# Topic Page: Oases

Definition: **oasis** from *The Hutchinson Unabridged Encyclopedia with Atlas and Weather Guide*

Area of land made fertile by the presence of water near the surface in an otherwise arid region. The occurrence of oases affects the distribution of plants, animals, and people in the desert regions of the world.

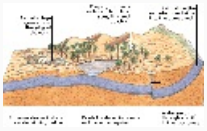


Image from: **Libya** in *Geography of the World*

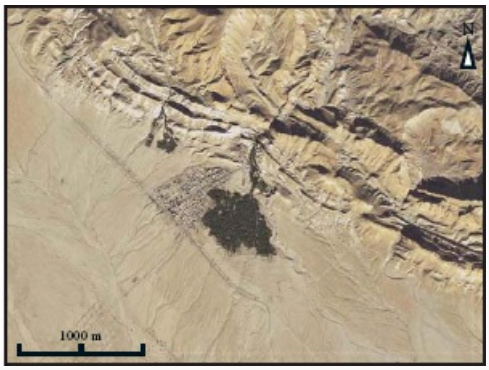
Summary Article: **OASES**
From *Encyclopedias of the Natural World: Encyclopedia of Islands*

The term "oasis" is often taken in its metaphorical and very broad sense: a spot of life within an inhospitable environment. In that way, it has repeatedly been used to designate patches of vegetation in less-vegetated and dry landscapes, isolated ice-free areas in Antarctica, isolated life-rich areas in marine ecosystems, and every other kind of isolated habitat. Even though these systems are comparable in that they are isolated and different from their surroundings, their structure, origin, and evolution, as well as the factors affecting their dynamics, are widely different. Oases are more classically defined as relatively more fertile areas in a desert or wasteland, made so by the presence of water. There are numerous so-defined oases in North Africa, eastern Asia, Australia, and the southwestern region of North America (Baja, in particular), and as such, they represent important models to investigate the role of isolation for the dynamics and conservation of biodiversity in arid landscapes. This article focuses on the original meaning of "oasis" (i.e., a date palm grove in a desert), and provides information on the ecology and dynamics of these particularly poorly known island-like systems.

## OASES AS SEMI-NATURAL CONTINENTAL ISLANDS

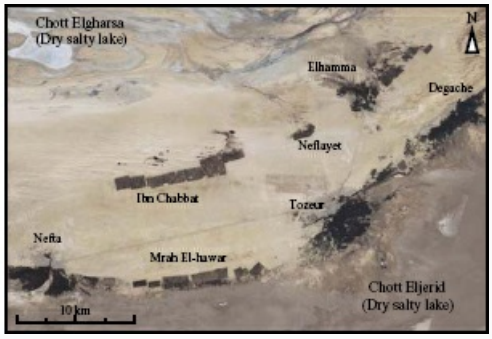
The world distribution of date palm oases shows that they are mainly associated with Saharan regions in Arabia, eastern Asia, the Middle East, and North Africa, where water resources are localized and where the date palm trees *Phoenix dactylifera* have been cultivated for thousands of years (Figs. 1–3). The structure, evolution, and functioning of these particular continental island systems depends upon a great complexity of environmental, historical, and socioeconomic factors. Their faunas and floras are also greatly shaped by those factors.

The desert environment surrounding oases is characterized by harsh climatic conditions, with annual rainfalls rarely exceeding 100 to 200 mm and a summer temperature often exceeding 40°C. In this environment trees, are mostly absent, and the vegetation is composed of sparse steppe shrubs. Nevertheless, the particular geological conditions of some areas, in particular the existence of major faults, permitted the emergence of fossil groundwater as springs. The use of this water for irrigation by local human populations has allowed the practice of agricultural activities and the development of a thick vegetation typically composed of three distinct layers (palm trees, fruit trees, and herbaceous plants), which has induced a local microclimate that strongly contrasts with the arid climate of the surroundings (Fig. 4). This so-called oasis effect is responsible for the insular character of desert oases.




