



History of formation and current state of deserts, semi-deserts and steppes of Northern Eurasia (part I)

FOREST-STEPPES, STEPPES, SEMI-DESERTS AND DESERTS WERE FORMED DUE TO CLIMATE CHANGES CAUSED BY THE DESTRUCTION OF KEYSTONE SPECIES BY HUMANS



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<https://sites.google.com/site/wvugeol616advancedsed/home/sonnet?tmpl=%2Fsystem%2Fapp%2Ftemplates%2Fprint%2F&showPrintDialog=1>

HISTORY OF FORMATION OF THE SAHARA

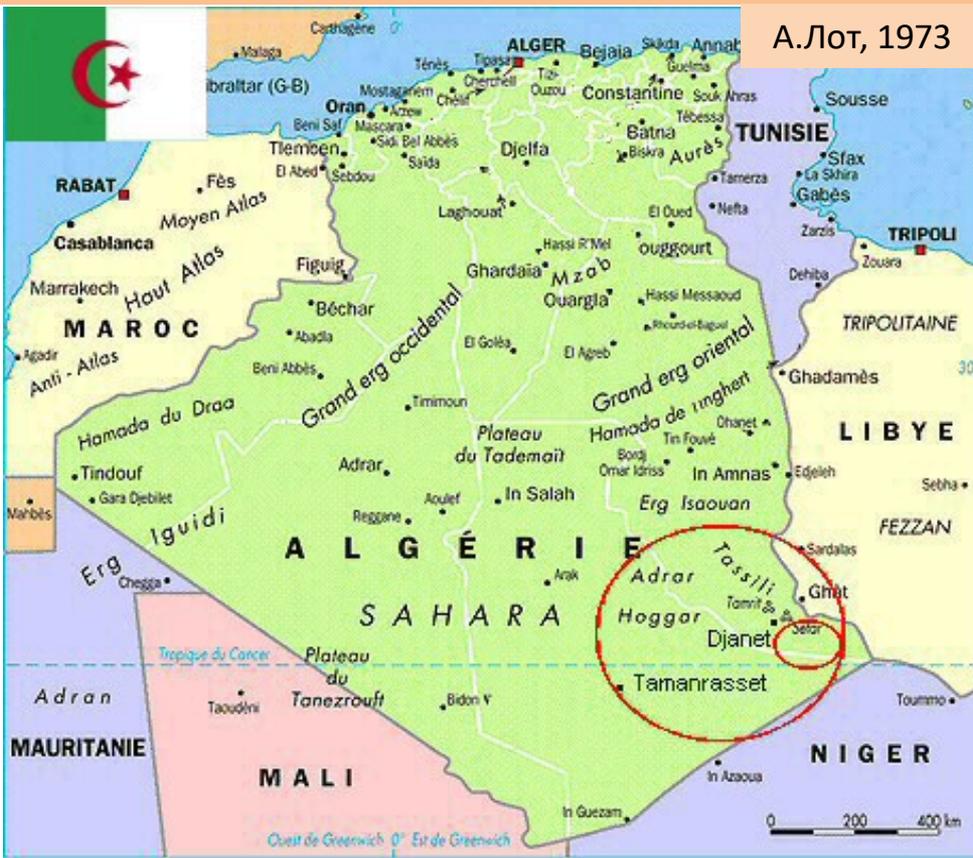
"...only a continuous unbroken cover of undisturbed natural forest, bordering the ocean or sea along the entire coastline, is able to sustainably keep enough moisture to maintain life no matter how far inland..." (*Gorshkov, Makarieva, 2006*)



In prehistoric times territories that are marked on modern geographical maps as treeless (steppes) or almost completely devoid of vegetation (deserts) played an important role in the history of mankind. Materials of the Quaternary research and numerous finds indicate that in modern steppes, semi-deserts and deserts, human sites appeared much earlier than in modern forests and changed the living cover of these territories significantly earlier and to a greater extent. One of the most interesting places in this regard is the **SAHARA**.



HISTORY OF FORMATION OF THE SAHARA

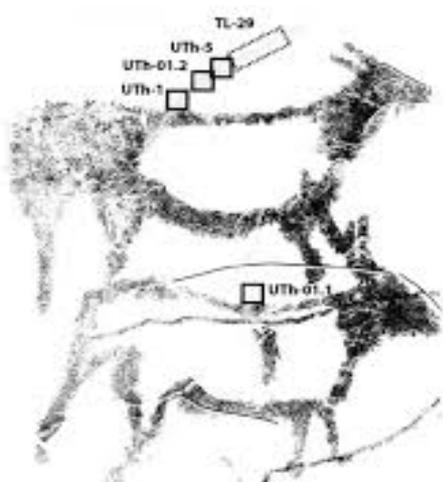


Sites of the prehistoric man in Tassili-Ajjer

<https://www.inst.at/trans/23/tassili-n-azdjer-a-site-of-the-world-heritage-to-be-visited-in-the-region-of-algerian-sahara/>

Copies of unique frescoes with images of animals, people and features of life that had been persisting in this territory for many millennia were made thanks to the research of the French archaeological expedition of Henri Lhote in the remote mountainous region of the Central Sahara — Tassili-Ajjer. These data allow us to make a preliminary reconstruction of the living cover of this territory in prehistoric times and in a first approximation determine the time of formation of the desert (A. Lot, 1973). Further research reveals new data and clarifies the times of various stages of transformation of the Sahara as a result of economic activity.



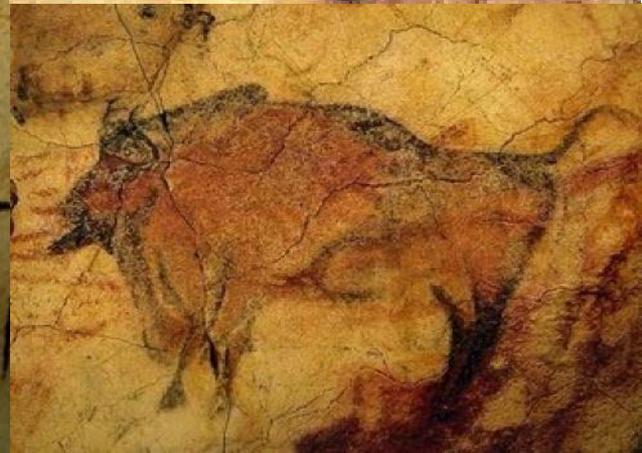
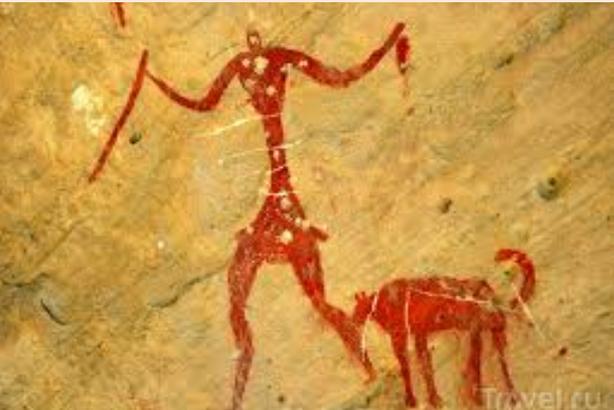


TL-29: 34175 ± 3850
UTh-5: 26800 ± 480
UTh-01.2: 28000 ± 1850
UTh-1: 26500 ± 960
UTh-01.1: 37000 ± 1100

25 cm



Cave art, Henri Lhote (A. Lot, 1973)



DEVELOPMENT OF APPROPRIATING AND PRODUCING ECONOMY IN THE SAHARA

"...I found traces of ancient fishermen's sites: large piles of fish bones..., skeletons of hippos and elephants, stone tools. 500 kilometers to the south, on the border of the Sahara and Sudan, I found a dozen more campsites. There were heaps of fish bones, turtle shells, clam shells, hippopotamus, giraffe, and antelope bones; human skeletons.... On the site of this prehistoric massacre I managed to collect many magnificent tools, including beautiful bone harpoons, thin flint arrowheads, sinkers for fishing nets, and many other artifacts... South of the Hoggar Mountains, at the foot of the cliffs of In Guezzam, in the most desolate parts of the Sahara, a similar find was made — human skeletons, bones of various animals, and, besides, thousands of fragments of pottery...".



Wadi Al-Hitan is more often called the Whale Valley. This is a unique monument of paleontology in the western desert of Egypt.

<https://shnyagi.net>



DEVELOPMENT OF APPROPRIATING AND PRODUCING ECONOMY IN THE SAHARA

"...I could give many more examples: only in the vicinity of the Hoggar Mountains I found about eighty places with traces of prehistoric sites.

It suggests that the Sahara was once densely populated and its fauna was similar to that of the modern savanna. While the most ancient artifacts, such as the remains of fishing camps, are several hundred thousand years old, there are some that are only four to five thousand years old..."

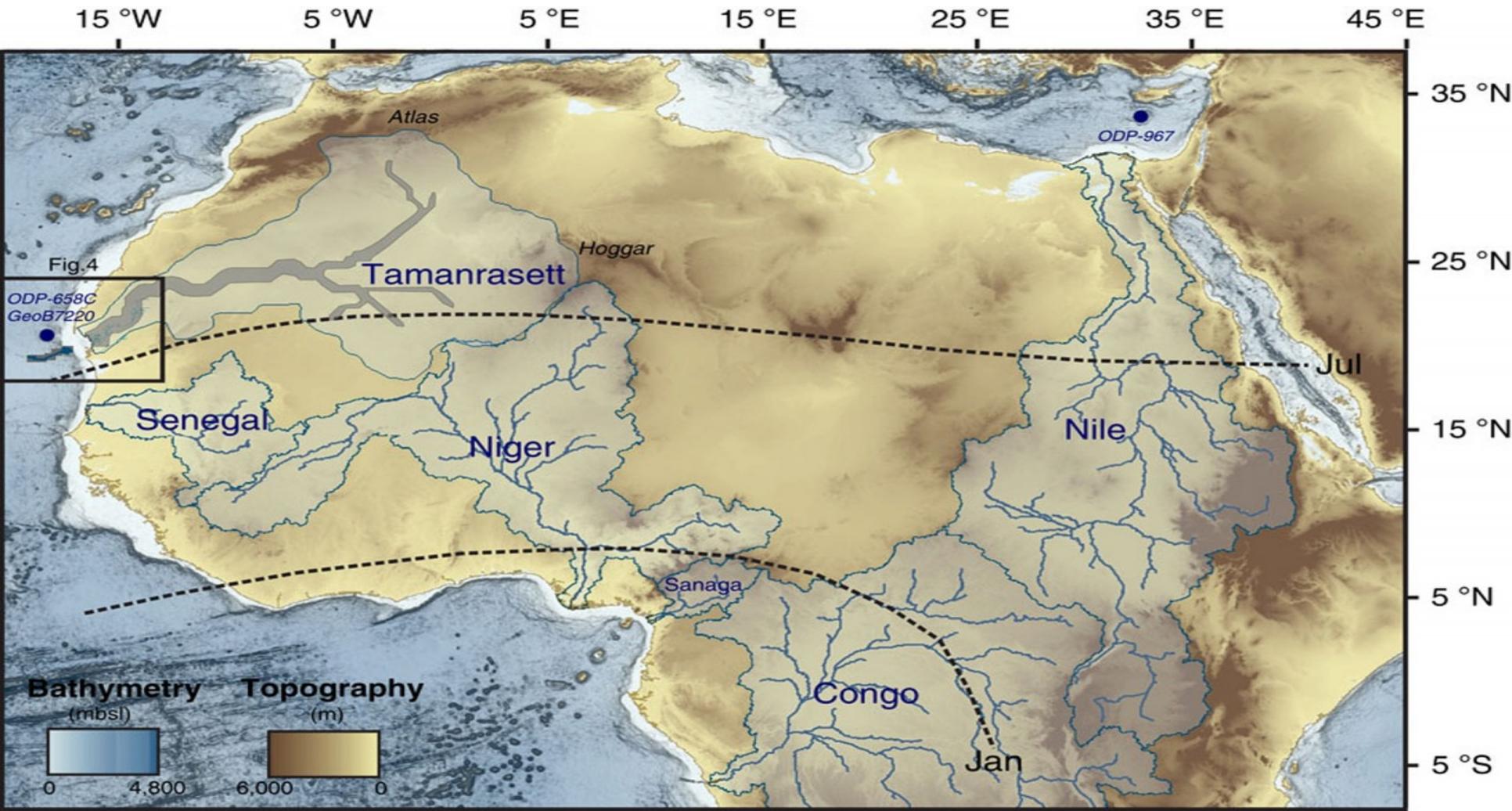
"The clearly dominant aquatic nature of the fauna is evidence of the high humidity of these places in the past and the presence of full-flowing rivers. These rivers, originating in the mountain group of Ahaggar, Tassili, and Adrar des Iforas, formed a large hydrographic network connected with the Niger, lake Chad, and other large lakes, the remnants of which are preserved as salt lakes (schotts) in southern Tunisia. And now these dry riverbeds are still visible during ground research or from satellite images..." (A. Lot, 1973)

