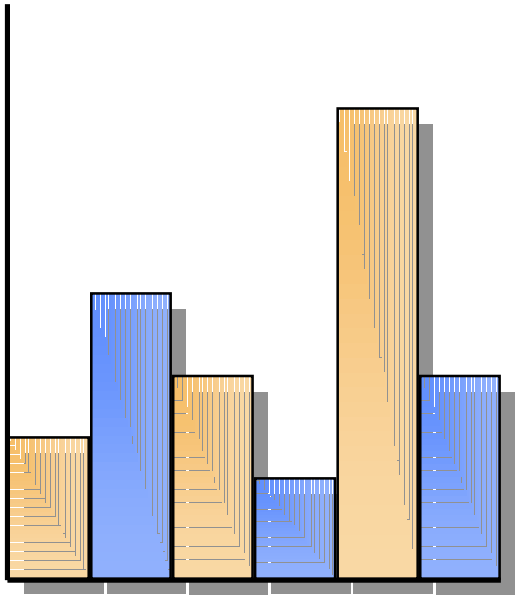
Ecogeographic Surveys

Unit 5.2



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Objectives

Outline

- Introduction
  - Phase 1 - Project Design
  - Phase 2 - Data Collection and Analysis
  - Phase 3 - Product Preparation
  - Conclusion

The Threat of Genetic Erosion

- Genetic erosion - a global issue
- The use of ecogeographic data
  - in identifying and assessing the threat of genetic erosion
  - in developing conservation strategies
  - in planning collecting missions

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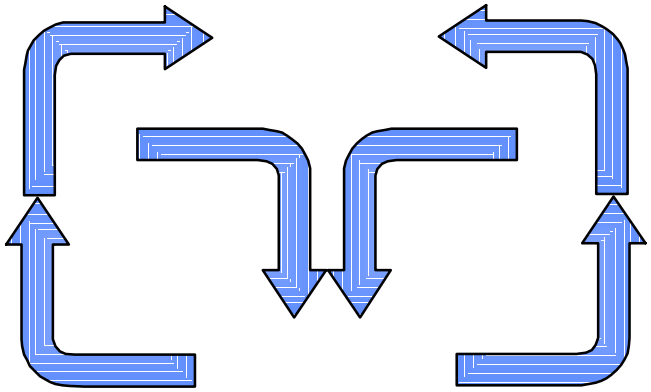
A Definition

"An ecogeographic study is a process of gathering and synthesizing ecological, geographical and taxonomic information. The results are predictive and can be used to help formulate conservation strategies and collecting priorities."

