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Landscape Katena "Northern Ergeni"

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Abstract. The landscape catenary reflects the role of the leading geological-geomorphological factor. This is consistent with the synergetic principle of subordination (Haken's principle). The object of the study was the landscape catenary of the ecotone space between the south of the Volga upland and the Northern Yergeny. The test sites "Lysaya Gora", "GZLP Volgograd-Cherkessk", and "Chapurnikovskaya Balka" were identified. During the study, the methodology of landscape-catenary sections was used, including the study of: mesorelief; plastic relief (the ratio of positive and negative elements of mesorelief); microrelief and the structure of the soil cover. The novelty of the research lies in the fact that for the first time in domestic practice, a method of analysis and modeling of landscape catenae is proposed, based on the synthesis of the principles of the catenary-logistics approach, methods of terrain plasticity, morphodynamic analysis and remote monitoring.The methodology of landscape-catenary sections allows us to conduct a modern analysis of the plasticity of mesorelief and soil-landscape cover. This makes it possible to adapt the technologies of creating a forest management system to the intra-national variation of forest suitability, i.e., the adaptation of forest reclamation systems to the spatial heterogeneity of specific litho-national and soil conditions.

Keywords: Catena, leading factor; geological and geomorphological facto; relief plasticity; granulometric composition; type of tracts.

Introduction

For the first time, the concept of a catena was proposed in soil science [6]. The catenary complex is understood as a sequence of soil varieties formed, as a rule, on the same parent rocks, but with differences in altitude level, relief slope and unequal characteristics of water flow. Slope differentiation of surface runoff is one of the most important reasons for the regular change in the morphological structure of soil profiles in Topokaten.Gradually, the concept of catena became more voluminous:the soil-hydrological content of the term was supplemented with soil-cartographic, soil-geomorphological, landscape.

The analysis of processes based on the catena concept is mainly aimed at clarifying the type, intensity and action of lateral processes leading to the formation of conjugations of landscape units. Katena should be called a mono-vector connection of communicating stows in a regular series caused by certain laterally acting processes. At the same time, the focus is not on the location of tracts in the chain, but on the spatial connection carried out by the processes. It is not caused by groundwater and substrate, but created primarily by relief and gravity.

The cyclic development inherent in the relief determines the ontogeny of soils and the phylogeny of the structures of the soil cover. G.N. Vysotsky [2] wrote "... nothing like relief complicates, diversifies, does not reform all other factors of life". These differences are most pronounced on the slopes. Slopes are an integral geotopodynamic system with a fairly large number of possible combinations of the relative position of sections of a certain shape, length and steepness: convex-concave, convex-rectangular-concave, stepped, straight. There are various interrelationships between the morphometry of the slope and many properties of the soils lying on them (morphological, chemical, water-physical, etc.). On convex areas, soil erosion increases downward with increasing steepness and length. On concave soils, weakly eroded and reclaimed soils are formed due to a decrease in the steepness and runoff energy. Summarizing the above and other particulars, we can say that the relationship between soil properties and geomorphological processes on the slopes is controlled mainly by the steepness, length and curvature. The principle of the leading factor is traditionally applied in physical geography and landscape ecology, however, it is interpreted in different ways. Many recognize two main independent factors as the leading landscape differentiation - bioclimatic and lithological-geomorphological [11].But other, sometimes inherently extreme, views on this matter are known. F.N. Milkov [10], for example, considered it expedient to distinguish heterogeneous genetic series and groups of landscapes: climatogenic (for example, monsoon), tectogenic (mountain and lowland), lithogenic (for example, karst), hydrogenic (bog, floodplain, saline), etc. Depending on the specifics of the natural conditions of the regions, the leading role in their emergence and development may belong, in his opinion, to one or another factor. Hence, the conclusion is drawn "about the equivalence of landscape factors". N. A. Solntsev adheres to a fundamentally different position [12]. He was convinced that the main thing in the regional physical and geographical differentiation of the earth's land and the morphological organization of the landscape is always one of the most "strong", in his opinion, the geological and geomorphological factor. All others play a subordinate role. In recent years, the well-known geomorphologist A.N. Lastochkin has actively supported the views ofN.A. Solntsev [4].

