

Big Dismal Sink (with sinkhole lake; Leon County) Photo by Ann F. Johnson

Sinkhole

Description: Sinkholes are cylindrical or steep-sided conical depressions that are generally formed by the slumping of soil into subterranean cavities or the solution of limestone near the surface. They are common in areas of karst terrain where the underlying limestone is riddled with solution cavities. Although they may exist within most natural communities across Florida, which has more sinkholes than any other state, they are most often associated with hardwood forest communities such as mesic hammock and upland hardwood forest in the Florida Panhandle and peninsula, or rockland hammock in extreme South Florida.

Sinkhole vegetation is highly variable and usually influenced by the matrix community in which the sinkhole develops. Vertical or steep walls may be mostly devoid of plants. Where soil covers the underlying rock, the vegetative structure may be that of a well-

developed forest that is virtually indistinguishable from the surrounding environment. Species distribution along the slope of a sinkhole can be influenced by a number of different factors that vary by sinkhole, such as light availability, temperature, humidity, soil presence and type, drainage and seepage, and steepness of the sinkhole walls (Hardin 1954). The typically sheltered position of most sinkholes promotes a moist microclimate that is moderated from temperature extremes. Sinkholes with ephemeral standing water, and therefore less likely to support predatory fish, are important breeding sites for many amphibian species.

Characteristic Set of Species: There is no specific set of species associated with sinkholes. Vegetation on the steep slopes can range from almost absent to a well-developed hardwood forest.

Rare Species: Rare plants in sinkholes are usually restricted to the limestone outcrop community, which is often present within sinkholes. Though sinkholes provide important habitat for many rare animal species, none are restricted to these geologic features.

Range: Sinkholes occur throughout Florida (Sinclair and Stewart 1985; Fernald et al. 1998; Whitney et al. 2004) but are most common in North and Central Florida ranging from Leon and Wakulla counties in the Panhandle, south to the east coast in Flagler County, and southwest into parts of Polk and Highlands counties. Elsewhere in the Panhandle, sinkholes are common in parts of Washington, Holmes, and Walton counties (Sinclair and Stewart 1985). Small dissolution sinkholes, often called solution holes, are frequent in extreme South Florida within rockland hammock, marl prairie, and pine rockland.

Natural Processes: Sinkholes can form in three ways. Dissolution sinkholes form when limestone is dissolved at or near the surface. Ongoing erosional processes result from the chemical and physical actions of underground water, which slowly dissolves the limestone and enlarges these cavities. Subsidence sinkholes, the most common type in Florida, form when the land subsides as limestone beneath is dissolved. These sinkholes develop into bowl-shaped depressions (Fernald et al. 1998) which can be shallow or deep. Collapse sinkholes can form when the water level in an underground cavern is lowered, either naturally (e.g., drought) or unnaturally (e.g., water table drawdown), creating a space between the water level and the roof of the cavern, which can cause a collapse of the roof. These sinkholes form rapidly when the weight of overlying sediments cause a collapse into the underground cavity. Where unnatural water manipulations have occurred, collapse sinkholes, such as the 1981 Winter Park Sinkhole may develop rapidly and more frequently (Fernald et al. 1998).

Sinkholes generally have higher relative humidity levels and lower light and temperature readings than the surrounding natural community (Hardin 1954). Whether they form a complete canopy or not, trees on the upper slopes or rim shelter the sinkhole from intense solar radiation. The depression itself also limits the effects of desiccating winds. Standing water in the bottom of the sinkhole, together with seepage from the surrounding uplands, helps to raise and maintain humidity levels. These conditions also buffer temperature extremes, providing frost-free habitats for cold sensitive species. This often allows for a unique mixture of tropical and temperate flora to exist in many Florida

sinkholes. The sheltered habitat of sinkholes is also naturally protected from fires. Sinkholes that develop in fire-maintained communities often develop a hardwood canopy.

Sinkholes drain readily and only contain standing water during, or for short periods following, heavy rains. Those that hold water throughout much of the year, drying down only during extreme droughts, are additionally classified as having a sinkhole lake. The size of an individual sinkhole is variable and depends in large part on the local geology and hydrology.

Community Variations: The vegetation of sinkholes varies widely according to the surrounding natural community, geographic location, and sinkhole type and age. The geographic location of a sinkhole within the state also influences the vegetation. Sinkholes in South Florida are dominated by a mostly tropical species assemblage. Northern and Central Florida sinkholes support a diverse array of temperate tree species.

Associated Communities: Sinkholes may occur within most natural community types. In pyrogenic communities, sinkholes may form a natural barrier to fire that allows hardwood species to become established around the edge and upper slope and form an island of upland hardwood forest or mesic hammock.

A sinkhole that holds water throughout most of the year and dries down only during extreme droughts is considered to have an included sinkhole lake. They may co-occur if the upper portions of the limestone are typically above water level, while the lower portions are typically below water level (e.g., Big Dismal Sink, Leon County; see photograph). Additionally, aquatic caves can occur within the sinkhole. Springs can emerge from these aquatic caves into the sinkhole lake.