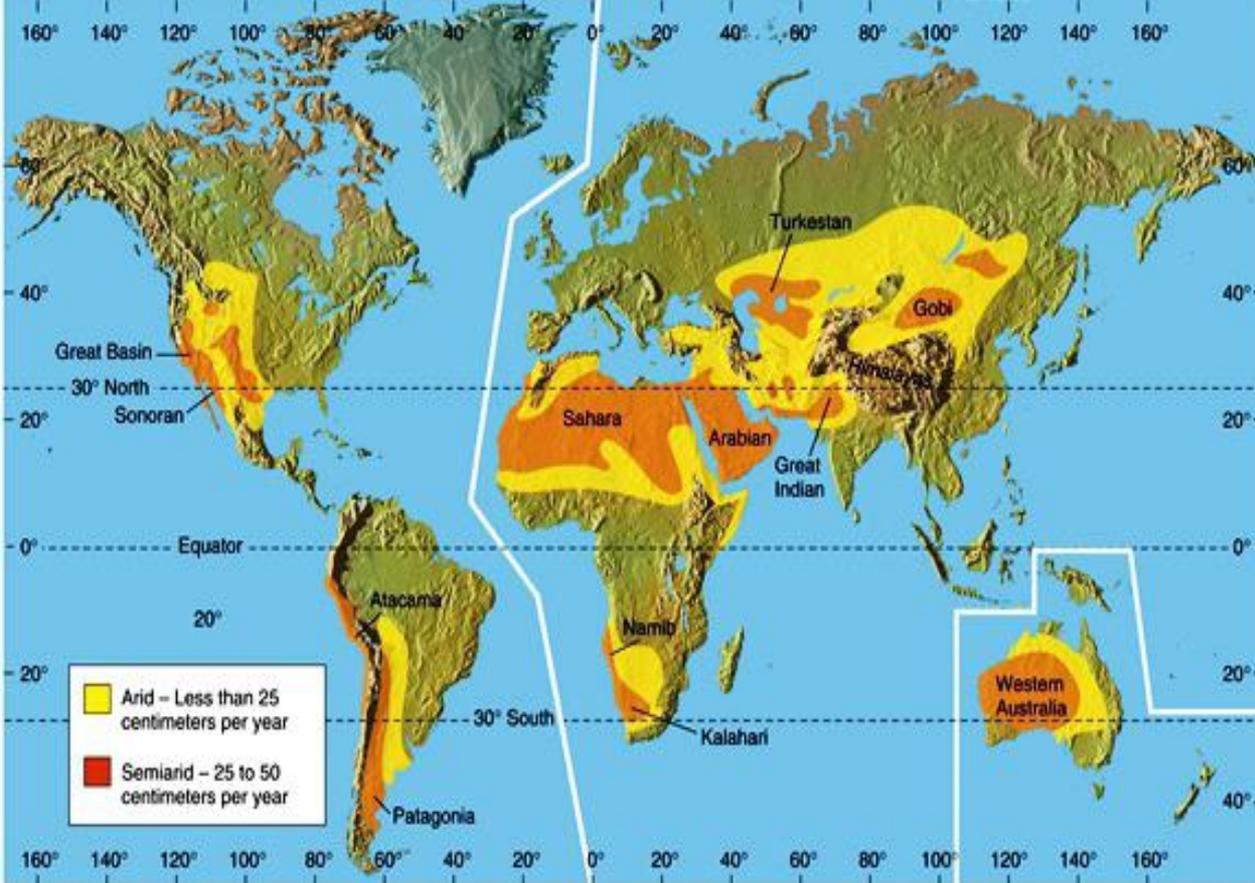


<http://www.membrana.ru>



THE TAMANRASETT RIVER EXISTED ABOUT FIVE THOUSAND YEARS AGO. Its origins were in the South of the Atlas mountains and the Hoggar Mountains in modern Algeria. This river with numerous tributaries was more than 500 km long and in the area of Mauritania it ran into the Atlantic ocean. Satellite images confirmed the existence of a huge river system in what is now desert. Scientists believe that in ancient times, the river basin was abundant with animals and plants, and it completely dried up within two thousand years.





Semi-deserts and deserts occupy 17–25% of the entire land area on the world map, and in Africa and Australia they occupy 40% of the area.

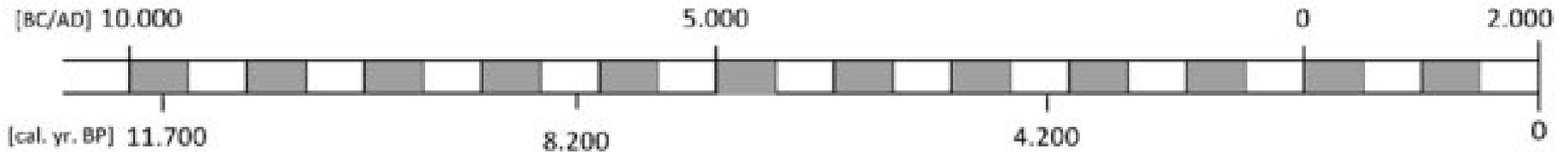
The largest deserts in the world:
 in Africa: Sahara, the Libyan Desert, Kalahari and Namib;
 In South America; Monte, the Patagonian Desert and Atacama
 in Australia: the Great Sandy Desert and Victoria

in Eurasia: the Arabian Desert, Gobi, the Syrian Desert, the Rub'al Khali Desert, the Karakum Desert, the Kyzylkum Desert

About 150 years ago, scientists noted an increase in the area of the Sahara. Archaeological excavations and paleontological studies have shown that this area was not always a desert. In the 11th century, one could practice agriculture on the territory of North Africa up to 21° north latitude. Over the course of seven centuries, the northern border of agriculture moved southwards to the 17th parallel, and by the twenty-first century it has moved even further. **In 1938, Stebbing's work "The man-made desert" became a sensation. The author gave data on the progress of the Sahara to the south and blamed improper farming, in particular, trampling of cereals, which is the main animal feed, by cattle and suboptimal farming systems.**

PERIODIZATION OF THE HOLOCENE

(c)	Late Stone Age				Bronze Age	Iron Age	Middle and Modern Age
(b)	Preboreal	Boreal	Atlantic	Subboreal		Subatlantic	
(a)	Early Holocene		Middle Holocene			Late Holocene	



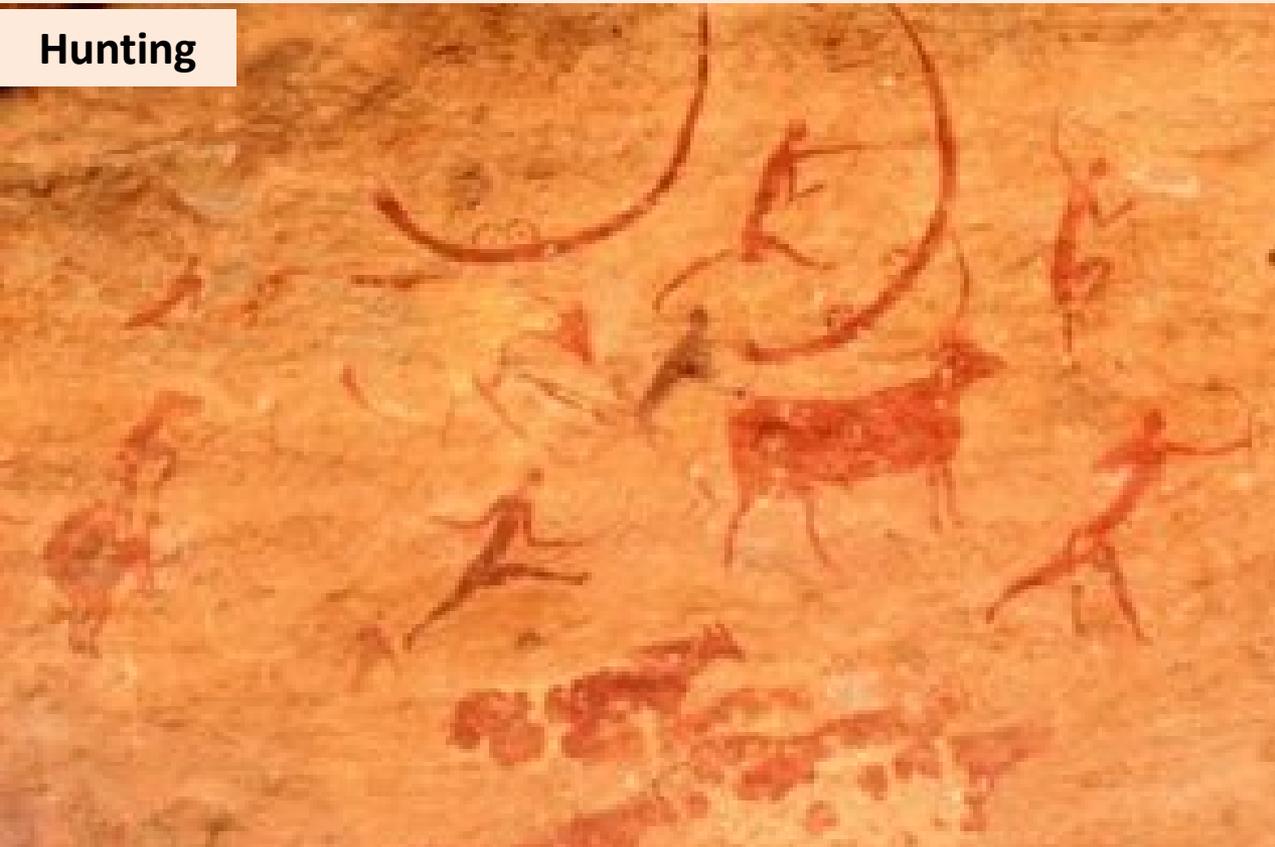
<https://www.researchgate.net/publication/336150437> The Eurasian steppe belt Status quo origin and evolutionary history Evrazijskij stepnoj poas status-kvo proishozdenie i evolucia/figures?lo=1

Study of lake deposits in Africa revealed two **early wet phases**, i. e. 11,000-9,500 (10,000-8,500) BC and 9,000-7,000 (8,000-6,000) BC. Today, most experts believe that during the period of interest in North Africa and the Sahara, there was a **wet phase at the end of the Pleistocene and two wet phases in the early and middle Holocene, and the latter of these phases was milder than the first**. The presence of full-flowing rivers and deep lakes that connected remote areas greatly facilitated contacts between people and led to the formation of the single culture in vast territories.

