NATAL DISPERSAL OF EASTERN IMPERIAL EAGLES

PRELIMINARY RESULTS FOR THE CENTRAL EUROPEAN POPULATION

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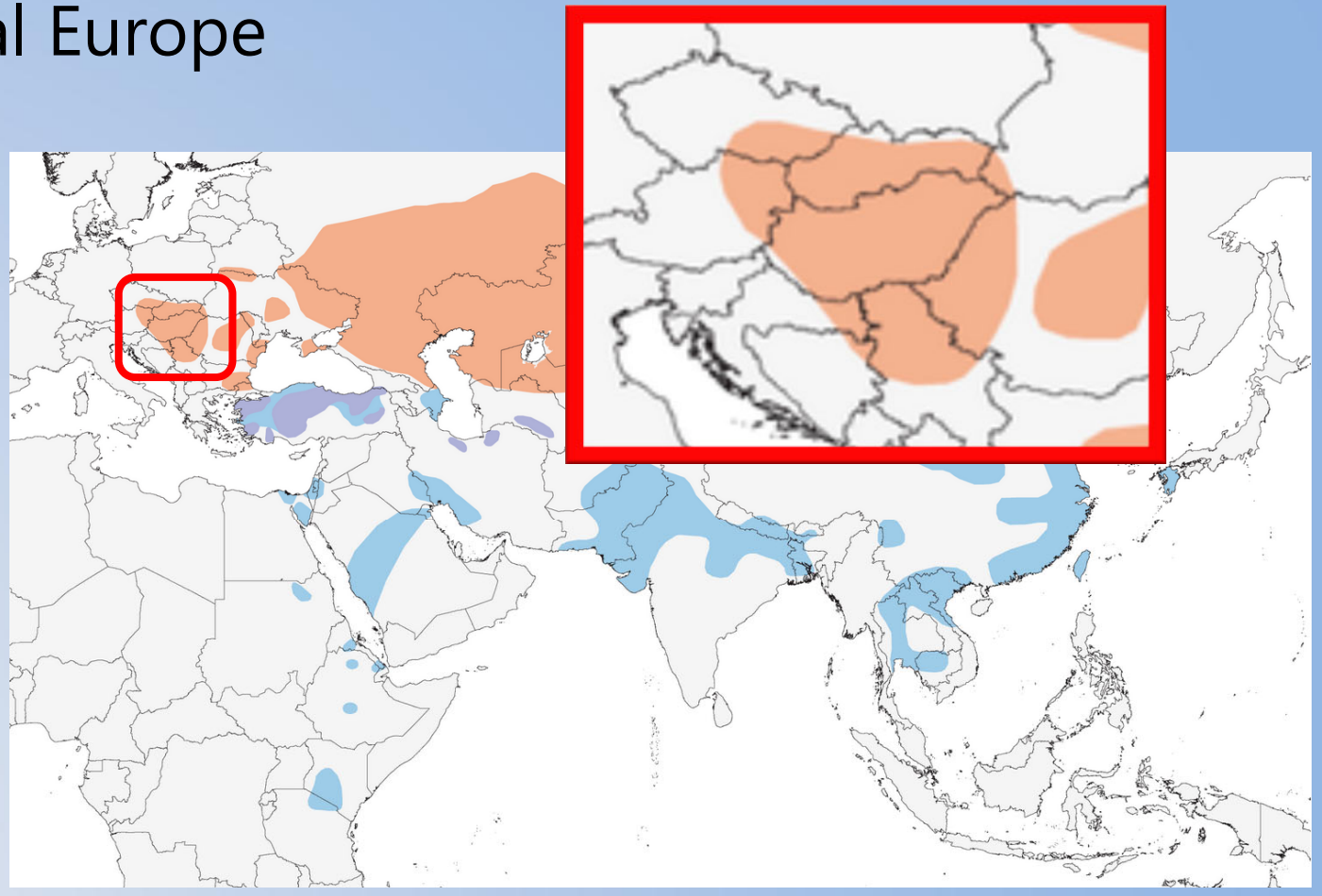
Eagles of the Palearctic: Study and Conservation
Third International Scientific and Practical Conference
IX International Conference on the Conservation of the Eastern Imperial Eagle Almaty, Kazakhstan, 27. September 2023

Eastern Imperial Eagle in Central Europe

western distribution edge
resident population
sharp decline in last centuries
recovering in the last decades

~ 500 Breeding pairs



Meyburg, B.-U. and G. M. Kirwan (2020). Imperial Eagle (Aquila heliaca), version 1.0. In Birds of the World (J. del Hoyo, A. Elliott, J. Sargatal, D. A. Christie, and E. de Juana, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bow.impeag1.01

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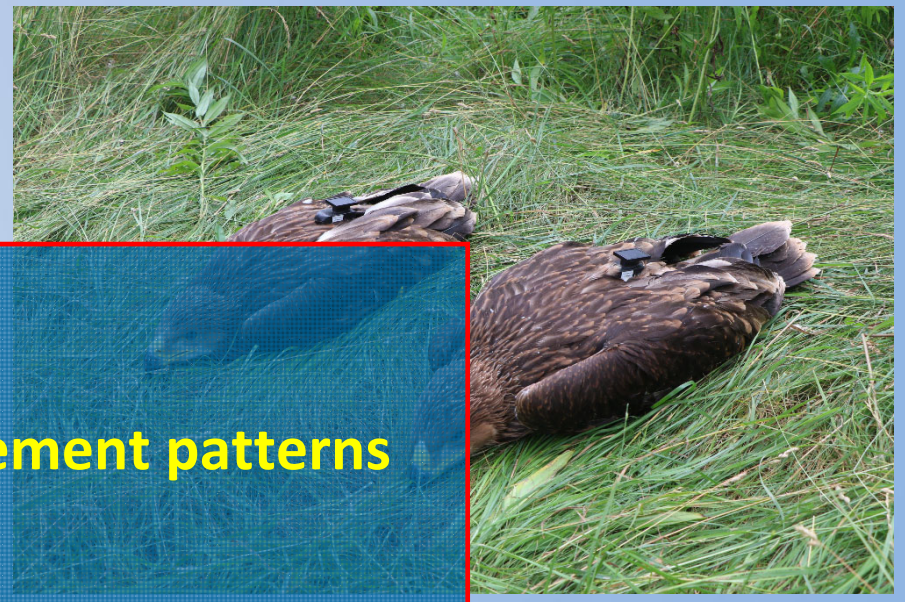
Eastern Imperial Eagle in Central Europe

Conservation Programs in the different countries
(HU,SK,AT,CZ,RS, RO)
established international collaboration
several projects in past decades
tagging as part of research in all countries

+ data of cooperation
with private companies (TB Raab Gmbh)

Aim of this study:
➔ **start and duration of dispersal**
➔ **analysis of natal dispersal movement patterns**
➔ **Identify UD & Hotspots**



Data sources

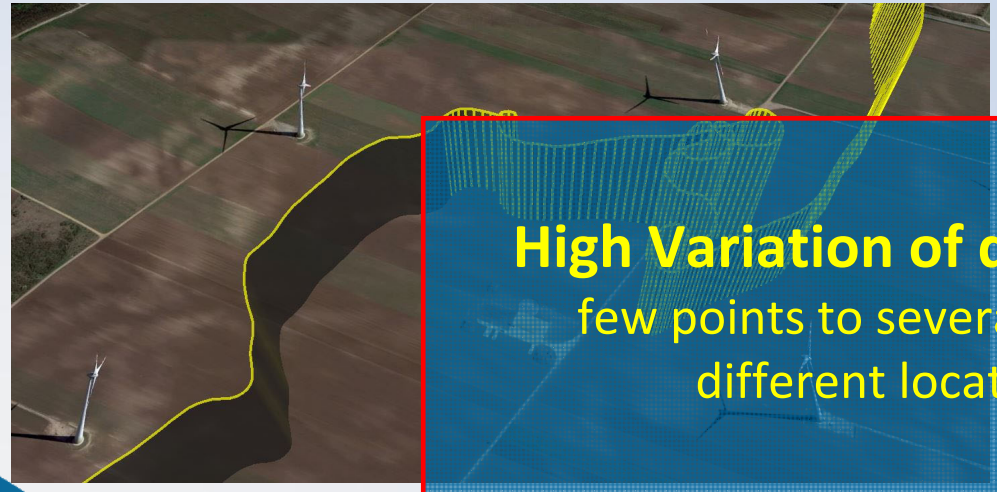
Data sources

Number of Animals	143
Time Span	2003-2023
Number of Locations Records	15.136.060
Tracking days	92.408
Data management	5 Movebank Projects

Data sources

different technologies
➔ different data

- *ARGOS-GPS; GPS-GSM UHF, GPS-GSM*
- *Solar-powered (less data in Winter)*
- *backpack harness/ leg loop harness*



High Variation of data quality and amount
few points to several thousand points per day
different location accuracy / errors