It should be emphasized that the principle of the leading factor in the organization of open systems has found weighty confirmation in the theory of synergetics, the founders of which were made in the 70s. XX century I. Prigogine and G. Haken [16]. Haken's research has established: in self-organizing systems, when variables with different characteristic times interact, the real behavior of the system as a whole is described mainly by slowly changing variables, while mobile variables adjust, adapt to more stable. In other words, long-lived variables of self-organizing systems dominate short-lived ones. As a result, the behavior of the dissimilar components of the system becomes coherent - consistent. This conclusion formed the basis of the synergetic principle of subordination (the principle of G. Haken).

Through the efforts of landscape ecologists, the slope dynamics of soils began to be considered in conjunction with the dynamics of biota [2]. The catenary approach assumes that in the chain of regularly replacing each other landscape units (facies, tracts, localities) from the watershed down the slope to the foot to the bottom of the valley, the evolution of soils occurs, the succession of vegetation and animal population.

Materials and methods

The object of the study was the landscape (natural-anthropogenic) catena of the ecotonic space between the south of the Volga Upland and the Northern Yergeny along the route Lysaya Gora - Chapurnikovskaya Balka - VDNC (Volga-Don navigable canal).

The landscape catena "Northern Ergeni" provides for a transect polygon with the following test sites:

–Lysaya Gora;

–GZLP (state protective forest belt) Volgograd-Elista-Cher-kessk;

–Chapurnikovskaya beam.

During the study, the methodology of landscape-catenary sections was used, including the study:

–mesorelief;

–relief plastic (the ratio of positive and negative mesorelief elements);

–microrelief and structure of the soil cover.

Studies of natural and natural-anthropogenic landscapes were based on the use of a complex of heterogeneous data and included several stages:

–collection of a priori information on geomorphological and soil data, as well as on topographic and thematic maps;

–office decoding and field standardization of space photo information;

–landscape profiling of catenary complexes of key areas;

–landscape-reclamation interpretation of space and cartographic information in order to assess reclamation conditions and landscape zoning of the territory of polygons.

The method of relief plastics, which consists in establishing the boundaries between convex and concave relief forms according to the isohypsum of topographic maps, makes it possible to obtain the basic basis of a landscape map. The method was developed by A.N. Lastochkin, I.N.Stepanov, A.A. Ilyina and others [14].

In the selected model forest belts, guided by OST 56-69-83 [1], training-type test plots were laid, the number of which in each of the landscape areas was determined taking into account the prevalence of the species composition and age structure of plantations used in protective afforestation.

The soil cover is represented mainly by chestnut soils. The system of soil horizons of chestnut soils according to the accepted classification and diagnostics of soils is given below.[8]:

Soil type - chestnut:

-typical with a deeply developed profile (80-120 cm) – AJ-BMK-CAT-Cca, [A-B(B_1)-BCk(Ck)-Cc];

-typical with a medium developed profile – AJ-BMK-CAT-Cca,[A-B(B_1)-BCk(Ck)-Cc];

-typical on two-term – AJ-BMK-CAT-Cca-P, [A-B(B_1)-BCk(Ck)-P].

The development of these soils occurs under conditions of unstable and insufficient moisture by atmospheric precipitation, which causes a small accumulation of humus, a small depth of soil wetting with moisture and leaching of salt products of soil formation.

The morphological profile of the soils of the study area is characterized by a clarified structure-less-layered humus horizon of low thickness, a clearly pronounced compacted horizonB_1, a dense and deep carbonate horizonS_k.

The advantage of the landscape-catenary section methodology is that it allows analyzing the processes of soil-landscape cover at several levels at once - from combinations of natural boundaries that make up the type of terrain to landscape areas.

The novelty of the research lies in the fact that for the first time in domestic practice, a technique for analysis and modeling of landscape catenas based on the synthesis of the principles of the catenary-logistic approach, methods of relief plastics, morphodynamic analysis and remote monitoring has been proposed.

Soil and forestry research was based on a comparative geographical approach [15]. The study of the structures of the soil cover of various levels of complexity was carried out by laying profiles and drilling wells with subsequent sampling of soil samples in key areas.

During landscape-catenary profiling, taxonomic features of soils (field name, combinations, variations, mosaics, tachets), mesorelief (uplands, lowlands, mesoslopes), moisture conditions (automorphic, hydromorphic, semi-hydromorphic), lithological composition of rocks, granulometric composition of carbonate content (depth boiling), the thickness of the humus horizon (A + AB_1, cm).

