# Habitat preference of golden jackal (*Canis aureus*) in Serbia

Neda Bogdanović, Aleksandra Penezić, Duško Ćirović

3rd International Jackal Symposium
Gödöllő, Hungary

University of Belgrade
Faculty of Biology

# Golden jackal and its distribution

- LC (IUCN)

- degradation and fragmentation of natural habitats due to rapid human expansion
- low permeabilty of human-modified landscapes

- strong expansion across entire Europe
- highly adaptive to human-modified habitats

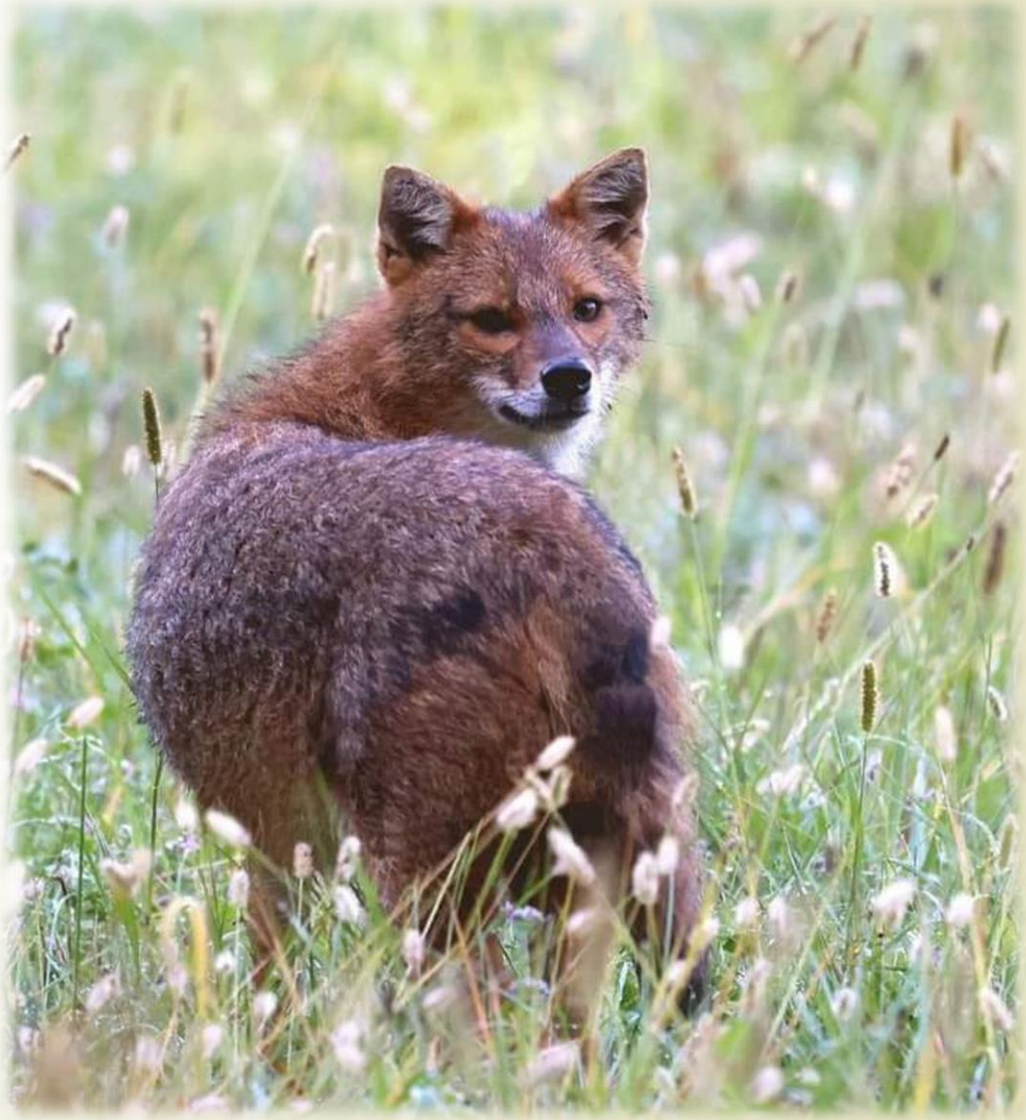
- Hypothesis

availability of anthropogenic food

absence of wolf

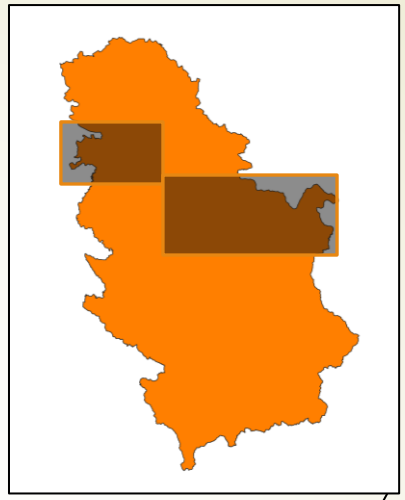
climate changes

intensive modification of natural habitats



# Jackal distribution in Serbia

- 80th jackals began to recolonize its former range (expansion)
- high number of jackal observations from mountainous area
- game species
- evidence – large number of hunted individuals (~12,000 last year)
- current population estimate in Serbia is 30-40,000 individuals



