Hydroecological Assessment and Monitoring of Groundwater Dependant Wetlands

Geology Society
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Introduction

What we're going to talk about:

1. Our role in the AMP4 WREP
2. Hydrogeological scene-setting
3. Hydroecology – use of geostatistics as a tool for monitoring groundwater influenced ecological change

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Hydroecological Investigations

Inception Reporting & Desk Studies

- assess the theoretical impact of abstraction and consider historical abstraction scenarios

Site investigations

- Signal tests, hydrochemical surveys, long-term water level monitoring, ecological surveys.

Hydroecological impact assessments

- Findings of investigations to date, geostatistical vegetation mapping, results of regional groundwater modelling

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The Big Challenges

- Understanding the often complex hydrogeology of the sites
  - Confidence in the regional groundwater models
- Establishing any impacts of abstraction on the ecology
  - Establishing baseline data & monitoring change
  - Assessing impacts as a result of 'other' activities
  - Agreeing what constitutes an 'acceptable target'

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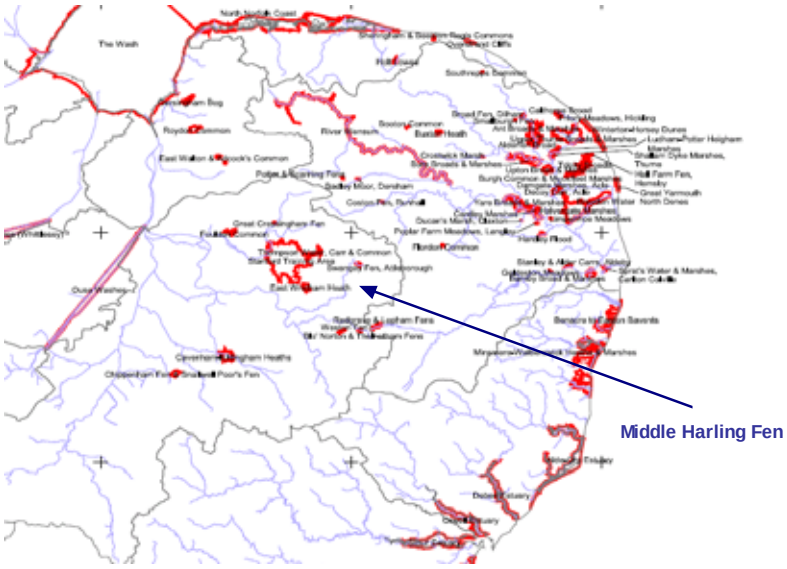

Of 33 Schemes, 23 are SPAs and SACs, 7 are SSSIs, 3 are Low Flow Rivers

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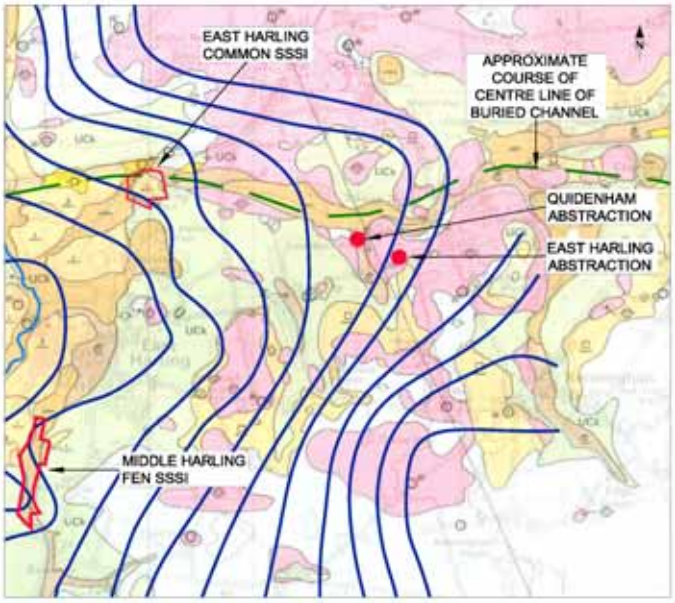

