Laurea / B.A.
in Global Governance

4. BIOMES: hot and cold desert

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- Areas in which the annual precipitation is less than 200 mm and the temperature, elevated throughout the year, it causes the evaporation of the low surface water of meteoric origin
- Arid areas where rainfall is scarce (<100 mm / a) and the vegetation is restricted to a few favorable areas
- Ecosystems where water metabolically available to organisms is severely limited, therefore characterized by a small biomass and low biodiversity

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This implies the presence of a discontinuous vegetation and a reduced biodiversity.

Representing 40 million square kilometers of land area and are inhabited by 500 million people.

30 % OF LAND: 16% HOT DESERT 14% COLD

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Classification of arid ecosystems

TABLE 7.1 Classification of Arid Ecosystems

Type	*Mean Annual Precipitation*	*Above Ground Primary Production*	*Below Ground Production*
Extremely arid or "true desert"[a]	less than 60–100 mm.	less than 30 g/m²	less than 100 g/m²
Arid[b]	from 60–100 mm. to 150–200 mm.	30–200 g/m²	100–400 g/m²
Semiarid[c]	from 150–250 mm. to 250–500 mm.	100–600 g/m²	250–1000 g/m²

[a]In true deserts, vegetation is restricted to favorable areas only.
[b]In arid areas, one finds diffuse natural vegetation.
[c]In semiarid areas, it is possible to carry out diffuse dryland farming, but its success is highly unreliable.

Source: Adapted from pp. 25, 44, 45 of Imanuel Noy-Meir, "Desert Ecosystems: Environment and Producers." Reproduced with permission from the *Annual Review of Ecology and Systematics*, Vol. 4 © 1973 by Annual Reviews, Inc.

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Geo-climatic characteristics

- Annual precipitation is scarce (max 200 mm) and concentrated in short periods
- High solar radiation
- extreme temperatures
- high winds
- Soils with low water retention capacity

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these parameters vary according to latitude, altitude, topography

the biome desert hasn't a continuous geographical distribution, but rather fragmented, this involves a wide diversity of climatic, geological and biological

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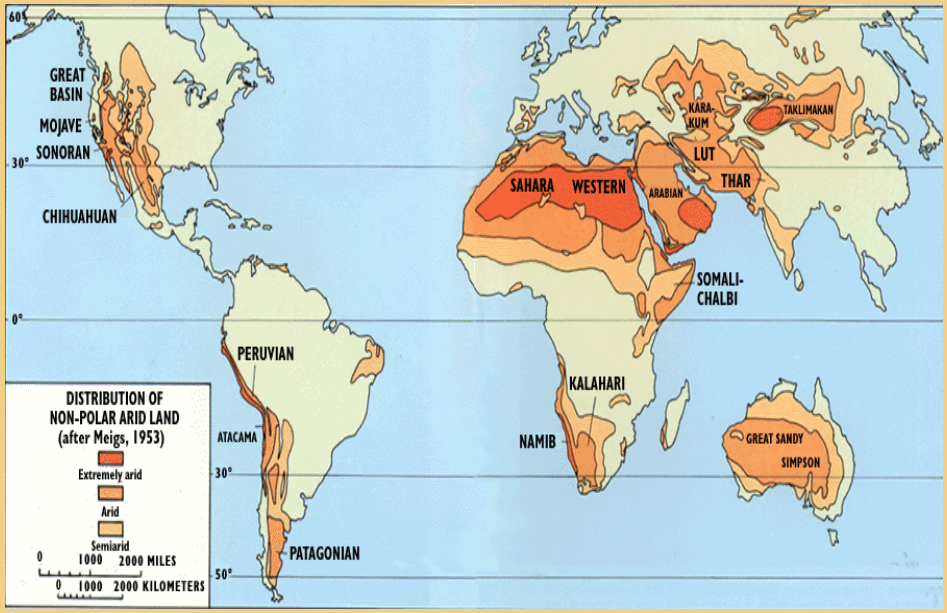
Distribution of drylands