- Negotin, Morava valley, Danube valley and Srem most populated areas (based on hunting data)

# Telemetry of golden jackals in Serbia

- highly reliable data in a relatively short time
- GPS telemetry data widely used in studies of animal space use, habitat selection and behavior

- jackals monitored since 2017
- belisle foot-hold snares
- chemically immobilized (Ketaxyl)

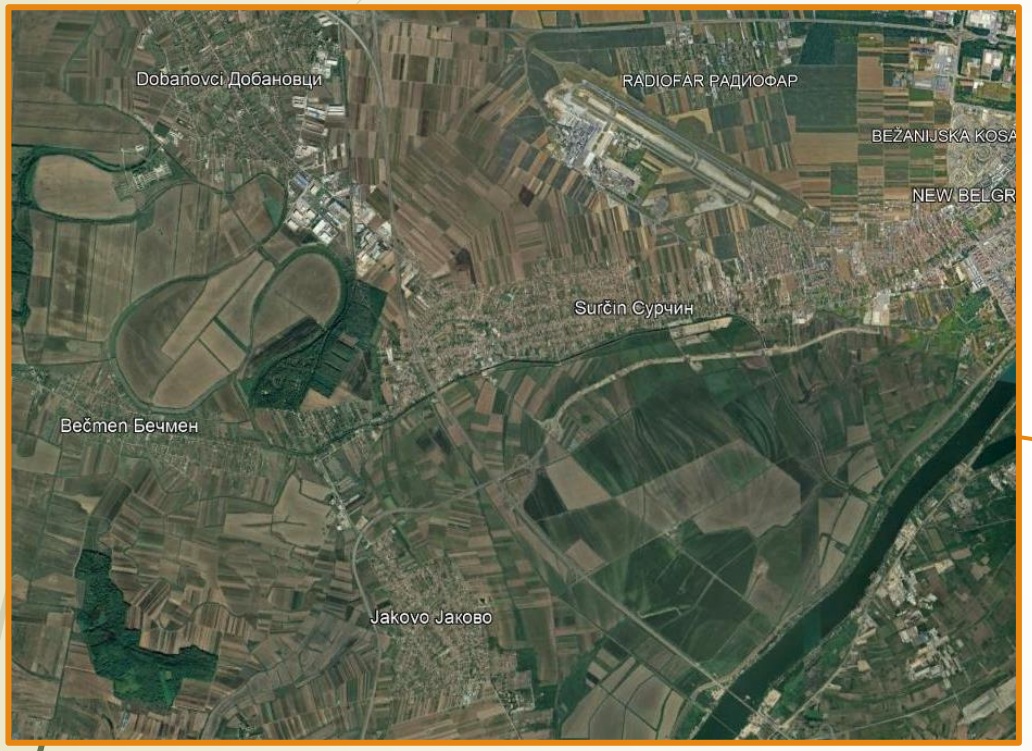
# Telemetry of golden jackals in Serbia

- GPS Plus; Vectronic Aerospace GmbH, Berlin, Germany
- timer-controlled drop-off system
- jackals released at the trap site
- GPS collars scheduled to record a location every 3 hour (8 positions/day).
- GPS relocation success rate > 90%
- 16 individuals collared (9 males and 7 females)
- mean monitoring period – 206 days

