

# General Characteristics, Distribution, and Ecology of Rodents in the Samarkand Region

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Received: 2025 25, Nov

Accepted: 2025 21, Oct

Published: 2025 07, Dec

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**Annotation:** The article examines the general characteristics, distribution, and ecology of rodents in the Samarkand region. Within the scope of the research, the species of synanthropic rodents widespread in the region, their biological characteristics, reproduction patterns, and the damage they cause to the economy were analyzed. It was determined that the Norway rat (*Rattus norvegicus*), Turkestan rat (*Rattus turkestanicus*), house mouse (*Mus domesticus*), and yellow ground squirrel (*Citellus fulvus*) species are widely distributed in the region. Statistical analyses showed the presence of 23-45 rat colonies per hectare in major trading areas of Samarkand district. A single rat consumes 7-15 kg of food per year and stores 10-25 kg of grain and other products in its nest. In 2024, 755 citizens were bitten by rats in the region. Rodents cause significant economic damage by

destroying agricultural crops, spreading infectious diseases, and disabling communication systems. The article covers comprehensive control measures against rodents and ecological monitoring issues

**Keywords:** *Synanthropic rodents, Norway rat, house mouse, yellow ground squirrel, population dynamics, ecology, distribution range, deratization, epidemiological hazard, biological control, Samarkand region, pests, rodent monitoring, infectious diseases, agricultural damage.*

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## INTRODUCTION

In recent years, a sharp increase in the population of rodents in the Samarkand region has caused numerous problems in agriculture and the national economy. In particular, the rapid growth in the number of gray rats has created a range of ecological and epidemiological risks for the population in urban environments. Their harmful effects on animals, humans, infants, and even corpses have reached an intolerable level.

In addition to rats, the growing populations of species such as the yellow ground squirrel and the large field mouse—which have increasingly occupied cemeteries and caused public dissatisfaction—also pose a serious threat and contribute to the emergence of epidemiological situations among the population.

At present, rodent control has become a pressing global issue. It is no coincidence that this problem has been included in the programs of the World Health Organization. According to these programs, international airports, railway stations, and ports are taken into account, and the species composition and population size of rodents in these areas are continuously monitored.

Rats are considered cosmopolitan species that have spread across all regions of the world. They infest residential buildings, warehouses, basements, landfills, wastewater discharge sites, sewage systems, irrigation canals, and areas surrounding large agricultural fields. In some years, their spontaneous population outbreaks have caused unprecedented damage to humanity.

In recent years, the expansion of grain-cultivated areas in the Republic has created favorable conditions for the rapid reproduction and widespread distribution of field rodents, including rats.

**Materials and methods.** In the Samarkand region, rats inhabit areas around irrigation ditches, canals, rivers, lakes, collectors, and other water sources, as well as cemeteries, livestock shelters, and locations with various types of waste. Subsequently, they migrate into residential areas, buildings, and warehouses. They not only spread infectious and parasitic diseases but also severely damage agricultural crops, destroy large quantities of grain and livestock products, disrupt buildings and communication networks, and gnaw on electrical and communication cables, rendering them unusable. All of these factors indicate the urgent need to develop and implement continuous, comprehensive rodent control measures. This requires statistical monitoring of rodent populations, in-depth study of species composition, development of epizootiological monitoring systems, testing of existing control methods, and the wide practical application of environmentally safe and effective control strategies.

**Analyses and results. *Distribution and General Characteristics of Rodents.*** Rats are classified as cosmopolitan species that have spread throughout the world and are found on all continents except Antarctica. In terms of global distribution, the gray rat ranks first, followed by the black rat in second place, while the house mouse occupies third place.

*The gray rat (Rattus norvegicus)* is distributed worldwide, with the exception of extreme northern zones. Originating from tropical Asia, it spread across Africa and Europe. Gray rats appeared in Europe around 1550 and, through human activity, were introduced to North America in 1775. By the 17th century, they had spread throughout Europe, multiplied extensively in the forests of Norway, and later expanded to the British Isles. The scientific name *Rattus norvegicus* was assigned due to its wide distribution in Norwegian forests; however, it was later established that its original homeland was Asia rather than Norway.

