Tropentag 2010
ETH Zurich, September 14 - 16, 2010
Conference on International Research on Food Security, Natural Resource Management and Rural Development

Vegetation and Geobiocoenological Typology of the Soqotra Island

Habrova[a], Hana and Bucek[b], Antonin

a Mendel University in Brno, Zemedelska 3, 61300 Brno, Czech Republic, habrova@mendelu.cz
b Mendel University in Brno, Zemedelska 3, 61300 Brno, Czech Republic, bucek@mendelu.cz

Introduction & Methods

During the years 2001-2004, complex field observations on more than 250 localities of Soqotra Island (Republic of Yemen, 12°19´-12°42´ N latitude and 53°18´-54°32´ E longitude) were made. Field notes and phytosociological releves served as a basis for specifying and processing the characteristics of geobiocoenological units. In the records, main features of ecotopes are characterized: altitude, aspect and slope inclination, general characteristics of the parent rock, topography and soil properties; and synusia of trees (general level of the upper canopy, layering /stratification/, degree of coverage of particular species).
Differentiation of the natural (potential) condition of geobiocoenoses, i.e. of a condition which would occur in the present landscape after elimination of man impacts, is the objective of geobiocoenological typology based on the application of the theory of geobiocoene type (Zlatnik 1975). As a result, a geobiocoenological typological system describing vegetation of the island has been produced, as it can provide necessary data for the landscape protection, frameworks for differentiated landscape cultivation and bases for planning the landscape sustainable use.

Results

Superstructural Units

Altitudinal vegetation zones

Altitudinal vegetation zones (AVZ) express connection of the sequence of vegetation differences with the sequence of differences in altitude and aspect climate. Vegetation zonation is particularly dependent on air and soil temperatures and on the amount and time distribution of atmospheric precipitation including horizontal precipitation. 5 AVZ of Soqotra Island (delimited by means of the computer image analysis of multitemporal data of the MODIS satellite [Kral & Pavlis 2006]) are already described in detail in the paper by Habrova (2004).

1. Altitudinal Vegetation Zone: *planar,* (*meterhel*)
2. Altitudinal Vegetation Zone: *collinean,* (*emhar*)
3. Altitudinal Vegetation Zone: *submontane,* (*ariob*)
4. Altitudinal Vegetation Zone: *montane,* (*dagesh*)
5. Altitudinal Vegetation Zone: *alto-montane,* (*azabzabahan*)

Trophic ranges

Trophic ranges (TR) and inter-ranges (IR) express conditions of the biota, given by soil nutrient contents and soil reaction. Classification of geobiocoenose segments into TR and IR is more unambiguous than their classification into AVZ. In natural and near-natural geobiocoenoses one may use sets of plant bioindicators, often with a narrow ecological amplitude, which can clearly indicate mineral supply and soil environment acidity in the rhizosphere. In the geobiocoenological system, TR are marked by capital letters of alphabet.

Trophic range D – bazic: Alkalic litic soils on limestone and karren fields, soils are only slightly developed. Trees on D TR: *Dracaena cinnabari*, various frankincense trees i.e. *Boswellia dioscorides, B. bullata, B. nana, B. popoviana*.
Trophic inter-range BD – mesotrophic-bazic: Neutral to slightly alkalic soils (pH > 6,5), very well reserved soils on limestone substrates and other calcic sediments, on basalt and loess. This trophic range dominates on most of island area.
Trophic range C - nitrophilous: Very rich soils in mineral supply, high content of nitrogen, on transit-accumulation and accumulation shapes of relief, mainly on slope debris. Presence of nitrophilous bio-indicators, i.e. *Dioscorea lanata, Ledebouria grandifolia, Trichodesma scotii*, centre of presence of trees: *Sterculia africana* var. *socotrana* and *Lannea transulta*.
Trophic inter-range CD – nitrophilous-bazic: very well saturated soils with higher nitrogen supply on slope debris on limestone
Trophic inter-range BC – mesotrophic-nitrophilous: Present only on limited area of mountain slope debris on granite substrate.
Trophic range B – meso-trophic: Soils well supplied with minerals, slightly acid (pH 5,5-6,5), present mainly on igneous rocks with high supply of alkaline minerals.
Trophic range S - salty: Alkaline soils with high salt supply, mainly on seacoast and coastal plains with influence of seawater. Vegetation halophitic: *Limonium socotranum, Limonium paulayanum, Atriplex grifithii, Atriplex farinose, Zygophyllum decumbens, Tamarix nilotica* and *Acacia edgeworthii*, trees: *Avicennia marina*.

