Uniwersytet Wrocławski

TOWARZYSTWO HERPETOLOGICZNE NATRIX

JAGIELLONIAN UNIVERSITY IN KRAKÓW

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Microscale habitat preferences and habitat use of *Coronella austriaca* – a geoinformatic approach

INTRODUCTION

Reptiles distribution research based on geoinformatic techniques is still not enough and it is still in the stage of testing the usability of available methods. Models that can predict the distribution of individuals and can predict the changes of distribution are promising. Their significance is constantly growing due to rapid disappearance of the population, habitat fragmentation and climate change.

Based on the digital elevation models, high-resolution orthophotomap, meteorological and population data collected in 2016 in the post-mining area in Opole Voivodeship, Poland, we try to recognize the microscale habitat preferences and the spatial distribution of *Coronella austriaca*. We hope that this study will help to designate (more effectively and more explicitly) protection zones for this species, required by Polish law.

GOALS:

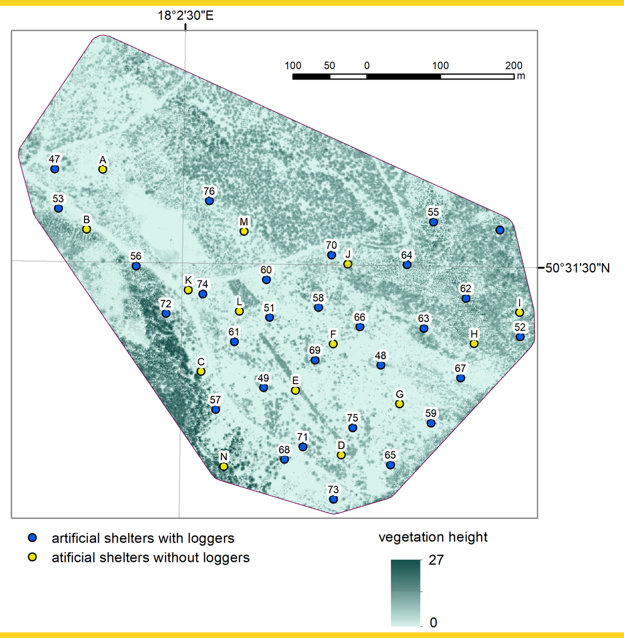
1. To check the impact of microscale environmental variables on the distribution of smooth snake *Coronella austriaca*

2. To recognize the spatial pattern of population and habitat use, depending on age and sex.

GENERAL APPROACH

24 field trips were conducted throughout the season. Before spring, 43 artificial shelters were put relatively evenly in the area. The caught snakes were weighted, measured (Snout-Vent Length – SVL and Tail Length – TL), and the age group (adult, subadult, juvenile) and sex for adults was listed. There also were 28 HOBO loggers put at the ground level that recorded air temperature and relative air humidity.

All spatial analyses were performed in projected coordinate system EPSG: 2180 (PUWG 1992) and the processing range was limited to a 20 m buffer from the convex hull of snakes observation and shelter sites. Some of the analyses concerned a circular neighborhood with a 10 meters radius - the size was chosen based on the nature of the smooth snakes daily movement.



digital elevation models
- Digital Terrain Model (DTM)
- Digital Surface Model (DSM)

focal statistics & map algebra

high-resolution orthophotomap
(< 3,5 cm/px)
based on hundreds of pictures
from UAV (drone)

