Anthropogenic transformation of landscapes in ancient times
(on the example of the town of Artesian in Crimean Pryazovia)

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Abstract. On the basis of a comparative analysis of known historical and archaeological data the paper shows the formation of the anthropogenic landscape for the period of 800 years of the ancient town of Artesian (Crimean Pryazovia). It was found that the process of transformation of all components of biocenoses has not always been progressive. In certain periods (war, earthquake) there was a decrease in the anthropogenic load and the natural landscapes were restored on the periphery of the territory controlled by the town. However, these periods did not change the overall outcome – radical and irreversible change of all components of the landscape by man. The obtained data are well aligned with known literary findings about the significant human influence on landscapes in past eras and confirm their existence in the northeastern part of Crimea.

1. Introduction

Recently, there have been many articles demonstrating that the anthropogenic landscape transformation was quite critical in the past and even irreversible in some cases [1]. Those works cover many regions of the world and Russia [2–8], they are also applicable for the south of our country [9–12]. At the same time, no such research was carried out for a number of territories, for example, in the Crimean Pryazovia, although there are a large number of large antique towns forming part of the Bosporan Kingdom, operating simultaneously and being located within the line of sight.

The purpose of the study is to show radical anthropogenic changes of all landscape components over the span of antiquity on the example of one of the towns of Crimean Pryazovia – Artesian. Many years of excavations carried out by one of the authors of this work allowed restoring the complex history of the town, determining chronological periods of its ups and downs. The detailed historical and archaeological reconstruction allows not only defining the types of technogenic transformation of landscapes both within the town itself and in its vicinity, but also, taking into account the narrow chronological limits of various stages of its life, considering the dynamics of such transformation from the beginning of the town’s formation to its almost complete abandoning. It is also possible to conclude that modern dry-steppe landscapes of the region are directly related to anthropogenic transformation of landscapes in the ancient times.
2. Objects and methods
The multilayered ancient settlement of Artesian (45°39′63.66″AD, 36°16′71.91″E) with a capacity of cultural stratification of the Neolithic-Bronze age, antique and medieval times up to 5–6 meters occupied the area of not less than 7 hectares and was located on the natural height between two water cut putlogs. Now the excavated sections of the town form a complex of ruined diachronous structures overgrown with dry-steppe vegetation.

During the antique period, the settlement has been operating since V-IV centuries BC up to the IV century AD, existing almost throughout the history of the Bosporan Kingdom. It was during the antique period that the impact of the town on the nearby landscapes was most intense, so in our study we will only consider it, i.e. the interval from V-IV centuries BC to IV AD (about 800–900 years).

It seems important that during this period the town survived the war and at least two strong earthquakes [14, 15], the consequences of which on the local ecosystem, geomorphological processes, the hydrologic regime of the territories in terms of speed and rate of impact could even exceed the time-stretched results of anthropogenic impact of calm development stages [16].

The main method of study includes relatively analytical, when, based on known historical and archaeological data, it is possible to make conclusions on the type and intensity of anthropogenic impact on the landscape both on the town itself and on the surrounding lands.

3. Results
The main results of the comparative analysis are shown in Table 1.

The table clearly shows that the intensive growth of the town began approximately from 370–315. BC and lasted until the war of 44/45–46/47 AD, i.e. about 400 years. Even the earthquake of 63 BC did not affect the general trend of expansion of the town, intensification of economic activity, complete and maximum restructuring of landscapes of the whole territory controlled by the town. It was in the final stages of this period that the dominant type of landscape became anthropogenic.

War and fire destroyed the town. The population decline led to the abandoning of peripheral lands with domineering natural processes and restored natural landscapes.

The reconstruction of the town was accompanied by its expansion, restoration of economic and industrial activities on the previous and even larger scale. For example, a large necropolis was created on the area of about 35 ha, i.e. the plant cover and the top 100 cm of soil was completely destroyed to build multiple stone vaults and ground tombs on a huge area. Abandoned land was again unraveled or used for pasture. In other words, it is possible to talk with confidence about the absolute dominance of anthropogenic landscape in all lands under the jurisdiction of the town. This second rise of the town of Artesian lasted for about 200 years before a strong earthquake in the second half of III century AD.

The ensuing strongest earthquake completely destroyed the town and the stone vaults of a huge necropolis. Obviously, all restored hydraulic facilities (drainage, sewerage), roads, craft shops were destroyed or demolished. After this impact of nature, the town recovered, but not in the same capacity. The process of degradation began, proper layout of districts was disrupted, in some areas of the settlement the flat rows of buildings were replaced by local chaotic construction. Although among archaeological findings relating to that time, feeders and country houses for livestock, grain storages, wineries, wells are found, their number is insignificant compared to those of the earlier periods.

