2.6. Ecosystem extent in protected areas

2.6.A. Extent of protected areas in Armenia

In accordance with Decree N 1059-Ա (25.09.2014) of the Government of the Republic of Armenia, the PAs in 2014 were as follows:

- 3 state reserves ("Khosrov Forest", "Shikahogh" and "Erebuni"), which occupy an area of 35,439.6 hectares or 1.19% of the total area of Armenia,
- 4 national parks ("Sevan", "Dilijan", "Lake Arpi" and "Arevik"), which occupy an area of 236,802.1 hectares or 7.96% of the total area of Armenia,
- 232 natural monuments,
- 27 state sanctuaries, which occupy an area of 114,812.7 hectares or 3.95% of the total area of Armenia.

The total area of state reserves, sanctuaries, and national parks was 387,054.4 hectares, which accounted for 13.1% of Armenia's total territory.

Table 1. PAs areas in 2014 according to the Ministry of Environment of Armenia

PA	*Area, ha*
STATE RESERVES	
Khosrov Forest	23 213.5
Shikahogh	12 137.1
Erebuni	89.0
NATIONAL PARKS	
Sevan	147 455.0
Dilijan	33 765.0
Lake Arpi	21 179.3
Arevik	34 401.8
NATURAL SANCTUARIES	
Akhnabad	25.0
Arjatkhlenu	40.0
Juniper sparse forest	3 312.0
Gyulagarak	2 576.0
Herher sparse forest	6 139.0
Jermuk Forest	3 865.0
Sosu Park	64.2
Aragats Alpine	300.0
Banks pine	4.0
Goravan sand dunes	95.99
Caucasian rosehip	1 000.0
Arzakan-Meghradzor	13 532.0
Gandzakar	6 813.0
Getik	5 728.0
Ijevan	5 908.0
Margahovitti	3 368.0
Yeghegnadzor	4 200.0
Goris	1850.0
Red worm	219.85
Boghakar	2 728.0
Black Lake	240.0
Deep wound	50.28
Hanqavan Hydrological	5 169.04
Jermuk Hydrological	17 371.0
Zangezur	25 870.64
Zikatar	150.0
Khustup	6946.74

2.6.B. Ecosystem extent in PAs based on ESRI land cover data

At the present stage, we do not have access to official data covering all Armenian PAs for the period after 2014, official digitized maps of PA boundaries, or land cover data specifically refined for the territory of Armenia. Therefore, the following analyses are based on the available digital PA map referenced below and the global ESRI land cover dataset.

The use of the ESRI land cover dataset for relatively small PA areas leads to significant errors in area estimation. In the examples below, we demonstrate only the type of analysis that can, in principle, be conducted for ecosystem accounting of PAs based on land cover data. All resulting estimates are of methodological value only and should be refined using official PA boundaries and land cover data provided by the PAs.

This example of accounting is based on the PA map provided by Acopian Center for the Environment, American University of Armenia (Figure 26B-1), the vegetation map prepared in the framework of our project (Section 2.3), and ESRI land cover data from 2017 and 2023.