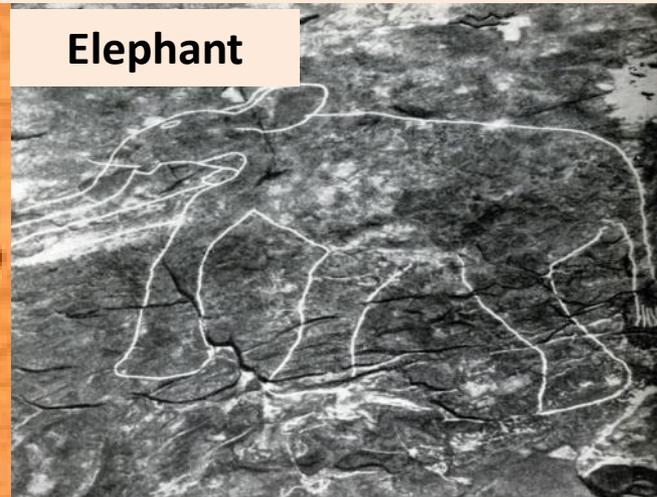
PERIODIZATION OF THE STAGES OF CIVILIZATION DEVELOPMENT IN THE SAHARA (A. Лот, 1973)

1. "Hunter Period" — 5,000-2,000 BC. It is represented by realistic ancient rock drawings: hippos, rhinos, elephants, giraffes, buffaloes, antelopes ...and ostriches. During the Neolithic, various types of coniferous and deciduous trees such as oak, oleander and myrtle, as well as citrus and olive trees grew in this water-rich area. Numerous valleys, now filled with sand, were as full-flowing rivers as the Nile and the Niger. They abounded in fish and large animals (hippos, crocodiles), whose bones were preserved in the places of ancient settlements.

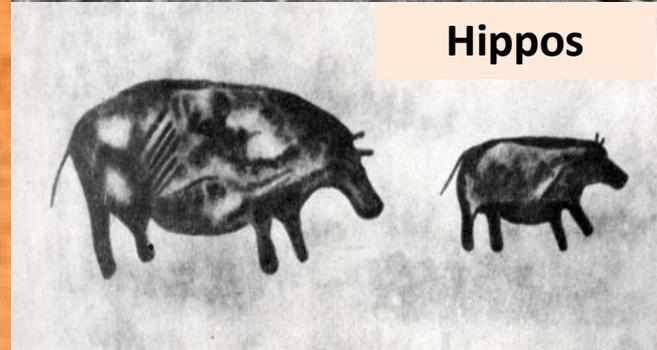
Hunting



Elephant



Hippos

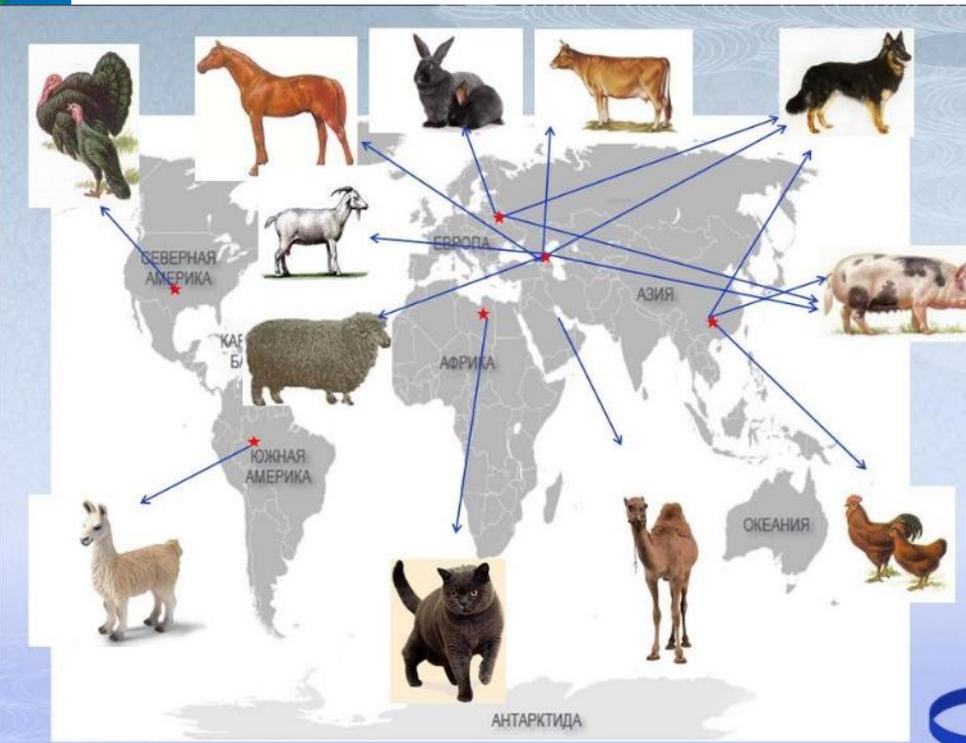
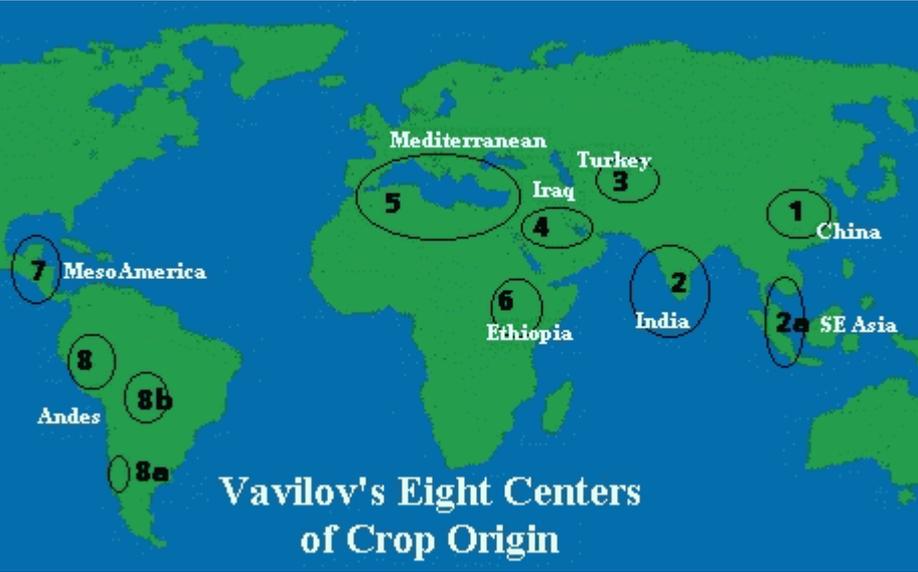


More than 2 thousand years ago, Hannibal brought war elephants from North Africa to conquer Rome. They then harboured in the forests that grew on the site of the modern Sahara

ANIMAL HUSBANDRY AND AGRICULTURE ORIGINATED IN THE NEOLITHIC AND BRONZE AGE ABOUT 10-12 THOUSAND YEARS BC.

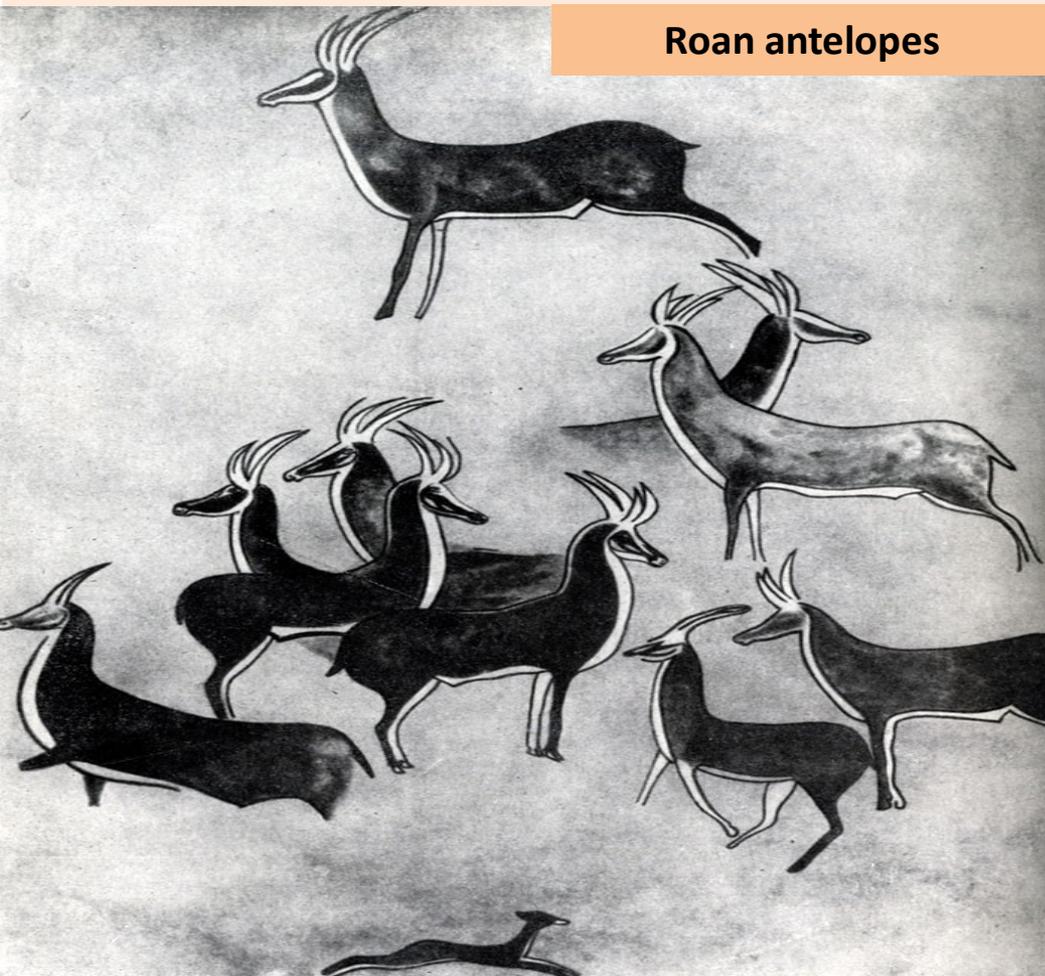
The development of agriculture has always depended on the climatic conditions of the area, and since the tropical and subtropical belts of the Earth were not subjected to Pleistocene glaciation, at the end of the Pleistocene there were favourable conditions for the development of agriculture and animal husbandry.