Zoka

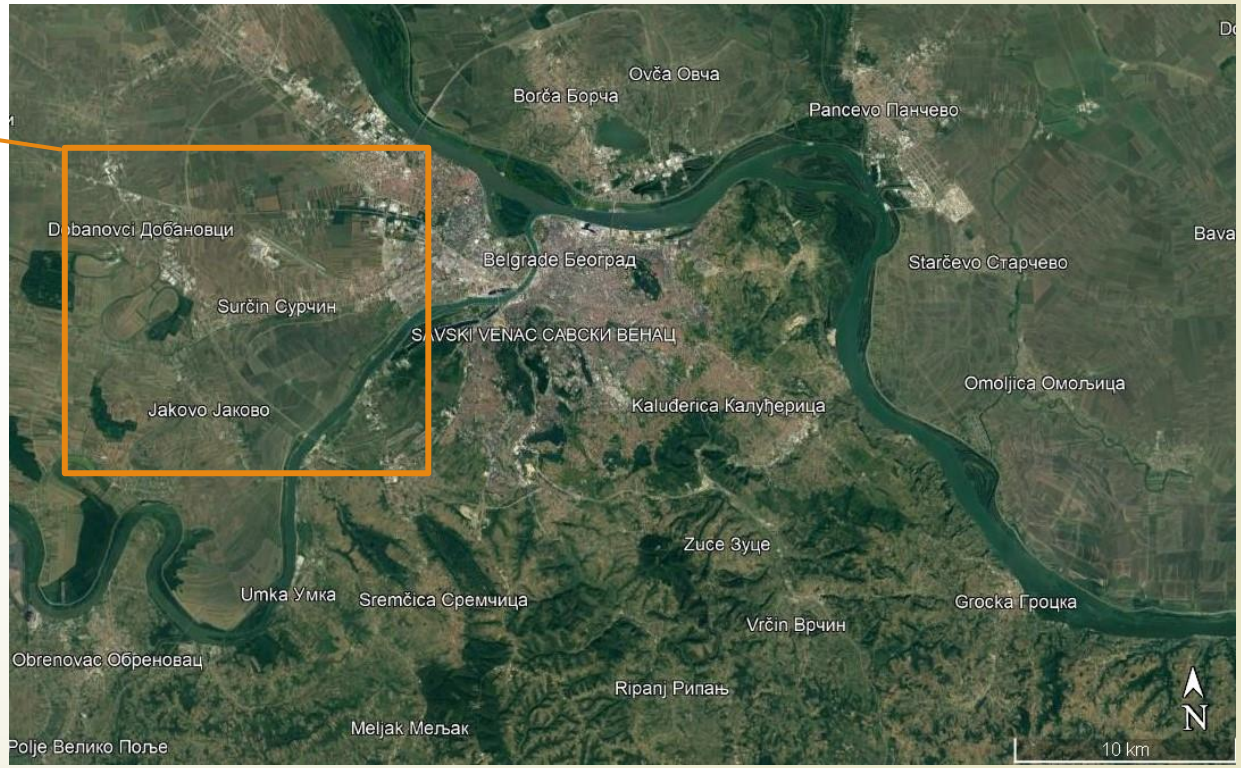
Neda

# Telemetry of golden jackals in Serbia

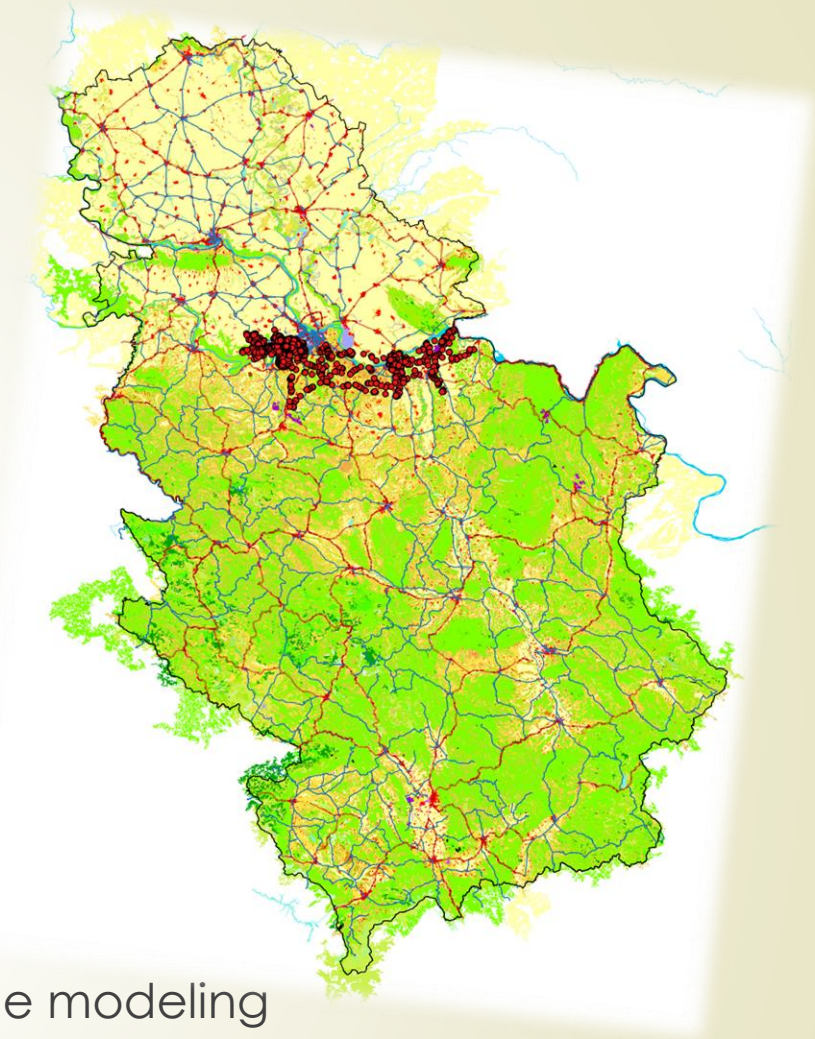



- future plans: to collar jackals in other habitats types
- change collar fixation period (2 or 1h)

