TWO of OUR TERRESTRIAL ECOSYSTEMS: THE TUNDRA and THE DESERT-A Comparative View

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This paper looks at the differences and similarities found between the two terrestrial ecosytems called the tundra and the desert. Often considered types of deserts due to the level of aridity that exists in both of these systems, we will have a view of the physical factors affecting these regions and some of the interesting adaptations certain flora and fauna have evolved in order to make life possible in these extreme and severe areas.

In terms of a global orientation, the 'hot' deserts are found typically 20-30 degrees north and south of the earth's equator-a sector sometimes termed the horse latitudes as it is an area of low winds where American bound ships were often becalmed and lost some of their cargo of horses.[1] 'Hot' deserts also lie as far north as above the Tropic of Cancer where stretches the Mongolian Desert as well as farther than 30 degrees south of the equator in the center of certain continental masses like the Great Sandy Desert of Australia.

Tundra is found right above the tree-line at a latitude of about 68 degrees North of the equator. This is an area which includes true magnetic north.

Temperature in the desert averages 120 degrees during the day and may drop by as much as fifty degrees at night due to the lack of humidity which prevents the retention of heat. A desert gets colder the farther above sea level it is situated as well as the closer it's proximity to

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to either of the earth's poles. It's seasonality is contingent upon,for the most part, it's rainfall which averages not more than 10 inches annually. It has,therefore, primarily a growing season during it's rainfall periods and a survival season -drought

Rainfall in the tundra averages 8 inches annually though appears much wetter than the desert as it retains it's water which is not lost through evaporation to as great an extent as in the desert. The seasons of the tundra also are marked by a brief growing season though this is due to the temperature rise which does not generally exceed 10 degrees centigrade. It's long cold winters are generally less than 0 degrees centigrade.

In the tundra, water exists,for the most part, in the form of frozen ground called permafrost which often extends to more than 1000 feet below the surface. With the onset of the summer season, the top layer of permafrost thaws providing adequate moisture for tundra plants to sprout and sufficient access through the soil to allow for deeper root systems to take hold. It is this permafrost that makes for an unstable ground and forces trees to have shallow root systems. This accounts for the phenomenon of the'drunken' forests that exist along the parameters of the tundra where the tree-line evidences trees growing at a slant, tilting to one side and then to another in response to the shifting earth of this region. These trees often live to a great age. They are very stunted and often,like the Black Spruce[2], are forced to creep along the ground to avoid the cold and drying effects of the arctic wind. Arctic willows[3],grow very slowly and may be 400 to 500 years old remaining dwarfed with a trunk only

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afew centimetres around with a length of up tp five metres long as they grow horizontally rather than vertically along the ground.

Deserts are the most arid regions of our planet and,as mentioned earlier, tundra areas are often arid enough to qualify as deserts. Precipitation in the 'hot' desert from the atmosphere is greatly exceeded by plant transpiration and surface evaporation. There is alot of potential moisture available in the tundra it is just that it is locked up in the form of the permafrost so that it can not evaporate.

In the desert drought is the perpetual threat to flora and often seeds lie dormant for months waiting for the rain. These are the drought evaders and are the seeds of grasses,weeds and certain flowering plants whose actual life span above the ground is brief. This allows for them to be extravagant and use all the available water to produce large showy blossoms in many instances as with Phlox[4] and the Evening Primrose which open during the dusk and/or early morning hours and are generally white or pale yellow emitting a powerful fragrance. The opening times,color and scent of these flowering desert annuals assist in the attraction of moths which play a major role in pollination. Butterfly attracting flowers,such as the Indian Paintbrush,fiddleneck and many varieties of desert lilies,open during the daylight and are most often bright orange and red combinations. Sunflowers are a type of desert annual that may be pollinated by a number of different insect groups like flies and beetles and therefore are not insect specific. The life span of these flowering plants is long enough for them to bloom, and produce seeds which will again wait beneath the surface of the desert for rain.

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For flowering plants in the arctic, of which there are over a thousand[5], existence is possible only when the temperature stays above freezing for afew weeks a year in the milder areas. One of the survival issues with arctic plants is the conservation of heat. Often, as with the Sea Bluebell, plants will grow close to the ground in dense mats which keep them protected from the cool wind. This also keeps them in closer contact with the soil which retains some of the solar heat even at night. The fragile saffron colored Arctic Poppy[6] has downy hairs covering it's stalk to insulate it from the cold. This appearance is a rarity. It flowers and produces seeds in less than a month.