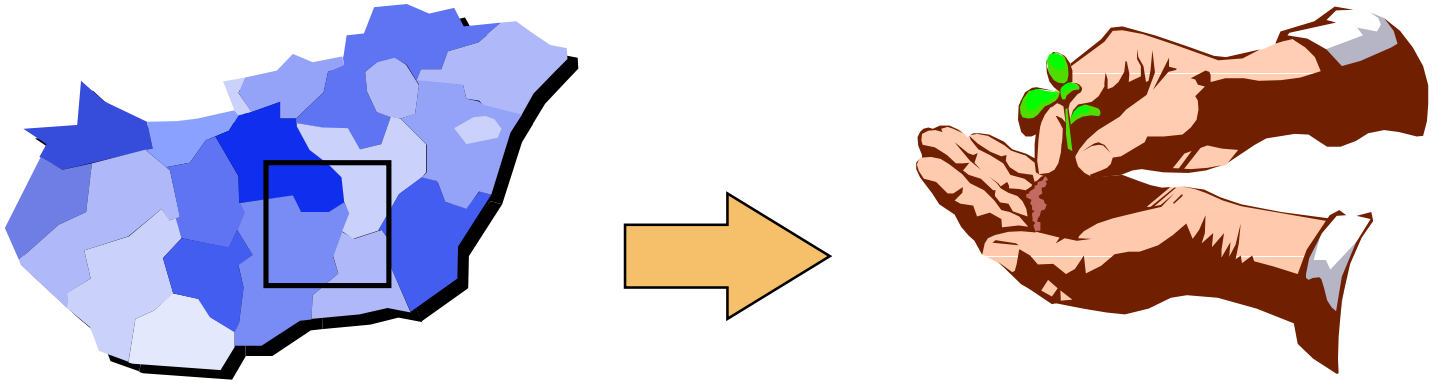
Maxted et al. *(1995)*



Ecogeographic Surveys and Conservation

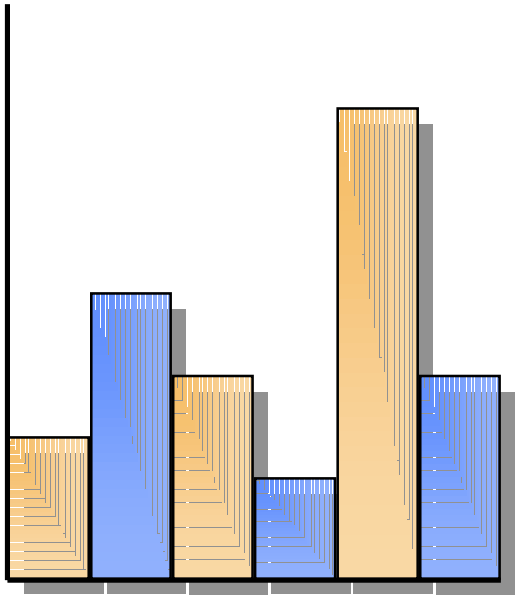
Example - Planning Collecting Missions

- To identify target species, collecting areas and habitats
- To predict where a species may be located



Ecogeographic Surveys: a Methodology

- Phases
  - Project Design
  - Data Collection and Analysis
  - Product Preparation
- Outputs
  - Database
  - Conspectus
  - Report



Outline

- Introduction
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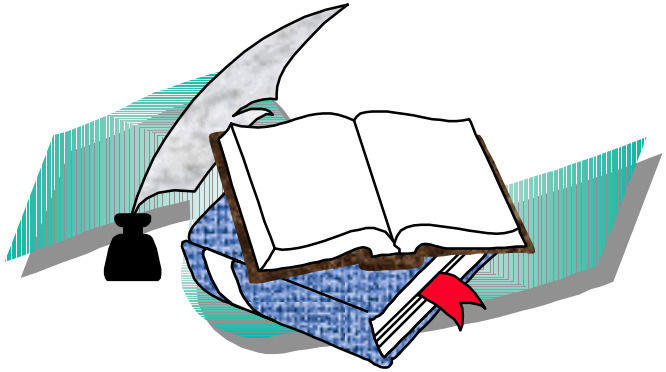
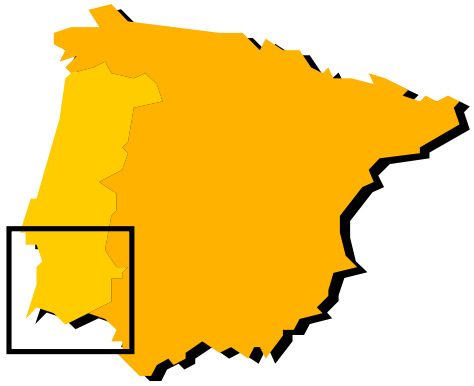
Project Commissioning

- Taxonomic scope
- Geographic scope
- Commissioning agency

Lupinus hispanicus
Lupinus luteus
Lupinus mutabilis
Lupinus pilosus





Project Commissioning - an Example

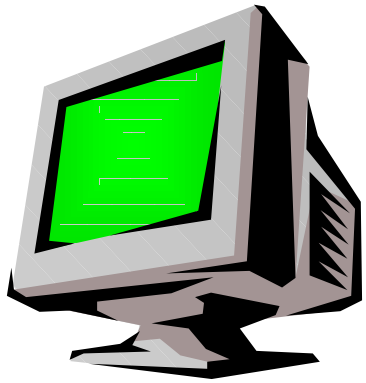
*"A general survey of **Corchorus** L. species was commissioned by the International Jute Organisation to provide the necessary background data on which future germplasm collecting expeditions could be based ... the survey was required to identify those wild species for potential use in the future genetic improvement of jute, in addition to identifying the countries and locations where collecting expeditions would be most profitable ..."* Edmonds (1990)

Project Commissioning - Selection of a Specialist

- Desirable qualities
  - familiarity with ecogeographic data
  - familiarity with the target group
  - familiarity with the geography of target area

Identification of Suitable Taxonomists

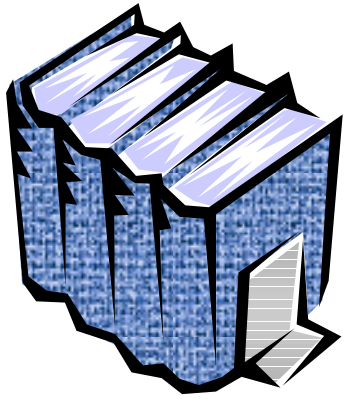
- A taxonomist can assist with
  - locating relevant literature
  - identifying herbaria to visit
  - identifying other taxonomists
- Lists of taxonomists can be found
  - in *Index Herbariorum*
  - on the Internet



Selection of Target Taxonomy

- Understand the taxonomy of the target group
  - Determine the accepted classification
  - List the taxa in target group
  - Identify further sources of ecogeographic data

Lupinus hispanicus
Lupinus luteus
Lupinus mutabilis
Lupinus pilosus



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Delimitation of the Target Area

- Area should be chosen carefully
  - to maximise the predictive value of the survey
- Taxon should be studied
  - throughout its range ***or***
  - throughout a well-defined area, biogeographically or floristically

Identification of Taxonomic Collections

- Need to visit relevant herbaria and collections
  - major sources of ecogeographic data
- Money and time restrictions
  - choose most appropriate herbaria/collections

Herbaria: International or Regional?

