

Research Article / Научная статья

УДК 902«637»:636.03(470.55/.58)

[https://doi.org/10.14258/tpai\(2022\)34\(3\).-07](https://doi.org/10.14258/tpai(2022)34(3).-07)

## ETHNOZOOLOGY FOR ARCHAEOLOGY: RESULTS OF THE STUDY OF THE MODERN LIVESTOCK BREEDING SYSTEM IN THE STEPPE ZONE OF THE SOUTHERN URALS

**Alexey Yu. Rassadnikov**

*Institute of History and Archaeology, Ekaterinburg, Russia;  
ralu87@mail.ru, <https://orcid.org/0000-0002-3772-303x>*

**Abstract.** The work is devoted to a detailed study of modern livestock breeding in the south of the Chelyabinsk region. The article describes in detail the system of grazing and keeping livestock in the summer and winter periods in the villages of the Southern Urals. The main purpose of the work is to create an information basis for future archaeological and archaeozoological studies of the sites of pastoralists of the Bronze Age and more correct interpretations in the reconstruction of ancient pastoralism. The main research tools were interviewing shepherds and personal observations of grazing and keeping livestock at different times of the year. The main form of grazing and keeping livestock at present is the pasture-stall system, which is quite variable depending on various factors. The warm period of the year is characterized by grazing in the vicinity of villages and stall keeping in the cold season. The study shows the wide possibilities and resistance of small areas of the steppe river valleys to grazing. The results of the study of modern pastoralism can be used in archaeological research in various studies that are associated with a settled model of pastoralism.

**Key words:** cattle, caprines, sheep, horse, pastoralism, archaeozoology, Bronze Age

**Acknowledgements:** I express my gratitude to E. V. Kupriyanova and the Arkaim Reserve for assistance in studying modern animal husbandry in the area of their work (Stepninsky and Kizilsky districts of the Chelyabinsk region). Special thanks are given to Yuri Zuikov for sending photos of winter and spring grazing in the vicinity of Arkaim, as well as to Polina and Maxim Ankushev for the photos of summer grazing in the Kizilsky and Verkhneuralsky districts of the Chelyabinsk region. I also express my gratitude to the reviewers, whose recommendations made it possible to make the work better.

**For citation:** Rassadnikov A. Yu. Ethnozoology for Archaeology: Results of the Study of the Modern Livestock Breeding System in the Steppe Zone of the Southern Urals. *Teoriya i praktika arheologicheskikh issledovaniy = Theory and Practice of Archaeological Research*. 2022;34(3):112–130. (In English). [https://doi.org/10.14258/tpai\(2022\)34\(3\).-07](https://doi.org/10.14258/tpai(2022)34(3).-07)

## ЭТНОЗООЛОГИЯ ДЛЯ АРХЕОЛОГИИ: РЕЗУЛЬТАТЫ ИССЛЕДОВАНИЯ СОВРЕМЕННОЙ СИСТЕМЫ ЖИВОТНОВОДСТВА В СТЕПНОЙ ЗОНЕ ЮЖНОГО УРАЛА

**Алексей Юрьевич Рассадников**

*Институт истории и археологии, Екатеринбург, Россия;  
ralu87@mail.ru, <https://orcid.org/0000-0002-3772-303x>*

**Резюме.** Работа посвящена изучению современного животноводства на юге Челябинской области. Статья подробно описывает систему выпаса и содержания домашнего скота в летний

и зимний периоды в деревнях Южного Урала. Основной целью работы является создание информационно-основы для будущих археологических и археозоологических исследований памятников скотоводов бронзового века и более корректных интерпретаций при реконструкции древнего скотоводства. Основными инструментами исследования являлись интервьюирование пастухов и личное наблюдение за выпасом и содержанием скота в разное время года. Основной формой выпаса и содержания скота в настоящее время является пастбищно-стойловая система, которая довольно вариативна в зависимости от различных факторов. Теплый период года характеризуется выпасом скота в окрестностях деревень и стойловым содержанием в холодное время года. Исследование показывает широкие возможности и устойчивость небольших участков степных речных долин к выпасу скота. Результаты изучения современного скотоводства могут быть использованы в археологических исследованиях, которые связаны с оседлой моделью скотоводства.

**Ключевые слова:** крупный рогатый скот, мелкий рогатый скот, овцы, лошадь, скотоводство, археозоология, бронзовый век

**Благодарности:** выражаю признательность Е. В. Куприяновой и заповеднику Аркаим за содействие в изучении современного животноводства в районе их работ (Степнинский и Кизильский районы Челябинской области). Отдельная благодарность Юрию Зуйкову за присланные фото зимнего и весеннего выпаса скота в окрестностях Аркаима, а также Полине и Максиму Анкушевым за фото летнего выпаса скота в Кизильском и Верхнеуральском районах Челябинской области. Также выражаю признательность рецензентам, чьи рекомендации позволили сделать работу лучше.

---

**Для цитирования:** Рассадников А. Ю. Этнозоология для археологии: результаты исследования современной системы животноводства в степной зоне Южного Урала // Теория и практика археологических исследований. 2022. Т. 34, №3. С. 112–130. [https://doi.org/10.14258/tpai\(2022\)34\(3\).-07](https://doi.org/10.14258/tpai(2022)34(3).-07)

---

## Introduction

The river valleys of the steppe zone of the Southern Urals (Fig. 1) are quite extensive and valuable datasets on issues that are primarily related to the study of the environment, vegetation, and animal husbandry. It is not a secret that in the steppe zone it is the river valleys that concentrate the areas used for settlements, agriculture and animal husbandry. This is typical both for the early periods of history and for our days. The uniqueness of the river valleys of the southern steppe zone lies in the fact that here, as in the Bronze Age, livestock breeding remains the main type of economy. Paleobotanical studies demonstrate that the environmental conditions of the territory under consideration for most of the Bronze Age and today are approximately the same (Stobbe, 2013, p. 323). This fact suggests that a thorough study of modern processes and aspects can lead to the data that can later be extrapolated to archaeological studies of the Bronze Age. One of the successful manifestations of this approach was the discovery of the phenomenon of osteophagia in livestock and the study of pathologies of the bones of modern cattle in the valley of the Karagaily-Ayat River. This made it possible to study the phenomenon of osteophagia as a type of modification changes in bones and subsequently to regularly identify bones with traces of exposure to ungulates in the Bronze Age settlements (Rassadnikov, 2017). The study of the pathologies of the bones of modern cattle and caprines made it possible to identify relatively reliable osteological markers of the physical exploitation of bulls and typical age-related changes