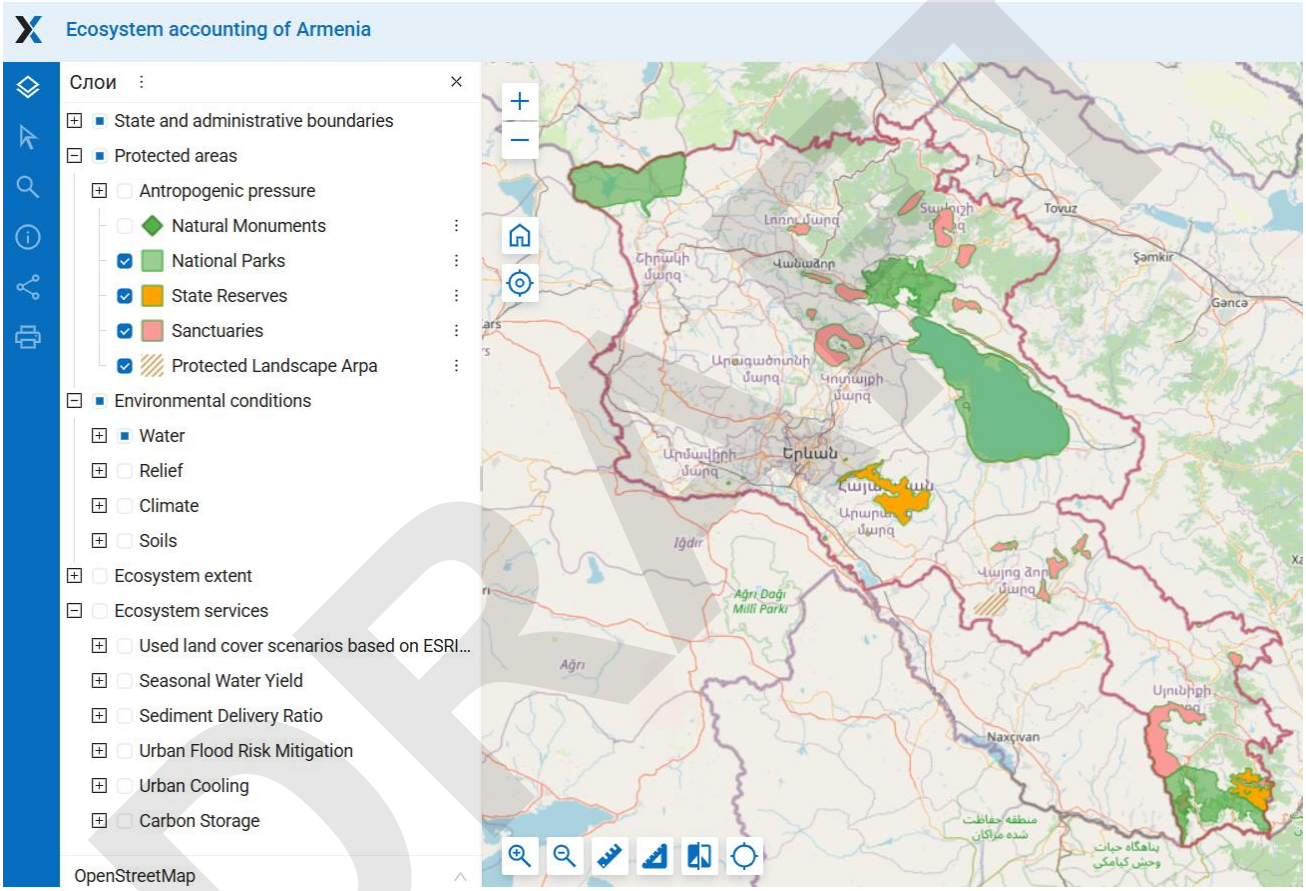

Figure 26B-1. The map of protected areas of Armenia. For details see project WEB GIS, Protected areas here. (The location of the Goravan Sands Sanctuary needs to be clarified)

The extent of land-cover classes in the PAs indicates the area of woody vegetation and the degree of human-induced transformation (Figure 26B-2; Table 26B-1). According to ESRI (2023), the entire area of the Ararat Vordan Karmir Sanctuary is occupied by croplands and built-up areas. Human-modified territories cover about half of the Goravan Sands and Goris Sanctuaries. The areas of Sevan and Arpi Lake National Parks, as well as the Khor Virap Sanctuary, are also significantly transformed. Forest vegetation occupies most of the territory of the Shikahogh Reserve and the Dilijan National Park, as well as the Gandzakar–Upper Aghdan, Ijevan, Pine of Gyulagarak, and Zikatar Sanctuaries. By contrast, forest is almost absent in the Erebuni Reserve, Arpi Lake National Park, and in 11 other sanctuaries.

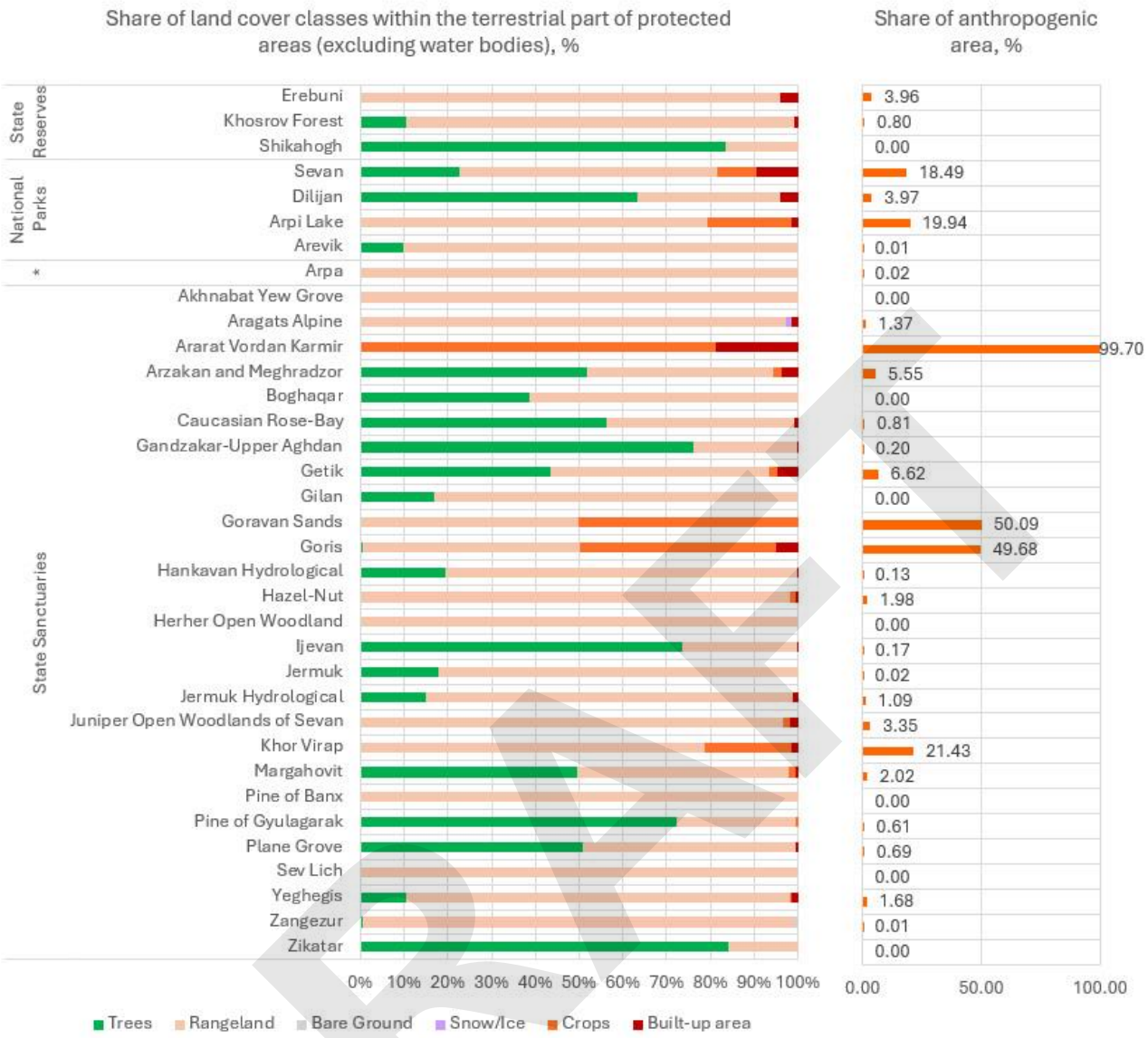

*Figure 26B-2. The share of area of land cover classes and anthropogenic areas, %. *Arpa is protected landscape*

All vegetation zones are represented in the PAs. The area of some PAs is entirely covered by vegetation of a single zone, for example: Goravan Sands – desert; Erebuni, Ararat, and Khor Virap — semi-desert;Hazel Nut – broadleaf woodlands; Gandzakar-Upper Aghdan, Goris, Hankavan Hydrological, Pine of Gyulagarak, Plane Grove – forest zone; Akhnabat Yew Grove, Pine of Banx, Sev Lich — subalpine meadows; Aragats Alpine – alpine meadows (Figure 26B-3).