- Aim to visit both types of herbaria
  - contain different specimens
  - availability of different expertise
  - broader sampling of data
- International herbaria
  - broad coverage
  - other resources (e.g. specialists, libraries)
  - predominance of older collections

Herbaria: International or Regional?

- Regional herbaria
  - good local coverage
  - better documentation
  - regional specialists
  - fewer resources

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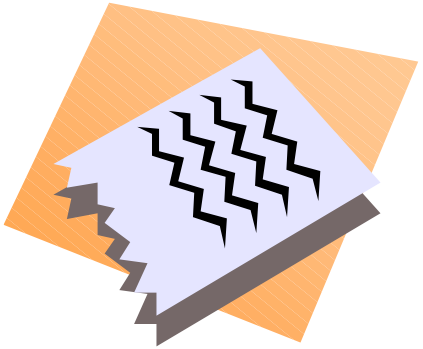
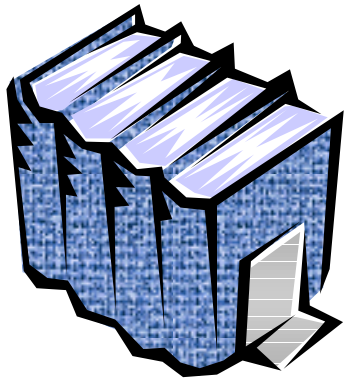
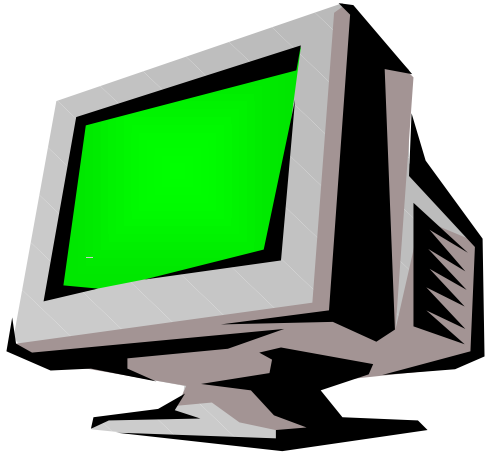
Assess Current Conservation Activities

- Sources of information
  - catalogues and databases of herbaria/collections
  - directories and databases from other agencies
    - e.g. ECP/GR, IPGRI
  - relevant taxonomists







Problems in Interpreting Data (1)

- Conserved material is incorrectly identified
- Quantity of material conserved is misleading
- Availability of germplasm is restricted
- Status of material conserved

Problems in Interpreting Data (2)

- Genetic variation of original population is not represented in the samples
- Few or no passport data are available

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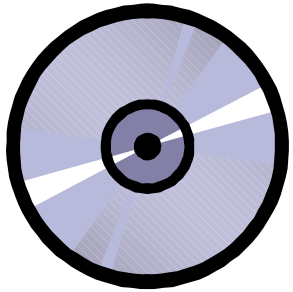
Survey of Geographical, Ecological and Taxonomic Data

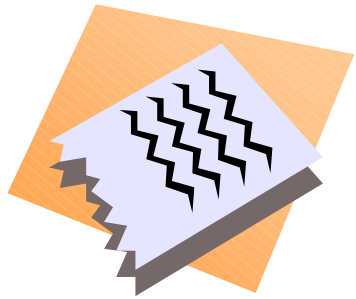
Taxon-specific data

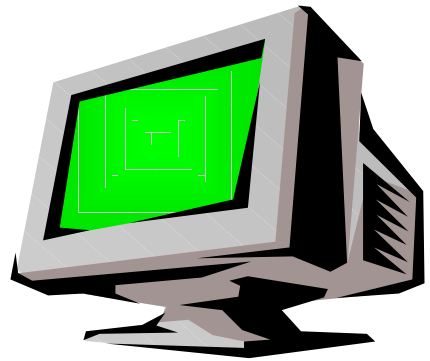
- Accepted taxon name
- Locally used taxon name
- Where species grows
- Timing of local flowering/fruiting
- Habitat preference
- Topographic preference
- Soil preference
- Geological preference
- Climatic and microclimatic preference
- Breeding system
- Genotypic/phenotypic variation
- Biotic interactions
- Archaeological information
- Ethnobotanical information
- Conservation status

Survey of Geographical, Ecological and Taxonomic Data

- Area-specific data
  - geographic, climatic
- Sources of data
  - printed media
  - microfiche
  - on-line databases
  - CD-ROM
  - Internet







Collection of Specimen-Specific Data

- Herbaria and genebanks contain millions of accessions, many in duplicate
- Resources and time are limiting
- Not all data are relevant

Choose carefully which specimens to include

Confirm identification of each specimen

Which Specimens to Select?

