POPULATION DYNAMICS AND ECOLOGICAL FACTORS OF NESOKIA INDICA AND MERIONES TAMARISCINUS IN THE SOUTHERN ARAL SEA REGION

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Abstract: The article presents a comparative analysis of the ecological characteristics of the short-tailed bandicoot rat (*Nesokia indica* (Gray, 1830)) and the sympatric tamarisk gerbil (*Meriones tamariscinus* (Pallas, 1773)) in anthropogenically transformed landscapes of the Southern Aral Sea region. The long-term population dynamics, diet composition, and endogenous and exogenous factors influencing *N. indica* were assessed, while habitat distribution, reproduction, and age structure were analyzed for *M. tamariscinus*. A multiple regression model explained 86.74% of the variation in *N. indica* population dynamics (R^2 = 0.8674), with the hydrological regime of the Amu Darya River accounting for 24% of the explained variance. Hydrological conditions, habitat moisture, and anthropogenic transformation were identified as the main factors determining the spatial and temporal dynamics of both species. The results provide a scientific basis for rodent monitoring and population management in agricultural ecosystems.

Keywords: Southern Aral Sea region, *Nesokia indica*, *Meriones tamariscinus*, population dynamics, hydrological regime, habitats, regression analysis.

Annotatsiya: Maqolada Janubiy Orolbo‘yining antropogen o‘zgargan landshaftlarida plastinka tishli kalamush (*Nesokia indica* (Gray, 1830)) va simpatrik yulg‘un qumsichqoni (*Meriones tamariscinus* (Pallas, 1773)) populyatsiyalarining ekologik xususiyatlari qiyosiy tahlil qilindi. *N. indica* ning 1960–2015-yillardagi son dinamikasi, oziqlanishi va unga ta’sir etuvchi endogen hamda ekzogen omillar baholandi; *M. tamariscinus* ning biotopik taqsimlanishi, ko‘payishi va yosh tarkibi o‘rganildi. Ko‘p omilli regressiya modeli *N. indica* sonidagi o‘zgarishlarning 86,74 % ini (R^2 = 0,8674) izohladi, bunda Amudaryo gidrologik rejimining ulushi 24 % ni tashkil etdi. Natijalar gidrologik sharoit, biotop namligi va antropogen transformatsiya har ikki tur populyatsiyasining fazoviy-vaqt dinamikasini belgilovchi asosiy omillar ekanini ko‘rsatdi. Olingan

ma’lumotlar kemiruvchilar monitoringi va agroekotizimlarda ularning sonini boshqarish choralarini asoslash uchun xizmat qiladi.

Kalit so‘zlar: Janubiy Orolbo‘yi, *Nesokia indica*, *Meriones tamariscinus*, populyatsiya dinamikasi, gidrologik rejim, biotop, regressiya tahlili.

Аннотация: В статье проведён сравнительный анализ экологических особенностей популяций пластинчатозубой крысы (*Nesokia indica* (Gray, 1830)) и симпатричного вида — тамарисковой песчанки (*Meriones tamariscinus* (Pallas, 1773)) в антропогенно трансформированных ландшафтах Южного Приаралья. Оценены многолетняя динамика численности, питание, а также эндогенные и экзогенные факторы, определяющие состояние популяции *N. indica*. Для *M. tamariscinus* изучены биотопическое распределение, размножение и возрастная структура. Многофакторная регрессионная модель объяснила 86,74 % изменчивости численности *N. indica* (R^2 = 0,8674), при этом вклад гидрологического режима Амударьи составил 24 %. Установлено, что гидрологические условия, увлажнённость биотопов и антропогенная трансформация являются ключевыми факторами пространственно-временной динамики обоих видов. Результаты могут использоваться при мониторинге грызунов и обосновании мер регулирования их численности в агроэкосистемах.

Ключевые слова: Южное Приаралье, *Nesokia indica*, *Meriones tamariscinus*, динамика популяции, гидрологический режим, биотоп, регрессионный анализ.

