

Using prognostic mapping method in revealing and solving nature-use conflicts in Numto nature park

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Goals and objectives

Goal: define areas of risk for ecosystems with various types of use and protection

Method: prognostic mapping

Objectives:

1. Define value, stability and sensitivity of ecosystem units
2. Define existing practices of nature use
3. Reveal conflicts of interests
4. Combine all above spatially

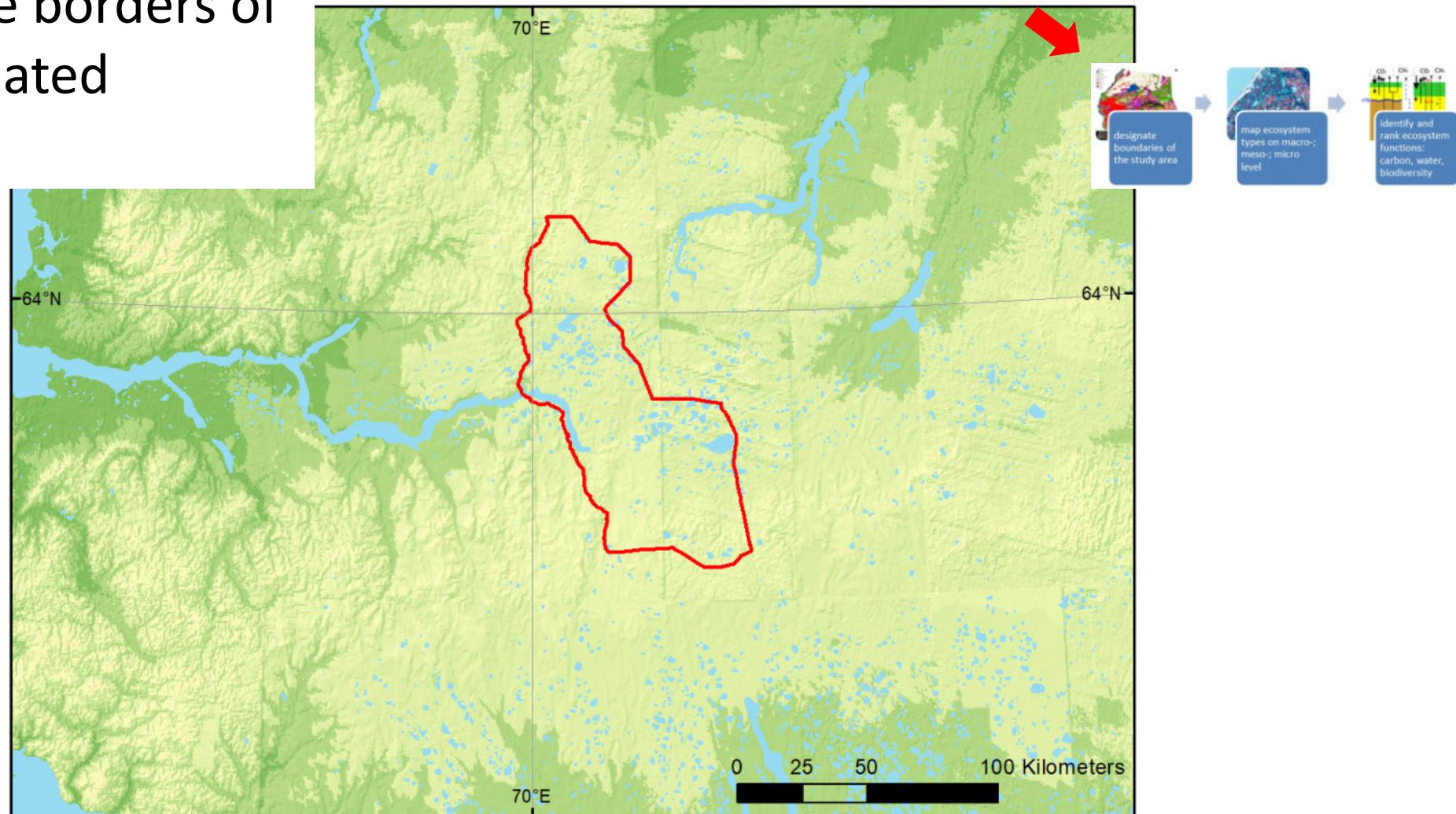


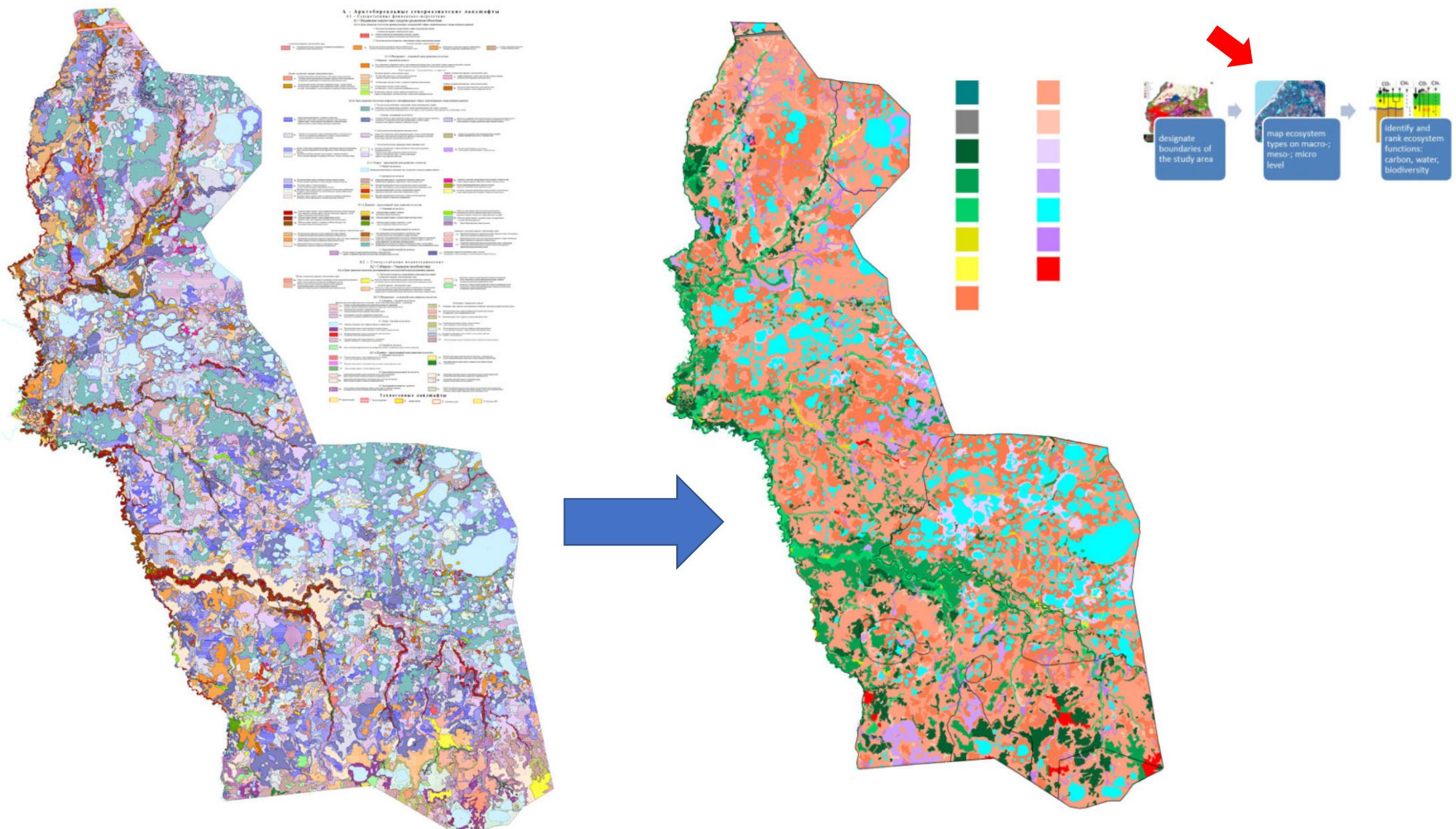
Methodology for mapping ecosystem functions by prognostic mapping method