in sheep and goats. These data can be applied in archaeozoological studies of the Bronze Age and other periods (Rassadnikov, 2021; 2022). The study of modern animal husbandry is a continuation of the implementation of this approach in the archaeology of the Bronze Age. The study of modern animal husbandry practices and the use of the obtained data for reconstructions is not new in archaeology. There are already examples in the Bronze Age archaeology of observing the modern pastoral system at the excavation site and extrapolating these data to archaeological reconstructions (Anthony et al., 2005, p. 403; Anthony et al., 2016). In general, the practice of studying modern pastoral practices or their individual components is quite common (e.g. Lugli, 2021; Ng et al., 2022). The valley of the Karagaily-Ayat River (Fig. 2) of the Kartalinsky district of the Chelyabinsk region (Russia) is the main area where modern cattle breeding has been studied for several years. This microdistrict is a unique testing ground for this kind of research. Here, in close proximity to each other (10 km from each other), there are three fortified settlements of the Sintashta culture and accompanying burial complexes. In addition to the fortified settlements, several unfortified settlements and related kurgan groups of the Late Bronze Age are concentrated there (Krause, Koryakova, 2013; Koryakova, Krause, 2022). The concentration of sites of pastoralists from different periods of the Bronze Age is also typical for other river valleys of the steppe zone of the Southern Urals. The basis of the life support system of the Bronze Age collectives was the breeding of livestock (Kosintsev, 2000; Rassadnikov, 2019; 2020, 2021). The results of paleobotanical studies, a number of indirect indicators and preliminary results of isotope studies with a high degree of probability suggest that cattle breeding in the Bronze Age was sedentary and a radius of about 4–5 km from the village was used for grazing (Rassadnikov, 2019; 2020, 2021; Stobbe et al., 2016). The likely practice of sedentary pastoralism and the rearing of the same types of livestock in the Bronze Age greatly enhances the importance of a thorough study of modern pastoralism in the river valleys of the Southern Urals. In our opinion, the implementation of such an approach in the context of the Karagaily-Ayat river valley is a unique opportunity to obtain accurate data for future archaeological and archaeozoological studies of the Bronze Age in the steppe zone of northern Eurasia. To increase the level of correctness of the study, in addition to the valley of the Karagaily-Ayat River, the data on modern animal husbandry from microdistricts of four other river valleys of the steppe zone of the Southern Urals were involved, which coincide with the location of a number of settlements of the Sintashta culture (Fig. 1). The main purpose of the work is a thorough description of the modern pastoral system in the same area and approximately the same environmental conditions in which numerous settlements of pastoralists of the Bronze Age were located. Another goal of the work is to show, using the example of a specific river valley, how individual sections of the valley are exploited under different conditions and at different seasons. In this case, an important task is to study the possibility of long-term grazing in one area and what consequences this may lead to (for example, the likelihood of overgrazing). The general principle of work is to combine the data of shepherds and personal observations. In our opinion, it is the shepherds who have the most complete and correct knowledge about all aspects of keeping and grazing livestock.

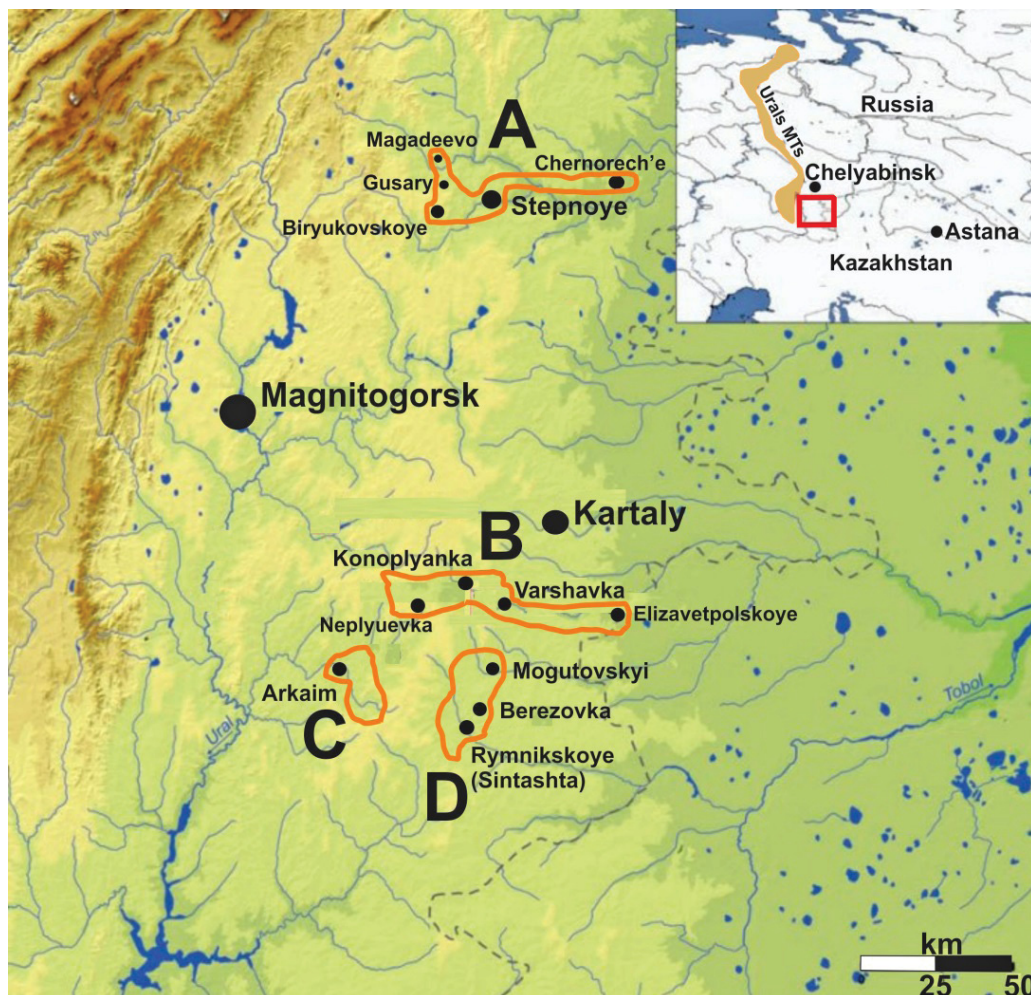


Fig. 1. Map of the steppe zone of the Southern Urals and the location of the microdistricts where the study of the modern livestock breeding system was carried out: A – research area in the valley of the Uy River near the village of Stepnoe (Uisky and Stepninsky districts of the Chelyabinsk region); B – the main research area in the valley of the Karagaily-Ayat River (Kartalinsky district of the Chelyabinsk region); C – research area in the valley of the Karaganka River and Arkaim (Kizilsky district of the Chelyabinsk region); D – research area in the valleys of the Sintashta and Kamysty-Ayat rivers (Bredinsky district of the Chelyabinsk region). Map by Stobbe et al. (2022)

Рис. 1. Карта степной зоны Южного Урала и расположение микрорайонов, где проводилось изучение современной системы скотоводства: А – зона исследований в долине реки Уй в районе села Степное (Уйский и Степнинский районы Челябинской области); В – основная зона исследований в долине реки Карагайлы-Аят (Карталинский район Челябинской области); С – зона исследований в долине реки Караганка и Аркаима (Кизильский район Челябинской области); D – зона исследований в долинах рек Синташта и Камысты-Аят (Брединский район Челябинской области). Карта по (Stobbe et al., 2022)



Fig. 2. Microdistrict B from Figure 1 – main research area in the valley of the Karagaily-Ayat River. Designations: yellow rectangles – designation of farmer’s crops in the river valley; red circles are active livestock enclosures; orange contours – approximate daily itinerary and area of the river valley, which is used by the herd of each enclosure; K1, M1, N1, V1 and others – the names of the herds that were observed. Map by Knoll (2014)