Scientists learned about the transition from the simple collection of naturally growing fruits to their cultivation from archaeological finds and rock paintings of ancient people. Long-term focused search for the oldest traces of agriculture carried out by F. Wendorf and colleagues revealed a series of early Neolithic settlements of the Sudanese tradition (early Khartoum Neolithic) dated back to the end of the 8th — second half of the 5th (end of the 7th — beginning of the 4th) millennia BC located in the Kharga oasis and the Nabta Playa basin in the now desert areas. Excavations in these places have revealed a lot of plant remains, including a **cultivated variety of barley**. At the same time, these researchers found **bones that belonged to domestic goats and sheep, and possibly cattle**.



PERIODIZATION OF THE STAGES OF CIVILIZATION DEVELOPMENT IN THE SAHARA (A. Lot, 1973)

2. "Shepherd period" 3,500-1,000 years BC It is represented by drawings of herds of bulls, goats, horses, and dogs. Shepherds and cattle-farmers were also hunters; in their rock paintings they gave an accurate idea of the Saharan fauna of that time, i. e. elephants, rhinos, giraffes, hippos, roan antelopes, gazelles, aardvarks, lions, wild donkeys, ostriches, hippos, crocodiles and fish. Tree pollen is represented by pine and juniper species, pistachio, alder, and grass pollen — by Mediterranean species. All this wildlife could only exist in the presence of fertile pastures and humid climate.



Roan antelopes



A herd of bulls

The abundance of grindstones and mealing stones, as found both in Tassili-Ajjer and other parts of the Sahara, suggested that agriculture was practiced here. However, palynologists have proven that there are no seeds of cultivated cereals in the layers of this time. Together with hunting and cattle-breeding, people collected seeds of wild cereals, processed them with grindstones and mealing stones, and consumed.

REASON FOR THE LOSS OF RAINFORESTS IN THE SAHARA



A group of geochemists led by **Germain Bayon** from the French Research Institute for Exploration of the Sea concluded that the main role in the loss of rainforests and the formation of savannas and deserts was played by people. To reconstruct the history of the African climate, scientists analyzed sedimentary rocks from the mouth of the Congo river. Thus the authors found out when exactly over the past 40 thousand years there was active weathering of rocks in this region.

It turned out that in the period from 20,000 years ago to 3,500 years ago, the weathering processes were perfectly consistent with the amount of precipitation in the region... But about 3 thousand years ago, these processes were put out of sync. According to Bayon and his colleagues, this means that at that time, in addition to the climate, some very powerful extraneous factor came into force. Scientists believe that these were Bantu peoples, whose tribes at that time just began to move from the territory of today's Nigeria and Cameroon to Central Africa. They were actively engaged in agriculture and cleared space for arable land, cutting down rainforests. **The authors believe it quite possible that this was a decisive fact in the formation of savannas on the site of felling and further development of deserts.**

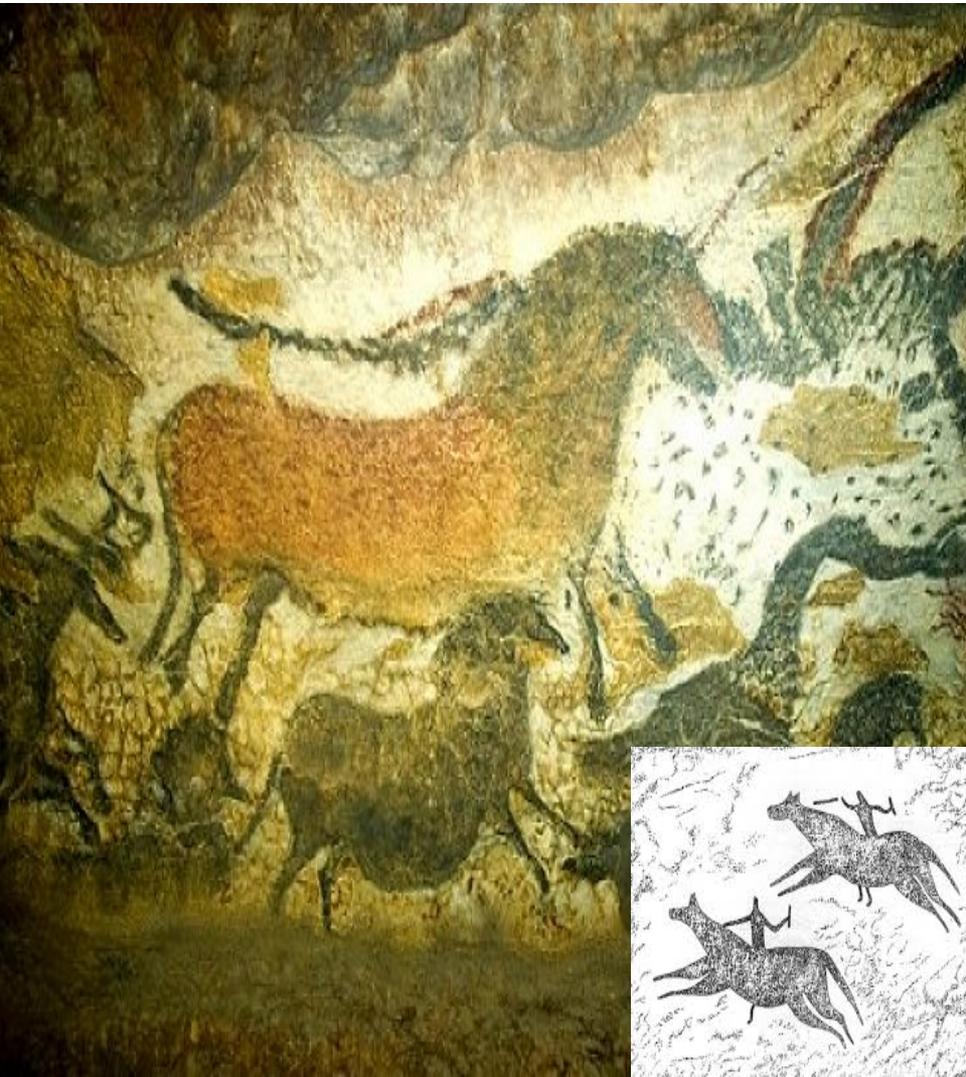
The first wild grass that people began to harvest (using wooden or bone sickles), and then to sow, was barley, which grew in the highlands of Asia Minor, Palestine, Iran and southern Turkmenistan, as well as in North Africa. Later, other grasses were domesticated.



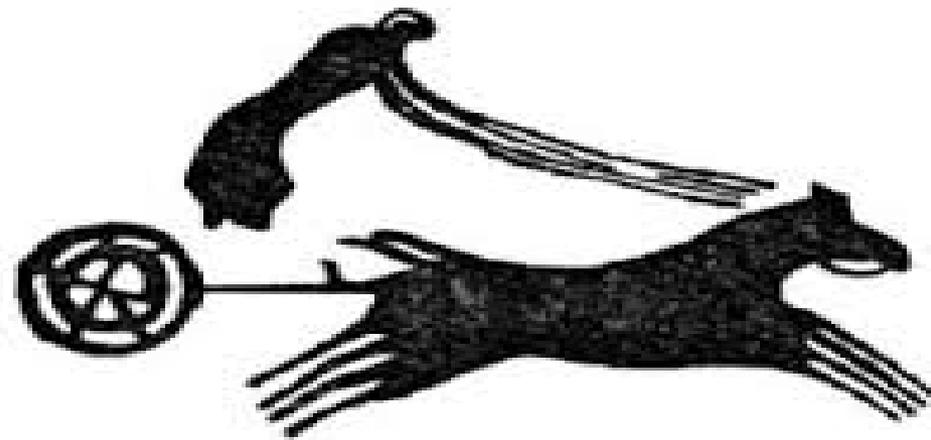
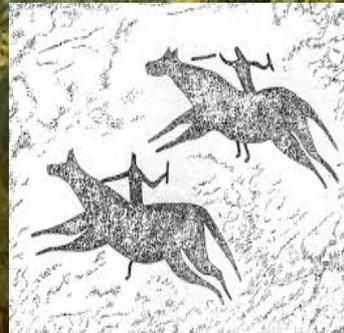
Slash-and-burn agriculture

PERIODIZATION OF THE STAGES OF CIVILIZATION DEVELOPMENT IN THE SAHARA (A. Lot, 1973)

3. **"Horse period" 1,500 years BC** Wild horses have been known since the early Neolithic from bones found during excavations. In the middle and late Neolithic, paintings and engravings of these animals in the wild were created in Tassili, Fezzan, the Tibesti Mountains, and the Atlas mountains. They were domesticated at the beginning of the second millennium BC. Around the middle of the second millennium BC, images of horses in war chariots, as well as horsemen on horseback, appear in the Sahara.



This was the time of significant deterioration of the moisture regime, depauperization of the animal world and vegetation cover, and the beginning of active desertification. Elephants, rhinos and hippos disappeared as a result of hunting and overgrazing, i.e. the destruction of vegetation by rather large herds of cattle, goats and sheep. In rock art, there are still drawings of giraffes, antelopes, moufflons; woody vegetation is less and less common, pastoral nomadism begins.



PERIODIZATION OF THE STAGES OF CIVILIZATION DEVELOPMENT IN THE SAHARA (A. Lot, 1973)

4. **"Camel period" around the 2nd century AD.** The "camel" period begins when the horse is no longer able to move through the cloggy desert sands. The camel became the ship of the desert. **In the Sahara, the camel appeared in the 1st century AD and gradually became a common animal.** The advent of the camel to the Sahara coincided with the final onset of drought and profound changes in the lives of the local population. As a result of a fundamental change in the water regime and climate, the only possible economic activity left was pastoral nomadism, the most extensive system of animal husbandry.



Pastoral nomadism is widespread in the most arid regions of the world: in the Sahara desert and on the Arabian Peninsula where the average annual precipitation is not more than 200 mm. The life of nomads depends entirely on livestock, which is the main and only source of their livelihood and a measure of social prestige. The drier the areas, the more camels there are in the herds of nomads; they are able to endure extreme natural conditions and provide their owners with wool, milk, and blood, which is sometimes used instead of water and food. **Nomads do not have a permanent place of residence, are not involved in husbandry, and their families move with their herds across the wide open spaces of desert areas in search of water and pasture.**

FORMATION OF MODERN STEPPES OF NORTHERN EURASIA

ARCHAEOLOGICAL ARTIFACTS SHOW THAT PEOPLE SETTLED ON THE TERRITORY OF MODERN STEPPES AND SEMI-DESERTS ABOUT 1 MIO YEARS AGO. At this time, it was home to the ancestors of mammoths (trogontheria), horses, bison, tours, aurochs, beavers, wolves, foxes, reindeer, saiga, marmots, lemmings, etc. When comparing changes in the ranges of forest, steppe and tundra animal species from the end of the Pleistocene to the middle (late) Holocene it is evident that the vegetation cover of these territories for a long time was represented by alternation of forest and open spaces of different sizes which were sufficient for the sustainable existence of a huge diversity.



