



Conflict Mapping of Birds and Medium-voltage Electricity Grid in Hungary

Márton Horváth, Szabolcs Solt,
Károly Nagy & Péter Tóth
MME BirdLife Hungary

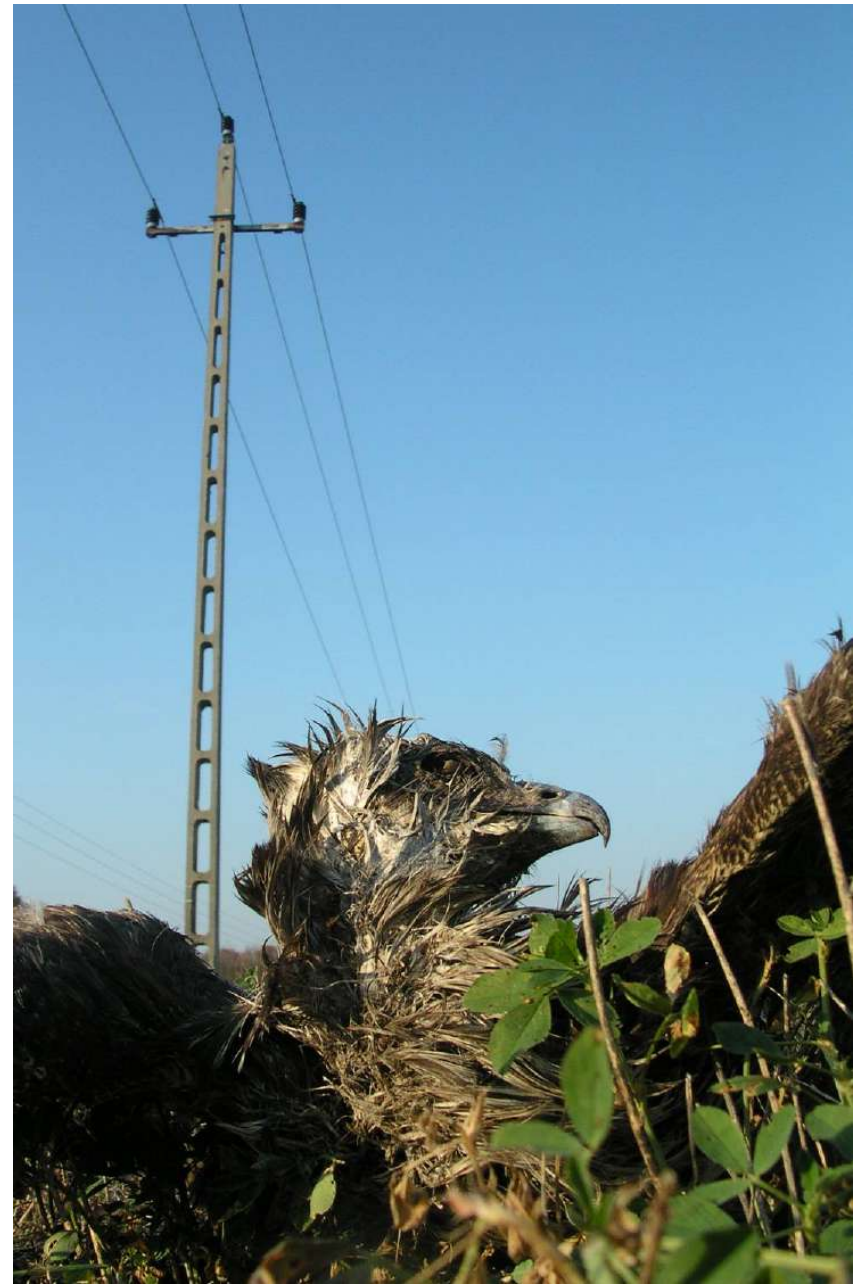


Connecting Biodiversity - Reconciling nature and the electricity grid

8-9 November 2023, Berlin

INTRODUCTION

- 1983-2002: Facing the problem, first mitigation measures (Bagyura et al.)
- 2003-2007: Large scale surveys, large scale mitigation measures (Demeter et al.)
- 2008: Accessible Sky Agreement and the 1st Conflict Map (Horváth et al.)
- 2009-2023: Newly developed pole structures and many more... (Solt et al.)



Csávoly, 16 October 1983



János Bagyura

10 pylons:

4 buzzards, 5 kestrels, 1 red-footed falcon, 3 hooded crows



„Cross-arm insulation” program 1989-2002



„Cross-arm insulation” program 1989-2002



- The crossarms of ca. 32'000 pylons had been covered till 2003 (ca. 5% of all medium-voltage pylons)
- Decreased mortality, BUT it was a temporary & not perfect

INTRODUCTION

- 1983-2002: Facing the problem, first mitigation measures (Bagyura et al.)
- **2003-2007: Large scale surveys, large scale mitigation measures (Demeter et al.)**
- 2008: Accessible Sky Agreement and the 1st Conflict Map (Horváth et al.)
- 2009-2023: Newly developed pole structures and many more... (Solt et al.)



Electrocution of birds on medium-voltage pylons

- Large scale national surveys
- MME and ranger service
- 2004-2014
- Results:
 - >200 participants
 - 57,486 pylons surveyed
 - 3,400 carcasses
 - 79 species



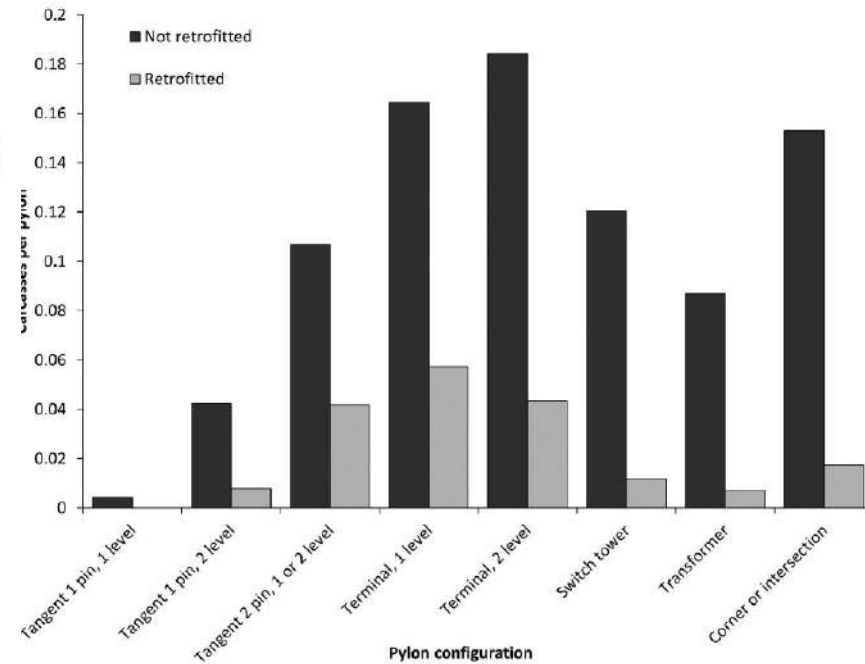
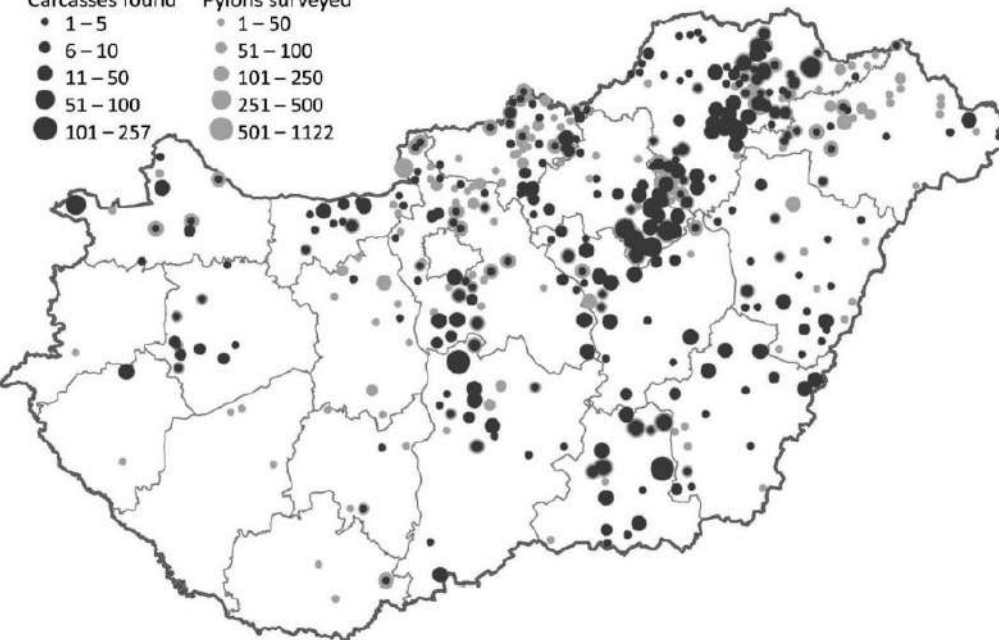
The Wilson Journal of Ornithology 130(3):600–614, 2018

Documenting and reducing avian electrocutions in Hungary: a conservation contribution from citizen scientists

Iván Demeter,¹ Márton Horváth,¹ Károly Nagy,¹ Zoltán Görögh,¹ Péter Tóth,^{1,4} János Bagyura,¹ Szabolcs Solt,¹ András Kovács,³ James F. Dwyer,^{2*} and Richard E. Harness²