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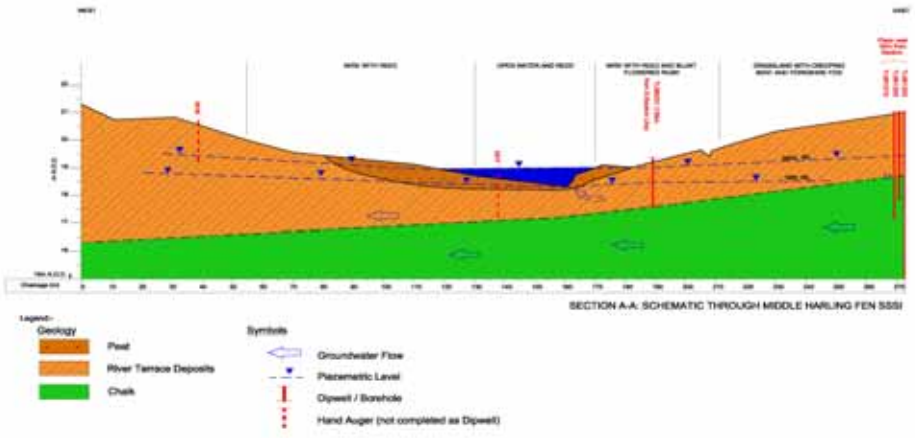

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Background to the ecological monitoring of GWDTEs

Simon James, RPS Group.

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What are the issues?

Question – Is groundwater abstraction adversely effecting the ecological value of these sites?

1. What and where is the ecological value of the site
2. Are there adequate data against which to measure any change to the ecology of the site and identify the cause?
3. If not, what data are needed and how can these be collected.

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Questions needing answers

1. What habitats, communities and species occur on the site?
2. On what environmental factors are they dependant?
3. How sensitive are the species to change in the various environmental factors?
4. What changes are taking place – species and/or factors?
5. What is the magnitude and direction of these changes?
6. Is the magnitude of any change sufficient to adversely effect the ecological integrity of the site?
7. Which (if any) of those significant impacts could be due to groundwater abstraction?

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Baseline ecological data

What (if any) ecological data needs to be collected?

1. The data must be able to act as a baseline for the measurement of any change
2. Must be representative of what is present on-site
3. Must have sufficient sensitivity to be suitable for monitoring purposes.
4. Must be repeatable
5. Should not be subject to variation between surveyors
6. Should allow statistical testing

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Different methods used. . . .

Previous surveys at the site have been carried out using **NVC** (English Nature 1993 survey)

NVC does not provide details of individual species distributions so is unsuitable for distribution monitoring

NVC does not provide data which can be compared directly between surveys, due to surveyor variation

Surveys may be carried out along transects **(Wheeler-Shaw method).** May be effective when location of any changes in plant distribution are known; but cannot account for range shifts in unexpected parts of the site

Geostatistical Vegetation Mapping (GVM), overcomes these potential weaknesses

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Geostatistical Vegetation Mapping (GVM)

GVM survey methodology advantages

1. Quadrat based – standard quadrat survey techniques
2. Geo-referenced – each quadrat is accurately located on the survey site, without the need for permanent markers.
3. Additional data can be recorded with exact location (ie specific chosen species or features)
4. Data can be accurately mapped within a GIS
5. Data maps are not subjective or prone to surveyor error
6. Data collection is replicable between surveyors
7. Data collection is replicable over time
8. Data is statistically valid and treatable by conventional statistics as well as by spatial geostatistics
9. Data can be analysed independently

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Middle Harling Fen

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GVM sampling methods

- 1 x 1m quadrat split into 9 squares. Presence / absence of each species recorded in these.
- Quadrat sampling points form a 10 x 10m grid over site.
- Data recorded on hand held GPS unit.
- Downloaded directly into excel for use in Geostokos or ArcGIS.

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Quadrat sampling points

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Middle Harling Fen

- 168 species were found at Middle Harling Fen
- In practice, indicator species would be chosen for ecological monitoring
- 7 species are represented in the following slides as examples of different ecological niches.