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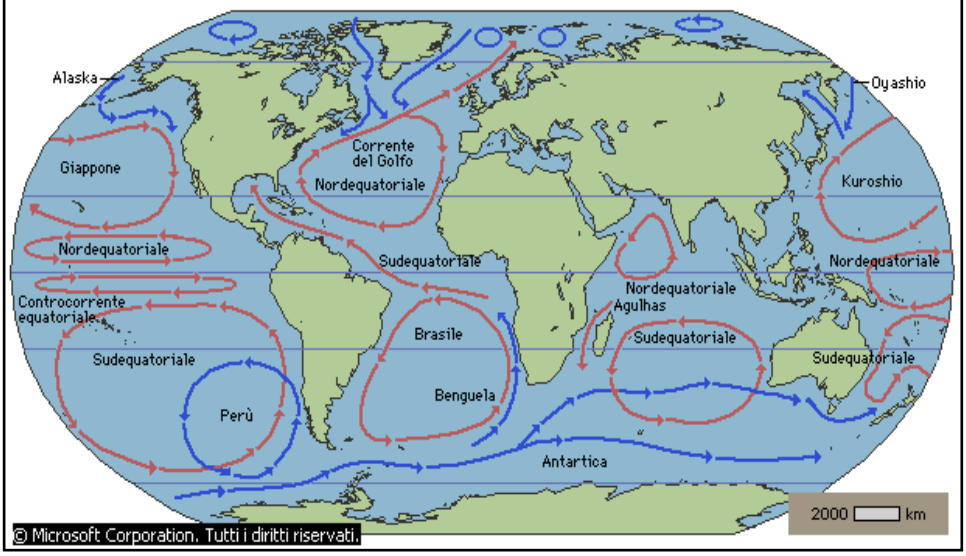
ocean currents



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Deserts can be distinguished

Hot deserts ➡ Sahara, the Namib, Great Sandy

Cold deserts ➡ Gobi (Asia), Patagonia (South America)

Altitude deserts ➡ Andes, Himalayas

Salty deserts ➡ Dead Sea region

* In Italy Etna at 1900-2000 m arid areas due to the lava substrate

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Soil

Pedogenesis mainly due to phenomena of physical alteration:

temperature range

erosion by wind and heavy torrential rains

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Energy flows

The energy flows in these ecosystems are very limited but the interactions between the various sectors are well integrated in order to optimize the exchange of energy and matter

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The plants and the deserts

The living conditions of extreme desert do not allow the development of a high biomass in this biome and favor species that have evolved mechanisms of adaptation to:

high insolation ➡ heliophilous species

high temperatures ➡ eurytherme species

absence of water for long periods ➡ succulence

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Depending on the level of erosion desert are distinguishable :

- Rocky Desert (hammada)
- Stony (regs)
- Sandy (ergs)



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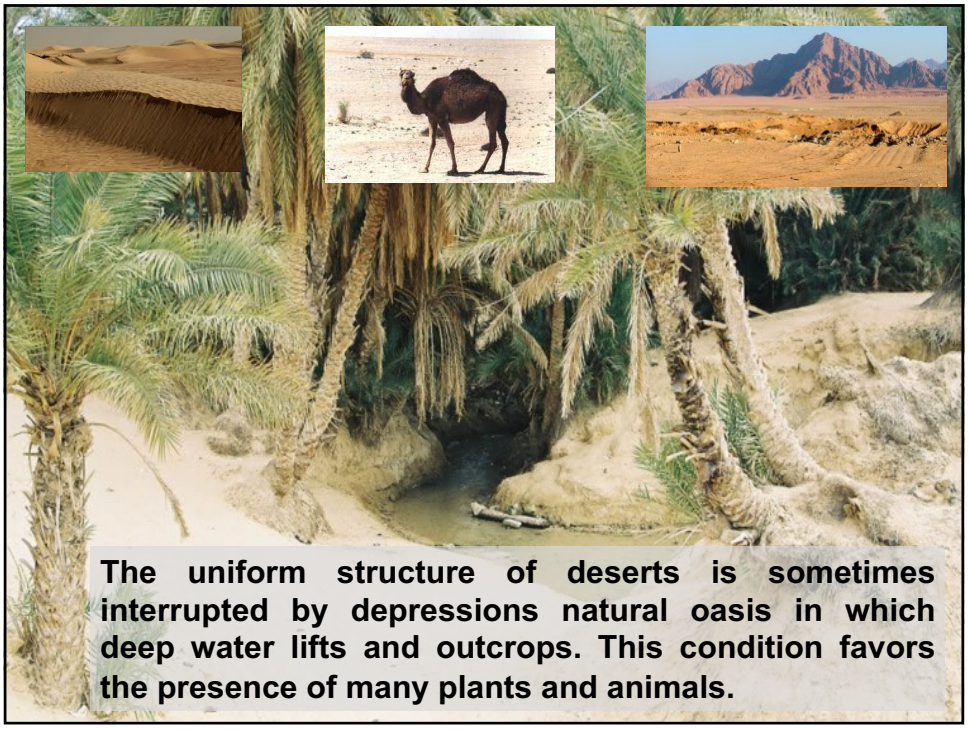