Carcasses found
 • 1–5
 ● 6–10
 ● 11–50
 ● 51–100
 ● 101–257

Pylons surveyed
 ● 1–50
 ● 51–100
 ● 101–250
 ● 251–500
 ● 501–1122



INTRODUCTION

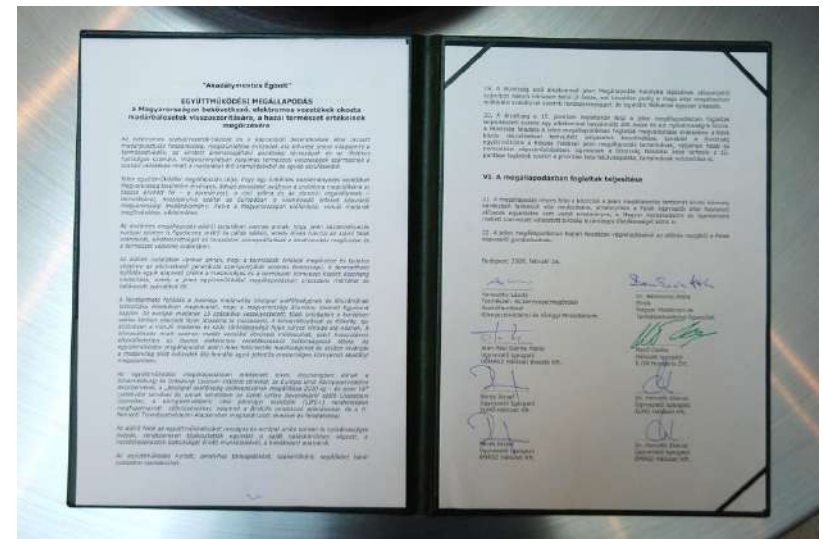
- 1983-2002: Facing the problem, first mitigation measures (Bagyura et al.)
- 2003-2007: Large scale surveys, large scale mitigation measures (Demeter et al.)
- **2008: Accessible Sky Agreement and the 1st Conflict Map (Horváth et al.)**
- 2009-2023: Newly developed pole structures and many more... (Solt et al.)



Accessible Sky Agreement

26 February 2008

- Signed by:
 - Ministry of Agriculture
 - Electric companies
 - MME
- Voluntary agreement
- Political initiation
- Declares to „eliminate the problem by 2020”
- No prior planning
- No realistic objectives

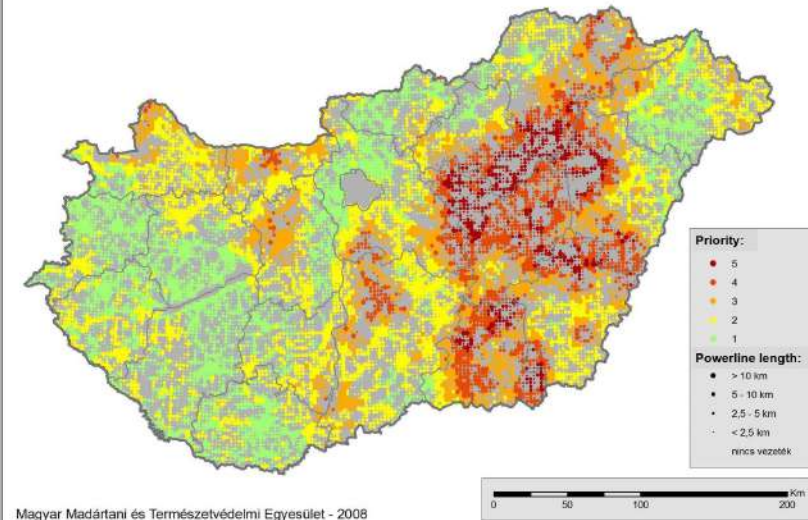


Agreement between Ministry of Environment and MME BirdLife Hungary August-November 2008

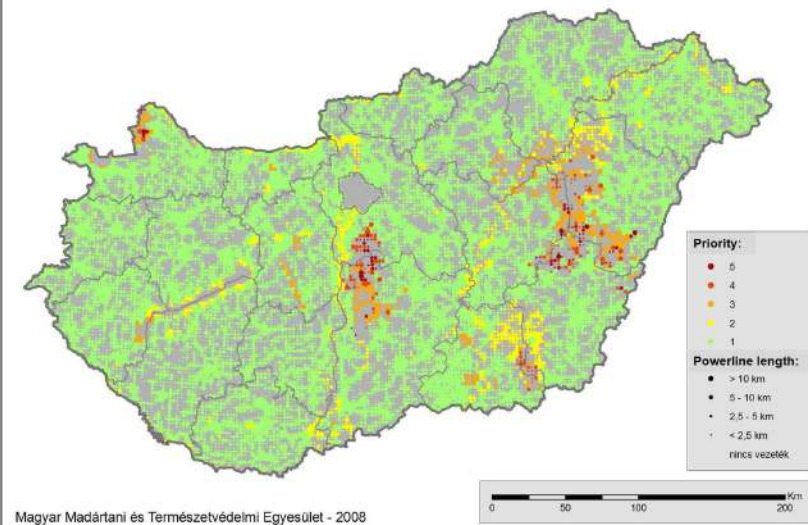
A. Development of conflict maps for locating the most critical areas of bird and power line interactions (electrocution + collision)

B. Development of a possible time-frame for bird-friendly modifications

Conflict map 1.: Electrocution



Conflict map 1.: Collision



INTRODUCTION

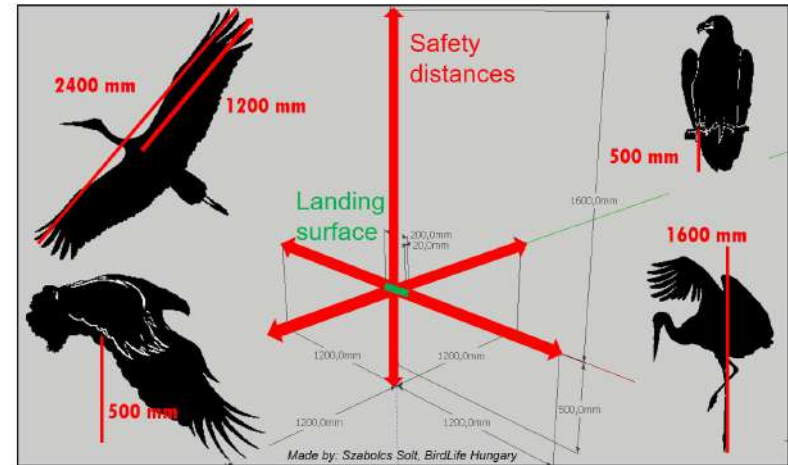
- 1983-2002: Facing the problem, first mitigation measures (Bagyura et al.)
- 2003-2007: Large scale surveys, large scale mitigation measures (Demeter et al.)
- 2008: Accessible Sky Agreement and the 1st Conflict Map (Horváth et al.)
- **2009-2023: Newly developed pole structures and many more... (Solt et al.)**



Recent activities

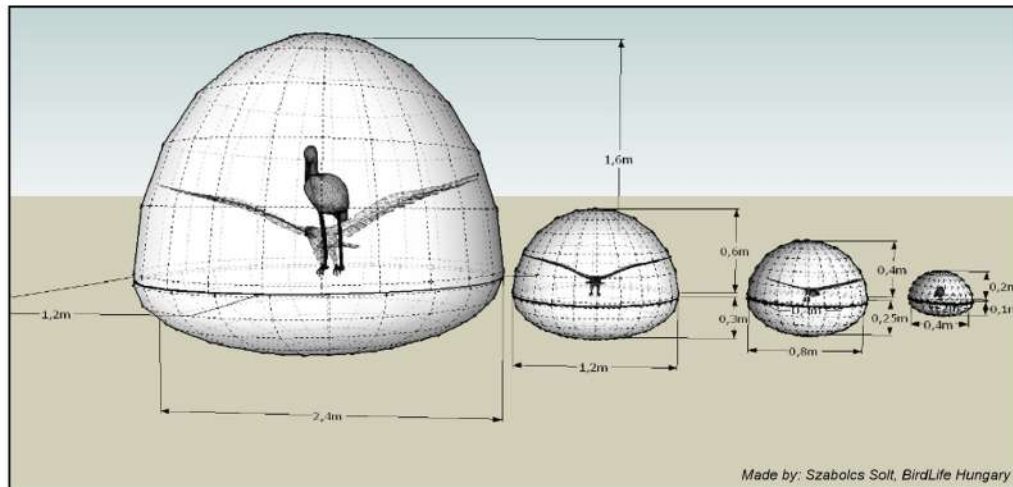
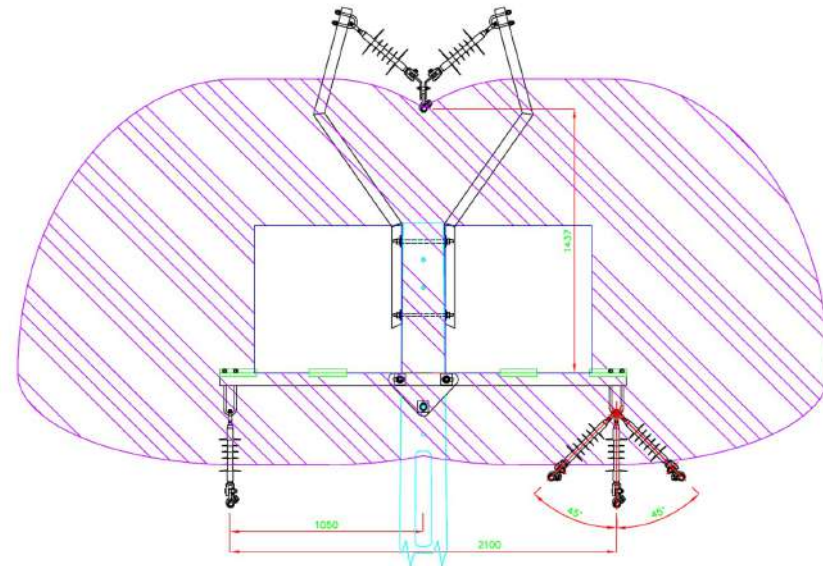
- 3D modelling and development of new, bird-friendly pylon types in cooperation with engineers & electric companies
- Focused and repeated field surveys
- Legal procedures for mitigation measures in case of detected mortality

„A” CATEGORY = LARGE-SIZED BIRDS



Critical safety spaces and distances
(Prevention of phase-to-phase and ground-to-phase short-circuits on mid-voltage electric pylons)

New Mid-voltage pylon type designs in Hungary using the 3D Modelling of MME/BirdLife Hungary – 1.