Execution sequence

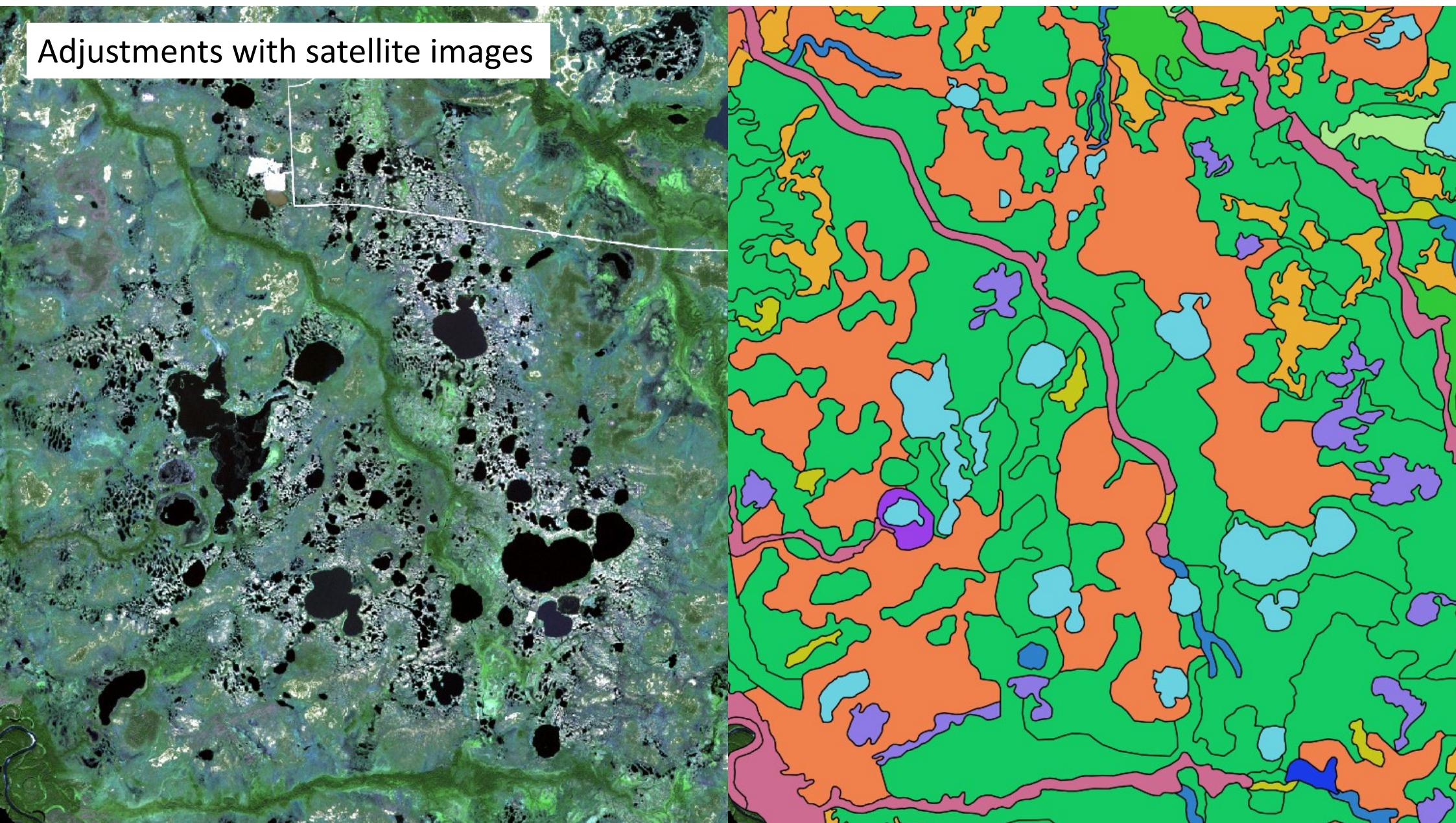


Select the borders of the evaluated territory





Adjustments with satellite images



Assigning ranks to ecosystem units for the following parameters

hydrological group of natural functions:

- water filtration rate;
- natural flow regulation rate;
- permafrost constancy;
- water storage capacity;
- flow lines.

Indicators of carbon balance:

- above-ground phytomass;
- carbon storage;
- short term carbon accumulation rate;
- long term carbon accumulation rate;
- GHG emission factors.

Indicators of biodiversity (list of flora and fauna):

- potential species richness of flora (vascular plants);
- potential species richness of fauna (mammals, birds);
- the uniqueness of habitats at species level (flora and fauna);
- the abundance of rare and endangered species (flora and fauna);
- abundance of migrating species;
- effectiveness of habitat use by migrating species;
- provisional plant species (richness);
- provisional animal species (richness);
- Ecosystem diversity – structural;
- Ecosystem diversity – typological.

