GEOKARTO 2024

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Land cover changes and their impact on fragmentation of natural landscape in national parks and their surroundings in Slovakia

Zuzana Pazúrová, Šimon Opravil, Robert Pazúr

INSTITUTE OF GEOGRAPHY SLOVAK ACADEMY OF SCIENCES

The aim

VEGA project _ Ecosystem services assessment and its implementation into strategic planning and future development of national parks and their surroundings

Budúcnosť Vysokých Tatier: vysokohorská príroda alebo beztvaré predmestia?

Ako je Tatranský národný park zaťažený nekontrolovanou predmestskou zástavbou.

Približne jedna tretina ochranného pásma Tatranského národného parku je už v schválených územných plánoch určená pre novú výstavbu apartmánov, domov a rekreačných zariadení a jeho ekologický účel tak prestáva plniť svoju úlohu. Inými slovami, zhruba jedna tretina ekosystémových funkcií a služieb v tejto zóne môže byť zničená. Prepojenie jednotlivých biotopov a migračných koridorov divo žijúcich zvierat bude prerušené, zvyšujúc tak extrémne možnosť

Výstavba hotela v Demänovskej doline ešte nie je hotová vec, minister Budaj preverí povolenie výstavby

- identify the main land cover changes
- impact on pattern of land cover classes

Study area

Tatra

Pieniny

Little Fatra

Poloniny

Big Fatra

Slovak Paradise

Low Tatra

Muran Plateau

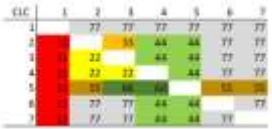
Slovak Karst

Photos: https://sk.wikipedia.org/

Data and methods

Land cover change analysis

- Global Land Cover and Land Use Change dataset for 2000 and 2020
- mapping the transition between LC classes



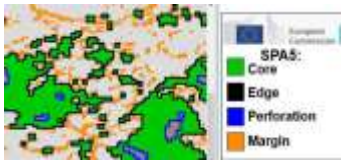
11 settlement increase
22 agricultural intensification
33 extensification
44 afforestation
55 deforestation
66 forest disturbance

Landscape structure/ pattern analysis

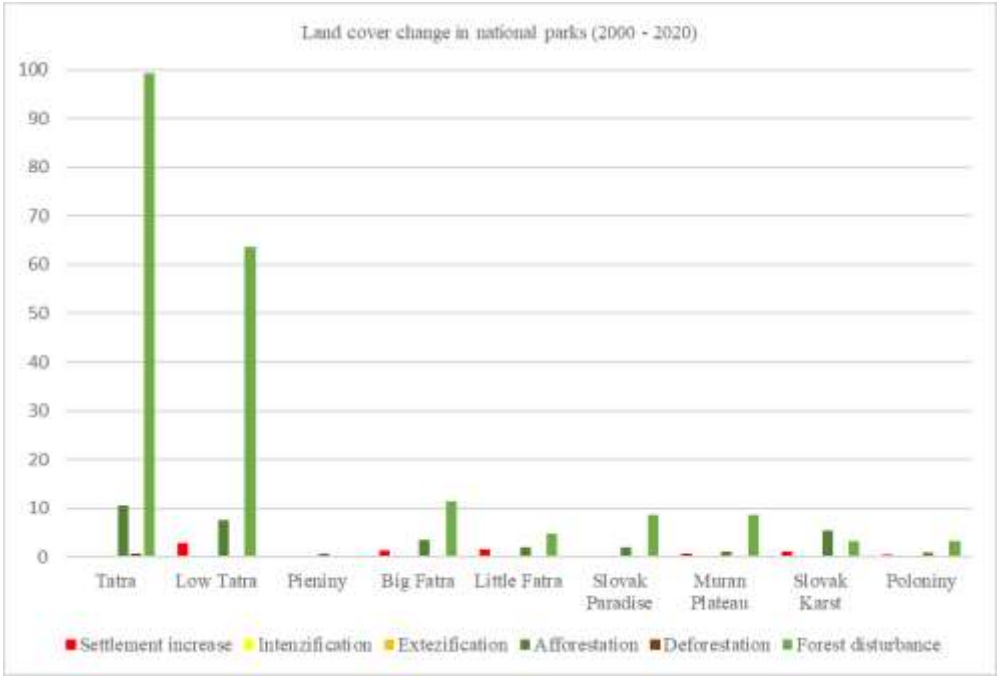
GuidosToolbox (Graphical User Interface for the Description of image Objects and their Shapes - GTB)

