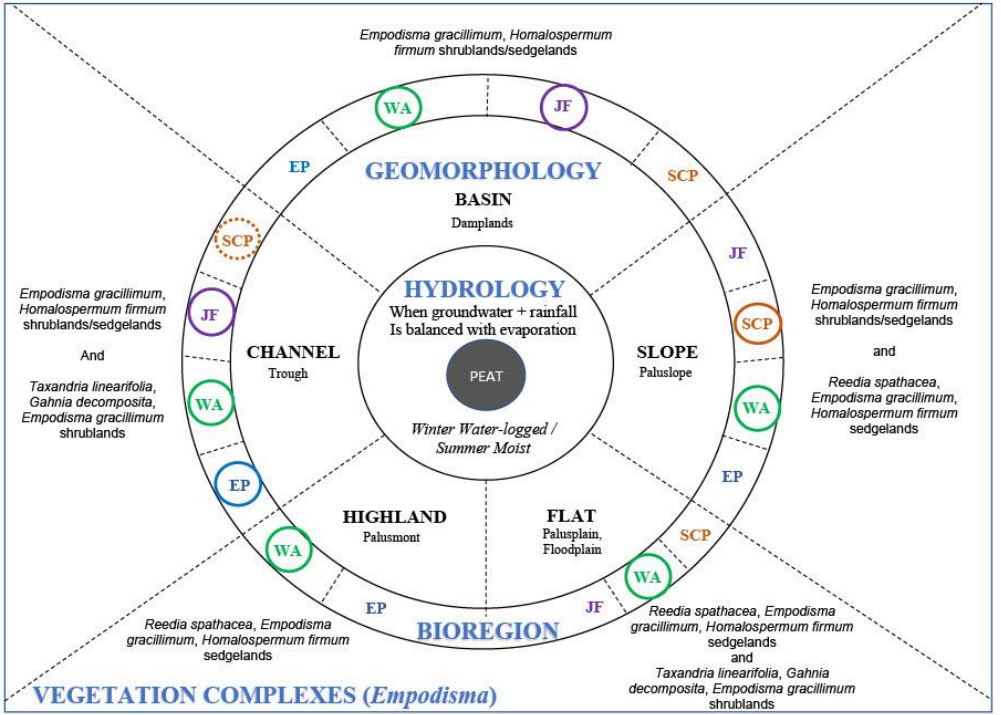
Local Knowledge

# A priori knowledge - peatlands



Model Development

- Literature Review
- Stakeholder Engagement
- Conceptual model
    - Hydrology,
    - Geomorphology,
    - Vegetation and
    - Bioregion