Overall, vegetation zones are unevenly represented in the PAs. The forest zone occupies the largest area within the PAs—about 1,400 km². Other zones are much smaller, ranging from 500 km² of subalpine zone to 46 km² of marshes (Figure 26B-4 a). The shares of the zones' areas preserved in the PAs are also highly unequal. 26% and 32% of the forest and juniper zones are preserved in the PAs while for the semi-desert, steppe, and open woodland zones this share is less than 10% (Figure 26B-4 b). The desert zone is not indicative in this analysis, as it is represented by only one small unique site).

Between the total area of a vegetation zone and the share of its area preserved in the PAs, a weak, non-significant tendency towards a negative relationship between the total zonearea of a vegetation zone and its representation in the PAs: the larger the total area of a zone, the lower its representation in the PAs (Figure 26B-5). Even from this weak trend it is possible to distinguish zones that are better represented in the PAs, lying above the trend line (juniper, forest), and underrepresented zones, lying below the trend line (semi-desert, broadleaf woodland).

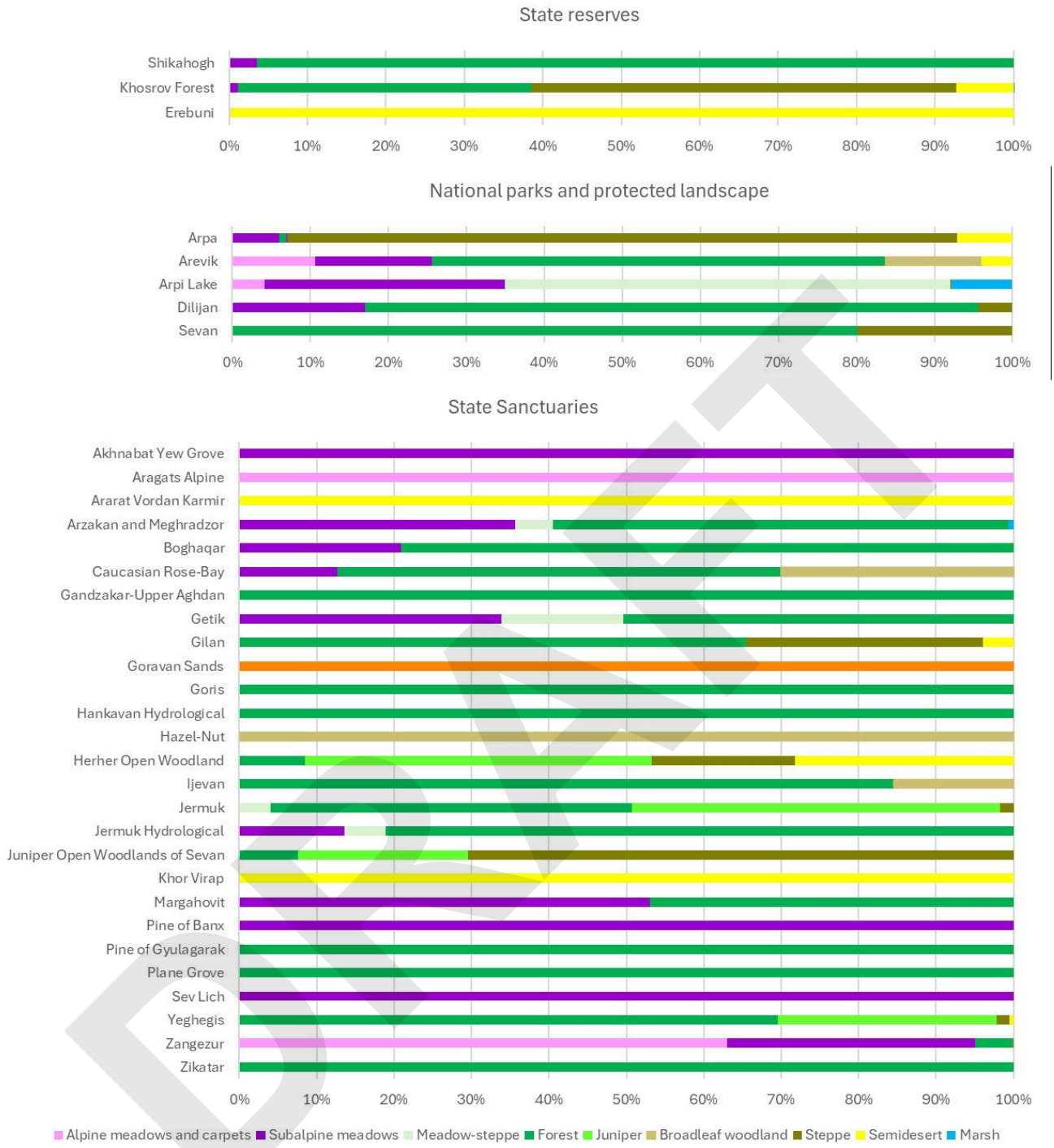

Figure 26B-3. The share of area of vegetation zones in PAs, %

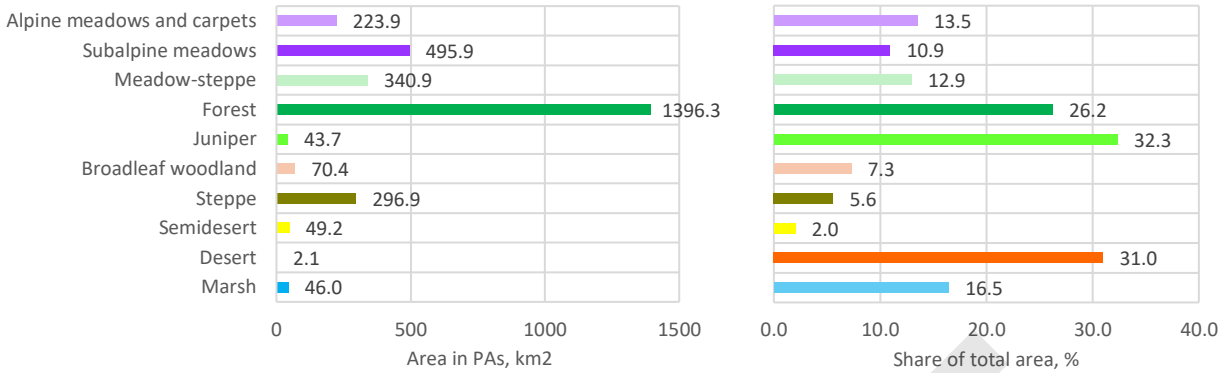

Figure 26B-4. Area and the share of the natural area of a vegetation zone located in the PAs

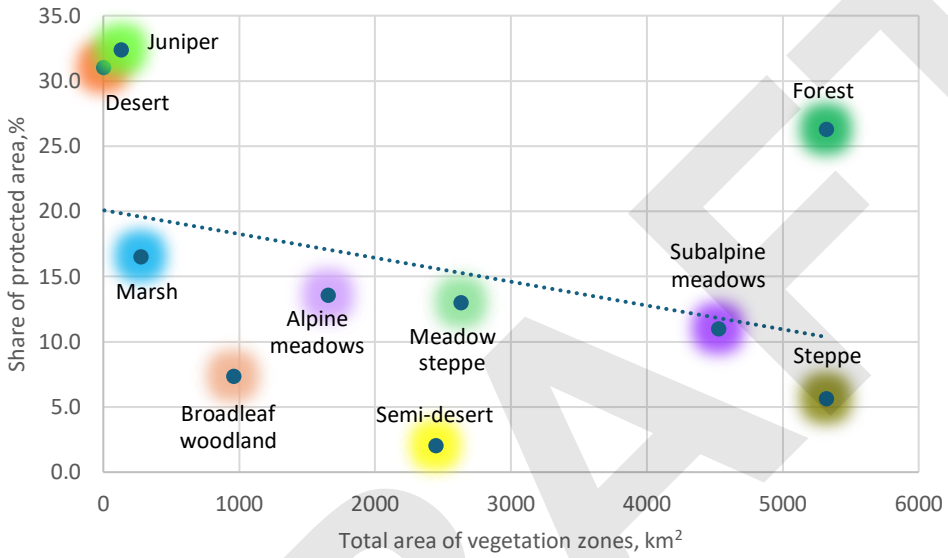