Predicted species diversity

Example of the analysis of the potential (predicted) species diversity

Step 1	Action	Source of information
1. Input data	Annotated species list of the area	Regional surveys published, species finders
2. Preliminary analysis	Assignment every species to the habitat type	Work with species annotations
3. calculations	Identify list of species potentially could be met in this habitat	Transform table "species-habitat" to the table "habitat – species"
4. output	To carry out ranking of the table "ecosystem type – number of species"	Using ranking formula

Species	Annotation	Habitat type
Species 1	River valleys, riparian habitats, mineral soils	2, 14, 23
Species 2	Sandy soils	15, 17
Species 3	Forested peatlands	23, 25
Species 4	Peaty soils, open habitats	15, 14
Etc.		

Habitat type	Rank
2	1
14	2
15	2
17	1
23	2
25	1

Habitat type	Species	Number of species
2	sp 1	1
14	sp1, sp 4	2
15	sp 2, sp 4	2
17	sp 2	1
23	sp 1, sp 3	2
25	Sp 3	1



The basis for ranking – table of species

№ п/п	Русские названия*	Латинские названия*	Трансформированные человеком угодья, в том числе поселения.	кедровники (реликтовые)	Боры беломошники	Рямы	рямовые верховые болота	плоско бугристые болота	мезотрофные участки, хасерии	грядово-мочажинные комплексы верховых болот	Берёзов криволес
27	Луток	<i>Mergellus albellus</i>									
28	Средник крохаль	<i>Mergus serrator</i>									
29	Осоед	<i>Pernis apivorus</i>									
30	Орлан-белохвост	<i>Haliaeetus albicilla</i>		гн.	гн.	гн.				гн	
31	Степной лунь	<i>Circus macrourus</i>									
32	Полевой лунь	<i>Circus cyaneus</i>					гн.	корм.	гн.	корм.	гн.
33	Тетеревятник	<i>Accipiter gentilis</i>	корм.	гн., корм	гн., корм	гн., корм	корм.	корм.	корм.	корм.	корм.
34	Перепелятник	<i>Accipiter nisus</i>	корм.	гн., корм	гн., корм	корм.	корм.	корм.	корм.	корм.	корм.
35	Обыкновенный канюк	<i>Buteo buteo</i>		гн., корм	гн., корм	корм.	корм.	корм.	корм.	корм.	
36	Зимняк	<i>Buteo lagopus</i>	мигр. остан.	мигр. остан.	мигр. остан.	мигр.	мигр. остан.	мигр.	мигр. остан.	мигр. остан.	мигр. остан.
37	Беркут	<i>Aquila chrysaetos</i>		гн.?	гн.?		корм.	корм.	корм.	корм.	корм.
38	Скопа	<i>Pandion haliaetus</i>				гн.					
39	Кобчик	<i>Falco vespertinus</i>									
40	Дербник	<i>Falco columbarius</i>									
41	Чеглок	<i>Falco subbuteo</i>									
42	Кречет	<i>Falco rusticolus</i>					корм.	корм.	корм.	корм.	корм.

Example of ranking technique

Species diversity

On the start – number of species in each ecosystem unit

Ecosystem unit	Number of species
1	28
2	13
3	16
4	34
5	25
6	54
7	23
8	14
9	17
10	19
11	22
12	24
13	12
14	17
15	19
16	29
17	32
18	34
19	45
20	17
21	19
22	24
23	28

Sorting ecosystem units according to number of species

Ecosystem unit	Number of species
13	12
2	13
8	14
3	16
9	17
14	17
20	17
10	19
15	19
21	19
11	22
7	23
12	24
22	24
5	25
1	28
23	28
16	29
17	32
4	34
18	34
19	45
6	54

Ranking according to the formula

Number of species	Rank
12-13	1
14-16	2
17-22	3
23-29	4
30-35	5
36-40	6
41-44	7
45-48	8
49-52	9
52-54	10

Replacing number of species by ranks

Ecosystem unit	Rank
1	4
2	1
3	2
4	5
5	4
6	10
7	4
8	2
9	3
10	3
11	3
12	4
13	1
14	2
15	3
16	4
17	5
18	5
19	8
20	3
21	3
22	4
23	4

$$\text{Rank} = [(X - X_{\min}) * (S_{\max} - S_{\min}) / (X_{\max} - X_{\min})] + S_{\min}$$

X – Initial value of ranked factor;

X_{\min} – Minimum value of ranked factor;

X_{\max} – Maximum value of ranked factor;

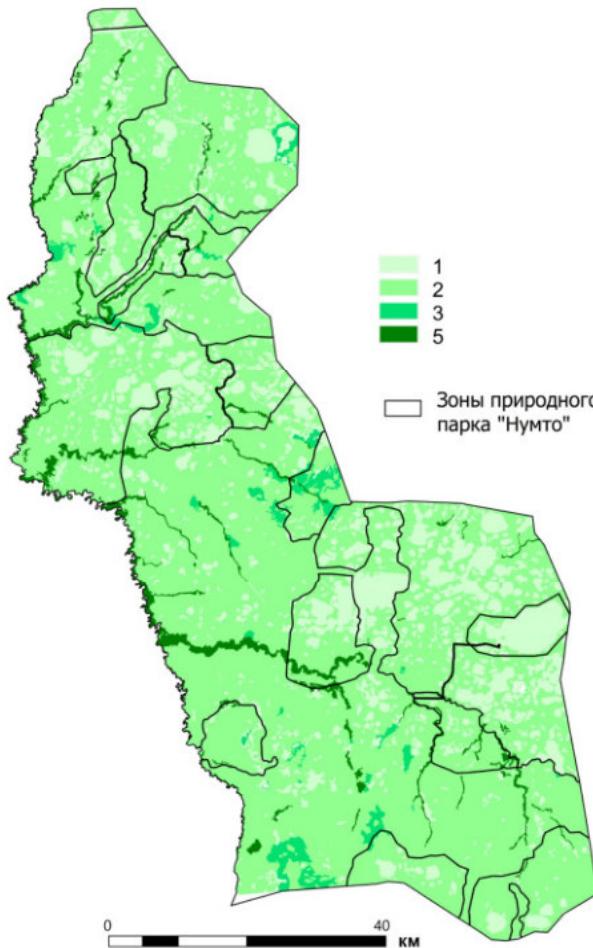
S_{\min} – Minimum value of the scale;

S_{\max} – Maximum value of the scale.

