land

Article

Ancient Agricultural and Pastoral Landscapes on the South Side of Lake Issyk-Kul: Long-Term Diachronic Analysis of Changing Patterns of Land Use, Climate Change, and Ritual Use in the Juuku and Kizil Suu Valleys

Claudia Chang [1,*], Sergei S. Ivanov [2], Perry A. Tourtellotte [3], Robert N. Spengler III [4], Basira Mir-Makhamad [4] and David Kramar [5]

1 Institute for the Study of the Ancient World, New York University, New York, NY 10028, USA
2 International Relations and Oriental Studies, Kyrgyz National University, Frunze Street, Bishkek 720033, Kyrgyzstan; sergiove1982@gmail.com
3 Independent Scholar, Syracuse, NY 13210, USA; patourtellotte69@gmail.com
4 Department of Archaeology, Max Planck Institute for the Science of Human History, 07745 Jena, Germany; spengler@shh.mpg.de (R.N.S.III); mirmakhamad@shh.mpg.de (B.M.-M.)
5 Carrington Research Extension Center, North Dakota State University Cooperative Extension, Fargo, ND 58108, USA; david.kramar@ndsu.edu
* Correspondence: cchang@sbc.edu

check for updates

Citation: Chang, C.; Ivanov, S.S.; Tourtellotte, P.A.; Spengler, R.N., III; Mir-Makhamad, B.; Kramar, D. Ancient Agricultural and Pastoral Landscapes on the South Side of Lake Issyk-Kul: Long-Term Diachronic Analysis of Changing Patterns of Land Use, Climate Change, and Ritual Use in the Juuku and Kizil Suu Valleys. *Land* **2022**, *11*, 902. https://doi.org/10.3390/land11060902

Academic Editor: Tim Denham

Received: 15 May 2022
Accepted: 8 June 2022
Published: 14 June 2022

Abstract: The main goal of this paper is to present results of preliminary archaeological research on the south side of Lake Issyk-Kul in Kyrgyzstan. We test the hypothesis that agropastoral land use changed over four millennia from the Bronze Age through the Kirghiz period due to economic, socio-political, and religious shifts in the prehistoric and historic societies of this region. Our research objectives are to: (1) describe and analyze survey results from the Lower Kizil Suu Valley; (2) discuss the results of radiometric and archaeobotanical samples taken from three stratigraphic profiles at three settlements from the Juuku Valley, including the chronological periods of the Wusun (140 to 437 CE), the Qarakhanid (942 to 1228 CE), and the historic Kirghiz (1700 to present CE); and (3) conduct preliminary GIS spatial analyses on the Iron Age mortuary remains (Saka and Wusun periods). This research emerges out of the first archaeological surveys conducted in 2019–2021 and includes the Lower Kizil Suu alluvial fan; it is an initial step toward developing a model for agropastoral land use for upland valleys of the Inner Tian Shan Mountains.

Keywords: archaeological landscapes; Iron Age; Medieval Period; agriculture; pastoralism; vertical zonation; Issyk-Kul Lake; archaeobotany; GIS mapping

1. Introduction

During the summer field seasons of 2019 and 2021 archaeological reconnaissance and survey was conducted on the south side of Lake Issyk-Kul in the Juuku and Lower Kizil Suu Valleys in the Republic of Kyrgyzstan (see locator map, Figure 1). Archaeological sites spanning the Bronze Age through ethnographic Kirghiz periods have been identified [1] that cover a four millennia period. In this paper we specifically provide the detailed stratigraphic profiles for two settlements in the Upper Juuku Valley. We add additional radiometric dates recovered from ancient seeds discovered during the archaeobotanical analyses. These archaeobotanical and radiometric sequences provide a baseline for examining the development of settlement patterns over the last three or four millennia of human occupation on the south side of Lake Issyk-Kul. The paper also puts forth preliminary GIS spatial analyses of site loci found in the Lower Kizil Suu, an alluvial fan covering about 19.7 sq km in total area. These survey data can be used to reconstruct ancient land-use patterns of agriculture and pastoralism over the last four millennia. The Central Tian-Shan region was important as a segment of a larger trade, migration, and communication route, tying Central Asia to both the east and west branches of the proto-Silk Road routes. In the Juuku and Kizil Suu Valleys, the ecoclines spanning 1600 to 2100 m asl provide ideal conditions for cultivation of wheat (*Triticum aestivum*), barley (*Hordeum vulgare*), the two East Asian millets (*Panicum miliaceum* and *Setaria italica*) and the herding of sheep, goat, cattle, and horses. In addition, humans likely foraged for wild plants and hunted wild animals, such as deer, ibex, hare, rodents, waterfowl, and other birds. Not only did the natural landscape provide a range of potential subsistence niches for ancient populations, but these populations also altered local environments through their settlement activities. By the Medieval period and possibly as far back as the Iron Age (ca. 800 BCE to 550 CE) ancient people also built check dams and simple irrigation systems. The burial *kurgans* (earthen or stone mounds), often ranging from 2 to 90 m in diameter and from flat to 9 m in height, were mortuary monuments that altered the natural land surfaces. The high density of burial mounds, settlements, and features on the alluvial fans and valleys Saka (800 BCE to 260 BCE to Wusun periods 140 BCE to CE 438) may also be used as rough demographic indicators of the populations occupying these valleys.

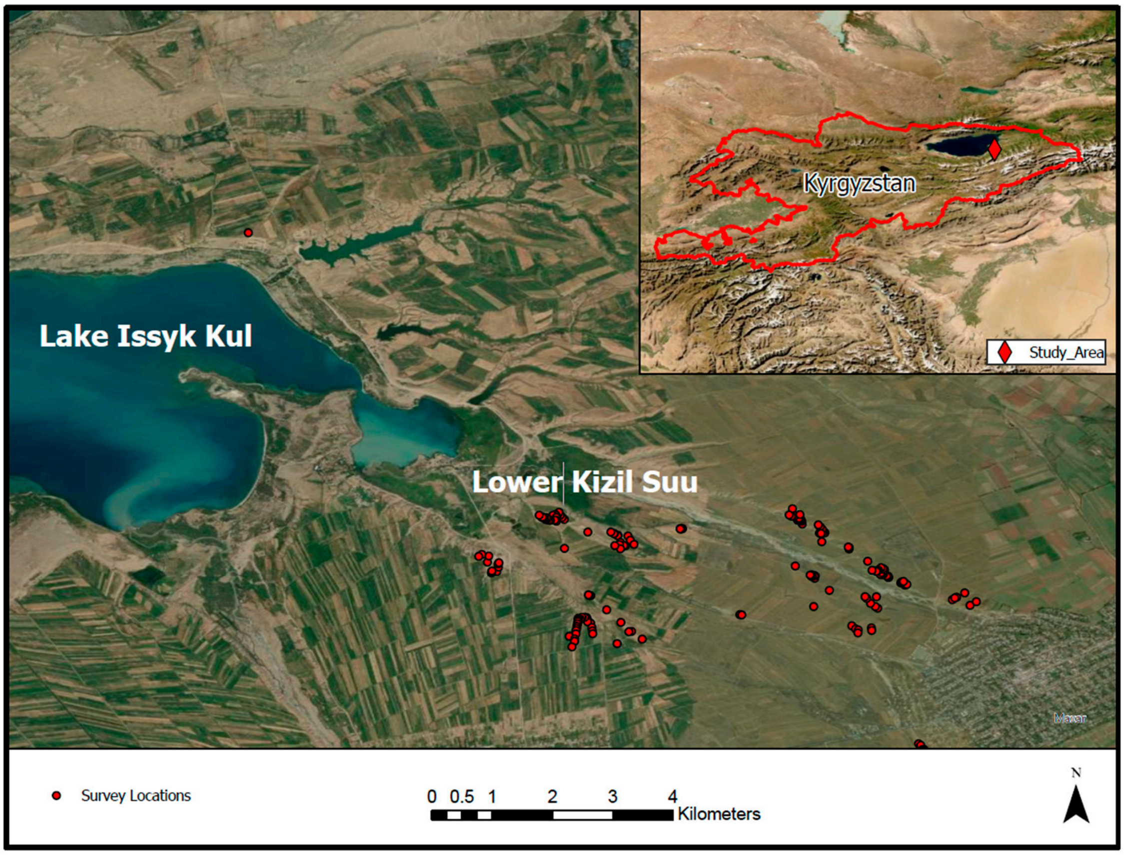

Figure 1. Locator Map of Study Area of Kizil Suu region.

By tracing changing settlement and land-use patterns over a four millennia period of the Late Holocene by means of survey research, we lay out a long-term strategy for testing our ideas about the social development of upland societies in this region. We have also conducted some preliminary studies in: (1) radiometric dating of stratigraphic deposits at three settlements using both charcoal and carbonized seed samples [1]; (2) archaeobotanical analyses of soil samples taken from cultural deposits at these three settlements; and (3) preliminary spatial analyses of the kurgan locations from the Lower Kizil Suu alluvial fan. The three profiles located at an Iron Age settlement, a Medieval (Qarakhanid) settlement, and a 19th century Kirghiz settlement, were selected for radiometric dating of seeds and charcoal, and initial archaeobotanical analyses of carbonized plant materials from ancient contexts. These initial chronological sequences at Juuku Valley allow for speculative hypotheses about changing land use patterns from the latter part of the Iron Age through the present Kirghiz period of occupation. The recent research done by palynologists working in the Karakol area of Issyk-Kul provides invaluable proxies for documenting climate change over four millennia of occupation. The spatial analyses of burial mound loci, known as kurgans, for two sets of Iron Age cultural phases, the Saka period (ca. 800 BCE to 260 BCE) and the Wusun period (ca. 140 BCE to 437 CE) are significant indicators of ritual landscapes and their boundaries along the ridges above stream beds on the large alluvial fan of Kizil Suu. GIS (Geographic Information Systems) analyses provide statistically relevant data about spatial relations between the mortuary landscapes of two different Iron Age cultural groups. The spatial boundaries between Saka and Wusun culture groups, may also represent a kind of "filling in" strategy whereby the later Wusun groups situated themselves in territories proximate to earlier Saka burial grounds, yet maintained clear spatial and ritual boundaries.

Our intentions are to elucidate changing patterns of subsistence over time; also we eventually hope to contribute to a more fine-grained understanding of pastoral mobility, agricultural sedentism, and short and long-distance exchange routes along one segment of the Inner Asian Mountain Corridor. Frachetti [2] defined the Inner Asian Mountain Corridor as a series of short-distance pastoral pathways, which served as geographic pulses for large-scale long-distance mobility across the geographic regions of Central Asia, the Eurasian steppe, and northeastern China. Although contemporary archaeologists have the laboratory tools to trace population movements and shifts through aDNA on human skeletal material [3,4] and isotopic analyses of human and animal bone remains from archaeological sites [5,6], there is still the need for detailed archaeological field research. Surveys and excavations at ancient sites not only provide important material, such as ancient seeds, animal bones, and other ecofacts, but they also document the artifacts, features, and architecture of ancient monuments and settlements. These rich contextual data then allow field archaeologists to re-evaluate, revise, and reconstruct former patterns of social, political, and religious organization of societies, especially those with little textual data. In order to design comprehensive research programs field archaeologists often have to conduct pedestrian surveys such as ours in the Juuku and Lower Kizil Suu valleys, searching for artifacts scatters, architectural features, such as house structures, pits, and fireplaces, and burial mounds. These data will inform us as to how we may conduct long term research that includes test sondages, block excavations, and laboratory studies.