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Methodology

Defining life stages

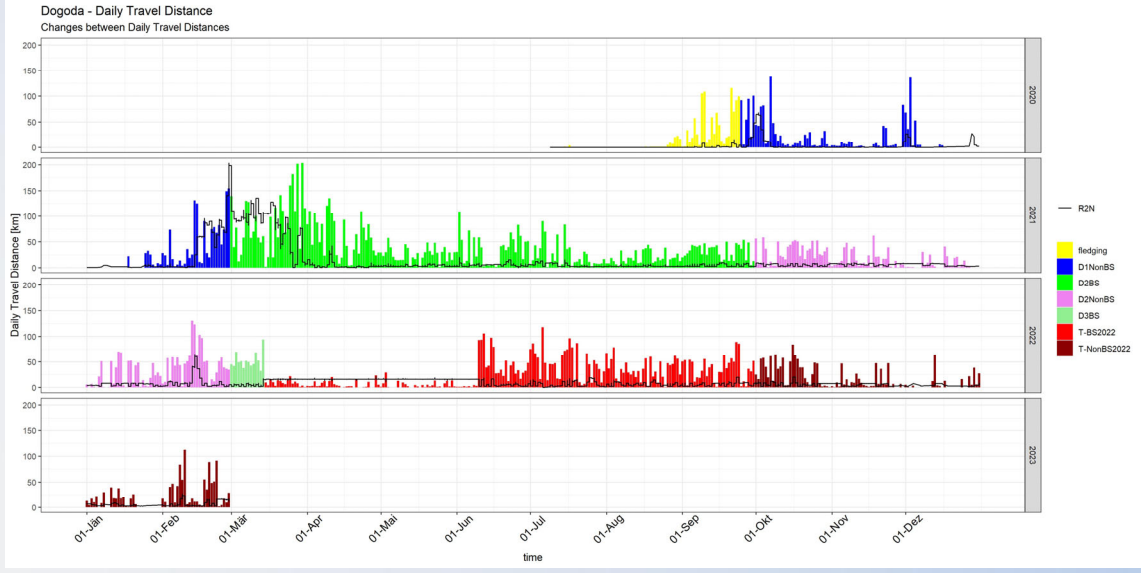
start of dispersal

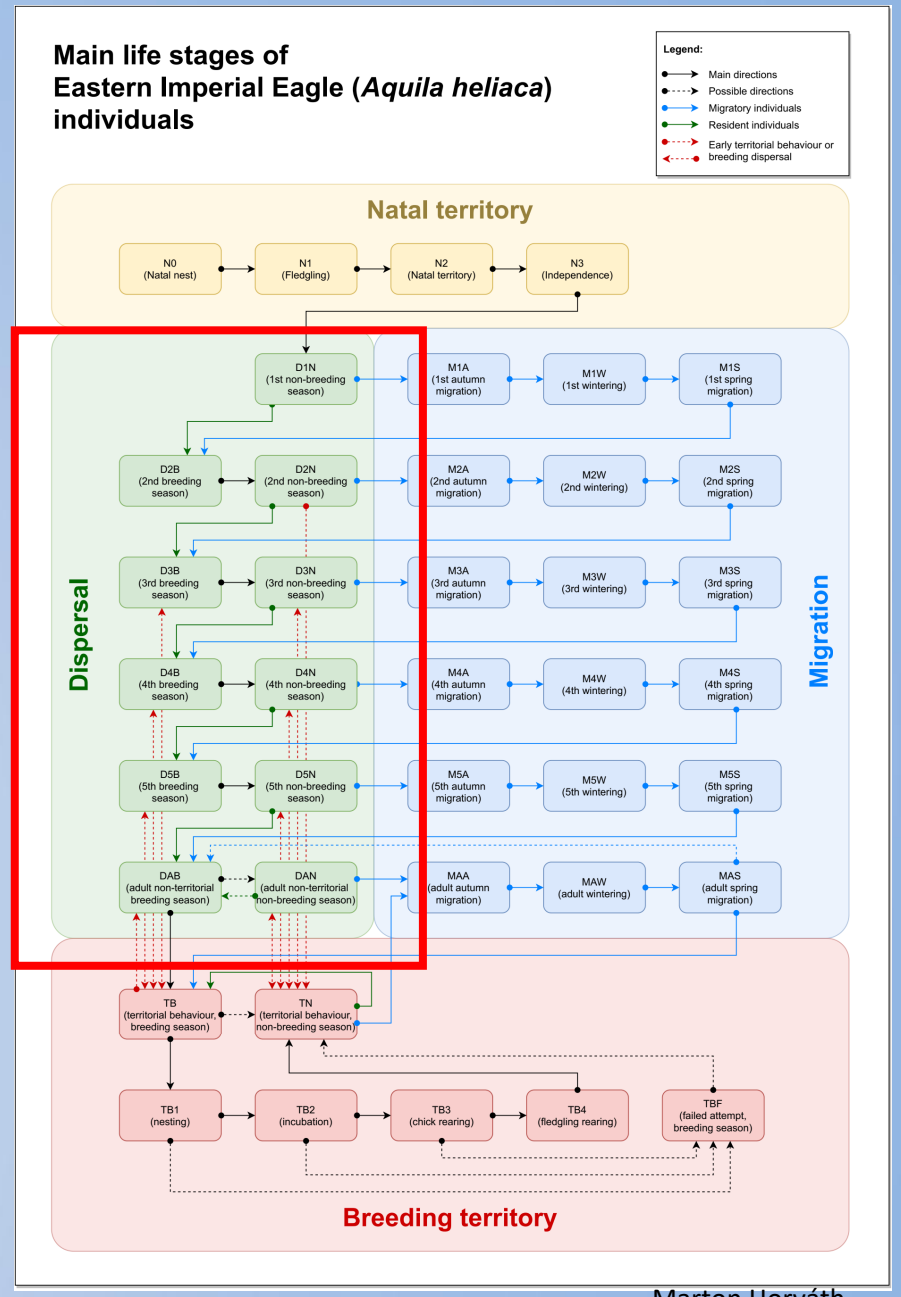
10d consecutive days outside of natal territory (5km)

Breeding Season / Non Breeding season

End of dispersal

expert opinion according movement pattern





Marton Horváth

Methodology

Analysis of movement pattern

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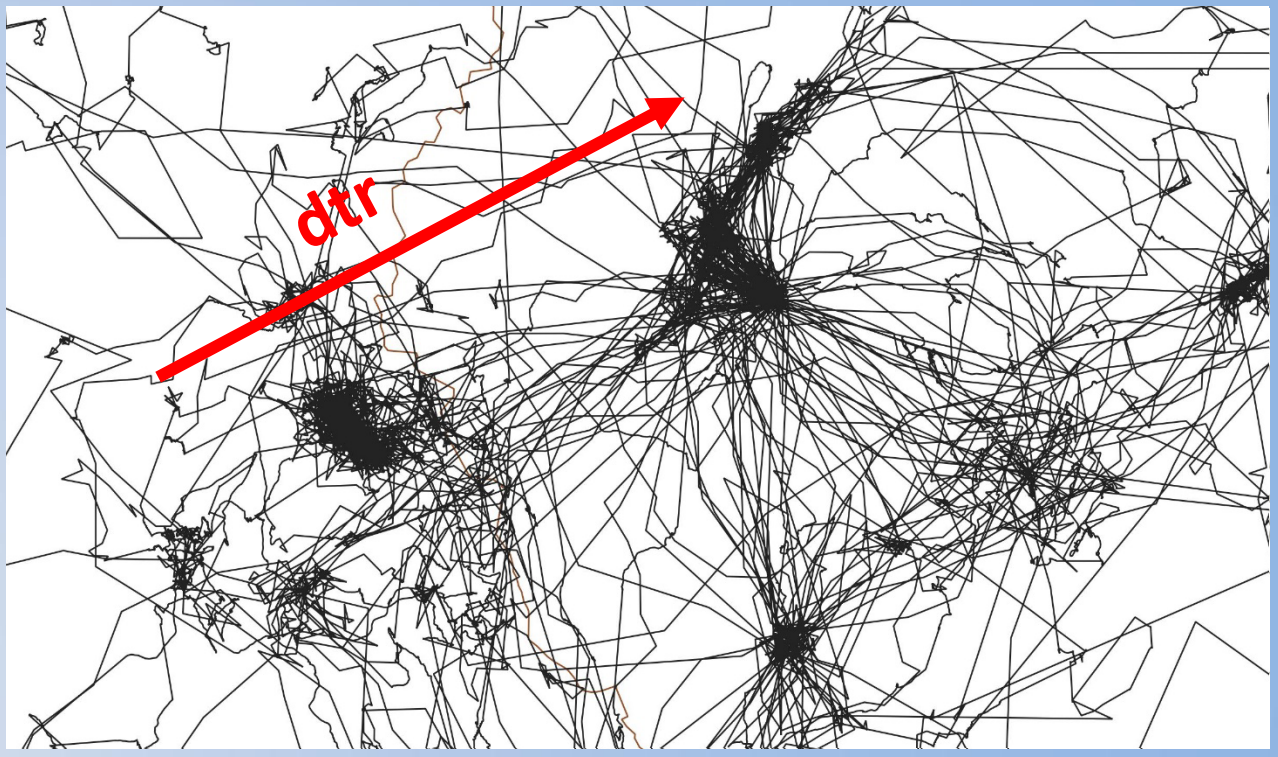
Methodology

Analysis of movement pattern

- daily travel range[1]
  - ➔ activity & range
  - ➔ robust to data quality variation



1) Steiniger & Hunter 2013

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Methodology

Analysis of movement pattern

- daily travel range[1]

➔ activity & range

➔ robust to data quality variation

- Squared Displacement (R2N)[2]

➔ **squared distance between first location (natal nest site)**

➔ **Indicator for Displacment**

1) Steiniger & Hunter 2013 2) adehabitat-Package/ Calenge 2020

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Methodology

Utilization distribution (UD)

dynamic Brownian Bridge Modell[1]

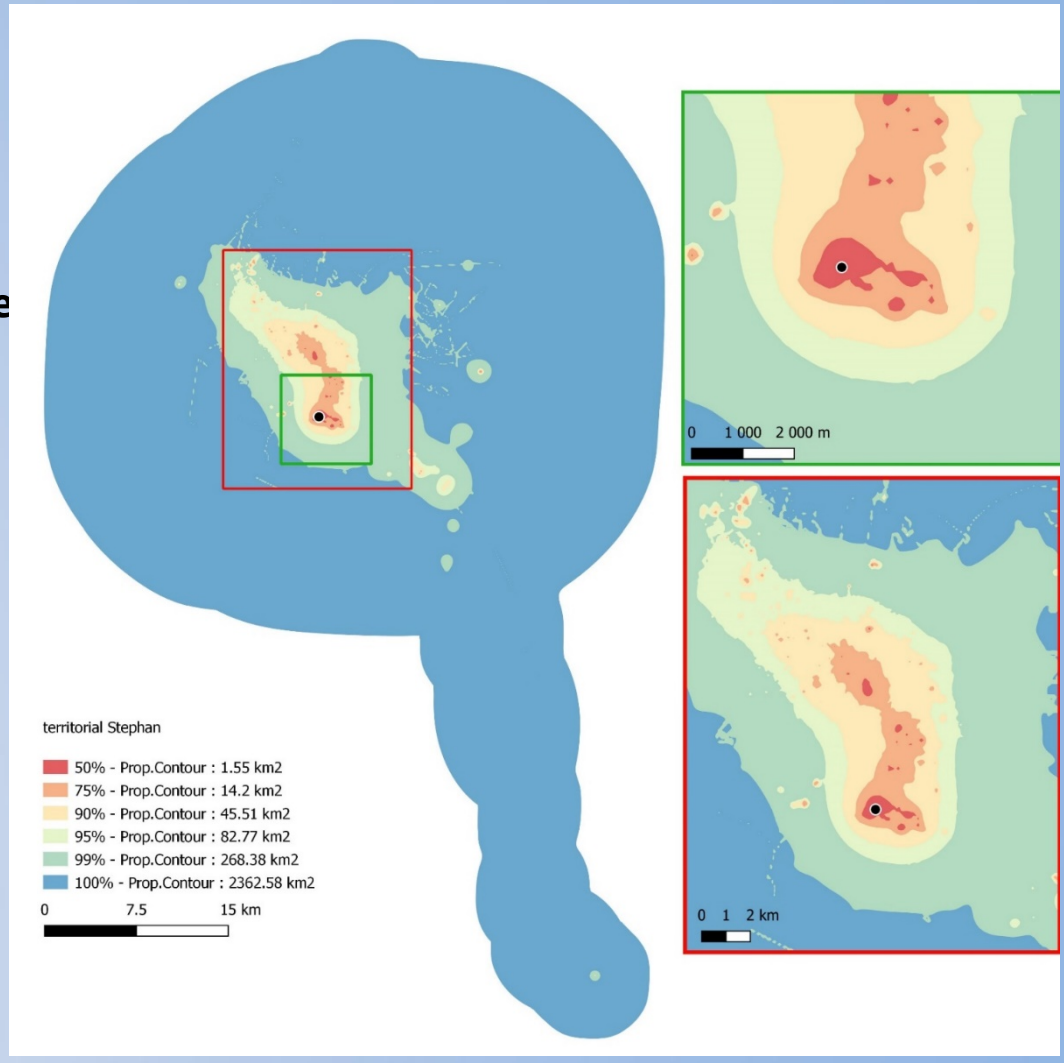
good for data with high variation over time

raster size 1000m, window size: 11, margin size: 5,
time step – data dependent
gaps more than 8 hours => bursts