Modelling critical safety spaces and distances
(Prevention of phase-to-phase and ground-to-phase short-circuits on mid-voltage electric pylons)

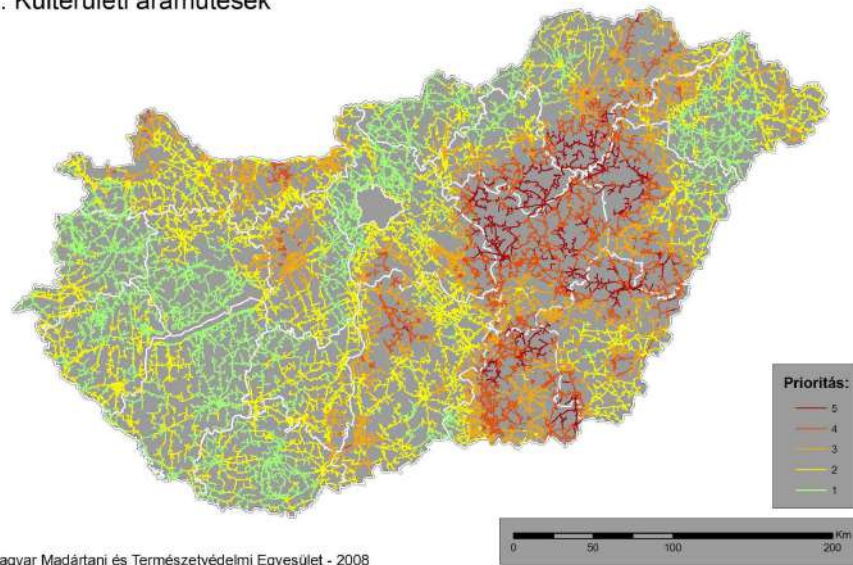
Objective

Revision of the „Conflict map” 1.0 (2008)

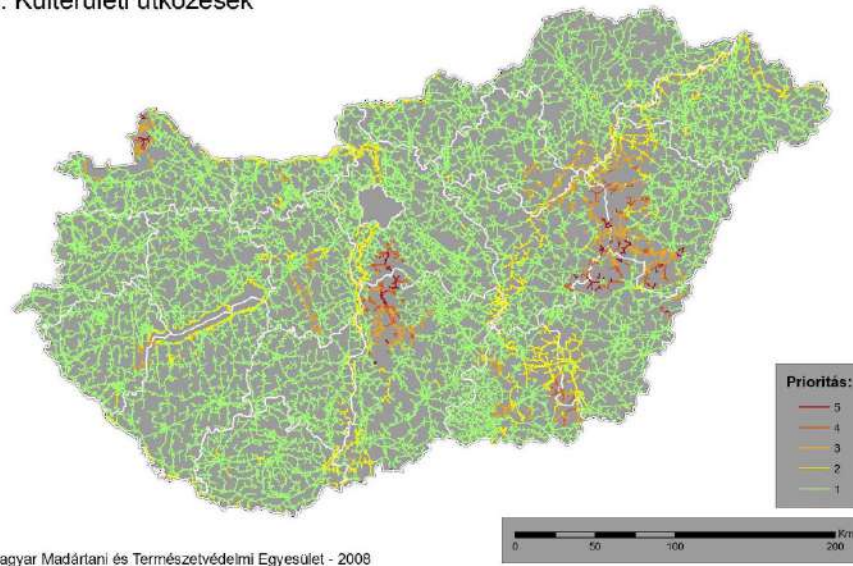
2020:

- New database on bird distribution (precision & changes)
- New registry of electric grid (precision & changes)
- New database on habitat structure
- „Fine tuning” of methodology

Védett madárfajokat veszélyeztetető közepesfeszültségű vezetékhalózati:
1. Külterületi áramutések



Védett madárfajokat veszélyeztetető közepesfeszültségű vezetékhalózati:
3. Külterületi ütközések



Methods

- The base for the national model was the:
 - I. Distribution of priority bird species (probability of occurrence)**
- Known mortality data is highly dependent on local survey efforts
 - NOT suitable for spatial modelling in national scale
 - BUT suitable for estimating the magnitude of species specific effects
 - AND suitable for estimating effects of:
 - II. Microhabitat**
 - III. Pole structure/type**
 - IV. Mitigation measures**

I. Distribution of priority bird species

II. Microhabitat around the pole/powerline

III. Pole structure/type

IV. Applied bird-friendly solution

Steps

I. Distribution of priority bird species

II. Microhabitat around the pole/powerline

III. Pole structure/type

IV. Applied bird-friendly solution

I.



I. Distribution of priority bird species

- I.1 **Select species and define the species' relative weight**
- I.2 Define the distribution of selected species
- I.3 Define the cumulative priority map of threatened species



I.1 Weighting the species - Methodology

RELATIVE WEIGHT OF BIRD SPECIES			CONSERVATION STATUS				
			Globally threatened (IUCN: CR, EN, VU, NT, EU: spec 1)	Threatened in Europe (EU: spec2, spec 3)	Threatened in Hungary (HU: CR, EN, VU, NT)	Protected in Hungary	Not protected in Hungary
RELATIVE EFFECT OF POWERLINES	Population-level effect	Critical threat on population (found carcass/mature individual >5%)	5	5	4	3	0
		Threat on population (found carcass/mature individual >1%)	5	4	3	2	0
	Individual-level effect	Critically high individual mortality (>5% of found carcasses)	5	4	3	2	0
		High individual mortality (>1% of found carcasses)	4	3	2	1	0
		Individual mortality (>0.1% of found carcasses)	3	2	1	0	0
	No effect	No significant mortality (<0.1% of found carcasses)	0	0	0	0	0



I.1 Weighting the species - Electrocution

RELATIVE WEIGHT OF BIRD SPECIES			CONSERVATION STATUS				
			Globally threatened (IUCN: CR, EN, VU, NT, EU: spec 1)	Threatened in Europe (EU: spec2, spec 3)	Threatened in Hungary (HU: CR, EN, VU, NT)	Protected in Hungary	Not protected in Hungary
RELATIVE EFFECT OF POWERLINES	Population-level effect	Critical threat on population (found carcass/mature individual >5%)		Bubo bubo	Aquila chrysaetos	Ciconia ciconia	
		Threat on population (found carcass/mature individual >1%)	Milvus milvus, Aquila heliaca, Falco cherrug	Falco tinnunculus, Coracias garrulus, Tyto alba*	Ciconia nigra, Haliaeetus albicilla, Accipiter gentilis*, Circaetus gallicus	Buteo buteo, Buteo rufinus	
	Individual-level effect	Critically high individual mortality (>5% of found carcasses)					
		High individual mortality (>1% of found carcasses)				Corvus frugilegus	
		Individual mortality (>0.1% of found carcasses)	Falco vespertinus		Falco peregrinus, Strix uralensis*	19 species * 3 species has no national database 16 species used	
	No effect (<0.1% of found carcasses)						



I.1 Weighting the species - Collision

RELATIVE WEIGHT OF BIRD SPECIES			CONSERVATION STATUS				
			Globally threatened (IUCN: CR, EN, VU, NT, EU: spec 1)	Threatened in Europe (EU: spec2, spec 3)	Threatened in Hungary (HU: CR, EN, VU, NT)	Protected in Hungary	Not protected in Hungary
RELATIVE EFFECT OF POWERLINES	Population-level effect	Critical threat on population (found carcass/mature individual >5%)	Otis tarda				
		Threat on population (found carcass/mature individual >1%)					
	Individual-level effect	Critically high individual mortality (>5% of found carcasses)				Grus grus	
		High individual mortality (>1% of found carcasses)	Waterbirds*	Waterbirds*	Waterbirds*	Ciconia ciconia Waterbirds*	
		Individual mortality (>0.1% of found carcasses)				3 species * 1 group with average weight „3”	
	No effect (<0.1% of found carcasses)						

I. Distribution of priority bird species

- I.1 Select species and define the species' relative weight
- I.2 Define the distribution of selected species**
- I.3 Define the cumulative priority map of threatened species



I.2 Define the distribution of selected species

- The best available datasets (MME - Nat. Park Dir. cooperation):
 - Birdatlas Program (MAP)
 - Common Bird Monitoring (MMM)
 - Waterbird Database
 - Species specific database (breeding, observation)
- 2,5 x 2,5 km UTM grid cells (15,442 cells for Hungary)
- 5 categories for estimating the probability occurrence:

1: not significant habitat

2: occasionally used habitat

3: frequently used habitat

**4: important habitat
(breeding, settlement)**

**5: most important habitats
(hotspots)**



I.2 Define the distribution of selected species

- limitation of available data (unequal survey effort) and high dispersal capacity of birds
- therefore we also extrapolated data to the surrounding quadrats (decreased by distance)