Remains of the **REINDEER** from the middle and late Holocene are found in most of the Russian plain, as well as in the Kursk steppes and in the steppes of the Black Sea region.

Remains of the **SAIGA** from the late Holocene were found in Grodno (Belarus), in Moscow and Ryazan oblasts, in Tatarstan, at the Eastern foothills of the Carpathian mountains, in Kazakhstan, ex-Soviet Central Asia, Dzungaria and Western Mongolia where the remains of forest animals were also found.

Remains of wild horses in the Middle Holocene were found in the Baltic States, Ukraine, and Voronezh and Saratov oblasts. In the Late Holocene within Eastern Europe, only three finds were recorded: in Moldova, in Moscow and Rostov oblasts.

THE MIXED NATURE OF THE FAUNA OF NORTHERN EURASIA DURING MOST OF THE HOLOCENE indicates that the composition of forest-meadow-steppe landscapes that were gradually losing keystone species of animals and plants, remained the same until the Late Holocene.

(Tsalkin, 1954; Catalog of mammals of the USSR., 1981; Chibilev, 1990; Eastern European forests, 2004).



FORMATION OF MODERN STEPPES OF EASTERN EUROPE

According to spores and pollen data, the modern forest-steppe and steppe in the Meso- and partly Late Holocene was a territory with absolute dominance of broad-leaved forests. They reached the Black sea, and along the valleys of the Don and Volga — the Azov and Caspian seas; through Ergini they connected with the broad-leaved forests of the Caucasus and of the Volga uplands. The species composition of the Azov region fauna is evidence of the forest-steppe character of this territory, and a large number of beaver bones is indicative of a significant percentage of forest cover of river valleys.

At the same time, pollen and grains of cultivated grasses and weeds are constantly found in the pollen spectra of the Central Russian upland, starting from the Middle Holocene. Peatlands later covered by the arable layer due to erosion were also found here.

DURING THE LATE HOLOCENE, THERE WERE CATASTROPHIC CHANGES IN BROAD-LEAVED FORESTS IN EASTERN EUROPE: THEIR SOUTHERN BORDER MOVED 200-400 KM TO THE NORTH, AND THE FOREST TYPE OF VEGETATION WAS REPLACED BY STEPPE AND SEMI-DESERT TYPE. THESE CHANGES COMPLETELY COINCIDED WITH THE BRONZE AGE IN THE

DEVELOPMENT OF HUMAN CULTURE (*Krupenin, 1973; Dinesman, 1976; Krasnov, 1971; Kirikov, 1966; Neustadt, 1957; Dicusbanko, 1958*)



A picture of the Stavropol steppes

Large social herbivorous animals sustainably exist in in steppes and semi-deserts due to the fact that annually they consume up to 60-70% of aboveground phytomass without any harm to plants. The reason for this is the dominance of dense sod grasses: their leaves grow back after biting, and dormant buds start to grow when the turf is damaged by hooves (Herbivorous animals ..., 1986).



In the Black Sea region, southern Siberia, Mongolia, and Kazakhstan, the horse was tamed by nomadic peoples in the 3rd-4th millenium BC. In the second half of the 3rd millennium BC, the horse was also used in Western Europe. The use of harnessed horses in the steppes of Eurasia is known from the 14th-16th century BC.

FORMATION OF MODERN STEPPES OF NORTHERN EURASIA

TRYPILLIAN CULTURE IS THE OLDEST ONE; IT EXISTED IN MODERN MOLDOVA, IN MOST OF UKRAINE AND IN SOUTHERN RUSSIA. TO THE EAST OF THIS TERRITORY LIVED THE TRIBES OF THE ANCIENT YAMNAYA CULTURE. THESE TWO CULTURES STARTED TO FORM AS FAR BACK AS ABOUT 6000 YEARS AGO. The climate of the Trypillian culture had considerable humidity with the dominance of broad-leaved forests with forest fauna (*Passek, 1949*). The bones of wild animals (roe deer, elk, beaver, and hare) are often found in Trypillian settlements. However, hunting and gathering played an auxiliary role in the economy. The main occupation of people of the Trypillian culture was cattle breeding and partly agriculture, as well as the smelting of copper tools, which requires a large amount of wood; the population density reached 30-35 people per square km. Trypillian people bred small, thin-legged and large cattle, similar in type to wild auroch, as well as sheep and pigs. By the end of the Trypillian culture, the domestic horse appears (*Armand, 1955*).



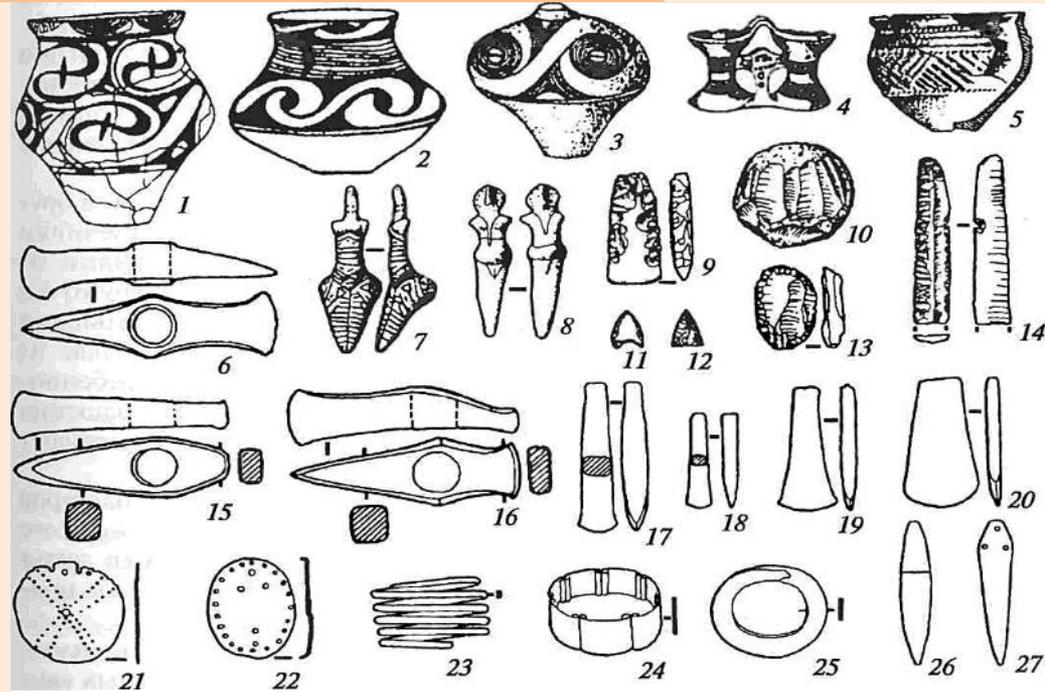
FORMATION OF MODERN STEPPES OF NORTHERN EURASIA

<https://arheologija.ru>

The Trypillians worked the land using hoes made of stone, bone and horn. Wheat, barley, and millet were mainly grown. The crop was harvested with primitive sickles. Sickles made of solid stone and with inserted blade were found, and metal reaping sickles cast from copper also appeared in the later period.

The level of development of the producing economy among the tribes of the ancient Yamnaya culture was somewhat lower than that of the tribes of the Trypillian culture.

They had tools made predominantly of stone and bone, whereas bronze was much less common. They were engaged in hunting, fishing, and probably primitive cattle breeding (Gorodtsov, 1927).

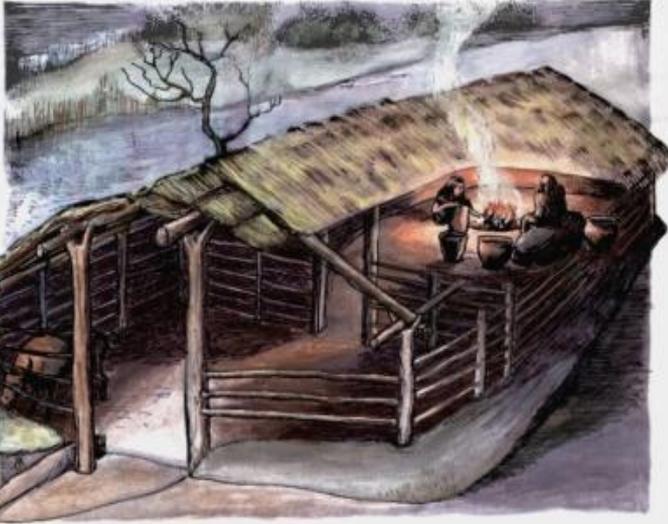


**Mealing
stone**



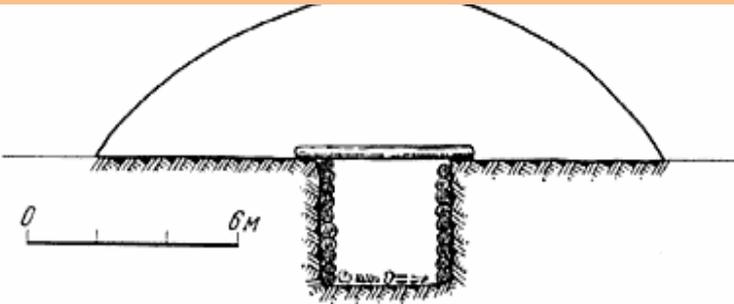
<http://генофонд.рф>

FORMATION OF MODERN STEPPES OF NORTHERN EURASIA



House of the times of the Srubnaya culture

TRIBES OF CATACOMB AND SRUBNAYA CULTURES (17th-12th centuries BC), which replaced the tribes of the ancient Yamnaya culture, the level of reproducing economy was high. It was based on highly developed husbandry (breeding horses, cattle, and sheep). Agriculture was spread mainly in the floodplains. People were engaged in processing metals, stone, bone, wood, and making materials similar to fabrics. Typical artifacts are moulded ware and bronze items, i. e. axes, knives, daggers, spears, riveted cauldrons, sickles, etc., iron items appear in the later period. Settlements made up of half-dugout houses with wooden log constructions and gable roofs were located along river banks. Complex wooden structures were erected for burials. A significant increase in cattle breeding caused the settlement of tribes of the Srubnaya culture from the Dnieper river in the west to the Ural river in the east and from the right tributaries of the Oka river in the north to the Kuban river in the south. The Scythians who occupied the northern Black Sea region 2,500 years ago, when this territory was already treeless, were formed on the basis of the Srubnaya culture tribes. According to spore and pollen data, sheep's fescue-sagebrush and mixed grass-stipa grass steppes were very common and they replaced the forest and forest-steppe of the Middle Holocene (*Neustadt, 1957, 1957; Skify, 1992*).