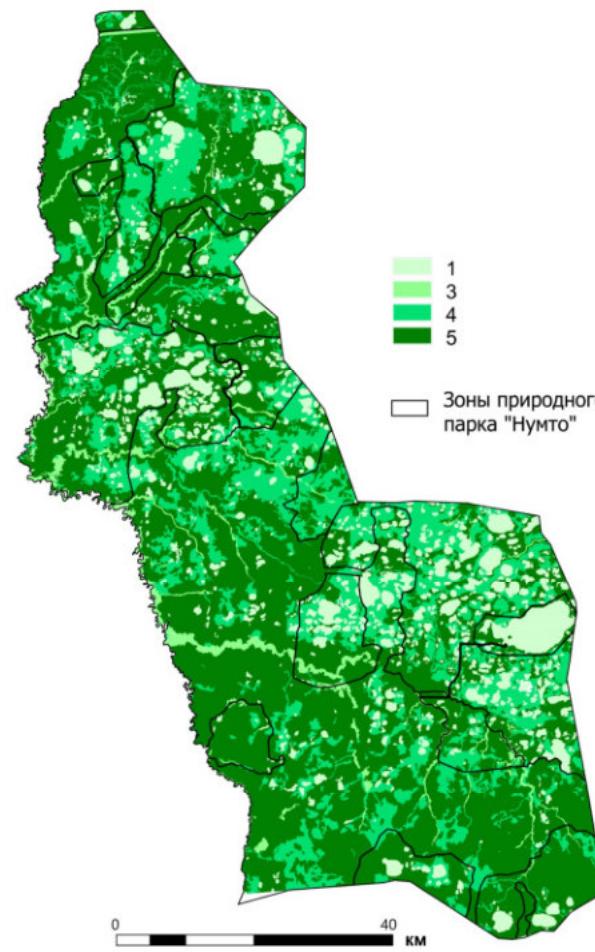
Assigning ranks to the factors of each ecosystem unit

	Bird species diversity	Migrating birds	Rare birds species	Mammals species diversity	Vascular plants species diversity	Rare vascular plants species	Harvested species of vascular plants	Peat depth	Productivity of ecosystems	Permafrost
Lakes	4	5	5	1	1	1	1	1	1	1
Rivers	4	5	5	1	1	1	1	1	1	1
Anthropogenically transformed sites	3	3	1	3	1	1	2	1	1	1
Pine dwarf shrub moss forests	3	1	2	5	2	1	3	1	2	1
Pine white moss forests	2	1	2	5	2	1	2	1	2	1
Valley cedar pine forests	1	1	1	3	5	1	5	1	3	1
Birch flooded forests	3	1	2	5	2	1	3	1	4	1
Palsa mires	4	2	5	4	2	1	2	5	5	5
Aapa mires	4	2	4	4	3	5	2	5	4	1

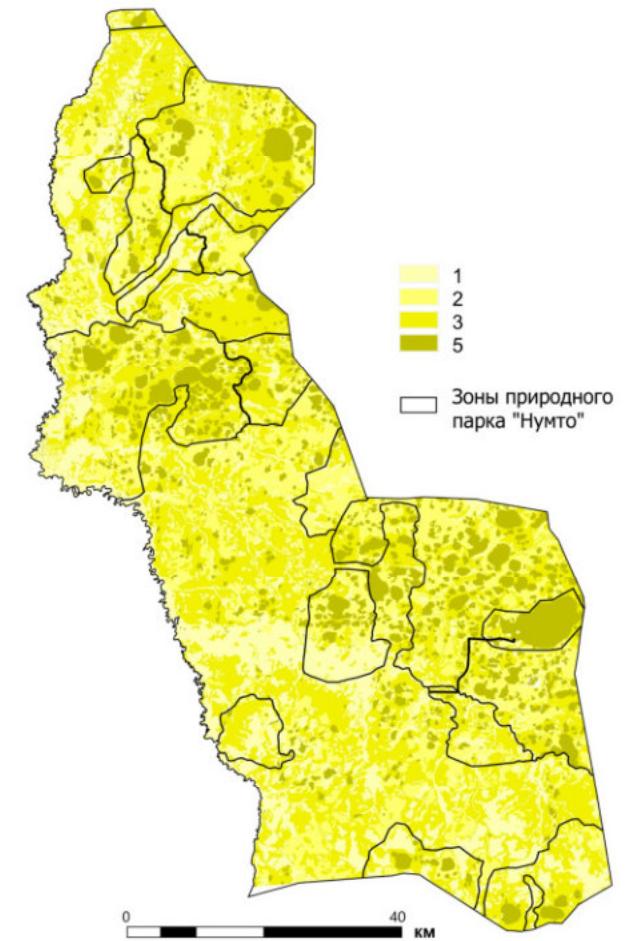
Variety of maps made in GIS with selected method



