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Parasitological aspects of animal introduction and acclimatization

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Abstract

Background and Aim. The introduction and acclimatization of wild ungulates, such as the Bukhara deer (*Cervus elaphus bactrianus*), are widely practiced to restore populations and biodiversity. However, these processes pose parasitological risks, including the loss and acquisition of native and new parasites, respectively. This study evaluated the parasitological outcomes of relocating Bukhara deer to the Ile-Balkhash State Nature Reserve.

Materials and Methods. In total, 45 fecal samples from Bukhara deer were collected during expeditions in 2024-2025. Samples were preserved and examined using the Fulleborn flotation method with an ammonium nitrate solution (density: 1.3). Microscopic analysis was performed to identify protozoan oocysts and helminth eggs based on morphological features, following standard parasitological references.

Results. In the new habitat, the deer retained host-specific protozoa (*Eimeria* spp.) but lost several species-specific helminths, including *Fasciola hepatica, Echinococcus granulosus*, and 13 nematode species. Conversely, they acquired new parasites from the local environment, such as the cestode *Anoplocephala perfoliata* and the nematode *Cylicocyclus insigne*. These shifts in parasite fauna reflect both a “parasitological filter” effect and the potential for local parasites to adapt to introduced hosts.

Conclusion.The introduction and acclimatization of wild ungulates significantly influence host–parasite dynamics. A comprehensive parasitological evaluation is vital for managing biological risks and ensuring the ecological safety of wildlife translocations.

Keywords: acclimatization; animal; helminth; introduction; parasite; protozoan.

Introduction

Humanity has long relied on nature’s resources. In prehistoric times, human impact on the environment was minimal, but it gradually increased over time. This growing influence reduced populations of wild animals and birds. Additionally, with the emergence of animal husbandry, natural ecosystems began to change, transforming into pastures for domestic animals. As agriculture development, human pressure on nature intensified.

106 mammalian species and subspecies have been extinct on the planet for 2000 years. Currently, about 600 species and subspecies of vertebrates are on the verge of extinction if they are not taken measures to protect them.

One of these animals listed in the Red Book of Kazakhstan (1991) is the tugai (Bukhar) deer – Cervus elaphus bactrianus Lydekker, 1900 [1, 2].

This deer species inhabits riparian thickets across Central Asia, Kashmir, Afghanistan, Tajikistan, and the Amu Darya region. It is mainly endemic to Central Asia. In Kazakhstan, it lived in the lower and middle reaches of the Syrdarya River until the mid-20th century. Historically, it may also have inhabited the Almaty region, particularly the groves along the floodplain and mouth of the Ili River. Owing to river flow regulation and extensive development of floodplain groves, Bukhara deer disappeared from Kazakhstan. In 1981, the species was reintroduced to the Karachingil hunting farm on the left bank of the middle Ili River. In the same year, 19 deer were brought from Tajikistan. Within 5 years, the population grew to 60; by the mid-1990s, it reached 200. A March 2001 census recorded 310 individuals. Currently, the hunting farm and adjacent floodplain groves support around 350 Bukhara deer. Reacclimatization efforts are ongoing in the Altynemel National Natural Garden and the groves at the confluence of the Syrdarya and Arys rivers.

The Ile-Balkhash State Natural Reserve was established by Decree No. 381 of the Government of the Republic of Kazakhstan on June 27, 2018. Covering 415.164.2 ha, the reserve is located in the Balkhash district of the Almaty region. It was created with support from the UNDP Project for the Conservation of Biodiversity and Ecosystems. Expanding and creating new specially protected natural areas is a major achievement for Kazakhstan in biodiversity conservation. These efforts align with the country's commitments to the Sustainable Development Goals on protecting and restoring terrestrial ecosystems and addressing climate change.

Kazakhstan has initiated a project to reintroduce the tiger into the Ili Delta and other rivers flowing into Lake Balkhash. The primary goal of the reserve is the reintroduction of tigers in Kazakhstan. To establish a food base for tigers, Bukhara deer were reintroduction here in 2018 and kulan in 2021.

