DOWNLOAD PDF NEGEV, LAND, WATER, AND LIFE IN A DESERT ENVIRONMENT

Chapter 1 : China Science Journal

Daniel Hillel. Introduction. In antiquity the desert was regarded as a world unto itself, an extraterritorial realm separate from and additional to the other two known realms - the seas and the habitable rain-fed lands.

Introduction In antiquity the desert was regarded as a world unto itself, an extraterritorial realm separate from and additional to the other two known realms - the seas and the habitable rain-fed lands. The settled and "civilized" residents of the latter viewed the nomadic and "wild" people of the desert with fear and hostility, perceiving them to be a threat to civilization - as, indeed, they often were. The desert itself was held in awe as a place of terror, a largely useless and dangerous domain. One ventured into its mysterious vastness only at great risk. But just what do we mean by the term desert? In what sense does it differ from what is commonly called an arid zone? Aridity in general is an imbalance between the demand for water and its supply, the supply being too scarce to meet the demand. Obviously, there can be different degrees of aridity. Such are the vagaries of climate that even so-called humid regions can experience occasional drought and even prolonged dry spells, though a humid region, by definition, is one in which annual precipitation is generally sufficient to sustain crop plants and, at times, may even be excessive. A semi-arid region is one in which precipitation is sufficient in most seasons but in which droughts causing crop failure occur frequently enough to make rain-fed farming a somewhat hazardous venture. An arid zone is one in which rain-fed farming is marginal successful in a few years but so frequently unsuccessful as to make the practice of rain-fed farming a highly insecure venture. In such regions, therefore, the scales are weighted heavily against agriculture from the outset. The imbalance must be rectified by augmentation of water supply i. Despite the ever-present hazard of drought, farming populations can and do exist there, however precarious their economy. Extensive grazing - in addition to crop production and, occasionally, in preference to it - becomes a major form of land use in such areas. The situation is fundamentally different in real desert areas, which are extremely arid. Here, even the precipitation in an average year - let alone in a drought - is definitely insufficient to sustain agricultural crops, so regular rain-fed farming is impossible. Hence, the biblical definition of the desert as "the land unsown. For humans to subsist in a desert without having to import most of their vital requirements, they must devise ingenious stratagems to obtain supplementary supplies of water, either by wresting the precious fluid from underground aquifers, if available, or by collecting it off the slopes of barren ground during brief episodes of rainfall, or by conveying it from another region. Only by such means can agriculture become possible, and then only on a fraction of the land area. Civilization in the Negev Though the word is derived from the Latin term for "deserted" or "abandoned," deserts are not totally useless wastelands. In fact, some deserts were settled by extraordinarily diligent and ingenious people, who proved that civilization can be established even in extremely difficult circumstances. In the original Hebrew, the name Negev denotes dryness. As deserts go, it is rather small, constituting only a minuscule part of the great desert belt of North Africa and South-West Asia. Being on the fringe of this desert belt, much of the Negev is not an exceedingly dry desert. The mean annual rainfall varies from mm in the north-west to about 25 mm in the far south, and is confined to the winter months, November to April. The distribution of rainfall within the rainy season is highly irregular, and the total seasonal amount fluctuates widely from year to year. Hence, it has always served as a crossroads of trade and traffic between the continents. The advantages of controlling the region, however, were frequently offset by the disadvantages. The same routes that made trade possible and opened up cultivable areas to civilized settlement in times of peace were the ones followed by invading armies in times of war. Moreover, neighbouring desert nomads were always ready to plunder the settled land and its inhabitants. Thus, to the difficulties posed by the paucity of water, the erodible soil, and the fragile vegetation, was added the requirement of constant vigilance against the danger of encroachment by hostile forces. The