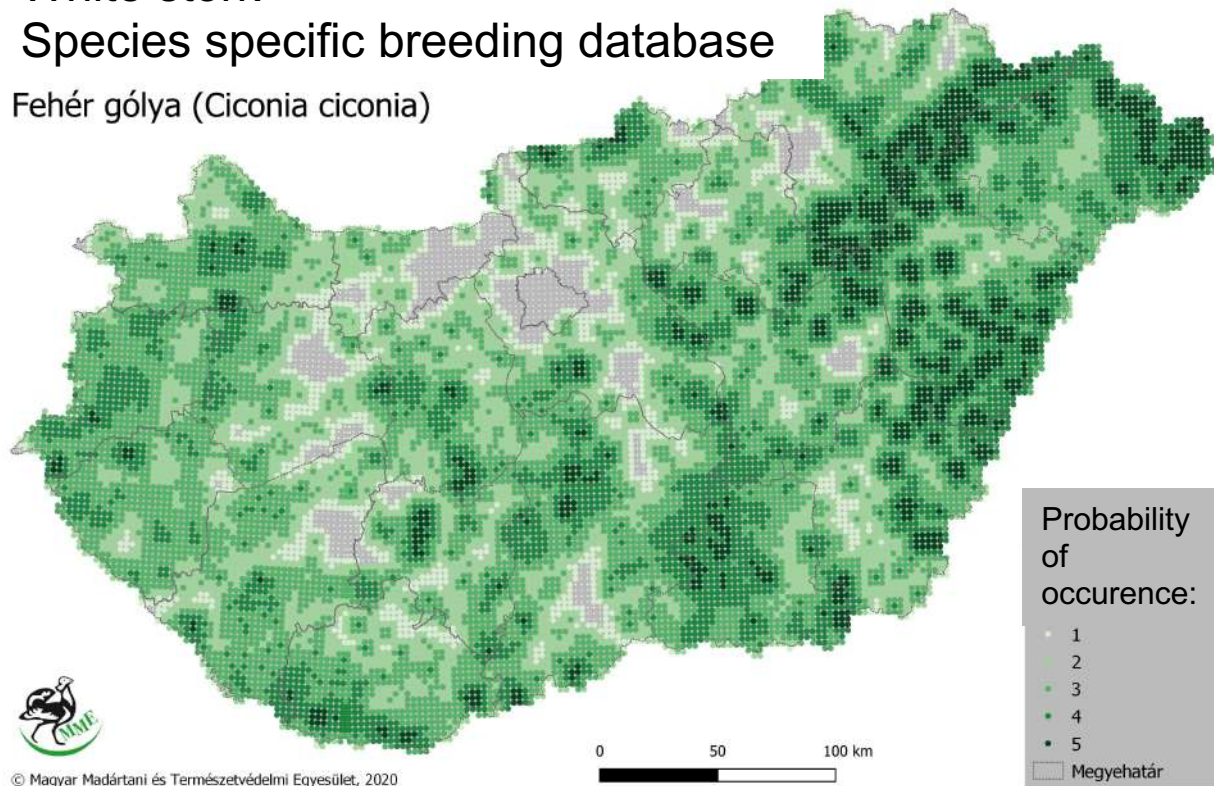
RELATIVE WEIGHT OF UTM QUADRATS FOR THE SELECTED BIRD SPECIES		DATA WITHIN THE UTM QUADRAT				
		Very high breeding/presence probability	High breeding/presence probability	Medium breeding/presence probability	Low breeding/presence probability	Very low breeding/presence probability
DATA IN THE SURROUNDINGS OF THE UTM QUADRAT	0 km	5	5	4	3	0
	2.5 km	5	4	3	2	0
	5 km	4	3	2	1	0
	7.5 km	3	2	1	0	0
	10 km	2	1	0	0	0
	>10 km	0	0	0	0	0

I.2 Define the distribution of selected species

White stork
Species specific breeding database
Fehér gólya (*Ciconia ciconia*)



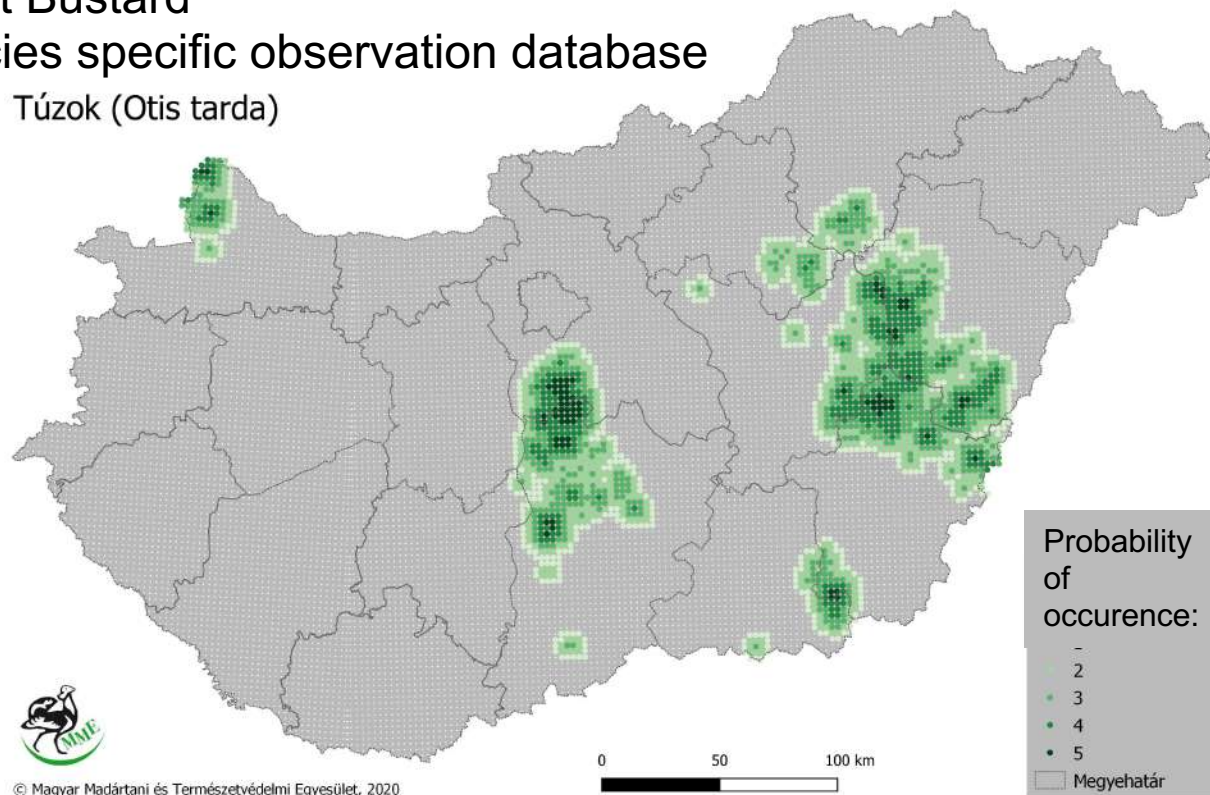
© Kokay Szabolcs - MME - www.mme.hu



	Very high breeding/presence probability	High breeding/presence probability	Medium breeding/presence probability	Low breeding/presence probability	Very low breeding/presence probability
<i>Ciconia ciconia</i>	very high (annually >10 pairs)	high (annually 6-10 pairs)	medium (annually 2-5 pairs)	occasionally or low (min 1 pair in every 5 years)	rarely (1 pair in >5 years) or no data

I.2 Define the distribution of selected species

Great Bustard
Species specific observation database
Túzok (*Otis tarda*)

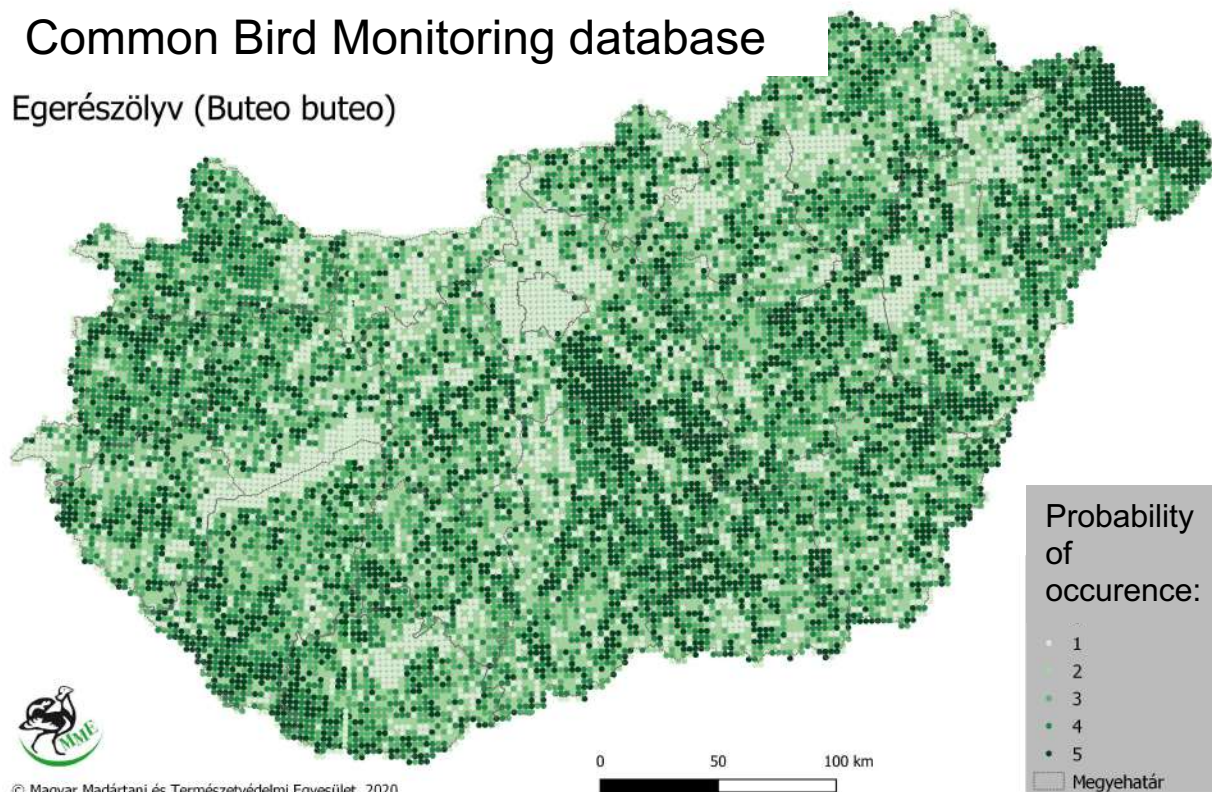


	Very high breeding/presence probability	High breeding/presence probability	Medium breeding/presence probability	Low breeding/presence probability	Very low breeding/presence probability
Otis tarda	very high (>10000 observed specimens)	high (1001-10000 observed specimens)	medium (101-1000 observed specimens)	occasionally or low (2-100 observed specimens)	rarely (max 1 pld) or no data

I.2 Define the distribution of selected species

Buzzard
Common Bird Monitoring database

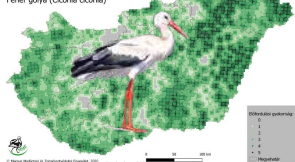
Egerészölyv (*Buteo buteo*)