How did ancient and historic populations use both agrarian and pastoral strategies to adapt to upland valleys and in turn transform these physical landscapes over the past four millennia? In recent papers [7–13] archaeologists and other specialists working in Central Eurasia have tended to define the articulation of agriculture with pastoralism using the umbrella term "agro-pastoralism". In this paper we specifically refer to these separate economic strategies of land use as pastoralism and agriculture. This then allows us to examine how both economic strategies and land use systems sometimes articulated with one another, and at other times were practiced in opposition and even in conflicting ways. In the vast literature on Eurasian nomadic pastoralism, social anthropologists, and archaeologists such as Khazanov [14] and Kradin [15] have already argued that there were almost no cases of "pure pastoralism" since most Eurasian pastoral groups also practiced foraging, fishing, and farming. The northern Mongolian reindeer herders were one of the few pastoral groups who almost exclusively engaged in pastoral pursuits. One way of bypassing the tendency to pigeon-hole and, therefore, typologize pastoral strategies from "pure nomadic pastoralism" to settled agro-pastoralism is to examine the nature of variation within all ancient and modern pastoral societies and their complicated relationships with the "outside world". Those relations, between the historic populations of Kirghiz and Kazakhs who practiced animal husbandry and their settled neighbors were often quite varied and, in many cases, demonstrated the necessity for mutual dependence and symbiosis, as well as competition over water and land [14,16]. Over 50 years ago, Dyson-Hudson [17] reprimanded social anthropologists and geographers for typologizing pastoral societies on the basis of their mobility practices, thus ignoring so many other variables that exist in nomadic pastoral life such as the species herded by humans, the fact that herders and their animals represent "co-incident populations of animals and humans," and the social and political advantages gained by regular seasonal or cyclical movement in search of pasture and water. In the recent literature on Central Eurasia archaeologists have argued about the nature of agropastoralism versus pastoral nomadism during the Bronze Age through the Medieval periods [7]. Nomadic mobility and its role for the spread of Indo-European language, the new technologies of metalworking (specifically bronze production), and the importance of horse transport (both riding and as traction animals) [2,18] have dominated our understandings of agricultural and pastoral interactions over the last four millennia of Eurasian steppe and mountain adaptations. Contributing to these discussions have been the exciting new developments of complete radiometric sequences of both Bronze and Iron Age settlement and cemetery contexts, DNA studies on human skeletal remains, archaeobotanical findings of early crops of domesticated millets, wheat, and barley, and the use of isotopic studies on both human and faunal materials [5,6,19–22]. No doubt it has been an exciting time for the fine-grained laboratory analyses of seeds, animal bones, and human remains.

At the same time field archaeologists continue to survey and excavate settlements and burial grounds along the Inner Asian Mountain Corridor, often testing the Corridor hypothesis [23–27]. Archaeological studies of pastoral mobility have been successful in delineating both short and long-distance mobility during the Bronze Age in particular [2,6,28,29]. More recent studies of mobility patterns in the Iron Age and Medieval Periods in Central Asia have begun to tease out patterns of mobility as well as symbiosis and competition between agriculturalists and mobile pastoralists [6,10,20,30–33]. Settlement pattern studies have been initiated in the nearby Kochkor Valley by Rouse and her team [25,26]. Recently Motuzaite-Mateviciute and her team [22] have examined 78 human and 84 animal samples from 17 archaeological sites in Kyrgyzstan, primarily along the Naryn corridor and the south side of Lake Issyk-Kul for carbon and nitrogen isotopes indicating the consumption of millets at Bronze Age through Medieval period occupations. The initial conclusions show that millet consumption and fodder use did not occur before the Bronze Age, and in two cases, the very early use of millet may have come from immigrants from outside this region [22].

We suggest that our survey results show the influx of new groups into these valleys. Here we present a chronology for the South side of Lake Issyk Kul. This chronology can then be used to define how each cultural group in a given time period most likely practiced different economic strategies and ritual land use (see Table 1).

Table 1. Time Periods, Phase Designations, and Dates used for the Juuku and Lower Kizil Suu Surveys.

Time Period	Phase Designation	Dates
Late Bronze Age		2000 BCE–900 BCE
	Final Bronze	1100 BCE–800 BCE
Iron Age		800 BCE–550 CE
	Saka	800 BCE–260 BCE
	Wusun	140 BCE–437 CE
	Kenkol (only in TianShan)	200 CE–550 CE
Medieval Period		500 CE–1500 CE
	Turkic Period	552 CE–900 CE
	Qarakhanid	942 CE–1228 CE
Early Kirghiz		1500 CE–1700 CE
Kirghiz Period		1700 CE–Present
Soviet Period		1917–1991
Post-Soviet, Kyrgyz Nation		**1991–**

For example, the Andronovo Bronze Age farmers and herders of the second millennium BCE were replaced by Iron Age nomadic confederacies. Some groups within the Iron Age nomadic confederacies continued to cultivate barley, wheat, and the two millets, as well as herd sheep, goats, cattle, and horses [31]. During the latter part of the Iron Age, outside groups like the Wusun, may have incorporated indigenous Saka groups into their quasi-states or confederacies. In the Turkic and Medieval periods, (ca. 600 to 1500 CE) the rise of urbanism is apparent from the variety of site types including rural homesteads and outlying corrals and encampments, caravanserais, military outposts, early towns, and cities [34,35]. The demographic increases during the Turkic and Medieval periods undoubtedly placed more pressure on local resources, including land. When did the local people begin to use irrigation and who owned the herds of domesticated animals? During the later periods when early states became increasingly hierarchical, questions such as who worked the land, and who owned land as property become essential elements in our models of land-use. Also, it is important to consider how the Medieval and historic Kirghiz periods were also those times of maximum pressure on land, water, and other natural resources, especially in these small, circumscribed upland valleys? Greater impact on the natural landscapes must also have affected local communities, not only economically, but socially and politically and may have aided in the transformation of sacred landscapes. Our answer to such broad questions begins with documenting the results of our archaeological surveys and the ancillary studies conducted because of the 2019 and 2021 field seasons. Each aspect of this project, such as the survey results, the radiometric dating at three settlements, preliminary archaeobotanical analysis, and GIS spatial analysis of Lower Kizil Suu mortuary landscapes all contribute to the diachronic study of landscape change in the Late Holocene.

2. Materials and Methods

2.1. Study Area

In this paper we discuss the research results of three settlement profiles from the Juuku Valley and the survey results of the Lower Kizil Suu Valley (Figure 2). Both upland valleys are found on the south side of Lake Issyk-Kul, a large saline lake located between the Northern and Inner Tian Shan Mountain ranges. Lake Issyk-Kul is fed by 102 streams and lakes; the lake levels fluctuate according to seasonal glacial melt. Juuku Valley is a small intermontane valley with the high peak of It-Tash (elevation of 4808 m) to the south and extends about 50 km to the north where it empties into the Lake Issyk-Kul. The two survey polygons of the Juuku Valley, Polygon 1 in the Lower Juuku alluvial valley, is about 6.4 sq km and ranges from 1750 to 1950 m asl and Polygon 2 in the Upper East River Branch of the Juuku Valley is about 0.5 sq km in area and ranges from 2060 to 2100 m asl (see Figure 2). The survey results found on both polygons of the Juuku Valley have already been reported by Chang, Ivanov, and Tourtellotte [1]. The geology of these upland valleys is similar to that of the Dzhety-Ogyuz Valley described by Abdrakhmetov and Korjenkov [36]. Paleozoic granites and metamorphic rocks form the foundation of the Juuku and Kizil Suu valleys. The Lower Kizil Suu is a broad alluvial fan of 19.7 sq km; the Kizil Suu streams empty into Lake Issyk-Kul. The elevation of the alluvial fan ranges from 1610 to 1740 m asl (see Figure 2, map of Lower Kizil Suu). Jurassic quartzites cover the earlier granites and metamorphic rock. The distinctive red sandstone formations found in these intermontane regions are a result of Eocene and Pliocene deposits. The terraces, alluvial valleys, and alluvial fans consist of fluvial deposits of boulders, river cobbles, pebbles, and sand often covered with deposits of topsoils consisting of sand, clays, silt, loess, and humic layers. There is substantial seismic activity apparent on the south side of Lake Issyk-Kul [37,38].

Climatic conditions in the environs of Karakol on the South side of Lake Issyk-Kul can be reconstructed from pollen cores taken in 1998 [39]. These archives show the occurrence of a wetter period from 2450 to 750 BCE based on the decline of *Ephedra*, a species associated with the dry conditions of the Artemisia steppe.

According to the Karakol pollen core samples, there appears to be a spruce (*Picea* sp.) die back, or cooling period from 1450 BCE to 950 BCE, usually the Late Bronze Age/Final Bronze Age period [39] (Table 2). Again, the documented Dark Ages of cold and wet, occurred between CE 300 to 600, at the Wusun and Early Turkic periods [39]. Then a relatively dry phase occurred during the Medieval period, ca. 1000 to CE 1350, during the Qarakhanid occupation of this region. The "Little Ice Age" took place between ca. 1500 to CE 1850, within the historic Kirghiz occupation. The climate became colder, and at an Issyk-Kul core (IK98i-28) as well as Core C087 there appears to be an increase in *Picea* (spruce) as well as an increase in Poaceae (grasses), which may be attributed to human impact due to farming [39]. During the Little Ice Age, the Tian Shan glaciers were most extensive. These pollen records suggest the following climatic trends: (1) wetter and colder conditions at the end of the Bronze Age that continued into the Iron Age; (2) the peak of the wet and cold conditions came towards the end of the Iron Age (CE 300 to 600), also known as the Dark Ages elsewhere; (3) during the height of Medieval occupation in this region, the Qarakhanid period (10th to 12th centuries CE), was marked by a relatively dry and warm period; and finally after the 15th century and into the 19th century, the Little Ice Age marked a cooling and moist period. If climate proxies from pollen cores can be collected from the Kizil Suu area it may be possible to correlate local climatic trends with changing land use patterns.

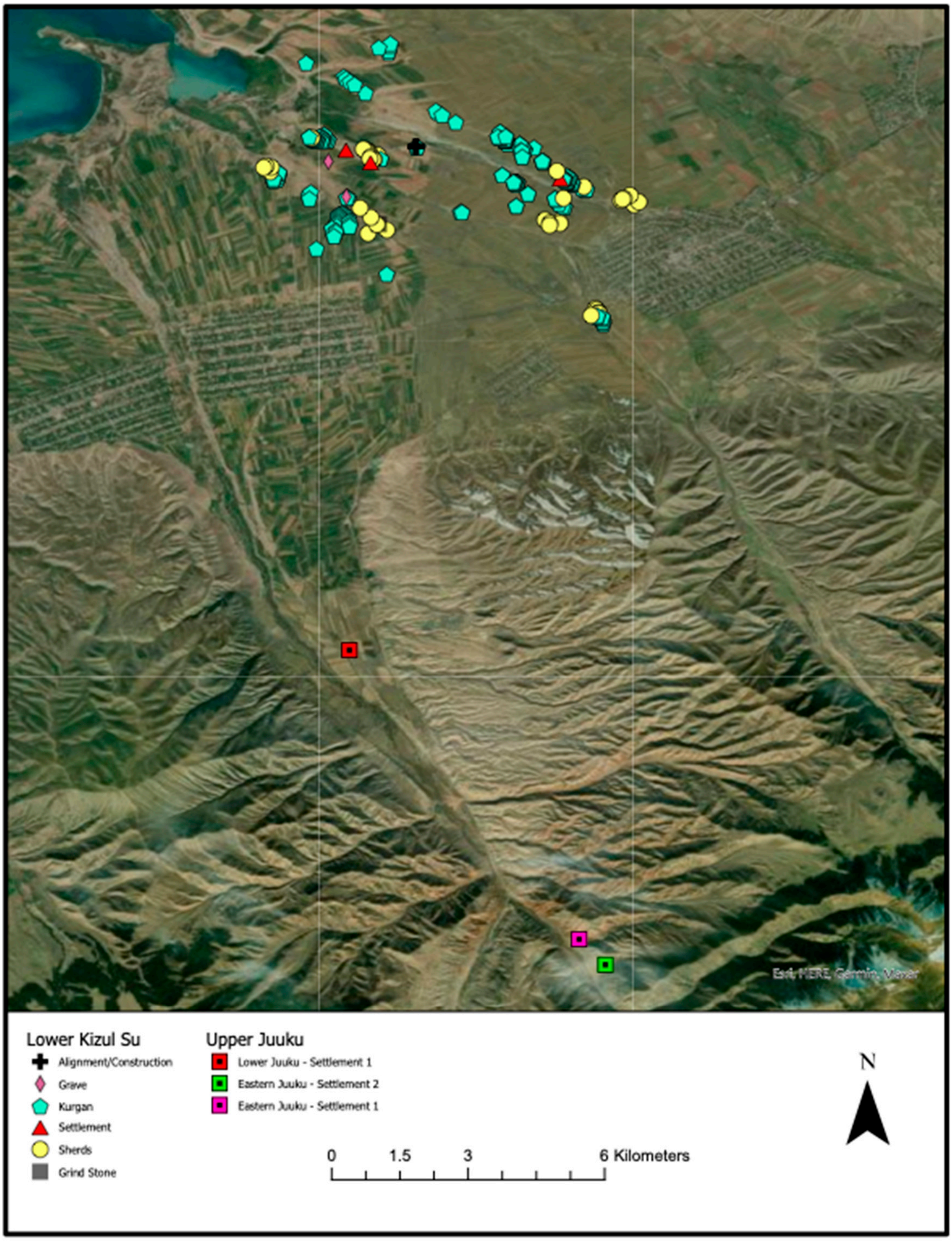

Figure 2. Map of Lower Kizil Suu Survey also shows the location of Eastern Juuku, Settlement 1 (1st to 5th century CE), Eastern Juuku, Settlement 2 (10th to 11th centuries CE), and Lower Juuku, Settlement 1 (17th to 19th centuries CE).