➔ **UD calculated on individual level**

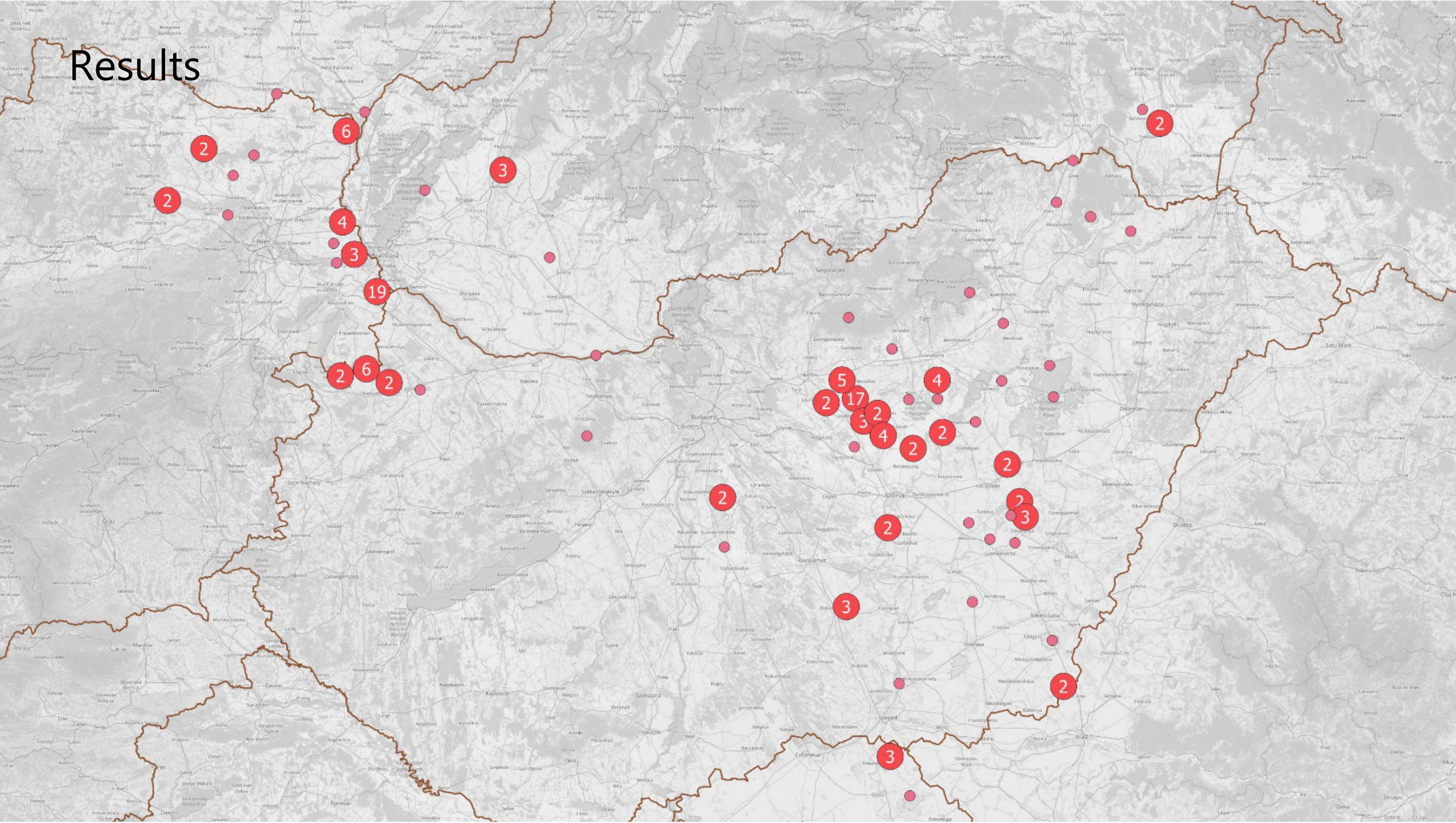
➔ **weighted mean UD for all individuals**

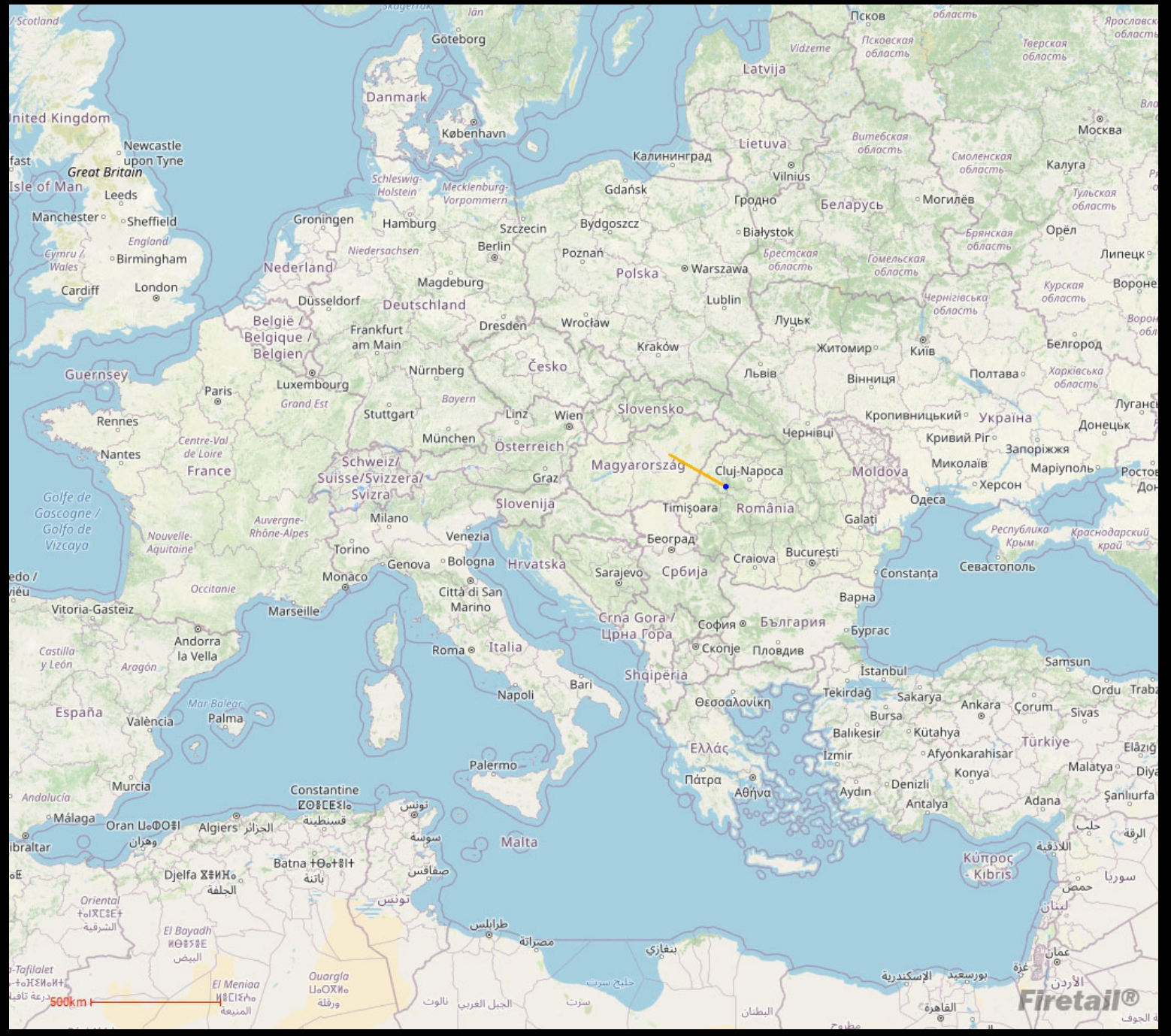
weighted mean by days of dispersal
for the whole population



1.)Kranstauber, B.; Kays, R.; LaPoint, S.D.; Wikelski, M.; Safi, K. A Dynamic Brownian Bridge Movement Model to Estimate Utilization Distributions for Heterogeneous Animal Movement. *Journal of Animal Ecology* **2012**, *81*, 738–746.