Figure 26B-5. A weak, non-significant tendency towards a negative relationship between the total area of a vegetation zone and its representation in the PAs.

Table 26B-1. Area of land cover classes in PAs, han (the total area of PAs shown on the map used may differ from the official data, as the PA boundaries on the map require further clarification)*

PA type	*PA*	*Trees*	*Rangeland*	*Bare Ground*	*Snow/ Ice*	*Water and flooded vegetation*	*Crops*	*Built-up area*	*Total area of PA**
State Reserves	Erebuni	0	84.84	0	0	0	0	3.5	88.30
	Khosrov Forest	2404.91	20231.17	31.76	0	0.51	5.33	176.63	22868.59
	Shikahogh	9854.31	1937.14	0	0	0	0	0	11810.26
National Parks	Sevan	5525.1	14346.23	13.23	0	126863.3	2173.48	2336.68	151374.99
	Dilijan	24757.79	12862.58	0	0	5.21	11.41	1546.26	39214.50
	Arpi Lake	186.33	43922.3	8.64	0	2123.82	10719.45	810.1	57828.90
	Arevik	4158.48	37530.44	36.28	1.25	3.11	0	5.12	41852.62
Protected landscape	Arpa	1.49	8148.12	1.01	0	0	0	1.7	8158.56
State Sanctuaries	Akhnabat Yew Grove	0	24.85	0	0	0	0	0	24.86
	Aragats Alpine	0	276.72	0.17	4.1	15.67	0	4.11	301.07
	Ararat Vordan Karmir	0	0.37	0	0	0	166.63	38.36	205.60
	Arzakan and Meghradzor	7503.25	6181.2	3.39	0	7.27	285.16	521.26	14518.08
	Boghaqar	1112.76	1757.96	0	0	0	0	0	2872.27
	Caucasian Rose-Bay	1037.93	794.25	0	0	0	0	15.02	1848.58
	Gandzakar-Upper Aghdan	2973.96	925.74	0	0	0	0.07	7.73	3910.26
	Getik	1354.88	1559.37	0.03	0	1.65	58.24	148.68	3124.67
	Gilan	48.48	238.6	0.23	0	0	0	0	287.41
	Goravan Sands	0	106.47	0	0	0	106.93	0	213.47
	Goris	11.93	934.73	0	0	0	847.96	96.39	1901.05