- jackals captured in suburban habitats
- close vicinity of Belgrade - Surčin, Jakovo, Boljevci
- landscape mainly under agriculture (85%)
- highway, national and local roads, irrigation channels



# Species distribution modeling (SDM)



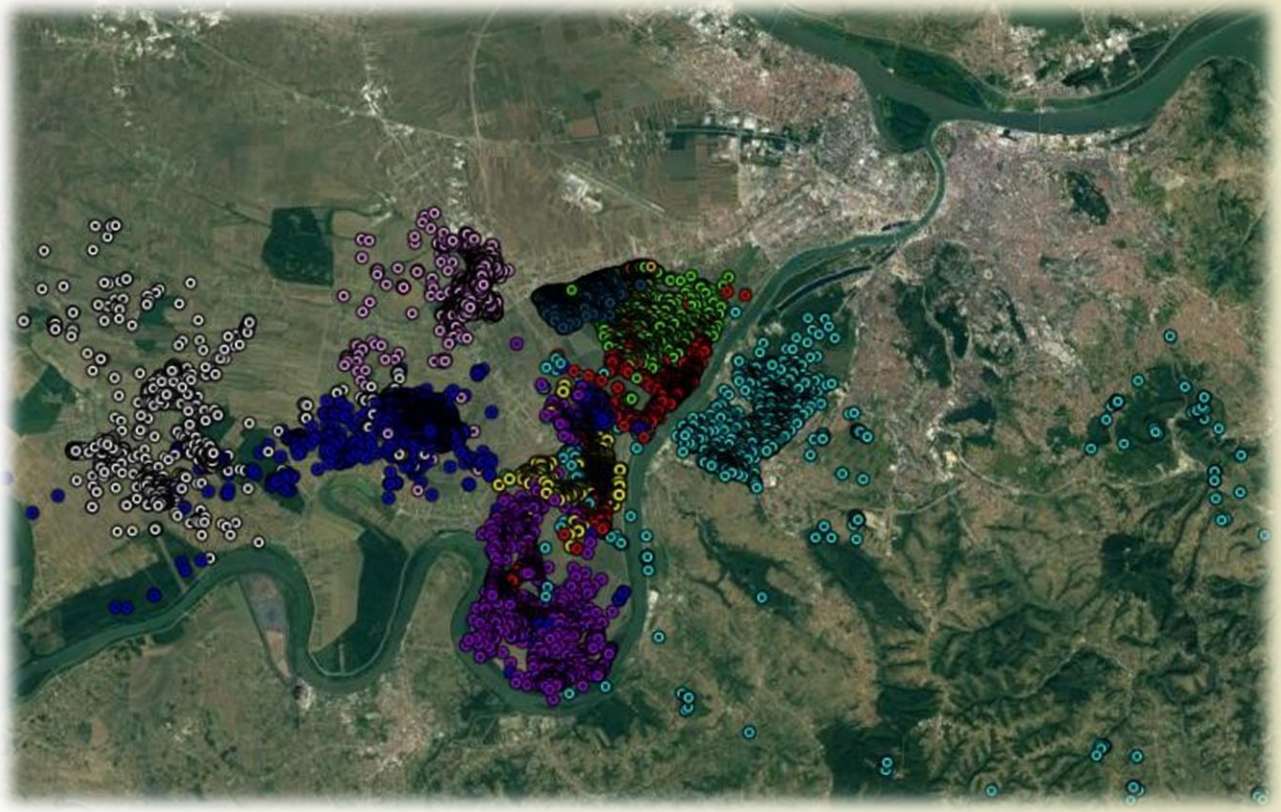
- low permeability of human-transformed landscapes
- species able to adapt to the human-created environmental condition
- to associate known distribution data of species with environmental variables
- understand the relationships between wildlife and environment
- Maxent most frequently used software for ecological niche modeling

  animal populations with unforeseen densities and distributions

- unique opportunity to plan our managements activities

# Species distribution modeling - aims

- habitat suitability models with a maximum entropy approach (MaxEnt) to analyze jackals habitat selection patterns
- two different spatial scales (5x5 km and 1x1 km)
- GPS telemetry data
- 23,425 fixations of 16 individuals



- We aimed to:

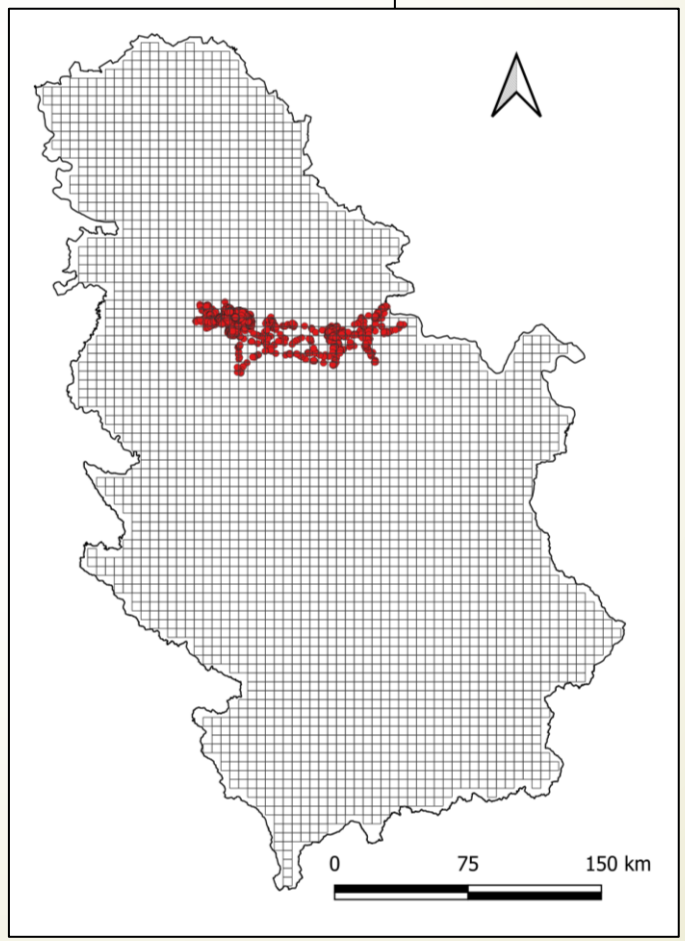
identify environmental variables which drive jackal habitat selection

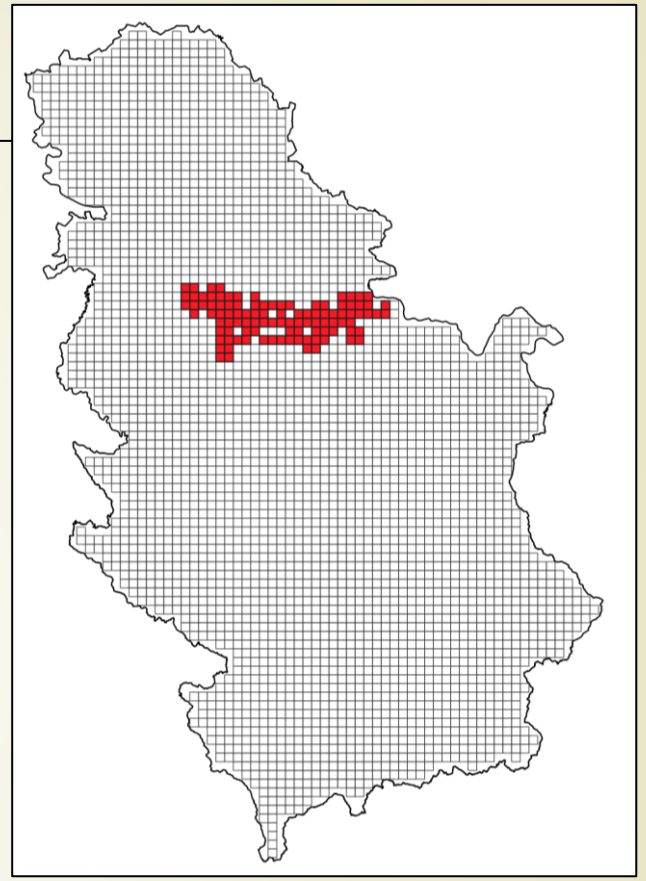
define most suitable jackal habitats in Serbia based on GPS telemetry data

discuss jackal rapid expansion in Serbia based on obtained results

# Species distribution modeling - data

- Animal next step depends on its current step
- Telemetry data - temporal autocorrelation ?
- For each scale, we select cells with at least one GPS fixation
- Calculated center coordinates (input data for the model)



# Species distribution modeling – validation

- 11 environmental variables related to land cover and human infrastructure
- Pearson correlation coefficients (> 0.7) and high variance inflation factor (VIF's >5)
- 10 uncorrelated variables