*Aerial image of Chebika oasis, southwestern Tunisia (34°19'00"N, 7°56'20" E). Modified from Google Earth© views.*


*Aerial close-up of Chebika oasis. Modified from Google Earth© view.*



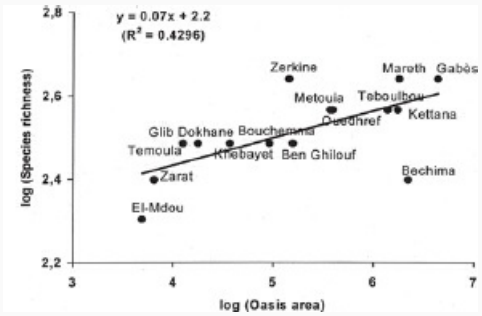

*Aerial photography of the oasis archipelago of the Jérid area in southwestern Tunisia. The darker and more irregular patches correspond to traditional oases; the lighter and more regular patches correspond to modern plantations. Modified from Google Earth© view.*

Given the pronounced physical and climatic contrasts between an oasis interior and the surrounding environment, and because oases are directly dependent on the availability of water and on human activities for irrigation and maintenance, they can be considered as semi-natural continental islands. Furthermore, given that the geographic location of an oasis is primarily constrained by the existence of a water spring, oases are not randomly distributed in the desert, but are generally concentrated in some areas where geological conditions have permitted the emergence of groundwater, leading to regional "archipelagoes" of oases.

*Understory view within Teboulbou oasis (33°50'30" N, 10°07'33" E; southeastern Tunisia), showing the strong stratification of the vegetation. Photograph by S. Selmi.*

## INSULAR SPECIFICITIES OF OASIS COMMUNITIES

In spite of their originality and the current threats to which they are exposed, the flora and animal biodiver-sities of oases have not been much considered by biologists until recently. For instance, within the abundant ecological literature on the biodiversity of continental insular systems, there is very little information on the dynamics of animal and floral oasis communities. The main contributions on these aspects have dealt with oasis bird communities from southern Tunisia (work by the authors). These studies have shown that the occurrence of several non-desert adapted Palearctic bird species, such as the common blackbird *(Turdus merula)*, blue tit *(Cya-nistes caeruleus)*, chaffinch *(Fringila coelebs)*, serin *(Serinus serinus)*, orphean warbler *(Sylvia hortensis)* and woodchat shrike *(Lanius senator)*, in the arid land of southern Tunisia is strictly related to the oasis habitat. They also highlighted the very insular characteristics of oasis breeding-bird communities, notably the fact that their species richness is linked to oasis-area vegetation characteristics and degree of spatial isolation. In particular, it was shown that the number of breeding species in a given oasis is positively related to its area (Fig. 5). Such a typical species-area relationship is an important characteristic of island systems. Species richness of avian communities also depends on vegetation structure: Oases with a diversified structure (notably in terms of the presence of date palm trees, fruit trees, and herbaceous plants), and with a dense structure showing a sharp contrast with the surrounding desert, host richer bird communities than do more open oases where vegetation is less dense and diversified. In addition, it was shown that bird species richness and composition varied as a function of the degree of geographic isolation of the oasis. Oases close to each other host very similar communities, independently of their area and the quality of their habitat. This suggests that the dispersal of individuals and the exchange of species between neighboring oases play an important role in shaping oasis communities.




*Relationship between the number of breeding-bird species and oasis area in a sample of oases of southeastern Tunisia.*

Overall, the work on the breeding bird communities of Tunisian oases has shown that a combination of

ecological, geographical, and historical, but also socioeconomic, factors seems to determine the diversity of oasis faunas. At the scale of an oasis archipelago (a geographic area regrouping a set of oases), the sets of species constituting the local communities would be subsets of a pool of potential colonists that would have reached the region. The size and the composition of the pool of potential colonists (regional richness) are determined by the geographic location of the region of interest with regard to sources of potential colonists (notably, the closest woodland and semi-woodland areas). Those characteristics of the regional communities will also depend on the capacities of the species to extend their area of distribution and to colonize new areas.