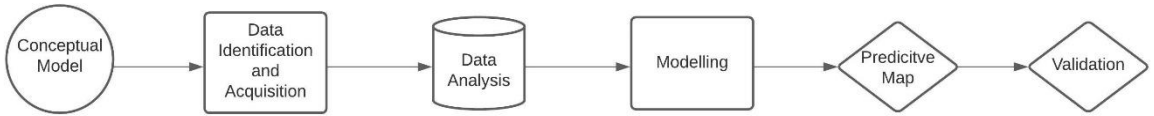
# Data

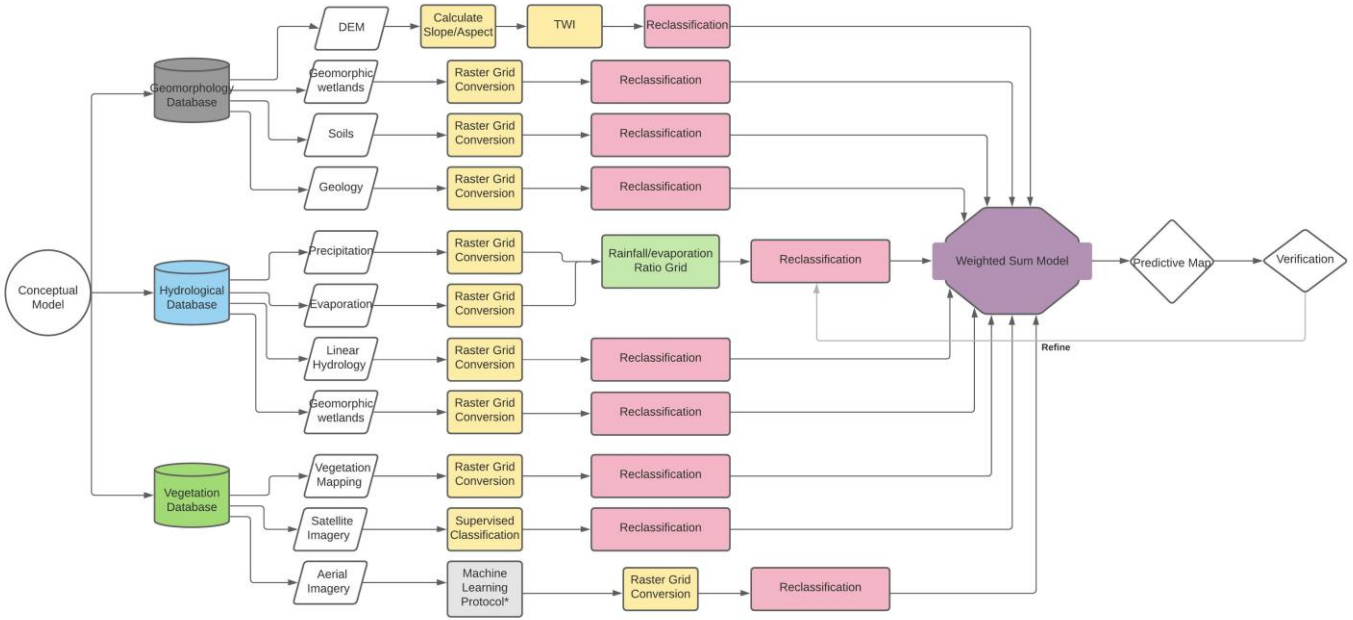


| Conceptual Model | Environmental Variable | Data Source |
|---|---|---|
| Geomorphology | Topography (various indicators) | 5m – Digital Elevation Model (DEM) |
| | Wetland geomorphology | Geomorphic wetlands suite – south west; Augusta to Walpole<br>Wilderness peat wetlands (DBCA) |
| | Soil type | Soil landscape mapping (DPIRD-027)<br>Australian Soil Resource Information System (ASRIS) |
| | | |
| Hydrology | Precipitation | Bureau of Meteorology |
| | Evaporation | Bureau of Meteorology |
| | Streams and river hydrology | Hydrography linear hierarchy<br>National surface water information |
| | Wetland hydrology | Geomorphic wetlands suite |
| Vegetation | Vegetation complexes | Pre-European Vegetation (DPIRD-006); Vegetation Complexes – South West forest region of Western Australia (DBCA-047) |
| | Reedia sp. | Aerial/Sentinel imagery |
| | Empodisma sp. | Australian Virtual Herbarium |

# Weighted Sum Analysis





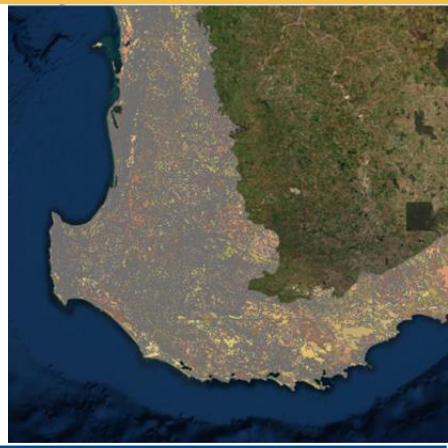



# Geomorphology – Soil classification



## Swan Coastal Plain

| Values | Attributes/Keywords |
|---|---|
| 3 | Peat; peaty podzols; humus peaty podzols; saturated fibrous organic soil; broad shallow channels with peaty soils; Broad U-shaped minor valleys with swampy floors and wet soils |
| 2 | Subject to inundation with humic and peaty sands; wet and semi-wet soils with reeds; humus podzols; gently sloping depressions; drainage lines and reeds in wetter locations; swampy drainage lines; peat-rich sand; peaty silt; peaty sand; extensively flat swampy areas with sedges and reeds. |
| 1 | Swamp soils; humic swamp soils; lower slopes and flat areas with swamp soils; seasonal swamps fringed with sedges; narrow swampy small depressions; drainage depressions with humic pans and reeds; peaty sand – slightly peaty; seasonally inundated swamps and depressions near the base of foothills. |
| 0 | Everything else – saline soils, gravel, clay soils, rock outcrop |