long history of human habitation in the Negev began, evidently, during the Chalcolithic Age, and continued, intermittently, throughout the Bronze and Iron Ages. It includes the early Israelite period, as reflected in the biblical accounts of King Solomon and his Judaean successors - Asa, Jehoshaphat, and Uzziah. Some time after the destruction of the Kingdom of Judah by the Babylonians in the sixth century before the Christian era [B. They built a magnificent civilization there, the achievements of which excite the imagination and admiration of visitors to the region to this day. Starting as nomadic traders, the Nabateans in time became superb architects and engineers, as well as expert hydrologists and diligent cultivators. The Nabatean domain lay astride the important ancient trade routes between Arabia in the south and Syria in the north, and between the Orient, including India, and the Mediterranean world. These were the routes along which camel caravans transported spices and silks, ivory and incense, frankincense and myrrh, and medicinal herbs- commodities as prized in antiquity as are perfumes, cosmetics, and drugs today. Spices were more highly prized then than now, not so much because people in ancient times had preferred stronger tastes than we do, but because canning, refrigeration, and other means of food preservation that we take for granted were then unknown, and food could quickly become inedible without a heavy dosage of spice. Caravans passing through the desert needed stopping places where they might rest and obtain water and provisions. To secure and supply their trade, the Nabateans therefore had to establish and maintain regularly spaced bases along their main routes, at important crossroads with secure sources of water. These bases gradually grew into permanent self-supporting villages and eventually into towns, and the Negev became more densely populated than ever before. To maintain a population of many thousands, the Nabateans perforce had to develop agriculture in order to ensure a livelihood for their people. The same population continued even after the Romans annexed the region and made it a frontier province. And after the division of the Roman Empire and the establishment of Byzantium, the entire eastern realm of the empire enjoyed a period of stability. The Negev became still more densely populated, and the technical achievements of the era surpassed even those of the Nabateans when they were independent. The eclipse of that civilization in the Negev came in the seventh century. Following the Moslem conquest in C. Desert nomads took over and ushered in a long period of retrogression and poverty. Where thousands once prospered, a few hundred now eked out a bare subsistence. Magnificent monuments were prised apart, or crumbled gradually into haphazard heaps of stone. Great cisterns were choked by dust, and strongly built dykes were loosened by time and left unrepaired. Complete farm systems were left untended and allowed to disintegrate. Overgrazing the dry stream beds caused erosion, so that the formerly wide bottomlands irrigated by waterspreading methods became narrow, gouged-out gullies. Terraces once green with crops were left high and dry while torrential floods rushed uncontrolled through breached dykes and scoured the creeks. Thus, the best efforts and experience of generations of diligent people were wasted by neglect and abuse. The casual visitor to the Negev finds it difficult to understand how the ancients could have developed so grand a civilization in the midst of such barrenness. Only a careful study of their techniques can reveal the answer. Freshwater utilization Permanent rivers are totally absent in the Negev, and even springs or proper locations for digging shallow wells are few and far between. Hence, the major source of water for humans and animals could only be the collection of surface run-off obtained from sloping ground during winter rains, a task that has been called "water harvesting. This was done by means of cisterns, which are artificially constructed reservoirs filled by directed surface flows during each infrequent rainstorm. Building efficient cisterns became possible after the advent of watertight plaster, the recognition of suitable rock formations, and the proper construction of channels to collect and divert overland flow. Where cisterns could be located along the rim of a natural watercourse, they were filled by flash floods. However, most cisterns in the Negev were hewn into hillsides and depended on the direct collection of run-off. Many hundreds of such cisterns were built in the Negev, and they are clearly