	Very high breeding/presence probability	High breeding/presence probability	Medium breeding/presence probability	Low breeding/presence probability	Very low breeding/presence probability
Buteo buteo	very high (probability min 0.8 percentile)	high (probability min 0.6 percentile)	medium (probability min 0.4 percentile)	low (probability min 0.2 percentile)	very low (probability <0.2 percentile)

I.2 Define the distribution of selected species

Légyveretők által veszélyeztetett madárfajok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



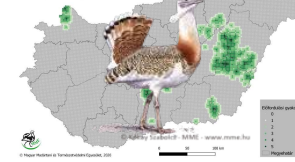
Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



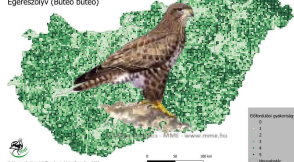
Légyveretők által veszélyeztetett madárfajok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárfajok
elterjedési területe Magyarországon



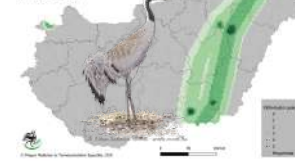
Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



Légyveretők által veszélyeztetett madárlapok
elterjedési területe Magyarországon



18 species
1 group

I. Distribution of priority bird species

I.1 Select species and define the species' relative weight

I.2 Define the distribution of selected species

I.3 Define the cumulative priority map of threatened species





I.3 Cumulative priority map of threatened species

We summed up the probability values of each species multiplied by its relative weight for each UTM grid cell

Electrocution:

$$\sum_{i=1}^{16} \text{Species}_i (\text{Probability of occurrence} \times \text{Relative weight})$$

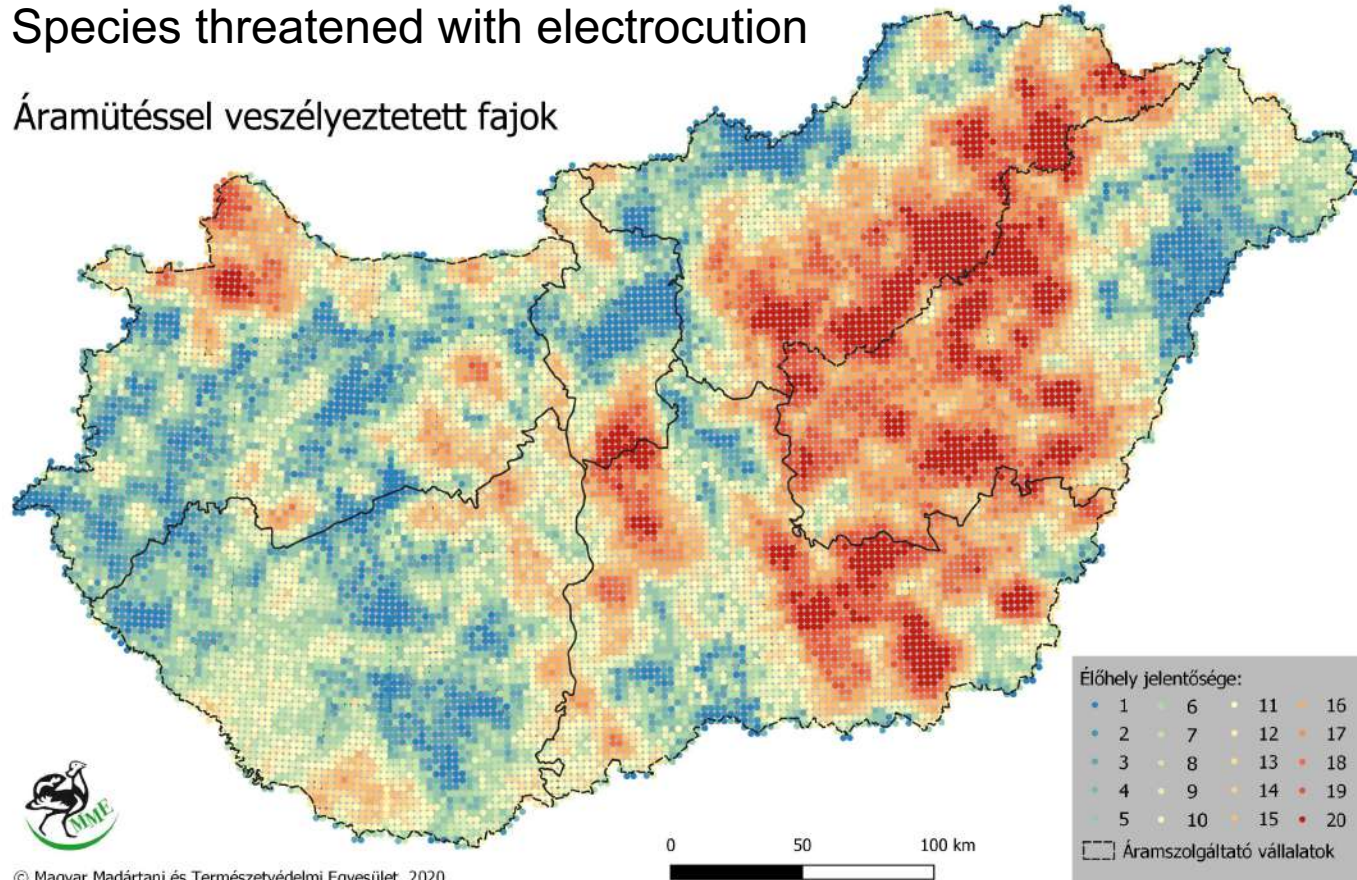
Collision:

$$\sum_{i=1}^4 \text{Species}_i (\text{Probability of occurrence} \times \text{Relative weight})$$

I.3 Cumulative priority map of threatened species

Species threatened with electrocution

Áramütéssel veszélyeztetett fajok



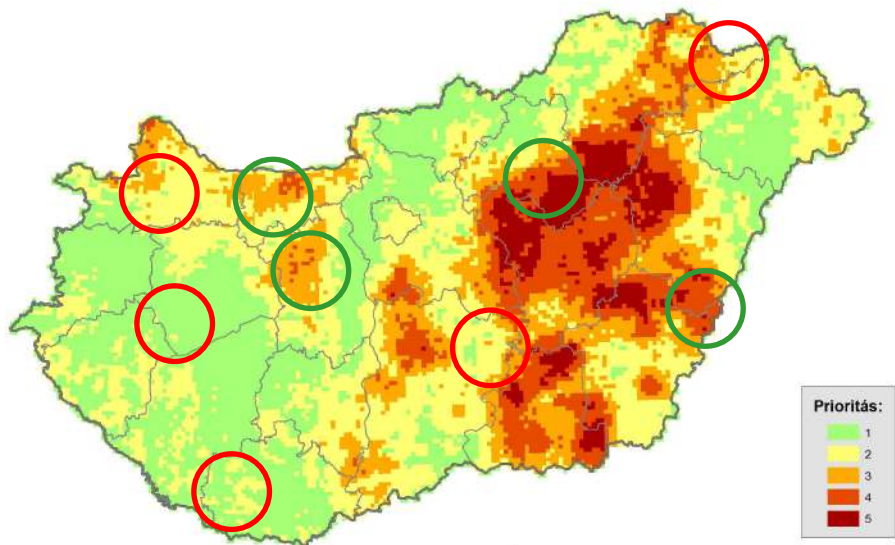
I.3 Cumulative priority map of threatened species

Species threatened with electrocution

2008

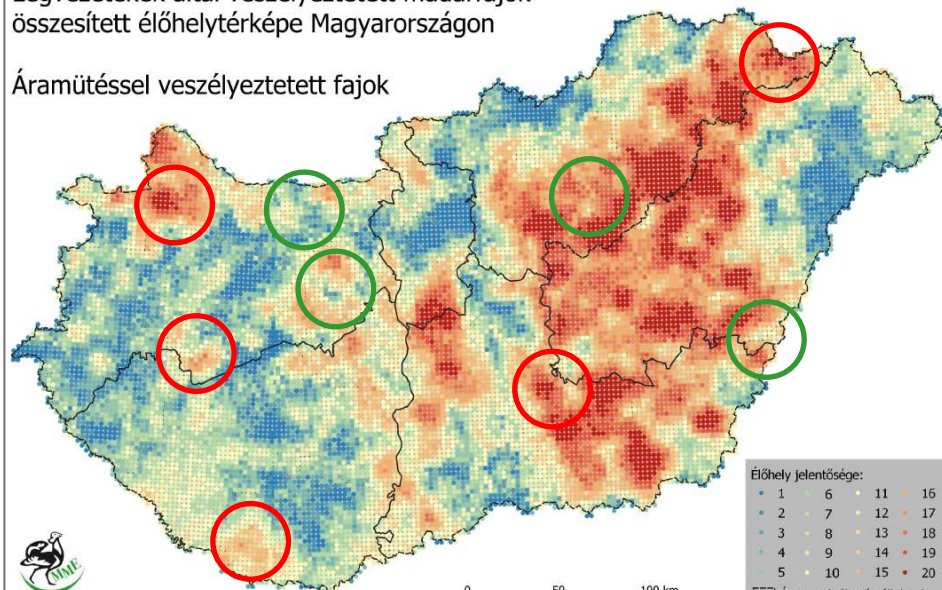
2020

Áramütéssel veszélyeztetett védett madárfajok prioritásterületei



Légvezetékek által veszélyeztetett madárfajok összesített élőhelyterképe Magyarországon