Results

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Калуга
Орёл
Липецк
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Київ
Белгород
Полтава
Харків
Вінниця
Львів
Kraków
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Dresden
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Malatya
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Краснодарский край
Ростов
Луганськ
Донецьк
Україна
Oran
Algiers
Djelfa
Batna
Constantine
Málaga
Gibraltar
Murcia
Andalucía
Castilla y León
Aragón
Occitanie
Nouvelle-Aquitaine
Auvergne-Rhône-Alpes
Centre-Val de Loire
Grand Est
Bayern
Niedersachsen
Schleswig-Holstein
Mecklenburg-Vorpommern
Golfe de Gascogne / Golfo de Vizcaya
Oriental
El Bayadh
El Meniaa
Ouargla
Tafilalet
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حلب
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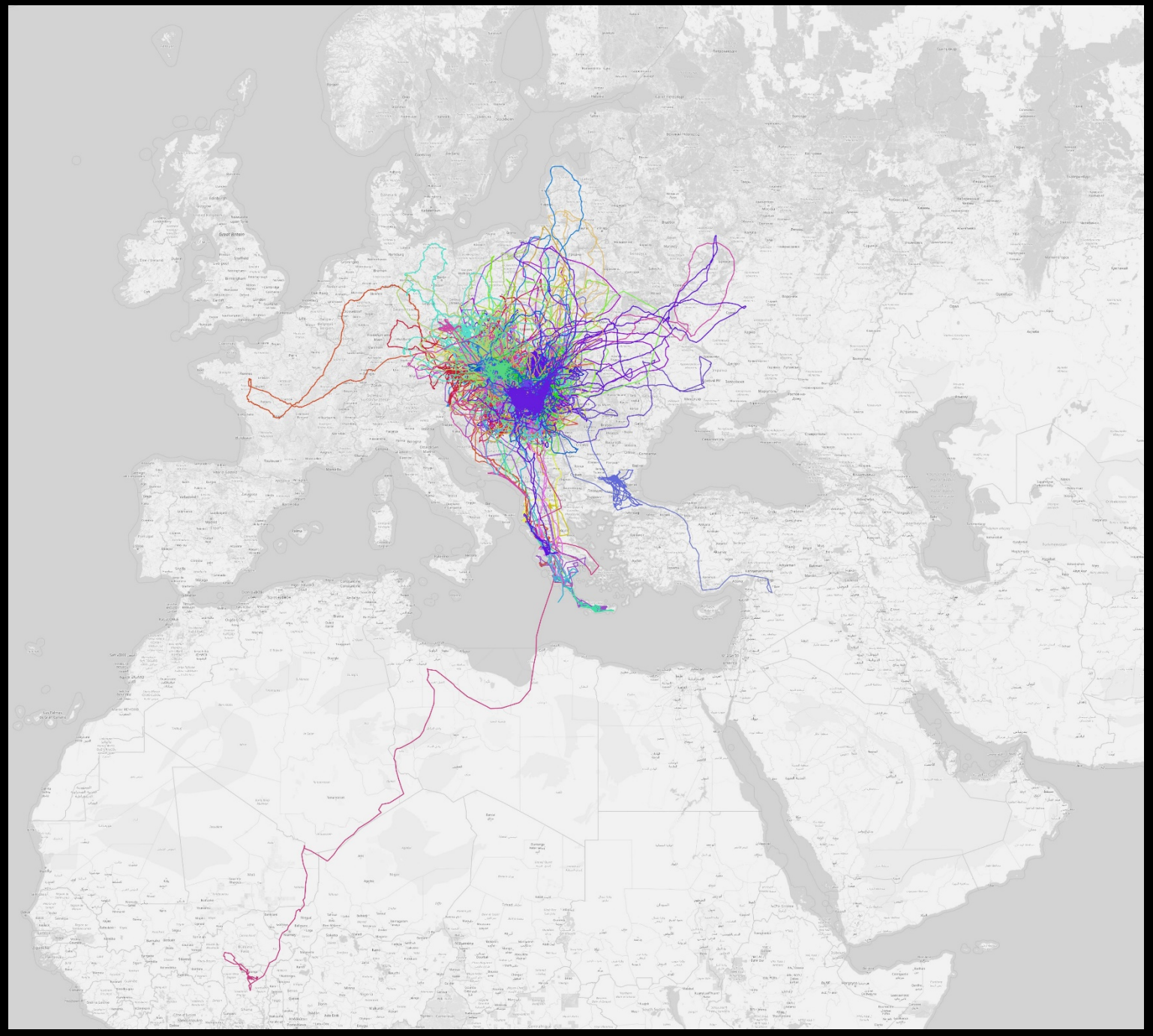
سوريا
حمص
لبنان
اللاذقية
عمان
غزة
الأردن
الإسكندرية
بورسعيد
القاهرة
500km
Firetail®