discernible landmarks even today. A typical hillside cistern resembles a giant necklace, with the glistening white pile of excavated rock seeming to hang as a pendant from the two collection channels that ring the hill and curve down its sides from opposite directions. To the thirsty ancient traveller, to whom these cisterns beckoned from afar, no sight could be more gladdening. Run-off water was also used for irrigating crops. The run-off from winter rains falling on adjacent slopes was gathered and directed to bottomland fields for periodic soakings, to accumulate and store sufficient moisture in the soil to produce crops. This ingenious type of agriculture is called "run-off farming. They then collected this run-off from a large area of slopes and directed it to a relatively small cultivated area in the bottomlands. The cultivated area was usually divided into small field plots, which were levelled and terraced to ensure the efficient spreading of water as well as the conservation of both water and soil. The oldest version of run-off farming probably consisted of terracing the small creek beds that collected the run-off naturally. Terracing transformed the entire length of each creek into a continuous stairway, with stairs perhaps metres wide and centimetres high. The terrace walls were designed to spread the flood and to prevent erosion. The slowed-down cascade from one terrace to the next could thus irrigate the field plots sufficiently for a crop to be grown. Distinct groups or series of terraced plots, having definable catchment areas and surrounded by stone walls, formed integral farming units of perhaps several hectares of cultivated land. The remains of hundreds of such farm units are spread throughout the Negev Highlands, most commonly around the principal ancient towns. Detailed observation of ancient run-off farm units reveals that each unit was served by a particular well-delineated portion of the watershed. An elaborate system of conduits was constructed to collect run-off from specific sections of the adjacent slopes, not merely for each farm but, indeed, for each terraced field within the farm. The complete farm unit comprised both the slope catchment the run-off-contributing area and the bottomland fields the run-off-receiving area. Fields could be made productive only if associated with a catchment from slopes, since the meagre rainfall alone was far from sufficient for any crop. The larger the catchment, the greater the water supply one could expect and the corresponding plot of land that could be irrigated. Clearly defined catchment areas, allocated to serve particular farm units, constituted "water rights," as specified in the ancient documents found in the region. Typical farm units consisting of 0. The ratio of run-off-contributing catchment to runoff-receiving crop land varied from Added to its own reception of the annual mm of rainfall, the plot would thus have received a total of 35 mm, just enough to produce a crop. If, however, the run-off yield constituted 20 per cent of annual rainfall, the amount of water received by the field could equal plus , for a total of mm, an amount equivalent to the rainfall of the relatively humid habitats along the Mediterranean coast of Israel. The fraction of rainfall yielded by any given watershed varied, of course, from rainstorm to rainstorm and hence from year to year. Gentle showers contributed practically no run-off, whereas intense squalls might yield 30 per cent or more of their rain. So, even with all the alertness, ingenuity, skill, and diligence they could muster, the run-off-farmers of the Negev operated a risky business and had to face new uncertainties each season. It is all the more remarkable, therefore, that they were able to cope with all the difficulties and to sustain a viable agricultural economy for so long on such a scale. That scale is worth emphasizing: The Negev run-off farmers apparently did more than merely gather natural runoff: The hillsides in the Negev, as in many other deserts, are naturally strewn with a pavement of stones and gravel, and this covering inhibits and detains the flow of run-off over the surface. The ancient Negevites deliberately cleared the stones off the slopes and thus smoothed the surface and exposed the finer soil, to facilitate the formation of a self-sealing crust. Consequently, we find countless heaps, mounds, and strips of gravel on many hillsides, particularly in the vicinity of the old towns of Shivta, Ovdat, and Nitzana. Our own field trials in that region have shown that the practice of removing the surface gravel can increase the run-off yield by per cent.