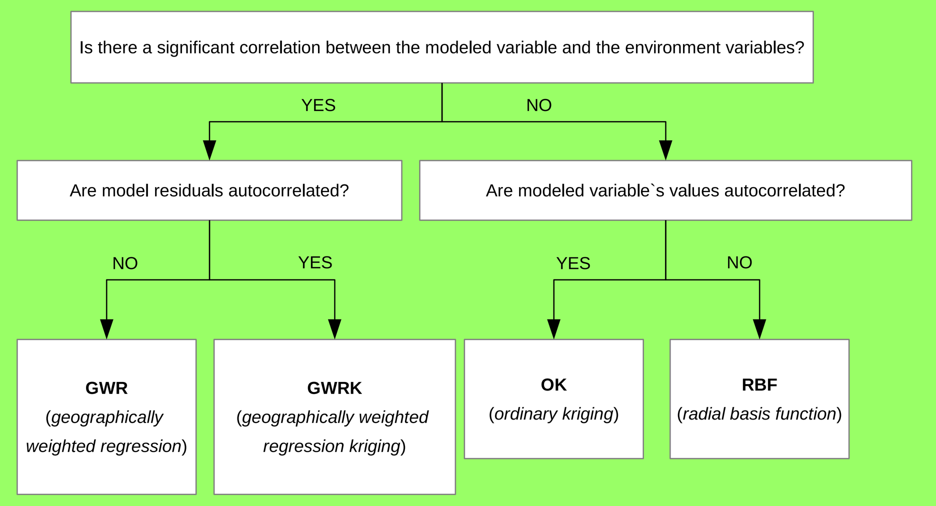
image supervised classification

(Spectral Angle Mapper method)

SPATIAL INTERPOLATION

of air temperature and relative air humidity surfaces

the decision-making scheme of the method selection for each period



The explanatory variables used in the GWR interpolation method were vegetation height or potential insolation layer (from DSM and DTM processing), the selection of variables was based on correlation analysis.

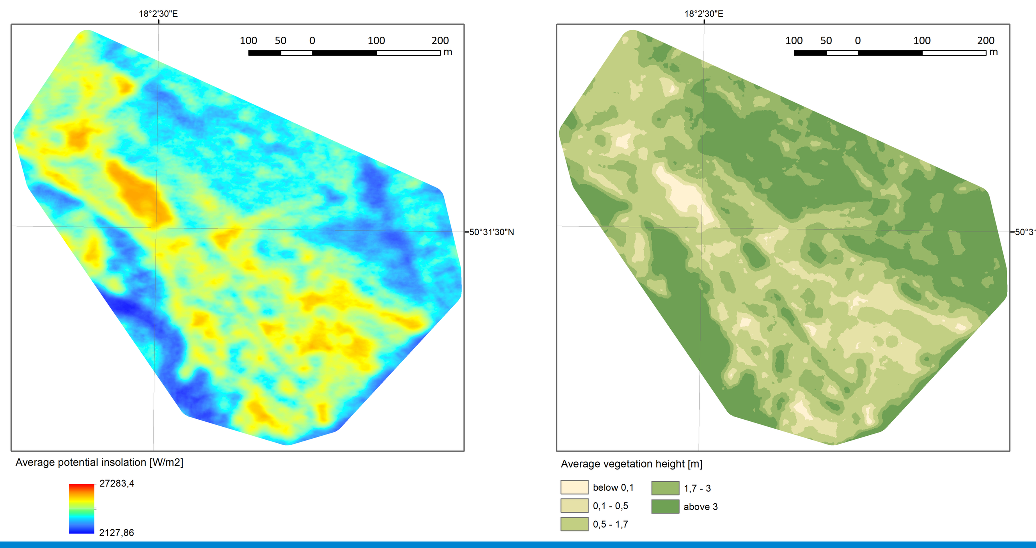
meteorological data
(from data loggers)
2-min logging interval

population data
(SVL, TL, body mass, sex, age)

spatial autocorrelation and spatial distribution analysis

density functions

ENVIRONMENTAL VARIABLES



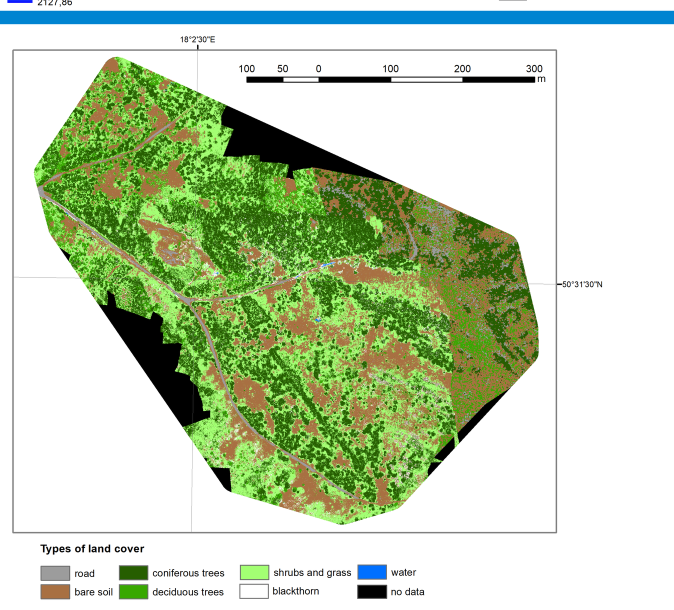
LEFT MAP: The potential insolation layer - calculated using the Area Solar Radiation tool based on the DSM as the total solar energy delivery [Wh/m^2] per each raster cell for the entire field survey period, under clear sky conditions.

