# INFLUENCE OF GROUNDWATER DEPTH AND SOIL TEXTURE ON NEST FORMATION AND VIABILITY OF TERMITES OF THE GENUS ANACANTHOTERMES JACOBS

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***Abstract.*** *In recent years, the expansion of termite habitats in the Khorezm oasis has been accompanied by increasing economic damage to buildings, infrastructure, and historical monuments. Despite the ecological importance of termites, their activity poses serious risks in irrigated and densely populated areas. This study investigates the influence of groundwater depth and soil mechanical composition on nest formation and overwintering survival of termites of the genus* Anacanthotermes *in the Khorezm oasis and adjacent regions. Field investigations were conducted during the spring rise of groundwater levels. Four termite nests located in contrasting landscape conditions were excavated to depths of up to 250 cm. In addition, more than 30 termite nests were examined in Khiva, the Khorezm region, and the Beruniy and Ellikkala districts of the Republic of Karakalpakstan to assess nest structure, depth distribution, and construction type. The results showed that overwintering termites descend to depths ranging from 150–165 cm to 240–250 cm, depending on groundwater level and soil properties. In low-lying areas and near irrigated lands, rising groundwater submerged lower nest chambers, causing partial mortality of overwintering termites and weakening of colonies. In contrast, nests located on elevated sites along irrigation canals and drainage collectors provided more favorable overwintering conditions.*

***Keywords:*** *termites, Khorezm region, Anacanthotermes, Karakalpakstan.*

**Introduction.** In recent years, an expansion of the termite habitat range has been observed in our Republic, accompanied by a significant increase in the level of damage they cause. Termites play an important ecological role in nature; however, as a result of their activity, they inflict substantial damage on construction sites. Termites primarily feed on materials and objects containing cellulose and cause considerable economic losses to various building structures, timber, bridges, water supply systems, and even historical monuments. Therefore, it is important to study termites and to develop modern measures for their control.

It is known that, like other termite species, termites of the genus *Anacanthotermes* Jacobs are adapted to a nest-dwelling lifestyle and construct their nests in soil, i.e., underground (Brajne, 1986). Depending on nest structure, it has even been proposed to distinguish separate species within this genus. In particular, according to A. N. Luppova (1955) and a number of other authors (Kakaliev, 1968; Soyunov, 1991), the termite species *Anacanthotermes ahngerianus* Jacobs is characterized by constructing its nest high above the soil surface in a hemispherical form, whereas *Anacanthotermes turkistanicus* Jacobs, on the contrary, does not bring its nest to the surface but places it deep in the ground. Haytboyeva (2026) demonstrated that *A. ahngerianus* forms stable colonies in desert and semi-desert environments, with nest density and morphology varying according to habitat type. In natural landscapes, especially sandy desert zones, termite nests are predominantly mound-shaped and reach heights of 40–70 cm, whereas in anthropogenic

environments nests are often associated with irrigation systems, drainage collectors, and residential areas.

These observations support our findings that soil mechanical composition and hydrological conditions play a decisive role in nest construction type and colony survival. As is well known, under the conditions of Central Asia, during winter, when the upper soil layers and the nests experience significant cooling, termites descend to greater depths where the temperature is maintained at about 10 °C. In spring, as the soil warms, termites begin to migrate to the warmer upper chambers of the nest. Such overwintering under continental climatic conditions is an adaptive response to pronounced temperature fluctuations in the absence of diapause and stored food reserves. The beginning and end of the winter dormancy period are largely depend on weather conditions.

The influence of groundwater dynamics on the overwintering reserve of termites has not been studied. Under the conditions of the Khorezm region, groundwater levels depend on the irrigation of agricultural crops. On irrigated lands, the optimal groundwater depth during the growing season of agricultural plants is 1.5–2.0 m and decreases to 2.5 m by the beginning of preventive leaching irrigations. According to data from the Khorezm “Hydrogeology” Expedition, the groundwater depth in the Khiva district, where the study was conducted, varies throughout the year from 1.0–1.2 m to 2.5–3.0 m. On a monthly basis, it changes as follows: January 2.5–3.0 m, March 1.0–1.2 m, April 1.5–1.8 m, May 1.5 m, June 1.2 m, October 1.5 m, November 1.2–1.5 m, and December 2.3–2.5 m.