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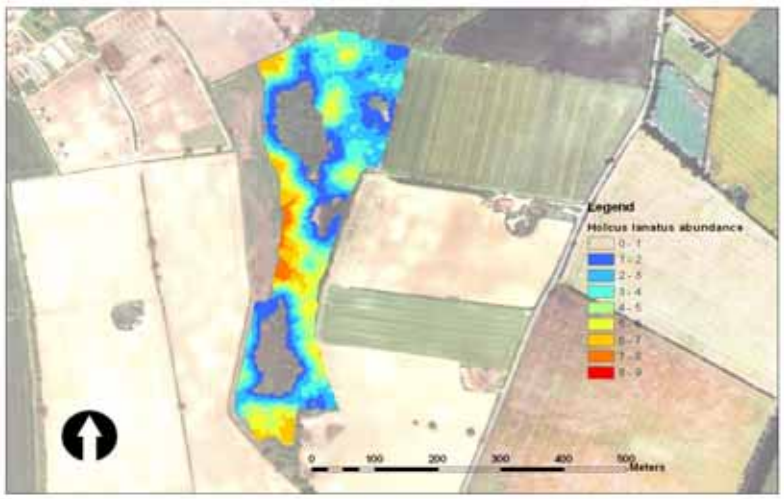
Yorkshire Fog



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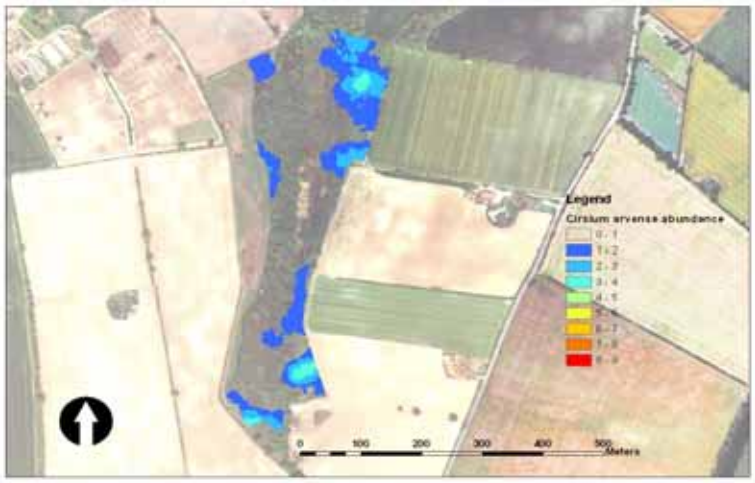
Creeping Thistle



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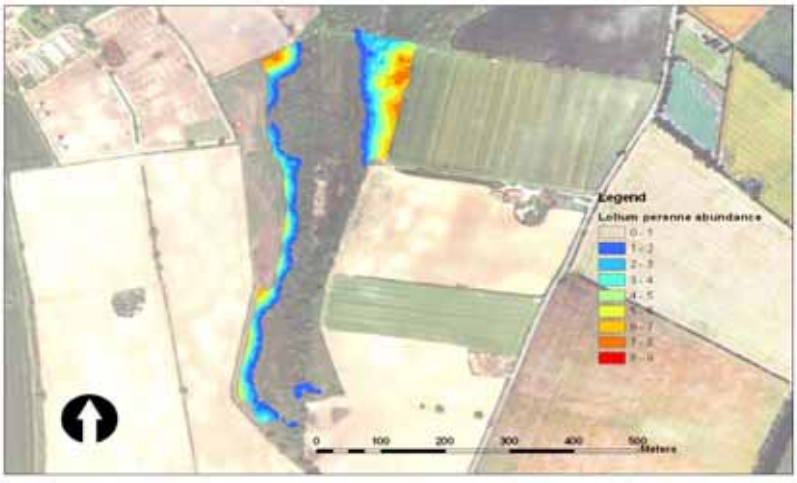
Rye Grass