Gray rats are capable of reproducing and surviving in regions of the Russian Federation with temperatures ranging from  $-10$  to  $-15^{\circ}\text{C}$ . Approximately 140 rodent species are found across Russia, among which gray and black rats occupy particularly extensive territories. According to available data, gray rats can survive in extreme climatic conditions, including temperatures as low as  $-40^{\circ}\text{C}$ , as well as in environments exceeding  $+40^{\circ}\text{C}$ . American scientists observed that during nuclear weapons testing on Engebi Atoll in the western Pacific Ocean, gray rats were the only species that remained genetically healthy, indicating their high resistance to radioactive radiation.

*The black rat (Rattus rattus)* is distributed across India, Sri Lanka, Myanmar, southern China, the Indochina Peninsula, as well as the islands of Java, Sumatra, Kalimantan, and the Philippines. Within the Russian Federation, it occurs from the Arkhangelsk region and the Black Sea coasts to the Far East.

The Turkestan rat (*Rattus turkestanicus*) is found in Uzbekistan, Tajikistan, southwestern Kyrgyzstan, southern Kazakhstan, Kashmir, Punjab, and from China to Taiwan.

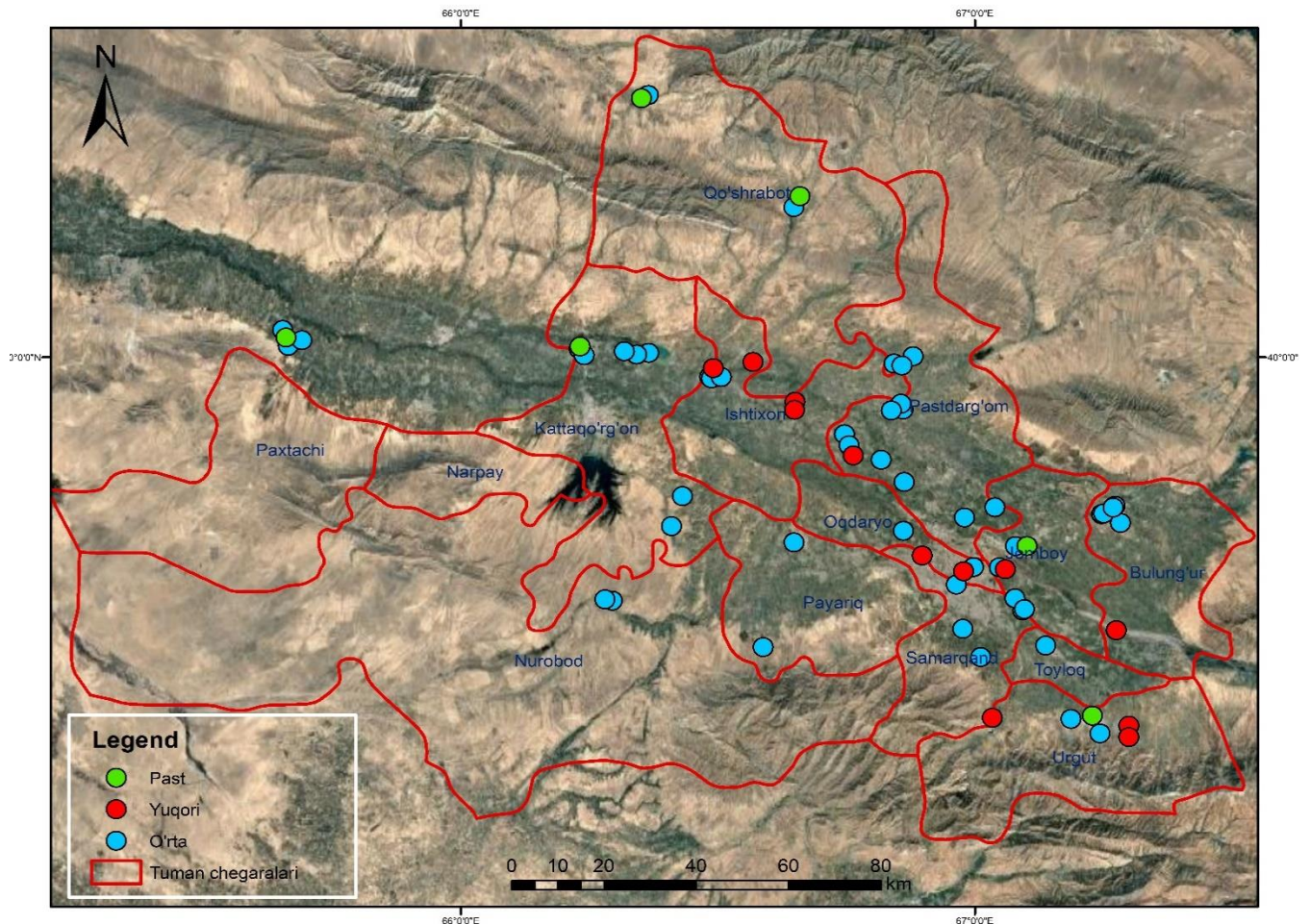
The Indian mole rat, or bandicoot rat (*Nesokia indica*), inhabits the riparian and tugai zones near water bodies in Central Asia, including the Zarafshan, Amu Darya, Syr Darya, Murghab, Tedjen, and Kopetdag regions, as well as Afghanistan, southern China, northern India, Pakistan, northern Africa, and other parts of Asia.