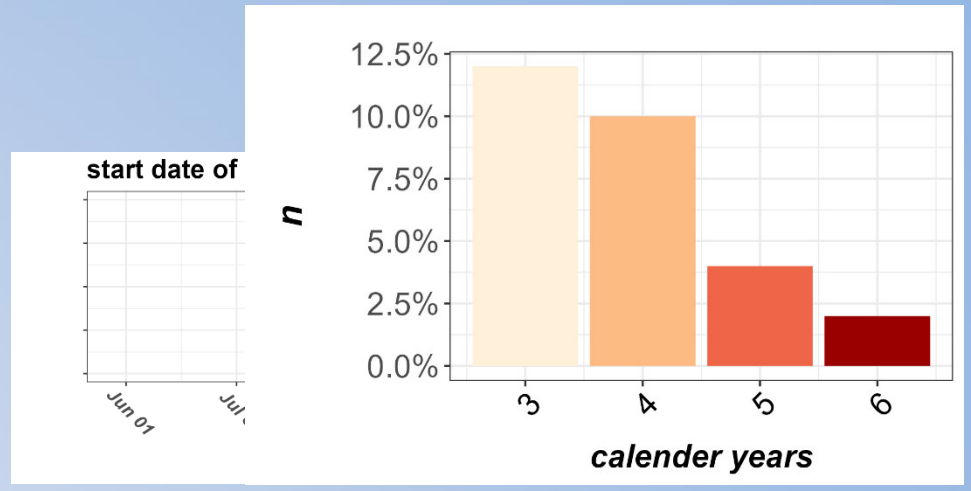
Results

Start of Dispersal

median date 25. Sept

min date 6. August

max date 27.Dec

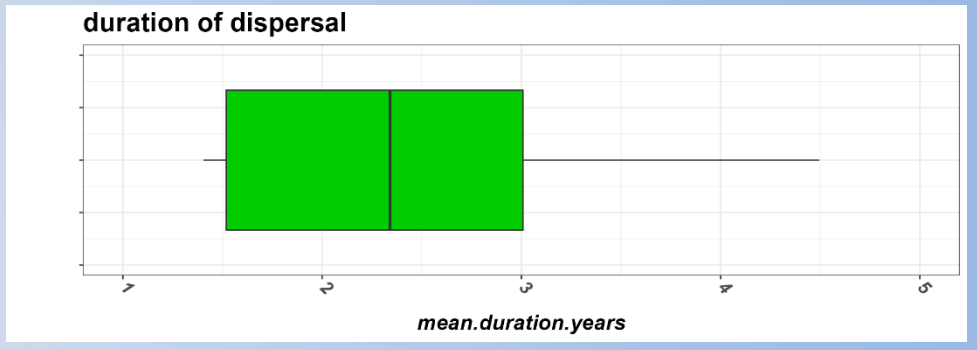


Duration of Dispersal

mean 2.37 years

min 1.4 years

max 4.5 years



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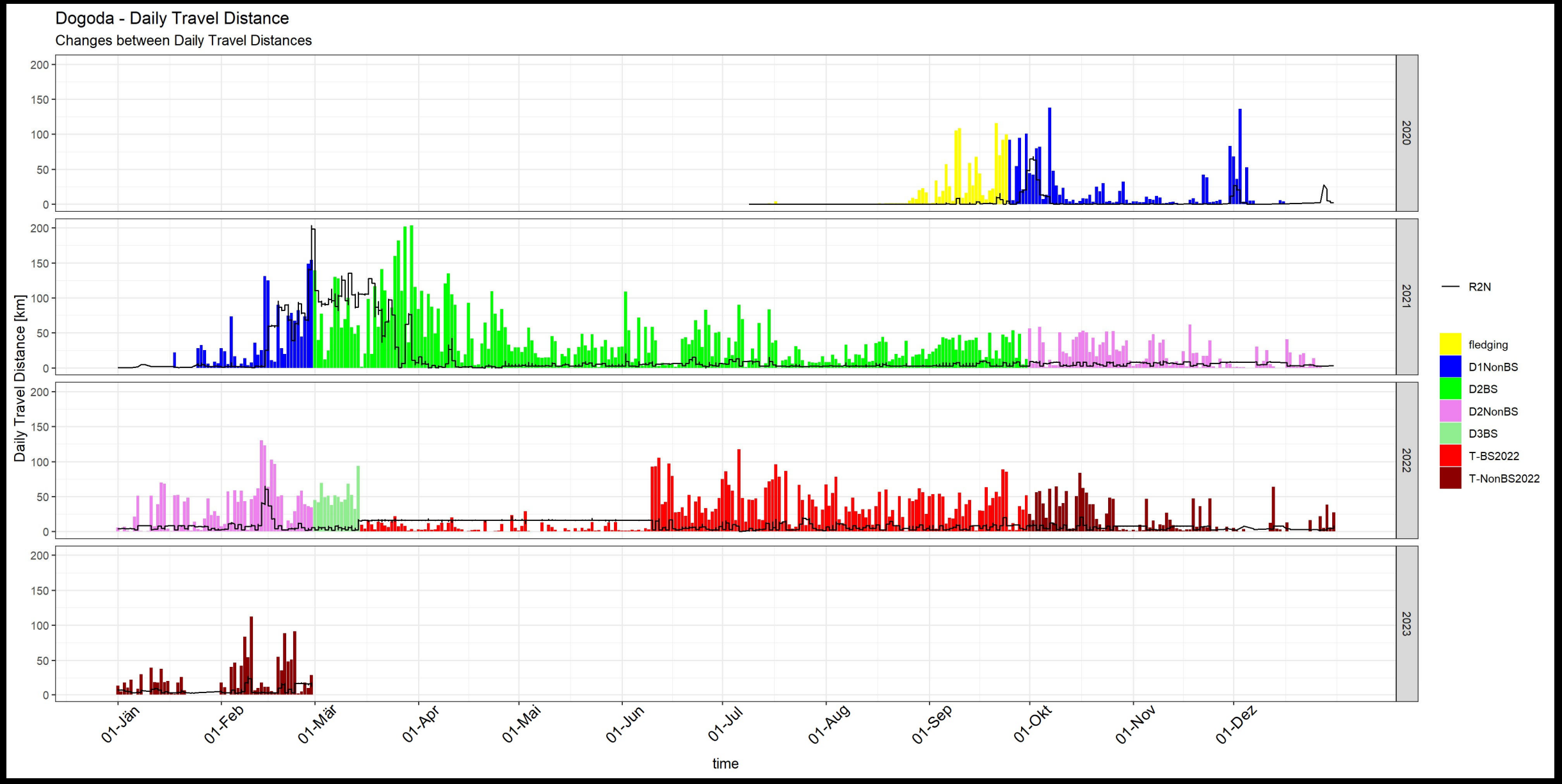
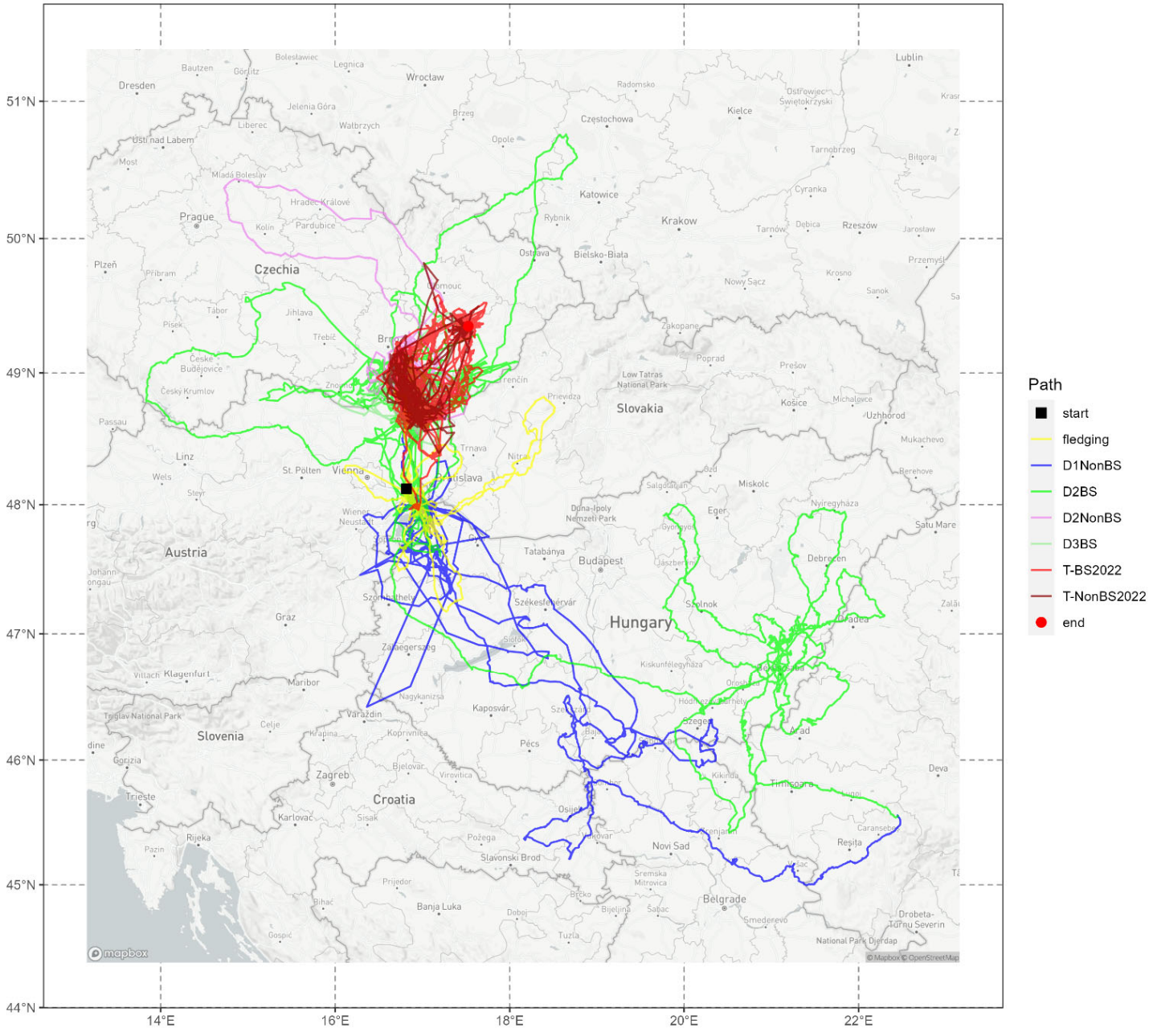
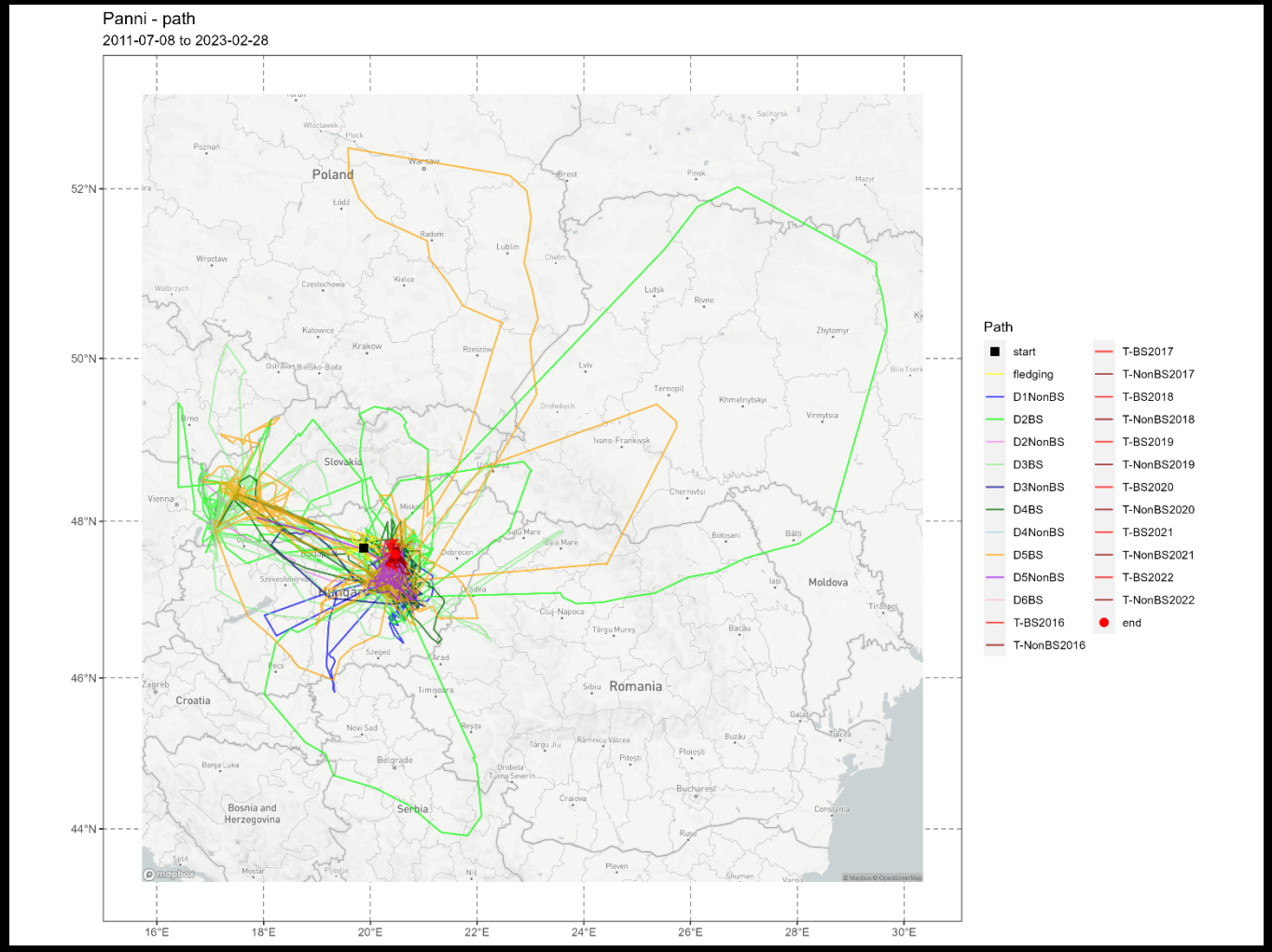
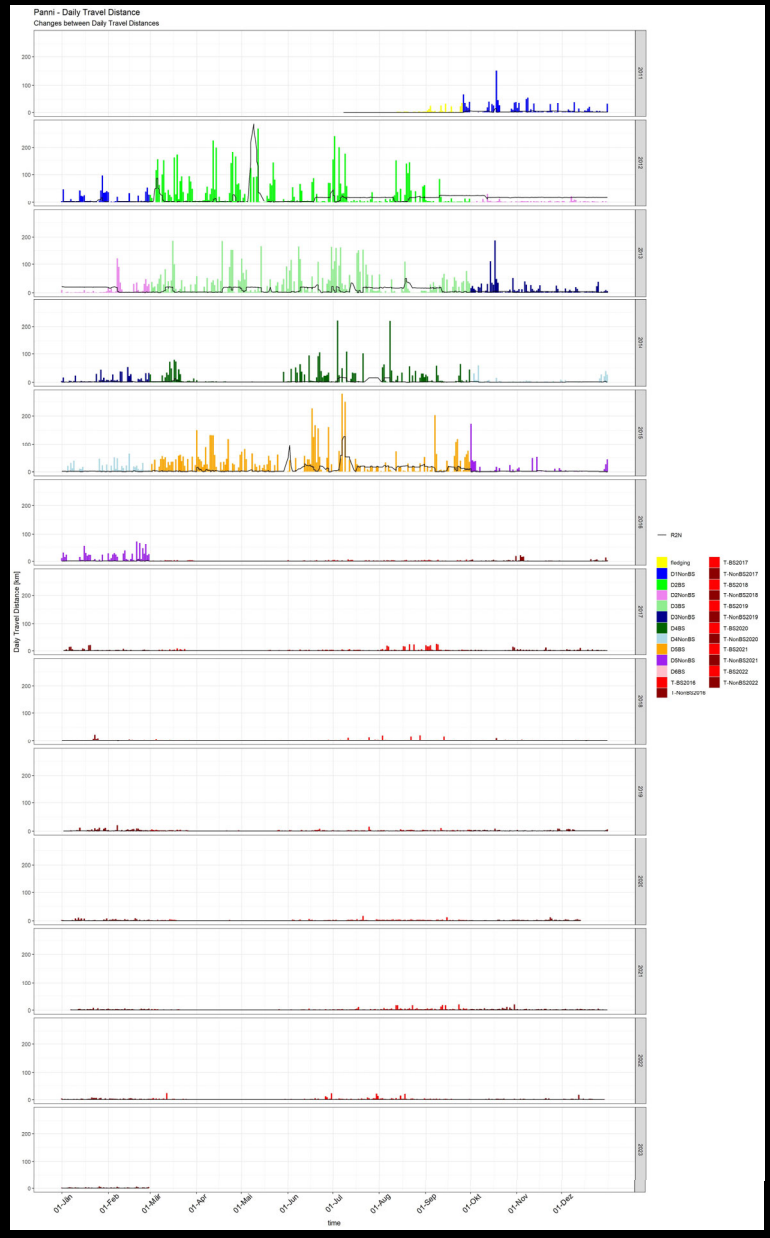

Dogoda - Daily Travel Distance
Changes between Daily Travel Distances
Daily Travel Distance [km]
200
150
100
50
0
2020
2021
2022
2023
01-Jän
01-Feb
01-Mär
01-Apr
01-Mai
01-Jun
01-Jul
01-Aug
01-Sep
01-Okt
01-Nov
01-Dez
time
R2N
fledging
D1NonBS
D2BS
D2NonBS
D3BS
T-BS2022
T-NonBS2022