Burial hill with a log tomb

Analysis of paleobotanical and archaeological data shows that from the **beginning of active settlement in the Black Sea region to the formation of Scythian tribes, i.e. for 3,000-3,500 years, the southern border of broad-leaved forests retreated to the north by 400-600 km**; it happened in the subboreal period, which was cooler than the previous periods (*Gorodtsov, 1927; Merpert, 1974*).



The most common way to influence the nature of steppes and prairies in recent millennia was **spring and autumn fires organized by the population** to activate the growth of young shoots of grasses on pastures. Consequences: almost complete destruction of woody vegetation, a significant drop in total biodiversity, climate change and hydrological regime change; aridization of large areas (*Val'ter, 1975*).

ANTHROPOGENIC TRANSFORMATION OF THE EASTERN EUROPEAN STEPPES IN THE HOLOCENE

Stages	1	2	3	4	5
Duration, years	2,950-1,950	2,300	70	90-110	60
Vegetation type	Fescue–stipa grass, moderate grazing	Stipa grass–fescue, intensive grazing	Mixed grass–stipa grass–fescue, overgrazing	Spring wheat (crops)	Winter wheat (crop rotation)
Phytomass entering the soil (F), g/m ² ,	1,210	600	600	148	324
Consumed phytomass (P), g/m ²	40	60	76-101	138-146	745-773
Humus entering the soil MJ/m ² per year	5.4	4,5	4,2	0.54	1.55
P/F ratio, J/m ²	1: 28	1: 9	1: 6	1: 0.97	1: 0.40

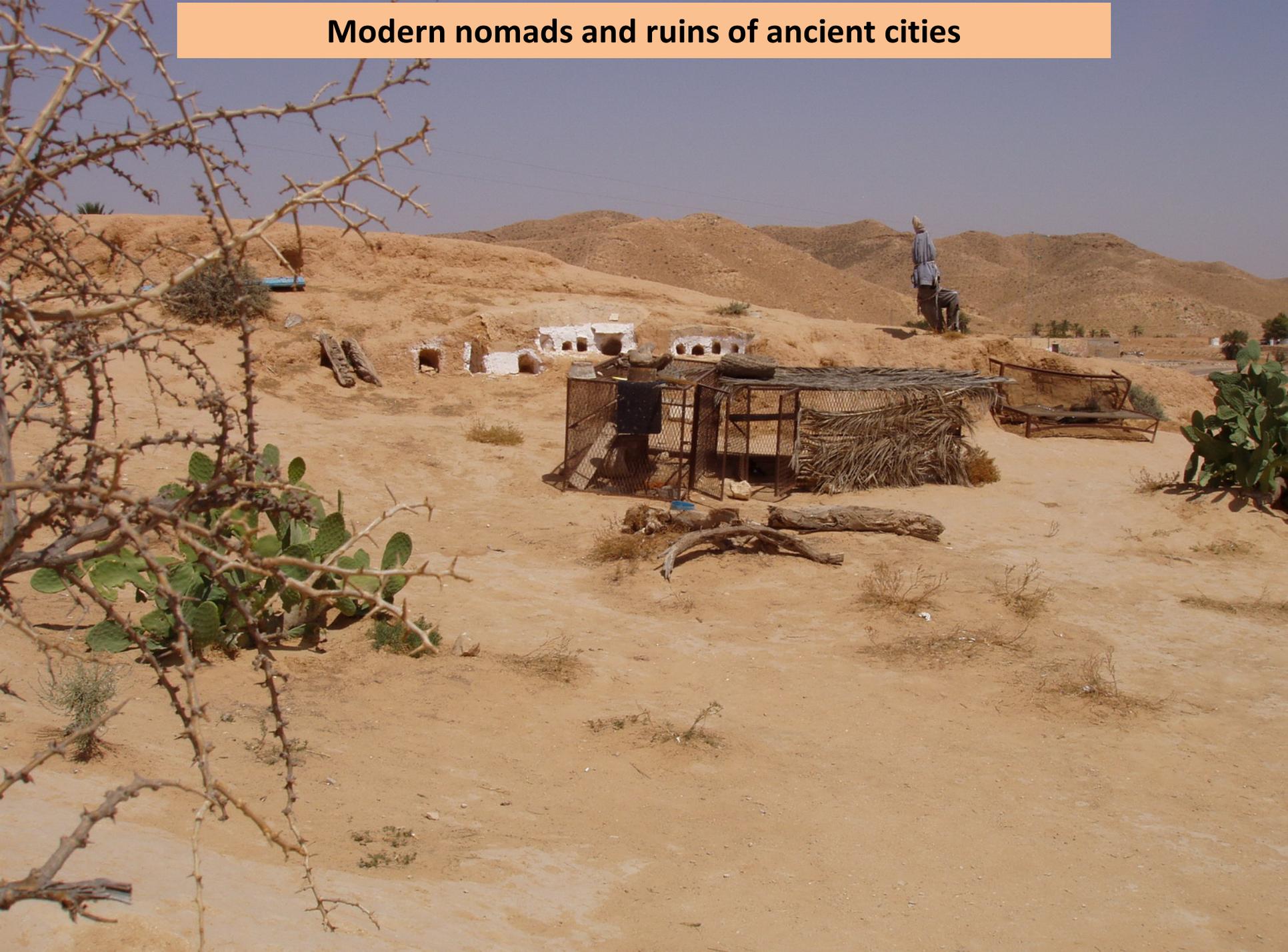
STEPPE WHICH PLAYED A VITAL ROLE IN THE HISTORY OF MANKIND WAS THE FIRST OF ALL OTHER ZONAL TYPES OF LANDSCAPES OF NORTHERN EURASIA ON THE VERGE OF LOSING THE ORIGINAL CHARACTER DUE TO THE ALMOST COMPLETE DESTRUCTION OF WOODY VEGETATION, REPLACEMENT OF NATURAL MEADOW-FOREST-STEPPE ECOSYSTEMS BY PASTURES AND FIELDS, AND OF NATURAL PHYTOPHAGES — BY LIVESTOCK.

IN THE SECOND HALF OF THE 19th CENTURY THE AGRICULTURAL RECLAMATION OF THE STEPPES OF THE UKRAINE, THE VOLGA AND THE DON REGIONS WAS COMPLETED.

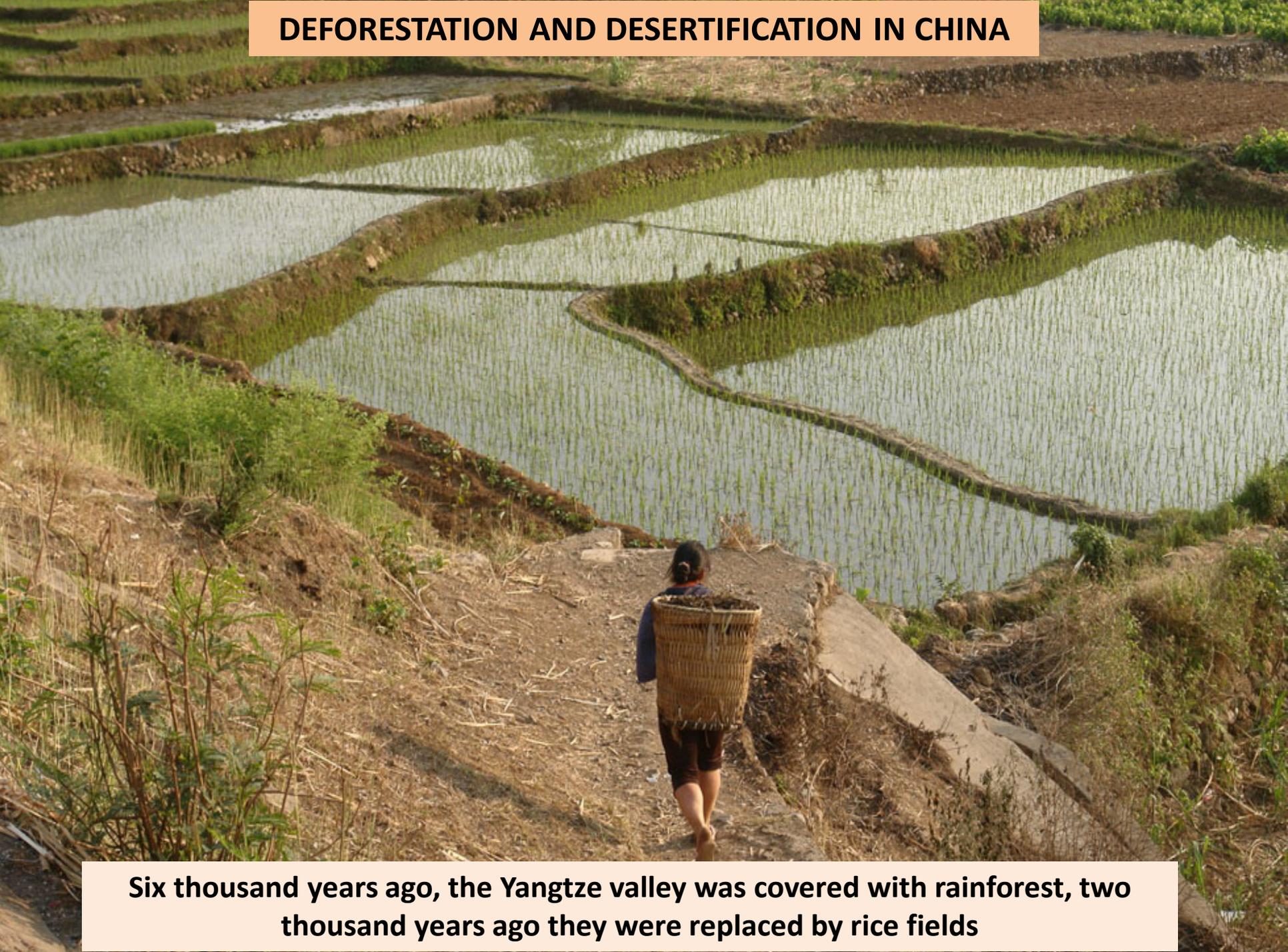
BEGINNING OF THE 20th CENTURY ACTIVE COLONIZATION OF THE NORTHERN STEPPES OF THE URALS, KAZAKHSTAN, AND SOUTH SIBERIA STARTED, AND IN 1950-1960s YEARS VIRGIN AND FALLOW LANDS OF THE ENTIRE STEPPE ZONE OF THE VOLGA, THE URALS, KAZAKHSTAN AND SIBERIA WERE FULLY RECLAIMED.

NO OTHER LANDSCAPE ZONE IN NORTHERN EURASIA HAS SUCH A HIGH PROPORTION OF FARMLAND (87-96 %) AND ARABLE LAND (40-85 %) IN THE TERRITORIES. IN THE STEPPE ZONE, RIVER FLOW REGULATION REACHED 40-55 %, AND ITS TOTAL LOSSES AMOUNTED TO 1/3 OF THE ORIGINAL VOLUME (*Liseckij F.N.*, 2011).