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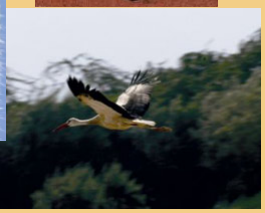
The heat and drought are the limiting factors for the development of life in the desert.

Fauna

- **Most of the animals reduced the activities during the day staying in the shade during the hottest hours;**
- **The larger animals such as ungulates, carnivores, birds make real migrations during the day to reach the oasis.**



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Types of desert plants:

- **Therophytes: reduction of life cycle, only in favorable periods. Plants with the life cycle of about 3 weeks.**

Geophytes are perennial. Conservation only of the organs underground (*W. mirabilis*)

- **Xerophytic morphological changes regarding the reduction of the transpiring surfaces (leaves)** (*Cactus*).

Phreatophyte plants that grow in the oases have long roots that reach the moisture coming from the aquifer (Date Palm).

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Adaptations of desert plants

Predominantly annual very resistant Seeds

very fast germination and life cycle

Perennials and bulbs are dormant for much of the year

Trees and shrubs with roots very extensive

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Adaptation to high temperatures

Resistance evapotranspiration and temperature kept at values livable by:

1. Reduction of leaf area
2. Thick leaf cuticle
3. Loss of leaves
4. pubescence
5. sunken stomata
6. Paraheliotropic
7. C_4 and CAM

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1. Reduction of the leaves

Euphorbia ssp.

Echinocactus sp.

Haloxylon aphyllum

Green stems without leaves and cladophyll

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2. Thick leaf cuticle

Fam. Zigophyllaceae

Low shrubs with leathery leaves, rich. Glands which give off a characteristic odor of oil

Larrea tridentata

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3. Loss of leaves

Cercidium floridum (fabaceae)

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4.Pubescence

Cephalocereus senilis

Artemisia absenthium

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5. sunken stomata

Agave

Welwitschia mirabilis

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6. Para-heliotropic leaf

Capacity of some plants to orient leaves parallel to the direction of the solar rays, in order to reduce the effects of an excessive irradiation

Silphium sp. (Asteraceae)

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7. Cycle C_4

Stipa parviflora

The plants have a cycle C4 greater affinity for CO_2 than normal C3 plants, which allows them to keep their stomata open for a shorter period in order to have equal photosynthetic production, avoiding excessive evapotranspiration

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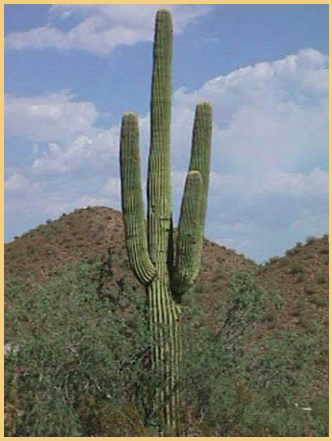
7. Cycle CAM

= Acid Metabolism of Crassulaceae:

The stomata are open only during the night when the T is low; CO_2 is stored by the plant in the form of C4 acids and used during the day for photosynthesis



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Adaptation to drought

1. Well developed root system
2. Ability to absorb water of condensation
3. Lifecycle modified
4. Succulence

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1. Shallow root system, but widespread

Opuntia spp.