Plants species richness

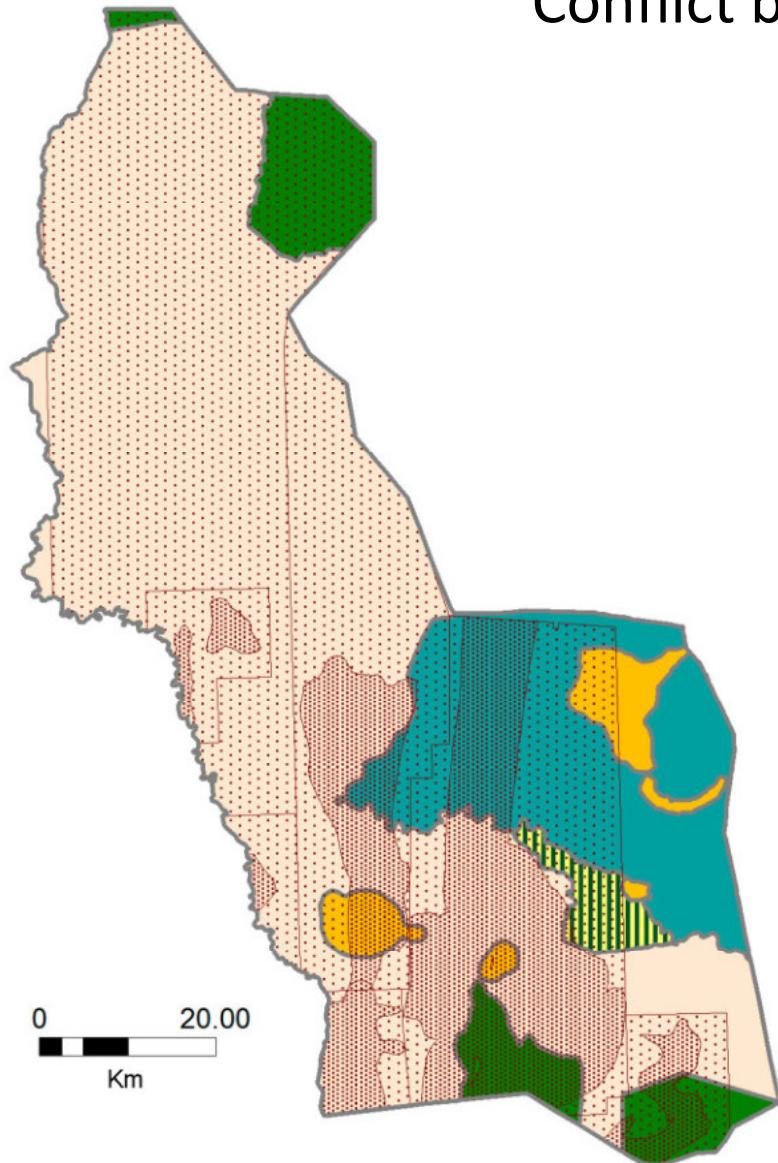


Mammals species richness

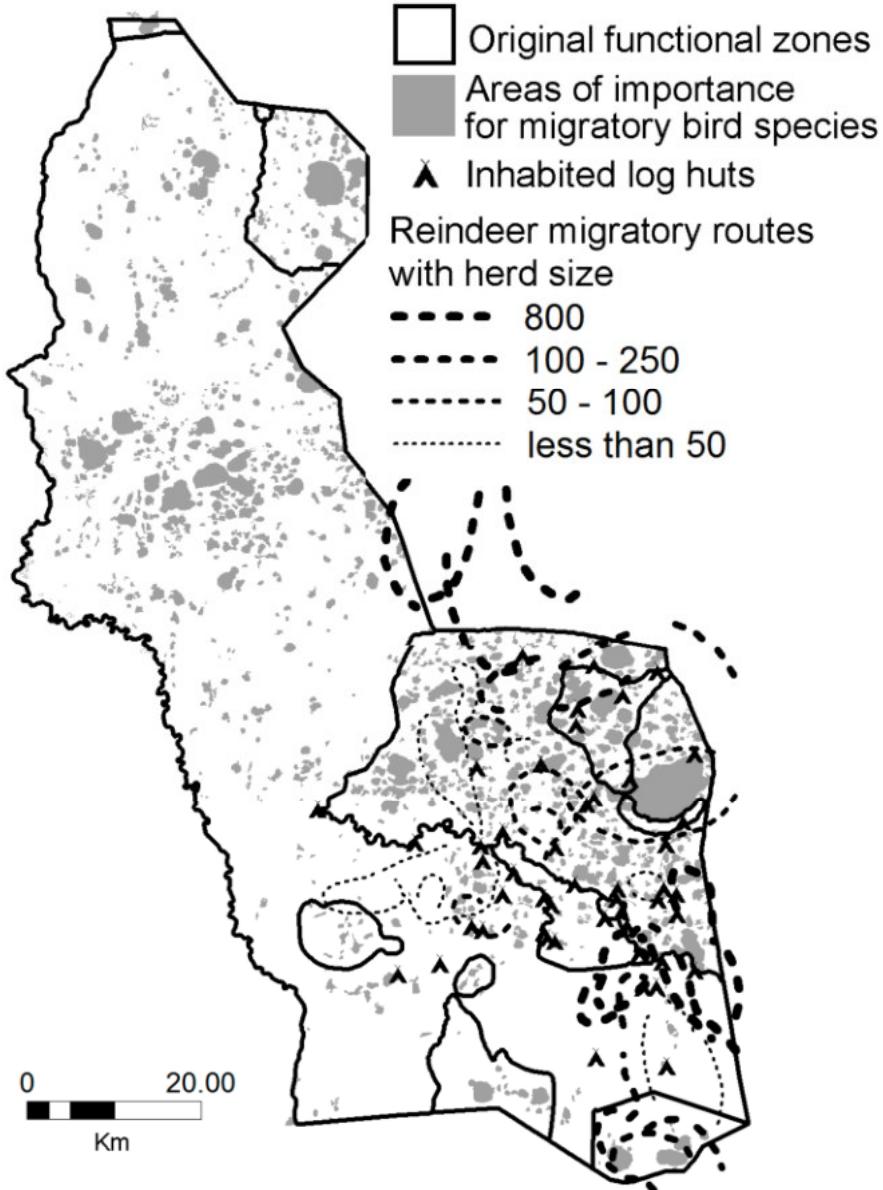


Potential for migratory birds

Conflict between nature conservation and oil industry

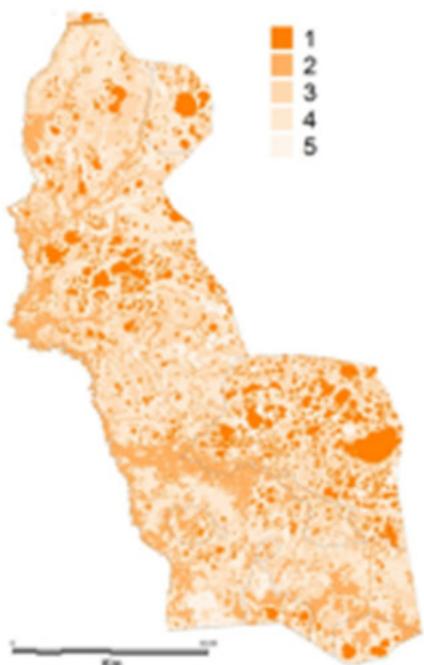


- █ Strict nature reserve zone ('zapovednik')
Зона заповедного режима
- Zone of regulated economic activity
Зона хозяйственного использования
- █ Wetlands protection zone ('zakaznik')
Водно-болотные угодья
- Recreation zone
Рекреационная зона
- Areas of protection of historical, cultural sites,
and habitats of rare bird species
Участки археологических памятников и
мест обитания редкой орнитофауны
- License blocks
Границы лицензионных участков
- Oil and gas fields
Границы месторождений