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This is because they reflect more of the incoming light and their albedo is higher than that of forests or the sea. The structure of the sheet consists of thin horizontal layers of coarse silt and very fine to medium grain sand, separated by layers of coarse sand and pea-gravel which are a single grain thick. These larger particles anchor the other particles in place and may also be packed together on the surface so as to form a miniature desert pavement. They form perpendicular to the wind direction and gradually move across the surface as the wind continues to blow. The distance between their crests corresponds to the average length of jumps made by particles during saltation. The ripples are ephemeral and a change in wind direction causes them to reorganise. They form downwind of copious sources of dry, loose sand and occur when topographic and climatic conditions cause airborne particles to settle. As the wind blows, saltation and creep take place on the windward side of the dune and individual grains of sand move uphill. When they reach the crest, they cascade down the far side. As this wind-induced movement of sand grains takes place, the dune moves slowly across the surface of the ground. When these are extensive, they are known as sand seas or ergs. Barchan dunes are produced by strong winds blowing across a level surface, and are crescent-shaped with the concave side away from the wind. When there are two directions from which winds regularly blow, a series of long, linear dunes known as seif dunes may form. These also occur parallel to a strong wind that blows in one general direction. Transverse dunes run at a right angle to the prevailing wind direction. Star dunes are formed by variable winds, and have several ridges and slip faces radiating from a central point. Rounded mounds of sand without a slip face are the rare dome dunes, found on the upwind edges of sand seas. In "eolian deflation", the wind continually removes fine-grained material, which becomes wind-blown sand. This exposes coarser-grained material, mainly pebbles with some larger stones or cobbles , [36] [47] leaving a desert pavement , an area of land overlaid by closely packed smooth stones forming a tessellated mosaic. Different theories exist as to how exactly the pavement is formed. It may be that after the sand and dust is blown away by the wind the stones jiggle themselves into place; alternatively, stones previously below ground may in some way work themselves to the surface. Very little further erosion takes place after the formation of a pavement, and the ground becomes stable. Evaporation brings moisture to the surface by capillary action and calcium salts may be precipitated, binding particles together to form a desert conglomerate. Other landforms include plains largely covered by gravels and angular boulders, from which the finer particles have been stripped by the wind. In some places the wind has carved holes or arches and in others it has created mushroom-like pillars narrower at the base than the top. Here the Colorado River has cut its way over the millennia through the high desert floor creating a canyon that is over a mile 6, feet or 1, meters deep in places, exposing strata that are over two billion year old. One of the driest places on Earth is the Atacama Desert. The cold Humboldt Current and the anticyclone of the Pacific are essential to keep the dry climate of the Atacama. Some weather stations in the Atacama have never received rain. Evidence suggests that the Atacama may not have had any significant rainfall from to The desert surface is evidence of this with dry stream channels known as arroyos or wadis meandering across its surface. These can experience flash floods , becoming raging torrents with surprising rapidity after a storm that may be many kilometers away. Most deserts are in basins with no drainage to the sea but some are crossed by exotic rivers sourced in mountain ranges or other high rainfall areas beyond their borders. The River Nile , the Colorado River and the Yellow River do this, losing much of their water through evaporation as they pass through the desert and raising groundwater levels nearby. There may also be underground sources of water in deserts in the form of springs , aquifers , underground rivers or lakes. Where these lie close to the surface, wells can be dug and oases may form where plant and animal life can flourish. A lake occupied this depression in ancient times and thick deposits of sandy-clay resulted. Wells are dug to extract water from the porous sandstone that lies underneath. They are usually shallow and saline, and wind blowing over their surface can cause stress, moving the water over nearby low-lying areas. When the lakes dry up, they leave a crust or hardpan behind. This area of deposited clay, silt or sand is known as a playa. The deserts of North America have more than one hundred playas, many of them relics of Lake Bonneville which covered parts of Utah, Nevada and Idaho during the last ice age when the climate was colder and wetter. The smooth flat surfaces of playas have been used for attempted vehicle speed records at Black Rock Desert and Bonneville Speedway and the United States Air Force uses Rogers Dry Lake in the Mojave Desert as runways for aircraft and the space shuttle. Problems they need to solve include how to obtain enough water, how to avoid being eaten and how to reproduce. Photosynthesis is the key to plant growth. It can only take place during the day as energy from the sun is required, but during the day, many deserts become very hot. Opening stomata to allow in the carbon dioxide necessary for the process causes evapotranspiration , and conservation of water is a top priority for desert vegetation. Some plants have resolved this problem by adopting crassulacean acid metabolism , allowing them to open their stomata during the night to allow CO2 to enter, and close them during the day, [68] or by using C4 carbon fixation. Cacti