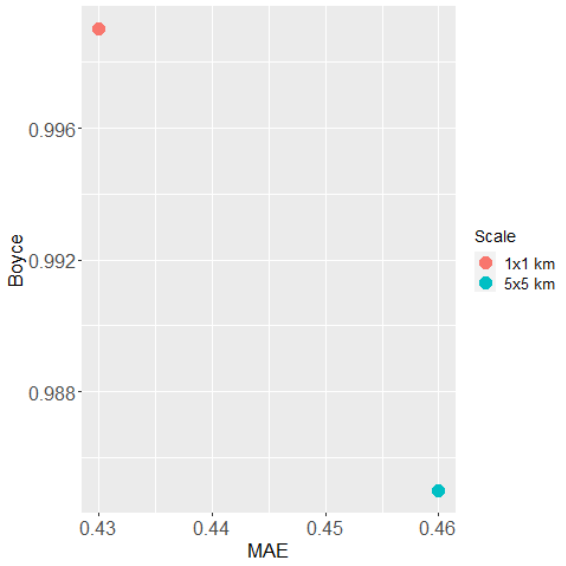
| Layer name | Layer description | Source | Format |
|---|---|---|---|
| Roads 1 | Distance from centroids to highways | GEOFABRIK | Vector |
| Roads 2 | Distance from centroids to local roads | GEOFABRIK | Vector |
| Roads 3 | Distance from centroids to footpaths and mountain roads | GEOFABRIK | Vector |
| Water | Distance from centroids to rivers and streams | GEOFABRIK | Vector |
| Urban | Distance from centroids to infrastructure | CORINE Land Cover | Vector |
| Hum.pop. | Human population density | Republic Geodetic Authority | Vector |
| Forest* | % of forests per grid | CORINE Land Cover | Vector |
| Pasture | % of pastures per grid | CORINE Land Cover | Vector |
| Scrub | % of scrubs per grid | CORINE Land Cover | Vector |
| Infrastructure | % of infrastructure per grid | CORINE Land Cover | Vector |
| Agroland | % of agriculture per grid | CORINE Land Cover | Vector |

- candidate models - Akaike's Information Criterion
- for evaluating model performance:

  Boyce index (-1 to 1)

  Mean Absolute Error (MAE)

# Species distribution modeling - results



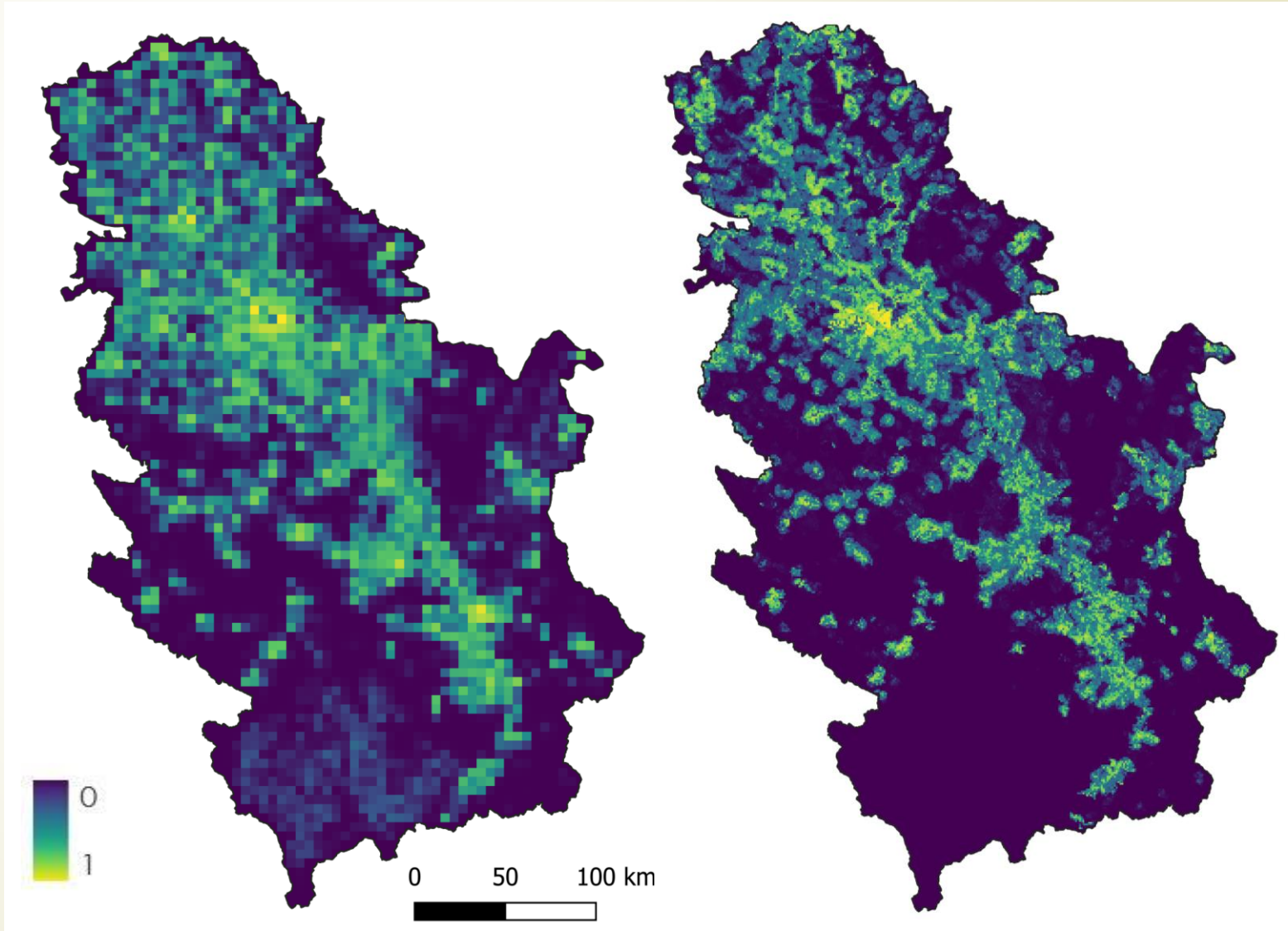

- Most important variable at both scales
- Human related variables
- Negligible contribution of agriculture ?