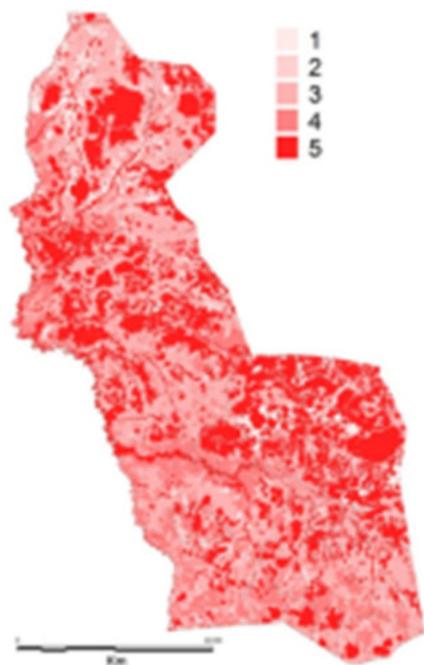


Conflict between nature conservation and traditional nature use

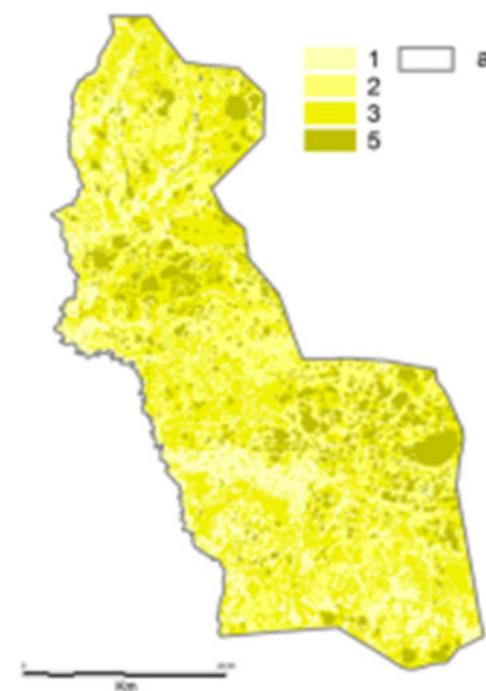
Zoning for nature conservation purposes



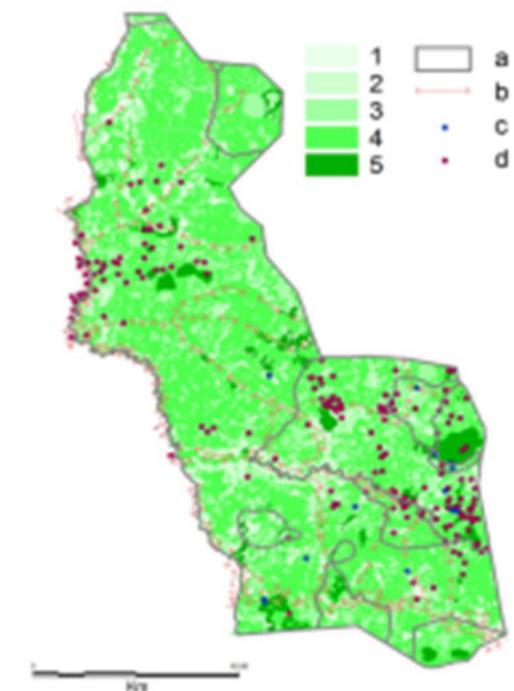
Stability of ecosystems



Sensitivity of ecosystems



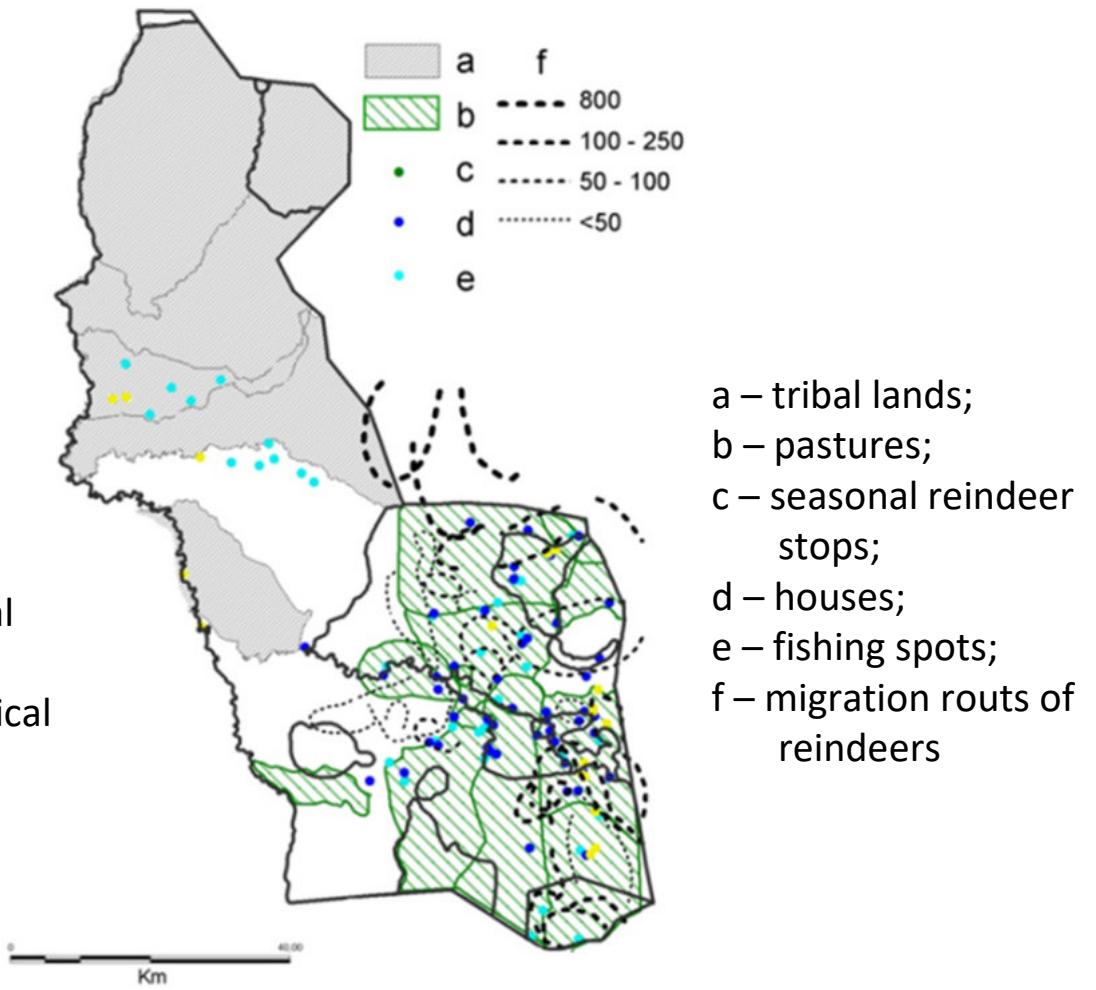