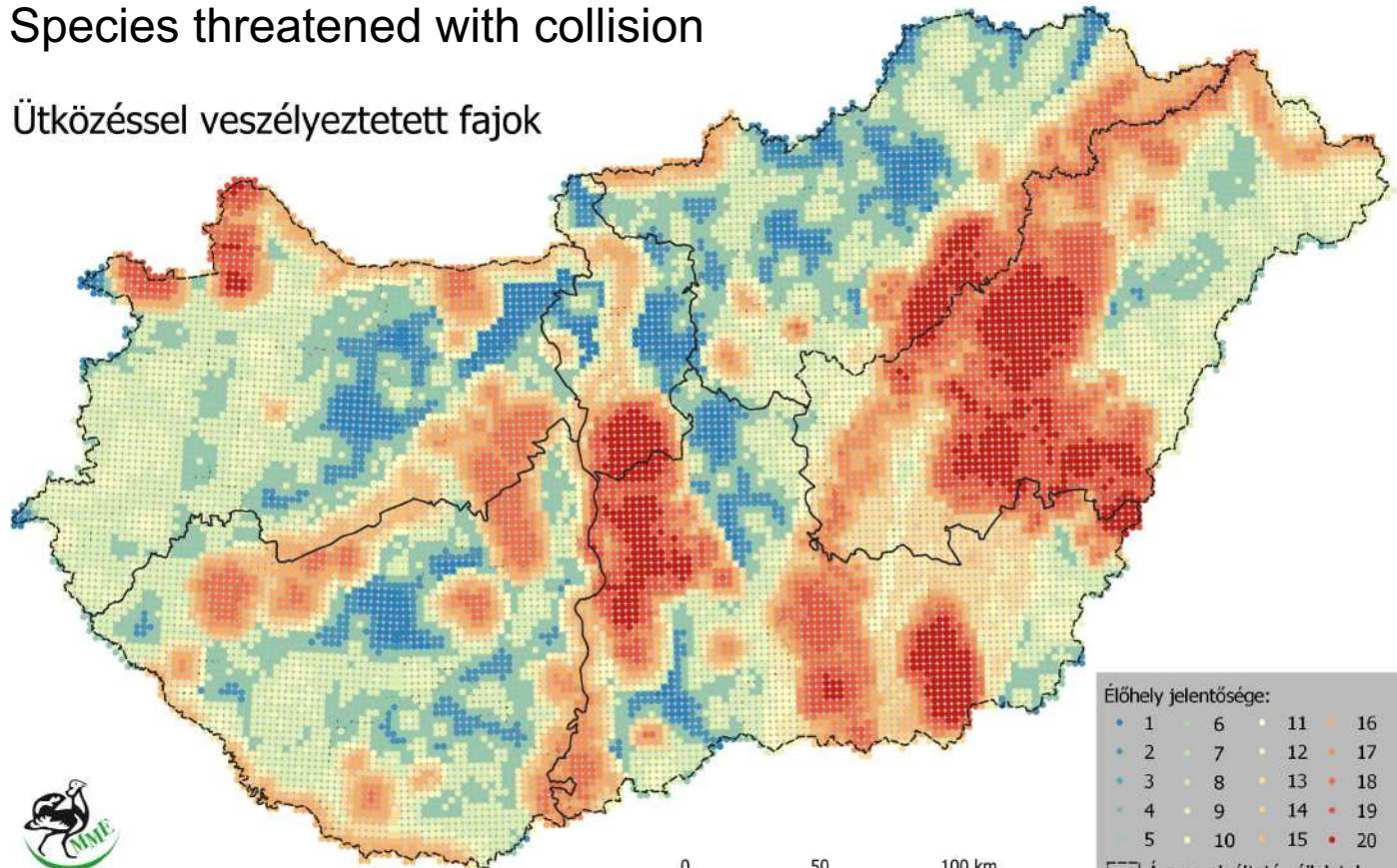
Áramütéssel veszélyeztetett fajok



I.3 Cumulative priority map of threatened species

Species threatened with collision

Ütközéssel veszélyeztetett fajok



I.3 Cumulative priority map of threatened species

Species threatened with collision

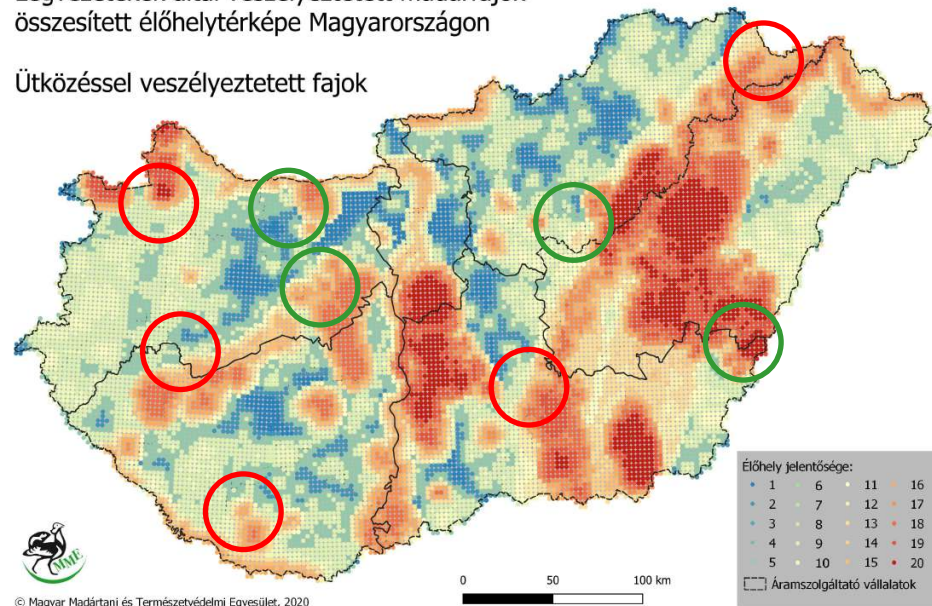
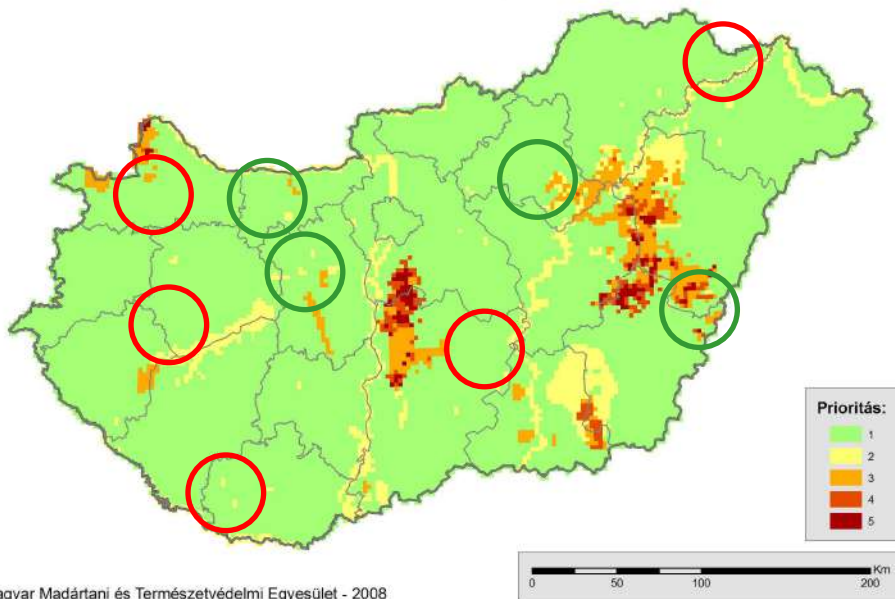
2008

2020

Ütközéssel veszélyeztetett védett madárfajok prioritásterületei

Légvezetékek által veszélyeztetett madárfajok összesített élőhelyterképe Magyarországon