In the classification of soils in Russia [8], the taxonomy of chestnut soils has undergone significant changes. Subtypes of chestnut and light chestnut soils are distinguished at the type level in the division of accumulative-carbonate low-humus soils called "chestnut soils". Some of the light chestnut soils are classified as brown soils in the same section. An underdeveloped genus was placed together with underdeveloped brown semi-desert soils in the department of organo-accumulative soils called light-humus soils. Dark chestnut soils are also assigned to a different division.

The division of the type into subtypes in the classification of 2004 [8] was carried out on the basis of alkalinity, salinity, and hydromorphism, as well as due to anthropogenic disturbances in the upper part of the profile. Five subtypes have been identified: typical, solonetzic, saline, hydrometamorphic (according to the 1977 classification [7], these are meadow chestnut soils) and turbocharged.

Results and discussion

Numerous studies [5,13,17] - I.V. Mushketova, A.D. Arkhangelsky, A.V. Tsygankov drew the border between Ergeny and the Volga Upland along the Otradnensky fault within the Volgograd, which is a southwestern continuation of the Great Volgograd fault.

The geomorphological distinction of Northern Ergeni lies in the presence of ancient erosional forms, the beams have a trough-like shape in the transverse profile. For the south of the Volga Upland, young erosional incisions prevail. This is due to the different intensity of the latest tectonic movements. Northern Ergeni envisage a low asymmetric location, which abruptly drops off to the Sarpinsky lakes and imperceptibly merges with the Don plains. As a result of erosion processes, the plateau is built into a chain of hills and ridges, separated by strongly eroded gully valleys. The eastern slope is the most dissected, because the difference in the basis of erosion is 25-30 m between the western and eastern slopes. The landscape catena "Northern Ergeni" runs along the junction of two landscapes of erosional plains: Volgograd and Severo-Ergenensk, described by A.G. Zhurkina [3]. The catena ends in the Sarpa landscape of the accumulative sea plain.

The test site "Lysaya Gora" is located on a slightly wavy watershed-upland plain and belongs to the type of tract of slightly wavy plains of interbeam watersheds on loams with a thickness (0,5-1 m) underlain by Ergeninskiy sands of light chestnut, weakly alkaline soils.The Lysaya Gora test site is of interest from the point of view of the heterogeneity of its lithological-facies structure. On a small area with significant elevation changes, almost the entire set of sediments characteristic of the Volgograd region is found.

The absolute heights vary from 140 m to 50 m. The elevation changes are reflected in the nature of the relief - the spurs of the hill, relatively sharply descending to the valley of the river Volga.

Along with extraglacial deposits, which include loess-like loams, deposits of Caspian transgressions can be found here - from clays to quartz sands. The coordinates of the center of the test area are 48°38’Nand 44°24’E. According to the data on the granulometric composition (table 1), they are characterized as loose sandy soils. Physical clay content in the arable horizon 3-1,7%. To a depth of 2 meters, the granulometric composition varies from sand and sandy loam to an interlayer of light loam. The humus content is presented in table 2. The amount of humus in the surface horizon varies from0,48 to 0,16%, 0,36 to 0,08% in the 20-40 cm horizon and from 0,28 to 0,08% in the 40-60 cm horizon.

Table 1 - Granulometric composition of soil (according to Kachinsky) test site "Lysaya Gora" 2016.

№	Incision	Depth cm	Fraction size, mm							Soil name
			1-0,25	0,25-0,05	0,05-0,01	0,01-0,005	0,005-0,001	<0.001	Physical clay	
1	Section 3 (point 3)	0-20	16,37	79,15	1,48	1,44	0,44	1,12	3,00	Loose sand
2		20-40	19,06	77,38	1,88	0,64	0,48	0,56	1,68	«
3		40-60	12,59	84,02	1,33	0,61	0,40	1,05	2,06	«
4		60-80	21,49	74,08	1,53	0,44	0,61	1,13	2,18	«
5		80-100	17,13	68,08	5,50	2,02	2,14	5,13	9,29	Coherent sand
6		100-120	15,92	55,45	8,40	2,02	2,84	15,37	20,23	Sandy loam
7		120-140	16,75	65,54	5,96	1,55	1,10	9,10	11,75	Sandy loam
8		140-160	24,79	57,83	6,69	1,47	1,47	7,75	10,69	«
9		160-180	22,43	62,38	4,24	1,58	1,57	7,80	10,95	«
10		180-200	22,79	48,81	10,77	1,64	3,95	12,04	17,63	«
11		200-220	16,04	46,67	14,88	1,81	5,52	15,08	22,41	Light loam
12		220-240	0,86	90,62	4,84	0,29	0,20	3,19	3,68	Loose sand
13		240-260	24,82	39,46	8,40	2,89	5,37	18,70	27,32	Light loam
14		260-280	0,33	83,47	4,57	1,14	1,68	8,81	11,63	Sandy loam

15		280-300	2,85	87,70	2,54	0,93	0,45	5,53	6,91	Loose sand

Table 2 - Volumetric (acidimetric) method for the determination of carbonates in soil samples (Point №3).