Рис. 2. Зона В из рисунка 1 – долина реки Карагайлы-Аят. Обозначения: желтые прямоугольники – обозначение фермерских посевов в долине реки; красные кружки – действующие загоны для скота; оранжевые контуры – примерный участок долины реки, который используется стадом каждого загона; K1, M1, N1, V1 и другие – названия стад, за которыми велось наблюдение. Карта по (Knoll, 2014)

### Geography and Environment

Observations of summer and winter grazing were carried out in the steppe zone of the Southern Urals, which approximately coincides with the territory of distribution of fortified settlements of the Sintashta culture and the south of the Chelyabinsk region (Fig. 1). The northernmost microdistrict of the study is the valley of the Uy River in the area of the settlement of Stepnoye – from the village of Biryukovskoye (Uysky district) to the village of Chernorechye (Stepninsky district). The main and longest observations were carried out in the valley of the Karagaily-Ayat River from the village of Akmulla to the village of Grazhdanskoye, Kartalinsky District, Chelyabinsk Region (Fig. 2). Part of the observations were carried out in the valley of the rivers Kamysty-Ayat (village of Mogutovsky, Bredinskiy district), Sintashta (village of Rymnikskoye, Bredinskiy district) and Karaganka (village of Arkaim/Aleksandrovskoye, Kizilskiy district).

The territory of the South Urals lies to the East of the Ural Mountains — between 50- and 54-degrees North latitude and between 59- and 62-degrees East longitude. The terrain is slightly hilly and divided by many river valleys (Fig. S3–34, Dataset#1. Further, all references to illustrations and video that begin with S can be found in the two datasets attached to the article. Links to them are located before the bibliography. In the case of Dataset#1, the illustration number always matches the page number). The climate of the South Urals is continental with an average annual temperature of 3.7°C, from –18°C in January to +20.6°C in July, and significant daily and yearly temperature variations. The average annual rainfall in the Bredinsky District is 300 to 400 mm [Stobbe, 2013; Stobbe et al., 2016] and the snow cover is 10 to 20 cm (Fig. S311–328, Dataset#1). The territory under study belongs to the steppe zone with herbaceous feather-grass and fescue steppe or feather-grass steppe (Stobbe, 2013). This area is also called false steppe: pine and birch forests comprise approximately 10% of the territory (Stobbe, 2013) (Fig. S17–18, Dataset#1). The valley of the Karagaily-Ayat River and other river valleys are characterized by rich meadows and also arable and grazing land (Stobbe 2013; Ruhl, Herbig, Stobbe, 2015; Stobbe et al., 2016) (Fig. S132, 146–147, Dataset#1). One of the most important points in the context of this work is that the environment of the Karagaily-Ayat River valley and the composition of its vegetation in the Bronze Age were comparable to those of the current environment, and the degree of afforestation did not exceed the current values (Stobbe, Kalis, 2012; Ruhl, Herbig, Stobbe, 2015).

### **Methodology**

The main method of this work is personal observation of grazing and keeping of livestock in certain areas of the steppe zone of the Southern Urals in summer and winter. In a number of cases, it was possible to trace the almost complete daily cycle of the movement of the herd from leaving the pen to returning to it. This made it possible to find out the approximate distance that the herd overcomes and to reveal the preferences of animals in choosing places for grazing and resting. For the convenience of research, some herds have been given names that include belonging to the village and the serial number of the herd (For example, herd K1 is one of five herds that belong to the village of Konoplyanka). The grazing system of all herds around the villages of Konoplyanka and Varshavka, as well as the pens belonging to these villages, has been studied in the most complete way (Fig. 2). The second method of this work is interviewing shepherds. Mostly adult and elderly male shepherds, who have extensive experience in working with livestock, were chosen for the conversation. Depending on various factors, both a special questionnaire and a casual conversation were used to obtain certain information. The main emphasis during the conversations was on finding out the possibilities of long-term grazing in a limited area of the river valley and finding out the abilities of each type of livestock for winter grazing. The paper does not use a method for calculating biomass volumes, since in the context of this work it is important to show not the model capabilities of a separate steppe area (Stobbe et al., 2016), but the actual practice of exploiting sections of steppe river valleys at different times of the year and under different conditions, during prolonged drought).

### **Results**

#### ***Summer grazing and livestock management***

Nowadays, the inhabitants of the villages of the steppe zone of the Southern Urals practice one basic model of keeping and grazing livestock. In the warm season, this form of live-

stock breeding is represented by grazing individual herds in the immediate vicinity of villages or summer pens in the vicinity of villages (Fig. 2–3). In winter, stall keeping of livestock is practiced (Fig. 4) with periodic grazing of certain species of ungulates (Fig. 5). The warm period usually lasts from mid-April to early November. But in each case, the dates may be shifted depending on weather conditions or stocks of hay. If little hay is harvested, then cattle can be released to graze in conditions of incomplete snowmelt or generally practice winter grazing in the case of private herds of several cows (Fig. S329–336, Dataset#1). Summer grazing around the villages is represented by three varieties. The first and main variety is represented by private herds of individual villagers or combined herds, which consist of animals of individual villagers (Fig. S35–131, Dataset#1). For summer grazing, a paddock is created either in the village itself or on its outskirts. Every day a herd with a shepherd grazes 2–3 km around the village and near the river. In the evening, the herd returns either to a common pen (e.g., video S14, Dataset#1), or residents take their cows, sheep or horses to their yards (e.g., herd K2 — Fig. 2 and Fig. S227–229, Dataset#1). In several villages there are large livestock farms and breeding plants. If in winter the entire livestock (several thousand heads) is kept in large hangars, then starting from spring, the entire livestock is divided into several herds of 300–500 animals and, with the help of summer pens, is evenly distributed along the river valley. As a rule, part of the river valley is assigned only to the summer paddocks of such farms (Fig. 2 — herds V2–V9; Fig. S132–163; video S19, Dataset#1). Herds of farmers and villagers use other parts of the valley to graze (herds K1, K2, K5 and V1, Fig. 2). The winter hangars themselves continue to function as a summer paddock and a small part of the herd remains there, which grazes around the farm during the day, and returns to the paddock at the hangar in the evening (Fig. S139–143, Dataset#1). The system of summer paddocks is that each herd has its own shepherd who chooses a site for grazing every day and makes sure that the herd does not damage the crops. As a rule, shepherds try to change grazing areas daily to allow vegetation to regenerate and provide livestock with better nutrition. The farthest paddocks are located no further than 10 km from the farm. Pens can be located both on hills and at the edge of the forest. In both cases, the distance to the river is 1–3 km. The location on the tops of the hills is caused by the need for easy viewing of the area by the shepherds and the prevention of stagnant water during heavy rains. The location of the paddocks at the edge of the forest is primarily due to protection from the winds. Pens can be located both a few kilometers from each other, and in close proximity to each other. In the latter case, the shepherd of the herd of one paddock tries not to use the area that is assigned to the herd of the neighboring paddock. Most cattle pens are 15–20 meters long and wide and can hold up to 500 head. Sheep and goat pens are about 10 meters (sometimes a little more) and can accommodate a herd of up to 400–500 heads. Corrals for cattle and horses do not differ in area and are often used in turn for either cattle or horses. A more detailed description of the summer paddock system can be found in Dataset#2 (Fig. S57–1333). The third variation of this model is the grazing of small herds of cattle (from 2–3 animals to 10–20 heads) directly in the village or on its outskirts without a shepherd (Fig. S164–198, Dataset#1). In very rare cases, such small flocks may have shepherds. Direct grazing of livestock can be carried out in two forms. The first and main form of grazing is the grazing of individual herds of livestock, which consist of one species of ungulates (Fig. S45–49; 56–63, 73–76, 111–131, Dataset#1). Less common, but equally basic, is