	Hankavan Hydrological	191.05	783.42	0	0	0	0	1.3	976.53
	Hazel-Nut	0	40.73	0	0	0	0.58	0.24	41.48
	Herher Open Woodland	7.17	2047.41	6.58	0	35.85	0	0	2098.67
	Ijevan	5725.75	2048.54	0	0	0	5.7	7.29	7793.64
	Jermuk	726.01	3336.61	0	0	0	0.94	0	4066.48
	Jermuk Hydrological	388.69	2163.31	0	0	0.05	0	28.1	2581.86
	Juniper Open Woodlands of Sevan	8.9	3764.79	21.6	0	0.2	60.96	70.75	3930.40
	Khor Virap	0.01	124.8	0	0	0.28	31.71	2.45	159.37
	Margahovit	2285.4	2222.63	0	0.14	0	69.85	23.13	4604.38
	Pine of Banx	0	4.62	0	0	0	0	0	4.61
	Pine of Gyulagarak	1768.24	661.81	0	0	0	14.27	0.61	2446.95
	Plane Grove	1098.25	1049.34	0	0	0	1.43	13.58	2174.57
	Sev Lich	0	150.56	0.47	0	89.14	0	0	240.32
	Yeghegis	230.75	1927.08	0.45	0	0	0.52	36.32	2196.95
	Zangezur	127.06	24156.19	241.24	3.54	33.9	2.03	0	24711.29
	Zikatar	2691.57	504.37	0	0	0	0	0	3198.61

Table 26B-2. Area of vegetation zones in PAs, ha (the total area of PAs shown on the map used may differ from the official data, as the PA boundaries on the map require further clarification)*

PA type	PA	Alpine meadows and carpets	Sub-alpine meadows	Meadow-steppe	Forest	Juniper	Broad-leaf woodland	Steppe	Semi-desert	Marsh	No data	Total area of PA*
State Reserves	Erebuni	0	0	0	0	0	0	0	88.34	0	0	88.34
	Khosrov Forest	0	268.64	0	8533.69	0	14.72	12399.13	1626.9	3.58	3.65	22850.31
	Shikahogh	0	405.25	0	11224.97	0	0	0	0	0	176.04	11806.26
National Parks	Sevan	0	0	16.03	20957.52	0	0	5204.09	0	0	125080.4	151258.04
	Dilijan	0	6667.11	15.37	30799.09	0	0	1701.68	0	0	0	39183.25
	Arpi Lake	2375.27	17575.65	32567.5	0	0	0	40.31	0	4514.36	726.2	57799.33
	Arevik	4371.3	6231.62	0	23943.92	0	5172.4	0	1651.39	0	461.3	41831.9
Protected landscape	Arpa	0	490.08	0	73.14	17.23	0	6997.61	574.26	0	0	8152.32
State Sanctuaries	Akhnabat Yew Grove	0	24.85	0	0	0	0	0	0	0	0	24.85
	Aragats Alpine	300.77	0	0	0	0	0	0	0	0	0	300.77
	Ararat Vordan Karmir	0	0	0	0	0	0	0	205.36	0	0	205.36
	Arzakan and Meghradzor	1.87	5171.99	699.07	8547.13	0	0	0	0	86.52	0	14506.58
	Boghaqar	0.32	600.73	0	2269.67	0	0	0	0	0	0	2870.72
	Caucasian Rose-Bay	0	235.19	0	1051.5	0	560.51	0	0	0	0	1847.2
	Gandzakar-Upper Aghdan	0	0	0	3907.5	0	0	0	0	0	0	3907.5
	Getik	0	1057.62	491.27	1573.96	0	0	0	0	0	0	3122.85
	Gilan	0	0	0	187.18	0	0	87.72	11.24	0	1.17	287.31
	Goravan Sands	0	0	0	0	0	0	0	213.4 (desert)	0	0	213.4
	Goris	0	0	0	1900.32	0	0	0	0	0	0	1900.32
	Hankavan Hydrological	0	0	0	975.77	0	0	0	0	0	0	975.77
	Hazel-Nut	0	0	0	0	0	41.55	0	0	0	0	41.55
	Herher Open Woodland	0	0	0	177.97	938.57	0	388.05	592.42	0	0	2097.01
	Ijevan	0	0	0	6581.18	0	1206.1	0	0	0	0	7787.28
	Jermuk	0	0	164.7	1896.6	1932.97	0	69.29	0	0	0	4063.56

	Jermuk Hydrological	0	351.27	136.5	2092.38	0	0	0	0	0	0	2580.15
	Juniper Open Woodlands of Sevan	0	0	0	298.17	861.8	0	2767.2	0	0	0	3927.2
	Khor Virap	0	0	0	0	0	0	0	159.25	0	0	159.25
	Margahovit	0	2440.85	0	2160.31	0	0	0	0	0	0	4601.16
	Pine of Banx	0	4.62	0	0	0	0	0	0	0	0	4.62
	Pine of Gyulagarak	0	2.62	0	2442.31	0	0	0	0	0	0	2444.93
	Plane Grove	0	0	0	2160.46	0	0	0	0	0	12.97	2173.43
	Sev Lich	0.07	240.1	0	0	0	0	0	0	0	0	240.17
	Yeghegis	0	0	0	1527.23	619.0	0	37.75	11.1	0	0	2195.12
	Zangezur	15340.85	7825.73	0	1148.02	0	45.62	0	0	0	336.6	24696.79
	Zikatar	0	0	0	3195.94	0	0	0	0	0	0	3195.94

2.6.C. Changes in the area of land cover classes in state reserves and national parks

According to ESRI, between 2017 and 2023 the most notable changes occurred in Arpi Lake National Park, where the area of croplands increased by more than half, and in the Erebuni Reserve, where it decreased by one third. In the Arevik Reserve, the forest area decreased by 18% (Figure 26C-1).