Complete coverage

Spatial resolution

Different attributes based upon bioregion

## Warren

| Values | Attributes/Keywords |
|---|---|
| 3 | Peaty soils on narrow floor; Plains with swamps; gently sloping terrain with thickets, heath and reeds; Broad U-shaped drainage depressions with swampy floors; Humus and peaty podzols; shallow valleys in swampy terrain with peaty sands on floor; Humus podzols on plains with peat in swamps; Humus peaty podzols |
| 2 | Small broad U-shaped drainage depressions with swampy floors; shallow minor valleys with swampy floors and wet soils; broad swampy drainage zones with sedges; Humus podzols; peaty podzols on minor valley floors |
| 1 | Narrow drainage line; low valley slopes; river channel; swampy plains; drainage floors; swampy floor; winter wet soils |
| 0 | Everything else – saline soils, gravel, clay soils, rock outcrop |

# Geomorphology – Geomorphic Wetlands



| Swan Coastal Plain | |
|---|---|
| **Values** | Attributes/Keywords |
| **3** | Paluslope; creek |
| **2** | Floodplain, Basin (dampland), Flats (Palusplain), Palusvale, Palusmont |
| **1** | Sumpland (seasonally inundated basin) |
| **0** | Everything else – Permanently Inundated, dam, dryland, estuary, artificial lake |

Incomplete coverage

Spatial resolution

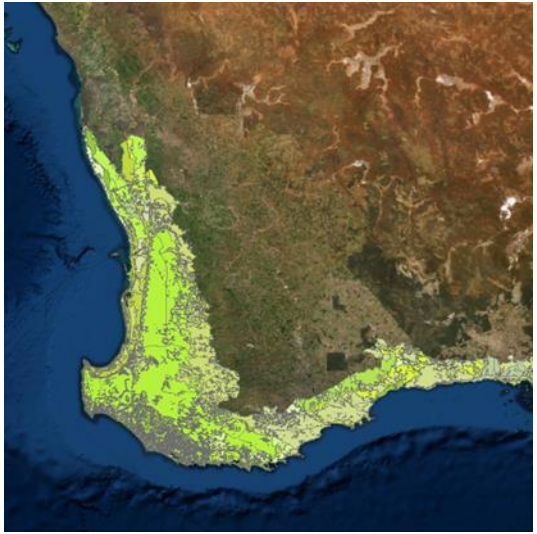
Different attributes based upon bioregion

| Warren | |
|---|---|
| **Values** | Attributes/Keywords |
| **3** | Paluslope; Flats (Palusplain); Floodplain; Basin (dampland); Palusvale |
| **2** | Palusmont; Swamp |
| **1** | Sumpland (seasonally inundated basin), other basin wetlands, Shoreline |
| **0** | Everything else – Permanently Inundated, dam, dryland, artificial lake |

# Vegetation



| Swan Coastal Plain | |
|---|---|
| **Values** | Attributes/Keywords |
| **3** | Segdeland |
| **2** | N/A |
| **1** | N/A |
| **0** | Everything else – Heath, Woodland, Forest |



Complete coverage

Spatial resolution

Different attributes based upon bioregion

| Warren | |
|---|---|
| **Values** | Attributes/Keywords |
| **3** | Segdeland |
| **2** | Scrub/heath |
| **1** | Thicket |
| **0** | Everything else – Heath, Woodland, Forest |

# Hydrology



| Swan Coastal Plain | |
|---|---|
| **Values** | Attributes/Keywords |
| **3** | N/A |
| **2** | N/A |
| **1** | Swamps; Land Subject to Inundation |
| **0** | Everything else – Lake, Farm Dam, Reservoir |