mixed grazing (Fig. 3). With this model, cattle, horses and sheep with goats graze in the same herd (Fig. S35–44; 51–54, 77–100, Dataset#1). When choosing a grazing site for livestock, two main strategies are observed. A number of shepherds try every day to direct the herd to a different area for grazing. This is done to enable a more complete restoration of vegetation in small areas of river valleys. If the village has several herds, then the shepherds try to divide the areas for grazing. However, with such a system, there are situations when 2–3 herds graze in the same area for some time (Fig. S272–274, 338, Dataset#1). Another part of the shepherds grazes their flock every day in the same place with minor variations. This strategy may not change even in severe drought conditions. In the case of the Karagaily-Ayat river valley, in the context of observing how parts of the valley are exploited, an extremely important point is the fact that almost the entire right bank is occupied by farmers' crops (Fig. 2). Throughout the river, which is used for grazing, there are crops on the opposite bank with minor gaps. With the help of these corridors between the fields, livestock can get to the watering place from pastures far from the river. Land for crops is used for grazing only after the farms have harvested. As a rule, this happens in the first half of September. From the end of September to the beginning of November (the appearance of snow), shepherds willingly use the fields for grazing, which makes it possible for the main summer pastures to rest. Hay for winter stall keeping is harvested either in hayfields near villages that are not specifically used for grazing, or in areas that are located along the far perimeter of pastures (3–5 km from the village, in rare cases further). In the case of the village of Konoplyanka, such a hayfield is a steppe area far from the river and which is located between forests. Hay harvesting starts around mid-July.

The sex and age structure of each herd, as a rule, has its own characteristics. If we talk about private small herds of cattle, which number from a few to 10–15 animals and which often graze near the village or directly in it without a shepherd (in rare cases with a shepherd), then they can consist of adult cows, young bulls and calves. Every evening these animals return to the yard, and the owners milk the cows (for example, Fig. 178–186, Dataset#1). Young bulls are bred for subsequent slaughter or sale. If the owners keep sheep and goats according to the same system, then in the evening some owners can also milk the goats. If we consider mixed private herds, which are sorted out every evening by the owners in the yards (the best example is the k2 herd), then they are also extremely heterogeneous in their sex and age structure. The herd contains adults and old animals, young animals and often just born animals. When the villagers sort out their animals (Fig. 227–229, Dataset#1), then the cows, as a rule, are milked. If we consider private herds (the owner is either one farmer or an enterprise: herds k1, v1–v9, e2), which consist of one species of ungulates, then the main purpose of such herds is reproduction for the uninterrupted sale of livestock for meat and conservation of breeding stock. Cows of such herds are not milked but are used only for feeding calves. The sex and age composition of such herds is highly heterogeneous. The herd consists of adult cows kept for reproduction, calves, young animals (1.5–2.5 years) and a small proportion of old animals (mainly bulls for reproduction). In rare cases, a herd may consist entirely of cows and their calves. But in most cases, the age and sex composition of the herd is quite heterogeneous. Horses are usually bred for sale and meat (k5 and v5 herds). For this reason, adult and old females and males, as well as young animals with newly born animals, are simultaneously in the herd. Locals do not practice milking horses.





Fig. 3. An example of a mixed grazing pattern where horses, cattle and caprines are grazing together. The photo was taken in the floodplain of the Uy River in the vicinity of the village of Stepnoe in July (Stepninsky district of the Chelyabinsk region)

Рис. 3. Пример смешанной модели выпаса, при которой лошади, крупный и мелкий рогатый скот выпасаются вместе. Фото сделано в пойме реки Уй в окрестностях села Степное в июле (Степнинский район Челябинской области)

### ***Summer daytime grazing cycle on the example of individual herds***

**Herd K1.** A sheep flock with a small share of goats numbering about 500 heads is kept in a hangar in winter, and in a traditional summer paddock on the outskirts of the village of Konoplyanka during the warm season (Fig. S331–349; 354–438, Dataset#2). Every day in the morning the herd moves away from the river for a distance of 2–3 km and in the afternoon returns to the river to drink and rest (Fig. 2; Fig. S199–218; video S1–4, Dataset#1). The time and duration of the rest by the river depends on the weather. It is not uncommon for a herd to rest in a paddock in the middle of the day. As a rule, the herd follows approximately the same route every day, using areas that are not used for grazing by other herds. By 8–9 p.m. the herd usually returns to the paddock.

**Herd K2.** Mixed private herd of cattle and caprines with a total number of about 100 heads. Every morning the villagers give their cows, bulls and sheep to the shepherd, who uses the same section of the river valley for grazing with slight variations. The herd goes to the far

point of the route along the river and usually also returns along the river to the village, where the inhabitants sort their cattle (Fig. 2; Fig. S219–231; video S5–6, Dataset#1). The greatest distance from the corral is 3.5 km. Several times a day, the herd stops by the river for rest and watering. This section of the valley, as in the case of herd K1, is used only by this herd.

**Herd K3.** Private herd of sheep and cows, totaling about 20 animals (Fig. 2; Fig. S232–243; video S9–10, Dataset#1). The herd daily grazes in the immediate vicinity of the village of Konoplyanka and does not intersect with the rest of the herds. For grazing, areas are used no further than 1 km and areas near the edge of the forest or clearing between forests (Fig. S233–236, Dataset#1).

**Herd K4.** A private flock of sheep with about 30–40 animals. The daily grazing cycle approximately coincides with the K3 herd. The difference lies in the fact that the shepherd of this herd uses forest glades less and moves a little further from the village, using open spaces (Fig. 2; Fig. S244–246; video S11, Dataset#1).

**Herd K5.** A private herd of about 100 horses is kept year-round in a paddock at the edge of the forest (Fig. S454–479, Dataset#2). The daily grazing area overlaps with the areas used by K1 and V1 herds. A herd of horses is released every day for watering and for grazing uses both the floodplain of the Karagaily-Ayat River and the areas of the steppe between forests remote from the river (Fig. 2; Fig. S247–263; video S12–13, Dataset#1).

**Herd V1.** Combined herd of cattle numbering about 100 heads. The herd consists of private cattle from individual households in the village of Varshavka. For the summer period, the villagers rent their cattle to a common herd, which has a corral located 1.5 km from the western outskirts of the village (Fig. S480–496, Dataset#2). Before the start of the stall keeping, the owners take their animals and keep them in their yard. All daylight hours the herd grazes in the immediate vicinity of the corral. Sometimes the opposite bank of the river and parts of the steppe remote from it can be used. Often the shepherd tries to use areas along the forest (Fig. 2; Fig. S264–274, Dataset#1).

At certain times of the day, herds K1, K5 and V1 intersect and use the same part of the river valley for grazing or resting. The same situation regularly occurs in other parts of the river valley (Fig. S272–274, Dataset#1).