- Select accessions with detailed passport data
  - Good provenance data are essential
- Select accessions of taxonomic, geographical or ecological interest
  - Positively select accessions to reflect the range of ecogeographic conditions
  - Avoid duplicates

Specimen-Specific Descriptors

- Herbarium, etc.
- Collector's name and number
- **Collecting date**
- **Sample identification**
- **Locality**
- **Altitude**
- **Habitat**
- Phenological data
- Soil type
- Vegetation type
- Site slope and aspect
- Land use
- Phenotypic variation
- Pests and pathogens
- Competitive ability
- Palatability
- Vernacular names
- Plant uses

Use of Data Standards

- Data must be recorded
  - consistently
  - using data standards
- Essential for meaningful data analysis and exchange

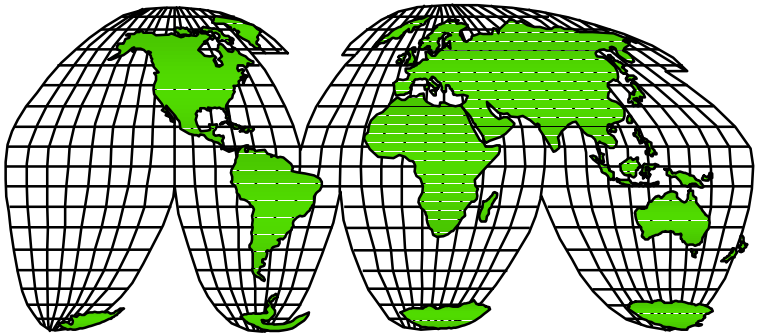
Problems with Data Collection

- Older specimens
  - poorer quality passport data
  - illegible hand-written labels, unfamiliar language used
  - difficulties in determining provenance data because place names may have changed
  - need to infer data (e.g. altitude)

Inferred data should be flagged in the database

Problems with Data Collection

- Older specimens do not necessarily reflect the current distribution of the species



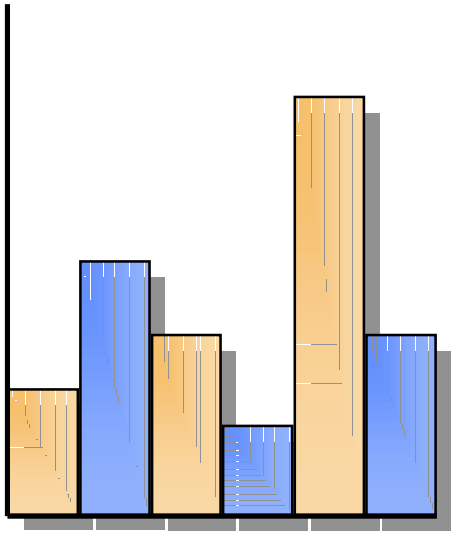
Data Verification

- Assess completeness of the data set
  - certain analyses are not possible if it is incomplete
- Check for errors
  - duplications
  - typing errors
  - inconsistencies e.g. latitude/longitude