RIGHT MAP: Numeric Model of Vegetation Cover (NMVC) - the differential layer between DSM and DTM.

Averaging filter in circular environment of 10 meters radius (focal statistics) was used. The focal statistics algorithm visits each cell in the raster and calculates the specified statistic with the identified neighborhood.

The places where young snakes hid were on average 84% warmer than the places where adults specimen were found.

The average vegetation surrounding the places occupied by juvenile snakes was about half that of the places occupied by adults.



The study area is a mosaic of different types of land cover patches. Based on this map, the percentages of each type were counted in a buffer of 10 meters from each artificial shelter.

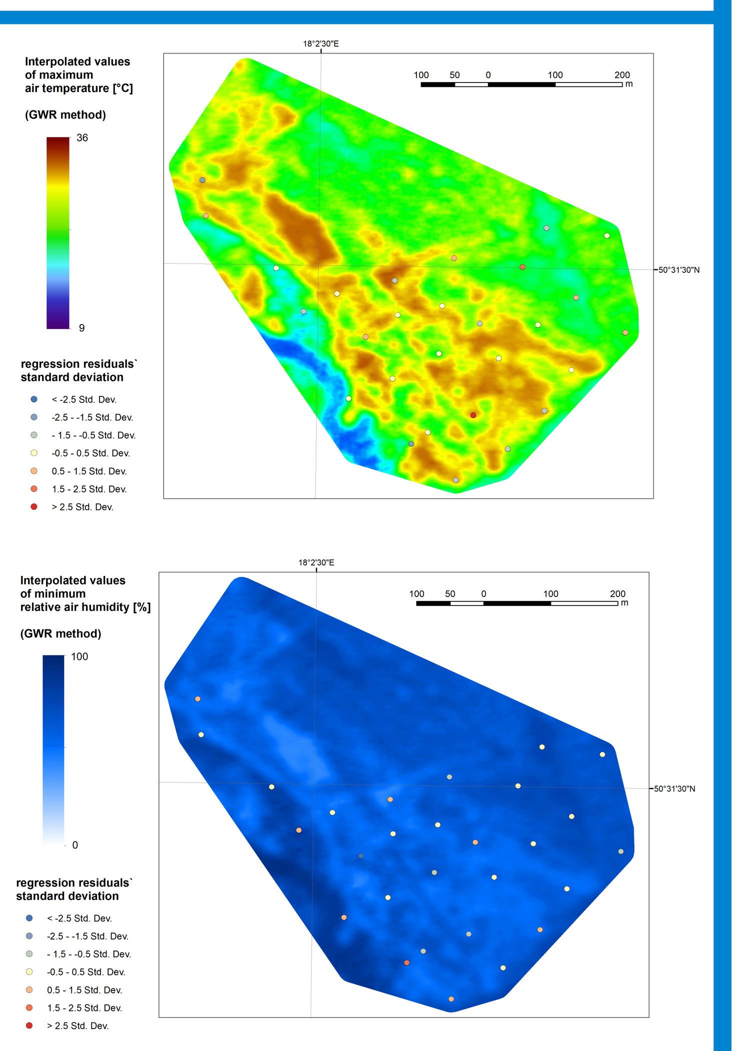
The average cover in the buffer zones was: 31.5% for bare soil, 34.4% for shrubs and grasses, 30.4% for trees. The rest is just a few percent of the area.

The results were different in buffer zones of shelters under which snakes were found: bare soil – 45%, 30-31% - shrubs and grasses, 20-22% - trees. There were no differences between young and adults snakes. The places where the shelters were laid, belonged to one of three types of cover: bare soil, shrubs and grasses, trees.

Interpolation results are maps of air temperature and relative air humidity for the entire season, each month and for each analyzed period (table below).

Statistics calculated for meteorological parameters	
The period for which calculations were made	**Statistics**
individual days of the study period	average, minimum and maximum daily air temperature average and minimum daily relative air humidity
periods of 4, 12, 24, 48 and 96 hours before each visit	average, minimum and maximum air temperature for a given period average and minimum relative air humidity for a given period
individual months and the entire research season	average, average minimum and average maximum air temperature average, average minimum and average maximum air humidity

On the right: two sample maps: maximum air temperature and minimum relative air humidity surface for the entire season, interpolated (in this case) with GWR method.