One factor influencing the breeding and reproduction of Bukhara deer is parasites. Therefore, their presence must be studied. Certain parasites markedly affect the reproduction and survival of wild animals. One such parasite is *Eimeria*, which causes pathological changes in the intestines, disrupting their function and impairing the activity of other organs by poisoning the body as a whole. As the body is constantly exposed to these pathogens, infected animals release them into the environment over a prolonged period, leading to their accumulation. This creates a persistent source that poses a continuous threat to susceptible animals.

The importance of *Eimeria* as a pest is considerable. Some species of this genus inhabit the walls or lumen of the intestines in wild and domestic animals, causing large-scale losses among livestock, birds, and other wildlife. All coccidia are true geoprotists, which are especially common in herbivores and birds, as these animals ingest cysts containing spores from food collected on the ground.

Eimeria reproduce asexually in the intestines of infected animals. This leads to a rapid progression of the infection in most cases, increasing the number of destroyed intestinal cells and worsening the condition of the affected animal. Among infected animals, ≥50% may die. Young offspring are especially vulnerable, which is why eimeriosis is often referred to as a "disease of cubs." For this reason, young Bukhara deer calves may also suffer losses. To date, *Eimeria* species specific to Bukhara deer have not been studied.

Helminths are another factor affecting the growth and health of Bukhara deer. Individual helminths are widespread in nature and harm animals in several ways. First, they cause serious damage to the host's organs, including the brain; second, they hinder proper development and reduce productivity. They can also lead to severe illnesses and death. The destructive impact of helminths results from both mechanical damage and toxic effects.

Helminths occupy a prominent place among infectious diseases affecting grazing livestock. Natural biotopes provide favorable conditions for helminth distribution. Wild ungulates, including Bukhara deer, are released into these areas. Given the high number of domestic animals kept in pasture zones, often taxonomically related to wild ungulates and confined to narrow grazing areas, the infestation level in Bukhara deer increases markedly when they interact with domestic livestock.

In Kazakhstan, helminths of Bukhara deer have not yet been studied. The purpose of this study was to identify the current helminth and *Eimeria* fauna of the Kazakh population of Bukhara deer. Helminths of the Bukhara deer were previously studied only in Tajikistan [3]. In total, 14 helminth species were identified there: 2 trematodes, 3 cestodes, and 9 nematodes. The most prevalent were flukes (*F. hepatica* and *D. lanceatum*, – 33-42%, cestoda larvae (*T. hydatigena* and *E. granulosus* – 25%, adult Cestodes (*M. expansa* – 30% and nematodes (*T. skrjabini* – 40%, *G. pulchrum* – 33%, *M. elongatus* – 16,6%)). The most numerous were worms, with an infestation rate reaching 648 individuals, followed by 42 *Gongylonema*, 57 flukes, and 18 adult cestodes.

In the 21st century, researchers from the Institute of Zoology, led by academician O. Berkinbay and Professor *K.K. Baitursinov* from the Yasavi International Kazakh-Turkish University, studied Bukhara deer parasites. Baitursinov's group focused on the Syrdarya River floodplains and Berkinbay Island within the Ile-Balkhash State Nature Reserve. Their research identified three *Eimeria* species in Bukhara deer in Kazakhstan, namely *Eimeria sholpanae, Eimeria kulashae,* and *Eimeria aruzhanae*, as well as 20 helminth species. These included 2 trematodes, 3 cestodes, and 16 nematodes: F*asciola hepatica, Dicrocoelium lanceatum, Echinococcus granulosus* (larval stage), *Moniezia expansa, Anoplocephala perfoliata, Parabronema skrjabini, Onchocerca skrjabini, Setaria cervi, S. digitata, S. labiato-papillosa, Oesophagostomum columbianum, O. radiatum, O. venulosum, Cooperia* sp. (females only), *Haemonchus contortus, Nematodirus spathiger, Nematodirus* sp. (females only), *Dictyocaulus eckerti, D. filaria, Cylicocyslus insigne* and *Trichocephalus skrjabini* (Table 1) [4, 5].

Materials and Methods

The studied material consisted of 45 fecal samples collected from Bukhara deer during expeditions in 2024 and 2025 within the Ile-Balkhash State Nature Reserve.