The gradual attenuation of life in the town can be traced to the end of IV century AD, i.e. it lasted for about 150 years. During this period, peripheral lands and partly nearby territories with domineering natural landscape restoration processes were completely abandoned.
Table 1. Ancient town of Artesian. The relations between the stages of functioning and transformation of landscapes during the ancient period

| Historical data | Archaeological data | Economic activity | Natural environment | Type of landscape |
|-----------------|--------------------|-------------------|---------------------|-------------------|
| From IV–V century BC to 370-315 AD | Small ancient settlement, mud huts, buildings from stone, wood, cane and mudbrick. | Forest cutting, excavation of rocks, sand, loam, clay for construction, crafts and economic needs. | Broadleaf and coniferous forests, chernozemic soils under meadows, watered putlogs. | Mainly natural. Beginning of anthropogenic transformation. |
| 370-315 BC – 63 AD (earthquake) | Terraces. Stone household-residential complexes with wooden floors, tiles, ovens, hearths, roofs. Temples, pipes of ceramic water ducts. | Mass cutting of trees, cane, excavation of stone, clay, sand. Well sinking. | Severe disorders of biosphere, lithosphere, pedosphere. Changes of hydrological parameters. | Formation of anthropogenic landscape in the town and in the nearest vicinity. |
| 63 BC – 44/45 AD | Expansion of the town, large capital structures, deep (3.2-3.6 m) ditch, wineries, grain storages, stalls, tins, cattle feeders. Finds of hooks, viticultural knives, saws, moths, axes, ploughs, grain furnaces for tile burning, metallurgical furnaces. Drainages and sewerage. | Benching of slopes, pottery; livestock, poultry, wine production. Mass tile production. Metallurgy. Deforestation, extraction of mineral resources, stone, clay. Well sinking. Construction of communications and necropolises. | Creation of quarries and overburden operations on a large area, change of hydraulic network, soil and plant cover. | Expansion of anthropogenically transformed landscapes. |
| 44/45 – 46/47 AC (war, fire) | Burning the entire suburb and citadel. Pillage of the necropolis. | Complete demolition of constructions. Attempt to renovate structures between storms. | Initial stages of restoration of plant and soil cover on the periphery. | Predominantly anthropogenic, locally natural-anthropogenic, on the periphery – natural. |
| 46/47 AD – Second half of III century AD | Expansion of the territory of the ancient settlement. Wider (10-12 m) ditch, wineries, production complexes, grain storages, stalls, tins, livestock feeders. More than 17 wells. Drainages. Sewerage. Metal slags. Extension of necropolis up to 35 hectares. | Creation of new mining quarries. Extraction of clay, sand, limestone on a considerable scale, maximum expansion of lands for grazing, farming, winemaking. Tile production and metal smelting. | Restoration and expansion of the area of fundamental transformation of landscapes. Necropolis – withdrawal of lands from circulation with complete destruction of vegetation and soils. | Anthropogenic landscapes throughout the area under the control of the population of the town. |
| Second half of III century AD Earthquake of magnitude 9-10. | Total destruction of buildings and stone vaults of the necropolis. | Attempts to build destroyed production and economic complexes. Viticulture, animal husbandry, farming, craft. | Changes of all landscape parameters due to earthquake. | In the center – anthropogenic, locally – naturally anthropogenic, on the periphery – natural. |
| III – IV century AD | Elements of chaotic building. Finds: wineries, feeders and countries for livestock, slags, grain storages, wells. | Viticulture, animal husbandry, farming, craft in small volumes. Degradation of the ancient settlement. | Partial restoration of plant and soil cover in the peripheral zone. | Natural-anthropogenic, on the periphery – natural. |
| After IV century AD | Desolation. Termination of necropolis. | Not revealed | Restoration of natural complexes | Natural |
4. Conclusion
During the period of about 700–800 years of economic activity in the ancient era, the area of the town itself and key territories around it were radically and irreversibly changed by man. Almost all components of nature were changed: lithosphere, soil and plant cover, animal world. Certainly, the maximum transformations happened within the area of the town, significant – in the area of necropolis, but the ecosystem and peripheral part were completely rebuilt.

The growing trees were cut down for fields, gardens, vineyards and pastures. The plowing of lands was accompanied by the disruption of the soil cover and the development of soil erosion. Regular long-term grazing was accompanied by the appearance of new, more xerophytic species of plants resistant to damage, and prevented the recovery of the tree tier.

The development of industries (pottery, metal smelting), continuous construction and/or reconstruction of buildings required considerable volumes of overburden operations, movement of many tons of clay, sand and stone, which changed the surrounding landscape. Irrigation work, for example, to provide water to the inhabitants of the town, changed the direction and volume of water flows, and household and sewage runoff from the town affected the overall environmental situation, thus increasing the negative effects of each anthropogenic transformed component.

Since in ancient times there were quite a lot of similar towns in the region, they were located within almost the line of sight, at neighboring heights and watersheds, and hence the boundaries of economic facilities of the nearby towns were closed. Since Artesian is a typical fortified and fairly urbanized military-economic settlement of the Bosporan Kingdom [17], the drawn conclusions can be confidently extrapolated to other similar towns. In other words, a fundamental and irreversible restructuring of the landscape took place not only within a single town and its economic district; it was substantially larger and affected the entire part of Bosporan ecumene. Thus, our research confirmed the conclusions made for other regions of the peninsula that modern steppe landscapes of Crimea, most likely, have not natural, but anthropogenic basis of their formation [11, 18].

It is important that the degradation of the natural environment under massive human influence continued after the ancient era. This is illustrated by the marked consequences of wind and water erosion traced during archaeological surveys on the southern slope of Artesian: dust storms and flushes of open soils into the putlog. At present, these processes do not continue being a serious problem for the ecology of modern steppe Crimea, local nature, animal and plant world, saving/renewal of its water resources.

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