REGRESSION MODEL

Due to binary nature of the snake-to-shelter information at each visit (1 - the snake was found in an artificial shelter during the visit, 0 – the snake was not found in an artificial shelter), it was decided to use the logistic regression model as a method for estimating the probability of snake occurrence.

Independent variables were:

1. Average vegetation height
2. Average potential insolation
3. Interpolated meteorological parameters
4. Type of land cover (area in %)

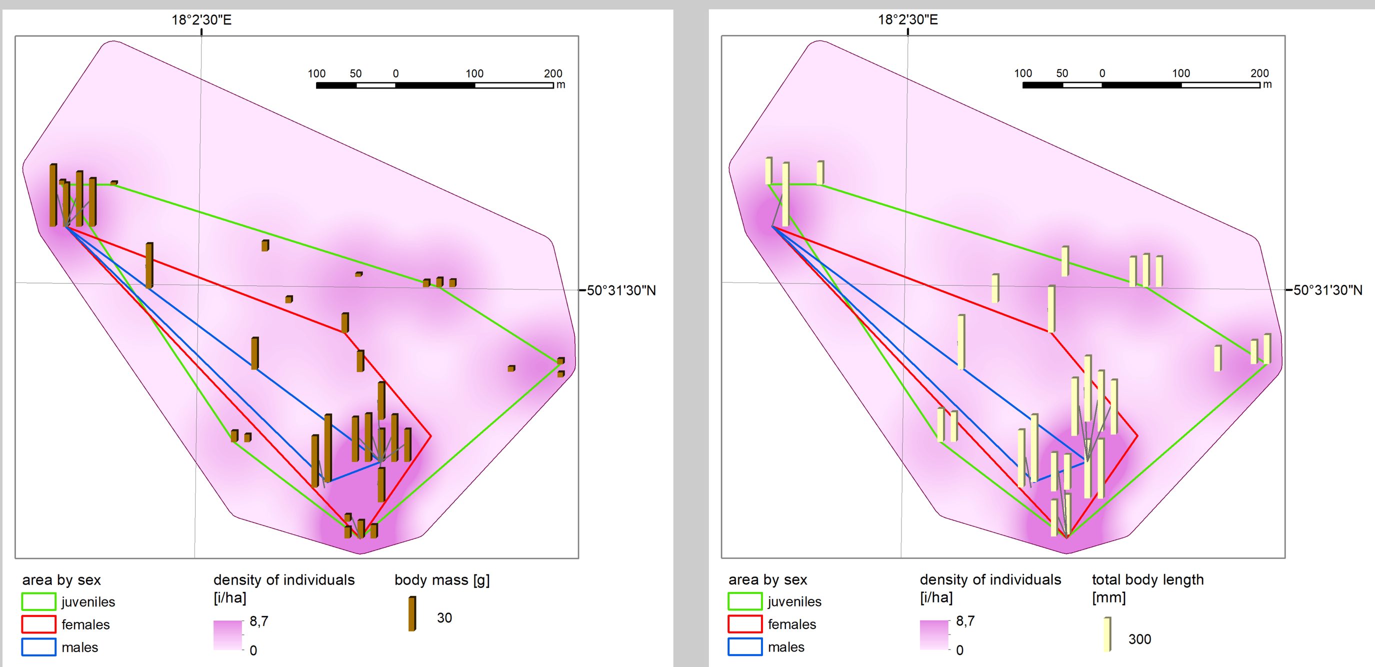
After analyzing the cases from the entire season (N=731), we found that the only factors significantly affecting the presence of snakes were the bare soil cover (positive dependence) and the percentage of conifer coverage (negative dependence).

Due to high mutual correlation (at -0.7) it was impossible to create a model based on both variables.

Y = bare soil * (0.04335764) – 4.618453
(p=.00001)

Y = coniferous * (-0.03168066) – 2.367425
(p=.00303)

POPULATION CHARACTERISTICS



The area occupied by males, females and young specimens was determined by the Minimum Convex Polygon method. Two maps above show morphometric attributes of each snake – body mass and total body length.

The spatial statistics checked the spatial SIMILARITY OF ATTRIBUTES.