#### ***Winter grazing and livestock keeping***

The main form of winter keeping of livestock is the stall model. It starts from the beginning of November or the beginning of December. During this period, the probability of wet snow is high. Herd owners are trying to protect their livestock from conditions where animal hair can get wet from sleet or snow at near zero temperatures, which will lead to hypothermia of livestock (as a rule, this applies more to sheep and goats). For this reason, sheep and goats are driven into the winter stall before such weather conditions. In conditions of little snow cover and not frosty weather, cattle and sheep can continue grazing until mid-December, and in some cases all winter (Fig. S329–332, Dataset#1). Cattle of large livestock complexes and individual households are kept in stalls with a small yard, on which you can move around and in which hay is poured (Fig. 4; Fig. S275–298; video S7–8, Dataset#1). If we consider each type of livestock separately, then horses can spend the whole winter on pastures near the village. They don't need a shepherd or a pen to spend the night (Fig. 5; Fig. S302–310; video S15–18, Dataset#1). The only support from a person may be to periodically feed the young during frosty periods or in the spring, when an

ice crust can form. Even though cattle and caprines can be grazed as well as horses, according to herders, they still need light shelter at night. Often the walls of such pens are insulated with the skins of cattle, and the floor with hay (Fig. S291–294; 300–301, Dataset#1). The main limiting factor for winter grazing of cattle is the availability of water. As long as the animals have the opportunity to drink water from the river, they will be able to graze without problems in the cold season. Cattle are most dependent on the availability of water, and eating snow can hardly meet all their water needs. It should also be noted that, according to the shepherds, there is no problem with cattle and sheep grazing in winter as well as horses, but the long-term practice of winter stall keeping of livestock weaned animals from such wintering conditions. The main message of the shepherds is that, if necessary, sheep and cattle can feed on their own, but they will need additional feeding. Winter housing is stopped either when the first patches of snow appear in late March or early April, or when the first grass begins to appear in late April (Fig. S332–336, Dataset#1). The decision to start grazing is made independently by each individual herd owner and often directly depends on hay stocks. On average, one cow may require 3 tons of hay or 15 tons of hay for 8–10 cows (depending on how the cattle are fed).



Fig. 4. An example of winter stall keeping of cattle and caprines.  
The photo was taken after a snowstorm in 2021 in early March in the village of Neplyuevka  
(Kartalinsky district of the Chelyabinsk region)

Рис. 4. Пример зимнего стойлового содержания крупного и мелкого рогатого скота.  
Фото сделано после снежного бурана 2021 г. в начале марта в деревне Неплюевка  
(Карталинский район Челябинской области)



Fig. 5. An example of winter grazing of horses.

The photo was taken after a snowstorm in 2021 in early March in the vicinity of the village of Neplyuevka (Kartalinsky district of the Chelyabinsk region)

Рис. 5. Пример зимнего выпаса лошадей (тебеневка).

Фото сделано после снежного бурана 2021 г.в начале марта в окрестностях деревни Неплюевка (Карталинский район Челябинской области)

### ***Osteophagia of cattle and caprines***

During the study of summer livestock pens and thanks to interviews with shepherds, it was possible to identify the phenomenon of osteophagia and lithophagy among cattle and caprines. The phenomenon of osteophagia is the eating by cattle and sheep of inedible objects, in particular bones. According to the shepherds and based on the finds of objects in the pens, cattle gnaw on wooden objects, plastic and metal objects (Fig. S2638–2682, Dataset#2). During the study of modern pens, an extensive collection of bones and objects with traces of gnawing and from the stomach of cattle and caprines was obtained (Fig. S1334–2637, Dataset#2). This collection of modified bones is critical to knowing the diagnostic criteria by which to detect whether bone has been affected by ungulates or size class of livestock, and to distinguish between these types of modifications from herding dog bone effects. Data on bone modification changes in cattle, sheep, goats and dogs are available in Dataset#2 (Fig. S1334–2637; S2731–2990). In addition to eating inedible objects in the valley of the Karagaily-Ayat River, a phenomenon of lithophagy related to osteophagia was recorded. A private herd of cows and bulls

quite actively licked the open ground (Fig. S63–66, Dataset#1). In order to reduce the deficiency of minerals, some paddocks can be seen containers with salt (Fig. S369, Dataset#1). The eating of bones, garbage, the wooden fence of the pens, and the licking of the earth is caused by the inability of the herbivorous diet of ungulates to meet all the body's needs for minerals (Cáceres et al., 2013, p. 3115). This is a typical and congenital feature of all ungulates, which is not a disorder, but a marker of mineral deficiency.

Horses are not seen eating bones and other items like cattle and sheep. But at the same time, the phenomenon of active gnawing of the wooden fence of the pens was recorded (cribbing). Fence chewing is inherently different from osteophagia. If, in the case of eating bones, we are talking about an attempt to compensate for the deficiency of minerals, then in the case of gnawing the fence, we are talking about a behavioral trait of horses (Houpt, 2012). In some cases, horses almost completely gnaw through the fence (Fig. S2683–2707; video S1–5, Dataset#2).

### ***Major livestock diseases***

In addition to various infectious diseases, each type of livestock has both inherent diseases and problems, as well as pathologies that are common among all three types of livestock. Common to all three types of livestock is a relatively high prevalence of manifestations of osteochondrosis, which is expressed in depressions and defects in the articular surface of the bones. Dental pathologies are common, but already only in cattle and caprines. They are caused by eating bones and other inedible objects, which leads to premature wear of the teeth, their ante-mortem loss and inflammatory processes (Rassadnikov, 2021; 2022). Cattle are characterized by lameness and thelaziosis (eye damage by nematode parasites). Thelaziosis leads to partial or complete loss of vision. Lameness is also a serious problem in horses. The main causes of lameness are accidental bruises, trauma, twisting of the legs, icing of paddocks in early spring, intraspecific collisions. Cows are also characterized by degenerative lesions of the hip joint, which lead to a sharp decrease in mobility and subsequent weight loss (Rassadnikov, 2021). The main problem in sheep and goats is foot rot (inflammation of the soft tissues of the lower legs. It is this problem that is one of the main factors in the periodic cleaning of cow pens from manure and the frequent change of sheep pens. On the old sheep pens, several old pens can be seen (Fig. S239–249, dataset #2). One of the important points in the context of the characteristics of animal husbandry and livestock health is the frequent death of adult animals and especially young animals. When examining modern pens, a fairly large number of dead calves, foals, and often adult animals were found (Fig. S582, 602–603, 765, 777, 782, 983, 1091, Dataset#2). The main causes of death of calves are infectious and pulmonary diseases. In rare cases, calves can die due to a crush in the enclosure.

### ***Other aspects of modern livestock breeding***

According to the shepherds, in addition to the end of the stall period, the most difficult time for livestock is the hot months of summer, and the most favorable are the end of April and May, the beginning of autumn, as well as not hot periods of summer. The entire daily cycle of some herds consists in the fact that the herd walks all day in conditional zigzags from the riverbank to the forests. On hot days, the herd can spend the whole day in the floodplain (Fig. S144–147, 150–151, Dataset#1). Also, during such periods, the herd walks all day a few kilometers from the water, and the direction can be set by the cattle themselves. On a not hot day, one cow may need about 30 liters of water. On hot days, a cow can stay by the river all

day and drink regularly. No type of livestock chews wormwood. As a rule, horses and cattle pull long grass, and sheep and goats pull short grass and various branches. This allows you to seamlessly graze all types of livestock in one herd. One of the most important remarks or observations of shepherds is that a small area of the river valley (for example, the area that is used by herds K1, K5, V1, V2, Fig. 2) can easily and for many years withstand the grazing of three herds of 150–200 heads. This number of herds is the most optimal in terms of the load on the vegetation in the grazing area.

