GEOGRAPHIC DISTRIBUTION AND DIVERSITY ASSESSMENT OF PLANT GENETIC RESOURCES IN SHKODRA REGION

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INTRODUCTION

Albania is very rich in biological and landscape diversity, in cultivated crops and in wild plant species (~3250 species, more than 27% of European Flora).

This diversity is attributable to the country geographic position (geological, hydrological, climatic, and soil and relief factors).

Plant genetic resources (PGR) play a key role in contributing to the sustainable development of agriculture, helping to increase agricultural food productions.

Wild plant species provide an invaluable source of genes that can be used for the improvement of cultivated species.

The information on plants biodiversity in Albania is generally lacking especially in terms of species. There are still flora/or taxonomic groups, especially crop wild relatives which are unknown or have not been studied.

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INTRODUCTION

Geographic information systems (GIS) are useful tools for eco-geographical analysis.

GIS analyses visualize geographic distributions of biodiversity in clear maps, and provide important information about the diversity in specific geographic areas.

Diversity indices serve as valuable tools that enable researchers to quantify diversity in a community and describe its numerical structure.

Because the Northern part of Albanian territory has highly heterogeneous environmental conditions,

the aim of this study was to assess the geographic distribution of PGR in Shkodra County areas.

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MATERIALS AND METHODS

**Geographic distribution:**

The study used the *ex situ data* of PGR present in Albanian Gene Bank (AGB) database, and it was conducted in *three* districts: Malësi e Madhe (MM), Puka (PU), & Shkodra (SH).

Each taxon/plant species/or population (group of individuals) represents a *geo-referenced* observation, *entered* into the GIS analysis, as *presence points*.

The geographic areas were separated into small grid square cells, and grid cells of *5 x 5 km, 10 x 10 km* were used.

The analysis focuses only on the study of diversity at *the species levels* (unit of alpha diversity).
MATERIALS AND METHODS

The measurement of diversity and geographic distribution was realized:

- analyzing the **number of observations per species and per district**, and
- the **area of occupancy by a specific species** (=indicator of abundance/rarity of a particular species).

**Diversity indices:**
Species richness (S), Simpson index (1–D), Shannon (H) and Brillouin index (B), and Evennes (e^H/S), Equitability (J), Menhinick and Margalef's richness indices (D_{MG}) were the diversity indices and richness estimators used.

Diversity indices and richness estimators were calculated and mapped using DIVA-GIS tools.
RESULTS AND DISCUSSION

Collecting data: A large range of information for 236 accessions (≡ presence data) was gathered and recorded for each plant species.

Data quality:
- Firstly geo-referenced or presence data were checked for inconsistencies.
- Data points without coordinates were removed from ex situ PGR data.
- Points with incorrect coordinates were assigned coordinates where possible.
- Duplicate or doubtful data were removed.
- Plant species were screened carefully to resolve any scientific name conflicts.
- The accessions not present physically in gene-bank were also removed.

Geographic distribution:
After checking the presence/absence data, in total only 227 presence points for 30 plant species were compiled and used to evaluate the geographic distribution, and diversity of currently plant species in three districts of Shkodra County.
Geographic distribution of plant species in MM, PU and SH districts

- Amygdalus communis
- Anthriscus sylvestris
- Cannabis sativa
- Castanea sativa
- Cornus mas
- Corylus avellana
- Fraxinus excelsior
- Helianthus annuus
- Juglans regia
- Malus domestica
- Morus alba
- Nicotiana tabacum
- Olea europaea L.
- Origanum vulgare
- Pistacia terebinthus
- Prunus avium
- Prunus domestica
- Prunus myraborlana
- Punica granatum
- Pyrus amygdaliformis
- Pyrus communis
- Rubus idaeus
- Salvia officinalis
- Satureja montana
- Sorbus aucuparia
- Thymus vulgaris
- Vaccinium myrtillus
- Vitis sylvestris
- Vitis vinifera L.
- Zea mays
RESULTS AND DISCUSSION

Comparison of diversity indices: Spatial analysis detects areas of high diversity. Species richness (S) shows the higher number of different plant species occurs in MM and SH district areas, (S respectively 19 & 17 species).

Simpson index (1-D > 0.80) (the prob. that 2 individuals randomly selected from a sample will belong to different species), shows presence of higher diversity in areas of MM and PU districts.

Shannon-Weiner index (H >2.30) show that areas of MM district was richer (no. of species) and more even (individuals among species) than other areas.

Higher number of individuals per species (6.1) and low evenness (0.39) and equitability (0.67) was observed at SH district areas.