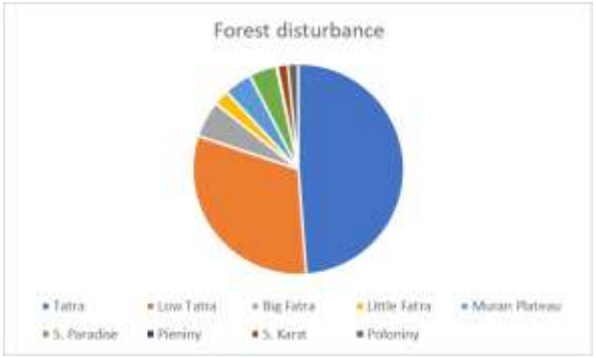
- collection of geometric analysis tools of raster image

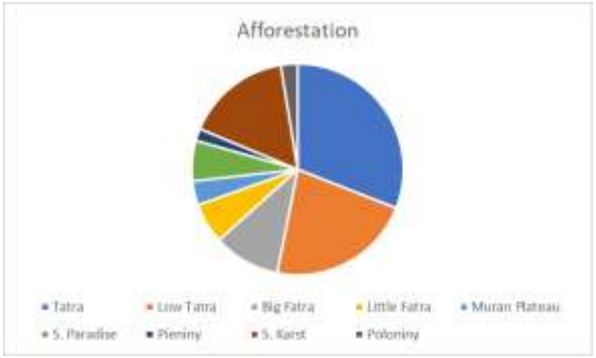
1. Landscape metrics
   - the number of patches, mean patch size
1. Morphological Spatial Pattern Analysis
   - identification of pattern features as core area, edges and connectors
1. Fragmentation
   - degree of fragmentation based on foreground area density (FAD)