### Discussion

The study demonstrates that the modern system of livestock breeding, and grazing is fairly common for almost all villages in the steppe zone of the Southern Urals. This system consists of keeping livestock in winter stalls and grazing around villages during the warm season. In rare cases, grazing in winter is allowed. This livestock way of life is quite stable and has been recorded since the 19<sup>th</sup> century for the territory under consideration (Khalikov, 2016). From the point of view of archaeological terminology, this system is a vivid reflection of the sedentary model of pastoralism. Both separate grazing and a mixed model are practiced, in which all types of livestock (cattle, sheep and horses) graze simultaneously in one herd. Grazing different species of ungulates in one herd does not lead to any problems in the form of eating certain grass by one species of ungulates, which is eaten by another species of ungulates. One of the main objectives of the work was to find out the possibilities of small areas (about 2–3 km from the paddock and 1–2 km from the river) of the river valley for grazing and to determine how such a small area for grazing satisfies the needs of livestock. In fact, far from the entire area of the immediate vicinity of a village or paddock in a river valley is available for grazing. In the case of the valley of the Karagaily-Ayat River, the main load in terms of grazing lies on the left bank from the village of Konoplyanka to the village of Varshavka and a little to the east (Fig. 2 — herds k2, k1, k5, v1, v2, v3, v4, v6, v7, v8, v9, e2). Almost the entire right bank is occupied by crops (Fig. 2). There are small gaps and patches between fields, but the crops are located in the most productive areas for grazing. Observations have shown that even under conditions of such intensive grazing, individual herds do not use the entire area available for grazing when the opposite bank of the river is occupied by crops. In fact, each large herd of one village uses, at best, a third of the radius of 2–3 km of one river bank. Even though figure 2 shows the almost complete absence of vacant lots, the reality is somewhat different. Border zones or areas between zones for grazing neighboring herds remain relatively free from grazing use. Areas next to forests and forest clearings or areas of the steppe between pine forests are extremely poorly used. One of the interesting and important discoveries was that even a long and severe drought has practically no effect on the choice of a grazing site. Even in the absence of green grass (Fig. S340–357, Dataset#1) herds continue to graze in almost the same places as under normal conditions. The only difference is that, for example, shepherds of large sheep and cattle herds try to use for grazing glades at the edge of the forest or clearings between pines, which are never used under normal conditions. Severe and prolonged drought directly affects the winter period of stall keeping. It is during this period that hay is used, which, during a drought, can be harvested significantly less. Another interesting and important observation is that even under conditions of extremely intensive grazing of large and heavy Hereford cattle for many years, overgrazing and complete degradation

of vegetation have not been recorded in the same place. According to the shepherds, the river valley of the Karagaily-Ayat River near the village of Varshavka is “tired” and requires a short rest. In this regard, the most interesting sections of the river valley, which for many years have been used for grazing large herds of Herefords (400–500 heads). Even there, there is no complete degradation of vegetation (Fig. S353–357, Dataset#1). But it should be borne in mind that in winter these areas are not used, as the Herefords switch to a stall mode of keeping. The most objective in terms of overgrazing are the parts of the valley that are used for grazing horses (Fig. 2, herds v5, v9, k5). It is in the case of horses that we have the opportunity to observe year-round grazing in one section of the river valley. In the warm season, these areas are periodically used by herds of sheep and cattle. The approximate total number of livestock grazing in the valley of the Karagaily-Ayat River from the village of Neplyuevka to the village of Elizavetpolskoe is about 4.5 thousand heads of all types of cattle (excluding 1.5–2 thousand cows and bulls, which are kept year-round in the stall of the Varshavskoe breeding farm). If we assume that in the case of the valley of the Karagaily-Ayat River, both banks will be available for grazing, and not one as it is now due to crops and there will not be too large herds of cattle (400–500 heads), then the statement about the problem-free ability of a small area river valley to year-round grazing of several herds of 150–200 heads can be done without any reservations. If both banks of the river are available for grazing, the problem of incomplete restoration of vegetation in areas with intensive grazing is completely removed. Another option for reconstruction may be the option of increasing the number of livestock by 1.5–2 times without the danger of pasture degradation while maintaining the pasture-stall grazing model.

### Conclusion

The study of modern animal husbandry in the steppe zone of the Southern Urals demonstrates that the practiced pasture-stall system is the most optimal system for the territory under consideration. This model of livestock keeping and grazing is quite variable in its implementation in practice and can quickly change depending on various factors. Small areas of river valleys (no further than 3 km from the village along one bank of the river) in the steppe zone of the Southern Urals are extremely resistant to intensive grazing and are able to withstand the load of predominantly grazing in the summer for decades without the danger of overgrazing. In rare cases, small areas of river valleys are used for year-round grazing and this does not lead to pasture degradation.

### Supplementary data:

[Dataset#1] — <http://doi.org/10.17632/5g2jh76mr5.1> — main data of this article: images of summer and winter grazing and keeping of livestock in the Southern Urals;

[Dataset#2] <http://doi.org/10.17632/4g5z2sn2ng.1> — description of the modern system of summer pens in the Southern Urals and bone surface modifications (livestock osteophagia and dog chewing).

### REFERENCES

Kosintsev P. A. Bone Remains of Animals from the Fortified Settlement of Arkaim. In: Archaeological Source and Modeling of Ancient Technologies. Proceedings of the Museum-Reserve Arkaim. Chelyabinsk : Institut istorii i arheologii UrO RAN, 2000. Pp. 17–44. (*In Russ.*)

Lugli F. The Use of Space in the Winter Camps of Steppe Pastoralists — an Ethnoarchaeological Point of View. *Vestnik Tomskogo gosudarstvennogo universiteta. Istoriya = Bulletin of Tomsk State University. History*. 2021;69:92–96. DOI: 10.17223/19988613/69/13. (In Russ.)

Rassadnikov A. Yu. Osteophagia of Domestic Ungulates in the Bronze Age Settlements of the Southern Trans-Urals (based on archaeozoological and ethnozoological materials). *Vestnik arkheologii, antropologii i etnografii = Bulletin of Archaeology, Anthropology and Ethnography*. 2017;2(37):163–168. DOI: 10.20874/2071-0437-2017-37-2-163-168. (In Russ.)

Rassadnikov A. Yu. Archaeozoological Studies at Konoplyanka, the Southern Trans-Urals. *Arheologiya, etnografiya i antropologiya Evrazii = Archaeology, Ethnography, and Anthropology of Eurasia*. 2019;47(2):33–39. <https://doi.org/10.17746/1563-0110.2019.47.2.033-039>. (In Russ.)