- Shallow roots compared to other species adapted to aridity but much more widespread (7 m)

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1. Root system developed in depth

Eucalyptus dumosa

Tamarix sp.(Tamaricaceae)

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2. Ability to absorb water condensation

Lichene crostoso

Welwitschia mirabilis

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3. Lifecycle modified

Nolana rupicale (Chile)
Fam. Nolanaceae

flight
from
drought

Eschscholtzia californica
Fam. Papaveraceae

Ptilophus sp.(Australia)
Fam. Amaranthaceae

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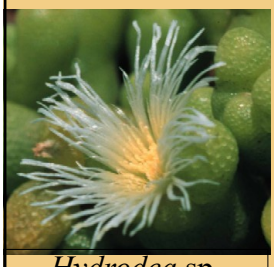
4. Succulence of the leaves



Hydrodea sp.

Mesembryanthemum sp.

Aizoon sp.

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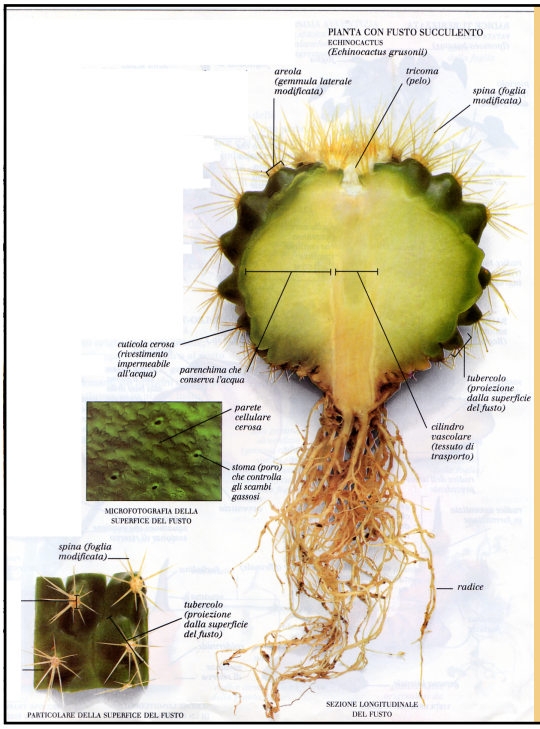

Succulence of the stem

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evolutionary convergence

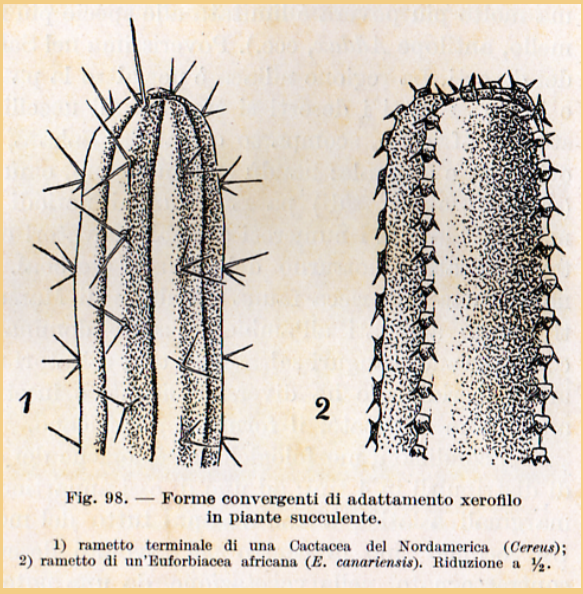

Fig. 98. — Forme convergenti di adattamento xerofilo in piante succulente.

1) rametto terminale di una Cactacea del Nordamerica (*Cereus*); 2) rametto di un'Euforbiacea africana (*E. canariensis*). Riduzione a ½.