Errors can be avoided with careful system design

Data Analysis

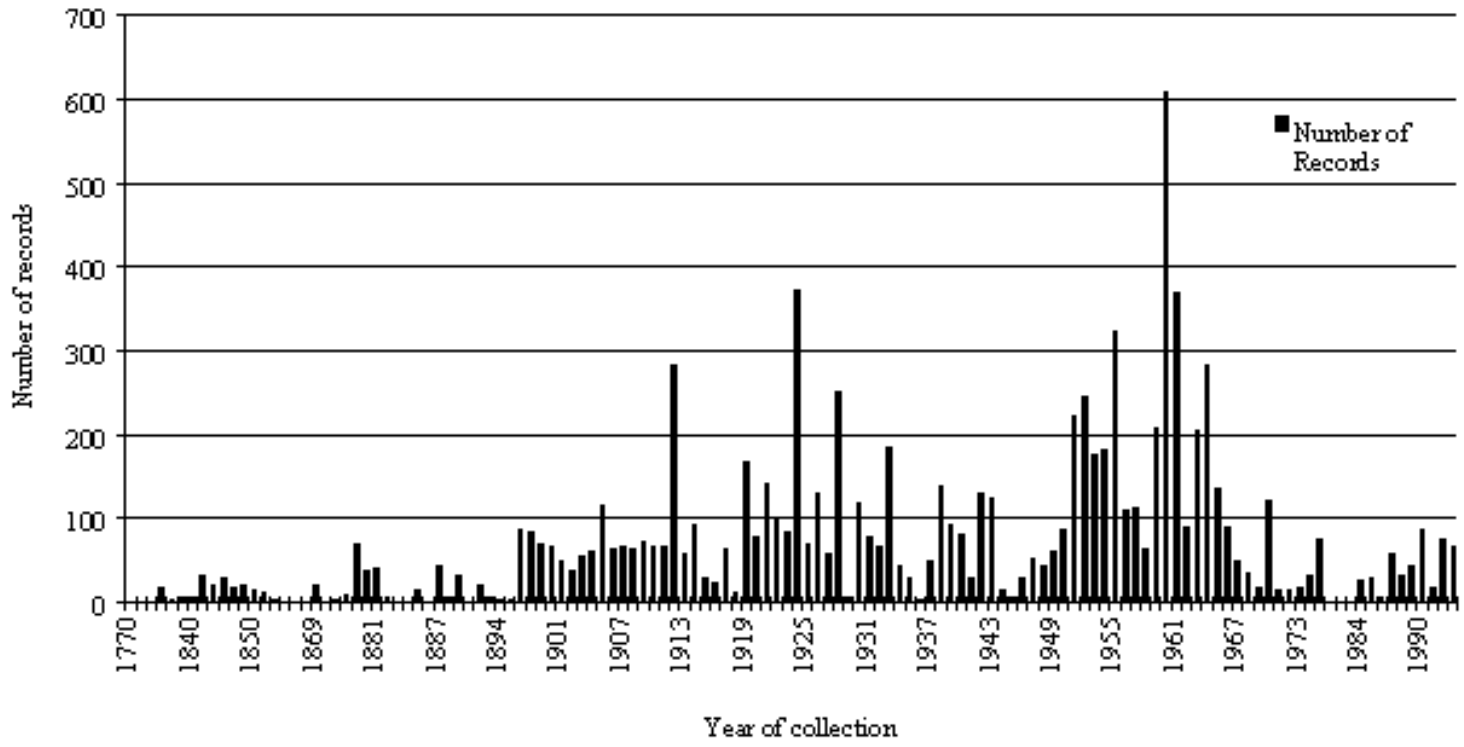
- Tables and bar charts
- Multivariate statistical analysis
- Maps
  - Enclosed line maps
  - Dot distribution maps
  - Contour maps
- Geographic Information Systems (GIS)



Tables and Bar Charts

- Used to display relative frequencies
  - of specimens from different sites
  - of characters from different sites
  - of specimens/characters against environmental variables
- Can identify ecological niche of target taxon
- Can show ecotypic adaptation in wild and cultivated species

Histogram - Collecting Frequency



Multivariate Statistical Analysis

- Analyses more than one variable at a time
- Many methods available
  - choose the most appropriate
  - only works with robust data
- Hierarchical clustering methods
  - divide objects into groups based on similarity
  - defined groups can be used in other analysis

Hierarchical Clustering (cont^{d})

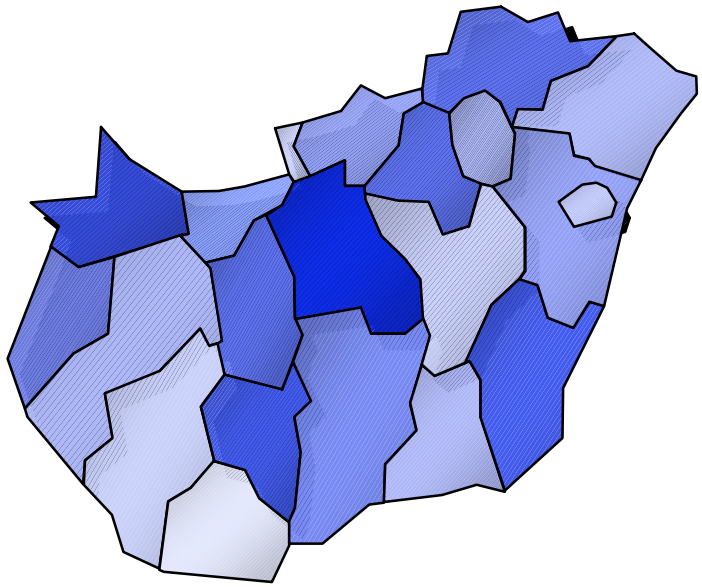
- **Stages in clustering**
  - Find the two objects which are most similar
    - choose most appropriate similarity coefficient
  - Place in a cluster and treat as an object
  - Repeat until all objects are in one cluster
- **Composition of clusters depends on**
  - methods used to determine similarity between clusters
  - other rules for membership of a cluster

