9 A Bioclimatic Map for Southern Morocco

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This map shows the potential distribution of the Emberger Index for the Drâa Catchment. Its calculation is based on two factors that limit the growth and distribution of plants: temperature and precipitation. First, the thermic range is confined by threshold values such as frost occurrence. Second, total annual precipitation sets the initial value for water balance. The resulting bioclimatic zones can serve as proxies for potential vegetation units.

Introduction

Bioclimatic indices have been developed as tools to explain the spatial distribution of vegetation units by the combination of different climatic factors (Gavilán, 2005). They are increasingly important because they facilitate the transfer of results from climate modelling to land use and vegetation science. They also help predict long-term trends in desertification (↗ 5).

Methodology

The mean minimum temperature of the coldest month (Tm), the mean maximum temperature of the warmest month (TM) and total annual precipitation (P) were derived for the Drâa Basin and its surroundings from the CRU database for the period 1961–1990. These variables are needed to calculate the Pluviometric Quotient (Q) of Emberger (1930):

$$Q = \frac{(P * 2000)}{(T_M + T_m)(T_M - T_m)}$$

In combination with ranges of Tm, this index defines the classification of bioclimatic zones according to a scheme ranging from driest to wettest and hottest to coldest. To calculate the thermic variants we used altitude-adjusted minimum temperature from the ECHAM4 -REMO model chain.

Luis Emberger developed this index as a tool to analyse the vegetation zones of Morocco. He later applied it to the whole Mediterranean region where it is still widely used. Daget (1977) refined the classification by more precisely delineating the climatic thresholds of the different classes. These bioclimatic zones were calculated using the Arc-GIS 9.2 (ESRI) Raster Calculator.

Bioclimatic Map

Figure 1 shows the distribution of 13 different bioclimatic units within the Drâa Basin. Arid to semiarid bioclimates in the hot thermal variant comprise the largest areas (about 70 %, Tab. 1). These areas generally correspond to vegetation units dominated by the Saharan flora.

Hot to temperate, subhumid bioclimates prevail in the mountain ranges of High Atlas and Jebel Siroua, and smaller patches occur in the Antiatlas. In total, this bioclimate class covers about 25 % of the Drâa Basin. These zones are mainly characterized by ibero-mauritanean Sagebrush-steppes and contain all the important grazing resources for transhumant pastoralists.

Subhumid and humid bioclimates in the cool to very cold variants constitute less than 5 % of the area. They are mostly restricted to the highest mountain ranges along the northwestern water divide of the Drâa Catchment. Vegetation of these areas is principally dominated by thorny cushion shrubs that serve as summer pastures for sheep and goats (↗ 10,12,13).

References

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***Tab. 1:** Area ratio of bioclimatic zones*

variant / bioclimate	cold	cool	fresh	temperate	warm	hot	total area [%]
perhumid	-	0.0	0.1	0.1	0.0	0.0	0.3
humid	0.1	0.3	0.9	1.3	0.5	0.5	3.6
subhumid	0.0	0.3	1.8	5.3	5.4	11.1	23.9
subarid	-	0.0	0.0	0.4	1.6	43.9	45.9
arid	-	-	-	-	0.0	24.9	24.9
perarid	-	-	-	-	0.0	1.5	1.5
total area [%]	0.1	0.6	2.8	7.1	7.5	81.9	100.0

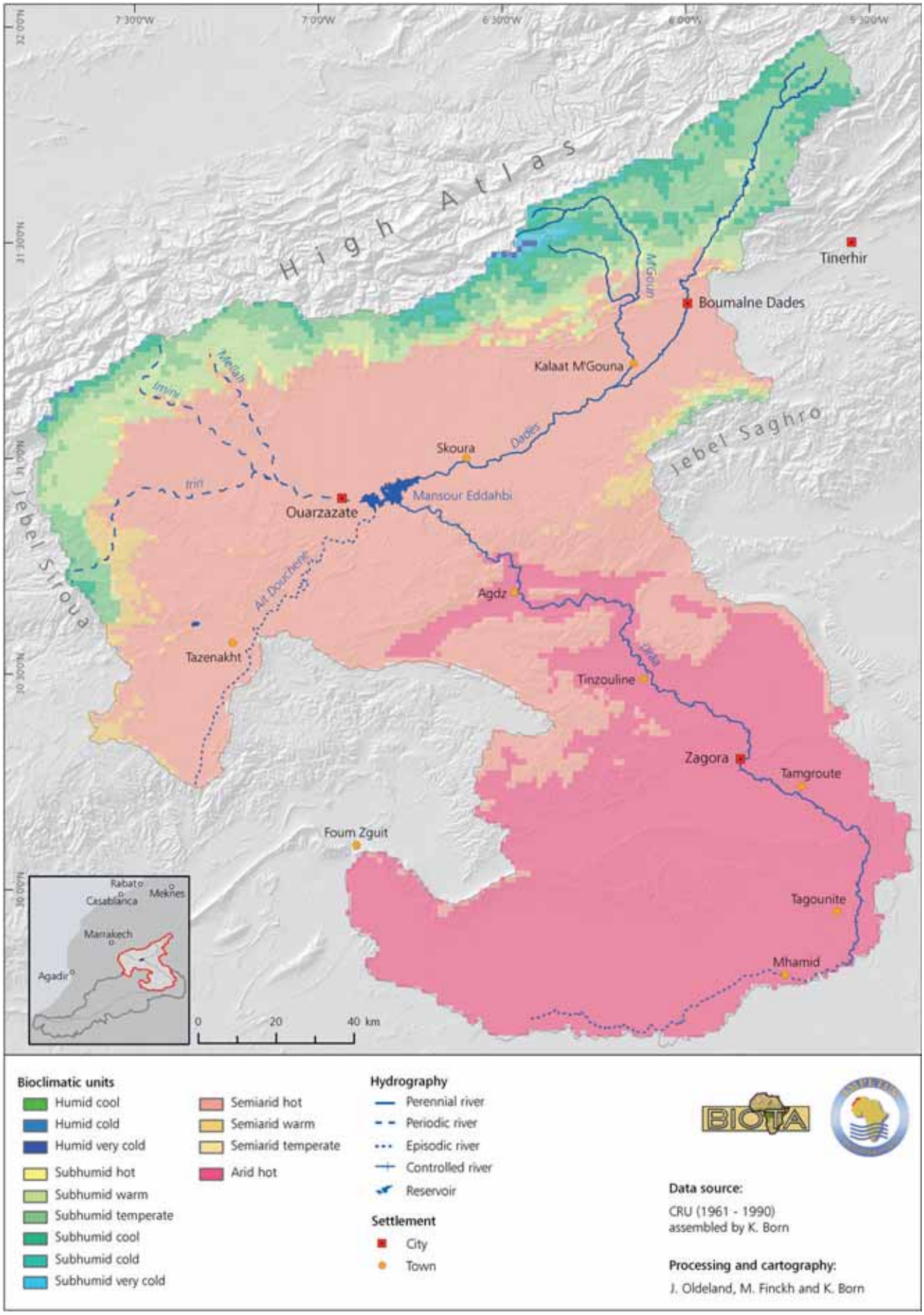

Fig. 1: *Bioclimatic map of the Drâa Catchment (potential distribution of the Emberger Index).*