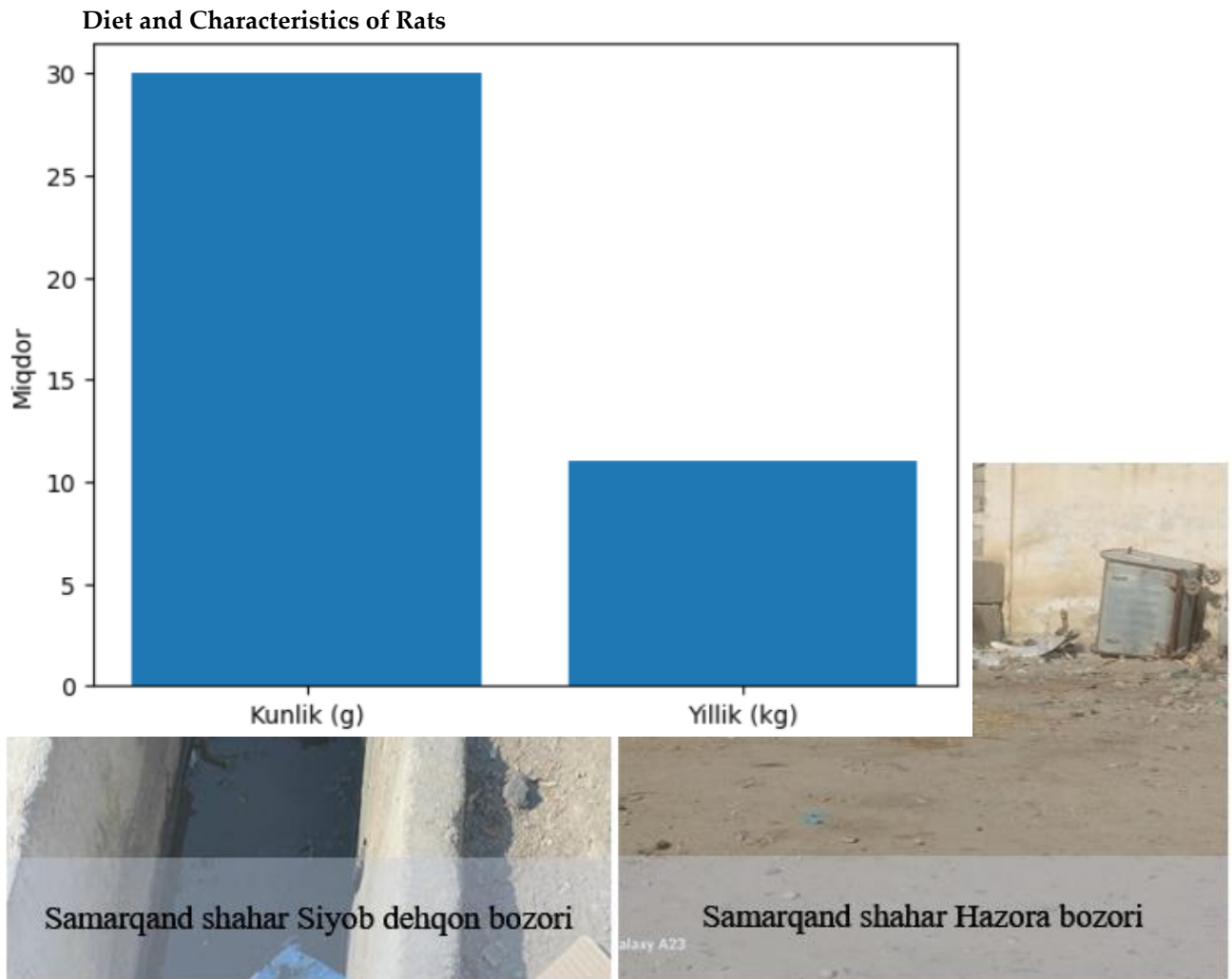
Under the conditions of the Samarkand region, gray rats and Turkestan rats are the predominant species. Notably, gray rats are displacing Turkestan rats, rapidly occupying the entire valley and continuously expanding their distribution range.