Land cover changes in national parks

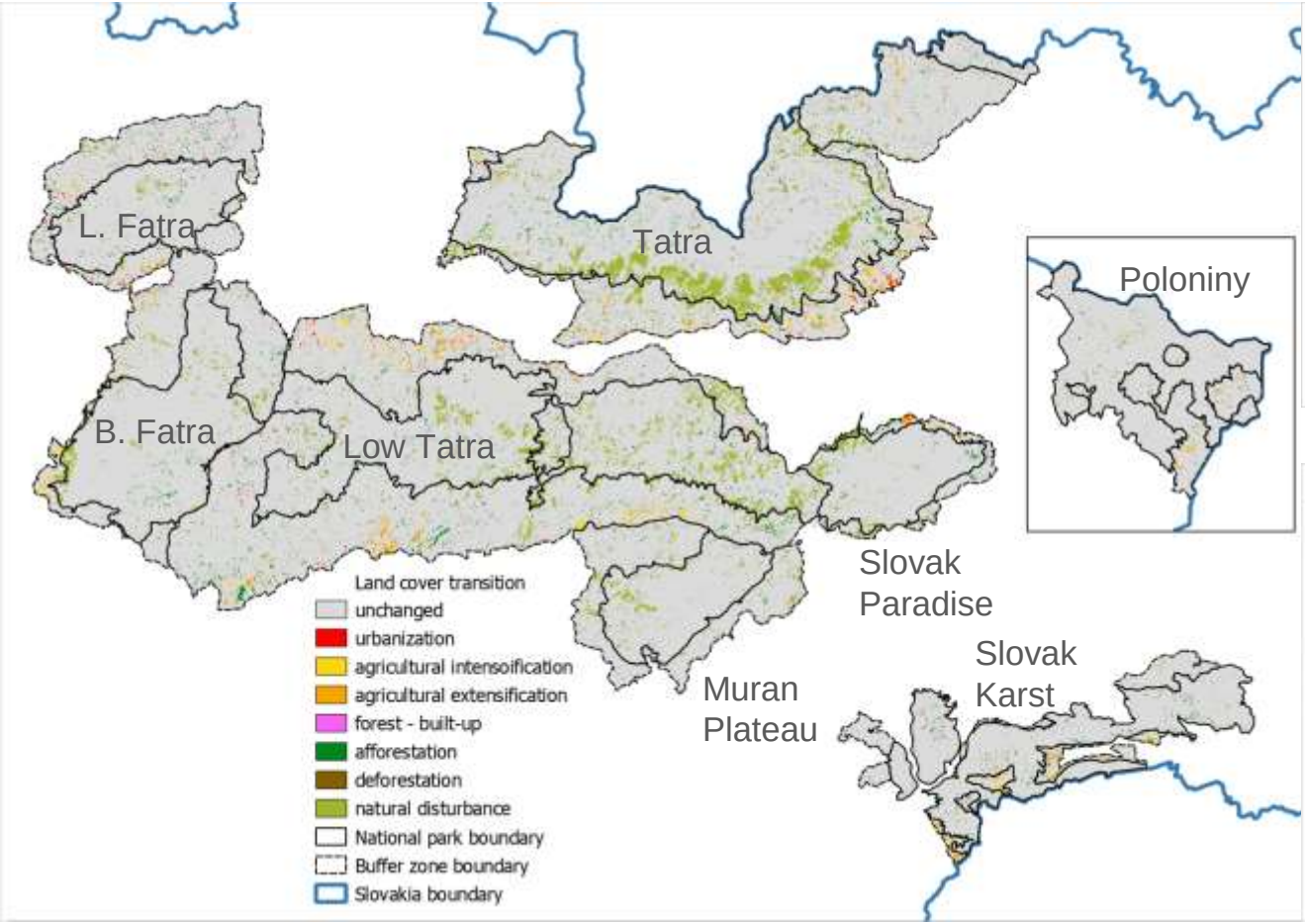


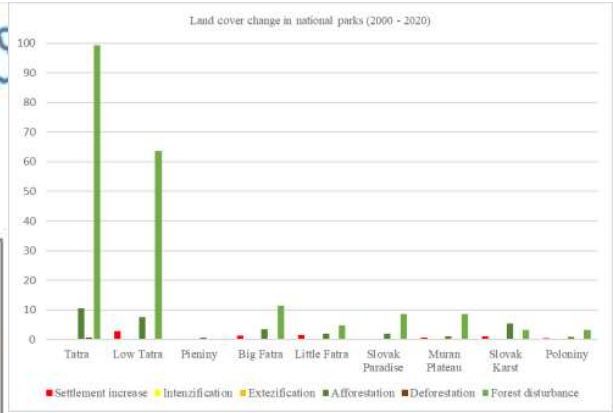


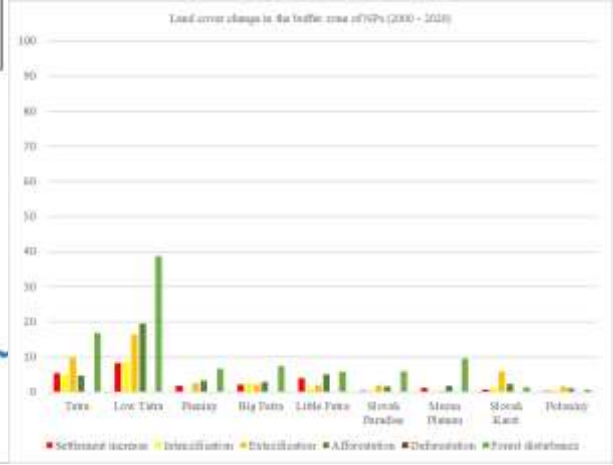


- the forest disturbance was most widespread land cover change
- although the extent varied highly through the national parks

Land cover changes 2000 - 2020



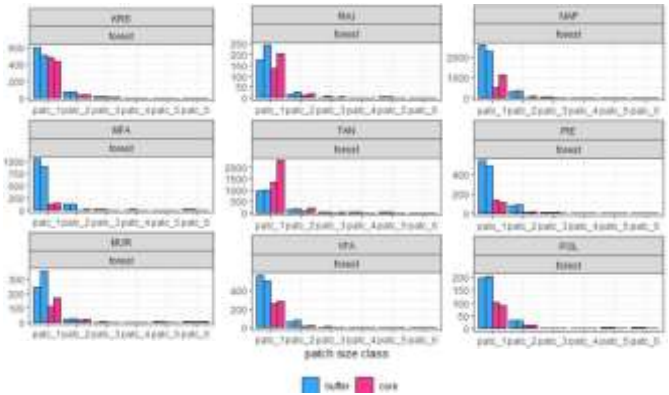




Landscape pattern analysis

Forest cover

1. Landscape metrics (Number of patches, mean patch size)



FOREST/ NATIONAL PARK

	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020
Size class	Tatra		L. Tatra		L. Fatra		B. Fatra		M. Plateau		S. Paradise		S. Karst		Poloniny		Pieniny	
0-1 ha	1348	2293	517	1105	127	138	252	277	110	166	134	206	483	434	102	90	135	112
1-10 ha	66	204	20	75	2	7	10	21	11	18	11	19	41	42	12	13	9	11
10-50 ha	2	19	1	7	0	2	1	2	0	0	0	4	8	7	0	0	3	2
50-100 ha	0	3	0	1	0	0	0	0	0	0	1	1	2	2	0	0	0	0
100-500 ha	0	3	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1
500 ha +	1	7	2	2	1	1	1	1	1	1	1	1	4	4	1	1	2	2
SUM	1417	2529	540	1190	130	148	264	301	122	185	147	231	539	490	115	104	150	125
Diff 2000-2020		1112		650		18		37		63		84		-49		-11		-25
Average Patch size	1055	492	3376	1401	4153	3577	3708	3172	4039	2547	3162	1934	1435	1586	6614	7240	381.3	449.4