Table 2. Dates, Time Periods, Climatic Trends on the South side of Lake Issyk Kul according to Pollen Cores from the Karakol area [39].

Dates	Approximate Time Period	Climatic Trend
1450 BCE to 950 BCE	Late Bronze Age/Final Bronze Age	Cooling period, spruce die-back
300 to 600 CE	Wusun Period/Early Turkic Period	Cool and wet phase
1000 to 1350 CE	Medieval Period/Qarakhanid Period	Dry phase
1500 to 1850 CE	Historic Period of Kirghiz occupation	Little Ice Age (cool and wet)

2.2. Description of Survey Methods

Chang, Ivanov, and Tourtellotte [1] conducted pedestrian archaeological surveys within the two polygons of the Juuku Valley. This article reports specifically on the survey results from the Lower Kizil Suu alluvial fan. A detailed study of digital maps from Nakarte and Google Earth allowed the team to locate areas where potential archaeological loci such as settlements, corrals, and burial mounds were visible from aerial views. Pedestrian surveys were conducted on the lower Kizil Suu alluvial fan during 2021. We covered a small sample area (0.53 sq km) of the total area of the alluvial fan (19.7 sq km), at elevations from 1610 to 1740 m asl. (The sample survey area is about 0.02 percent of the total alluvial fan area). Since so many of the lower terraces in Kizil Suu were planted in grain crops during the field season of 2021, we restricted our survey to the higher, stony terraces. These terraces and ridges were often the areas of Iron Age kurgans. A second phase of our sample survey was to field walk in agricultural fields that had been plowed, cut, or recently planted during the months of August and September. About 11 fields were intensively surveyed, an area of approximately 48 hectares (see Table 3). The overall survey methodology was opportunistic, often dependent on our own pre-survey predictions for promising areas for site locations. For example, the Saka kurgans were often visible on Google Earth or Nakarte digital imagery and therefore provided us with estimates of where clusters or concentrations of site loci might be found in Lower Kizil Suu. All materials found on survey, from isolated artifact finds to more house outlines were identified as loci. If it was apparent that a group of house foundations were part of a settlement, a series of points (loci) were recorded, but they were considered a single site. The survey team recorded artifact finds (ceramic sherds, grinding stones, etc.), artifact scatters (more than 5 artifacts per 10 m radius), house or pit depressions, stone foundations of houses and enclosures, paths marked by stone walls, and architectural features such as house foundations, walls, fences, and corrals, and graves, burial mounds, and other mortuary features associated with cemeteries. Figure 3 shows two field archaeologists recording a stone kurgan in Lower Kizil Suu. When the archaeological artifacts or features could be dated chronologically, they were placed in time periods. Excel data sheets were constructed for each archaeological loci recording GPS (Global Positioning Systems) coordinates and relevant site characteristics.

Table 3. Lower Kizil Suu Survey of Agricultural Fields.

Field Number	Field Area in Hectares	Finds
1	14.3	12 sherds
2	14.5	3 kurgans, 3 sherds
3	2.8	5 sherds, 1 hearth
4	1.49	5 sherds
5	1.65	5 sherds
6	1.94	2 sherds
7	3.9	11 sherds (between 50–100)
8	1.88	8 sherds 1 foundation
9	0.29	2 sherds
10	4.14	1 Kirghiz ethnographic grave, 1 Saka kurgan 7 sherds 1 grinding stone
11	1.13	8 sherds
TOTALS	**48.02**	

Figure 3. Recording stone kurgans in the Lower Kizil Suu. Large earthen Saka kurgans in the background.

2.3. Stratigraphic Profiles at Juuku Valley Settlements

Two stratigraphic profile cuts, Settlement 1 and 2 in the Upper Juuku Valley were drawn by the field team. The Lower Juuku settlement was photographed and recorded, but not drawn. The stratigraphic profiles illustrate cultural and natural soil layers. Several liters of archaeobotanical soil samples were taken from the Settlement 1 (EJS1) and Settlement 2 (EJS2) in Upper Juuku Valley and from Settlement 1 (LJS1) in Lower Juuku Valley. Additional radiometric dating of two charred seeds was taken from archaeobotanical findings at Settlement 1 (EJS1) in the Upper Juuku, a Wusun (Iron Age) settlement.

2.4. Radiometric Dating

Two samples of carbonized barley (*Hordeum vulgare*) and free-threshing wheat (*Triticum aestivum*) grains were selected for dating from the Eastern Juuku-Settlement-1. Dates were measured at Woods Hole Oceanographic Institute's Radiocarbon Laboratory and SUERC Radiocarbon Dating Laboratory. The results were calibrated using OxCal v4.4.2 software [40,41] and the IntCal 20 curve [42].

2.5. Archaeobotanical Methods

We conducted water flotation on seven sediment samples taken in 2019 from three archaeological sites in the Juuku Valley, using an overflow tank system, in September of 2021. Three of these samples were collected from site-EJS1 (Eastern Juuku-Settlement-1). Another two samples were collected from site-EJS2 (Eastern Juuku-Settlement-2) and two samples from site-LJS1(Lower Juuku-Settlement-2). In this report, we use the site nomenclature, as laid out in Table 4.

Table 4. Radiocarbon results from carbonized material found at three Settlements recovered from the Juuku Valley.

#	Lab ID	Material/Pretreat	d13C o/oo IRMS	Conventional Dates (BP)	Calibrated Dates at 95.4% (AD)	Settlement	
1	OS-165284	Wheat grain	—	1850 +/− 15	130–237	Site-EJS1	Eastern Juuku Settlement 1
2	OS-165285	Barley grain	—	1680 +/− 15	376–532	Site-EJS1	
3	Beta-603779	(charred material) acid/alkali/acid	−22.7	1930 +/− 30	22–206	Site-EJS1	
4	Beta-603780	(charred material) acid/alkali/acid	−25.3	1020 +/− 30	978–1151	Site-EJS2	Eastern Juuku Settlement 2
5	Beta-603781	(charred material) acid/alkali/acid	−26.5	110 +/− 30	1682–1932	Site-LJS1	Lower Juuku Settlement 1

Heavy fractions of each sample were collected down to 1.0 mm and light fractions down to 0.355 mm. The heavy fractions were sorted in Kyrgyzstan; while all light fraction samples were dried and transported to the Palaeoethnobotany Laboratory at the Max Planck Institute for the Science of Human History in Jena, Germany. Sediment samples ranged from 4.0 to 9.0 L in volume; in total, 43 L of sediment were floated and analyzed. In the laboratory, light fraction samples were sieved with mesh sizes of 2.00, 1.40, 1.00-, and 0.50- mm. Material smaller than 0.5 mm was not analyzed. After sieving, all samples were systematically sorted and specimens were analyzed under a low magnification microscope, a Leica M205C. Charred wood fragments larger than 2.00 mm were weighed and sorted, but they were not analyzed into a taxonomy. Length, width, and thickness measurements were made digitally with a Keyence VHX 6000 microscope for all whole wheat and barley grains. Highly fragmentary pieces of grains and legumes were placed into the categories:

Cerealia and Legume. Cerealia, Legume, crop by-products (like rachises and culm nodes), mineralized seeds, and unidentifiable seed fragments were not counted in the totals.

2.6. ArcGIS Methods for Spatial Analysis

The site locations from Lower Kizil Suu were imported into ArcGIS Pro 2.8 using the latitude and longitude coordinates for each locus. In the ArcGIS database an additional feature class was created for only the Iron Age mortuary remains of Saka and Wusun burial mounds (Figure 2). In an earlier article we put forth a chronology for Saka occupation (800 to 260 BCE) while the later Wusun occupation occurred between 140 BCE to 437 CE [1]. To understand the spatial distribution of the Saka and Wusun burial mounds, we conducted a co-location analysis to measure the spatial association between the Saka and Wusun loci. This statistic tests whether there is a spatial association between Saka and Wusun kurgans and measures the local patterns of spatial association between the Saka and Wusun kurgans using a co-location quotient statistic. The co-location quotient is calculated by analyzing each feature associated with the Wusun sites individually to determine if they are co-located with the Saka sites (e.g., fall within the same neighborhood of the Saka sites). In other words, we test the hypothesis that the later Wusun population either chose their site locations proximate to the earlier Saka burial mounds, or alternatively chose locations not proximate to the earlier Saka burial mounds, yet still in the same geographic region. The results of the co-location analysis will then show a distribution of co-location quotient values that determine the probability that the observed value might occur because of random distribution. If the resulting p-value is less than 0.05, the co-location quotient for the feature is statistically significant. Co-location quotient values greater than 1 indicates a statistically co-located group of sites. A co-location quotient less than 1 indicates a statistically isolated group of sites. We extend the co-location analysis by calculation the median centers of the Saka and Wusun kurgans, as well as calculating the directional ellipses of those kurgans.

3. Results

3.1. Survey Results

Elsewhere the survey results in the Juuku Valley have been reported [1]. A total of 277 loci were found from pedestrian survey on the Lower Kizil Suu alluvial fan: 168 loci were identified as stone or earthen kurgans; 14 loci were identified as settlements (stone alignments, house constructions, and fire pits); and 86 loci were either single sherds or sherd scatters; 9 were Bronze Age through Kirghiz graves. We also surveyed agricultural fields spacing transects 20 m. apart. Table 2 shows the results of 11 Agricultural Field Surveys, a total of 48.02 ha.

3.2. Stratigraphic Profiles

Two profiles are presented here from Settlements 1 and 2 found in the Eastern Upper Juuku branch. Both profiles were found on the eastern terraces below red sandstone foundations. These are erosional cuts from intermittent stream channels or run-off flowing toward the Eastern Branch of the Juuku River.

3.2.1. Profile at Site-EJS1 (Wusun Period Settlement)

The surface of this profile is situated at an elevation of 2044 m asl on a dissected terrace above the eastern branch of the Juuku River. The drawn profile (Figure 4) is about 3 m in length and about 1.5 m in depth. The cut shows a house pit with several periods of occupation and some thin ash layers. The lowest layers: brown sandy loam, red sandy or loam levels with coarse sand, and pebble and rock layer are probably the natural, parent soil of the ravine. The brown clay layers are prepared floors, and the ash layers are fire pits and areas with ash deposits. These ashy deposits are where the wood charcoal and archaeobotanical samples (EJS1) were collected. The dark grey layer with melted mudbrick and large stones represents a later re-building phase of this house pit. The cultural levels begin at the very surface of the profile cut (dark brown with humus or topsoil).