Incomplete coverage

Spatial resolution

Different attributes based upon bioregion

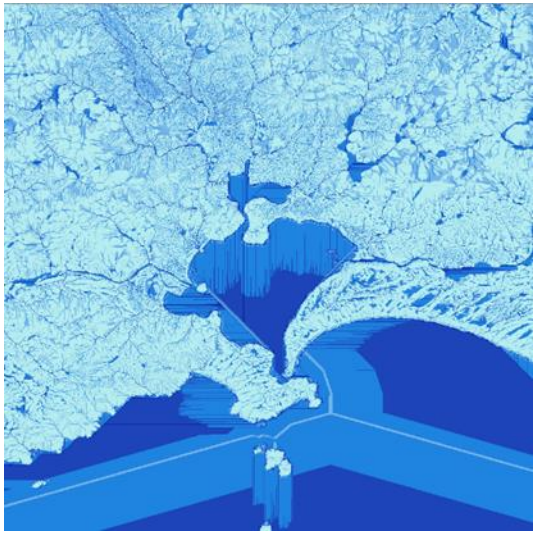
| Warren | |
|---|---|
| **Values** | Attributes/Keywords |
| **3** | Swamp |
| **2** | Land Subject to Inundation |
| **1** | Watercourse |
| **0** | Everything else – Lake, Farm Dam, Reservoir |

# Hydrology – TWI & Rainfall:Evaporation



| Slope+TWI | |
|---|---|
| **Values** | Attributes/Keywords |
| **1** | Flats at the base of a slope with moderate to high TWI values that occur in the high rainfall low evaporation areas |
| **0** | Moderate – High slopes, low rainfall high evaporation |

| Rainfall-Evaporation | |
|---|---|
| **Values** | Attributes/Keywords |
| **1** | High Rainfall; Low Evaporation |
| **0** | Moderate Rainfall-Evaporation |
| **-1** | Low Rainfall; High Evaporation |



Complete coverage

Spatial resolution

Same attributes

# Pre-European Model



| Pre-European | |
|---|---|
| Dataset | Value |
| Soils | 2 |
| Geomorphic Wetlands | 1 |
| Pre-European Vegetation | 1 |
| Hydrology | 1 |
| Slope&TWI | 1 |
| Rainfall-Evaporation | 1 |

# Post-European Model



| Catchment Scale Land Use Mapping (Warren) | |
|---|---|
| **Values** | Attributes/Keywords |
| **3** | Managed resource protection, other minimal use; Marsh/Wetland, Strict Nature Reserves, Wilderness Area, National Park, Natural Feature Protection, Protected Landscape, Conserved Area |
| **2** | Residual Native Cover, rehabilitation, recreation and culture, water, river, lake |
| **0** | Everything else – plantations, irrigation, residential, mining, agriculture, horticulture |