Nr. of Patches
Average Patch size

Significant fragmentation

Moderate fragmentation

Homogenization

FOREST/ BUFFER ZONE

	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020
Size class	Tatra		L.Tatra		L. Fatra		B. Fatra		M. Plateau		S. Paradise		S. Karst		Poloniny		Pieniny	
0-1 ha	965	986	2551	2260	1037	887	560	501	239	353	176	243	601	504	195	203	535	483
1-10 ha	134	172	296	332	118	124	58	75	16	25	16	26	78	75	33	33	79	84
10-50 ha	36	40	41	37	19	20	6	8	0	4	2	6	19	22	2	2	5	6
50-100 ha	12	14	4	11	4	7	1	2	0	0	1	2	2	3	0	0	0	0
100-500 ha	12	12	7	6	4	4	2	1	2	2	4	4	1	1	4	4	0	0
500 ha +	3	4	7	10	6	7	4	4	3	4	2	1	4	4	5	5	2	2
SUM	1162	1228	2906	2656	1188	1049	631	591	260	388	201	282	705	609	239	247	621	575
Diff 2000-2020		66		-250		-139		-40		128		81		-96		8		-46
Average Patch size	254.7	210.2	658.4	696.2	335.2	371.9	876.3	909.3	1924	1228	470.9	293.5	253.7	296	894.7	865.9	654.5	686.4

Nr. of Patches
Average Patch size

Homogenization

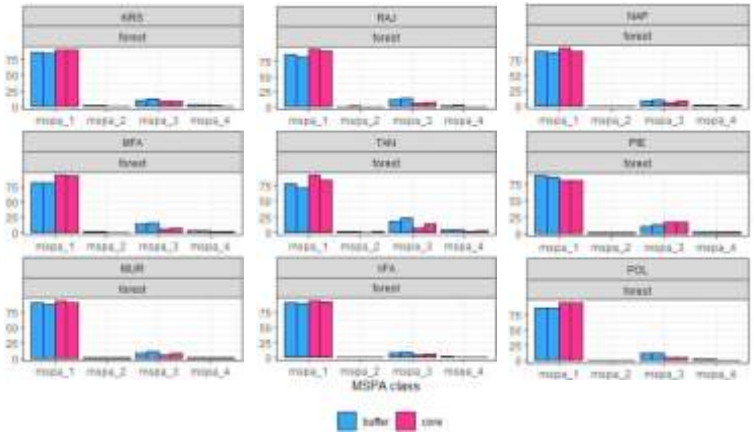
Fragmentation

Landscape pattern analysis

Forest cover

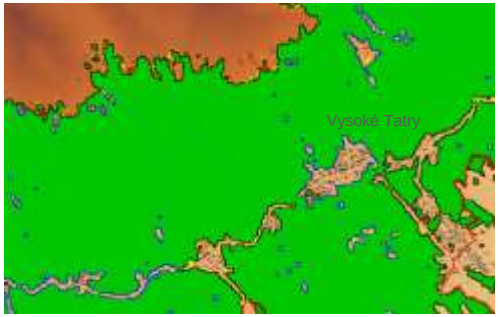
2. Morphological spatial pattern analysis (MSPA)

- decrease in core area of forest cover
- increase of transitional features in forest cover mostly