Modern nomads and ruins of ancient cities



DEFORESTATION AND DESERTIFICATION IN CHINA



Six thousand years ago, the Yangtze valley was covered with rainforest, two thousand years ago they were replaced by rice fields

A dried up lake Lop Nur was found in the Eastern part of the Taklamakan desert (China); Chinese scientists compiled maps depicting the lake in the 7th century.



<https://fb.ru>



<https://www.magicwaters.ru>



<http://anirov.gallery.ru>

DESERT TERRITORIES OF NORTHERN EURASIA

MONGOLIA



GOBI



CHINA



PROBLEMS OF DESERTIFICATION AND THE NEED TO ADDRESS THEM



Arid regions of the Earth cover 41% of the land. According to UN estimates, desertification will affect more than 1 billion people and about 1/3 of agricultural land. In 1995, the United Nations established the World day to combat desertification and drought, and from January 2010 to December 2020 – THE UNITED NATIONS DECADE TO COMBAT DESERTIFICATION.

DURING THE MAJOR PART OF THE HOLOCENE, THE TERRITORY OF CHINA WAS COVERED WITH FORESTS. OVERGRAZING AND IMPROPER FARMING PRACTICES HAVE LED TO THE DESERTIFICATION OF AN AREA THAT STRETCHES FOR 3,000 KM FROM WEST TO NORTH-EAST.



CHINA IS SECOND TO AUSTRALIA IN TERMS OF THE NUMBER OF PASTURES, THEY OCCUPY 40% OF THE TERRITORY IN THE ARID NORTH OF THE COUNTRY. THE DESERT HAS ALREADY COVERED 1/4 OF THE COUNTRY AND CONTINUES TO EXPAND.



ACTIVE ACTIONS: IN CHINA, EVERY HEALTHY PERSON FROM 11 TO 60 YEARS IS OBLIGED ! TO PLANT 3-5 TREES A YEAR, THUS CREATING THE GREAT GREEN WALL.

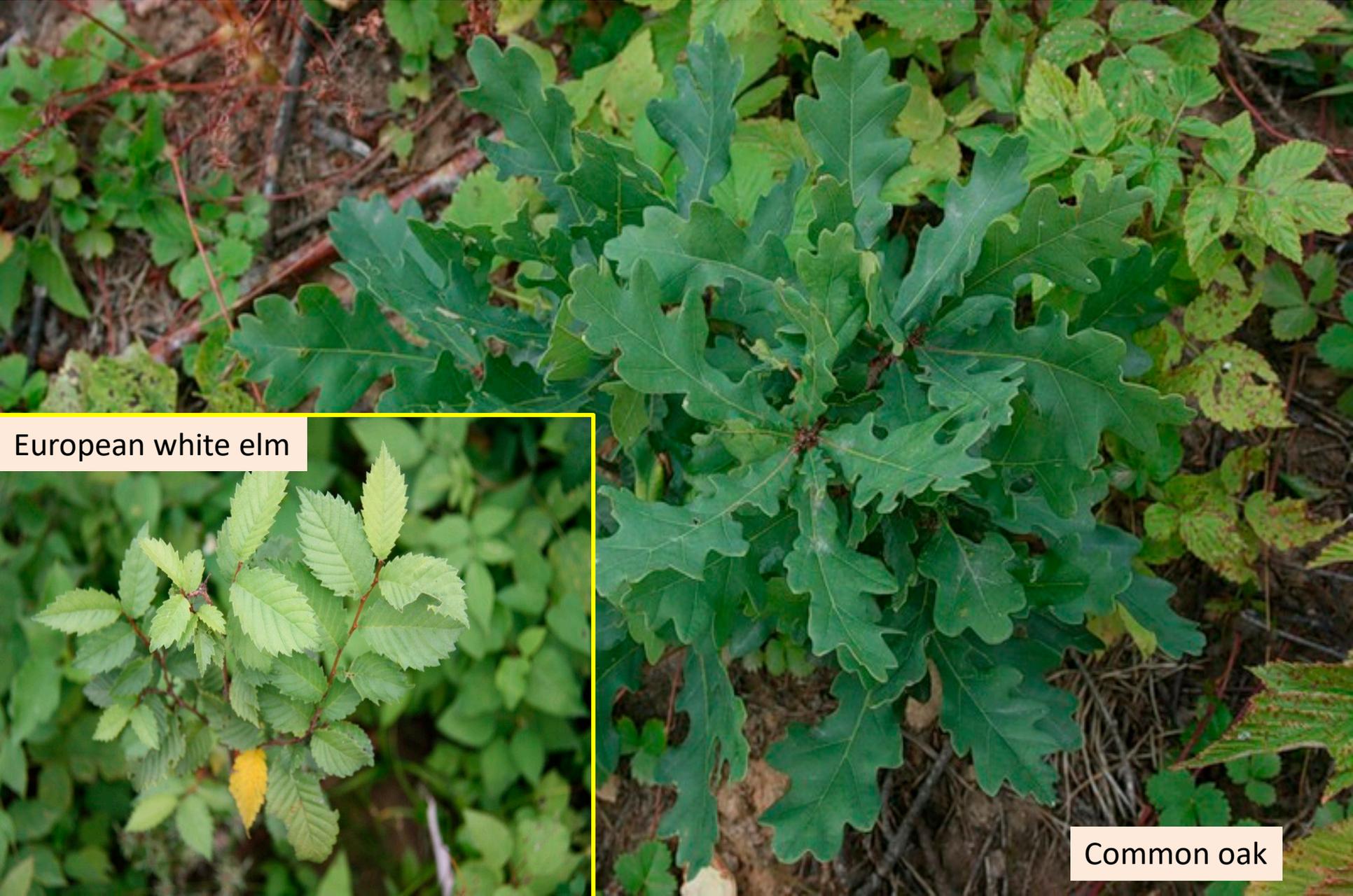
PLANTING TREES



MASS PLANTING OF MIXED FOREST CROPS IN SHCHELKOVSKY TEACHING AND EXPERIMENTAL FORESTRY, GREENPEACE RUSSIA A. Yu. Yaroshenko



**MASS PLANTING OF MIXED FOREST CROPS IN SHCHELKOVSKY TEACHING AND
EXPERIMENTAL FORESTRY, GREENPEACE RUSSIA A. Yu. YAROSHENKO**



European white elm



Common oak



MAATHAI, WANGARI (1940–2011) was a Kenyan ecologist, professor, laureate of the [Nobel peace](#) prize 2004, initiator and mastermind of the Green belt social movement (Maathai Green Movement). She was born in 1940 in Kenya to a family of Kikuyu people. Unlike most of her peers from rural Africa, she managed to get a higher education in the United States. In 1976, she put forward the idea of mass tree planting as part of the fight against deforestation in Kenya.



She was the initiator and mastermind of the Green Belt Movement, which was founded in 1977 and later became known as the **Maathai Green Movement**" **In 1986, the movement expanded beyond Kenya and became a pan-African tree-planting network.** In Kenya, this is especially important not only to protect the water regime of rivers, but also to provide firewood, which is still used for cooking by 90% of the rural population. Participants of the Movement organize nurseries for growing seedlings, which are then given to everyone free of charge. **Over 25 years of its existence, its participants, mostly women, have planted more than 20 million trees.**



PASTURE DEGRADATION IS THE MAIN REASON FOR THE FORMATION OF STEPPE AND THEN SEMI-DESERT ZONES IN THE STEPPES OF THE RUSSIAN PLAIN



IN CONTRAST TO FOREST TERRITORIES, CREATION OF RESERVES CONTAINING "FRAGMENTS" OF STEPPE VEGETATION IN THE ABSENCE OF KEYSTONE SPECIES (BISON, HORSES AND BEAVERS) LEADS TO A RAPID LOSS OF SPECIES DIVERSITY IN THE MAIN GROUPS OF LIVING CREATURES (grasses, insects, various invertebrates and small vertebrates...) DUE TO THE FACT THAT RESTORATION OF TREE AND SHRUB VEGETATION IS NOT RESTRAINED BY NATURAL HERBIVORES AND/OR MODERATE GRAZING OF LIVESTOCK.



MODERN STEPPES CANNOT BE PRESERVED AS “TOTALLY PROTECTED AREAS”



Studies of the nature management history of the modern steppe and forest-steppe nature reserves in Russia showed that gradual replacement of wild ungulate animals by domestic ones allowed to conserve at least part of the subordinate species of plants, animals and representatives of other kingdoms. For example, **breeding of valuable breeds of horses (stud farms) prolonged the life of the meadow steppes of the Central Black Earth reserve before they became a protected area.** Creating an absolutely protected area gradually led to a catastrophic decline in species diversity. Colourful grasslands and real steppes have begun to turn into tree and shrub communities poor in species.

MAIN TYPES OF DYNAMIC PROCESSES IN STEPPES AND FOREST-STEPPE



In the forest-steppes and steppes, after livestock grazing and plowing were ceased, preserved trees and shrubs began to spread actively, crowding out the species of steppe biota on agricultural land or completely suppressing their development. The biodiversity of all groups of living beings is rapidly declining.

PASTURE DEGRADATION OF MEADOW-STEPPE COMMUNITIES: STAGES 1-4

1



Undergrazing — predominance of meadow grasses

4



Overbrowsing — exposed soil and patches of weeds

2



Moderate grazing — predominance of stipa grasses

3



Excessive grazing — sparse cover —
predominance of fescue and sagebrushes

OVERGRAZING IS A WAY TO SEMI-DESERTS

Desertification threatens a vast territory in the south of Russia and in the Asian countries of the CIS.

The Kalmyks settled the Caspian sea region in the 17th century by a decree of Catherine II. At this time, forests of elm, oak and other trees grew along the river valleys, and the grass cover of the steppes was extremely rich in species and highly productive. Uncontrolled grazing led to the formation of the only desert in Europe, i. e. the Black Lands in Kalmykia. With a grazing rate of no more than 750 thousand sheep, 1 million 650 thousand were constantly grazing here. Besides, more than 200 thousand saigas lived on this territory. Pastures were overloaded with grazing exceeding the norm by 2.5-3 times. As a result, more than a third of the pasture area (650 thousand ha) has turned into drift sands. The Kalmyk steppe is gradually becoming a barren desert.



Currently, wild and feral ungulates (saiga, kulans, wild horses (tarpan), and camels) are found only in the desert steppes and semi-deserts of Kalmykia, the south of the trans-Volga region, the Chuya steppe in the Altai and Dauria and Mongolia, but in most of these territories they are replaced by livestock. As a result, biodiversity in steppes and semi-deserts can only be maintained if livestock grazing is moderate and small burrowing animals such as marmots, ground squirrels, and gerbils are preserved (see Presentation 3). At the same time, domestic animals in ecosystems have the better influence on the BIOTA of the steppes, the closer their life is to that of wild ungulates. Of all the models of animal husbandry, the most suitable one for preserving the biota of steppes and semi-deserts is free range animal husbandry (*Abaturov, 2006*).