Each Bioregion

Land-use with lowest classification used as mask

# Predictive Map

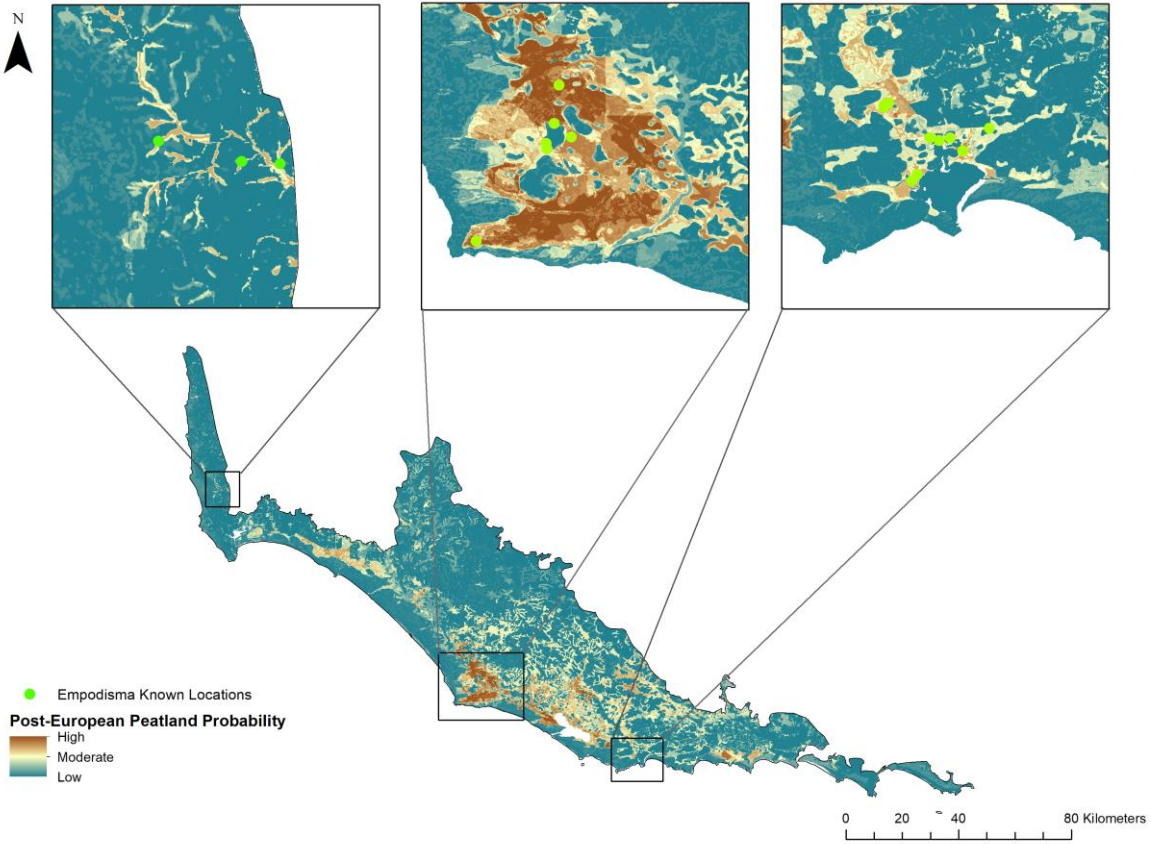


## Warren Region

Walpole

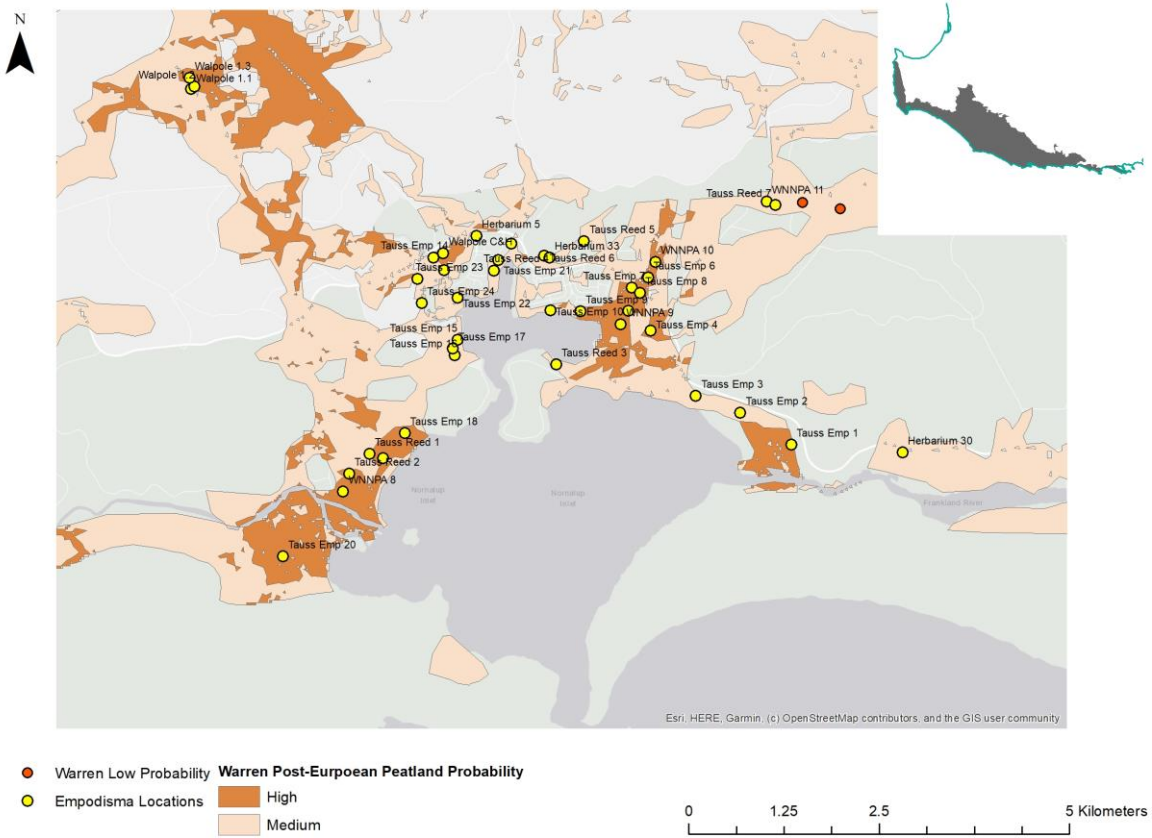
Windy Harbour

Geographe



## Warren Region

Walpole



# Predictive Loss



| Peatland probability | High | | | Medium | | |
|---|---|---|---|---|---|---|
| Vegetation | Pre-European | Post-European | %change | Pre-European | Post-European | %change |
| Swan Coastal Plain | 49.25 $km^2$ (0.3%) | 33.21 $km^2$ (0.2%) | -32% | 544.5 $km^2$ (3.5%) | 314.8 $km^2$ (2.1%) | -42.2% |
| Jarrah Forest | 436.8 $km^2$ (1%) | 310.6 $km^2$ (0.7%) | -29% | 4162 $km^2$ (9.2%) | 2914 $km^2$ (5.6%) | -30% |
| Warren | 436.4 $km^2$ (5.2%) | 416.9 $km^2$ (4.9%) | -4.5% | 1316 $km^2$ (15.6%) | 1106 $km^2$ (13.1%) | -16% |
| Esperance Sand Plain | 12.8 $km^2$ (0.04%) | 11.36 $km^2$ (0.03%) | -12% | 2571 $km^2$ (9%) | 1320 $km^2$ (4.5%) | -49% |

# Ground-truthing



Numerous sites in each Bioregion and for each classification

- Veg Id
- Peat depth

Historical Data

- Previous Studies
- Herbarium collection