Dogoda - path

2020-07-08 to 2023-02-28




Panni - path
2011-07-08 to 2023-02-28
Poland
Slovakia
Hungary
Moldova
Romania
Croatia
Bosnia and Herzegovina
Serbia
52°N
50°N
48°N
46°N
44°N
16°E
18°E
20°E
22°E
24°E
26°E
28°E
30°E
Path
start
fledging
D1NonBS
D2BS
D2NonBS
D3BS
D3NonBS
D4BS
D4NonBS
D5BS
D5NonBS
D6BS
T-BS2016
T-NonBS2016
T-BS2017
T-NonBS2017
T-BS2018
T-NonBS2018
T-BS2019
T-NonBS2019
T-BS2020
T-NonBS2020
T-BS2021
T-NonBS2021
T-BS2022
T-NonBS2022
end


Panni - Daily Travel Distance
Changes between Daily Travel Distances
Daily Travel Distance [km]
time
01-Jan
01-Feb
01-Mär
01-Apr
01-Mai
01-Jun
01-Jul
01-Aug
01-Sep
01-Okt
01-Nov
01-Dez

Results

Daily Travel Range

high daily variation

up to 500 km per day

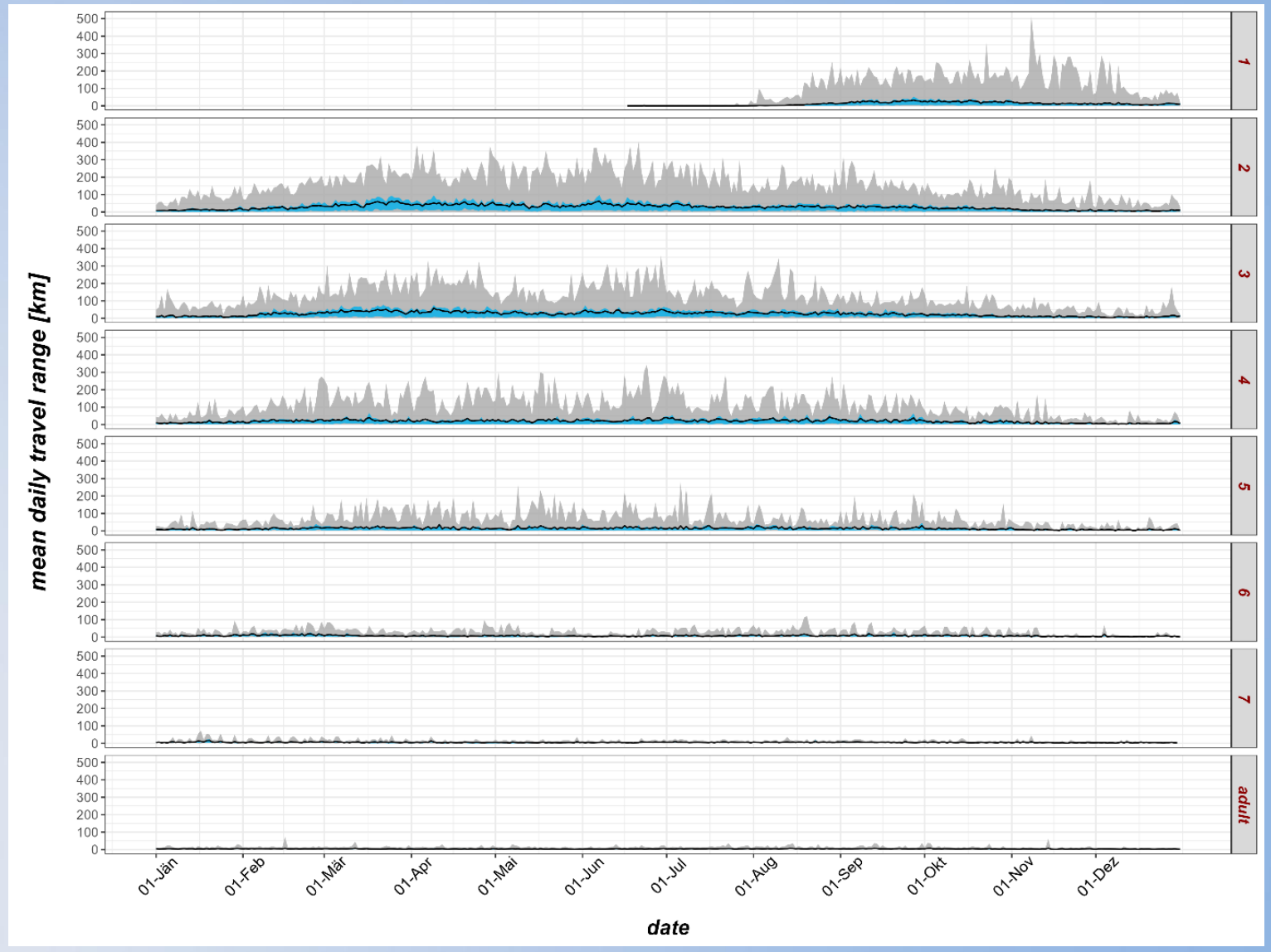
annual phenology

start of BS highest

decrease over season

winter lowest dtr

decrease of dtr with age of birds



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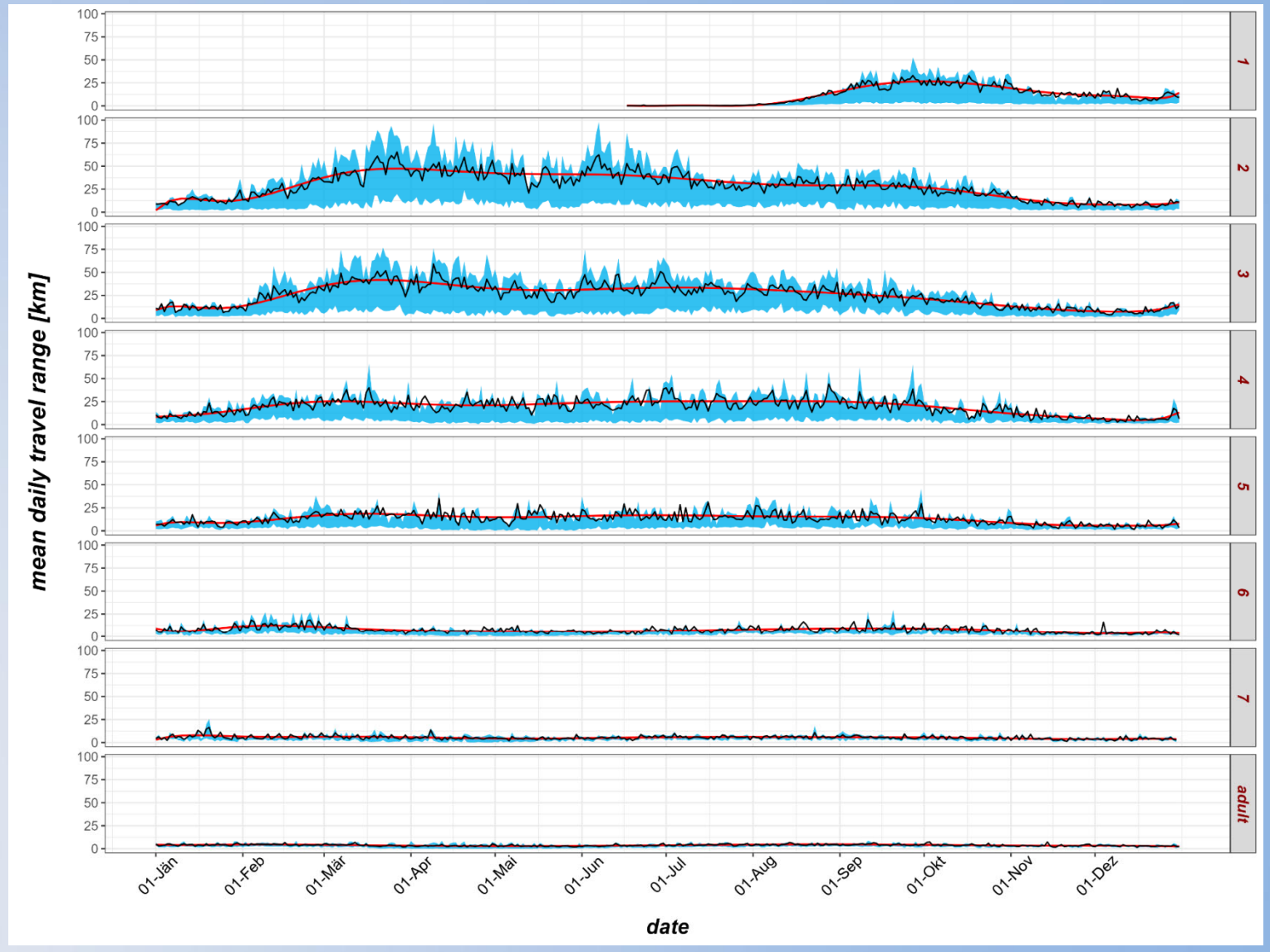