Lifetime parasitological studies of sheep were carried out using the *O. Berkinbay* et al., 2024 [6] method. Fecal samples (3 g each) were taken from Bukhara deer. The samples were placed in plastic containers and preserved with a 2.5% potassium bicarbonate solution for later analysis in the Nystitut laboratory. The feces were thoroughly mixed in a porcelain dish with 15–20 mL of ammonium nitrate solution (density: 1.3) and left to stand for 45 min. The upper film was then removed using a wire loop, placed on a microscope slide, treated with drops of distilled water, covered with a cover glass, and examined under a microscope.

The species identity of *Eimeria* was determined based on oocyst morphology, including shape, size, color, shell thickness and structure, and the presence of features such as micropyles, polar caps, residual bodies, and refractive bodies. Characteristics of sporocysts (shape, size, and presence of residual and styd bodies), sporozoites (shape, size, and presence of refractive bodies), and the time required for oocyst sporulation were also assessed.

At the same time, the data of *J.P. Dubey* were also taken into account [7].

Helminth eggs were identified based on shape, size, color, and shell structure and thickness; presence of polar caps, miracidia, or yolk-filled eggs; presence of tubercles, spines, or filaments in trematodes; pear-shaped apparatus with an oncosphere in cestodes; and bipolar plugs, crushing balls, or central larvae in nematodes.

Results and Disscusion

The fecal analysis of Bukhara deer (Cervus elaphus bactrianus) conducted across two regions-Turkestan and the Ile-Balkhash State Nature Reserve – revealed the presence of 25 parasite taxa, including protozoa, trematodes, cestodes, and nematodes (Table 1). A total of 22 species were detected in the Turkestan Region and 9 species in the Ile-Balkhash reserve.

Host-specific coccidia of the genus *Eimeria – E. sholpanae, E. kulashae* and *E. aruzhanae*-were identified in samples from both locations, confirming their persistence in the deer population across habitats.

In the Turkestan Region, a broader spectrum of parasites was recorded, including:

Trematodes: *Fasciola hepatica, Dicrocoelium lanceatum*

Larval cestodes: *Echinococcus granulosus*

Adult cestodes: *Moniezia expansa*

Nematodes: Setaria spp., *Oesophagostomum* spp., *Haemonchus contortus*, *Nematodirus* spp., among others

In contrast, the Ile-Balkhash site showed reduced parasite diversity, where only 9 taxa were found. Notably, *Anoplocephala perfoliata* (cestode) and *Cylicocyclus insigne* (nematode) were identified exclusively at this location, indicating potential new parasite acquisition in the reintroduced population.

The overall data indicate a difference in parasite prevalence and composition between the native and reintroduction areas.

Table 1 – Types of parasites found in Bukhara deer

Sequence number	Parasites	Turkestan region	Ile-Balkhash State Nature Reserve
1	*Eimeria sholpanae Berkinbay, Baytursinov* et *Elyubaeva*, 2012	+	+
2	*Eimeria kulashae Berkinbay, Baytursinov* et *Elyubaeva*, 2012	+	+
3	*Eimeria aruzhanae Berkinbay, Baytursinov* et *Elyubaeva*, 2012	+	+
4	*Fasciola hepatica Linnaeus*, 1758	+	-
5	*Dicrocoelium lanceatum Stiles* et *Hassall*, 1896	+	+
6	*Echinococcus granulosus* (*Batsch*, 1786), larvae	+	-
7	*Moniezia expansa* (*Rudolphi*, 1810) *Blanchard*, 1891	+	+
8	*Anoplocephala perfoliata Goeze*, 1782	-	+
9	*Parabronema skrjabini Rassowska*, 1924	+	-
10	*Onchocerca skrjabini Ruchljadew*, 1961	+	-
11	*Setaria cervi* (*Rudolphi*, 1819)	+	-
12	*S. digitata* (*Linstow*, 1906)	+	-
13	*S. labiato-papillosa* (*Alessandrini*, 1838)	+	-
14	*Oesophagostomum columbianum* (*Curtice*, 1890) *Stossich*,1899	+	-
15	*O. radiatum* (*Rudolphi*, 1803) *Railliet*, 1898	+	-
16	*O.venulosum* (*Rudolphi*, 1809) *Railliet* et *Henry*, 1913	+	-
17	*Cooperia* sp. (only the females)	+	-
18	*Haemonchus contortus* (*Rud*., 1803) *Cobb*., 1898	+	+
19	*Nematodirus spathiger* (*Railliet*, 1896) *Railliet et Henry*, 1909	+	+
20	*Nematodirus* sp. (only the females)	+	-
21	*Dictyocaulus eckerti Skrjabin*, 1931	+	-
22	*Dictyocaulus filaria* (*Rudolphi*,1809), *Railliet et Henry*, 1907	+	-
23	*Trichocephalus skrjabini* (*Baskakov*, 1924)	+	-
24	*Cylicocyslus insigne* (*Boulenger*, 1917)	-	+
Total		22	9