The desiccation of the Aral Sea, the reduction of the Amu Darya River discharge, the degradation of delta ecosystems, and the intensification of soil salinization have altered the composition and population dynamics of animal communities in the landscapes of the Southern Aral Sea region [1, 3, 9, 14]. Rodents, which respond rapidly to changes in environmental conditions, are considered important model organisms for assessing hydrological and anthropogenic transformations in the region.

The short-tailed bandicoot rat *Nesokia indica* (Gray, 1830) is associated with moist tugai forests, reed beds, irrigated agrocenoses, and collector–drainage systems, where it may cause damage to agricultural crops and hydraulic engineering structures [1, 4, 7, 8, 13, 15]. The tamarisk jird *Meriones tamariscinus* (Pallas, 1773), although characteristic of desert and semi-desert biotopes, also inhabits tamarisk thickets, reed beds, and the margins of irrigated fields in the lower reaches of the Amu Darya River [2, 11].

The aim of this study was to determine the long-term population dynamics and feeding characteristics of *Nesokia indica* in the Southern Aral Sea region, to identify the endogenous and exogenous factors affecting its population, and to comparatively evaluate the biotopic distribution and reproductive characteristics of *Meriones tamariscinus*.

The study was conducted in tugai forests, reed beds, tamarisk thickets, collector–drainage systems, and irrigated agroecosystems located in the Amu Darya Delta, as well as the Nukus and Muynak districts of the Republic of Karakalpakstan. Long-term monitoring data from 1960–2015 were used to assess the population dynamics of *Nesokia indica*, while field observations collected during 2011–2025 were employed for the comparative ecological analysis [1, 10, 11, 15].

Figure 1. Main observation sites in the Republic of Karakalpakstan.

Rodent density was determined using burrow counting and trapping-line methods and expressed as individuals per hectare (ind./ha) [6]. The diet composition was assessed based on 15 stomach samples collected from settlements and 118 samples obtained from natural biotopes. For *Meriones tamariscinus*, 433 individuals belonging to 18 species were recorded during 1,486 trap-nights. Pairwise correlation and multiple regression methods were used to analyze population dynamics, and the explanatory power of the model was assessed using the coefficient of determination (R^2). Statistical indicators were interpreted as descriptive ecological relationships within the available monitoring series.

Biotopic distribution and feeding. *Nesokia indica* was most frequently recorded in the Amu Darya Delta, reed beds, the margins of irrigated fields, and

along collector–drainage banks with soft soils. These habitats provide suitable conditions for burrow construction, shelter, and feeding. *Meriones tamariscinus* was mainly found in tamarisk thickets, reed beds, and sandy-saline biotopes; its occurrence in anthropogenically transformed areas indicates the species' ecological plasticity [1, 2, 4, 7, 8, 12, 13].

The diet composition of *Nesokia indica* varied significantly depending on its habitat. In settlements, grain products accounted for 78.3% of the diet. In natural biotopes, aboveground green plant parts constituted 35.2% and seeds 34.5%, resulting in a relatively diverse diet composition; insect remains were detected in 2.1% of the samples [1, 4, 7].

Long-term population dynamics of *Nesokia indica*: Monitoring data showed that the abundance of *Nesokia indica* changed in several stages in relation to hydrological conditions (Table 1). During 1970–1980, population density reached 60–80 ind./ha, whereas in 1990–2010 it decreased to approximately 20 ind./ha. In 2011–2015, relative stabilization at a level of 25–30 ind./ha was recorded around collector–drainage systems; after 2015, local occurrences with densities of 3–5 ind./ha were observed in rice and cotton fields [1, 7–11, 15].

Table 1

Long-term population dynamics of *Nesokia indica*

Period	Density, ind./ha	Main biotope/conditions	Trend
1960–1970	10–20; During the flood period: 200–250	Tugai forests, shrublands, delta	High variability
1970–1980	60–80	Delta and the vicinity of irrigated lands	High abundance
1990–2010	≈20	Reduced tugai forests and reed beds	Depression
2011–2015	25–30	Collector–drainage systems	Relative stabilization
After 2015	3–5	Local sites in rice and cotton fields	Low, local

The long-term decline in population size is associated with the desiccation of the Aral Sea, changes in the hydrological regime of the Amu Darya Delta, the

reduction of moist biotopes, and desertification processes. At the same time, the utilization of collector–drainage systems indicates the species' adaptation to irrigated landscapes [1, 3, 8–11, 14, 15].