A statistical analysis of rat populations and their natural predators revealed that gray rats were present in particularly high numbers at major commercial centers in the Samarkand region, specifically within the Samarkand district. The initial increase in their population was first recorded in the Samarkand district of the region; however, in subsequent years, a significant rise in their numbers was also observed in other districts of the region, including Akdarya, Urgut, Jomboy, Payariq, as well as in the city of Samarkand (Figure 1).

**Figure 1. Spatial distribution pattern of the gray rat (*Rattus norvegicus*) population in the Samarkand region.**

According to our research, an increase in the gray rat (*Rattus norvegicus*) population was also observed in the eastern border zones, specifically in the village of Qizil Qayrog'och and around industrial factories. In the city of Samarkand, in residential areas near Rudaki Street, as well as around the Siyob (39.663283, 66.978098) and Hazora (39.686300, 66.896909) markets, rat densities of 23–45 individuals per hectare were recorded.





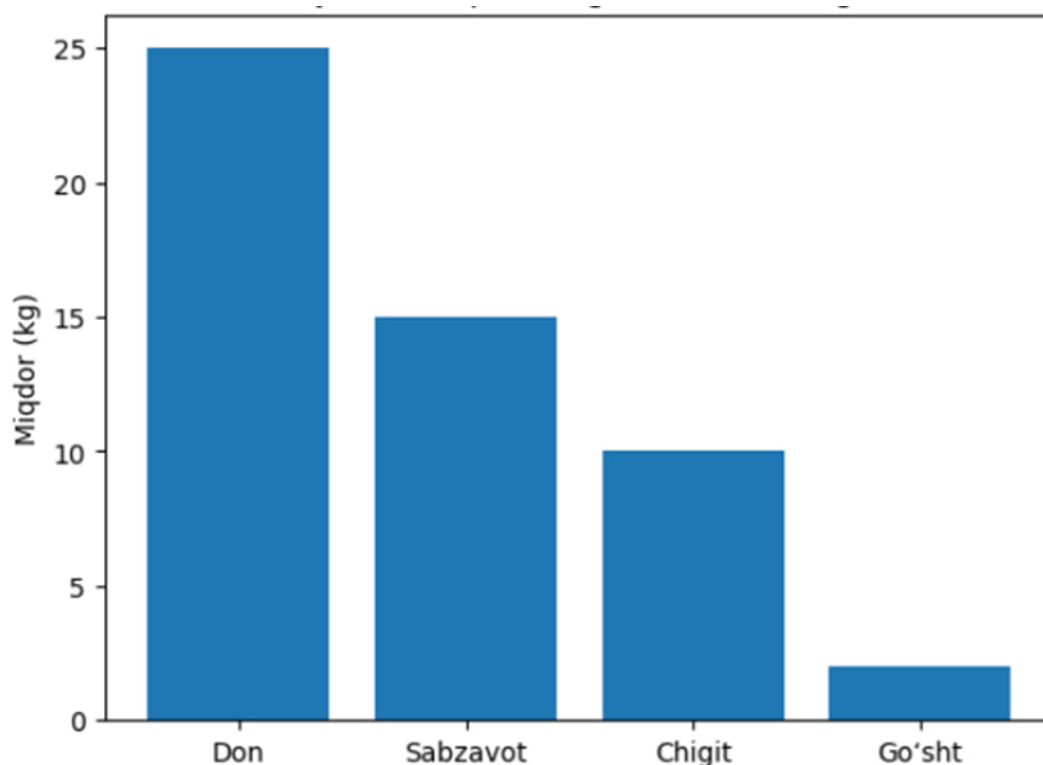
Rats are not selective in their diet; they consume not only grains but also fruits, vegetables, field crops, seeds sown in the soil, and grains in the ears of crops. They may also feed on poultry, including eggs and chicks, bite domestic animals, and in some cases even attack infants.