№	Sample name	Depth, cm	CO2 content of carbonates in% to dry soil	CaCO3 content calculated on dry soil
1	Point № 3	0-20	0,55	1,26
2		20-40	0,81	1,85
3		40-60	0,29	0,67
4		60-80	0,37	0,84
5		80-100	1,03	2,35
6		100-120	0,89	2,02
7		120-140	0,66	1,51
8		140-160	0,37	0,84
9		160-180	1,22	2,77
10		180-200	5,17	11,8
11		200-220	6,6	15,1
12		220-240	1,5	3,44
13		240-260	3,66	8,3
14		260-280	2,7	6,1
15		280-300	2,5	5,8

The test site "GZLP Volgograd-Elista-Cherkessk" is located on the territory of the Soviet and Kirovsky districts of Volgograd, the approximate area is 600,3 hectares. The border between the south of the Volga Upland and Northern Ergeny runs along the Otrada gully.The test site is a landscape ecotone, including mesocatens of the Gornaya Polyana, Otrada, Kapustnaya, and Prudovaya gullies, where the Ergeninsky aquifer is exposed. Therefore, these gullies have preserved unique forest ecosystems.

The following types of natural boundaries are distinguished [3]:

– slightly clayey upland-watershed plain on heavy and mantle loams, underlain by Yergenin sands with light chestnut alkaline soils, in places with meadow chestnut soils along depressions;

–gently sloping and sloping (3-10^0) coastal slopes of predominantly northern exposure on deluvial heavy loams with light chestnut slightly to medium washed out alkaline soils;

– sloping and steep (over 100) heavily eroded coastal slopes, southern exposure, composed of deluvial heavy and soft loams, underlain by the Ergenin sands and Maikop clays, with light chestnut steppe soils;

– damp sections of beams cutting through the Ergenin aquifer in the thickness of the Ergenin sands with meadow-chestnut or chernozem-like soils under forest ecosystems.

According to the data on the granulometric composition (table 3), the characterized soils are light clay and heavy loam. The content of physical clay in the arable horizon of light chestnut and meadow chestnut is from35,5 to 40,0 %. The predominant fraction is silty (0,001 mm), however, the content of coarse dust is very high. Thus, the soils are characterized as silty-coarse-silty.

Table 3 - Granulometric composition (test site "GZLP")

Horizon, depth cm	Fraction size, mm						
	1-0,25	0,25-0,05	0,05-0,01	0,01-0,005	0,005-0,001	‹0,001	‹0,01
Light chestnut							
A_1 0-10	0,31	7,69	34,37	12,66	12,01	30,66	55,53
B_1 11-28	0,19	6,26	34,79	6,65	11,79	37,72	56,16
B_2 28-38	-	4,79	35,96	5,96	8,89	36,00	51,85
B_2/C 40-50	0,20	4,63	33,72	6,34	8,46	31,06	45,86
C_1 50-70	-	8,07	34,21	5,67	8,91	24,93	39,41
C_2 90-100	-	8,48	32,96	5,91	10,00	26,06	41,97
C_2 140-150	0,12	10,85	34,99	5,13	9,97	26,47	41,57
Meadow chestnut							
A_{dp} 0-10	3,79	19,75	32,61	6,96	2,61	30,49	40,06
A_p 1-20	1,46	13,23	33,24	10,73	7,72	30,64	49,08
A_1 20-30	1,38	14,25	34,79	7,09	8,73	31,13	48,95
B_1 30-50	0,79	8,36	38,14	6,29	9,48	34,86	50,63
B_2 50-60	1,31	11,15	32,95	6,17	7,29	35,24	48,70
B_2/C 60-80	0,94	6,18	36,91	1,35	7,66	29,59	38,60
C_1 110-	2,58	17,47	31,44	9,09	2,06	20,84	31,99

120							
C_2 130-140	3,19	22,31	24,57	3,00	4,73	26,99	34,72

The humus content (Table 4) is low in the A_p horizon light chestnut 2,1% in the meadow chestnut in the 0-20 cm horizon 4%, in 20-40 cm 2%.