Ordination Methods

- Principal components analysis (PCA)
  - produces new quantitative variables which reflect the variation in the original descriptors
- Principal coordinates analysis (PCO)
  - similar to PCA; for quantitative and qualitative data
- Canonical variate analysis (CVA)
  - distinctiveness of pre-defined groups

Maps

- Enclosed line maps
- Dot distribution maps
- Contour maps



Enclosed Line Maps

- Simple approach but can give misleading results
  - no indication of frequency
  - no local variation
  - problems with isolated occurrences

Dot Distribution Maps

- Preferred choice for showing distribution patterns
- Can superimpose additional information
- Mapping software very useful for flexibility in the display of data

Dot Distribution Map

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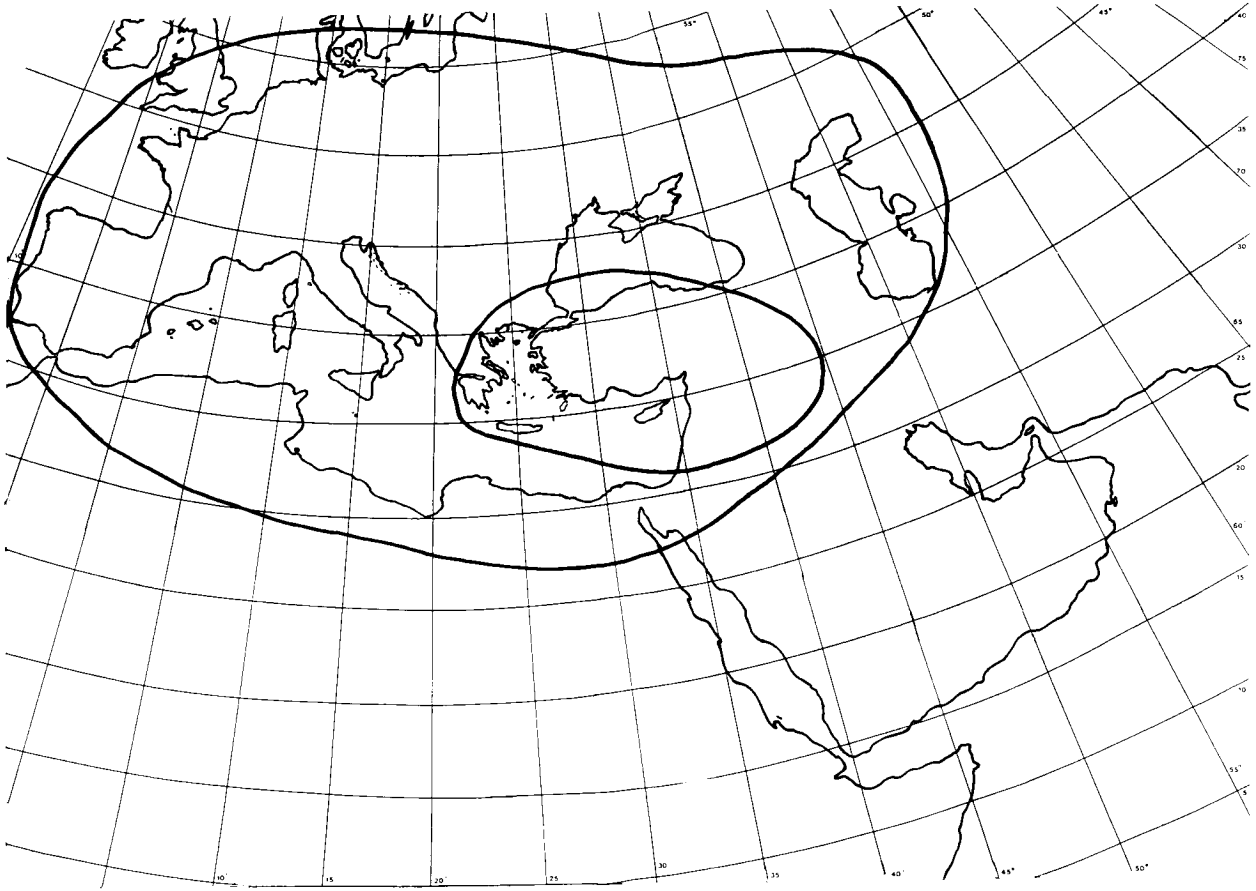
Application of Dot Distribution Maps

- Location of germplasm samples and herbarium records
- Passport, characterisation and evaluation descriptors
- Membership of different species, cultivars or landraces
- Synoptic descriptors
- Within-population variation