are desert specialists and in most species the leaves have been dispensed with and the chlorophyll displaced into the trunks, the cellular structure of which has been modified to allow them to store water. When rain falls, the water is rapidly absorbed by the shallow roots and retained to allow them to survive until the next downpour, which may be months or years away. Saguaro grow slowly but may live for up to two hundred years. The surface of the trunk is folded like a concertina , allowing it to expand, and a large specimen can hold eight tons of water after a good downpour. Other xerophytic plants have developed similar strategies by a process known as convergent evolution. Some are deciduous, shedding their leaves in the driest season, and others curl their leaves up to reduce transpiration. Others store water in succulent leaves or stems or in fleshy tubers. Desert plants maximize water uptake by having shallow roots that spread widely, or by developing long taproots that reach down to deep rock strata for ground water. Some desert plants produce seed which lies dormant in the soil until sparked into growth by rainfall. When annuals , such plants grow with great rapidity and may flower and set seed within weeks, aiming to complete their development before the last vestige of water dries up. For perennial plants, reproduction is more likely to be successful if the seed germinates in a shaded position, but not so close to the parent plant as to be in competition with it. Some seed will not germinate until it has been blown about on the desert floor to scarify the seed coat. The seed of the mesquite tree, which grows in deserts in the Americas, is hard and fails to sprout even when planted carefully. When it has passed through the gut of a pronghorn it germinates readily, and the little pile of moist dung provides an excellent start to life well away from the parent tree. Even small fungi and microscopic plant organisms found on the soil surface so-called cryptobiotic soil can be a vital link in preventing erosion and providing support for other living organisms. Cold deserts often have high concentrations of salt in the soil. Grasses and low shrubs are the dominant vegetation here and the ground may be covered with lichens. Most shrubs have spiny leaves and shed them in the coldest part of the year. Xerocole Animals adapted to live in deserts are called xerocoles. There is no evidence that body temperature of mammals and birds is adaptive to the different climates, either of great heat or cold. In fact, with a very few exceptions, their basal metabolic rate is determined by body size, irrespective of the climate in which they live. One well-studied example is the specializations of mammalian kidneys shown by desert-inhabiting species. Deserts present a very challenging environment for animals. Not only do they require food and water but they also need to keep their body temperature at a tolerable level. In many ways birds are the most able to do this of the higher animals. They can move to areas of greater food availability as the desert blooms after local rainfall and can fly to faraway waterholes. In hot deserts, gliding birds can remove themselves from the over-heated desert floor by using thermals to soar in the cooler air at great heights. In order to conserve energy, other desert birds run rather than fly. The cream-colored courser flits gracefully across the ground on its long legs, stopping periodically to snatch up insects. Like other desert birds it is well- camouflaged by its coloring and can merge into the landscape when stationary. The sandgrouse is an expert at this and nests on the open desert floor dozens of kilometers miles away from the waterhole it needs to visit daily. Some small diurnal birds are found in very restricted localities where their plumage matches the color of the underlying surface. The desert lark takes frequent dust baths which ensures that it matches its environment. Kangaroos keep cool by increasing their respiration rate, panting, sweating and moistening the skin of their forelegs with saliva. The arctic weasel has a metabolic rate that is two or three times as high as would be expected for an animal of its size. Birds have avoided the problem of losing heat through their feet by not attempting to maintain them at the same temperature as the rest of their bodies, a form of adaptive insulation. Being ectotherms , reptiles are unable to live in cold deserts but are well-suited to hot ones. They have few adaptations to desert life and are unable to cool themselves by sweating so they shelter during the heat of the day. In the first part of the night, as the ground radiates the heat absorbed during the day, they emerge and search for prey. Lizards and snakes are the most numerous in arid regions and certain snakes have developed a novel method of locomotion that enables them to move sidewards and navigate high sand-dunes. These include the horned viper of Africa and the sidewinder of North America, evolutionarily distinct but with similar behavioural patterns because of convergent evolution. Many desert reptiles are ambush predators and often bury themselves in the sand, waiting for prey to come within range. In fact, the few species that are found in this habitat have made some remarkable adaptations. Most of them are fossorial, spending the hot dry months aestivating in deep burrows. While there they shed their skins a number of times and retain the remnants around them as a waterproof cocoon to retain moisture. Heavy rain is the trigger for emergence and the first male to find a suitable pool calls to attract others. Eggs are laid and the tadpoles grow rapidly as they must reach metamorphosis before the water evaporates. As the desert dries out, the adult toads rebury themselves. The juveniles stay on the surface for a while, feeding and growing, but soon dig themselves burrows. Few make it to adulthood. Invertebrates, particularly arthropods , have successfully made their homes in the desert.