Management Considerations: Sinkholes are fragile communities, often with steep walls and limited soils. Human activities in the surrounding areas may affect the delicate microclimate of a sinkhole and induce deleterious responses. For example, logging of the surrounding canopy can increase both solar radiation and sedimentation levels. Major soil disturbances in the adjoining uplands could disrupt seepage water sources. Large withdrawals of groundwater could substantially lower water tables and reduce the hydroperiods of sinkholes.

Sinkholes are sometimes used as dumpsites. Because sinkholes drain directly to underground aquifers, refuse dumping should be strongly discouraged. Chemical applications, waste treatments, and spills on the surrounding upland require active monitoring to determine their potential impacts and mitigation requirements.

Invasive exotic species are sometimes problematic in sinkholes. Their establishment is often facilitated by the shaded, humid environmental conditions. Invasive species occurring in sinkholes include coral ardisia (*Ardisia crenata*), skunk vine (*Paederia foetida*), Japanese climbing fern (*Lygodium japonicum*), heavenly bamboo (*Nandina domestica*), giant reed (*Arundo donax*), and air-potato (*Dioscorea bulbifera*). Steep slopes and the presence of sensitive plant and animal species can complicate the treatment of exotic plants. Furthermore, the close connection of sinkholes to aquifers

requires especially careful applications of herbicides to avoid groundwater contamination.

Exemplary Sites: Devil's Millhopper State Park (Alachua County), Leon Sinks State Geological Area (Leon County), Falling Waters State Park (Washington County), Withlacoochee State Forest (Citrus County)

Global and State Rank: G2/S2

Crosswalk and Synonyms:

Other synonyms: sink, limesink, banana hole, solution pit, cenote, grotto, doline, chimney hole

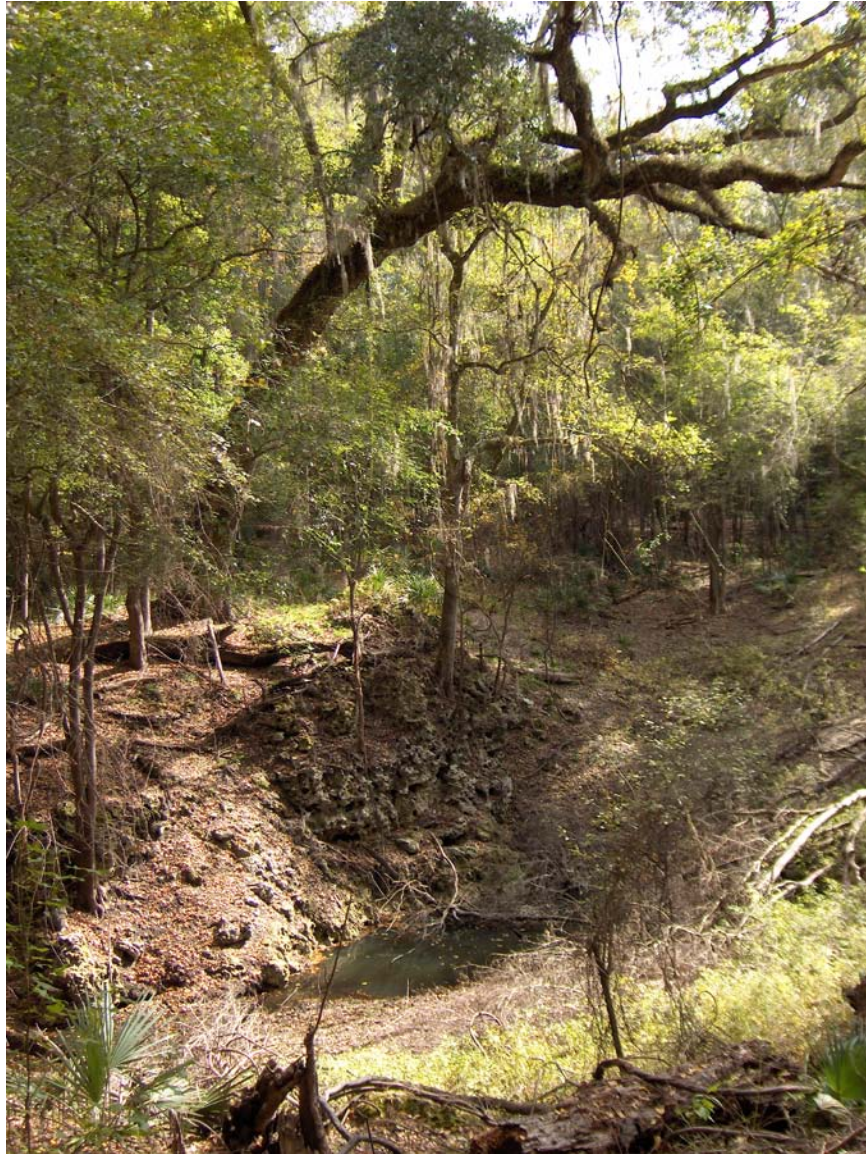
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Suwannee Ridge Wildlife and Environmental Area (Hamilton County)
Photo by Paul Russo