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Risk factors

- agriculture
- breeding

- Diversion of watercourses and exploitation of groundwater
- Exploitation of resources such as gol granite, oil, natural gas, diamonds
- desertification
- uncontrolled tourism

the former mining town of Kolmanskop

- Wars, military exercises, prisons, refugee camps
- Construction of roads
- hunting
- Production of "drugs"

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Why defend the desert

"These deserts are dynamic ecosystems and unique, that if treated properly can provide answers to many challenges that we face, for energy, food, medicine "(Zaved Zahedi, deputy director of the surveillance center of defense 'UN environment Programme)

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Since only the Sahara could capture enough solar energy and wind power to meet the electricity needs of the entire world;

Wildlife constitute new sources for pharmaceutical research, for industrial products and agriculture.

The majority of deserts has a brightness and ideal temperatures that favor the development and shrimp farming and fish (Arizona, Israel)

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How to help the desert

- New techniques for the use of water resources (watersheds and drip irrigation);
- Sensitization of local populations to environmental problems;
- Limit the power of multinational corporations and owners on resources such as oil, diamonds, gold, etc;
- Create management systems that are not limited only to protected areas;
- Increase controls especially on products imported from these countries.

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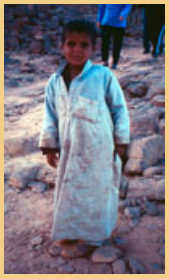
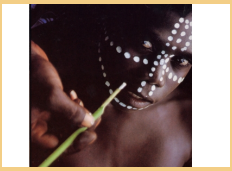
Populations of the desert

- Berbers, Tuaregs and Kabyles of 'Africa;
- Bedouins of the Arabian deserts;
- Beja in Namibia;
- San of the Kalahari;
- Australian Aborigines.





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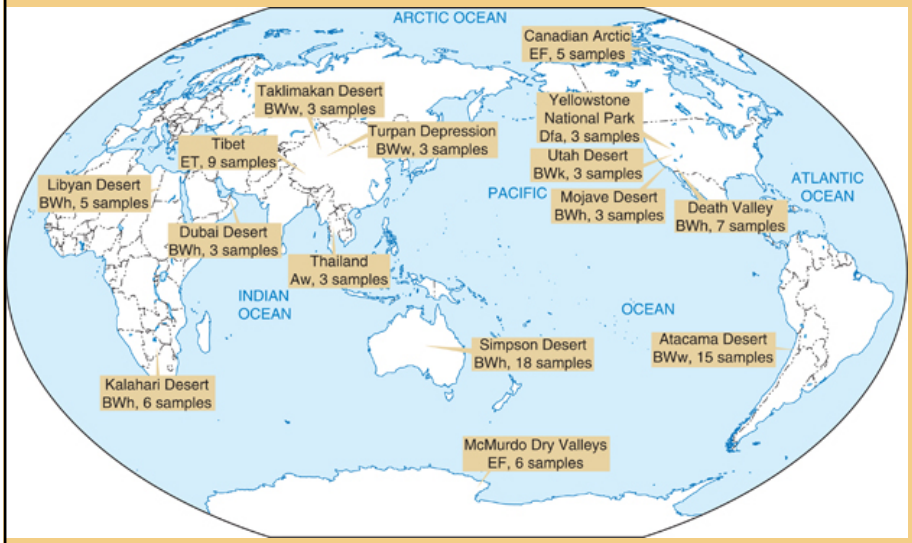
Cold deserts



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Cold desert

Desert biomes cover about 20% of the Earth's surface and are defined to occur where rainfall is less than 50 centimeters per year

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Cold deserts are often sub-divided into

Cold and Coastal types.

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Cold Desert Ecosystems

- Cold deserts are found in the Antarctic, Greenland, Northern and Western China, Turkestan, Iran and the Nearctic area. Many nomads have settled on farms in the Gobi Desert and it was crossed as early as the 13th century by Genghis Khan. Cold deserts can also be found in certain mountainous areas, such as the Great Basin area of western United States.