Depending on environmental conditions, rats can store 7 to 40–50 kilograms of grains, nuts, and groundnuts in preparation for winter. Adult rats weigh between 120 and 450 g, with a body length of 150–250 mm, a tail length of 120–210 mm, and a relatively small head with two large eyes and ears measuring 12–17 mm in height.

A gray rat (*Rattus norvegicus*) consumes on average 25–40 g of dry food and an equal amount of water per day. Based on this, a single rat can consume 7–15 kg of food annually. This level of consumption causes significant economic damage to warehouses, fodder and feed supplies, and grain reserves (Diagram 1).

**Diagram 1. Average daily food consumption of a gray rat (*Rattus norvegicus*).**

Rats are extremely opportunistic and adaptable. When their burrows are disturbed, they have been found to hoard food and other materials in quantities that vary according to the available resources: 10 kg, and sometimes up to 25 kg of grain, 10–15 kg of vegetables, 5–10 kg of seeds, 1–2 kg of meat, as well as eggs from domestic and wild birds, paper, cotton, polyethylene, and even metal objects. This demonstrates their remarkable gluttony and adaptability (Diagram 2).



**Diagram 2. Reserves accumulated in the nest (kg).**

Rats excrete urine and small, rounded feces proportional to the amount of food and water they consume daily, and shed over 50–100 small hairs. As a result, food and feed products become contaminated, creating microbiologically hazardous conditions.

Rats are cautious with any newly encountered food and tend to prefer fresh, high-protein and high-fat foods over older or stale items, particularly meat and fatty products. Therefore, without continuous control measures in areas near fat, dairy, and meat processing plants, finished product warehouses, and surrounding waste sites, their populations can increase 2–3 times faster than in fields or other areas.

Situation in the Samarkand region. The rat population in the Samarkand region has increased so significantly that farmers have been unable to harvest crops such as corn and wheat from their fields. Instances of rats consuming cotton seeds have been observed. Fruit trees, including grapes, dates, and nuts, have suffered losses due to rodents. Livestock and domestic poultry have experienced significant damage. Rat attacks and bites on humans have reached intolerable levels.

In 2024, 755 individuals in the Samarkand region were reported to have been bitten by rats, including 29 cases in Akdarya and 28–41 cases over nine months in Jomboy district, requiring medical attention. The widespread destruction of agricultural products, as well as harm to animals and poultry, has necessitated intervention at the government level.

Rats are highly sensitive, intelligent, cunning, and organized within a family-based hierarchy. Effective control requires detailed knowledge, implementation of scientifically proven strategies, and, in some cases, rigorous eradication measures, making rodent control a pressing contemporary issue.

Rodent taxonomy. The order Rodentia comprises 30 families, among which synanthropic species—those living in close association with humans—include rats and mice. In Central Asia, the most widely distributed species are house mice, gray rats, black rats, Turkestan rats, and yellow ground squirrels.

#### **Rodent Species, Characteristics, and Reproduction**

Rodents include species that inhabit both terrestrial and aquatic environments. Their diet primarily consists of plant material. A defining feature of rodents is the specialized structure of their teeth, adapted for gnawing hard plant foods. Each jaw contains a pair of large incisor teeth, which grow continuously throughout the animal's life. The cutting edges of these teeth are sharpened like a chisel, and the front surface is covered with a durable enamel layer. As a result, the teeth wear unevenly, maintaining a self-

sharpening edge. Rodents do not possess canine teeth. The incisors are separated from the cheek teeth by a toothless gap known as a diastema.

Rodents are adapted for running, jumping, climbing, burrowing, and, in some species, swimming.