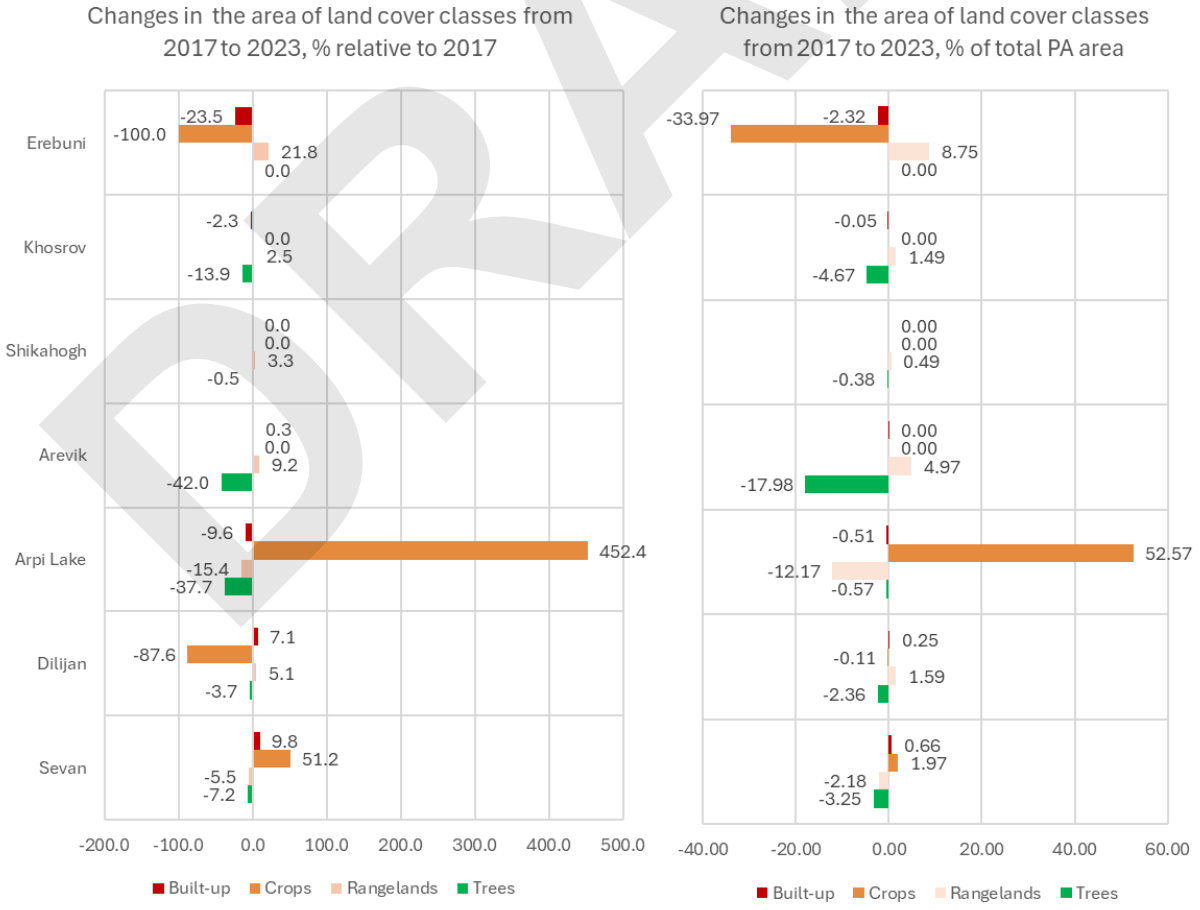

Figure 26C-1. Changes in the area of land cover classes within PAs

2.6.D. Distance from natural monuments to anthropogenic areas and roads

As an example of assessing anthropogenic threats to 'point' ecosystems and natural objects of very small area, distances were measured between the natural monuments shown on the PA map provided by Acopian Center for the Environment, American University of Armenia (Figure 26D-1), and anthropogenic areas (built-up areas and croplands according to the ESRI 2023 land cover data), roads including main roads and all other roads including trails from the dataset of Forest Atlas of Armenia, and population polygons with more than 100 residents based on the Kontur Population Dataset (Figure 26D-2).

This example shows, that even minor errors in land cover classification—amounting to just a few pixels—can significantly distort the calculated distances to natural monuments. Therefore, to obtain reliable results, it is essential to use land cover data specifically refined for Armenia.

Unfortunately, at this stage the lack of an officially approved digital map of PA boundaries, combined with errors in the ESRI land-cover data, prevents accurate accounting of ecosystem extent within PAs. For PAs with small areas, even minor land-cover errors can significantly distort the actual proportions of different ecosystem types. Moreover, the misclassification of anthropogenic areas where none exist leads to inaccurate assessments of threats to natural ecosystems and natural monuments. For instance, the misclassification of cropland and built-up areas in the high-mountain zone of the Gegham Ridge in the land-cover data artificially reduced the estimated distance between natural monuments and anthropogenic territories (26D-4).