At the scale of an oasis, the physical characteristics, notably area and the suitability of habitat for the various species, will determine the richness and composition of the oasis's community, which will be a subset of the regional pool. The physical characteristics of oases are in fact the result of the interactions between various environmental factors, notably water availability, and socioeconomic factors linked to the agricultural system in place in the oasis. If the environmental factors are critical for determining the mere existence of the oasis and can strongly affect its area by limiting its possible extension, then the socioeconomic factors are directly responsible for the quality of the within-oasis habitat that will be available to the various species. Finally, colonization processes from nearby oases, as well as local extinction, seem to play a role. Such metapopulation processes could also largely be responsible for the presence of some species at the regional scale, and thus for the maintenance of regional richness. Comparable mechanisms are likely to be involved in the dynamics of other animal and plant communities, although rates of colonization and extinction may be very different.

## THREATS TO OASIS BIODIVERSITY

For an oasis to exist within a desert matrix, two elements are needed: water and the exploitation of that water by humans for agricultural activities. This results in the creation of a green area. An oasis is thus a sort of semi-artificial continental island, but at the same time it is a very precarious and sensitive ecosystem. It can decay or actually disappear relatively quickly if water resources decline or if the oasis farming practices change, notably when oasis farmers change their way of life. Such factors are currently threatening the mere existence of numerous old oases, which can lead to the loss of the original and sensitive biodiversity that is living in oases.

Traditionally, the agricultural systems run by local oasis farmers fed a mainly self-sufficient local economy. Date palm and fruit trees, together with vegetables and food to feed animals, were grown using a stratified system of plantation that enabled the oasis farmers to optimize their use of water while producing a wide diversity of products. The traditional agricultural practice (notably based on complex local irrigation systems) was characterized by reliance on inter-family networks and by the use of traditional tools. It is those traditional agricultural activities that led oases to look like continental islands, and it is also those activities that seem necessary for the maintenance of local diversity of oasis animal and plant communities. This system, however, has seen and is currently seeing dramatic changes, directly linked with the socioeconomic changes occurring in some oasis societies. For instance, new types of palm plantations have been established in Tunisia since the middle of the twentieth century as a means of maximizing the production and exportation of dates of the well-known Deglet Nour variety. Those modern palm plantations are actual monocultures of date palm trees, which lack the vegetation structure of traditional oases, notably the stratification of the vegetation. The agricultural production is done by employees and uses modern techniques and tools. Those modern palm plantations do not lead to a sharp climatic contrast between the oasis and the surrounding desert,

and they do not host a wild biodiversity as rich as that of traditional oases. Moreover, those new oases are in competition with the traditional ones for limited fossil water. Hence, several springs that were irrigating traditional oases have dried up, leading to severe drought problems for those oases. In addition to these water-availability problems, socioeconomic issues linked with the abandonment of traditional agricultural practices are affecting oasis vegetation structure. The largest of such socioeconomic problems are the non-profitability of traditional agricultural production in the current economic context and the tendency for farmers to focus on a monocultural approach, such as date production, or to switch to more rewarding activities such as tourism and industry; the fragmentation of real estate within the oases over generations; the concurrent tendency for young people to move toward cities and to migrate to Europe; and the fast urbanization of some oases.

Overall, it seems that if oases are created by humans, then their possible disappearance can also logically be caused by humans. The case of oases illustrates how the development of modern agricultural practices, done to maximize profit, can represent an important threat to the biodiversity of precarious agro-ecosystems. As with other island and island-like entities that host specific and sensitive ecosystems, special efforts should be devoted to the protection of traditional oases. In this respect, a sound knowledge of their animal and plant communities is needed to better understand the dynamics of biodiversity in such systems. Any action plan for the conservation of these very original sociohistorical and ecological islands will have to consider the human aspect of things—economic, social, and cultural issues—as well as the physical and biological aspects.

## SEE ALSO THE FOLLOWING ARTICLES

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## FURTHER READING


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SELMI, S., Boulinier, T., & BOULINIER, T. (2009). Oases. In R. G. Gillespie, & D. A. Clague (Eds.), *Encyclopedias of the natural world: encyclopedia of islands*. Berkeley, CA: University of California Press. Retrieved from https://search.credoreference.com/content/topic/oases



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