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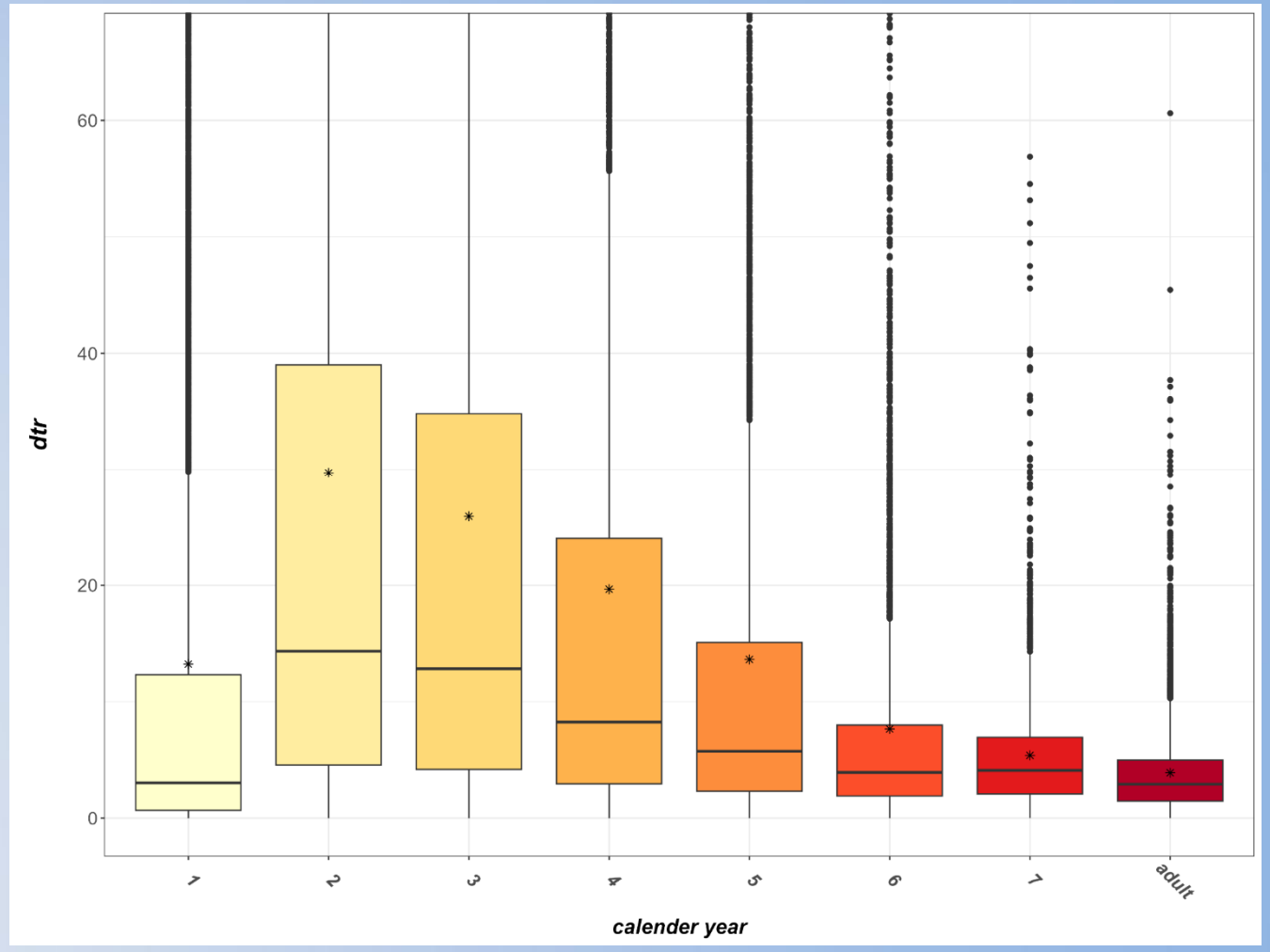
Results

Daily Travel Range per Age

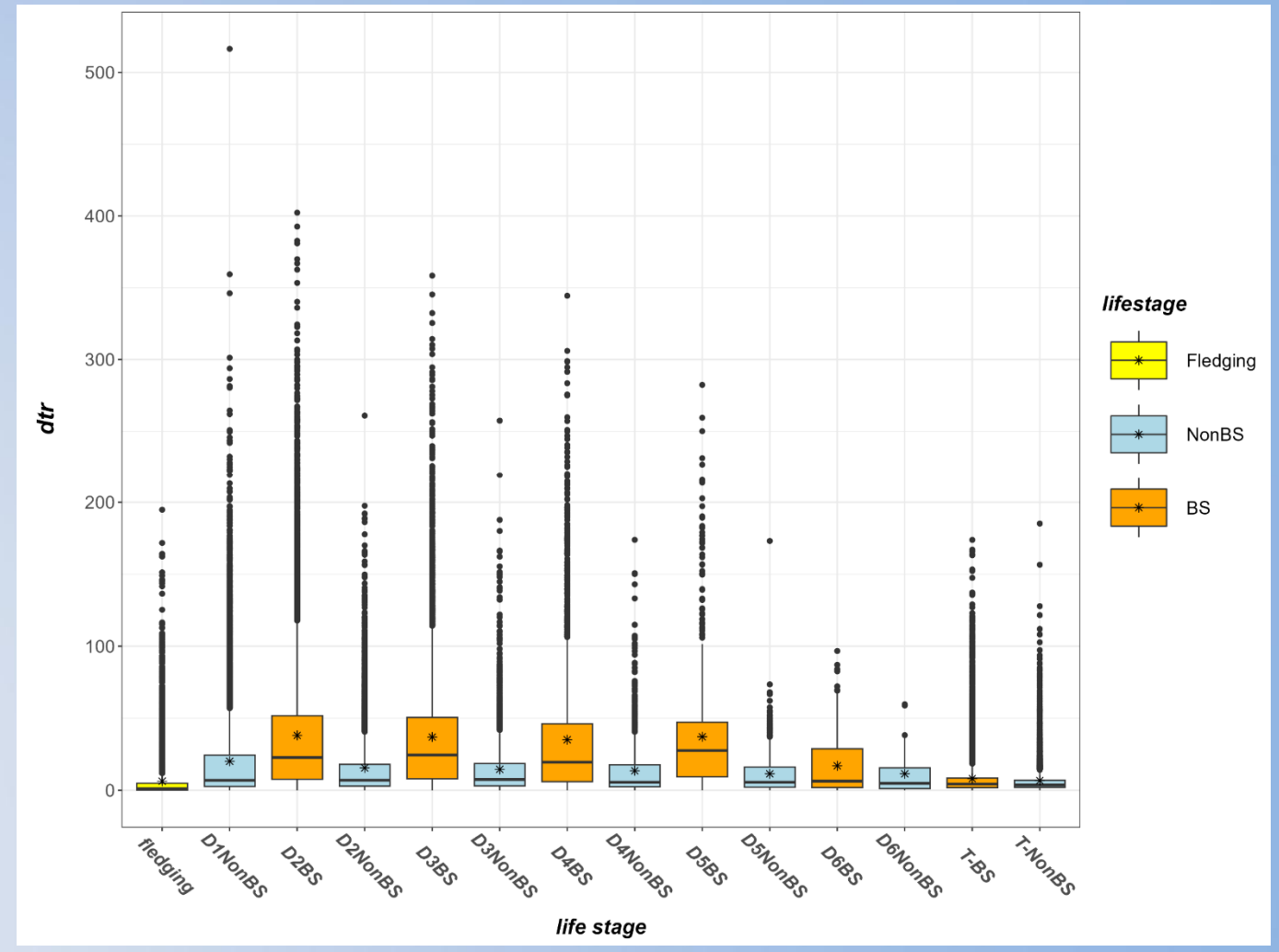
cy	mean.dtr	median.dtr	Q25	Q75	max.dtr	var.dtr
1	**13.3**	3.0	0.7	12.3	516	710.8
2	**29.7**	14.3	4.6	39.1	402	1565.6
3	**25.9**	12.8	4.2	34.8	358	1183.3
4	**19.7**	8.3	3.0	24.0	344	957.4
5	**13.6**	5.8	2.3	15.1	282	496.7
6	**7.7**	3.9	1.9	8.0	121	125.7
7	**5.4**	4.1	2.1	6.9	73	31.5
adult	**3.9**	2.9	1.5	5.0	73	16.5



Results

Daily Travel Range per Life Stage

life.stage	mean.dtr	Median dtr	Q25	Q75	max.dtr	var.dtr
fledging	6.3	**1.1**	0.2	4.9	194.8	210.8
D1NonBS	20.3	**7.0**	2.7	24.5	516.4	998.6
D2BS	38.2	**22.8**	7.7	51.8	402.3	2011.1
D2NonBS	15.6	**7.0**	2.9	18.0	260.9	488.7
D3BS	37.0	**24.5**	8.0	50.5	358.4	1708.2
D3NonBS	14.6	**7.6**	3.1	18.6	257.4	388.9
D4BS	35.1	**19.5**	6.0	46.2	344.4	2006.0
D4NonBS	13.6	**5.7**	2.4	17.7	173.9	365.5
D5BS	37.2	**27.6**	9.4	47.3	282.3	1703.8
D5NonBS	11.5	**5.7**	2.2	16.1	173.1	215.7
D6BS	17.0	**6.3**	2.0	28.8	96.7	382.7
D6NonBS	11.5	**4.9**	1.2	15.6	59.8	217.8
T-BS	8.1	**4.3**	1.9	8.6	173.8	168.5
T-NonBS	6.8	**3.7**	2.0	6.9	185.2	104.7