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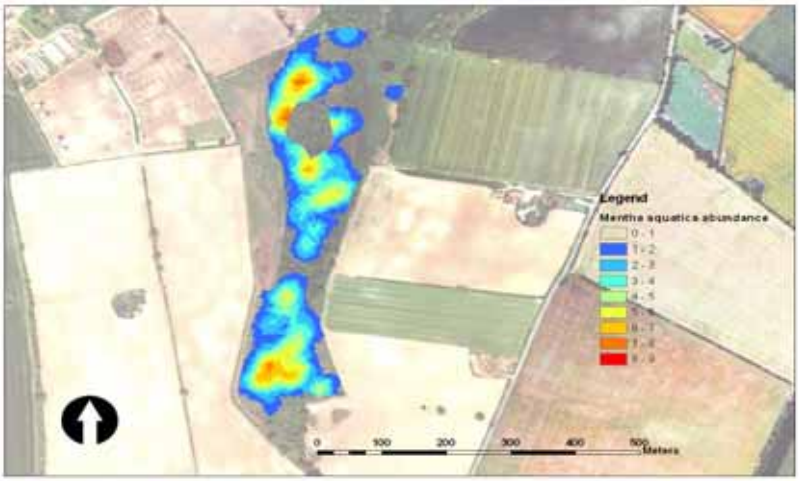
Water Mint



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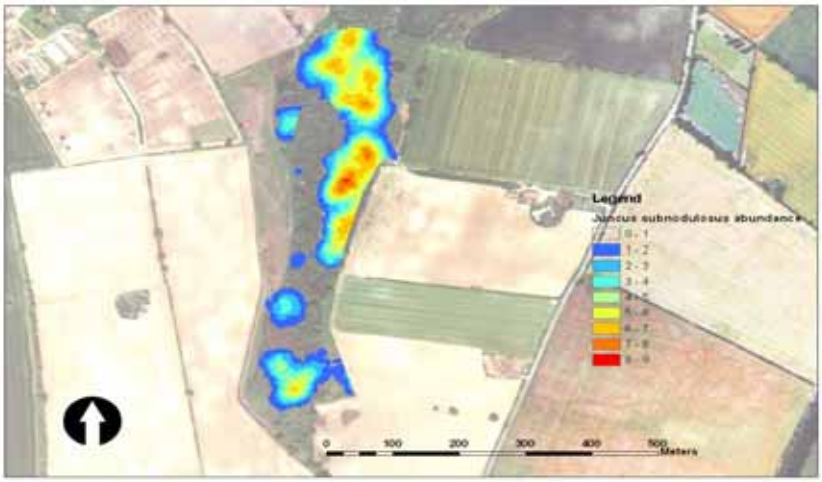
Blunt-flowered Rush



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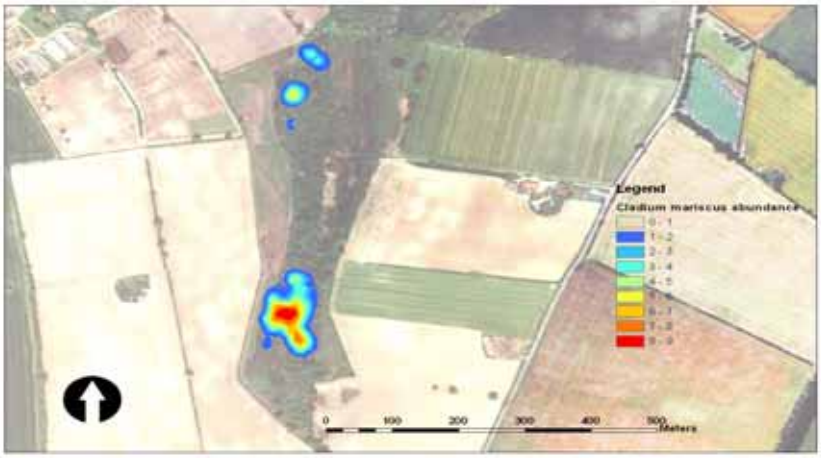
Great Fen-sedge