FATE OF THE EUROPEAN STEPPES

AT THE EXPOSITION UNIVERSELLE IN PARIS IN 1889, along with the **EIFFEL TOWER**, great attention was drawn to the pavilion of Russia, where a **MONOLITH OF CHERNOZEM FROM THE CENTRAL RUSSIAN STEPPES, RECOGNIZED AS A STANDARD OF FERTILITY, WAS DISPLAYED.** "Presentation" of the main wealth of Russia was prepared and conducted by V. V. Dokuchaev and N. I. Vavilov.

However, in 1891, these steppes were hit by a terrible disaster – a drought. The elements devastated fields in 20 provinces of the black earth zone. Whole families were starving to death...



Location of forest belts



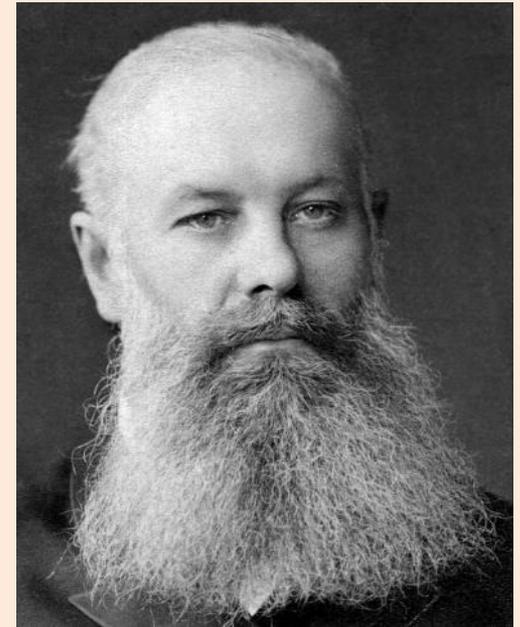
Forest belt



FATE OF THE EUROPEAN STEPPES

Thanks to the efforts of V.V. Dokuchaev and his colleagues a "Special expedition..." was organized in 1892. It **experimentally proved the possibility of changing the local climate and reducing aridity by forest reclamation**. Kamennaya steppe was one of the experimental sites. During the short time of the expedition, 43 forest belts were laid, representing 80 original scientific experiments that are of significance to this day. In these few years, the technology of steppe afforestation was formed. By the middle of the 20th century, the Kamennaya steppe was fully formed as a working model of the optimal agricultural steppe landscape. During the severe drought of 1946, the yields of all agricultural crops were 3-4 times higher in the Kamennaya steppe than in the surrounding territories. The multi-layered forest communities are home to many birds and more than 30 species of mammals.

V. V. Dokuchaev.



FATE OF THE EUROPEAN STEPPES

Forest belts of the Kamennaya steppe, together with the later planted forest belts of surrounding farms, became a "bridge" between the original woodlands — Shipovy forest and the Khrenovsky bor. This significantly expanded the living space for the animals that live there. Mole rat also contributed to the increased fertility of chernozems, because by mixing the soil it continuously improves its hydrophysical properties and structure.



<https://bravo-voronezh.ru>



FATE OF THE EUROPEAN STEPPES (*"Stalin's plan for the transformation of nature"*)



<https://ardexpert.ru>



A decree "On the plan of field-protecting forest plantations, introduction of grass-arable rotations, construction of ponds and reservoirs to ensure high sustainable yields in the steppe and forest-steppe regions of the European part of the USSR" was issued in 1948.

The objective of the plan was to prevent droughts, sand and dust storms by building reservoirs, planting forest protection plantations and introducing grass crop rotation in the southern regions of the USSR (Volga region, Western Kazakhstan, North Caucasus, Ukraine).

It was planned to plant more than 4 million hectares of forest, and restore the forests destroyed by war and negligent farming. For this purpose, Agrolesprojekt institute was created.

According to its projects, it was planned to plant 8 7,860-km long and 30-60-m wide state forest belts, as well as local forest belts along the perimeter of fields, along the slopes of ravines, along existing and newly created water reservoirs and drift sands. A program to create irrigation systems was temporarily launched.

FATE OF THE EUROPEAN STEPPES (*"Stalin's plan for the transformation of nature"*)

After the death of I.V. Stalin, the implementation of the plan was terminated. Many forest belts were cut down, several thousand ponds and reservoirs intended for fish breeding were drained, and 570 forest protection stations were liquidated by decrees of N.S. Khrushchev. **One of the consequences of the termination of the plan for the transformation of nature together and the huge increase in arable land in the USSR was the disaster of 1962-1963 caused by soil erosion on virgin land, which caused a catastrophic decline in yield and the subsequent food crisis.** The great programme justified by domestic scientists was completely terminated but now programmes with the same tasks are being implemented in the United States, China, and Western Europe. They also play a significant role in preventing global warming.



<https://www.livejournal.com>



PROBLEMS OF STEPPE NATURE RESERVES

Steppes of Russia, Ukraine and Kazakhstan suffer the highest degree of anthropogenic degradation of natural landscapes in Eurasia; the share of farmland in different landscape provinces is 80-96%. Against this background, the European steppes in the second half of the 19th century and the steppes of Kazakhstan in the middle of the 20th century saw a catastrophic decline in biological diversity, climate change, hydrological regime and soil productivity. **THE STEPPES OF EURASIA HAVE BECOME A DISAPPEARING BIOME.**



<https://elementy.ru>

The surface of the soil in the reserve (*left*) and on the pasture. In the absence of livestock grazing, the soil forms a crust of lichens (*Caloplaca raesaeneni*, *Endopyrenium desertorum*), moss (*Tortula desertorum*), and seaweeds (*Nostoc* spp.). The pasture is dominated by grazing-resistant *Artemisia pauciflora*, while the protected area is dominated by *Kochia prostrata*, a favorite food of animals. Джаныбекский стационар РАН, апрель 2006 г.

PROBLEMS OF STEPPE NATURE RESERVES

This problem cannot be solved only for protected areas. **IT IS NECESSARY TO RETURN TO THE DEVELOPMENTS OF V. V. DOKUCHAEV AND HIS FOLLOWERS** who created the "Stalin's plan for the transformation of nature" and to start (in exceptional cases as in the Kamennaya steppe – to continue) restoring the optimal ratio at the local and regional levels of unified complexes of forest, steppe, coastal-water and water landscapes. To do this, it is necessary to transform unproductive arable land into pastures and hayfields, reduce the load of livestock, create systems for pasture turnover that mimic free range animal husbandry, and create and maintain structurally optimal forest cover and water availability. Long-term observations in nature reserves have shown that it is impossible to preserve steppe vegetation without keystone animal species. At the same time, gradual replacement of wild ungulates with domestic animals allowed many species of plants, small animals and representatives of other kingdoms to survive. Thus, breeding of valuable breeds of horses supported the colourful meadow steppes of the Central Chernozem reserve before the beginning of the reserve state. At the same time, introduction of an absolute reserve regime in this and similar territories has led to a catastrophic decline in species diversity. Colourful grasslands and real steppes began to turn into tree and shrub communities poor in species, and the composition of the soil biota changed significantly.



The state of steppe vegetation on a plot with litter, where grazing is excluded (*left*) and next to it on a pasture plot without litter. Dzhanybek Scientific Station, RAS, 2000

PROBLEMS OF STEPPE NATURE RESERVES

Having played an extremely important role in the history of mankind, the steppe was the first among all other zonal landscape types to be on the verge of completely losing its original appearance due to the replacement of indigenous ecosystems with agro-landscapes. No other landscape zone in Eurasia has such a high share of farmland (87-96 %) and arable land (40-85 %) in it. In the steppe zone, river flow regulation reached 40-55 %, and its total losses reached 1/3 of the original volume.



Dwarf iris is a bright stroke in the steppe. Photo by Tatiana Zharkikh.



The reserved steppe cherishes the pulsatilla. Photo by Vladimir Petrov.



Astragalus physocarpus is a miracle of the Pre-Urals steppe. Photo by Tatiana Zharkikh.

"The steppe is covered with bright colours, from soft yellow and white tones to dark purple and blue. These are irises in the first place: dwarf iris (*iris pimula*) and *iris scariosa*, as well as *pulsatilla* (windflower). It's too bad that all these rare plant species are **disappearing**".

Lyubov Linearova "Steppe palette. The world of plants of the Ural steppe " <https://oren.aif.ru>

PROBLEMS OF STEPPE NATURE RESERVES

The pressing environmental situation in the steppe zone is also illustrated by the fact that the share of extinct and included in the Red books of flora and fauna rare and endangered species is the highest here, whereas the amount of protected areas, especially nature reserves is the least. And this is all the more ironical because in 1895, after studying the state of nature of the steppe regions of southern Russia, V. V. Dokuchaev convincingly proved the need to create steppe reserves as permanent scientific stations "provided for the exclusive use of steppe inhabitants" Eurasian steppes: conservation of natural diversity and monitoring of the state of ecosystems. Materials of the International Symposium. Orenburg, 1997



The program for creating a semi-free ranging population of Przewalski's horse in the Orenburg nature reserve was developed and implemented by the Federal national state-funded institution "Zapovedniki Orenburzhya" and the Ministry of Natural Resources of Russia under the personal patronage of President Vladimir Putin. Its practical implementation began in July 2015 after the fifth plot "Preduralskaya steppe" was included in the reserve. Since then, three batches of horses have been brought to the region.

— The birth of the first foals in this project indicates that we are one little step closer to the goal of a stable self-reproducing population. It is in Orenburg region that the first generation of these wild horses is born today, — concluded Rafilya

SOLVING THE PROBLEM OF ECOLOGICAL RESTORATION OF STEPPE BIOMES REQUIRES:

1. Fundamental changes in the ways of nature management aimed at restoring the main ecosystem functions of these territories;
2. Recreation of analogs of pre-anthropogenic forest-meadow-steppe landscapes on areas the size and landscape structure of which are sufficient for sustainable existence of reintroduced keystone species of herbivorous animals and their accompanying species of different trophic groups. The "new steppes" recreated by nature and man, require a consumer of annual increment of phytomass, which can be both wild ungulates and adaptive breeds of livestock (*Pashchenko, 1992; Chibilev, 1998; Lysenko, 2005, 2014; Kazantseva et al., 2008; 2010; Bobrovskaya et al., 2012; Parnikoza, 2014*).



SOLVING THE PROBLEM OF ECOLOGICAL RESTORATION OF STEPPE BIOMES REQUIRES:

3. In-depth analysis of paleodata collected on specific territories for subsequent creation of model reconstructions of potential living cover;
4. Selection of reintroduced keystone species of herbivores and associated species of different trophic groups;
5. Determining the size of territories and features of their landscape structure necessary for sustainable existence of populations of keystone species of forest-steppe biota as the initial type of pre-agricultural communities;
6. Development of a long-term comprehensive programme for recreating analogs of prehistoric forest-steppes; the programme should be based on fundamental changes in the ways of nature management aimed at restoring the main ecosystem functions of these territories;
7. Recreation of analogs of pre-anthropogenic forest-meadow-steppe landscapes on areas the size and landscape structure of which are sufficient for sustainable existence of reintroduced keystone species of different trophic groups;
8. The "new steppes" recreated by nature and man, require a consumer of annual increment of phytomass, which can be both wild ungulates and adaptive breeds of livestock.



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