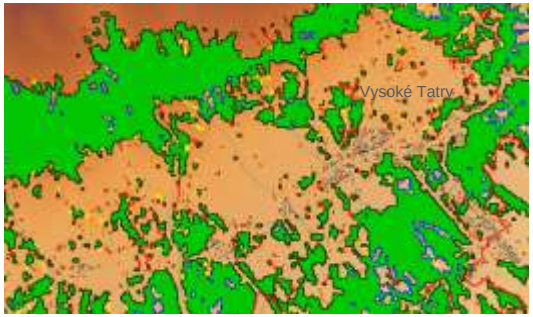


MSPA categories: mspa1 - core, mspa2- islet, mspa3 - border, 4 - linear

Tatras national park 2000

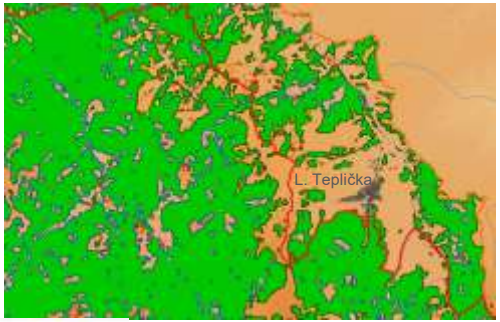


Tatras national park 2020



Low Tatras national park 2000

Low Tatras national park 2020

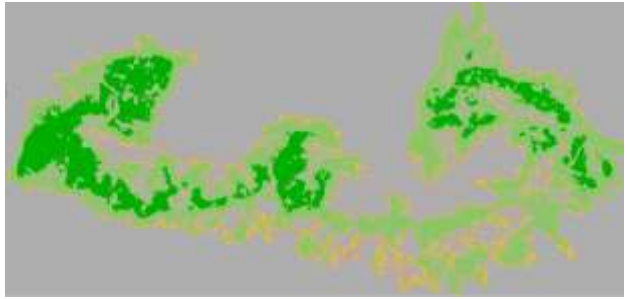


Landscape pattern analysis - forest cover

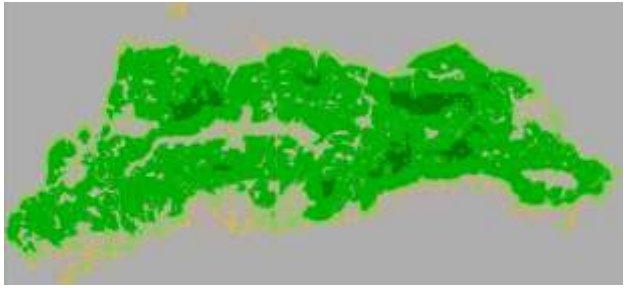
3. Fragmentation degree

Tatra national park 2000

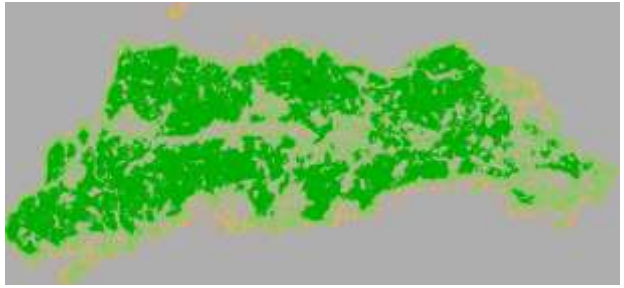
Tatra national park 2020



Low Tatra national park 2000



Low Tatra national park 2020



Foreground cover	Color	FAD/FAC	Connectivity	Fragmentation
1-Rare		0% ≤ x < 10%	Very low	Very high
2-Patchy		10% ≤ x < 40%	Low	High
3-Transitional		40% ≤ x < 60%	Intermediate	Intermediate
4-Dominant		60% ≤ x < 90%	High	Low
5-Interior		90% ≤ x ≤ 100%	Very high	Very low

- transforming large habitat patches into smaller more isolated fragments of habitat
- loss of interior connectivity

Landscape pattern analysis

Open land

1. Landscape metrics
   (Number of patches, mean patch size)

National parks

OPEN / NATIONAL PARK	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020
Size class	Tatra		L. Tatra		L. Fatra		B. Fatra		M. Plateau		S. Paradise		S. Karst		Poloniny		Pieniny	
0-1 ha	2263	3273	1307	2007	470	626	690	871	356	516	390	473	964	976	376	376	165	158
1-10 ha	298	557	258	529	69	101	106	178	102	147	79	103	183	191	72	72	39	41
10-50 ha	43	103	29	83	15	16	30	36	17	25	12	20	50	51	22	22	9	9
50-100 ha	10	17	2	9	3	3	1	2	3	3	2	2	9	9	5	5	0	0
100-500 ha	8	16	7	8	3	3	2	2	1	1	2	2	7	6	0	0	0	0
500 ha +	4	4	2	2			1	1									1	1
SUM	2626	3970	1605	2638	560	749	830	1090	479	692	485	600	1213	1233	475	475	214	209
Diff. 2000-2020		1344		1033		189		260		213		115		20		0		-5
Average Patch size	84.56	83.87	82.36	73.31	58.85	48.38	87.29	75.61	61.04	52.04	52.29	51.82	73.8	72.9	57.18	57.18	157.6	158.9