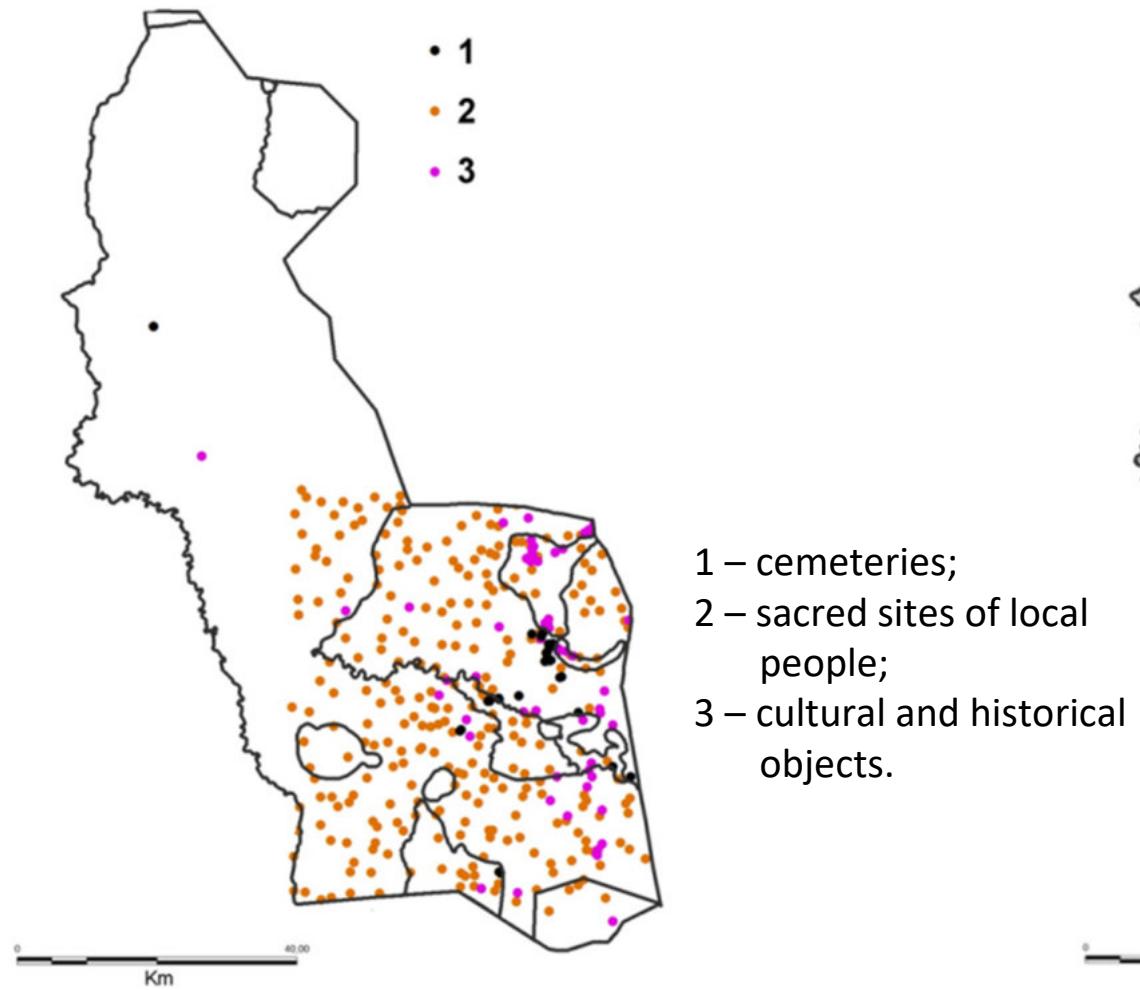
Potential for migratory birds



Natural value

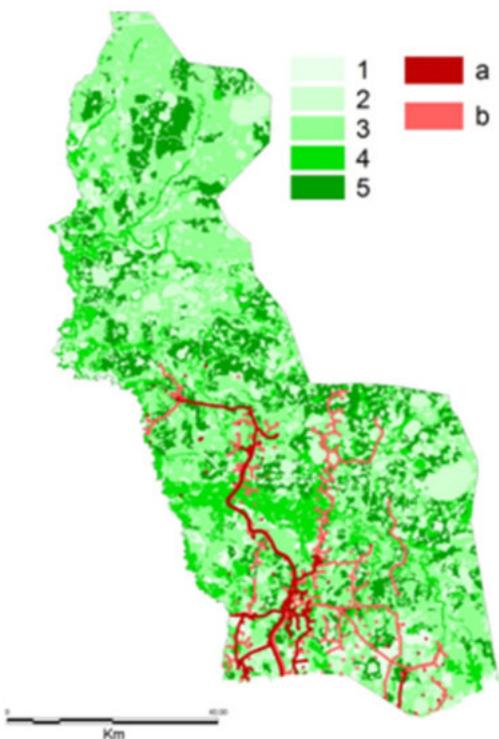
Sociological research



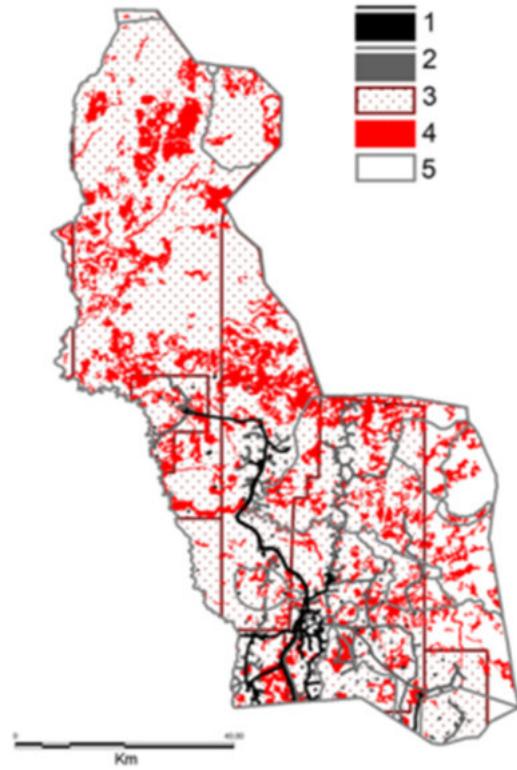


a – tribal lands;
b – pastures;
c – seasonal reindeer
 stops;
d – houses;
e – fishing spots;
f – migration routs of
 reindeers