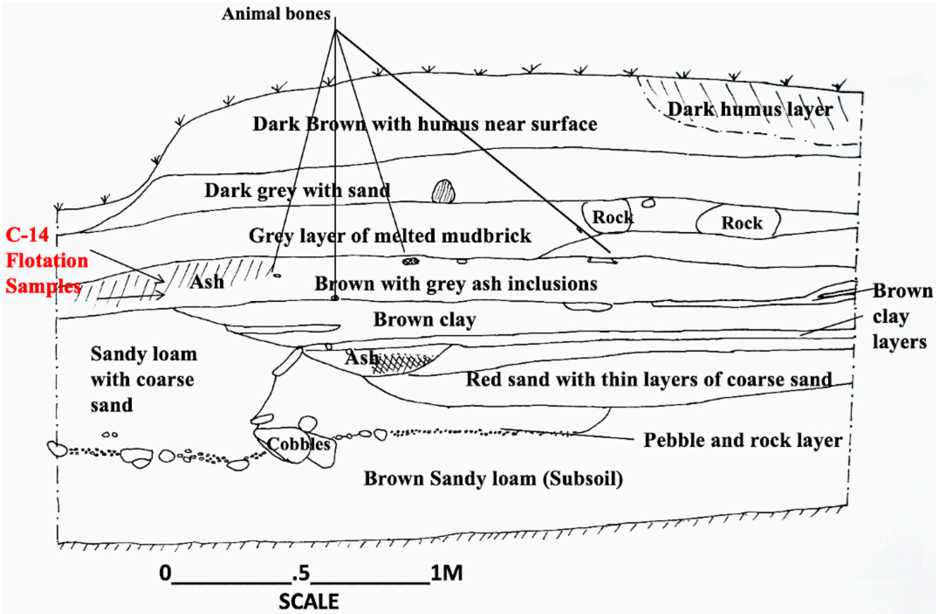

Figure 4. Archaeological Stratigraphy at Settlement 1 (EJS1): A section of a house pit. South facing profile.

3.2.2. Profile at Site-EJS2 (Qarakhanid Period Settlement)

The surface of this profile is situated at an elevation of 2090 m asl on an erosional gully that dissects an upper terrace above the Eastern branch of the Juuku River. The drawn profile is west facing, showing a series of occupational levels of a Medieval room. The profile measures 2.5 m in length and is 1.9 m in maximum depth. The bottom layer of sandy loam is the parent or natural subsoil below the cultural deposits (Figure 5). The series of light or thin clay levels found at the center of the profile drawing are a *sufa* or *kang* (plastered or clay sleeping platform/bed often found in Medieval dwellings). Above the clay levels is grey fill with ashes, representing midden or trash fill thrown into the dwelling over the earlier *sufa*. Later, a pit was dug into this midden layer which is lined with stones on the left-hand side and has sand and rubble on the bottom. This pit measures about 80 cm in length and 40 cm in depth. There are several middens or occupation levels above the center pit and a shallow ash pit to the left of the center pit. This upper ash pit measures about 70 cm in length and is about 15–20 cm thick. Above both pit features is a grey layer with burnt soil and ash, most likely a midden. The thick mud brick wall consists of individual unfired bricks and is 1.6 m in length and about 65 cm in height. Towards the top of the profile are destroyed or eroded mudbricks covered with dark humus. This later mudbrick wall covered over the earlier midden and deposits of the two ash pits and the earlier *sufa* which rested on a prepared occupation floor. Charcoal wood samples were taken from this profile (Beta 603780) from the ash pit to the left of center. Archaeobotanical samples were taken from the ash pits and the grey ashy midden levels.

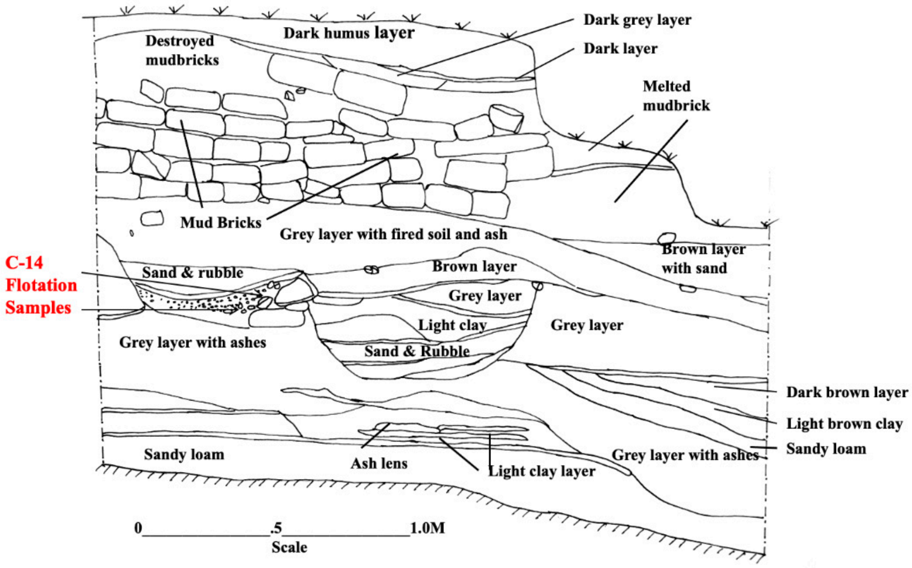

Figure 5. Archaeological Stratigraphy at Settlement 2 (EJS2). A section of a dwelling. West facing profile.

3.3. Results of Radiometric Dating

The results of two new radiocarbon dates are shown in Table 4 (#1 and #2), the occupation at Site-EJS1, the eastern Juuku-Settlement-1 spans from 130 to 532 cal. CE. Earlier presented radiocarbon dates from three sites at the Juuku Valley (Table 1, #3, 4, and 5) [1]: the occupation of Site-EJS1 (Eastern Juuku-Settlement-1) was dated to the Wusun Period (22–206 cal. CE), Site-EJS2 (Eastern Juuku-Settlement-2) dated to the end of the Qarakhanid period (978–1130 cal. CE), and Site-3 (Lower Juuku-Settlement-2) dated to the Kyrgyz ethnographic Period (1800–1932 cal. CE) [1]. New results from the one carbonized seed of barley (OS-165285) and one carbonized seed of wheat (OS-165284) corroborate the time sequence for the Eastern Juuku Settlement 1, established from charcoal wood samples (Beta-603779). The second sample at EJS1 expands the occupation period at the Wusun settlement to the beginning of sixth century CE.

3.4. Results of Archaeobotanical Analyses

A total of 43 L of floated sediment yielded 773 carbonized seeds and grains, which included domesticated crops and wild herbaceous plants. In addition to seeds, we recovered wheat (*Tiritcum aestivum*, $n = 2$) and barley (*Hordeum vulgare*, $n = 7$) rachises, grass culm nodes ($n = 25$), Cerealia ($n = 7$), Legumes ($n = 1$), and unidentifiable seed fragments ($n = 22$) that were too damaged to differentiate to properly identify. In total, 44.5 g of charred wood fragments (>2.0 mm) were recovered, predominantly coming from samples from site-2 (Figures 6 and 7).

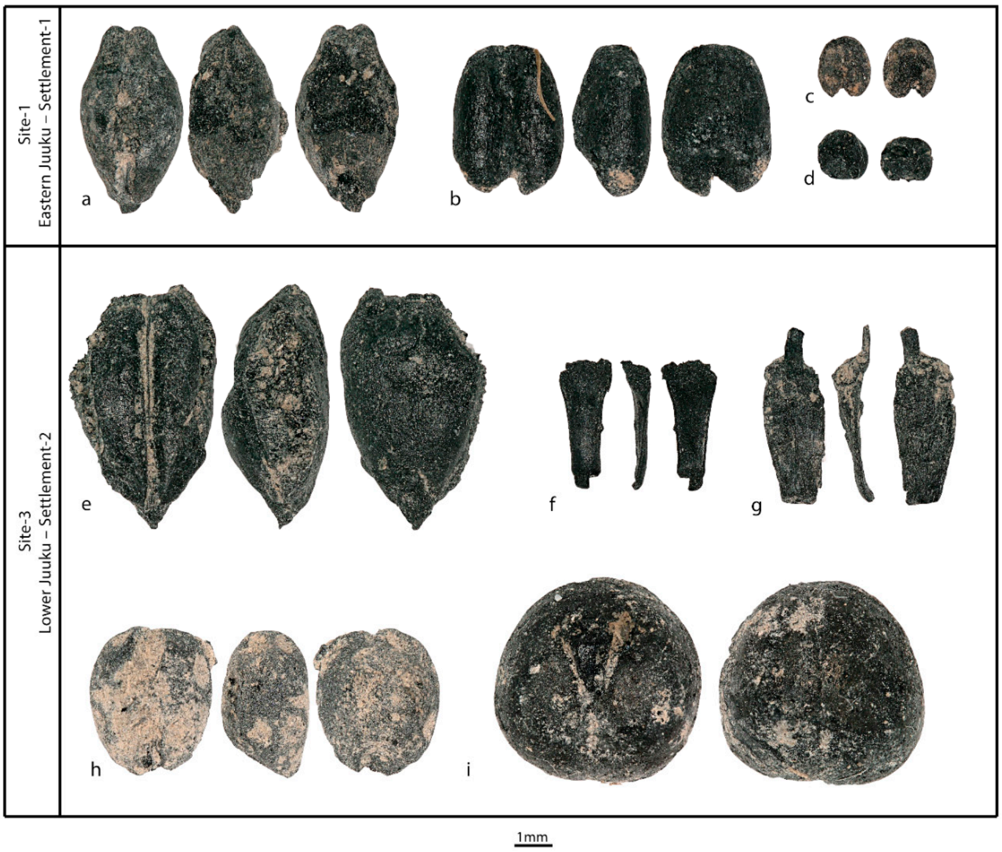

Figure 6. Site-EJS1: (**a**)—*Hordeum vulgare*, (**b**)—*Triticum aestivum*, (**c**)—*Setaria italica*, (**d**)—*Panicum millaceum*; Site-LJS1: (**e**)—*Hordeum vulgare*, (**f**)—Rachis of *Hordeum vulgare*, (**g**)—Rachis of *Triticum aestivum*, (**h**)—*Triticum aestivum*, and (**i**)—*Pisum sativum*.

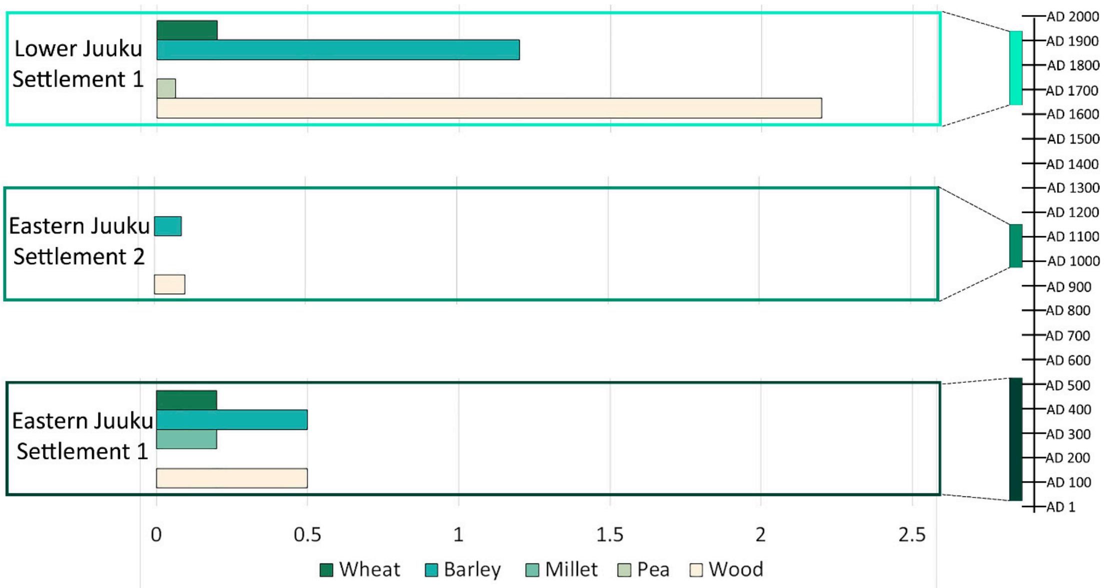

Figure 7. Cultivated crop and wood density from three sites at the Juuku Valley.