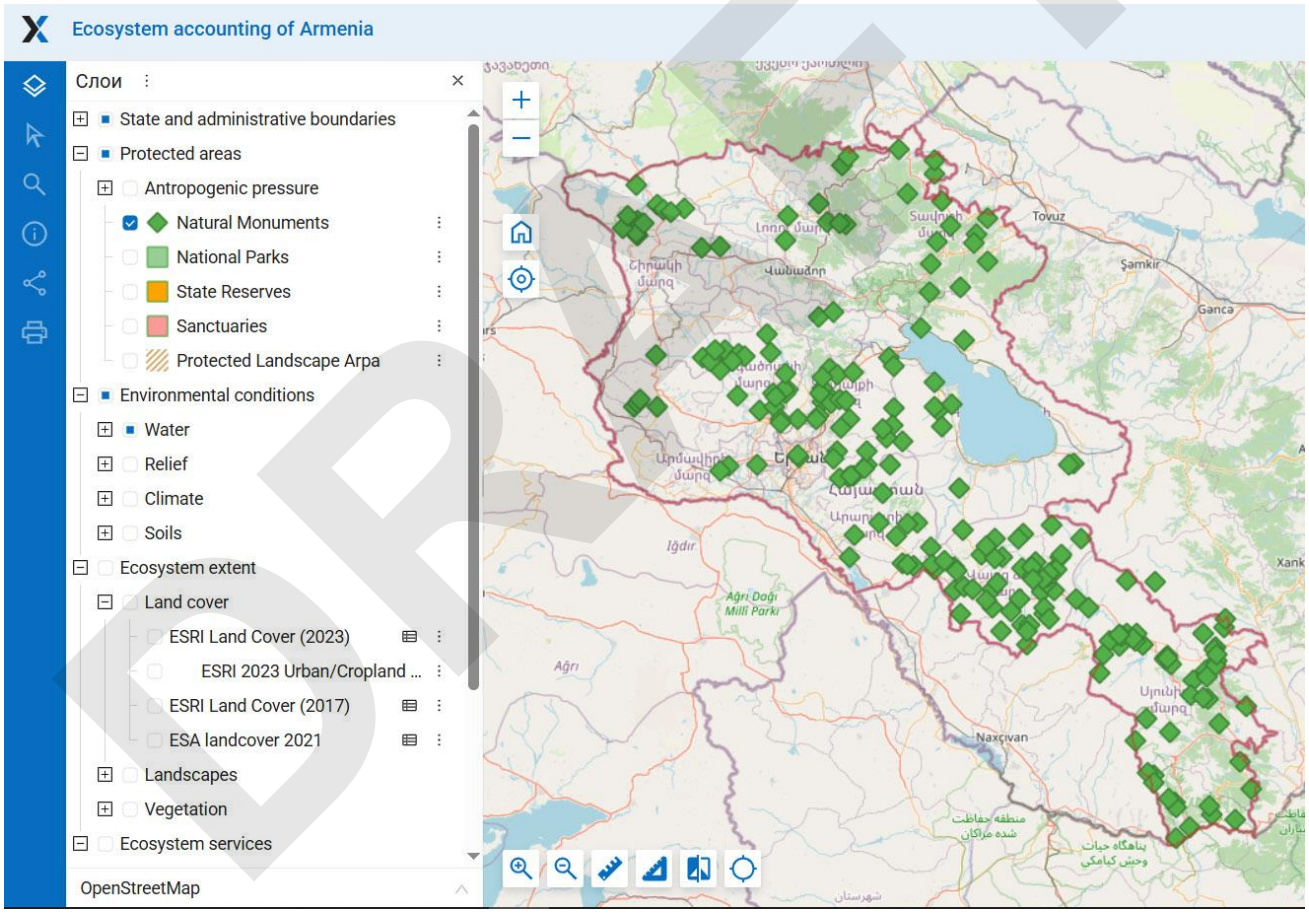

*Figure 26D-1. The map of natural monuments used (in details see project WEB GIS **Section Protected Areas**)*

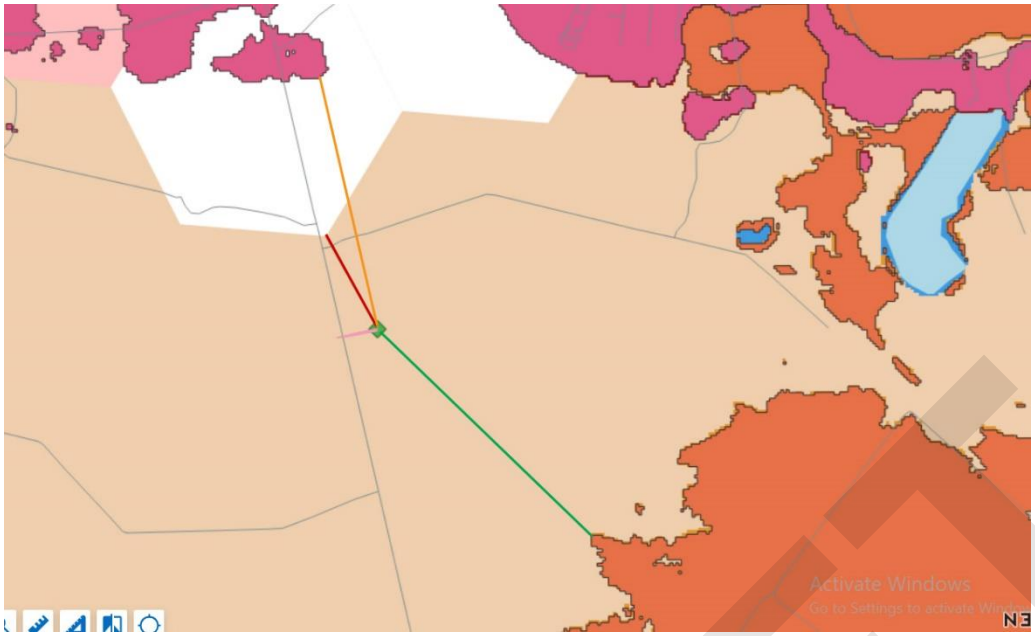

Figure 26D-2. An Example of distances for Dasak Biological Monument in Armavir marz