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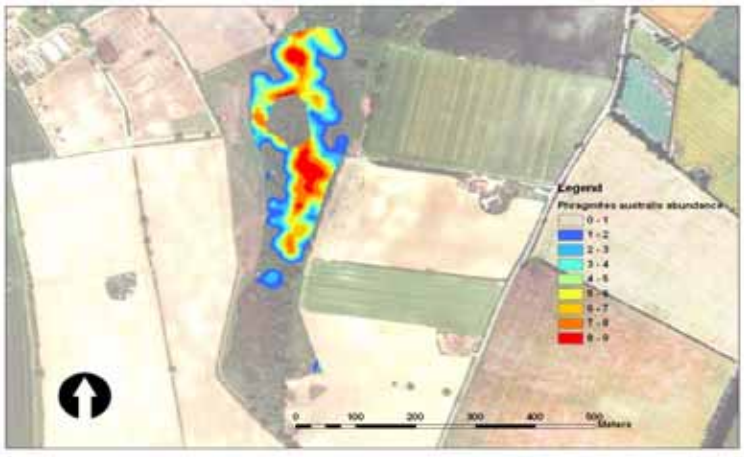
Common Reed



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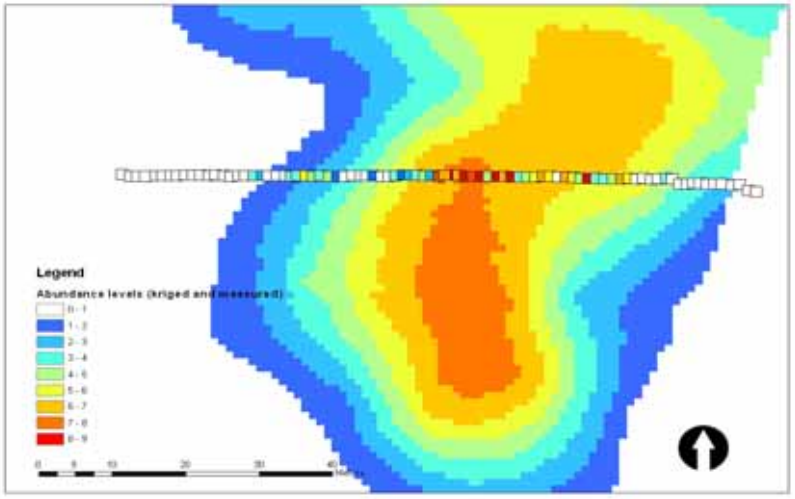
Comparison of predicted vrs actual distribution



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Ellenberg Values

- These are values assigned to each plant species, based on their ecological requirements in Great Britain.
- These values cover moisture, pH, nitrogen, light, and salinity.
- Use of Ellenberg values allows the distribution of these environmental factors to be mapped across a site and change over time to be measured.

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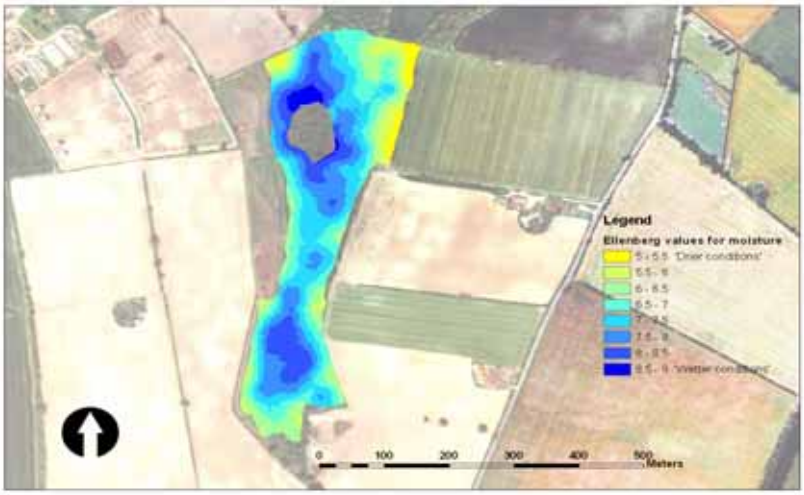
Ellenberg maps: Moisture