- The jackknife procedure and the heuristic method (MaxEnt) used to assess the relative importance of the environmental variables

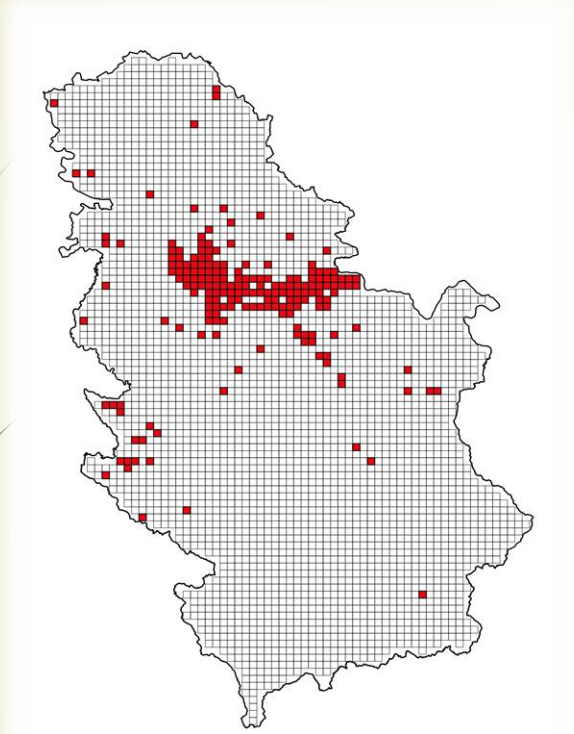
| Variable | Scale | |
|---|---|---|
| | 5x5 km | 1x1 km |
| Human population density | 51.8 | 59.8 |
| Distance to urban areas | 18.2 | 17.9 |
| Distance to primary roads | 1.8 | 6.6 |
| Distance to water bodies | 2.2 | 2.8 |
| Distance to secondary roads | 1.9 | 4 |
| % Scrubs | 0.5 | 2.8 |
| Distance to terciary roads | 1.2 | 2.5 |
| % Infrastructure | 18.6 | 1.3 |
| % Pastures | 0 | 0.8 |
| % Agricultural land | 3.6 | 1.3 |

# Species distribution modeling - results

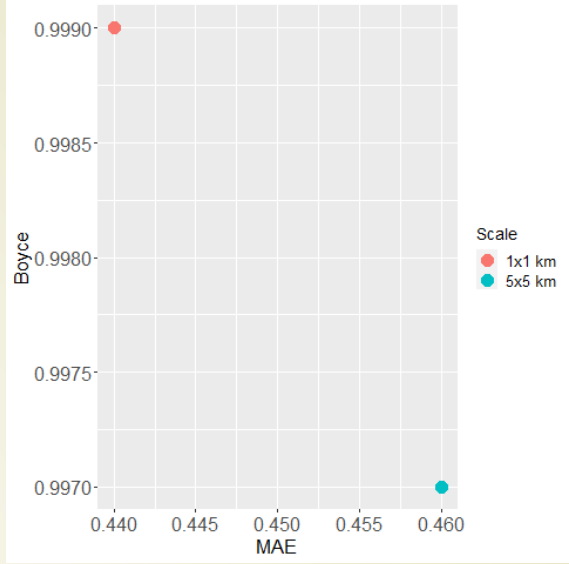
- Threshold- mean predicted suitability value for grids with jackals presence
- 0.54 (5x5 scale) and 0.57 (1x1 scale)
- Coarse scale ~ 12,000 km$^2$ as highly suitable habitat
- Fine scale ~ 3000 km$^2$ as highly suitable habitat



# Species distribution modeling - results



- GPS + jackal occurrence data
- two scales (5x5 and 1x1 km)
- same set of 10 variables used