Table 4 - Humus content in the test area, Lysaya Gora, 2016.

№	Section, cm	Depth, cm	Carbon content, %	Humus content, %
1	Point 1,	0-20	0,27	0,48
2		20-40	0,14	0,25
3		40-60	0,16	0,27
4	Point2,	0-20	0,19	0,34
5		20-40	0,21	0,36
6		40-60	0,16	0,28
7	Point3,	0-20	0,095	0,16
8		20-40	0,046	0,08
9		40-60	0,046	0,08

Severe forest growing conditions of the semi-desert created certain difficulties in growing large tracts of forest crops and, first of all, imposed restrictions on the range of tree and shrub species: the species composition of forest crops on the territory of Volgograd is rather poor (Table 5). The dominant species here are Scots pine (Pínus sylvéstris), pseudoacacia robinia (Robínia pseudoacácia), small-leaved elm (Ulmus parvifolia), ash-leaved maple (Ácer negúndo)and pedunculate oak (Quércus róbur), found in massifs, rocker, curtain) and mixing schemes. The most common shrub species is golden currant (Ribes aureum).

Table 5 - Taxonomic characteristics of forest stands

№	Species composition	Age, years	N_{sr}, m	D_{sr}	Bonitet	Stock, m^3 / ha	Number of trees per hectare	
							Total, pcs	Dead, %
Test site "Lysaya Gora"								
1	10s	45	9,2	14,3	III	190	1660	15

2	10s	49	9,6	15,0	IV	147	1200	20
3	10s	50	11,0	17,2	III	301	1400	10
Test site "GZLP Volgograd-Cherkessk"								
1	10 Ro	39	7,0	10,4	V	22	1100	60
2	10 s	45	7,2	18,0	V	50	300	45
3	5 klya	35	7,8	16,0	V	32	500	10
	5 Ro		11,0	13,0		40	500	15

The test site "Chapurnikovskaya Balka" has a length of 5 km, it stretches from north to southwest, having an arched shape in plan and numerous screwdrivers. The density of erosional dissection reaches 1,5 km per km^2. The depth of the main incision reaches 30-35 m in the middle part, decreasing in the lower reaches to 10 m. The slopes are smooth, since the gully is worked out in the sands. The plateau is formed from the surface by a thick, over 30 m thick stratum of Neogene Ergenin white sands, fine and medium-grained.The coordinates of the center of the Chapurnikovskaya gully are 48o 30'N, 44o30'E. The western slope of the eastern exposure is slightly lower, but steeper - about 6 °. Soil-forming and underlying rocks of the bottom and slopes of the gully are sharply different. The eastern slope is composed of a stratum of loess-like loams and clays of light brown and yellowish color. They are underlain by sandy-argillaceous deposits, below which there are Tertiary sands. On the western slope, the thickness of loess-like rocks varies from 0,5 m to 2,5 m; medium-grained sands, underlain by bluish shale clays, often pinch out onto the day surface. The western slope is irrigated with groundwater flowing from the above sandy layer. The bottom is lined with alluvial-deluvial sandy deposits, which are characterized by a loose composition and oblique bedding.

The following types of natural boundaries are identified within the test site:

–slightly undulating interbeam watersheds on low-thickness loams, underlain by the Ergenin sands with light chestnut slightly barely solonetsous soils;

–undulating-hilly slopes of inter-girder ridges, mown by Ergenin sands, laid on Maykop clays with meadow-chestnut light loamy soils;

–troughs and stretched in loess-like loams on meadow-chestnut soils wet sections of gullies cutting through the Ergeninsky aquifer, underlain by Maikop clays with dark-colored chernozem-like soils.

On the slope of the eastern exposure, the soil is the most homogeneous in terms of its granulometric composition; down the profile it changes from loamy to light loamy. The silt fraction (<0.001) is 22-31% (table 6).The soils of the western slope are light, the fraction of coarse dust is 10-12%, and the fraction of fine sand is 52-65%. The soils of the bottoms are layered with light loam sand. The largest percentage has a fraction of coarse dust 34-38%.