Ütközéssel veszélyeztetett fajok



Steps

I. Distribution of priority bird species

II. Microhabitat around the pole/powerline

III. Pole structure/type

IV. Applied bird-friendly solution





600 m

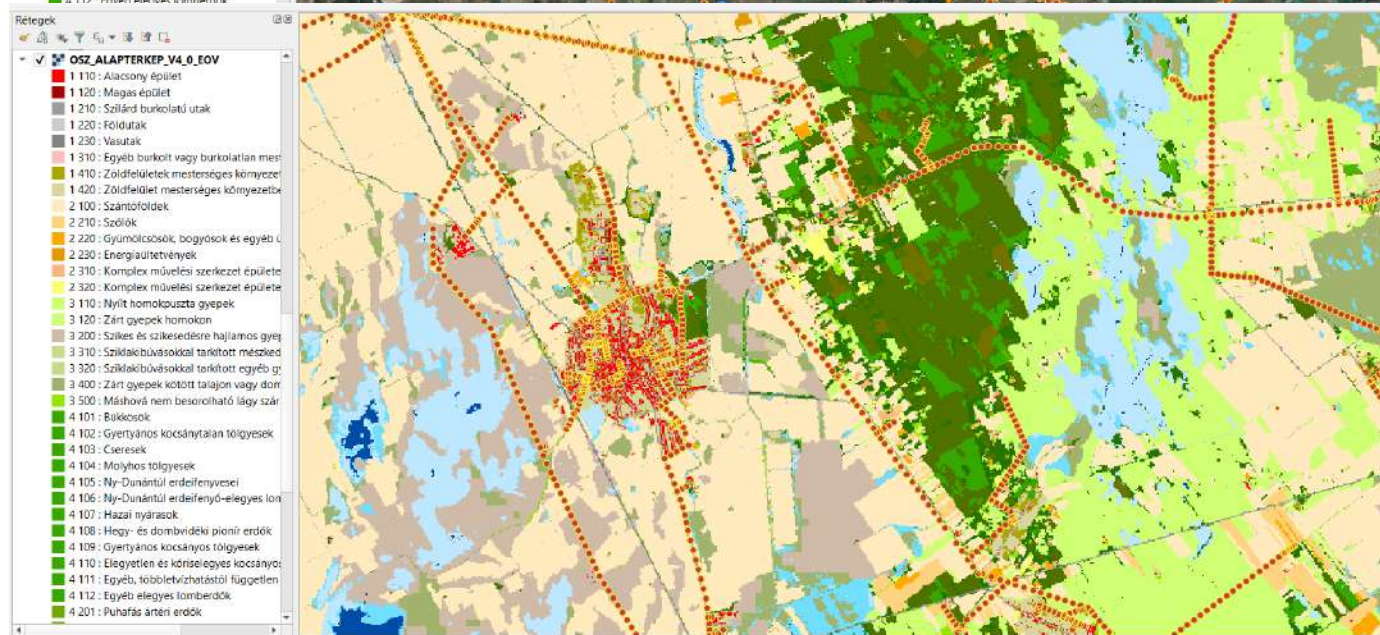
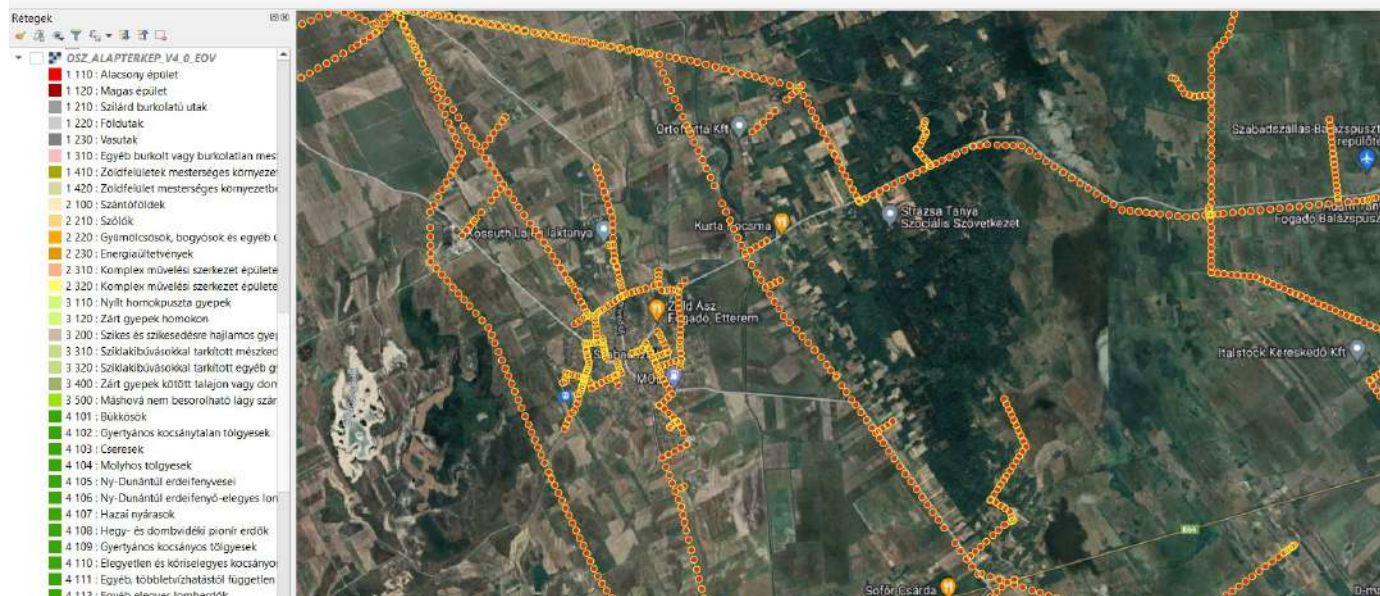
„NÖSZTÉP”

National ecosystem service mapping and evaluation project

Ministry of Agriculture 2019

Main habitat coverage

20m quadrats





150 m

„NÖSZTÉP”

National ecosystem service mapping and evaluation project

Ministry of Agriculture 2019

Main habitat coverage

20m quadrats



50 m

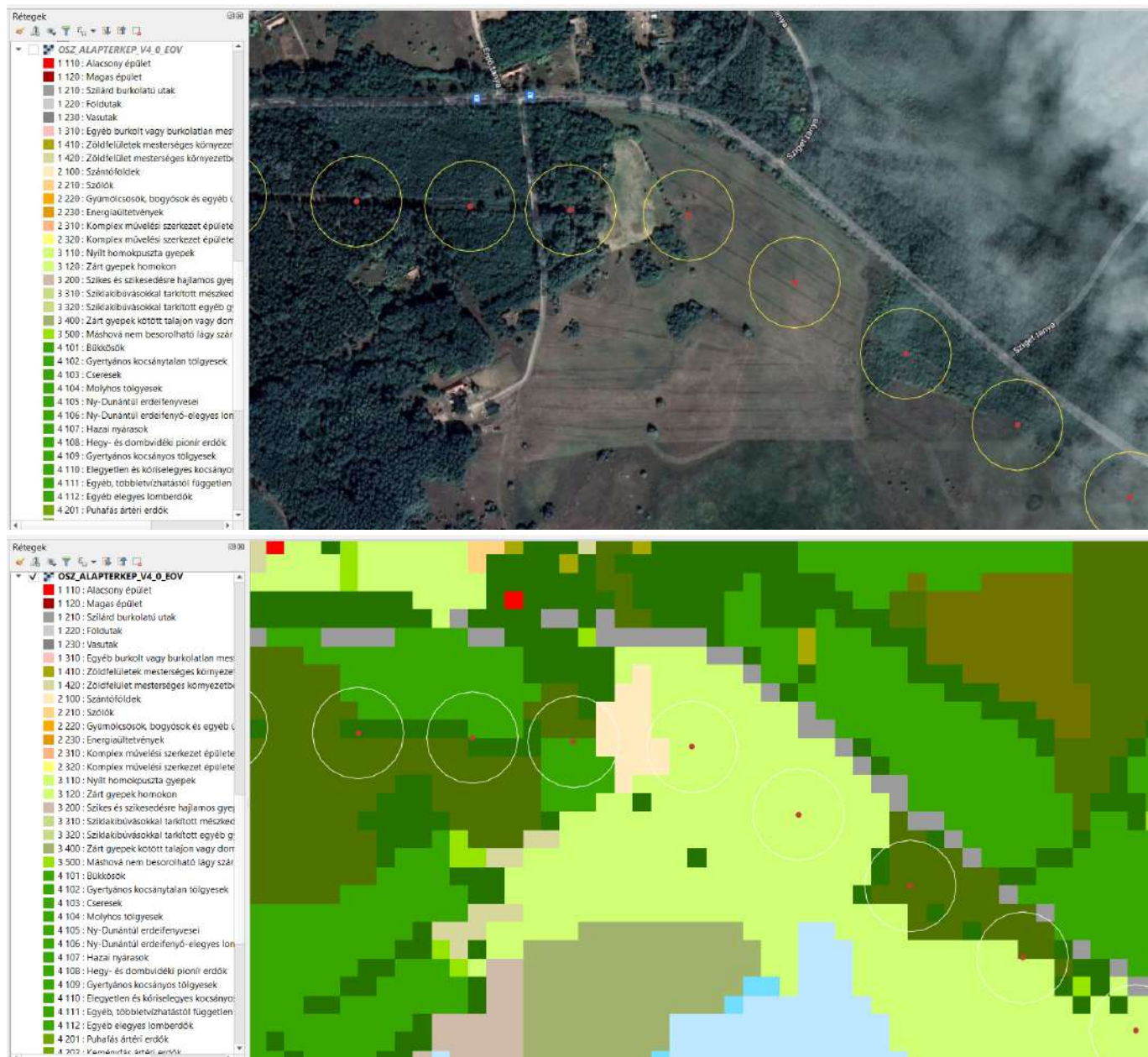
„NÖSZTÉP”

National ecosystem service mapping and evaluation project

Ministry of Agriculture 2019

Main habitat coverage

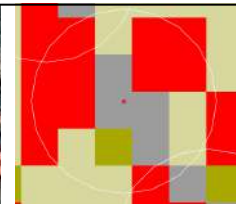
20m quadrats



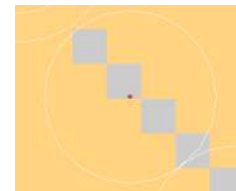
II. Microhabitat around the pylon

- 50m radius buffer around pylon (usually no or minimal overlap)
- 6 categories:
 - Dominant 5 main types: >50% coverage
 - Mixed habitats: <50% coverage for any types

Artificial/Industrial
(1110-1420)



Agriculture
(2100-2310)



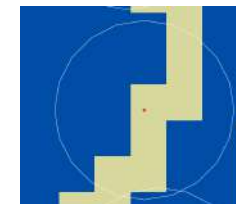
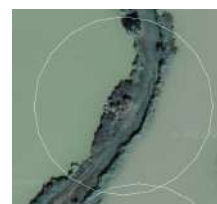
Grassland
(3110-3500)



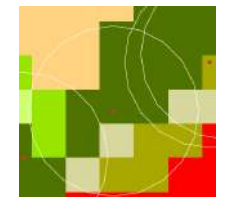
Forest
(4101-4600)



Wetland/Water
(5110-6200)



Mix





II. Microhabitat around the pylon

- Electrocution: detailed surveys in Heves-Borsod Plain (Péter Tóth, 2012-2017)
- Collision: no dataset available

Main habitat type (50 m)	Surveyed pylons	Controls	Carcass	Mortality rate per pylon	Relative risk of type	Risk category
Grassland	1235	2229	85	4.19%	234%	5
Wetland	305	619	17	2.90%	162%	4
Agricultural area	6293	11236	255	2.36%	132%	3
Forest	283	556	7	1.53%	85%	2
Mixed habitat	968	1773	16	0.91%	51%	2
Artificial	4289	8098	33	0.41%	23%	1
Total	13373	24511	413	1.79%	100%	

Steps

I. Distribution of priority bird species

II. Microhabitat around the pole/powerline

III. Pole structure/type

IV. Applied bird-friendly solution



III.



III. Pole or powerline structure/type

- Electrocution: detailed surveys in Heves-Borsod Plain (Péter Tóth, 2012-2017)
- Collision: no dataset available

Main pylon type	Surveyed pylons	Controls	Carcass	Mortality rate per pylon	Relative risk of type	Risk category
Suspender horizontal	367	730	67	9.13%	492%	5
Other mixed type	135	268	15	5.56%	300%	4
Suspender triangle	234	462	15	3.63%	196%	3
Switch tower	851	1691	34	2.12%	114%	2
Transformer station	495	974	11	1.31%	71%	1
Normal	4464	8870	86	1.06%	57%	1
Total	6546	12995	228	1.85%	100%	

Steps

I. Distribution of priority bird species

II. Microhabitat around the pole/powerline

III. Pole structure/type

IV. Applied bird-friendly solution



IV.