Buffer zones

OPEN/ BUFFER ZONE	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020
Size class	Tatra		L.Tatra		L. Fatra		B. Fatra		M. Plateau		S. Paradise		S. Karst		Poloniny		Pieniny	
0-1 ha	648	845	2512	2997	1338	1425	715	831	488	625	154	197	394	428	297	296	512	602
1-10 ha	116	148	428	623	207	231	120	155	132	165	23	42	40	51	99	99	127	147
10-50 ha	22	26	105	128	48	51	27	31	30	31	4	8	11	10	18	19	21	22
50-100 ha	5	5	18	17	11	13	7	7	2	2	0	1	3	3	3	3	4	7
100-500 ha	7	11	25	25	18	16	5	6	4	4	2	2	6	6	4	4	14	13
500 ha +	5	4	10	10			2	1			1	1	3	3			1	1
SUM	803	1039	3098	3800	1622	1736	876	1031	656	827	184	251	457	501	421	421	679	792
Diff 2000-2020		236		702		114		155		171		67		44		0		113
Average Patch size	502.7	394.4	210.6	175	95.74	89.72	112.1	101.4	70.44	61.99	215.9	174.3	212.3	211	109.8	109.5	201	173.6

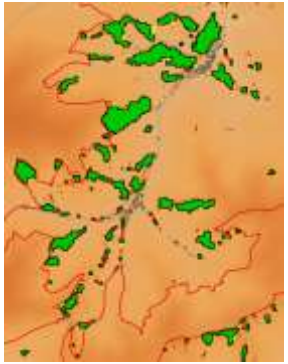
2. Morphological spatial pattern analysis (MSPA)

Low Tatra national park 2000

Low Tatra national park 2000y

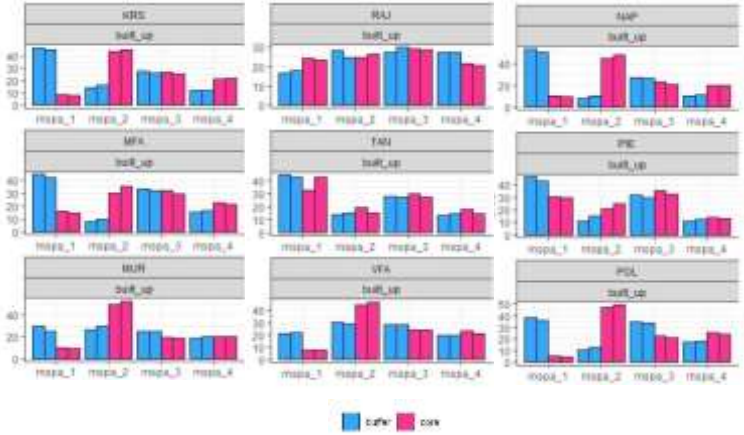
Low Tatra buffer 2000

Low Tatra buffer 2020

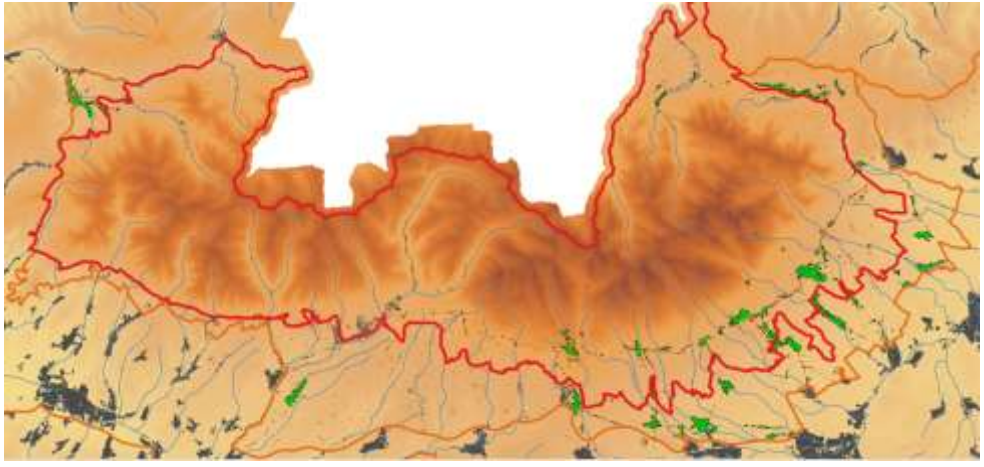


Landscape pattern analysis - Built up

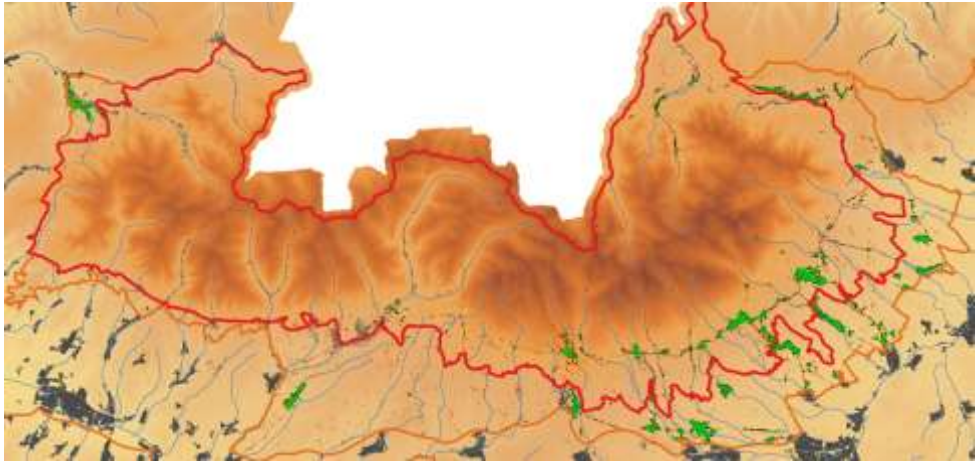
2. Morphological spatial pattern analysis (MSPA)