Shannon index ranges from 1.89 (SH areas) to 2.76 (MM areas) showing in general mid species richness and evenness.
RESULTS AND DISCUSSION

Comparison of diversity indices according to 3 districts of Shkodra County

<table>
<thead>
<tr>
<th>Indices/Districts</th>
<th>MM</th>
<th>PU</th>
<th>SH</th>
<th>Average</th>
<th>StDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxa_S</td>
<td>19</td>
<td>13</td>
<td>17</td>
<td>16.33</td>
<td>3.06</td>
</tr>
<tr>
<td>Individuals</td>
<td>60</td>
<td>63</td>
<td>104</td>
<td>75.67</td>
<td>24.58</td>
</tr>
<tr>
<td>Simpson_1-D</td>
<td>0.9267</td>
<td>0.8808</td>
<td>0.7132</td>
<td>0.84</td>
<td>0.11</td>
</tr>
<tr>
<td>Shannon_H</td>
<td>2.765</td>
<td>2.294</td>
<td>1.898</td>
<td>2.32</td>
<td>0.43</td>
</tr>
<tr>
<td>Evenness_e^H/S</td>
<td>0.8361</td>
<td>0.7623</td>
<td>0.3926</td>
<td>0.66</td>
<td>0.24</td>
</tr>
<tr>
<td>Brillouin</td>
<td>2.359</td>
<td>2.015</td>
<td>1.688</td>
<td>2.02</td>
<td>0.34</td>
</tr>
<tr>
<td>Menhinick</td>
<td>2.453</td>
<td>1.638</td>
<td>1.667</td>
<td>1.92</td>
<td>0.46</td>
</tr>
<tr>
<td>Margalef</td>
<td>4.396</td>
<td>2.896</td>
<td>3.445</td>
<td>3.58</td>
<td>0.76</td>
</tr>
<tr>
<td>Equitability_J</td>
<td>0.9392</td>
<td>0.8942</td>
<td>0.670</td>
<td>0.83</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Simpson_1-D > 0.80; Shannon_H > 2.30; Brillouin B > 2.0; Margalef MG > 3.5; Menhinick >2.00; Evenness (e^H/S) > 0.70; Equitability_J > 0.80,

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RESULTS AND DISCUSSION

Comparisons of diversity indices show the presence of variability in the areas (grid cells) analyzed and between observed areas/districts.

Shannon diversity test (t) (family indices/ alpha diversity) among two observed areas, show significant differences exist among MM and two other districts (PU and SH) areas.

Comparison of diversity among observed areas using Shannon diversity test (T)

<table>
<thead>
<tr>
<th></th>
<th>MM</th>
<th>PU</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxa S Index</td>
<td>19</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Variance</td>
<td>2.6154</td>
<td>2.1983</td>
<td>1.8214</td>
</tr>
<tr>
<td>t: df p(same)</td>
<td>3.2524 122.97 0.0014773**</td>
<td>2.297 163.7 0.022886</td>
<td></td>
</tr>
</tbody>
</table>

See illustration on next page

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RESULTS AND DISCUSSION

Comparison of diversity indices:
Diversity among MM district (red line) and PU and SH districts (respectively blue and green lines) are comparable.
The diversity among PU and SH districts (where blue line cross green line) are non-comparable among them.
RESULTS AND DISCUSSION

Cluster analysis:
Comparisons of diversity indices using cluster analysis (ward) method generate a dendrogram with three cluster groups.

Shannon, Brillouin, Menhinick, and Margalef indices, with similarity between them, were included into the 1st cluster group. The low distance (0.013546657) was observed among Brillouin and Menhinick diversity indices.

Richness estimators and diversity indices as Evenness, Equitability, and Simpson (1-D) show similarity between them, and were included into the 2nd cluster group. The low distances (0.001110923) was observed among Simpson (1-D) index (leader) and Equitability (J) (joiner).

The indices as taxa (S) and number of individuals (n) show higher distance (4.779181774) and were presented in dendrogram as separate clusters.
RESULTS AND DISCUSSION

Cluster analysis:

OTaxa_S
+ Simpson_1-D
+ Equitability_J
+ Evenness_e^H/S

Shannon_H
Brillouin
Menhinick
Margalef
Individuals

2 Cluster
1 Cluster
RESULTS AND DISCUSSION

In this study the Brillouin, Menhinick and Shannon indices tend to give similar comparative measures. This information measure results can be used in favour of the Shannon index when the species differ in their capture rates.

Districts as MM and PU show high species diversity, which suggests presence of a greater number of successful species and more relative stable ecosystems.

Results of this study show in the MM district areas more ecological niches are available.

SH district areas showing more less species evenness, suggests relatively not many successful species presence in these habitats, and the environment is more stressful with relatively few ecological niches available.
COCLUSION

- **Spatial analysis** show the presence of significant *diversity differences* between three observed (MM, PU, SH) areas, and detects the area of high (alpha) diversity was **MM district**.

- **Comparisons of diversity indices** using cluster analysis method divide diversity indices in **two principal** groups. Shannon, Brillouin, Menhinick, and Margalef indices show similar comparative measures (1st cluster group), and Evenness, Equitability, and Simpson (1-D) tend to give similar comparative measures (2nd cluster group).

- Diversity observed in MM district areas is significant and comparable with diversity present in PU and SH districts areas, but the diversity among PU and SH districts are non-comparable.

- **MM district** (high species diversity and evenness) suggests presence of a greater number of successful species and more relative stable ecosystems, where more ecological niches are expected to be available.
"Diversity for Life"

Thank you

Bridge of Postribe (Shkoder, Albania)