Factors determining population size: The multiple regression model explained 86.74% of the variance in the population dynamics of *Nesokia indica* (R^2 = 0.8674). The contribution of exogenous factors was 46.47%, while endogenous factors accounted for 40.27%; the hydrological regime of the Amu Darya explained 24% of the total variance. A positive relationship was observed between spring and autumn population indices (r = 0.62), whereas an inverse relationship was found between autumn abundance and winter survival (r = –0.84). Autumn density was associated with temperature (r = 0.42), hydrological conditions (r = 0.36), and the summer–autumn food supply (r = 0.52–0.64) [1, 10, 11, 15].

Predators participate in trophic regulation: The proportion of *Meriones tamariscinus* in the diet of foxes and jackals was 27.84% and 38.3%, respectively, while the share of *Nesokia indica* in the diet of the jungle cat reached up to 39.2%. However, in long-term population fluctuations, the influence of hydrological conditions and food availability was more pronounced than the impact of predation [1, 5, 7, 13].

Comparative ecological characteristics of the *Meriones tamariscinus* population: The highest density of *Meriones tamariscinus* was recorded in tugai forests and tamarisk thickets with well-developed vegetation cover and relatively stable moisture conditions (10–12 ind./ha). In reed beds, the density was 8–9 ind./ha, whereas in dry deserts and stabilized sandy areas it decreased to 0.5–1 ind./ha (Table 2) [2, 11].

Table 2

Density and occurrence frequency of *Meriones tamariscinus* across different biotopes

Biotope	Density, ind./ha	Occurrence frequency, %
Tugai forest	10–12	11–15
Reed bed	8–9	15–17
Tamarisk thicket	10–12	17–19
Dry desert	0,5–1	3–4
Stabilized sandy area	0,5–1	3–4

The breeding period of the species covered March–September, with reproductive activity reaching its highest level in April–June. The average number of embryos per female was 5.5 (range: 2–9), and approximately 75% of pregnant females had 4–7 embryos. In the lower reaches of the Amu Darya, the average number of embryos ranged from 5.4 to 6.4, while the proportion of reproductively active females constituted 35–37%. The high proportion of young individuals (60.8–61.0%) indicates a strong recovery potential of the population [2, 11, 12].

Ecological significance in agricultural landscapes: In irrigated areas, *Nesokia indica* and *Meriones tamariscinus* use collector–drainage systems, field margins, and sites with preserved vegetation cover as natural refuges. The burrowing activity of *Nesokia indica* may cause mechanical damage to canals, embankments, and crop root systems; *Meriones tamariscinus* feeds on cereal crops and the vegetative parts of wild plants. Therefore, monitoring should consider not only population abundance but also water regime, soil moisture, vegetation cover, and anthropogenic pressure [1, 4, 12, 13].

Conclusion: Long-term observations showed that the population dynamics of *Nesokia indica* during 1960–2015 were closely related to hydrological conditions. Population density ranged from 60–200 ind./ha in 1960–1980, decreased to approximately 20 ind./ha during 1990–2010, and after 2011 showed relative stabilization at 25–30 ind./ha. The decline in population size is explained by the desiccation of the Aral Sea and changes in the hydrological regime of the Amu Darya River. According to regression–correlation analysis, the hydrological regime of the Amu Darya accounted for 24% of the variance in population size changes.

The diet composition of *Nesokia indica* depended on habitat conditions; in settlements, grain products accounted for 78.3% of the diet, whereas in natural biotopes, aboveground and underground plant parts predominated. Although predators participate in the natural regulation of the population, abiotic factors played a leading role in long-term population dynamics.

The highest density of *Meriones tamariscinus* was recorded in moist biotopes such as tugai forests, tamarisk thickets, and reed beds. The breeding period of the species extended from March to September, with reproductive activity being highest in April–June; the average number of embryos was 5.5 per female. Overall, the distribution and population dynamics of both species depend on the hydrological regime, biotope moisture, vegetation cover, and anthropogenic impacts. Therefore, they can be used as bioindicators for assessing ecological changes in the Southern Aral Sea region.