Rassadnikov A. Yu. The Sedentary Pastoralism at the Turn of the 3<sup>rd</sup>–2<sup>nd</sup> Millennium BC in the Southern Trans-Urals Based on Archaeozoological Materials of the Kamennyi Ambar Settlement. *Izvestiya Laboratorii drevnih tehnologij = Reports of the Laboratory of Ancient Technologies*. 2020;16(3):46–64. <https://doi.org/10.21285/2415-8739-2020-3-46-64>. (In Russ.)

Rassadnikov A. Yu. Results of Archaeo- and Ethnozoological Research on the Settlement of the Late Bronze Age Chernorechë-2. *Teoriya i praktika arheologicheskikh issledovanij = Theory and Practice of Archaeological Research*. 2021;33(1):85–105. DOI: 10.14258/tpai(2021)33(1).-06. (In Russ.)

Khalikov N. A. The Traditional Economy of the Tatar-Cossacks of the Southern Urals (second half of the 19<sup>th</sup> — early 20<sup>th</sup> centuries). *Srednevekovye tyurko-tatarskie gosudarstva = Medieval Turko-Tatar states*. 2016;8:264–271. (In Russ.)

Anthony D. W., Brown D., Brown E., Goodman A., Kokhlov A., Kosintsev P., Kuznetsov P., Mochalov O., Murphy E., Peterson D., Pike-Tay A., Popova L., Rosen A., Russell N., Weisskopf A. The Samara Valley Project. *Eurasia Antiqua. Zeitschrift für Archäologie Eurasiens*. 2005;11:395–417.

Anthony D. W., Brown D., Kuznetsov P., Mochalov O. Bronze Age Herding Camps: Survey and Excavations in Peschanyi Dol. In: *A Bronze Age Landscape in the Russian Steppes: The Samara Valley Project*. Monumenta Archaeologica. Los Angeles : Cotsen Institute of Archaeology Press, 2016. No. 37. Pp. 421–441.

Cáceres I., Esteban-Nadal M., Bennàsar M., Dolores Marín Monfort M., Dolores Pesquero M., Fernández-Jalvo Y. Osteophagia and Dental Wear in Herbivores: Actualistic Data and Archaeological Evidence. *Journal of Archaeological Science*. 2013;40:3105–3116. <http://dx.doi.org/10.1016/j.jas.2013.04.006>

Houpt K. A. Motivation for Cribbing by Horses. *Animal Welfare*. 2012;21:1–7.

Knoll D. Siedlungs- und landschaftsarchäologische Untersuchungen zu den befestigten Siedlungen der Bronzezeit im Trans-Ural. In: *Zwischen Tradition und Innovation: Studien zur Bronzezeit im Trans-Ural (Russische Föderation)*. Bonn : Verlag Dr. Rudolf Habelt GmbH, 2014. Pp. 139–198.

Koryakova L. N., Krause R. The Bronze Age in the Karagaily-Ayat Region (Trans-Urals, Russia) Culture, Environment and Economy. *Frankfurt Archaeological Studies 43*. Bonn : Verlag Dr. Rudolf Habelt GmbH, 2022. 560 p.

Krause R., Koryakova L. N. Multidisciplinary Investigations of the Bronze Age Settlements in the Southern Trans-Urals (Russia). Bonn : Verlag Dr. Rudolf Habelt GmbH, 2013. 352 p.



Ng C., Wei W., Yu C., Zheng J. Herding pattern among Bronze Age steppe communities: An ethnographic approach to mapping pasture in the Southeastern Ural Mountains, Russia. *Front. Ecol. Evol.* 2022. 10:984725. doi: 10.3389/fevo.2022.984725

Rassadnikov A. Bone Pathologies of Modern Non-draft Cattle (*Bos Taurus*) in the Context of Grazing Systems and Environmental Influences in the South Urals, Russia. *International Journal of Paleopathology.* 2021;32:87–102. <https://doi.org/10.1016/j.ijpp.2020.11.003>.

Rassadnikov A. Bone Pathologies of Modern Caprines (*Ovis aries* & *Capra hircus*) in the Context of the Pasture-stall System of the Steppe Zone of the South Urals. *International Journal of Paleopathology.* 2022;38:18–31. <https://doi.org/10.1016/j.ijpp.2022.05.003>

Ruhl L., Herbig C., Stobbe A. Archaeobotanical Analysis of Plant Use at Kamennyi Ambar a Bronze Age Fortified Settlement of the Sintashta Culture in the Southern Trans-Urals Steppe, Russia. *Vegetation History and Archaeobotany.* 2015;24(3):413–426. DOI:10/1007/S00334-014-0506-7.

Stobbe A. Long-term Perspective on Holocene Environmental Changes in the Steppe of the Trans-Urals (Russia): Implications for Understanding the Human Activities in the Bronze Age Indicated by Palaeoecological Studies. In: *Multidisciplinary Investigations of the Bronze Age Settlements in the Southern Trans-Urals (Russia)*. Bonn : Verlag Dr. Rudolf Habelt GmbH, 2013. Pp. 305–326.

Stobbe A., Gumnior M., Ruhl L., Schneider H. Bronze Age Human-Landscape Interactions in the Southern Transural Steppe, Russia — Evidence from High-Resolution Palaeobotanical Studies. *The Holocene.* 2016;26(10):1692–1710. DOI: 10.1177/0959683616641740.

Stobbe A., Kalis A. J. Archaeobotanical Investigations in the Trans-Urals (Siberia): The Vegetation History. In: *Landscape Archaeology: Proceedings of the International Conference Held in Berlin, 6<sup>th</sup>–8<sup>th</sup> June 2012*. Berlin : Exzellenzcluster 264 Topoi, 2012. Pp. 297–303.

Stobbe A., Schneider H., Voigt R., Rühl L., Gumnior M. Reconstruction of the Holocene Vegetation and Landscape Development of the Karagaily-Ayat and Ural Valleys in the Southern Trans-Urals (Russia) Based on the Analysis of Pollen, Sediments, Plant Macro-Remains and Diatoms. In: *The Bronze Age in the Karagaily-Ayat Region (Trans-Urals, Russia) Culture, Environment and Economy*. Frankfurt Archaeological Studies 43. Bonn : Verlag Dr. Rudolf Habelt GmbH, 2021. Pp. 269–298.

## СПИСОК ИСТОЧНИКОВ

Косинцев П. А. Костные остатки животных из укрепленного поселения Аркаим // *Археологический источник и моделирование древних технологий*. Труды музея-заповедника Аркаим. Челябинск : Институт истории и археологии УрО РАН, 2000. С. 17–44.

Луйли Ф. Использование пространства на зимних стойбищах степных скотоводов — этноархеологическая точка зрения // *Вестник Томского государственного университета*. История. 2021. №69. С. 92–96. DOI: 10.17223/19988613/69/13.

Рассадников А. Ю. Остеофагия домашних копытных на поселениях бронзового века Южного Зауралья (по археозоологическим и этнозоологическим материалам) // *Вестник археологии, антропологии и этнографии*. 2017. №2 (37). С. 163–168. DOI: 10.20874/2071-0437-2017-37-2-163-168.

Рассадников А. Ю. Результаты археозоологических исследований на поселении бронзового века Коноплянка в Южном Зауралье // *Археология, этнография и антропология Евразии*. 2019. №47 (2). С. 33–39. <https://doi.org/10.17746/1563-0110.2019.47.2.033-039>.