In Uzbekistan, more than forty rodent species are distributed. Many of these species are significant pests and serve as vectors for dangerous diseases, causing substantial harm to humans. Determining whether a particular rodent species is beneficial or harmful requires a detailed study of its life activities. It is essential to consider both their ecological role in maintaining natural balance and their potential as pests—such as crop destruction, consumption of harvests, and the spread of infectious agents. Therefore, comprehensive studies of their biology and ecology are of considerable importance.

### **Reproduction**

The reproduction of rodents primarily depends on the initial population remaining within their distribution areas, the availability of food and water resources, and prevailing climatic conditions. An analytical population model has been constructed for gray rats (*Rattus norvegicus*), accounting for all relevant factors. This model considers five main influences: availability of protein- and fat-rich food sources, grain-based diets, vegetables and fruits, suboptimal plant materials and tree bark, and tertiary food sources. Additionally, it incorporates factors that reduce population size, such as starvation, disease, predation by dogs and cats, and human control measures.

Data collection and mathematical calculations indicate that the increase in gray rat populations over time can be estimated on a yearly basis, taking into account these factors and seasonal fluctuations. Year-by-year projections derived from this approach provide estimates that closely approximate real population dynamics.

### **Reproduction and Population Dynamics of Rats**

A pair of rats in natural conditions can produce 3–6 litters per year, each consisting of 7–10 offspring. The young reach sexual maturity in 3–4 months. Reproduction is most rapid in spring and autumn, slows by 20–30% during summer, and in winter, birth and mortality rates balance or may decrease by 50–60% compared to autumn. Based on these assumptions, population growth under high, medium, and low reproduction rates can be estimated as follows:

After 1 year: 100–130; 40–80; 20–25

After 2 years: 5,000–8,000; 800–3,500; 200–300

After 3 years: 300,000–500,000; 15,000–150,000; 1,500–4,500

After 4 years: 20–30 million; 0.8–6.0 million; 15,000–85,000

It should be noted that theoretical estimates in the literature and deratologists' calculations often exceed these values. Such calculations should also account for the mortality of a portion of the offspring and the fact that not all individuals participate equally in reproduction.

### **Historical Data**

The reproductive dynamics of rats are highly variable, as illustrated by historical observations. In Italy, one of the most densely populated rat regions in Europe, Rome alone reportedly had up to 15 million rats.

In 1985, during the so-called "Year of the Rat" in Taiwan, temporary suspension of rodent control measures led to a population increase to 60 million, resulting in the destruction of 6,000 tons of rice. Considering that an individual rat can store or consume approximately 10 kg of food per season, these population estimates are plausible. During the subsequent "Year of the Rat" in 1997, a significant population increase was not observed, although rodents and other pests still caused losses of about 20% of the harvested crops.

In Paris, 16,000 rats were killed within four weeks in a slaughterhouse. At a nearby livestock farm, rats gnawed the bodies of 35 horses in a single night. Assuming each rat consumed approximately 25 g of meat, the estimated population at the farm was 600,000–800,000 individuals.

Significant rodent outbreaks have also been recorded in Asia and in countries with large-scale grain production such as the United States, Canada, and France. In 1970, rats destroyed 15 million tons of wheat, maize, and rice in the U.S., and 87 million tons of grain in India. Using population modeling, these figures correspond to estimated rat populations of 1.5 and 8.7 billion, respectively, assuming the increase occurred over two years, with initial populations of 1 million and 5–6 million rats in these countries.

### **Conclusions**

The rodent species widely distributed in the Samarkand plain include:

House mouse – *Mus musculus* L.

Gray rat – *Rattus norvegicus* L.

Turkestan rat – *Rattus turkestanicus* L.

Yellow ground squirrel – *Citellus fulvus* L.

In the Samarkand region, species that expand their distribution annually include the gray rat, house mouse, and yellow ground squirrel.

Rodents exhibit a family-based hierarchy, with males being dominant. Sexually mature individuals establish new families from the third and fourth months of life, initiating intensive reproduction. Several familiar families form parcel-based groups, which should be considered in control strategies.

Biological control of rodents can involve their natural predators:

Urban environments: cats, dogs—especially breeds such as Dachshunds, Pinschers, and Fox Terriers.

Field environments: minks, ferrets, foxes, weasels; birds such as owls, hawks, crows; reptiles including snakes and lizards.

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