References:

1.Utemuratova G.N. Biodiversity of Small Mammals in the Southern Aral Sea Region (Ecology, Population Dynamics, Conservation and Sustainable Use): Abstract of the Doctor of Science (DSc) Dissertation, 03.00.10 — Ecology. Nukus, 2024. 65 p. Available at: https://api.ziyonet.uz/uploads/books/10000014/zuQr2khdohFWV9b.pdf (accessed 24 July 2026).

2.Tlegenov M.T., Bekmuratov B.M. Ecological Features of the Population of Meriones tamariscinus in the Lower Reaches of the Amu Darya River. Universum: Chemistry and Biology, 2022, No. 3(93). DOI: 10.32743/UniChem.2022.93.3.13097. Available at: https://7universum.com/ru/nature/archive/item/13097 (accessed 24 July 2026).

3.Micklin P. The Aral Sea Disaster. Annual Review of Earth and Planetary Sciences, 2007, Vol. 35, pp. 47–72. DOI: 10.1146/annurev.earth.35.031306.140120.

4.AgroAtlas. Nesokia indica: Distribution, Ecology and Economic Significance. Electronic resource. Available at: https://agroatlas.ru/en/content/pests/Nesokia_indica/ (accessed 24 July 2026).

5.Beklemishev V.N. Biocenological Foundations of Comparative Parasitology. Moscow: Nauka, 1970. 502 p. Available at: https://rusneb.ru/catalog/010003_000061_5d1665b2b55f85e43d5b1f27ea3006e9/ (accessed 24 July 2026).

6.Pesenko Yu.A. Principles and Methods of Quantitative Analysis in Faunistic Studies. Moscow: Nauka, 1982. 287 p. Available at: https://rusneb.ru/catalog/002178_000020_BGUNB-BEL%7C%7C%7CBIBL%7C%7C%7C0000532205/ (accessed 24 July 2026).

7.Reimov R. Mammals of the Southern Aral Sea Region. Tashkent: FAN, 1985. 95 p.

8.Reimov R. Materials on the Ecology of Rodents of the Southern Aral Sea Region. Tashkent: FAN, 1999.

9.Mambetullaeva S.M., Tleumuratova B.S. Impact of Environmental Changes in the Southern Aral Sea Region on the Abundance of Muskrat and Great Gerbil Populations. Bulletin of the Karakalpak Branch of the Academy of Sciences of the Republic of Uzbekistan, 2013, No. 2, pp. 22–24.

10.Mambetullaeva S.M., Utemuratova G.N. Population Dynamics of Small Mammal Species in the Southern Aral Sea Region. Proceedings of the International Scientific-Practical Conference “Society, Modern Science and Education: Problems and Prospects.” Tambov, 2012, pp. 105–106.

11.Utemuratova G.N., Tanirbergenov K.J., Bakhtiyorova Z.U. Ecology of Populations of Sympatric Rodent Species under the Conditions of the Aral Sea Region. Proceedings of the International Scientific-Practical Conference. Nukus: Ilim, 2020.
12.Karaseva E.V. The Influence of Virgin Land Plowing on the Lifestyle and Territorial Distribution of Murid Rodents in Northern Kazakhstan. Zoological Journal, 1961, Vol. 40, Issue 5, pp. 768–773.
13.Palvaniyazov M. Ecology and Economic Importance of Small Mammals of the Amu Darya Delta. Tashkent: FAN, 1993.
14.National Report on the State of Environmental Protection and the Use of Natural Resources in the Republic of Uzbekistan. Tashkent, 2006, pp. 31–40.
15.Utemuratova G.N., Abdinasyrova N.A. Rodent Population in the Lower Reaches of the Amu Darya River. Qo‘qon State Pedagogical Institute Scientific Bulletin, 2025, No. 4, pp. 611–621. Available at: https://cspu.uz/storage/files/5NDr2859tIKIHEQ95NZxvtRTmgre4jly0FQyIT9q.pdf (accessed 24 July 2026).