3.4.1. Eastern Juuku-Settlement 1, 1st–5th Centuries CE

Three samples (14.5 L) were taken from different profiles of site-1 (EJS1), from which we recovered 39 carbonized seeds. The total density (seed/liter of sediment) was 2.7 seeds per one liter, where 0.9 were domesticated and 1.8 were from wild herbaceous plants.

Four grain crops were identified at Site-1: barley (n = 8), wheat (n = 3), broomcorn millet (*Panicum millaceum*, n = 1), and foxtail millet (*Setaria italica*, n = 2). The average length of 3 wheat grains was 3.34 mm and the average width was 2.54 mm. There were 8 barley grains recovered, only 3 of them were measurable. The average length of these grains was 4.74 mm and the average width was 2.69 mm.

Wild plants represent a large part of the site-1 assemblage (Table 5). The dominant wild plants belong to the amaranth family (Amaranthaceae), notably chenopods (*Chenopodium* sp.), which are some of the most commonly recovered wild seeds in archaeological assemblages across Eurasia. In addition to plants of the amaranth family, seeds of the small wild legume family (Fabaceae) and cleavers (*Galium* sp.) were identified.

Table 5. Archaeobotanical counts from each Juuku Valley site.

Juuku 2021		**Eastern Juuku, Settlement-1 (1st–5th Centuries AD)**			**Eastern Juuku, Settlement-2 (10th–11th Centuries AD)**		**Lower Juuku, Settlement-1 (17th–19th Centuries AD)**		**Total**
	Sample #	FSJ6	FSJ6	FSJ3	FSJ6	FSJ7	FSJ4	FSJ5	
	Volume (L)	5.5	5.5	5	5.5	6	8	9	**43**
	Wood (Fragments > 2.00 mm) (g)	0.3	0.3	2.6	0.3	0.9	17.9	18.6	**44.5**
Grain Parts *Not in Totals	Wheat Rachis (Hexaploid)						1	1	**2**
	Barley Rachis						5	2	**7**
	Cerealia			3					**7**
	Legume								**1**
	Culm Node						11	14	**25**
Domesticated Grains and Legumes	*Hordeum vulgare* var. *vulgare*			5	1		11	11	**31**
	Triticum aestivum			1			3	2	**8**
	Panicum miliaceum								**1**
	Setaria italica			1					**2**
	Pisum sativum						1		**1**
Amaranthaceae	Amaranthaceaa	10	10	5	10	4	6	32	**62**
	Perisperm (Amaranthaceae)								**2**
	Chenopodium sp.	3	3	7	3	8	219	203	**440**
	Salsola type						4		**4**
Asteraceae	Asteraceae							1	**1**
Apiaceae	Apiaceae							2	**2**
Brassicaceae	small Brassicaceae							1	**1**
	Thlapsi Type							1	**1**
Fabaceae	Fabaceae						4		**4**
	small Fabaceae	1	1		1	1		13	**15**
	Medicago/Melilotus			1			7	10	**18**
	Trigonella sp.						2	1	**3**
Poaceae	Poaceae						1	4	**5**
	Small Poaceae					1		6	**10**
	Pooid						2	2	**4**
	Avena sp.						19	27	**49**
	Setaria (Wild)							1	**1**
	Bromus type						4	5	**9**
	Stipa type						6	3	**9**
	Panicoid						1		**1**
Polygonaceae	Polygonaceae						2	5	**7**
	Polygonum spp.						7	4	**11**
	Rumex spp.							3	**3**
Plantaginaceae	*Plantago* sp.	2	2		2		2	7	**11**
Rosaceae	*Potentilla* sp.						18	24	**42**
Rubiaceae	*Galium* sp.					2		4	**8**
Solanaceae	Solanaceae							3	**3**
Thymelaeaceae	*Thymelae* sp.							1	**1**
	Unidentified Seeds							6	**6**
	Unidentifiable Seed Fragments (not in total)			4		5		6	**22**
Total		**16**	**16**	**20**	**16**	**17**	**319**	**382**	**773**

3.4.2. Eastern Juuku-Settlement 2, 10th to 11th Centuries CE

A total of 33 carbonized seeds were recovered from two samples (11.5 L) coming from site-2 (EJS2). The total seed density was 2.9 seeds per liter. The seed assemblage is composed of mainly wild plants, only one barley grain was collected from the two samples. Many uncarbonized seeds likely represent high contamination with modern seeds, notably, again, chenopods; an abundance of uncarbonized insects (assumed to be modern intrusions) further attests to bioturbation at the site. Compared with the other two settlements discussed above, only 1.2 g of charcoal fragments larger than 2.00 mm was recovered from the samples.

3.4.3. Lower Juuku-Settlement 1, 17th to 19th Centuries CE

Two samples (17 L) were taken from site-3 (LJS1), located 6 km to the northwest of EJS1 and EJS2. Seed density is relatively higher than from the other two sites, 701 seeds were recorded with a density of 41.2 seeds per one litter of sediment, where 1.6 are domesticated crops and 39.6 are from wild plants. Compared with site 1, slightly more domesticated crops were recovered from those two samples. Collectively, there were three clearly domesticated field crops, including barley, wheat, and peas (*Pisum sativum*). In addition to grains, barley and wheat rachises were identified. All the wheat rachises have the characteristic morphology of hexaploid free-threshing wheat. There were only 5 wheat grains recovered, two of them were measured, where the average length was 4.5 mm and the average width was 3.6 mm. The most dominant crop in these two samples was barley (n = 22). While only 11 barley grains were measurable, their average length was 5.0 mm and the average width was 2.7 mm. Legumes are represented only by one pea.

Wild herbaceous seeds are the most abundant plant type in the samples. Many of the seeds could not be identified to the species level, but, again, the most numerous types were the chenopods. In addition to carbonized chenopods, there were many uncarbonized seeds that did not count, as they were presumed to be modern intrusions. The next most numerous types of weed seeds were the wild Fabaceae and grasses (Poaceae). Among the wild grasses, 46 wild oats (*Avena* sp.) were identified, and are presumed to represent weeds in local agricultural fields. Wild oats are prominent weeds in wheat and barley fields in the region today. In total, seeds of at least 27 different plant groups were attested. The overall abundance of wild seeds in LJS1 is much higher than at the other settlements analyzed in this preliminary study. In addition, to the high seed density recorded in these samples, 36.5 g of wood were recovered.

Archaeobotanical studies of first millennium BCE sites in the mountain foothills of Inner Asia, including Tuzusai, Tseganka 8, Taldy-Bulak, Begash, Chap, and Kyzyltepa [9,30,43–46], have demonstrated that agriculture was intensified during the beginning of the first millennium BC. Recent data illustrate that at least some portion of the overall population at this time remained stationary year-round to tend agricultural fields in the mountain foothills and to monitor grape vineyards. Our results in Table 4 bring new insights to the period just a few centuries after the increased focus on mixed farming systems, and these new data attest to the use of domesticated plants at the Juuku settlement during the first centuries CE (Figure 7). Compared with settlements across the Talgar alluvial fan in southeastern Kazakhstan, it appears that a similar assemblage of crops and a comparable mixed system of farming and pastoralism continued.

Often crop processing by-products are used to determine whether crops were grown locally or potentially imported [46,47], and yet, no rachises or culm nodes have been recovered from site-EJS1, dated to the first half of first millennium AD. Crop chaff was recovered together with grains at site-LJS1, providing loose evidence for local cultivation in the Kyrgyz Ethnographic Period.

3.5. Results of the ArcGIS Spatial Analyses

Results of the co-location analysis indicate that the Wusun sites, while clustered amongst themselves, are statistically isolated from the Saka sites in Figure 8 (co-location mean = 0.27, $p = 0.0087$). This isolation runs counter to a visual interpretation suggesting Wusun kurgans occur within the same spatial locations as the Saka kurgans. Table 6 shows the minimum and maximum colocation quotients. This spatial isolation suggests that Wusun kurgans were placed in a manner that facilitated "filling in" of space between the Saka kurgans, while maintaining a spatially distinct separation from the Saka kurgans. In addition, there may have been an historical reason for this, such as a political strategy by the Wusun to dominate or at least incorporate the indigenous Saka people. One way for the Wusun to assert themselves over the indigenous Saka was by occupying the similar mortuary areas that are also spatially distinct from the Saka mortuary areas. The Wusun could do so by utilizing available space in-between the existing Saka mortuary ground (Figure 9). Figure 10 shows area of actual co-location of Saka and Wusun Kurgans on the east side of Chong Kizil Suu River.

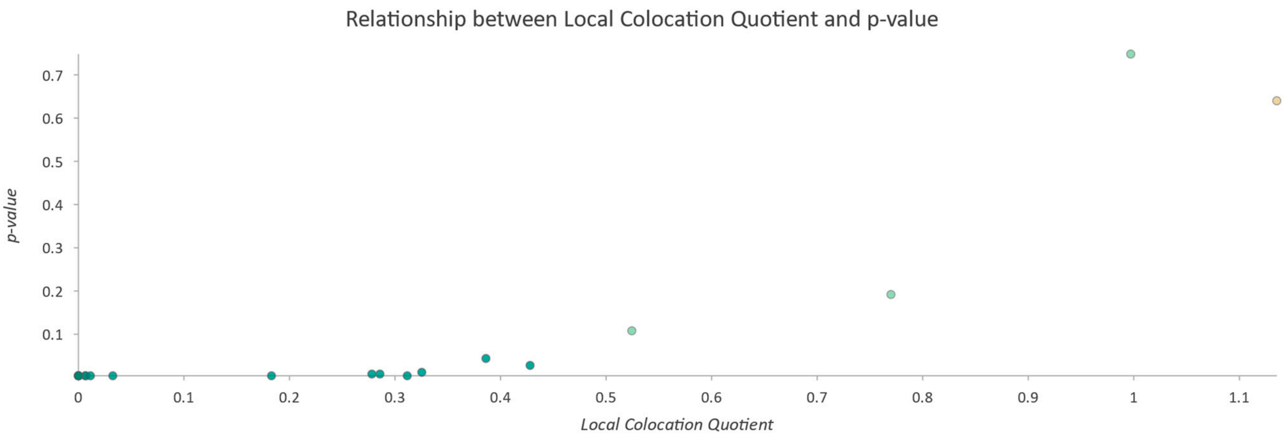

Figure 8. This graph shows the relationship between the Local Colocation Quotient and the *p*-value. With few exceptions, the Local Colocation Quotients indicate that the Wusun Kurgans are spatially isolated from the Saka Kurgans. There are two sites that are considered spatially isolated, yet not statistically significant. All other Wusun kurgans are significantly spatially isolated The colors in this figure correspond to the colors in Figure 10.

Table 6. Minimum and Maximum Local Co-locations and their counts. We find that the majority of the Wusun Kurgans have local colocation quotients that indicate statistically significant spatial isolation (<1).