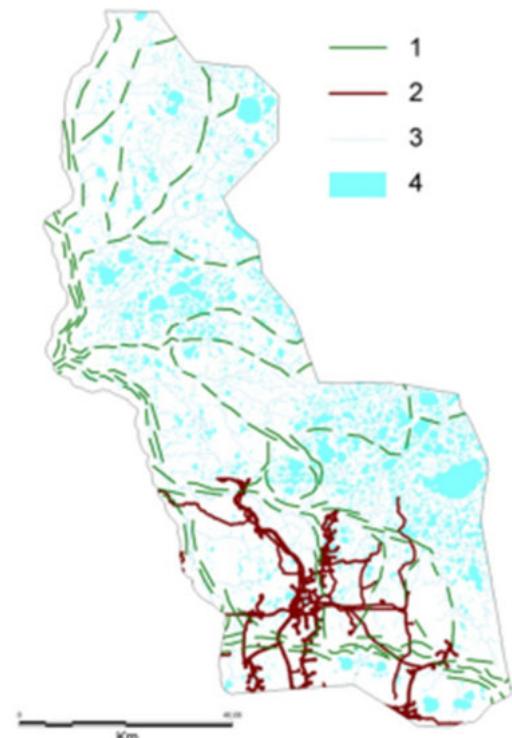
Spatial analysis of conflicts of interests



Potential of ecosystems for traditional nature use with scale from 1 to 5;
a – existing industrial infrastructure;
b – planned industrial infrastructure.

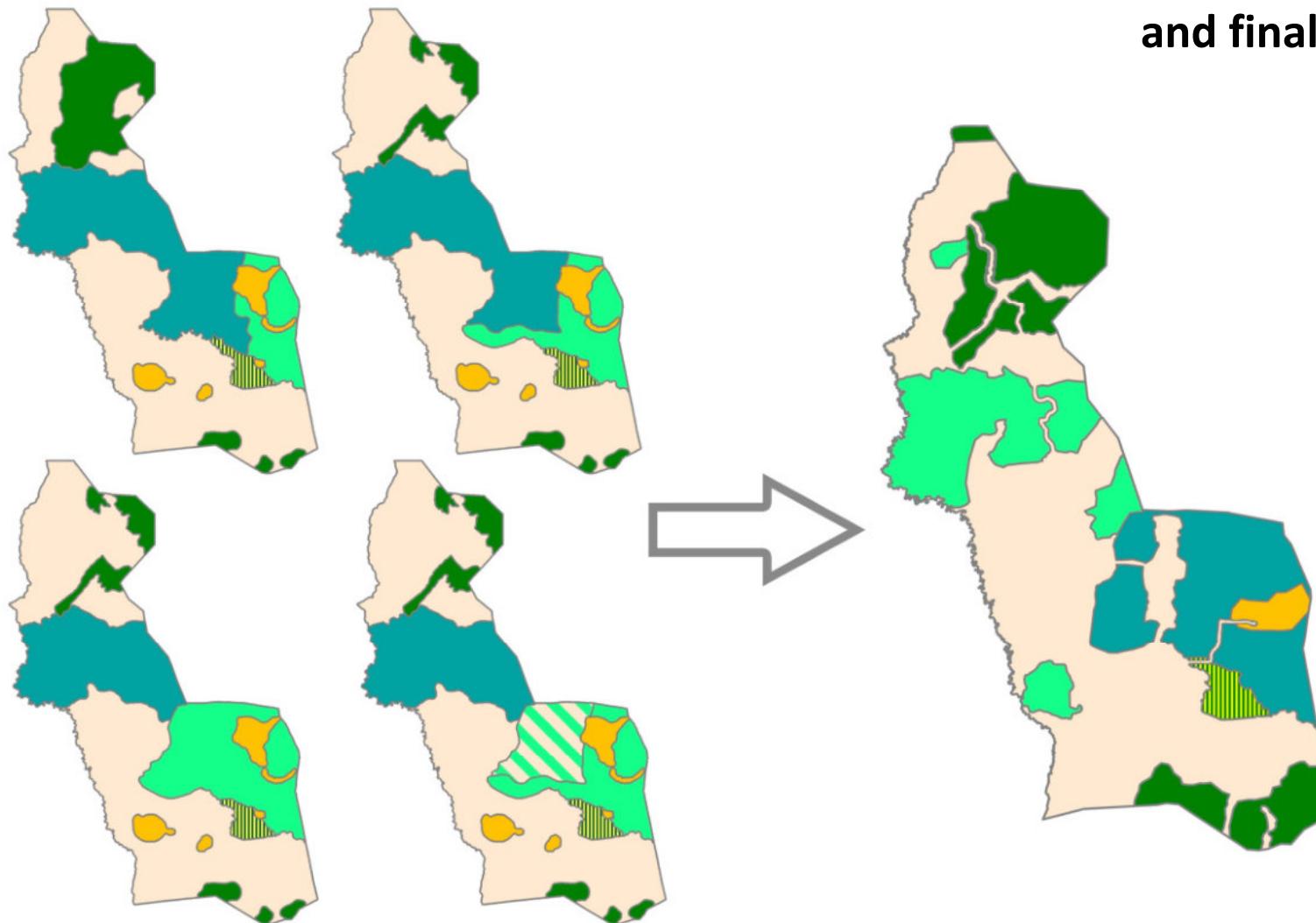


1 – existing industrial infrastructure;
2 - planned industrial infrastructure;
3 – license areas;
4 – areas of maximum natural sensitivity and vulnerability to mechanical impact;
5 – initial zoning of nature park.



1 – moose migration routs;
2 – linear infrastructure;
3 – rivers;
4 – lakes.

**Suggested 4 zoning approaches
and final approved zoning**



An aerial photograph of a vast wetland area. The landscape is characterized by numerous small, dark blue lakes of various sizes, which are interconnected by a network of narrow, winding channels. Interspersed between these water bodies are patches of green vegetation, likely moss or small shrubs, and some larger, more dense forested areas. The overall pattern is organic and repetitive, creating a textured appearance.

Thank you