Contour Map



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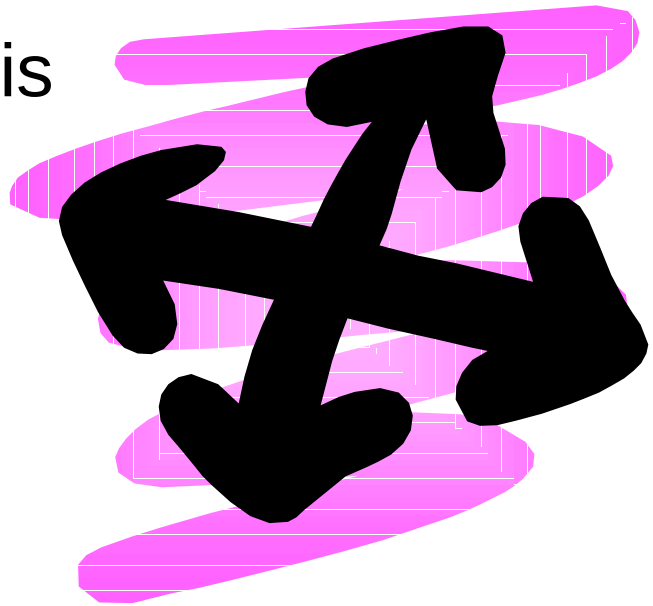
Geographic Information Systems (GIS)

- Dedicated to handling spatial data and logically related, non-spatial data
- Highly adaptable and versatile
- Powerful analysis tool

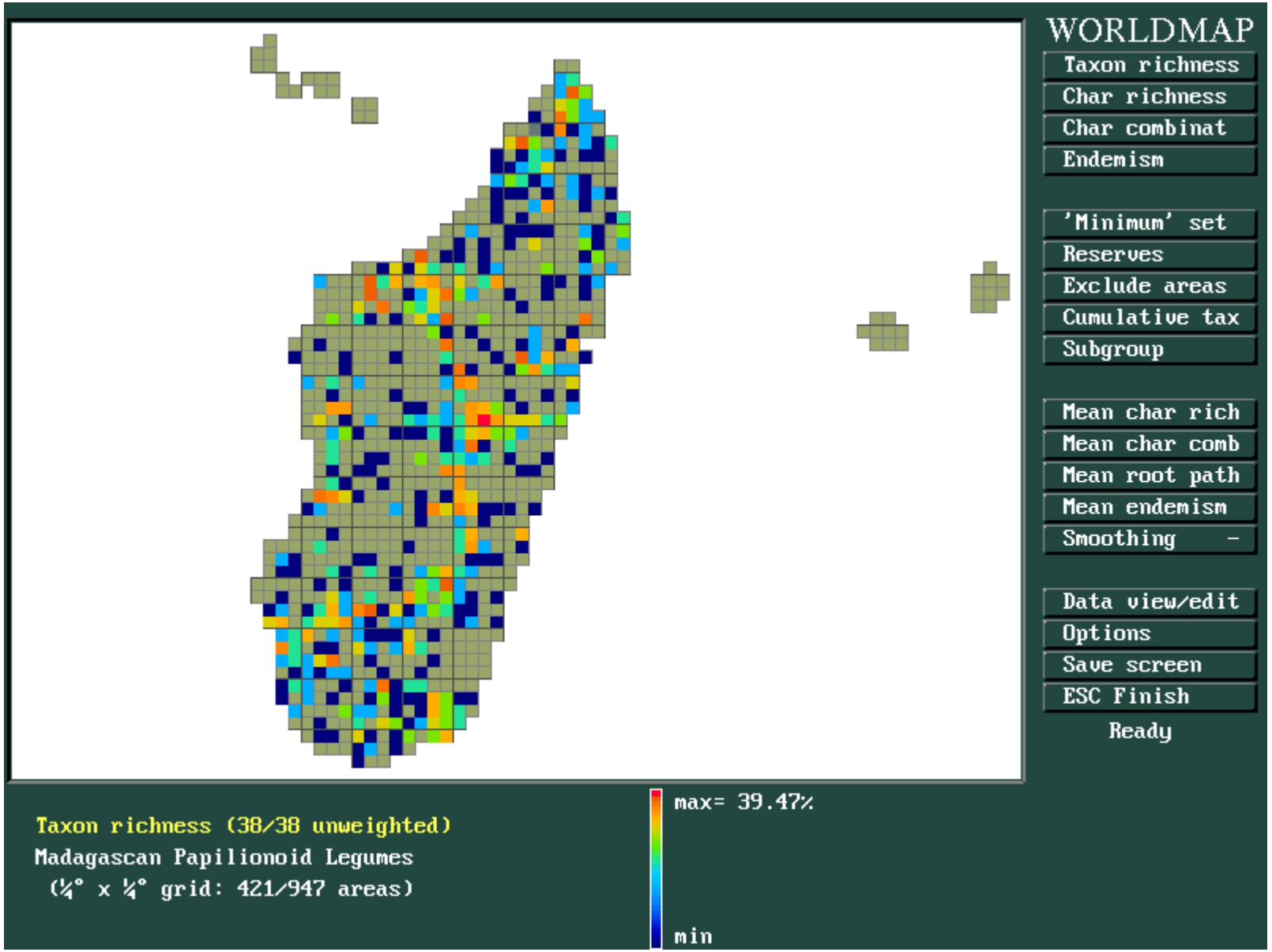
GIS Capabilities

- Geometric correction
- Digital terrain model analysis
- Interpolation
- Overlay analysis
- Proximity analysis
- Computation of statistics
- Location