Hydric ranges

Hydric ranges describe differences in moisture regime of soils, with individual ranges differing in amounts of water available within the soil space. The differences in humid regime of soils are in the framework of relatively homogenous climatic conditions of AVZ given principally by differences in relief morphology and in a soil character. In basic normal range, roots of plants usually use atmospheric precipitations. In dry and limited ranges, there occurs an abnormal drainage, vapour or infiltration; rhizospheres of waterlogged and wet ranges are influenced by accessory water, which come to a locality by overflow or subirrigation. In the geobiocoenological system, numbers mark hydric ranges from driest to wettest.

1. dry HR: - cliffs, slopes, rocks, sand dunes etc. with very quite runoff, strong evaporation or quick infiltration; vegetation sporadic, scarce; presence of succulents.
2. limited HR: shallow soils on steep slopes, usually influenced by sun or wind desiccation, the growth of woody plants is limited, presence of succulents.
3. normal HR: deeper soils without quick runoff or infiltration, atmospheric precipitation is utilised by plants for evapo-transpiration.
4. humid HR: rhizosphere is periodically or permanently influenced by additional groundwater, present usually in wadis in river valleys, around springs and permanent watercourses.
5. wet HR: permanently waterlogged soils, drying only on surface even in dry periods; on Soqotra only around coastal platforms influenced by salted groundwater.

Basic Units – Groups of Geobiocoene Types, Biotope Types

5 altitudinal vegetation zones, 4 trophic ranges and 3 inter-ranges (expressing soil conditions), 5 hydric ranges (expressing water condition in soil), 26 groups of geobiocoene types and within them (with respect to their actual condition of vegetation) 39 biotope types were delimited.

Geobiocoenological formula originates from the abbreviations of AVZ, hydric range and trophic range and it characterizes 26 groups of geobiocoene types (GGT). Each GGT is named according to one or two dominant tree (shrub) species typically growing in potential climax plant communities in given abiotic conditions. Each GGT is characterized by composition of Biotope types as a result of different succession stages.

Classification of biotopes is based on differences in physiognomy, structure and species composition of the vegetation component of present biocoenoses. Biotope types are divided according to differences in the species composition of dominant species, GGT are divided according to physiognomy and vertical structure of vegetation. Biotope types are usually named according to key species of plants in English.

1–S–5: Avicennia marina – on coastal area on salted soils, **biotope types**: F.2. Mangrove forest, Wt. Coastal lagoons.

1-S-4: Limonium socotranum – coastal plains on soils influenced by rising sea-water or salty winds. **Biotope types**: DS.2. Salted desert, S.2.7. Low halophilous shrubland, S.3.3. Dwarf halophilous shrubland.

1-S-1(2): Tamarix nilotica–Acacia edgeworthii – sand dunes near sea coast often influenced by salty winds. Plants usually with very deep rooting system. **Biotope types**: S.2.6. Tamarix shrubland, DS.1. Sand dunes.

1–CD–2(3): Adenium obesum–Dendrosicyos socotrana – stony to boulder debris mainly on north coast. **Biotope types**: S.1.4. Succulent shrubland.

1–BD–3: Croton socotranus–Jatropha unicostata - plains with warmest and driest climate, the most present GGS in 1.AVZ. **Biotope types**: W.4. Savannah woodland, S.2.1. Croton shrubland, S.2.3. Mixed low deciduous shrubland, S.3.1. Dwarf shrubland from lower altitudes.

1–BD–3(4): Ziziphus spina-christi – low terraces in wide wadis periodically flowing on costal plains. **Biotope types**: DP. Date palm plantations and Wa. Wadis.

2–B–1: Jatropha unicostata–Adenium obesum – rocky cliffs without soil coverage. **Biotope types**: R.2. Granite and basalt rocks.

2–D–1: Boswellia dioscorides–Adenium obesum – limestone rocks. **Biotope types**: R.1. Limestone rocks.

2–BD(D)–2(3): Euphorbia spiralis–Croton socotranus – exposed sites mainly on edges of limestone plateaus. **Biotope types**: S.3.4. Eolic dwarf shrubland.

2–CD–2(3): Adenium obesum – stony to boulder debris mainly on north coast. **Biotope types**: S.1.3. Succulent shrubland.