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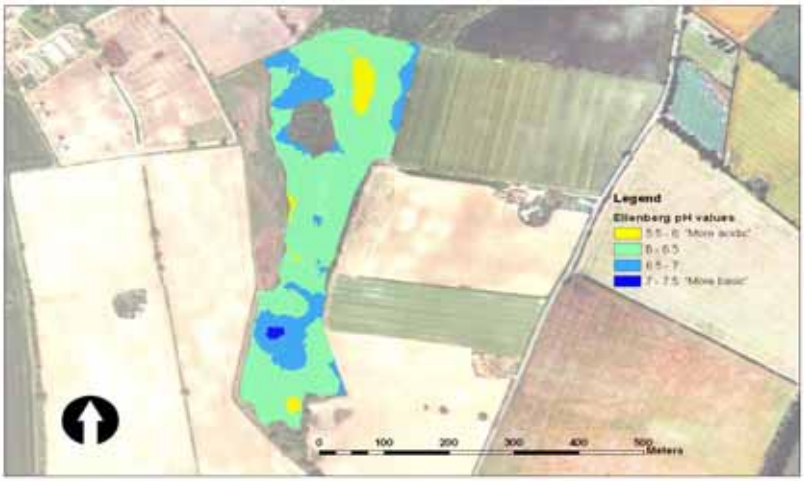
Ellenberg maps: pH



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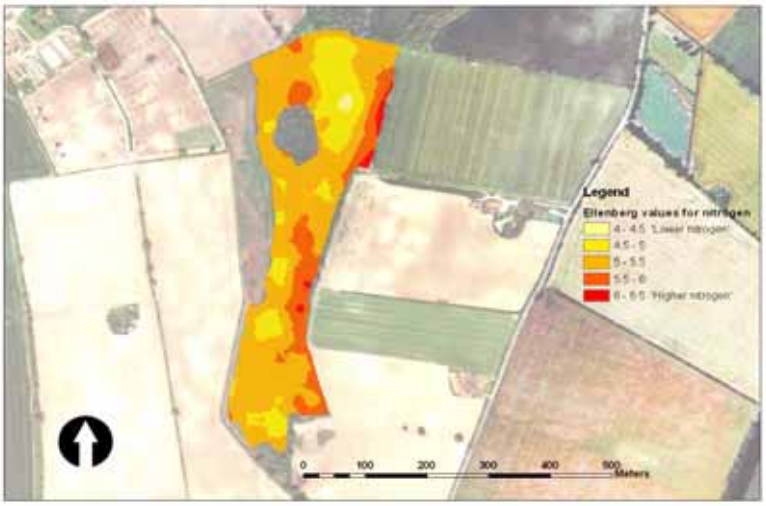
Ellenberg maps: Nitrogen



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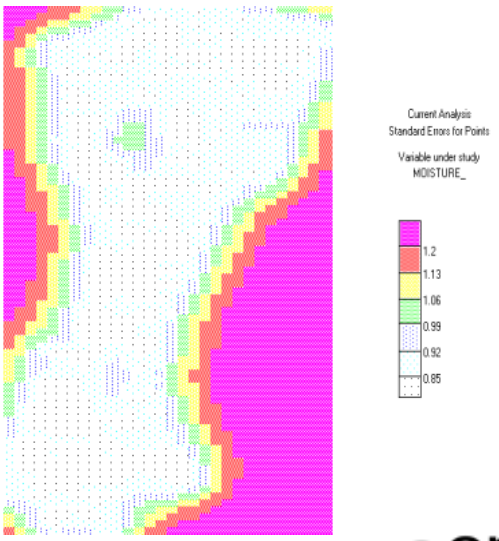
Standard Error Maps



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GVM Reliability

GVM gives:

1. Survey data that is accurately GPS mapped
2. Data that is treatable by conventional statistics
3. Data that can be treated geostatistically
4. Data that allows probability mapping of species distribution and abundance
5. Probability maps that have calculated confidence limits
6. Maps that have calculated values checked against known data points
7. Maps showing the degree of any error within the calculated values.

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This study has provided a strong baseline dataset showing:

•Ecological dependency on groundwater and other factors.

Future surveys will show:

•Any changes in plant distributions and abundance.

•how these relate to hydrological conditions

The methodology can also be applied at other sites where accurate monitoring of vegetation responses to changing environmental conditions is required

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