# Error Matrix

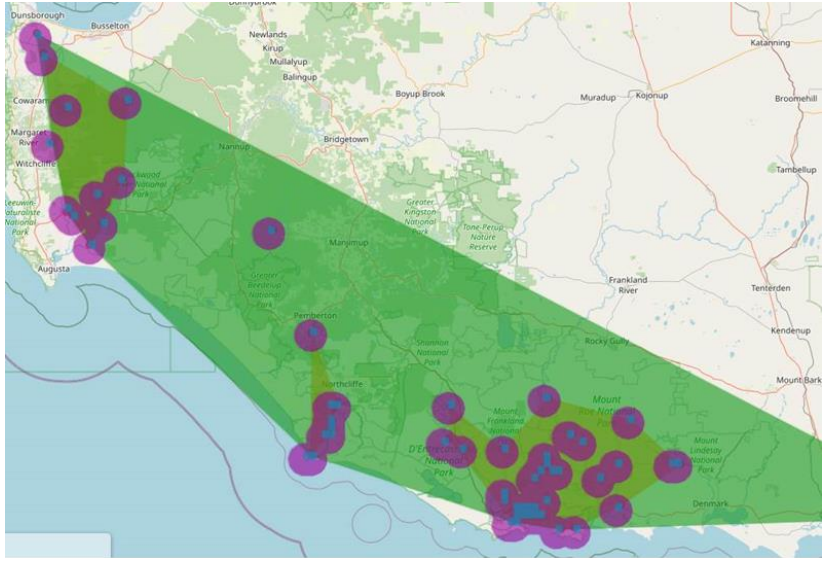


| | | Validation Data (field or desktop) | | | |
|---|---|---|---|---|---|
| | | High | Medium | Low | Total |
| Classified Data | High | 44 (39%) | 0 | 0 | 44 |
| | Medium | 41 (36%) | 5 (100%) | 3 (6%) | 49 |
| | Low | 28 (25%) | 0 | 50 (94%) | 78 |
| | Total | 113 | 5 | 53 | 171 |

# AOO



| Number of records used for the calculations | 123 |
|---|---|
| **Taxon** | *Empodisma* (Peatland Site) |
| **Area of Occupancy (AOO: 0.02 degree grid)** | 23,600 ha = 236 km$^2$ |
| **Area of Occupancy (Points with radius: 5000m)** | 476,700 ha = 4767 km$^2$ |
| **Extent of Occurrence (EOO: Minimum convex hull)** | 1,534,200 ha = 15342 km$^2$ |
| **Alpha Hull (Alpha: 2)** | 281,500 ha = 2815 km$^2$ |



# Limitations and Alternatives



Inconsistencies in areal coverage

Spatial resolution

Uniformity of availability of data across all four bioregions

- Hydrology
- Vegetation

Does not include losses due to

- Fire
- Climate change

Poor accuracy of herbarium data

Remote Sensing

- Machine Learning
- GEE
- Sentinel 1 - SAR