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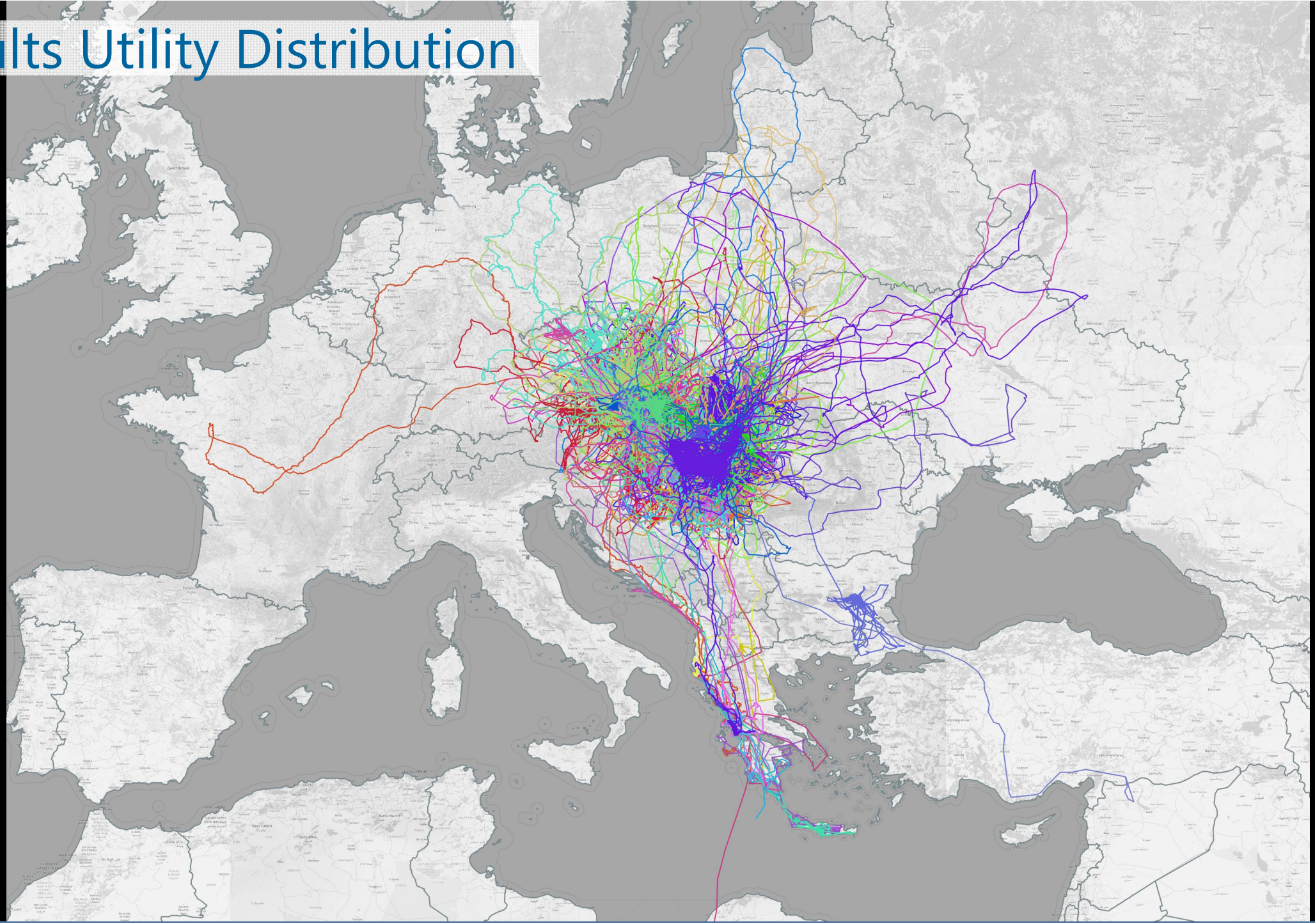
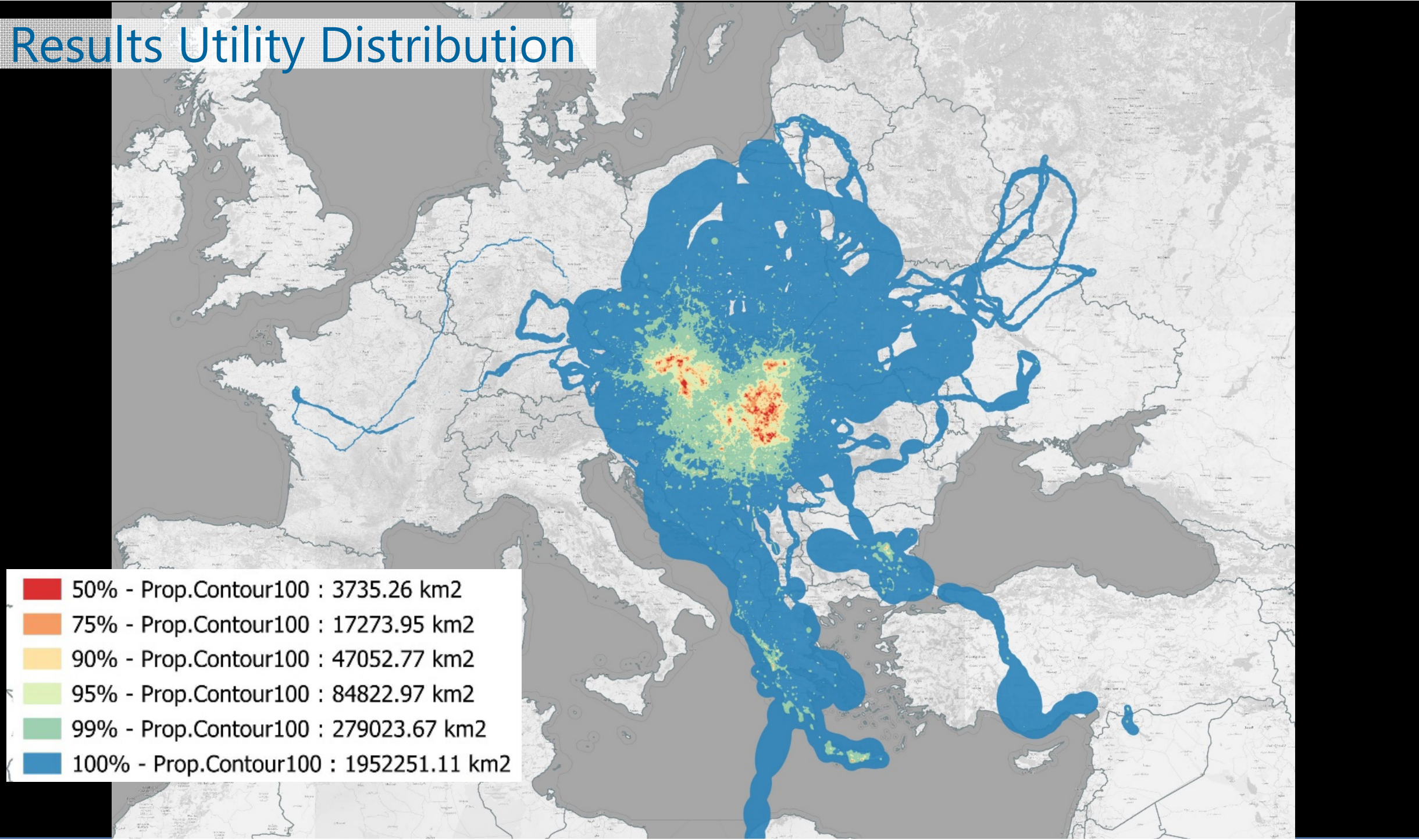
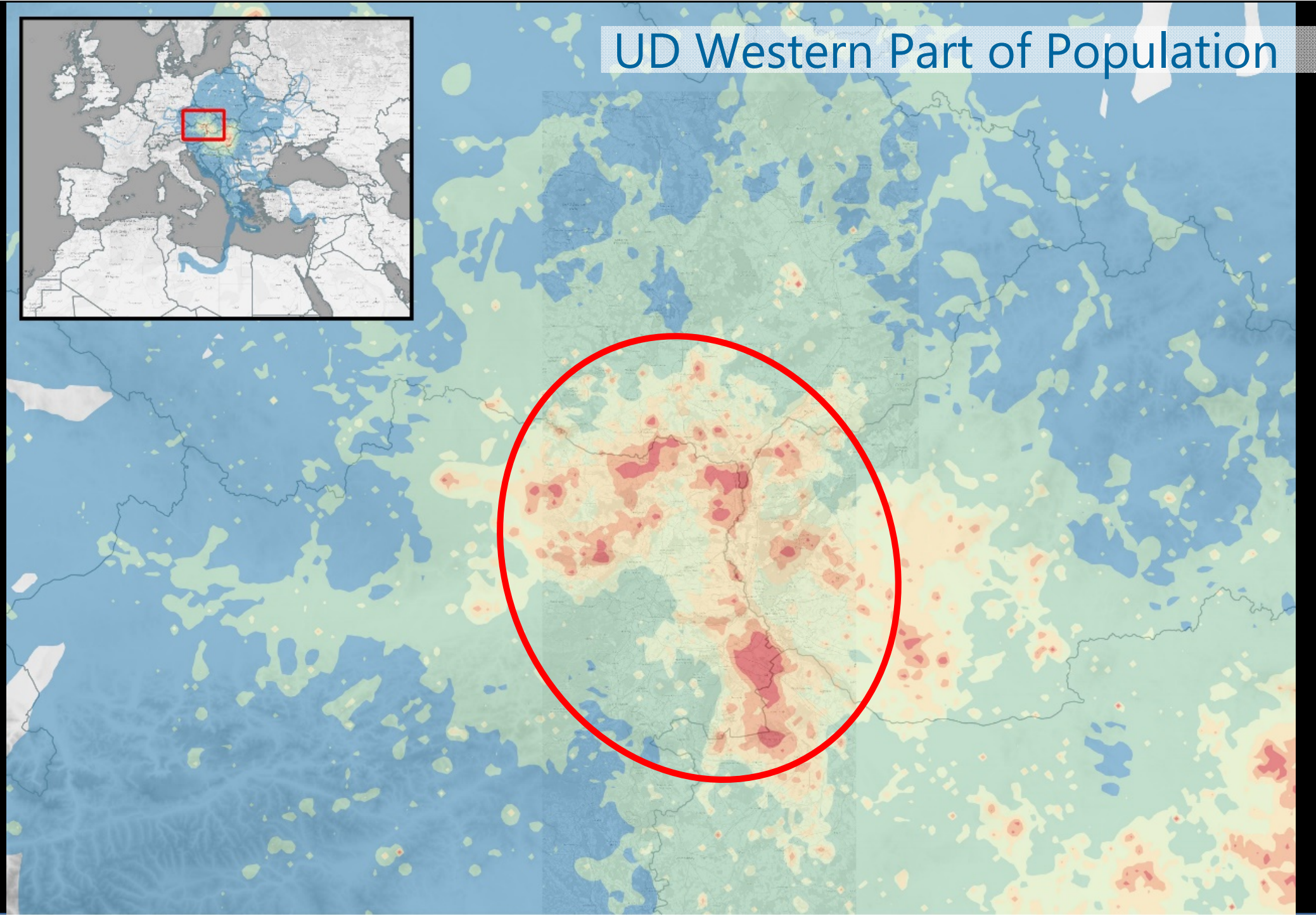
Results Utility Distribution



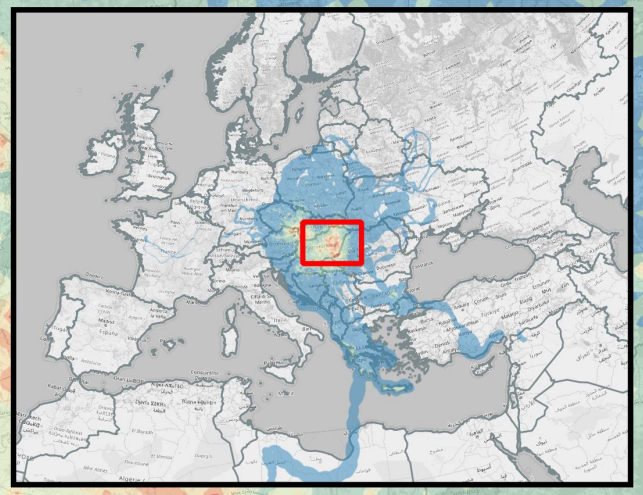
Results Utility Distribution



UD Western Part of Population



UD Eastern Part of Population



Conclusions

- high variation in start and end of dispersal
- high variation in daily travel range
- annual phenological pattern in daily movement range (dtr) during dispersal
- daily movement range (dtr) decrease with age of birds
- dispersal flights covers large parts of Central Europe
- highest density within the breeding range and close to the core areas
- Identification/confirmation of hotspot for conservation (eg. wind farm development)
- connectivity to Southeast Europe (partial migration?)
- single explorative flights far away from breeding area/Central Europe
- no/limited connectivity to Macedonian Population
- low connectivity to populations in the East

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Contact
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