The observed disparity in parasite diversity between the native Turkestan Region and the Ile-Balkhash State Nature Reserve aligns with well-documented ecological effects of translocation on host–parasite dynamics. Upon relocation, host populations often lose parasites for which required intermediate hosts or environmental conditions are absent – a process referred to as "parasite release" [8].

Specifically, the absence of Fasciola hepatica and Echinococcus granulosus in the Ile-Balkhash deer likely stems from the scarcity of necessary intermediate hosts – sails and canids – dsrupting their life cycles, as described in wildlife parasite reviews [9].

Conversely, detection of Anoplocephala perfoliata and Cylicocyclus insigne only in Ile-Balkhash indicates possible "parasite acquisition". Translocated hosts may acquire new parasites endemic to the introduction site, especially when interacting with sympatric species or environmental reservoirs [10, 11, 12].

Host-specific protozoa such as *Eimeria* spp. persisted across both sites, which is consistent with their direct fecal–oral transmission and host fidelity, as described in ruminant infection patterns [13]

Translocation may also alter parasite community structure in unintended ways: captivity or pre-release anthelmintic treatments can eliminate host-specific parasites, potentially increasing susceptibility to endemic parasites post-release due to lack of acquired immunity [14, 15].

From a public health viewpoint, losing zoonotic helminths like *F. hepatica* and *E. granulosus* after relocation may reduce spillover risk to livestock and humans, supporting One Health outcomes. Nonetheless, the risk from newly acquired parasites remains, underscoring the need for continuous monitoring [16, 17].

In summary, the study supports the need to integrate parasitological monitoring into wildlife management and reintroduction protocols. Understanding host–parasite–environment interactions is crucial to ensure the sustainability of conservation efforts under the principles of the One Health approach.

Conclusion

Parasitological aspects of animal introduction and acclimatization are critical factors that markedly influence the success or failure of these biological and ecological efforts. The introduction of animal species into new environments can result in the unintentional transfer of parasites and pathogens, posing risks not only to introduced populations but also to native fauna, potentially disturbing established ecosystems. Parasites may impair health, reduce reproductive success, and lower survival rates in acclimatized animals, thereby compromising conservation and economic objectives. Effectively addressing these challenges requires an integrated, multidisciplinary approach. This includes comprehensive epizootiological monitoring to assess parasite diversity and prevalence, risk assessments to forecast potential outbreaks, and targeted preventive and control measures. Such actions may involve quarantine protocols, veterinary treatment, habitat management, and ongoing postintroduction monitoring.

Sustainable management of biological resources depends on cooperation among parasitologists, ecologists, veterinarians, and wildlife managers. Only coordinated efforts can reduce parasitic risks, conserve biodiversity, and support the long-term viability of animal introduction and acclimatization programs. In summary, understanding and managing parasitological factors is essential for the success of animal introductions and the maintenance of ecosystem health. Future research should focus on developing innovative diagnostic tools, improving integrated pest management strategies, and fostering adaptive management frameworks that respond to emerging parasitological threats under changing environmental conditions.

Authors' Contributions

OB and LZh: Conceptualized and designed the study, conducted a comprehensive literature search, analyzed the gathered data and drafted the manuscript. LZh, BO, NJ and MS: Conducted the final revision and proofreading of the manuscript. All authors have read, reviewed, and approved the final manuscript".

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