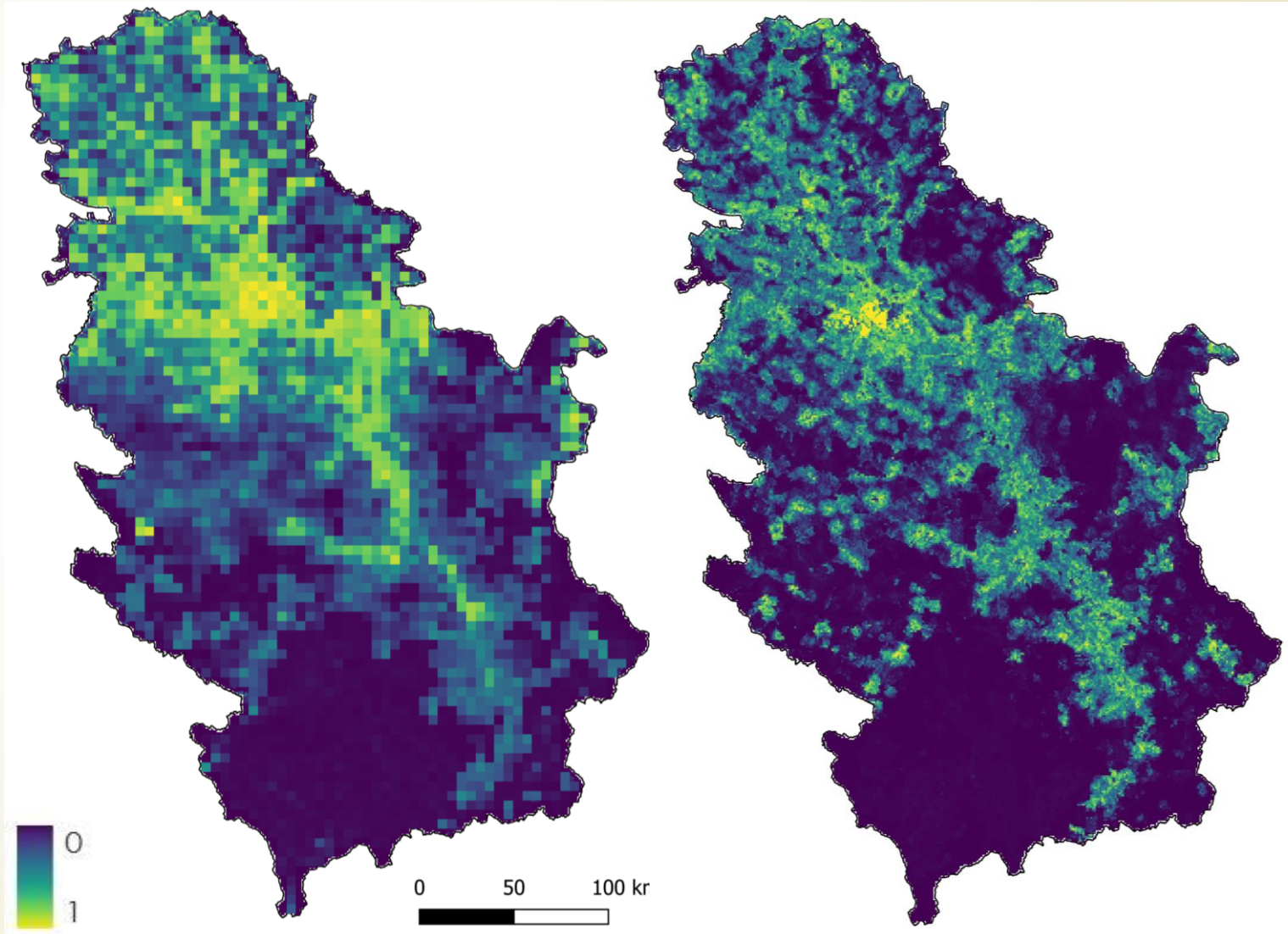



| Variable | Scale | |
|---|---|---|
| | 5x5 km | 1x1 km |
| Human population density | 68.4 | 66.3 |
| Distance to urban areas | 12.8 | 12.8 |
| Distance to primary roads | 1.8 | 5.7 |
| Distance to water bodies | 0.1 | 3.4 |
| Distance to secondary roads | 0.7 | 3.3 |
| % Scrubs | 1.6 | 2.6 |
| Distance to terciary roads | 2.2 | 2.1 |
| % Infrastructure | 12.3 | 1.9 |
| % Pastures | 0 | 0.9 |
| % Agricultural land | 0 | 0.8 |

- still most important variable at both scales
- contribution of agriculture even smaller ?

# Species distribution modeling – results

- Threshold- mean predicted suitability value for grids with jackals presence
- 0.54 (5x5 scale) and 0.56 (1x1 scale)
- Coarse scale ~ 18,000 km$^2$ as highly suitable habitat
- Fine scale ~ 5000 km$^2$ as highly suitable habitat



# Conclusions and next steps

- It is still necessary to improve our models
- collect more data:

telemetry data – collar more jackals

occurrence data (hunting data, camera traps data, etc.)

- collect data from different habitat types (especially data from hilly and forseted areas)
- include more variables (topography, road permeability, distance to artificial channels...)
- to mark areas where anthropogenic food sources are often illegally dumped (primarlily slaughter waste)

# Thank you for your attention!

If you have any questions or suggestion related to our research, we are welcome to hear it 😀

Our emails:
neda.bogdanovic@bio.bg.ac.rs
aleksandra.penezic@bio.bg.ac.rs
dcirovic@bio.bg.ac.rs