Minimum of Local Colocation Quotient	Maximum of Local Colocation Quotient	Label	Count
0	0.1	0–0.1	10
0.1	0.3	0.1–0.3	2
0.3	0.4	0.3–0.4	4
0.4	0.6	0.4–0.6	2
0.6	0.7	0.6–0.7	0
0.7	0.9	0.7–0.9	1
0.9	1	0.9–1	0
1	1.1	1–1.1	2

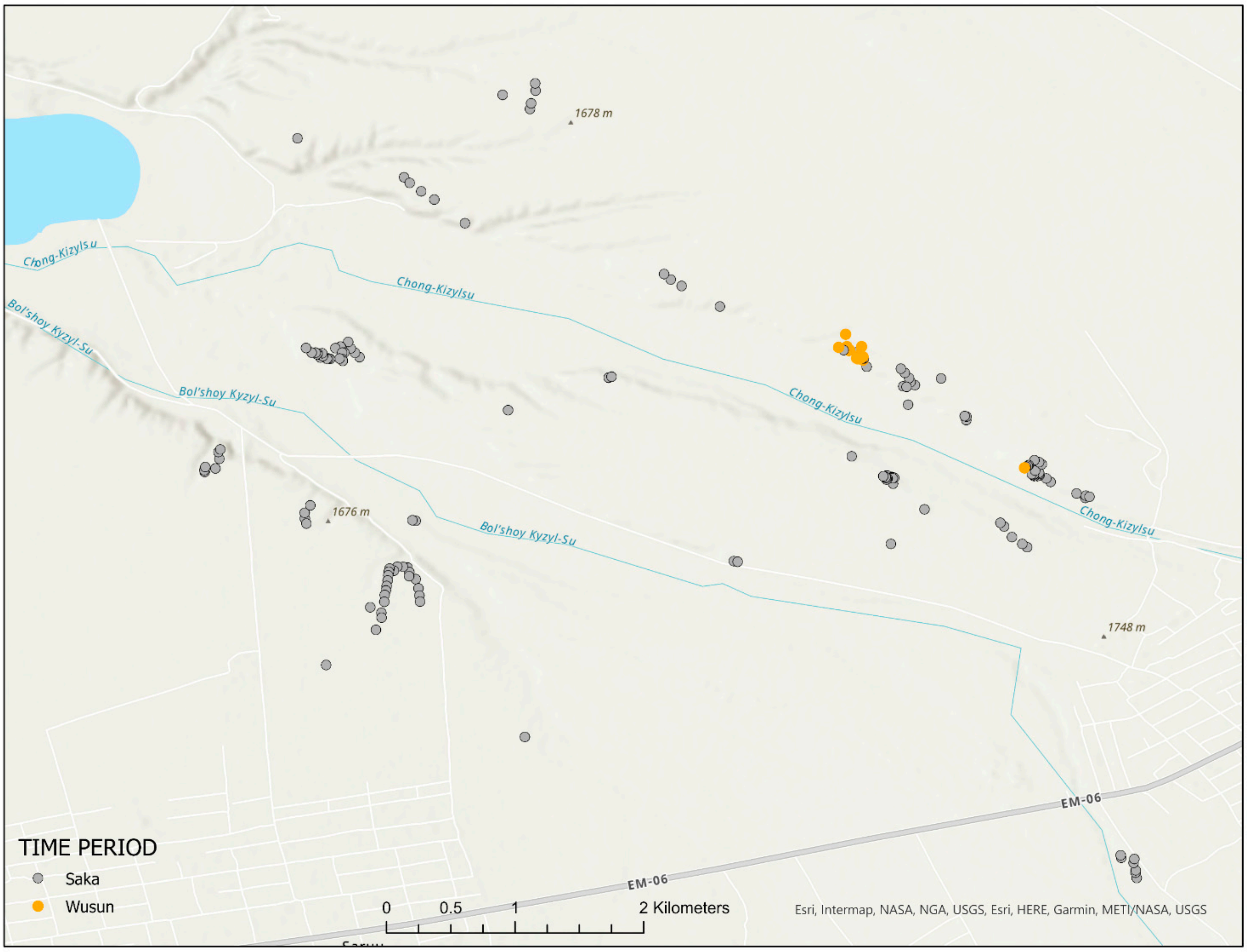

Figure 9. This map shows the spatial distribution of Saka and Wusun kurgans in Lower Kizil Suu.

Further analysis of the co-location outputs suggests the clustered nature of the Wusun sites, are in part, driving the statistical isolation (Table 6). Whereas the Saka locations exhibit a dispersed spatial arrangement (Figure 10). We find that the median centers of the distribution are quite separate, while the directional ellipses indicate a southeast-northwest trend which follows the linear ridgelines of the area.

Further analysis of the co-location outputs suggests the clustered nature of the Wusun sites, are in part, driving the statistical isolation (Table 6), whereas the Saka locations exhibit a dispersed spatial arrangement (Figure 11).

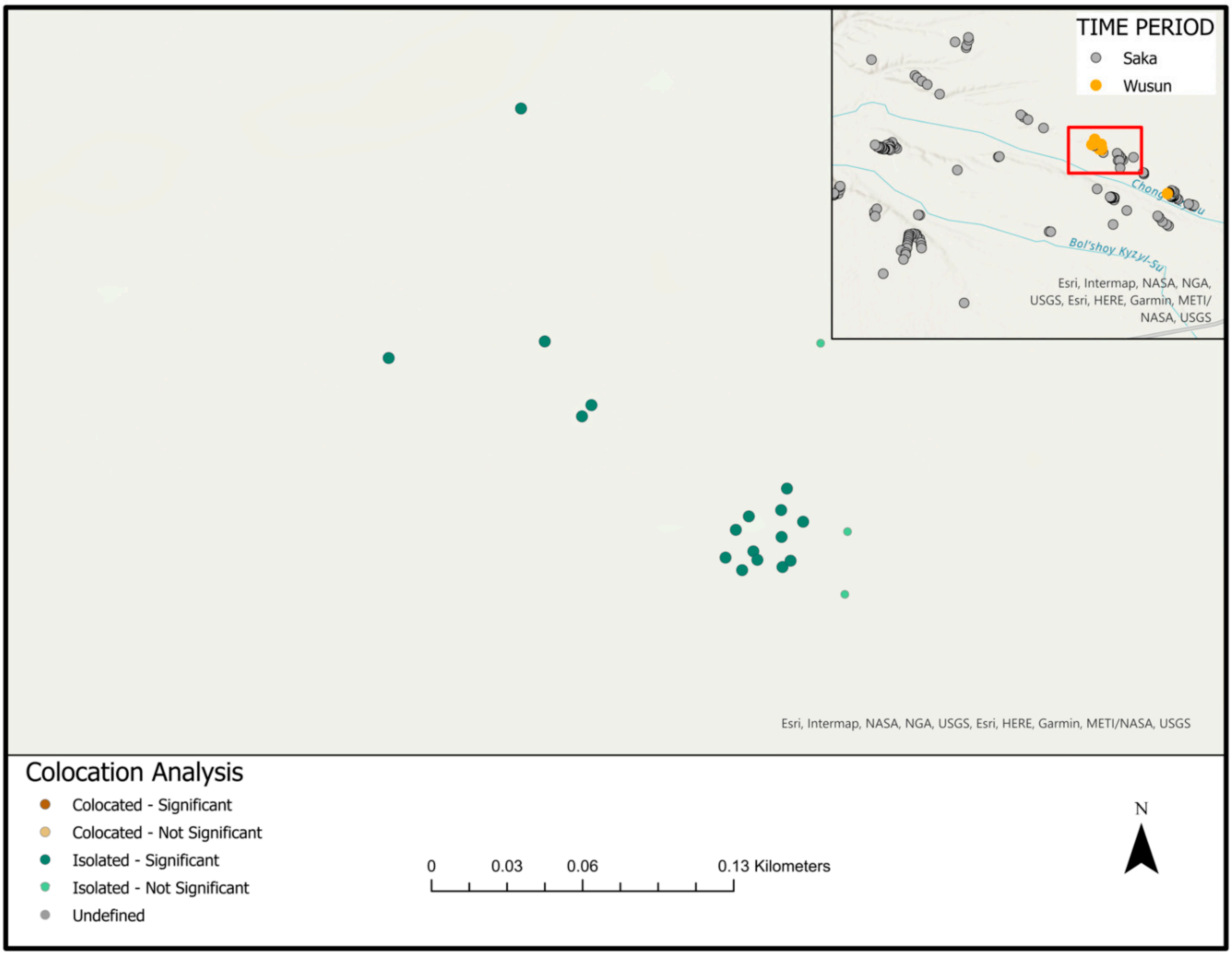

Figure 10. The results of the co-location analysis are indicated in the key and correspond to the main map (area in the red box in the inset map). In this particular cluster, all but two Wusun Kurgans are statistically spatially isolated from the Saka Kurgans. The two lighter green locations are still considered isolated, yet do not make statistical significance.

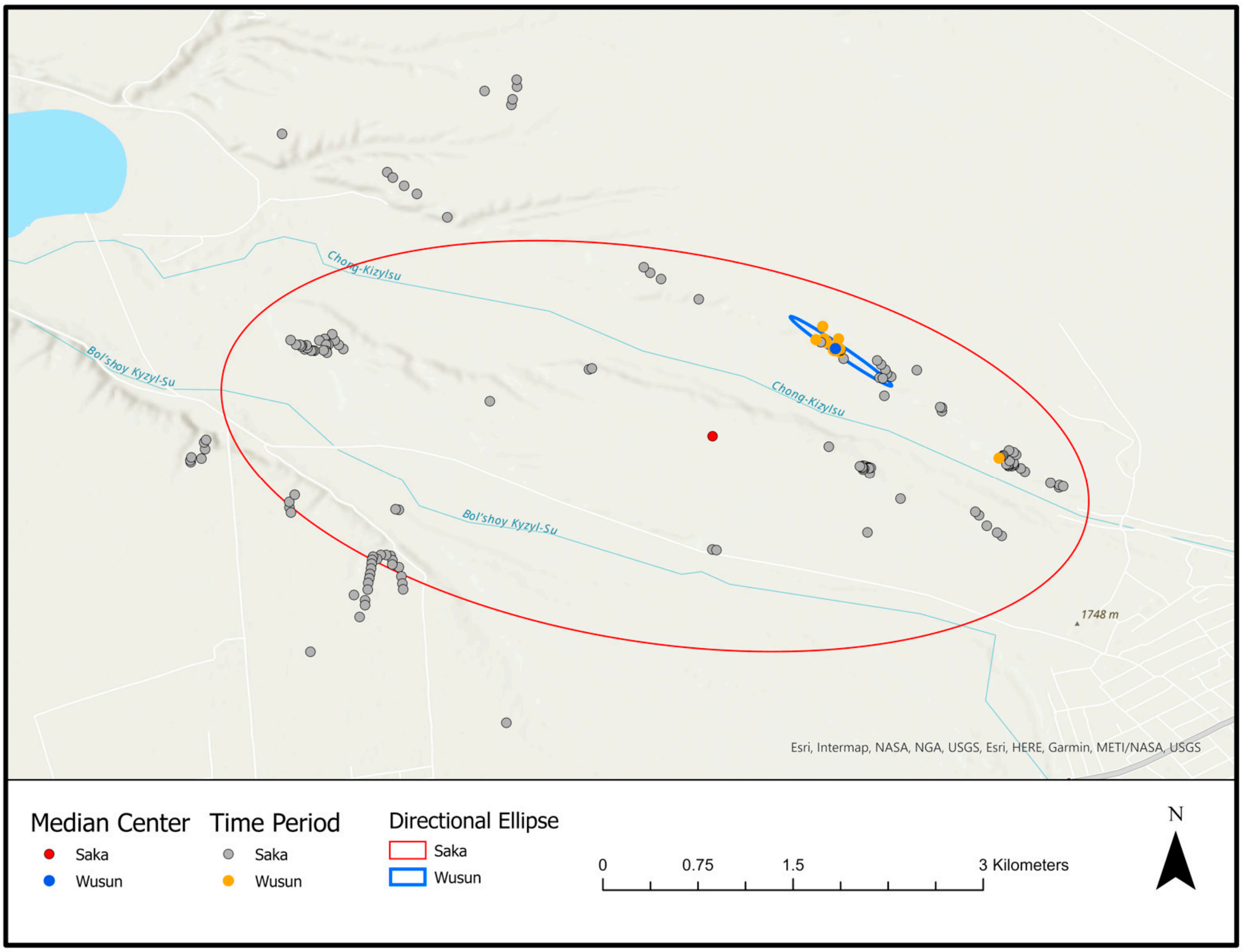

Figure 11. In this map, Wusun kurgans are noted by the orange symbology, while the Saka Kurgans are noted by the grey symbology. Both exhibit a similar directional ellipse, that falls in line with the topography of the area (e.g., following ridgelines), however the red (Saka) and blue (Wusun) exhibit two distinct median centers of spatial distribution.