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Deserts in this category have the following characteristics:

Large amount of snowfall in winter (and sometimes in summer), plus a high average of rainfall (15-26 cm.) occurring mainly in April and May or autumn, depending upon the area.
Short, wet moderately warm summers
Mean average winter temperature -2 to 4ºC
Mean average summer temperature 21-26º
Heavy, relatively porous soil with a lot of silt and salt
Good drainage to leach out most of the salt

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North Tibetan Plateau-Kunlun Mountains alpine desert

elevations ranging from 3,500 to nearly 6,000 (m. a.s.l).[45]

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- The Tibetan Plateau, treeless except in the southeastern river valleys, supports a range of alpine vegetation types that includes meadow, steppe, cold desert and sub-nival cushion plant communities at elevations ranging from 3,500 to nearly 6,000 (m). Dry, cold, and expansive, the Tibetan Plateau possesses an alpine landscape of complex zonation with a general trend from moist alpine scrub to steppe vegetation to high, cold desert along a transect from southeast to northwest.

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Tibetan antelope

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Kazakh semi-desert

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Patagonian steppe

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Patagonian steppe

The **Patagonian steppe** region extends approximately from the mid-Andean Precordillera southward, terminating immediately north of the Strait of Magellan near the Rio Gallegos. This steppe is bounded on the west by the cold temperate forest slopes of the Andes Range, and on the east by theAtlantic ocean. It extends northwest as shrubland steppe and to the north as thorn thicket gradually making the transition to Argentine Monte. This area is a cold desert scrub steppe, with very high wind velocities throughout the year, as well as year around frosts likely. This ecoregion has high levels of endemism for both plants and animals.

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Eastern Gobi desert steppe

1,000 to 1,500 meters

The Eastern Gobi Desert Steppe extends from the Inner Mongolian Plateau (China), situated at 1,000 to 1,500 meters (m) elevation, northward into Mongolia. Boundaries are determined to the east and north by the relatively moist grasslands of Mongolia and Manchuria, and to the west and south by the extensive semi-deserts of the Alashan Plateau. This region includes the Yin Shan, a mountain range that rises to an elevation of 1,500 to 2,200 m, and many low-lying areas with salt pans and small ponds. Although the region appears rather desolate, it provides potential habitat for many wildlife species and a human population of semi-nomadic herders

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POLAR DESERT

- A **polar desert** is a biome with precipitation below 250 millimeters per annum and a average temperature during the warmest month of less than 10 degrees Celsius. Typically occurring at higher latitudes than tundra biomes, polar deserts occupy approximately 5,000,000 square kilometers of land surface, chiefly comprised of exposed bedrock, talus or rocky plains. In the northern hemisphere this biome is often termed as the High Arctic. The soils regime of the polar desert is generally characterized by occurrence of permafrost.

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Climate

- A prominent feature of the polar desert is the complete absence of sunlight over a period of nine to ten months; corresponding the growing season is a maximum of two and one half months.
- Sand-seas (dunes) are not prominent features in these deserts, although snow dunes occur commonly in areas where precipitation is more plentiful.
- Temperatures of polar deserts commonly oscillate around the freezing point of water, producing patterned textures on the ground resulting from freeze-thaw cycles; these distinctive topographic features may have patterns as much as five meters in diameter.

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In the Arctic approximately one to five percent of the polar desert ground surface has plant cover, consisting of approximately 350 vascular species. Bryophytes are abundant here, with crustose and foliose lichens being common; moreover, fructose lichens occurre less frequentely.

The growth forms of plants are typically graminoid, cushion and rosette. Shrubs present a height ranging from five to 100 centimeters, while forbs have a stature ranging from two to ten centimeters. Studies conducted in the polar desert component in the former Soviet Union reveal carbon storage and carbon fluxes in polar desert much smaller than other biomes of tundra, taiga and steppe. For example total carbon flux from polar desert below ground mortmass (dead wood) was estimated at merely 0.2 Tgram carbon per year, and biomass litter decomposition at 0.1 Tgram per year, both values three orders of magnitude below that of tundra, taiga or steppe.

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