Table 6 - Granulometric composition of soils (test site "Chapurnikovskaya Balka")

Soil type	Horizon, depth, cm	Humus,% (according to Tyurin)	>1	1-0,25	0,25-0,05	0,05-0,01	0,01-0,005	0,005-0,001	<0,001	sum of particles <0,01
Light chest-nut loamy (eastern slopes)	A_1 0-10	2,00	–	1,1	19,5	36,1	5,7	7,5	24,9	38,1
	A_1 10-20	2,00	–	1,2	18,3	38,3	4,5	4,8	27,4	36,7
	B_1 25-35	0,94	–	0,7	15,5	35,1	5,1	4,7	22,9	32,7
Light chest-nut loamy (eastern slopes)	A_n 0-10	2,65	–	1,2	13,8	36,2	5,9	9,6	30,4	45,9
	A_n 10-20	3,50	–	1,8	14,2	33,2	6,6	10,1	31,9	48,6
	B_1 25-45	1,50	–	2,0	14,6	38,6	3,3	8,8	30,2	42,3
	C 85-95	–	–	1,0	13,1	36,5	6,3	4,6	30,9	41,8
Dark colored loamy	A_n 0-10	3,20	–	0,8	8,5	34,4	6,5	11,4	33,6	51,5
	A_1 10-30	4,20	–	1,7	7,8	37,1	6,2	10,7	34,0	51,7
	B_2 50-60	2,05	–	1,0	8,5	38,7	6,2	9,4	34,4	50,0
	C_1 90-100	–	–	1,1	8,9	38,4	6,0	–	–	–
Light chest-nut sandy loam (west-ern exposure slopes)	A_1 0-10	0,10	–	20,7	55,6	10,3	0,9	3,3	8,7	12,8
	A_1 10-20	1,17	–	24,2	58,6	6,7	1,0	2,1	7,2	10,3
	B_1 55-65	1,00	–	18,0	63,2	5,9	0,5	1,6	10,2	12,3
	C 80-90	–	–	16,7	64,8	6,2	0,3	1,7	9,9	11,9
Light chest-nut sandy loam (west-ern exposure slopes)	A_1 0-8	1,60	–	4,3	52,9	11,7	2,1	3,2	12,9	18,3
	A_1 10-20	3,00	–	13,1	60,5	9,6	1,0	3,0	12,2	16,2
	B_1 30-40	1,40	–	15,0	61,4	7,4	0,9	2,9	11,6	15,4
	C_1 83-90	–	–	12,8	61,5	10,0,	0,7	2,7	11,7	15,1

Chapurnikovskaya gully covers an area of 1127 hectares [9], includes areas of virgin steppes with a unique massif of ravine oak forest 120-150 years old, which is the southern outpost of oak (Quércus)in the southeast of the European part of Russia. Dubrava occupies 161 hectares. BIn the upper part of the gully, a stand of low-growing oak (Quércus) with an admixture of birch bark (Ulmus campestris) and ap-ple (Mālus) was formed. In the rare undergrowth there are Tatar maple (Acer tataricum), buckthorn lax-ative (Rhámnus cathártica), rose hip (Rōsa), hawthorn (Crataégus), euonymus (Euónymus)and the turn (Prúnus spinósa). Down the slope, in the deep part of the squirrel, oak stands prevail (Quércus)with a small admixture of aspen(Pópulus trémula)and birch bark (Ulmus). Rare old-growth dumpy oaks have survived here (Quércus).

Tatar maple in the underbrush (Acer tataricum)with an admixture of euonymus (Euónymus), hawthorn (Crataégus)and rose hips (Rōsa). Even lower along the slope, in the deeper part of the gully, where there are springs, powerful oaks with straight trunks grow. On the edges of the forest - Tatar maple (Acer tataricum)and euonymus (Euónymus), and below the spring along the stream - 40-50-year-old alder(Betulaceae)coppice origin. Oaks grow here only singly along the slopes together with dense thickets of Tatar maple (Acer tataricum),euonymus (Euónymus)and thorns (Prúnus spinósa). Towards the mouth, the gully expands, and due to the sharp increasing anthropogenic pressure, it has become almost treeless, overgrown with shrub and wormwood-grass vegetation.

The methodology of landscape-catenary sections makes it possible to carry out a modern analysis of the plasticity of the mesorelief and soil-landscape cover. This makes it possible to adapt the technologies for the creation of PFs to the intra-national variation in forest suitability, i.e. adaptation of the systems of forest reclamation to the spatial heterogeneity of specific lithofacies and soil conditions.

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