Some arctic plants that last throughout or almost throughout the year such as the lichens, algae and mosses, grow on rocks which help provide them with solar heat which the rock retains to a degree. The lichen, a partnership between a fungus and an alga, may possibly be thousands of years old. While the fungus secretes an acid[7] to etch a foothold on a windy rock surface and dissolves and delivers minerals to the algae, the algae absorbs and synthesizes these nutrients and both partners are fed. Lichens that sometimes may get only one day of growth annually can be found in the ecosystem termed Alpine Tundra which is determined by the altitude at which it is found rather than it's latitude. A very intriguing alga, chlamydomanas nivalis, can be found in alpine tundra. It is bright pink and lives in the snow itself. The pink pigment is believed to be an untra-violet ray filter as sunshine is so bright reflected off of snow at these heights. During one stage of the alga's life it has a kind of tail or flagellum which enables it to move through the snow to a position just below the surface where the amount of light suits it.[8] These organisms utilise only sunlight and some nutrients found in the snow, Being in the snow and not on it

they are safe from the hazards of the surface.

Perenial plants of the desert are the drought resisters and their population is sparse and a fair stretch of barren ground generally eextends between individuals. This spacing is a result of thecompetition for the scarce water resources which filter rapidly through the sandy earth of these areas. Stronger root systems of more established perenials will overwhelm those of younger or less established perennials. The senior plant not only of the desert but of the world is the Creosote Bush found at one instance to be from 10.000 to 12,000 years old[9]. It utilizes the available water so efficiently that no plant can grow within several feet of it. This applies to it's own seedlings as well. This bush not only has a shallow root system to catch moisture near the surface, it also has evolved deep tap roots to access moisture from soil layers that are much farther below ground[10]. An individual bush tends to propagate around itself by sending out new stems around the base of it's trunk growing outward in an increasingly expanding ring which uses the same growing root system.

The real giant plant of the desert is the Saguaro often found to be 200 years old and weighing as much as ten tons. Like arctic trees, it's growith rate is extremely slow, growing vertically an average of a yard in height over the course of 35 years. With it's fluted stem so that it can expand to hold water, the Saguaro has spines instead of leaves which not only discourage thirsty animals-they also assist in preventling evaporation by creatingan'invisible jacket of still air'[11] by breaking up air currents brewing around the cactus.

Desert perenials like the ocatillo, with leaves that are waxy to curb evaporation from leaf surface, often shed their leaves during drought

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to conserve even more moisture. Others, like the elephant tree, have thick, tank-like trunks that serve as water resevoirs. Many of these 'hot' desert perenials, like the Night Blooming Cereus, store their water under ground in bulb-like containers which are roots that will maintain the life of the plant even after the tops above ground may die and fall off during drought or after the growing season.

Bulbs, runners and underground shoots are a method of propagation that many arctic perenials have evolved instead of flowering and reproducing by seed. The Whiplash Saxifrage[12] sends out runners which become new plants and supplements it's water supply by growing in moist moss. What often appears to be a cluster of individual plants is often one partent plant amid it's offspring.

In the ecosystem of the tundra, the frost that is so necessary when thawed to the survival of plant life often destroys it. During a thaw, water seeps down into the cracks of rocks, freezes again and then shatters them which can cause debris covering a large area making for a very inhospitable ground for plants other than lichens. There is also a phenomenon called **solifluction**[13] which affects plants growing on slopes or at the base of them. Melting frost causes slippage of soil which can bury whole colonies of plants. These slopes, therefore, are a precarious place for plants eventhough the water availability may be relatively good there.

Plants in the arctic often survive thanks to hardier plants like woodrush and purple saxiphrage[14] which provide samll enclaves of shelter for more delicate plants to take root. Often the newcomers crowd out the pioneers, forming a dense carpet over bare ground. This can also make for a difficult situation for these plants

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as heat to the surface is reduced by this carpet and the depth of the melted layer of topsoil is made shallower. In addition to this, the rising permafrost distrubs the root systems which become exposed to erosion and to wind leading to the ground again becoming barren.

One plant that is very widespread in the the tundra regions is the lichen called the Reindeer Moss[15] and grows up to 6.5 inches in height from the ground and offers pasture for many of the large grazing arctic animals like Musk Ox and Caribou.