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Chapter 3 : Who is Daniel Hillel?

In view of the continuing increased concern about the extreme fragility of deserts and desert margins, Negev provides a timely discussion of land-use practices compatible with the often.

Armando Azua-Bustos Microb Ecol Here, hypolithic colonization rates hypolithic cyanobacteria. This finding strongly suggests that hypolithic quartz stones falls to virtually zero. Here, we report that along microbial communities thriving in the seaward face of the the coast in these arid regions, complex associations of Coastal Range can survive with fog as the main regular source cyanobacteria, archaea, and heterotrophic bacteria inhabit the of moisture. A model is advanced where the development of undersides of translucent quartz stones. Colonization rates in the hypolithic communities under quartz stones relies on a these areas, which receive virtually no rain but mainly fog, are positive feedback between fog availability and the higher thermal conductivity of the quartz rocks, which results in Electronic supplementary material The online version of this article lower daytime temperatures at the quartzâ€"soil interface doi: It is the driest and probably the oldest desert on Earth [21, 23]. The hyperarid core region of the Atacama is located near C. The antiquity and severity of the aridity in this central depression is evidenced by the accumulation of B. They advance the interesting idea that the crossed through the hyperarid zone from the coast to benefit of translucent rocks for cyanobacterial communities 4, m using samples from 25â€"30 cm below the surface. In total DNA in the sample, they concluded that the microbial the hyperarid deserts of China, Pointing et al. However, Wierzchos et al. These species derive of the Atacama Desert. We report on the microenviron- moisture from conditions of atmospheric humidity above mental temperature and relative humidity conditions at the the relative deliquescence of the halite [7]. Atacama, where the arid Coastal Range acts as a topo- graphic barrier to clouds and moisture-rich marine air moving eastwards from the Pacific Ocean, sites are Materials and Methods comparatively more humid. Here, moisture-rich air Coastal Range offer relatively more benign sites for the masses coming from the Pacific Ocean advance inland development of microbial life. Although much has been during late evening and night, supporting the growth of published about the hyperarid areas of the Atacama Desert, plant species [43]. They are primarily case of the Coastal Range. Two Our focus is on cyanobacteria growing below the surface of transects, one 30 m long and the other 25 m long, were set translucent quartz rocks. These hypolithic habitats are well- in one of these quartz fields. Besides the along each of these two transects, and all types of rocks well-known importance of light availability under translucent over 0. In substrates for the photosynthetic component of the hypolithic total, rocks were collected in the eight 1-m2 quadrants. In the separated and weighed. All rock samples were kept in southern Mojave Desert, [44] it was reported that temper- sterile bags until further analysis. However, a recently microscope equipped with a Qimaging MicroPublisher 3. Temperature and Relative Humidity Measurements Transmission Electron Microscopy In situ in the field and ex situ under lab conditions To verify the presence and characteristics of the microbes infrared temperatures of quartz rocks, soil, and other rocks living under quartz rocks, samples of the biofilms were were taken with a Raytek MiniTemp MT4 non-contact centrifuged at 3, rpm on a tabletop centrifuge. The loggers were set up to record the The sample was pre-embedded overnight with eponâ€" temperature every 30 min, for periods of up to 2 months. The were recorded during Observations were made with a simulated in situ conditions. Philips Tecnai 12 transmission electron microscope operated Relative humidity measurements at the quartzâ€"soil at 80 kV. The loggers were set up to record the temperature every 30 min for 30 days. Infrared three times, 20 minutes each. Air temperatures were taken with a DO material obtained from the underside of the quartz stones were thermometerâ€"hygrometer data logger Delta Ohm, Padua, aseptically