4. Discussion

The results of the 2019 and 2021 survey in the Juuku and Kizil Suu valleys are quite promising for examining site locations along a vertical gradient. These well-watered alluvial valleys and fans, and upland areas represent at least three different vertical zones: (1) the alluvial fan of Lower Kizil Suu (elevation 1610–1740 m asl); (2) the alluvial valley of Lower Juuku (elevation 1750–1950 m asl); and (3) the upland eastern Juuku Valley (elevation 2060–2100 m asl). Lociof kurgans, settlements, and artifact scatters occur in both valleys along the terraces and valleys of the Juuku and Kizil Suu streams. Of particular interest are the detailed stratigraphic profiles found in the Upper Juuku Valley; EJS1-is an Iron Age settlement (the Wusun period) that shows multiple levels of occupation within a house pit and EJS2 is a Medieval settlement (the Qarakhanid period) that has multiple floor levels and characteristic architectural features such as a sufa, clay floors, ash pits, and well-formed mudbrick walls.

At the Wusun period settlement in Upper Juuku, remains from four domesticated species are found (wheat, barley, and the two millets) along with a considerable component of wild seeds. During the period of occupation, between 130–527 CE, this also might correspond with the pollen records of cold and wet conditions, also seemed to be amenable to upland agriculture as well as animal herding (sheep bones and other animal fauna were found at this site). In contrast, the Medieval Qarakhanid site in Upper Juuku had only one barley grain and considerable evidence of bioturbation and disturbance. The meager seed remains at the Qarakhanid site may be due to either: (1) small sample size or (2) taphonomic disturbances. While speculative, we seek to further test the possibility that during the Qarakhanid period, upland sites were primarily used as camps or way stations for mobile pastoral groups or traders. According to pollen data, the Qarakhanid period falls within a period of dry and warm conditions, thus perhaps upland agriculture was less important since most crops could be grown at lower elevations. In contrast, the ethnographic Kirghiz settlement found in Lower Kizil Suu has the richest archaeobotanical remains that include barley, wheat, the two millets, and peas. This settlement is dated towards the end of the Little Ice Age (15th to 19th centuries) when the climate could have been undergoing warmer and drier conditions. Also, at lower elevations it is apparent that the Kirghiz could grow a wide range of domesticated crops.

The spatial analysis of Iron Age burial mounds is of considerable significance for interpreting Iron Age settlement patterns, beyond what can be visually observed.

Although Table 3 shows great potential for finding artifact scatters and settlement features in plowed agricultural fields; to date the most of sites have been identified as Iron Age kurgans. Settlement sites are much harder to identify because they can be buried below the surface. When artifact scatters such as ceramic sherds are found in plowed fields, it is not possible to know whether these scatters or single artifact finds are indicators of buried settlements without excavating test trenches below the surface. Not only are stone and earthen kurgans readily visible on the landscape, but they also marked the territories of different population groups. The Saka kurgans predominate the landscape. Their locations often overlook prime agricultural lands. The Wusun kurgans are much smaller in size, usually distinguished by an inner stone circle enclosed by two to four rectangular stone structures.

In the co-location analysis, it is apparent that most Saka and Wusun kurgans have their own independent mortuary fields, except for the one area on the east bank of Chichi Kizil Suu where both Saka and Wusun kurgans co-locate. Like the contemporary practice in which ethnographic Kirghiz graves are often placed on Saka earthen burial mounds, the Wusun groups sometimes chose locations near already established Saka burial grounds. Earlier we put forth the hypothesis that the Wusun were in-filling a mortuary territory used by earlier Saka groups as a kind of political or social strategy to also claim the same ritual landscapes. We hope to explore these ideas of why the Iron Age kurgans are located on terraces and ridge lines above the bottom lands near stream and riverbeds. In other publications [31,48,49] we have documented lines of kurgans on the Talgar alluvial fan in southeastern Kazakhstan at the foot of the northern Tian Shan range. These lines of kurgans represent territorial markers of important agricultural or pasture territories claimed by kin or clan groups. Similar linear groupings of Saka kurgans in the Juuku and Lower Kizil Suu valleys also could be indicators of a mortuary burial ground used to mark individual territories or boundaries. In any case the intrusion of Wusun populations into the Kizil Suu Valley sometime after the first century CE, also can be seen in their selection of burial ground territories.

5. Conclusions

The data, analyses, and interpretations in this article are part of a long-term research project: the main objective of this archaeological field project is to test hypotheses of land use practices during the Late Holocene period along the intermontane valleys of the Inner Tian Shan range. These preliminary studies indicate that agricultural and pastoral systems developed over time according to changing climatic conditions and along a vertical gradient of the valley. We might speculate that the cultivation of early grains (barley, wheat, and the two millets) occurred as far back as the Bronze Age and possibly earlier, as apparent from archaeobotanical findings of barley and wheat at the Chap Site in the Kochkor Valley [9,22,45]. By the Iron Age, these domesticated crops were probably well-established even during the cooler and wetter periods from 1450 to 750 BCE and another cool and wet period from 300 to 600 CE, and again from 1500 to 1900 CE [39]. If indeed the pollen cores from near Karakol are also indicative of climatic pulses for the last three millennia in the Juuku and Kizil Suu valleys, then perhaps the local population also fluctuated their economic strategies between agriculture and pastoralism accordingly. Our archaeobotanical samples are small and perhaps too scanty to make bold claims about how land use changed over time. The archaeobotanical analysis of additional collections from other settlements along with zooarchaeological analysis of animal bone remains shall provide more proxies for reconstructing changing land use. It also seems possible establishing a definite correlation between climatic research based upon pollen proxies could be successfully integrated with traditional archaeological materials (seeds, plant remains, animal remains, and artifacts). Nevertheless, these are the kinds of directions we hope to move our research project. Studying long-term diachronic changes over four millennia through multi-disciplinary approaches: archaeo-botany, zooarchaeology, geoarchaeology, and spatial analysis allow us to understand the complex dynamics between human populations, their herd animals, crops, and the natural landscapes of Central Asia. Finally, there is much to be said about ritual burial landscapes that also can provide many clues about the underlying economic and socio-political systems of ancient pastoral and agricultural groups. Do the Wusun newcomers seek to occupy Saka territories, or was there a different kind of ideological boundary system? All these are questions that future spatial analyses can begin to answer. Finally, there is one direction we hope to pursue more rigorously—that of the identification of the Bronze Age through Medieval period settlements in the intermontane valleys. Field data appears to indicate that the large Medieval sites might cover up or bury earlier Iron Age or Bronze Age settlements; yet those Medieval settlements seldom disturb the burial grounds of either Saka or Wusun kurgans. Why is this so? And what may it tell us about the different palimpsests of archaeological land use that exist in these circumscribed valleys during the Late Holocene.

Author Contributions: This article is the result of a multidisciplinary team of specialists and field archaeologists: Conceptualization of this article was undertaken by C.C., S.S.I. and P.A.T.; methodology, all five authors but specifically P.A.T. for the survey results and ground truthing of the loci found at Lower Kizil Suu, S.S.I. for drawing and interpreting the stratigraphic profiles; B.M.-M. and R.N.S.III for the archaeobotany and the radiometric dating of carbonized seeds; D.K. for the GIS analysis; digital software, P.A.T. and D.K.; validation; all five authors; formal analysis, B.M.-M. (Archaeobotany); D.K. (GIS spatial analysis); investigation, C.C., S.S.I. and P.A.T.; resources, S.S.I.; data curation, C.C., P.A.T. and S.S.I.; writing—original draft preparation, C.C.; writing—review and editing, all five authors; visualization, P.A.T. and D.K.; supervision, C.C.; project administration, C.C. and S.S.I.; funding acquisition, C.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the National Geographic Society, grant number NGS-58769R-19. R.N.S.III was funded by European Research Council Starting Grant 851102 for archaeobotanical research. The APC was funded by C.C. and P.A.T.

Institutional Review Board Statement: Not applicable.

Data Availability Statement: The data results of the archaeological surveys, radiometric dates, and GIS analyses are archived by C.C. (USA) and S.S.I. (Kyrgyz National University, Bishkek). The radiometric data is archived by Beta Analytic, Inc and the Max Planck Institute. Archaeobotanical materials archived at the Max Planck Institute for Human Sciences, Archaeobotany Laboratory. Artifact collections are archived by the Kyrgyz National University in the Department of International Relations.

Acknowledgments: We are also grateful to the initial grant preparation and field support provided in 2019 by Kathryn J. Franklin, Department of Classical and Medieval Studies at the University of London (Birkbeck College).