GLOBAL SPATIAL STATISTICS: Given a set of locality points and an associated attribute (body mass and total body length), global I Moran statistics evaluates whether the pattern expressed is clustered, dispersed, or random. If global I Moran shows tendency to clustering, general G statistic shows what type of values are concentrated - high or low.

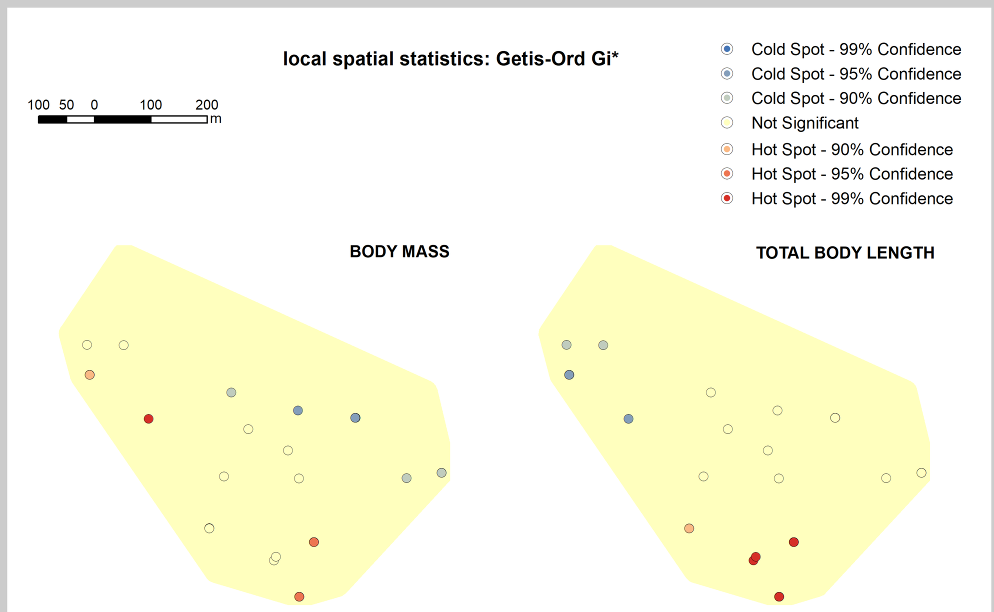
LOCAL SPATIAL STATISTICS: Local statistics testing internal variation within the set of values. The result of Getis-Ord Gi* tells us where features with either high (i.e. cold spots) or low values cluster spatially (hot spots). To use this statistic, we must first get a positive result of Anselin local Moran`s I statistic (a positive value for I indicates that a feature has neighboring features with similarly high or low attribute values) (not included on this poster).

GLOBAL SPATIAL STATISTICS

analysed parameter	I Moran statistics	Getis-Ord General G statistic
body length	distribution clustered E(I) = -0.0303 I = 0.3041 P-value = 0.0147	high values clustering E(G) = 0.0723 G = 0.1129 P-value = 0.0106
body mass	distribution clustered E(I) = -0.0303 I = 0.7033 P-value = 0.0000	high values clustering E(G) = 0.0723 G = 0.1494 P-value = 0.0001

E(I), E(G) – expected values (random distribution) for I Moran and Getis-Ord statistics

LOCAL SPATIAL STATISTICS



CONCLUSIONS

- Results show that land cover significantly affects the microscale distribution of smooth snakes. Greater share of bare soil positively affects the probability of the snake's occurrence, while conifer cover had negative effect.
- Unexpectedly, no relationship between microclimatic factors and occurrence of snakes was found, which requires further analysis. The snakes was found on 4-41°C on the 5 cm a.g.l.
- There was a spatial diversification between young and adult individuals, which may result from intraspecific predation.
- There was no difference between the land cover preferences between two age groups – all snakes prefer ecotonic zones, with a high share (40-50%) of bare soil but also covered by some trees, shrubs and grass.
- Young individuals occupied sites with higher average vegetation height and lower potential insolation, which may suggest that they choose hiding rather than thermoregulation.
- There was a difference in the size of occupied area between age groups – young individuals occupied larger areas than adults.
- The results should be taken into consideration in planning the species` active protection and modify existing regulations.

Decision numbers of the Regional Director of Environmental Protection in Opole, authorizing the research: WPN.6401.21.2015.TB and WPN.6401.88.2015.MSz

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software/tools: ArcMap, QGIS, Python, PostgreSQL, Statistica