collected using a sterile knife, and total genomic Italy. PCR conditions were as follows: The resulting plasmid outcrops, The size of quartz stones in these transects varied Sequencing Inc. As the size of the quartz rock increased, a concomitant increase in hypolithon colonization was Identification of Sequenced Clones observed. All quartz rocks over 20 g were colonized. To identify the closest relatives of the queried 16S rRNA Hypolithic Diversity gene sequences, the nucleotide sequence of the isolated 16S rRNA genes were analyzed using the Megablast option for Most of the quartz stones buried in the soil showed highly similar sequences of the BLASTN algorithm against abundant colonization of hypolithic microorganisms that the National Centre for Biotechnology Information non-formed a mat up to 5 mm thick in some places Fig. Assigned Moss was also found below one quartz rock. In some cases, Figure 1 Study site description. The green band is probably composed of Chroococcidiopsis sp. Both coccoid Chroococcidiop- sis sp. Observations with a stereoscopic component of the hypolithic biofilm, such as thylakoid microscope showed a variety of colored patches and membranes with embedded phycobillisomes and thick filaments corresponding to different members of the sheets of EPS surrounding the cell wall Fig. The 16S rRNA gene Confocal laser scanning microscopy CLSM examination analysis of the DNA extracted from the hypolithic of the hypolithic components resuspended in aqueous community shows the presence of at least seven species solution showed the autofluorescence typical of phycobilli- of Cyanobacteria, eight of bacteria and two species of somes, revealing a highly diverse population of cyanobac- archaea Table 1. Scanning electron microscopy applied to the underside Light Transmittance of Hypolithic Colonized Quartz Stones quartz surface confirmed the presence of a well-formed biofilm with numerous cells embedded in an EPS matrix The PPFD measured at the soil surface of the quartz Fig. Atacama clone 5 Scytonema sp. When comparing mean ing 0. When measuring nine than the soil around it. Combined with the infrared randomly selected quartz rocks in more detail, the PPFD temperature data, this shows that quartz rocks as assessed beneath any particular individual quartz varied from 0. The top Supplemental Figure 1. A similar trend was found when taking that RH fluctuates daily. Then, remained much cooler during the day and somewhat they dropped in the afternoon and began to rise again early warmer during the night Fig. Depending on the in the evening. Figure 3 Morphology of the different photosynthetic compo- nents of the hypolithic commu- nity. The four panels show CLSM micrographs of aqueous suspension of hypolithic cells extracted from the underside of quartz stones. The red fluores- cence is due to the autofluores- cence emitted by active chlorophylls. In the present work, we report on the colonization the temperature profile of the quartz stones at in situ profile of quartz rocks of a coastal site of the Atacama conditions was obtained. As seen in Fig. A more thorough study of the diversity of microorganisms under quartz rocks is presently Water Absorption in Sections of Hypolithic Biofilms being conducted. Nevertheless, our preliminary data show several types of cyanobacteria, archaea, and bacteria Fragments of hypolithic biofilm taken from randomly inhabiting the undersides of quartz rocks at this site Figs. The amount Hypolithic microorganisms are found under quartz rocks of absorbed water varied from 0. The latter are also found value of 3. This volume increase was accompanied by a inland, randomly distributed on the hills, but at much lower rapid greening of the biofilm. When analyzing the extent of the hypolithic colonization in the Coastal Range hills, we found that it is exclusively restricted to quartz rocks since Discussion no hypolithic or perilithic colonization was observed associated to other rock types, as it has been described for Hypolithic communities under translucent stones have been opaque rocks in the Arctic [6]. Thus, it is clear that fog is an effective 1 1 0. Our results confirm this 5 5 0. The sizes of these stones vary from small fragments 6 5 0. This finding is 9 11 1. In the 12 16 1. In this regard, there seems to be a threshold of 14 23 2. In