Example - WORLDMAP

- Graphical, analytical tool
  - Used to identify priority areas for conservation
- Displays distribution data with cladistic information
- Priority areas identified according to one or more criteria


WORLDMAP
Taxon richness
Char richness
Char combinat
Endemism
'Minimum' set
Reserves
Exclude areas
Cumulative tax
Subgroup
Mean char rich
Mean char comb
Mean root path
Mean endemism
Smoothing -
Data view/edit
Options
Save screen
ESC Finish
Ready
Taxon richness (38/38 unweighted)
Madagascan Papilionoid Legumes
(¼° x ¼° grid: 421/947 areas)
max= 39.47%
min

Outline

- Introduction
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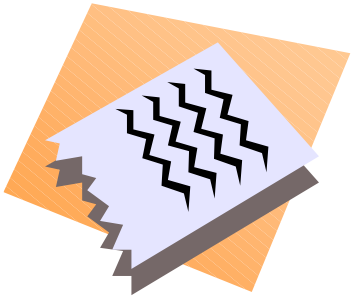
Data Synthesis

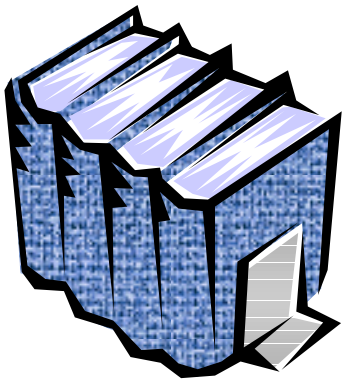
- Final synthesis of all data and analyses
- Products
  - ecogeographic database
  - ecogeographic conspectus
  - ecogeographic report

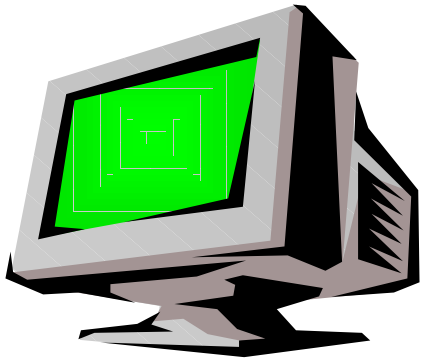
Important to know the completeness of the data set

Ecogeographic Conspectus

- Summarises all the available information collected in the survey
- Arranged in order of plant name
- Provides summaries for each geographical subunit





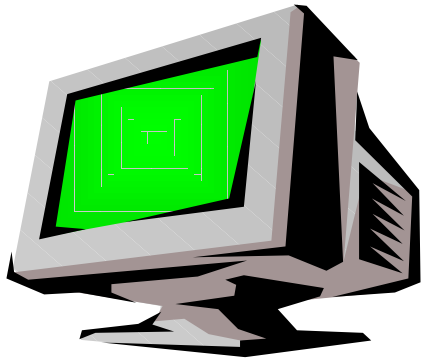
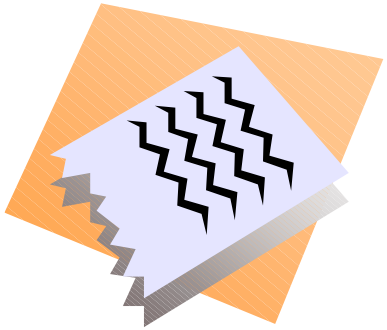


Conspectus - Information to Include

- Accepted taxon name, author(s), etc.
- Reference to published descriptions
- Morphological descriptions or identification keys
- Phenology, flowering season
- Ethnobotanical notes
- Geographical distribution
- Distribution maps
- Ecological, geographical and taxonomic notes
- Conservation notes

Ecogeographic Report

- The ecogeographic report contains
  - a discussion of the database and conspectus
  - conclusions regarding the group's ecogeography
  - a concise list of conservation priorities


Report - Discussion Points

- Taxon delimitation, classification
- Taxon ecology and uses
- Database structure; hardware/software used
- Taxon conservation status
- Suggested conservation priorities and strategy

Criteria Used in Setting Conservation Priorities

- Biological
  - Richness
  - Rarity
  - Threat
  - Representativeness
  - Function
- Social/Political
  - Utility
    - economic, scientific, social, cultural and religious use
  - Feasibility
    - political, economic, logistical and institutional considerations

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