Рассадников А. Ю. Оседлое скотоводство на рубеже III–II тыс. до н. э. в Южном Зауралье по археозоологическим материалам поселения Каменный Амбар // *Известия лаборатории древних технологий*. 2020. №16 (3). С. 46–64. DOI: <https://doi.org/10.21285/2415-8739-2020-3-46-64>.

Рассадников А. Ю. Результаты архео- и этнозоологических исследований на поселении позднего бронзового века Черноречье-2 // *Теория и практика археологических исследований*. 2021. №33 (1). С. 85–105. DOI: [10.14258/tpai\(2021\)33\(1\).-06](https://doi.org/10.14258/tpai(2021)33(1).-06).

Халиков Н. А. Традиционное хозяйство татар-казаков Южного Урала (вторая половина XIX — начало XX вв.) // *Средневековые тюрко-татарские государства*. 2016. №8. С. 264–271.

Anthony D. W., Brown D., Brown E., Goodman A., Kokhlov A., Kosintsev P., Kuznetsov P., Mochalov O., Murphy E., Peterson D., Pike-Tay A., Popova L., Rosen A., Russell N., Weisskopf A. The Samara Valley Project // *Eurasia Antiqua. Zeitschrift für Archäologie Eurasiens*. 2005. No. 11. Pp. 395–417.

Anthony D. W., Brown D., Brown E., Goodman A., Kokhlov A., Kosintsev P., Kuznetsov P., Mochalov O., Murphy E., Peterson D., Pike-Tay A., Popova L., Rosen A., Russell N., Weisskopf A. The Samara Valley Project. *Eurasia Antiqua. Zeitschrift für Archäologie Eurasiens*. 2005;11:395–417.

Anthony D. W., Brown D., Kuznetsov P., Mochalov O. Bronze Age Herding Camps: Survey and Excavations in Peschanyi Dol. In: *A Bronze Age Landscape in the Russian Steppes: The Samara Valley Project. Monumenta Archaeologica*. Los Angeles : Cotsen Institute of Archaeology Press, 2016. No. 37. Pp. 421–441.

Cáceres I., Esteban-Nadal M., Bennàsar M., Dolores Marín Monfort M., Dolores Pesquero M., Fernández-Jalvo Y. Osteophagia and Dental Wear in Herbivores: Actualistic Data and Archaeological Evidence. *Journal of Archaeological Science*. 2013;40:3105–3116. <http://dx.doi.org/10.1016/j.jas.2013.04.006>

Haupt K. A. Motivation for Cribbing by Horses. *Animal Welfare*. 2012;21:1–7.

Knoll D. Siedlungs- und landschaftsarchäologische Untersuchungen zu den befestigten Siedlungen der Bronzezeit im Trans-Ural. In: *Zwischen Tradition und Innovation: Studien zur Bronzezeit im Trans-Ural (Russische Föderation)*. Bonn : Verlag Dr. Rudolf Habelt GmbH, 2014. Pp. 139–198.

Koryakova L. N., Krause R. The Bronze Age in the Karagaily-Ayat Region (Trans-Urals, Russia) Culture, Environment and Economy. *Frankfurt Archaeological Studies 43*. Bonn : Verlag Dr. Rudolf Habelt GmbH, 2022. 560 p.

Krause R., Koryakova L. N. *Multidisciplinary Investigations of the Bronze Age Settlements in the Southern Trans-Urals (Russia)*. Bonn : Verlag Dr. Rudolf Habelt GmbH, 2013. 352 p.

Ng C., Wei W., Yu C., Zheng J. Herding pattern among Bronze Age steppe communities: An ethnographic approach to mapping pasture in the Southeastern Ural Mountains, Russia. *Front. Ecol. Evol.* 2022. 10:984725. doi: [10.3389/fevo.2022.984725](https://doi.org/10.3389/fevo.2022.984725)

Rassadnikov A. Bone Pathologies of Modern Non-draft Cattle (*Bos Taurus*) in the Context of Grazing Systems and Environmental Influences in the South Urals, Russia. *International Journal of Paleopathology*. 2021;32:87–102. <https://doi.org/10.1016/j.ijpp.2020.11.003>.

Rassadnikov A. Bone Pathologies of Modern Caprines (*Ovis aries* & *Capra hircus*) in the Context of the Pasture-stall System of the Steppe Zone of the South Urals. *International Journal of Paleopathology*. 2022;38:18–31. <https://doi.org/10.1016/j.ijpp.2022.05.003>

Ruhl L., Herbig C., Stobbe A. Archaeobotanical Analysis of Plant Use at Kamennyi Ambar a Bronze Age Fortified Settlement of the Sintashta Culture in the Southern Trans-Urals Steppe, Russia. *Vegetation History and Archaeobotany*. 2015;24(3):413–426. DOI:10/1007/S00334-014-0506-7.

Stobbe A. Long-term Perspective on Holocene Environmental Changes in the Steppe of the Trans-Urals (Russia): Implications for Understanding the Human Activities in the Bronze Age Indicated by Palaeoecological Studies. In: *Multidisciplinary Investigations of the Bronze Age Settlements in the Southern Trans-Urals (Russia)*. Bonn : Verlag Dr. Rudolf Habelt GmbH, 2013. Pp. 305–326.

Stobbe A., Gumnior M., Ruhl L., Schneider H. Bronze Age Human-Landscape Interactions in the Southern Transural Steppe, Russia — Evidence from High-Resolution Palaeobotanical Studies. *The Holocene*. 2016;26(10):1692–1710. DOI: 10.1177/0959683616641740.

Stobbe A., Kalis A. J. Archaeobotanical Investigations in the Trans-Urals (Siberia): The Vegetation History. In: *Landscape Archaeology: Proceedings of the International Conference Held in Berlin, 6<sup>th</sup>–8<sup>th</sup> June 2012*. Berlin : Exzellenzcluster 264 Topoi, 2012. Pp. 297–303.

Stobbe A., Schneider H., Voigt R., Rühl L., Gumnior M. Reconstruction of the Holocene Vegetation and Landscape Development of the Karagaily-Ayat and Ural Valleys in the Southern Trans-Urals (Russia) Based on the Analysis of Pollen, Sediments, Plant Macro-Remains and Diatoms. In: *The Bronze Age in the Karagaily-Ayat Region (Trans-Urals, Russia) Culture, Environment and Economy*. Frankfurt Archaeological Studies 43. Bonn : Verlag Dr. Rudolf Habelt GmbH, 2021. Pp. 269–298.

---

#### INFORMATION ABOUT THE AUTHOR / ИНФОРМАЦИЯ ОБ АВТОРЕ

---

**Alexey Yurievich Rassadnikov**, Candidate of Historical Sciences, Researcher of the Institute of History and Archaeology, Ural Branch of the RAS, Ekaterinburg, Russia.

**Рассадников Алексей Юрьевич**, кандидат исторических наук, научный сотрудник, Институт истории и археологии УрО РАН, Екатеринбург, Россия.

*The article was submitted 10.05.2022;*

*approved after reviewing 11.08.2022;*

*accepted for publication 16.08.2022.*

*Статья поступила в редакцию 10.05.2022;*

*одобрена после рецензирования 11.08.2022;*

*принята к публикации 16.08.2022.*