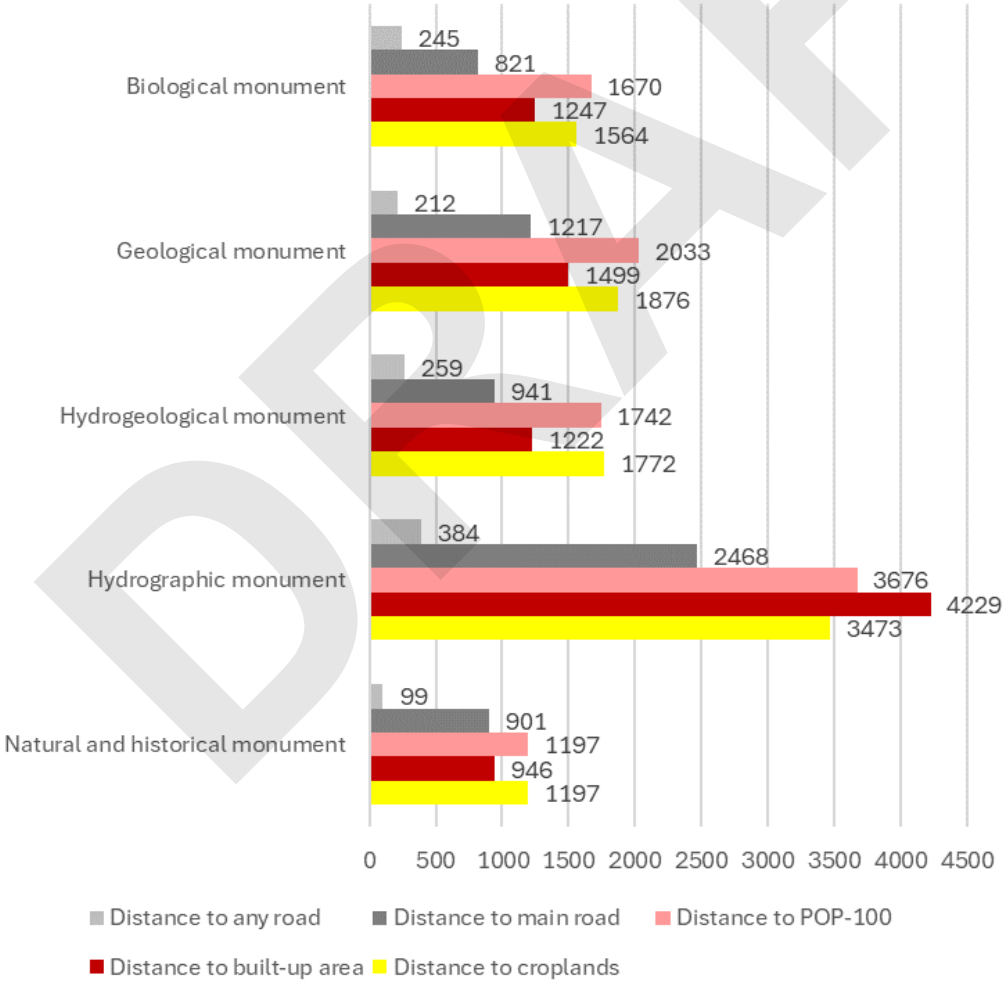

Figure 26D-3. Distance from different categories of natural monuments to various types of anthropogenic areas and roads, in meters (Pop-100 - hexagons with a population of more than 100 people).

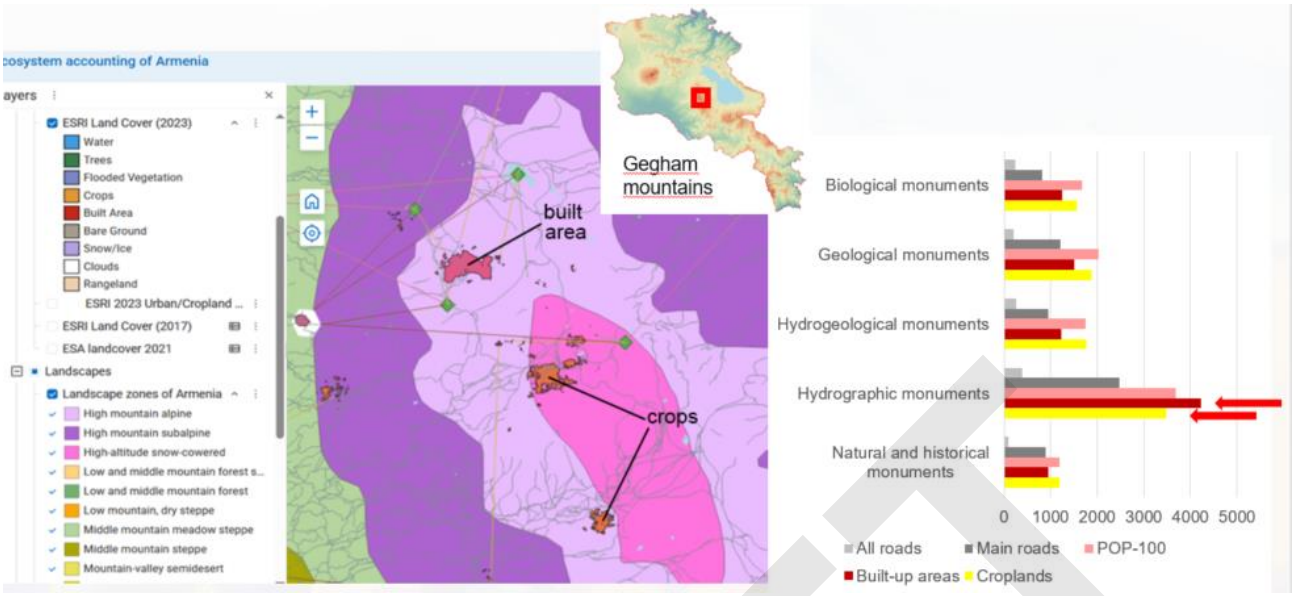

Figure 26D-4. Erroneous underestimation of the distance between anthropogenic areas and hydrographic monuments due to ESRI land cover mistakenly detecting croplands and built-up areas on the Gegham Ridge.