MSPA categories: mspa1 - core, mspa2- islet, mspa3 - border, 4 - linear



Tatra
2020



Tatra
2020

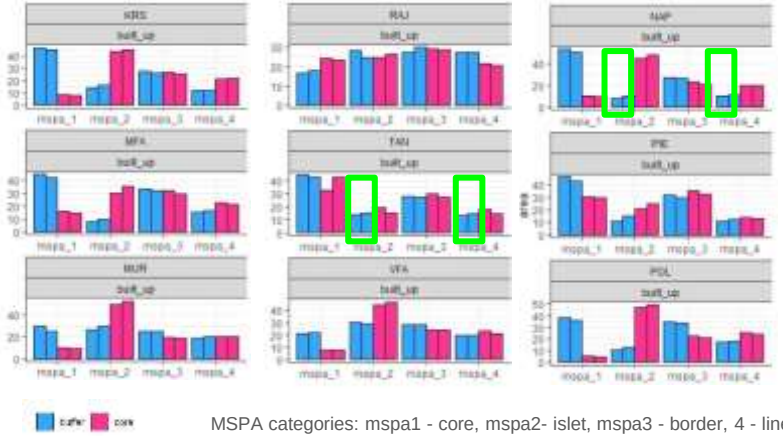
Landscape pattern analysis

Built up

1. Landscape metrics
   (Number of patches, mean patch size)

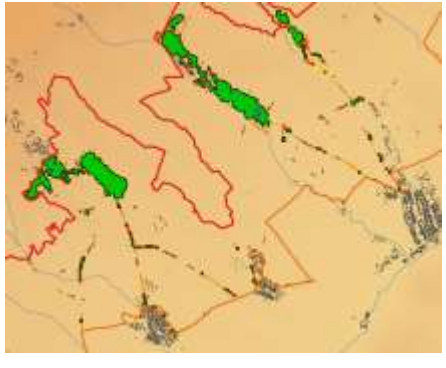
BUILT UP/ BUFFER ZONE	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020	2000	2020
Size class	Tatra		L.Tatra		L. Fatra		B. Fatra		M. Plateau		S. Paradise		S. Karst		Polonimy		Pieniny	
0-1 ha	1247	1727	3042	4219	848	1290	1078	1393	667	889	239	277	344	440	273	361	538	802
1-10 ha	124	171	279	344	129	171	97	105	67	95	32	37	42	44	33	43	51	79
10-50 ha	14	20	48	48	13	14	9	15	8	9	3	4	8	9	8	8	13	14
50-100 ha	4	5	20	21	5	4	0	1	1	1	0	0	1	1	1	1	4	5
100-500 ha	4	4	17	18	5	6	0	0	0	0	0	0	0	0	1	1	1	1
SUM	1393	1927	3406	4650	1000	1485	1184	1514	743	994	274	318	395	494	316	414	607	901
Diff 2000-2020		534		1244		485		330		251		44		99		98		294
Average Patch size	31.35	30.08	51.42	42.32	51.98	42.04	14.3	14.94	17.83	16.83	16.38	17.64	28.12	25.98	39.55	32.79	39.58	31.76