2–BD–3: Boswellia elongata–Commiphora ornifolia – vallys and slopes on various sediments. The most present GT in second AVZ. **Biotope types**: F.3. Frankincense forest, W.2. Frankincense woodland, S.1.3. High myrrh shrubland, S.2.1. Croton shrubland, S.2.2. Jatropha shrubland, S.2.3. Low mixed deciduous shrubland, S.2.5. Low Lycium shrubland, S.3.1. Dwarf shrubland from lower altitudes and D.1. Degraded land.

2–C(CD)–3: Sterculia africana – steep slopes in valleys. **Biotope types**: F.5. Debris forest and W.6. Debris woodland.

2–CD–4: Tamarindus indica–Ziziphus spina-christi – basis of slopes and river beds. **Biotope types**: W.5. Riverine woodland, S.1.2. Ficus shrubland, DP. Date palm plantations and Wa. Wadis.

3–B–1: Dorstenia gigas - granite rocks without soil cover **Biotope types**: R.2. Granite and basalt rocks.

3–D–1: Boswellia dioscorides – limestone rocks **Biotope types**: R.1. Limestone rocks.

3–BD(D)–2(3): Euphorbia spiralis - exposed sites mainly on edges of limestone plateaus. **Biotope types**: S.3.4. Eolic dwarf shrubland.

3–BD–3: Boswellia ameero – slopes and valleys in higher altitudes mainly on igneous substrates in north part of the island **Biotope types**: F.3. Deciduous frankincense forest, W.2. Deciduous frankincense woodland, S.1.4. Myrrh tree shrubland and S.2.2. Jatropha shrubland.

3–BD-D–3: Dracaena cinnabari – limestone plains, typical GT in third AVZ. **Biotope types**: F.1. Dragon‘s blood tree forest, W.1. Dragon‘s blood tree woodland, S.2.4. Low shrubland with Croton socotranus and/or Buxanthus pedicellatus, S.3.2. Dwarf shrubland of higher locations and G.2. Pastures on limestone plateaus .

3–CD–4: Ficus vasta – bases of slopes and wadis, area is very limited. **Biotope types**: Wa. Wadis.

4–B–1: Begonia socotrana - granite rocks without soil cover or with litosols. **Biotope types**: R.2. Granite and basalt rocks.

4–B–3: Sideroxylon fimbriatum–Cephalocroton socotranus – gentle slopes and plains on granite in Haggeher mountains **Biotope types**: W.3. Montane woodland, S.1.1. Evergreen montane shrubland, S.3.5. Dwarf montane shrubland with Hypericum scopulorum, G.1. Cleared mountain pastures on granite and D.2. Erosion rills and gullies on mountain pastures.

4–B(BC)–3: Euphorbia socotrana – mainly steep debris slopes in Haggeher mountains, in fourth AVZ only on limited area. **Biotope types**: F.4. Montane forest.

4–BD-D–3: Buxanthus pedicellatus – peaks of limestone plateaus. **Biotope types**: S.2.4. Low shrubland with Croton socotranus and/or Buxanthus pedicellatus, S.3.2. Dwarf shrubland of higher locations and G.2. Pastures on limestone plateaus

5–B–1: Helichrysum rosulatum – granite rocks without soil cover or on litosols. **Biotope types**: R.2. Granite and basalt rocks.

5–B–3: Spiniluma discolor – slopes in highest parts of the mountains, plain sites only scattered, granite as a substrate. **Biotope types**: W.3. Montane woodland, S.1.1. Evergreen montane shrubland, S.3.5. Dwarf montane shrubland with Hypericum scopulorum, G.1. Cleared mountain pastures on granite and D.2. Erosion rills and gullies on mountain pastures.

5–B(BC)–3: Pittosporum viridiflorum–Dracaena cinnabari – steep, often debris slopes in highest parts of Haggeher mountains. **Biotope types**: F.4. Montane forest.

Acknowledgement

This study was financially supported by Czech grant MSM: 6215648902. Further, we highly appreciate kind logistical backing of the Environmental Protection Authority of Yemen.

References

Habrova, H. 2004. Geobiocoenological Differentiation as a Tool for Sustainable Land-use of Socotra Island. Ekologia Bratislava. 23, 47-57.

Kral, K., Pavlis, J. 2006. The first detailed land cover map of Socotra Island by Landsat /ETM+ data. Int. J. Remote Sens. 27(15), 3239-3250.

Zlatník, A. (1975): Landscape Ecology and Geobiocoenology. VSZ Brno, 172 p. (in Czech)