DESERT ECOSYSTEMS: AN INTRODUCTION

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Summary

This chapter presents an introduction to Tropical Deserts Ecosystems showing the distribution of them in the planet and the main characteristic of these arid, inhospitable and ecologically fragile areas. The dry climatic condition of the environment in these areas is such that heat from the sun reaches the surface and creates a high day time temperature, but at night the temperature falls. Aeolian processes govern the shaping of surfaces, moving sediments provided by the weathering. In spite of their hard environmental conditions, these areas have been occupied by many forms of adapted flora and fauna, looking for their supplies of water and food. The human activities are ancient in this environment; some ancient civilizations flourish in the tropical deserts as Egyptian and Tuareg people in Africa and pre-Colombian people in South America. Plantation in these regions is difficult due to uncertainty of rains and recurrent droughts. Harsh environmental conditions make germination of seeds and survival of trees, shrubs, and grasslands difficult. Urbanization, industrialization and use of fertile land for development needs have imbalanced ecosystem to a serious extent. Increasing water requirements for human, livestock, urban and other development needs have depleted ground water to drastic levels. Two different processes occur in tropical areas near the deserts. Sandization happens in humid areas. The origin of this process is the reworking of non-consolidated surface sands, by water and wind. These sediments are constantly mobilized, which in turn, hinder the vegetation from fixing itself. The desertification

that happens in arid areas is the destruction or diminution of the biological potential of land, and can lead ultimately to desert-like conditions.

1. Introduction

Deserts ecosystems located in tropical regions are environment of extremes, with lack of moisture and generally synonymous with arid regions. They are some of the hottest and driest areas of the planet, with no or sporadic rainfall. These conditions are due to some different conditions as continentality, topography and subtropical high pressure cells' influence. These kinds of deserts are located in the southern and northern hemispheres, especially between 5 and 30 degrees of latitude (Figures 1 and 2)

The most important controlling factor for the tropical desert climate is the year-round presence of subtropical high pressure with hot, dry descending air cells called Hadley Cells, the Sahara, Arabian, Sonora and northern Atacama Deserts are of this type. The effect of descending air from subtropical high adiabatically warms causing the air to dry out and inhibit condensation. According UNEP (2006), "the heterogeneity of topography contributes to the deserts formation, in special outside the mid-latitude belts. In the tropics, for example, when the moisture-laden tropical trade winds reach continental mountain ranges they cool as they ascend, condensing fog and drizzle that feed montane cloud forests." Also, if the distance from moisture sources increases, aridity will also rise. Situation in the mountainous areas which creates rain shadow conditions also promotes dry conditions. Cool coastal deserts are found in areas along coasts where cold water is upwelling them. Olson et al, 2001.

2. Past Climates and Desert Evolution to Present Days

Different warming and cooling periods over the past two millions years affected the Earth induced by variations in the planet's orbit and the inclination of its axis. This period of time is known as Pleistocene and this is divided into glacial and interglacial sub periods. The creation of condition to increase desert areas and the low global forest cover was due to the lower concentration of atmospheric CO_2 and presence of large ice sheets, during the Last Glacial Maximum (LGM) period, (5–17 000 years before present [yBP]). (Emiliani, (1992),Strahler and Strahler, 1996)

Significant changes in Earth's ecosystems and climate occurred after Pleistocene glacial period and are occurring until nowadays. Firstly the tropical belt narrowed and the deserts moved towards the equator, shrinking in the mid-latitudes, being replaced by grasslands, semiarid scrubs, open woodlands and cold steppes. Secondly the ancestors of modern-day desert biota found refuge in what are now dry subtropical habitats, especially in places where arid conditions persisted under the rain shadow of large mountain ranges, or in areas that are now covered by dry tropical savannas which, lacking intense monsoons, were then more arid than at present.(UNEP 2006)

The glaciers retreated around 15 000 years ago after the finish of the last glaciations period. As a result it has giving place to a warm interglacial period: the Holocene or more well-known as current global climate. UNEP 2006, Rognon P. and Williams M. A. J. 1977)

Through the middle Holocene, ecological conditions maintained a “green Sahara” climate system in Africa. In spite of this, occurred a sudden change to a “desert Sahara”, the regime we know at the moment. The aridization trend of the mid- Holocene fed back into the deserts themselves by decreasing vegetation cover, reducing local inputs of moisture into the atmosphere, and then increasing the dry conditions. (Adams J.M. & Faure H. (1997), Adams J.M. (1997),UNEP 2006)