2. Morphological spatial pattern analysis (MSPA)

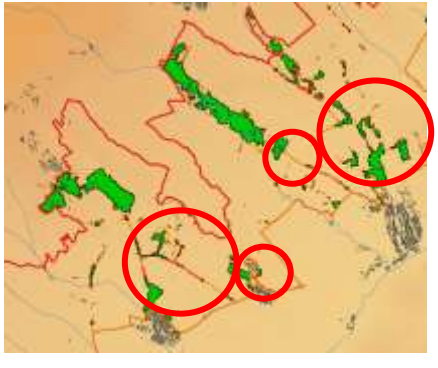


MSPA categories: mspa1 - core, mspa2- islet, mspa3 - border, 4 - linear

Tatra buffer zone 2000



Tatra buffer zone 2020

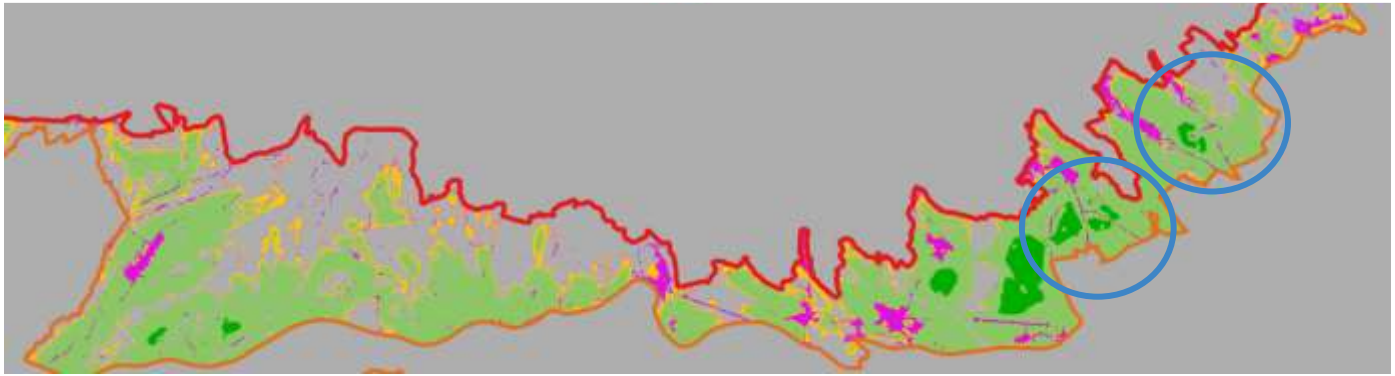


Landscape pattern analysis – open land

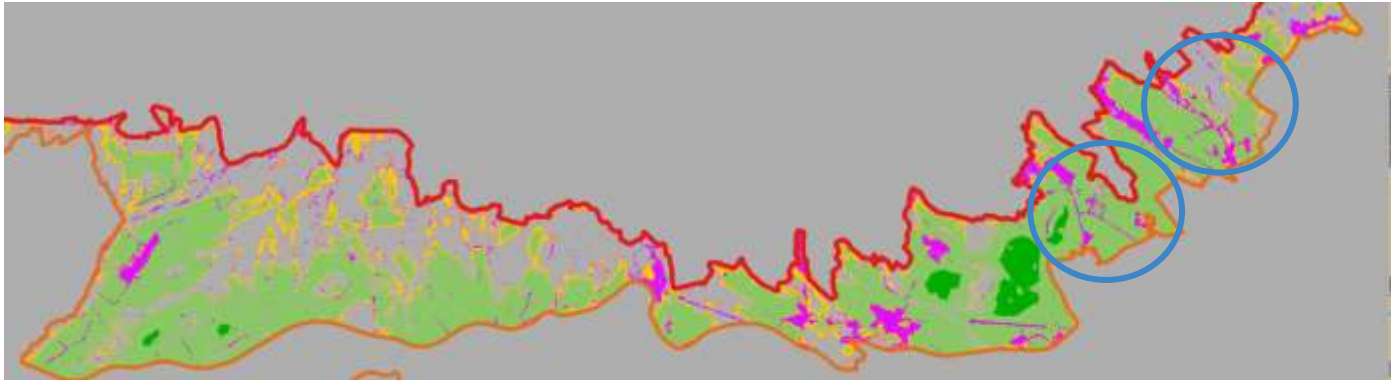
Foreground cover	Color	FAD/FAC	Connectivity	Fragmentation
1-Rare		0% ≤ x < 10%	Very low	Very high
2-Patchy		10% ≤ x < 40%	Low	High
3-Transitional		40% ≤ x < 60%	Intermediate	Intermediate
4-Dominant		60% ≤ x < 90%	High	Low
5-Interior		90% ≤ x ≤ 100%	Very high	Very low

3. Fragmentation degree

Tatra national park - buffer zone 2000



Tatra national park - buffer zone 2020



- loss of interior connectivity / difference in the level of LF between western and eastern part
- process is most obvious in intensively used regions where fragmentation is the product of the linkage of built up areas via linear infrastructure

Key findings

severe forest cover fragmentation caused by forest disturbances

open land fragmentation caused by housing and infrastructure development

the synergic effects of roads and other factors that operate simultaneously

relevance for biodiversity, the important role of large roadless areas for biodiversity conservation

Need for monitoring the Degree of Landscape Fragmentation

Implications for Nature Conservation and Urban Planning

THANK YOU FOR ATTENTION

INSTITUTE
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ACADEMY OF SCIENCES