**Materials and methods.** We examined the condition of termite nests during the spring rise of groundwater to a depth of 1.2–1.5 m. In total, four termite nests located in different areas were excavated. The first nest was situated near irrigated farmland where spring irrigation activities were carried out. The other nests were located along a drainage collector on elevated areas, where the groundwater level was deeper.

During the study of termites distributed in the Khorezm oasis, we collected data on the construction and structure of their nests. The reasons for the construction of termite mounds above or below ground were also examined, and it was established that termite colonies which, based on morphological characteristics, may be considered to belong to the same species are capable of constructing both types of nests mentioned above. A total of more than 30 termite nests were examined in Khiva, the Khorezm Region, as well as in the Beruniy and Ellikkala districts of the Republic of Karakalpakstan.

**Results and discussion.** Excavation of the first nest showed that during the spring rise of groundwater, isolated termite individuals were found at a depth of 130 cm. The upper chambers containing overwintering termites were detected at a depth of 155 cm. Several chambers with overwintering termites were also found at depths of 165–170 cm. It was established that the groundwater level rose to this depth, resulting in the overwintering termite colony being submerged in water. Under these conditions, the termites were already dead.

**The second nest** was excavated to a depth of 250 cm and had a diameter of 230–260 cm. Chambers containing overwintering termites were identified at a depth of 150 cm and deeper. The chamber with the largest number of termites was found at a depth of 240 cm. Below 250 cm, the soil was heavy loam, wet, and showed signs of groundwater presence. Under these conditions, overwintering termites survived successfully even at a depth of 240 cm.

**Two additional nests** were studied in the Beruniy district. The excavation results showed that nests located in hilly areas along irrigation canals and drainage collectors provide more

favorable conditions for termite overwintering than nests situated in low-lying areas or near irrigated lands. As a result of rising groundwater levels, a portion of overwintering termites in nests located in low-lying areas or close to irrigated fields die due to the influence of groundwater. This leads to a reduction in termite numbers and weakening of the colony.

Since the genus Anacanthotermes Jacobs is widely distributed mainly in desert zones, its nests are also found in the Kyzylkum Desert. All nests discovered under desert conditions have a mound-shaped form, forming elevations 20–60 cm above the ground surface and sometimes higher. As the main distribution areas of termites in the Khiva district are located around drainage collectors, termite nests constructed in soils with a heavy mechanical composition as well as in sandy conditions are also found in these areas. It was established that nests found in heavy soils lack hummocky structures, unlike those discovered in sandy areas. The internal structure of such nests does not differ significantly. The mechanical composition of spherical nests found in deserts, even when they are built partly in sand and partly on its surface, consists of coarse soil particles.

During the examination of nests at a stationary site at the foothills of the Kyzylkum Desert in the Beruniy district, at elevations of 1–2 m above ground level, the presence of a layer of fine soil with a heavy mechanical composition consisting of alluvial deposits was detected at depths of 4–5 m and even deeper in some cases. Termites have adapted to the construction of strong nests resistant to mechanical impacts by using soils with higher density and heavy mechanical composition, since it is impossible to build a durable nest from loose, clean sand. The mounds on the sand surface represent the above-ground part of the termite nest, which in fact consists of a rounded, spherical structure with a diameter of 50–60 cm or more, the lower part of which is connected to other chambers by tunnels. The lower chambers and the walls of the connecting tunnels are also constructed of soil.

Thus, arid populations of termites of the genus Anacanthotermes Jacobs, widely distributed in the desert zones of the studied region, form mound-shaped structures when constructing their nests. In contrast, termite nests inhabiting soils with a heavy mechanical composition are built not in sand but directly in the ground and therefore represent flat nests composed of solid chambers that do not form mounds.

**Conclusion.** Thus, under the conditions of the Khorezm oasis, termites descend to depths of 150–165 cm up to 240–250 cm for overwintering. Nests located in hilly areas along irrigation canals and drainage collectors provide more favorable conditions for termite overwintering than nests situated in low-lying areas or near irrigated lands. As a result of rising groundwater levels, a portion of overwintering termites in nests located in low-lying areas or close to irrigated lands perish due to groundwater influence. This leads to a reduction in termite abundance and weakening of the colony. In our opinion, termites distributed in the Khorezm oasis are adapted to constructing two types of termite nests—flat or spherical—depending on soil environmental conditions. Spherical nests are typically found in sandy desert environments, whereas flat nests occur in heavy soils where the soil composition is favorable for nesting.

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