3. Location of Tropical Deserts

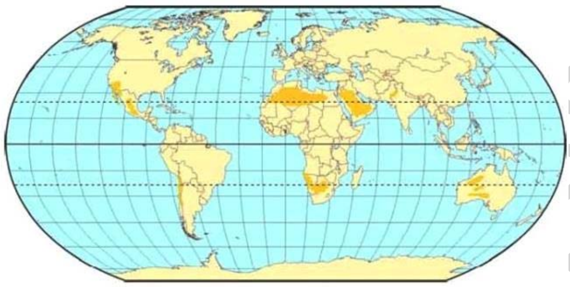

Figure 1. Location of tropical deserts.

Figure 2. Sample of desert landscape at drier climate condition in northern Argentina. Rodrigues 2003.

Deserts occur in specific latitudes (5-35° north and south of the equator) because of the general thermodynamics of our planet. Solar radiation hits the earth with highest intensity near the equator. Because the earth's axis is tilted 3.5° with respect to the plane of its orbit, during part of the year the zone of maximum solar interception shifts northwards, towards the Tropic of Cancer, and during part of the year it moves southwards, towards the Tropic of Capricorn. Thus, the warm tropics form a belt around the equator from latitude 3° north to latitude 3° south called Intertropical Convergence Zone, where the tropical heat generates rising, unstable air.

4. Biogeography of Deserts

The tropical desert is an environment of extremes: it is the driest and hottest place on earth. Rainfall is sporadic and in some years no measurable precipitation falls at all. The terribly dry conditions of the deserts are due to the year-round influence of subtropical high pressure and continentality. See Table 1 in *Geomorphology and Biogeography of Tropical Deserts.*

Deserts have an oppressive environment which host animals and plants living in extreme conditions. Although in most ecosystems plants compete for sunlight to grow, in tropical deserts presents too much solar energy and vegetation must be adapted to minimize its effects.

Plants and animals are involved in ecological cycle of tropical deserts. The strength of some desert-areas animals come from eating plants of the same area of them. However, those plants have some defensive mechanisms like sharp spines and chemical-laden leaves which are used to discourage vegetal-eaters. Most part of animals try to avoid future problems by feeding from seeds that, even easier to eat, are more difficult to find than ordinary desert-plants because of their small size and appearance alike sand grains. Figure 3.

Figure 3. Lizard looking for food in Cholistan desert (Pakistan). Ahmad, 2008.

The most focused plants by wildlife are those that are extremely productive and large, for instance cactus trees. Trees on desert areas can be more interesting because they also provide a place where birds can make nests, small lizards and termites may live. Additionally, there are birds that feed on the living insects of those plants. Also after death, solar energy can be seen moving forward the fascinating desert life by the trophic levels. WOLF (2000).

In tropical areas the heat enhances evaporation and the dryness conditions of the areas with little precipitation. Rain also occurs in a few events and quickly the moisture is absorbed by the soil or evaporated. These climatic conditions do not allow the geochemical processes of weathering to happen and most of the rock transformations are due to physical processes of contraction and expansion with the break of rocks in fragments.

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Biographical Sketch

Sílvio Carlos Rodrigues graduated in 1987 from the Universidade de São Paulo and obtained his doctoral degree from the same University in 1998. He had worked for some consulting enterprises from

1988 to 1999, especially on Environmental Impact Assessments of hydroelectric power stations in large rivers of the Amazonian and Savanna regions, and more recently on the Economic-Ecologic Management of Mato Grosso and Rondonia states. After 1999 he joined the Universidade Federal de Uberlândia (UFU), where he is currently employed. Sílvio Rodrigues is coordinator of the Soil Erosion and Geomorphology Laboratory at UFU, where he and his students carry out research on soil erosion and geomorphological cartography. Current projects include measurements of gully evolution and experiments on sheet erosion. From August 2004 until December 2006 he was President of Brazilian Geomorphological Union, which organizes the Brazilian community of geomorphologists and related researchers, including soil scientists and quaternary geologists. Since 2003 he has been member of the COMLAND – Commission on Land Degradation and desertification of the International Association of Geography.