IV. Applied bird-friendly solution

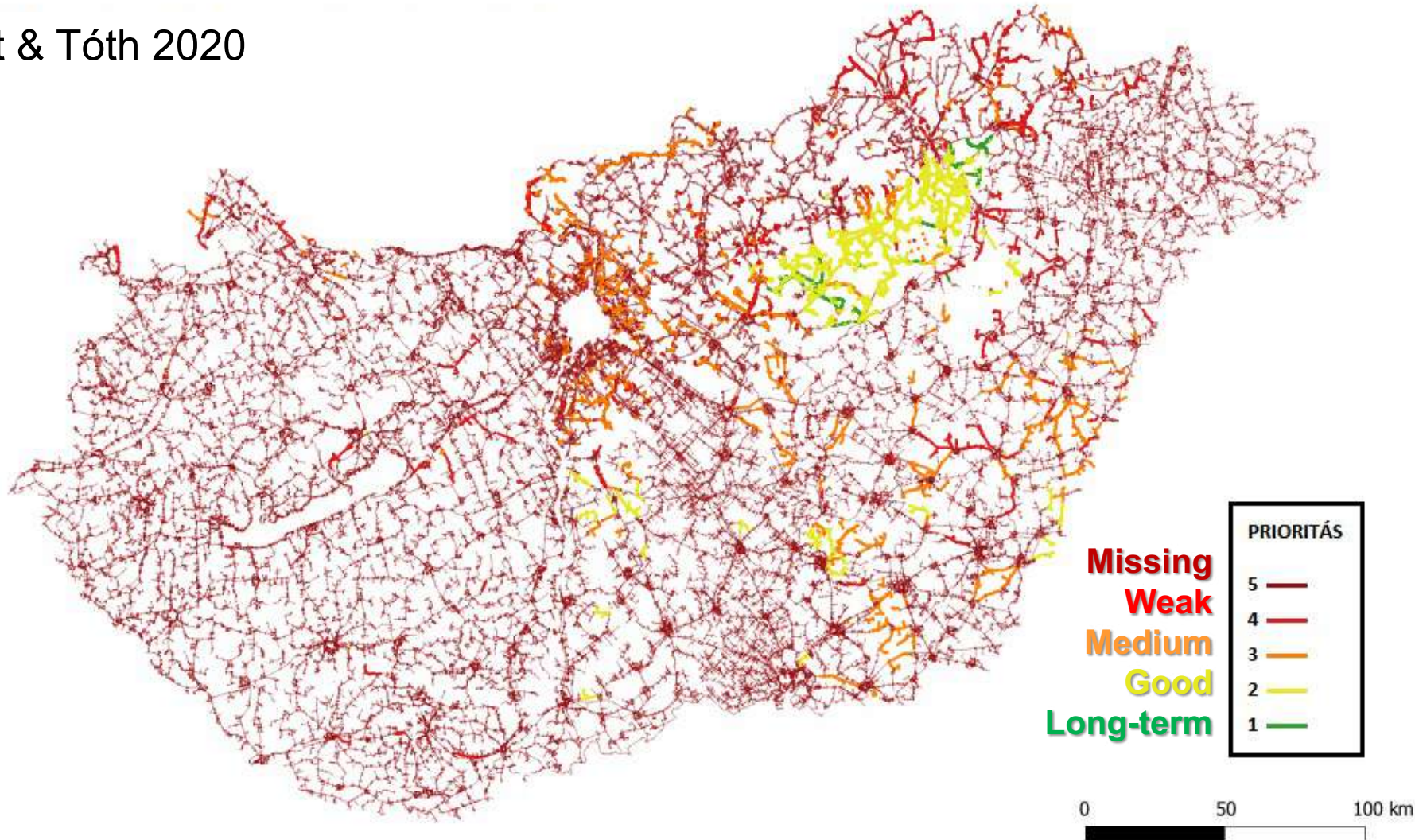
- Specific project (KEHOP-4.3.0-VEKOP-15-2016-00001) to survey available data (Solt & Tóth 2020)

5	Not mitigated OR no data available
4	Crossarm cover
3	Various solutions with limited precision
2	Best known mitigation measure on dangerous pylon
1	New, birdfriendly pylon type



IV. Applied bird-friendly solution

Solt & Tóth 2020



Significant gaps in available data!!!



Final scores (risk assesment) for each pylon/powerline section

**Electro-
cution:**

1-2500

Recently:
1-500

=

Bird priority:

1-20

X

Habitat:

1-5

X

Pole type:

1-5

X

Mitigation
category:

1-5

No available
data recenty

Collision:

1-2500

Recently:
1-20

=

Bird priority:

1-20

X

Habitat:

1-5

X

Powerline
type:

1-5

X

Mitigation
category:

1-5

No available
data recenty

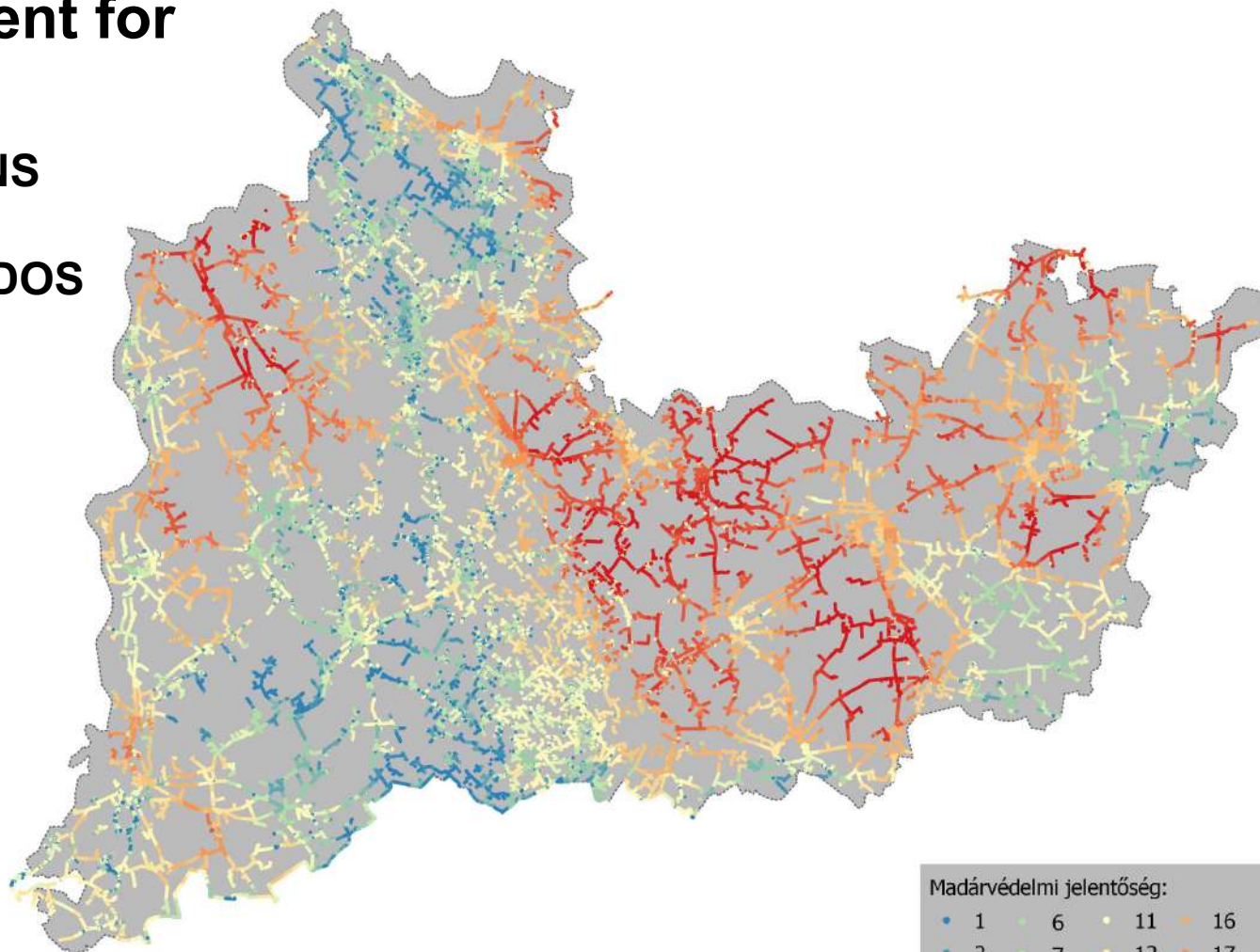
No available
data recenty

No available
data recenty

Risk assesment for each pylon

ELECTROCUTIONS

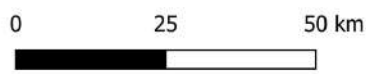
Territory of NKM DOS



Madárvédelmi jelentőség:

1	6	11	16
2	7	12	17
3	8	13	18
4	9	14	19
5	10	15	20

□ Megyehatár





ACKNOWLEDGEMENT

- The revision of the conflict map was financed by the DSO electric companies (2020-2021):
 - **NKM Áramhálózati Kft.**
 - **E.On Tiszántúli Áramszolgáltató ZRt.**
 - **ELMŰ Hálózati Kft. és ÉMÁSZ Hálózati Kft.**
- **Ministry of Agriculture and the 10 National Park Directorates**
- *Szabolcs Solt, Péter Tóth, Károly Nagy*
- Contributed with species specific data: *János Bagyura, Gábor Balogh, István Béres, Gergő Halmos, László Haraszthy, Béla Kalocsa, Miklós Lóránt, Péter Lovászi, Péter Palatitz, Zoltán Petrovics, Mátyás Prommer, András Schmidt, Petrovics Zoltán, Balázs Szelényi, Enikő Anna Tamás, Béla Tokody, Zsolt Végvári*
- **and the volunteers of MME**



„For a Bird-friendly Hungary!”

www.mme.hu

Thank you for
the attention!



Márton Horváth
horvath.marton@mme.hu
MME BirdLife Hungary