this case, 19 40 3. Our results support this assertion; 26 58 5. As rocks differed in size, the number of atures 7 AMâ€”7 PM during spring time Septemberâ€" measurements per rock changed accordingly November of autonomously recorded by micro- sensors placed around a quartz rock, it can be seen that the quartzâ€"soil interface containing the hypolithic commu- some degree of hypolithic colonization. At this site, the nity clearly remains colder than the environment around it: It is even higher than the colonization the Mojave Desert, Schlesinger et al. This is somewhat rocks was 1. According to the data collected by the of the day. This curious difference may be due to different Meteorological Chilean Service http: Figure 4 PPFD under selected quartz stones. Blue dots show the points where the three levels measured under nine randomly chosen quartz rocks. Their data clearly show that during part of the afternoon, night, and most of the morning temperatures under quartz rocks are cooler than those under Fig. Considering the virtually complete absence of rain at our Nocturnal hydration events supply daily net input averages site, the relative humidity values recorded under quartz rocks at of 1. They reach values higher than of water per cubic centimeter of soil in summer at the Namib Figure 5 In situ thermal environment around a quartz rock. A representative period of 7 days during spring time of is shown. Temperatures were autonomously recorded by microsensors placed around a quartz rock; sensor placed at the quartzâ€"soil interface bottom , blue. Sensor placed over the quartz top, green. Sensor placed at the soil surface, red. Sensor buried in the soil at the same depth of the sensor labeled as bottom, gray Atacama Desert Hypolithic Fog Supported Communities Figure 6 In situ temperature and relative humidity profile under quartz indicates zoomed in data period of panel B. Solid line, percent RH; temperature and relative humidity changes at the quartzâ€"soil interface dashed line, temperature degrees Celsius. Vertical solid RH shows days at which this RH value was reached. The shaded box lines mark midnight Figure 7 Infrared thermograph of quartz rocks in situ. Table 3 Number of hours at different ranges of RH mea- Percentage of RH range Number of hours Percentage of time Cumulative time hours sured at the quartz soil interface 90â€" 9, 5 0, 9 9, 5 80â€" This exceeds the theoretical threshold for water and may be related to the influence of the hypolithic availability to microorganisms [24], therefore fog and dew community under it. Since the EPS being produced by the events supply small but critical amounts of water important microbial community are highly efficient in absorbing water, for soil ecology in agreement with previous findings [34]. Only after the highest Relative humidity is not necessarily a good indicator of temperatures of the day have been reached, a concomitant liquid water in soils. Previous studies have used conduc- drop in RH occurs. The rate of water use by the microbial tivity sensors in addition to RH [9, 36], since conductivity component of the biofilm could also be playing a role. This sensors directly detect the liquid phase.

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Chapter 4 : Negev: land, water, and life in a desert environment - CORE

Abstract In view of the continuing increased concern about the extreme fragility of deserts and desert margins, Negev provides a timely discussion of land-use practices compatible with the often conflicting goals of preservation and development.

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Chapter 6 : Desert - Wikipedia

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Chapter 7 : 2: Negev: land, water, and civilization in a desert environment

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topics: deserts, history, desert soils, ecosystems, ecology, climate, soil water balance, plant water relations, *precipitation, runoff water, land use, nomadism.*

Chapter 9 : Daniel Hillel | Open Library

Settlement in Israel's Negev desert historically has been dependent on water conservation techniques. Fieldwork carried out on settlement sites constructed during the Byzantine period, when agriculture and trade flourished, revealed a variety of water installations some of which are in use today.