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

References

1. Chang, C.; Ivanov, S.S.; Tourtellotte, P.A. Landscape and Settlement over 4 Millennia on the South Side of Lake Issyk Kul, Kyrgyzstan: Preliminary Results of Survey Research in 2019–2021. *Land* **2022**, *11*, 456. [CrossRef]
2. Frachetti, M.D. Multiregional Emergence of Mobile Pastoralism and Nonuniform Institutional Complexity across Eurasia. *Curr. Anthr.* **2012**, *53*, 2–38. [CrossRef]
3. Gokcumen, O.; Frachetti, M. The Impact of Ancient Genome Studies in Archaeology. *Annu. Rev. Anthr.* **2020**, *49*, 277–298. [CrossRef]
4. Unterländer, M.; Palstra, F.; Lazaridis, I.; Pilipenko, A.; Hofmanová, Z.; Groß, M.; Sell, C.; Blöcher, J.; Kirsanow, K.; Rohland, N.; et al. Ancestry and demography and descendants of Iron Age nomads of the Eurasian Steppe. *Nat. Commun.* **2017**, *8*, 14615. [CrossRef]
5. Ventresca Miller, A.R.; Makarewicz, C.A. Isotopic approaches to pastoralism in prehistory: Diet, mobility, and isotopic reference sets. In *Isotopic Investigations of Pastoralism in Prehistory*; Routledge Press: Abingdon, UK, 2017; pp. 1–14.
6. Hermes, T.R.; Frachetti, M.D.; Doumani Dupuy, P.N.D.; Mar'Yashev, A.; Nebel, A.; Makarewicz, C.A. Early integration of pastoralism and millet cultivation in Bronze Age Eurasia. *Proc. R. Soc. B* **2019**, *286*, 20191273. [CrossRef]
7. Spengler, R.N., III; Miller, A.V.; Schmaus, T.; Matuzevičiūtė, G.M.; Miller, B.K.; Wilkin, S.; Taylor, W.T.T.; Li, Y.; Roberts, P.; Boivin, N. An Imagined Past? Nomadic Narratives in Central Asian Archaeology. *Curr. Anthropol.* **2021**, *62*, 251–286. [CrossRef]
8. Ventresca Miller, A.R.V.; Haruda, A.; Varfolomeev, V.; Goryachev, A.; Makarewicz, C.A. Close management of sheep in ancient Central Asia: Evidence for foddering, transhumance, and extended lambing seasons during the Bronze and Iron Ages. *STAR Sci. Technol. Archaeol. Res.* **2020**, *6*, 41–60. [CrossRef]
9. Matuzeviciute, G.M.; Mir-Makhamad, B.; Tabaldiev, K. The first comprehensive archaeobotanical analysis of prehistoric agriculture in Kyrgyzstan. *Veg. Hist. Archaeobot.* **2021**, *30*, 743–758. [CrossRef]
10. Ullah, I.I.; Chang, C.; Tourtellotte, P. Water, dust, and agro-pastoralism: Modeling socio-ecological co-evolution of landscapes, farming, and human society in southeast Kazakhstan during the mid to late Holocene. *J. Anthr. Archaeol.* **2019**, *55*, 101067. [CrossRef]
11. Betts, A.; Jia, P.; Abuduresule, I. A new hypothesis for early Bronze Age cultural diversity in Xinjiang, China. *Archaeol. Res. Asia* **2019**, *17*, 204–213. [CrossRef]
12. Li, Y.; Storozum, M.; Tian, D.; Frachetti, M.; Su, K.; Wang, X. Farming strategies of 1st millennium CE agro-pastoralists on the southern foothills of the Tianshan Mountains: A geoarchaeological and macrobotanical investigation of the Mohuchahangoukou (MGK) site, Xinjiang, China. *PLoS ONE* **2019**, *14*, e0217171. [CrossRef] [PubMed]
13. Spate, M.; Yatoo, M.A.; Penny, D.; Shah, M.A.; Betts, A. Palaeoenvironmental proxies indicate long-term development of agro-pastoralist landscapes in Inner Asian mountains. *Sci. Rep.* **2022**, *12*, 54. [CrossRef] [PubMed]
14. Khazanov, A.M. *Nomads and the Outside World*, 2nd ed.; The University of Wisconsin Press: Madison, WI, USA, 1994; pp. 232–262.
15. Kradin, N. Nomadic empires in inner Asia. In *Complexity of Interaction along the Eurasian Steppe Zone in the First Millennium CE*; Vfgarchpress: Bonn, Germany, 2015; pp. 11–48.
16. Masanov, N.E. *Kochevaya Tsivilizatsiya Kazkakhov: Osnov'i Zhisznedelatmel'nosti Nomadnogo Obshestsva (Nomadic Kazakh Civilization: The Foundation of Nomadic Society*; Sostinvest: Almaty, Kazakhstan; Moscowand, Russia, 1995. (In Russian)
17. Dyson-Hudson, N. The Study of Nomads. In *Perspectives on Nomadism*; Irons, W., Dyson-Hudson, N., Eds.; E.J. Brill: Leiden, The Netherlands, 1972; pp. 2–29.
18. Anthony, D.W. *The Horse, the Wheel and Language; How Bronze-Age Riders from the Eurasian Steppes Shaped the Modern World*; Princeton University Press: Princeton, NJ, USA; Oxford, UK, 2007.
19. Beisenov, A.Z.; Svyatko, S.V.; Duysenbay, D.B.; Akhiyarov, I.K.; Reimer, P.J.; Arkheologiya, P. New Isotopic Data on the Diet of the Saka Period Population from Central Kazakhstan. *Povolzhskaya Arkheologiya (Volga River Reg. Archaeol.)* **2020**, *3*, 208–218. [CrossRef]
20. Spengler, R.; Miller, N.; Neef, R.; Tourtellotte, P.A.; Chang, C. Linking agriculture and exchange to social developments of the Central Asian Iron Age. *J. Anthr. Archaeol.* **2017**, *48*, 295–308. [CrossRef]
21. Miller, A.R.V.; Spengler, R.; Haruda, A.; Miller, B.; Wilkin, S.; Robinson, S.; Roberts, P.; Boivin, N. Ecosystem Engineering Among Ancient Pastoralists in Northern Central Asia. *Front. Earth Sci.* **2020**, *8*, 168. [CrossRef]
22. Matuzeviciute, G.M.; Ananyevskaya, E.; Sakalauskaite, J.; Soltobaev, O.; Tabaldiev, K. The integration of millet into the diet of Central Asian populations in the third millennium BC. *Antiquity* **2022**, *96*, 560–574. [CrossRef]
23. Caspari, G.; Betts, A.; Jia, P. The Bronze Age in the Western Tianshan, China: A new model for determining seasonal use of sites. *J. Archaeol. Sci. Rep.* **2017**, *14*, 12–20. [CrossRef]
24. Tian, D.; Festa, M.; Cong, D.; Zhao, Z.; Jia, P.W.; Betts, A. New evidence for supplementary crop production, foddering and fuel use by Bronze Age transhumant pastoralists in the Tianshan Mountains. *Sci. Rep.* **2021**, *11*, 13718. [CrossRef]
25. Rouse, L.M.; Krumnow, J. On the fly: Strategies for UAV-based archaeological survey in mountainous areas of Central Asia and their implications for landscape research. *J. Archaeol. Sci. Rep.* **2020**, *30*, 102275. [CrossRef]

26. Rouse, L.M.; Tabaldiev, K.; Matuzeviciute, G.M. Exploring Landscape Archaeology and UAV-Based Survey in the Kochkor Valley, Kyrgyzstan. *J. Field Archaeol.* **2021**, *47*, 32–53. [CrossRef]
27. Frachetti, M.D.; Smith, C.E.; Traub, C.; Williams, T. Nomadic ecology shaped the highland geography of Asia's Silk Roads. *Nature* **2017**, *543*, 193–198. [CrossRef] [PubMed]
28. Dupuy, P.N.D.; Zhuniskhanov, A.S.; Bullion, E.A.; Kiyasbek, G.K.; Tashmanbetova, Z.K.; Rakhmankulov, E.Z.; Isin, A.I. The newly discovered bronze age site of Koken: Merging micro-regions with major study zones in the high steppes of Kazakhstan. *Archaeol. Res. Asia* **2021**, *27*, 100292. [CrossRef]
29. Rouse, L.M.; Cerasetti, B. Ojakly: A Late Bronze Age mobile pastoralist site in the Murghab Region, Turkmenistan. *J. Field Archaeol.* **2014**, *39*, 32–50. [CrossRef]
30. Spengler, R.; Frachetti, M.; Doumani, P.; Rouse, L.; Cerasetti, B.; Bullion, E.; Mar'Yashev, A. Early agriculture and crop transmission among Bronze Age mobile pastoralists of Central Eurasia. *Proc. R. Soc. B Boil. Sci.* **2014**, *281*, 20133382. [CrossRef]
31. Chang, C. *Rethinking Prehistoric Central Asia: Shepherds, Farmers, and Nomads*; Routledge: Abingdon, UK, 2017.
32. Frachetti, M.D.; Maksudov, F. The landscape of ancient mobile pastoralism in the highlands of southeastern Uzbekistan, 2000b.c.–a.d.1400. *J. Field Archaeol.* **2014**, *39*, 195–212. [CrossRef]
33. Mir-Makhamad, B.; Mirzaakhmedov, S.; Rahmonov, H.; Stark, S.; Omel'Chenko, A.; Spengler, R.N. Qarakhanids on the Edge of the Bukhara Oasis: Archaeobotany of Medieval Paykend. *Econ. Bot.* **2021**, *75*, 195–214. [CrossRef]
34. Tabaldiev, K.S. *Ancient Monuments of the Tian Shan*; Centralnoaziatskogo Universiteta: Bishkek, Kyrgyzstan, 2011; p. 318.
35. Amanbaeva, B.E.; Kol'chenkov, B.A.; Sulaimanova, A.T. *Archaeological Monuments of the Kyrgyzstan Portion of the Great Silk Road*; Institute of History and Culture: Bishkek, Kyrgyzstan, 2015.
36. Abdrakhmetov, K.; Korjenkov, A.M. *Climate Evolution in Central Asia during the Past Few Million Years: A Case Study from Issyk-Kul, ICDP Workshop Bishkek, Kyrgyzstan, June 12th to 17th, 2011. Field Excursions Guidebook*; GFZ Helmskotz-Zentrum: Potsdam, Germany, 2011.
37. Korjenkov, A.M. (Ed.) *Strong Earthquakes, Historical and Ancient Earthquakes of Issyk Kul and Their Position in the Formation of the Northern Tian Shan Range*; IFZ: Moscow, Russia, 2018; pp. 1–173.
38. Strelnikov, A.A.; Korzhenkov, A.M. Destruction of Medieval Archaeological Monuments by Strong Earthquakes in the Southwestern Issyk-Kul Basin, Tien Shan. *Seism. Instrum.* **2021**, *57*, 55–74. [CrossRef]
39. Leroy, S.A.; Giralt, S.R. Humid and cold periods in the last 5600 years in Arid Central Asia revealed by palynology of Picea schrenkiana from Issyk-Kul. *Holocene* **2020**, *31*, 380–391. [CrossRef]
40. Bronk Ramsey, C. Bayesian Analysis of Radiocarbon Dates. *Radiocarbon* **2009**, *51*, 337–360. [CrossRef]
41. Bronk Ramsey, C. OxCal 4.4. 2020. Available online: https://c14.arch.ox.ac.uk/oxcal/OxCal.html (accessed on 28 February 2022).
42. Reimer, P.J.; Austin, W.E.N.; Bard, E.; Bayliss, A.; Blackwell, P.G.; Ramsey, C.B.; Butzin, M.; Cheng, H.; Edwards, R.L.; Friedrich, M.; et al. The IntCal20 Northern Hemisphere Radiocarbon Age Calibration Curve (0–55 cal kBP). *Radiocarbon* **2020**, *62*, 725–757. [CrossRef]
43. Spengler, R.; Chang, C.; Tourtellotte, P.A. Agricultural production in the Central Asian mountains: Tuzusai, Kazakhstan (410–150b.c.). *J. Field Archaeol.* **2013**, *38*, 68–85. [CrossRef]
44. Wu, X.; Miller, N.F.; Crabtree, P. Agro-Pastoral Strategies and Food Production on the Achaemenid Frontier in Central Asia: A Case Study of Kyzyltepa in Southern Uzbekistan. *Iran* **2015**, *53*, 93–117. [CrossRef]
45. Matuzeviciute, G.M.; Tabaldiev, K.; Hermes, T.; Ananyevskaya, E.; Grikpedis, M.; Luneau, E.; Merkyte, I.; Rouse, L.M. High-Altitude Agro-Pastoralism in the Kyrgyz Tien Shan: New Excavations of the Chap Farmstead (1065–825 cal b.c.). *J. Field Archaeol.* **2020**, *45*, 29–45. [CrossRef]
46. Herrmann, G.; Kurbansakhatov, K. The International Merv Project Preliminary Report on the Second Season (1993). *Iran* **1994**, *32*, 53–75. [CrossRef]
47. Spengler, R.N.; Frachetti, M.D.; Doumani, P.N. Late Bronze Age agriculture at Tasbas in the Dzhungar Mountains of eastern Kazakhstan. *Quat. Int.* **2014**, *348*, 147–157. [CrossRef]
48. Chang, C.; Tourtellotte, P.A. The Kazakh-American Talgar Project Archaeological Field Surveys in the Talgar and Turgen-Asi Areas of Southeastern Kazakhstan: 1997–1999 by Claudia Chang and Perry A. Tourtellotte. In *Kurgans, Ritual Sites, and Settlements Eurasian Bronze and Iron Age*; Davis-Kimball, J., Murphy, E.M., Koryakova, L., Yablonsky, L.T., Eds.; International Series 890; British Archaeological Reports: Oxford, UK, 2000; pp. 83–88.
49. Chang, C. Lines of Power: Equality or hierarchy among the Iron Age agropastoralists of southeastern Kazakhstan. In *Revolutions and Regimes: The Archaeology of Power and Politics in Eurasia*; Hartley, C., Yazicioglu, C.B., Smith, A.T., Eds.; Cambridge University Press: Cambridge, UK, 2012; pp. 122–142.