The Musk Ox has adapted exquisitely to the imposing cold of the tundra by growing a silky, long inner coating of fur called quviut[16] during the autumn to prepare it for the freezing winter ahead. The Musk Ox has not changed much since the Ice Age[17] and has developed such a good tolerance to the cold it is considered a fine candidate for hybridization with domestic cattle to help increase their tolerance to the cold. Musk Ox find no shelter in the arctic and stay close together using eachother for additional warmth. Being such a great size, up to five feet at the shoulder and weighing up to 700 pounds, it is quite an adaptation they have managed by feeding off the mosses and lichens hidden beneath the snow during the long winter. Against wolves they form a phalanx presenting these predators with an impressive and formidable shield of horns. Of course there is plenty of snow to supply them with water.

In the Namib Desert[18] of S. Africa water is not so readily available and Zebras that spend their time there even during the rainy season have had to devise a method of locating water. Large springs and desert water holes can become tainted when thirsty animals fall in and drown so these Zebras use a technique by which they sniff out

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small pools that lie just below the gravel of dry stream beds. They the use their hooves to dig to a depth of three feet creating watering areas which become popular for other animals as well.

The lemming is one of the main food supplies for carnivores of the arctic and maintains it's numbers by producing up to 12 offspring per litteras many as three times a season and becoming mature enough to do soat 19 days old[19] to mate and give birth 20 days later. Known for their legendary mass migrations,it has been found that these are due not only to a population explosion but to some internal hormonal change that is cyclic in nature hence the 'lemming years'. All types of lemmings move in mass migrations periodically,and,interestingly enough,once they start traveling, stay in one compass direction,which may be different depending on the year of migration. Only the Scandinavian lemming[20] has been proven to already be near death,due to an inner chemical change, when it falls into the sea. Other lemmings make attempts to swim while crossing rivers,many make it across to continue on, rather than deliberately do themselves in as was once believed. Caribou have been seen chasing and killing lemmings. Generally a vegetarian, the Caribou can develop a taste for the lemming.

The Arctic Fox relies heavily on the lemming for food and it's population fluctuates with that of the lemming.[21] The Arctic Fox also bears large litters,averaging 11 cubs per brood, to increase the odds of survival in the harsh climate. Litters of up to 22 have been recorded in the Soveiet Union.The harsh climate affects the availability of different kinds of food. With the availability of the lemming so high,an average fox family consumes up to 100 lemmings

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daily. During lean lemming years cubs may fight and kill each-other off.

The Arctic Fox has several sub divisions one of which camouflages itself by turning brown during the summer and donning a white coat for the winter. This colour change allows it to better surprise it's prey as well as avoid it's enemies like bears or wolves or human beings.

The Fennec is a desert Fox which has developed large ears[22] to enable them to hear all kinds of sounds in the desert. Large ears also assist in coolong the animalas air blowing across them cools a physical network that then circulates throughout their body. The Fennec is about 17 inches long[23] and suited only for warm climates as they are very sensitive to cold. The Fennec is an African fox and includes gerbils and Jerboas in it's diet as well as insects, seeds and plants when available. It's American counter-part is the Kit Fox which feeds on the gerbil's American counter-part the Kangaroo Rat. Desert jumping rodents have parallel representatives in Australian deserts as well where there are the marsupial Pichi-Pichis and Jumping Mice.

Jumping desert rodents are a staple food source for desert carnivores such as snakes, owls and foxes. They are mostly nocturnal to avoid the heat of the day and have long tufted tails to assit them in maintiang their balance when they are making a get-away. Them have developed long, stiff hairs on their feet to give them traction in the sand.[24] They are usually beige to blend in with their background.

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In the hot desert,natural springs maintain oases and though there are are only afew of them per desert,relatively speaking,fertile areas develop around them and they are a haven for much desert life. Similarly, a curious arctic formation, a pingo, is formed periodically in some dry lkae beds. Also know as frost heaves,[25] the pingo is conically shaped and may rise as high as 300 feet from the ground. Most have a center of blue-white ice and springs often flow from fissures in these rock formations. As may be expected, these areas also give rise to sanctuaries for certain arctic life.

It is important to recognize how two seemingly radically different ecosystems such as the tundra and the desert can have so much in common. It stands to reason that time given to take a closer look at these ecosystems can reveal some remarkable things.

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