A scientific approach for large carnivore monitoring in the Romanian Carpathians

Ruben Iosif     Iasmina Maria Moza     Liviu Ungureanu     Barbara Promberger     Maja Jelenčič     Tomaž Skrbinšek

CARPATHIA®
European Wilderness Reserve

University of Ljubljana

Colțești – 25-28 November 2019
October 2016 – Government banned trophy hunting raising the opportunity and the obligation to implement a sustainable management based on scientific data.

Background
Coexistence through institutional collaboration

• “Embrace the principles and methods of sustainability sciences”

• “Create institutional spaces to implement transdisciplinary curricula”

• “Engage with institutions and stakeholders to create novel institutional structures that can respond to multiple challenges of human–large carnivore coexistence”

Conservation Biology

Essay

Mainstreaming human and large carnivore coexistence through institutional collaboration

Tibor Hartel,1,2† Ben C. Scheele,2† Abi Tamim Vanak,3,4,5 Laurențiu Rozylowicz,6 John D. C. Linnell,7 and Euan G. Ritchie8

1Hungarian Department of Biology and Ecology and Center of Systems Biology, Biodiversity and Bioresources (Center of ‘3B’), Babes-Bolyai University, Street Clujilor 5–7, Cluj-Napoca, Romania
Current monitoring approach

Counting animals per Hunting Concessions..

- Uncertain observations at feeding points
- Uncertain track measurements
- Only a few regional initiatives performing a quantitative assessment (e.g. WolfLIFE)

### Packs and Pairs distribution (2014-2017)

<table>
<thead>
<tr>
<th>Study area</th>
<th>Wolf density (No./2000km²)</th>
<th>Pack density (No./2000km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-PUSO</td>
<td>1.75</td>
<td>2.50</td>
</tr>
<tr>
<td>2-Hill</td>
<td>1.91</td>
<td>3.33</td>
</tr>
<tr>
<td>3-Calamari</td>
<td>2.80</td>
<td>4.00</td>
</tr>
<tr>
<td>4-VNT</td>
<td>1.00</td>
<td>1.66</td>
</tr>
</tbody>
</table>

- **Pack size:** 3-9 wolves/pack
- **Wolf density:** 1.95 wolves/100km²
- **Pack density:** 3.00 packs/1000 km²

**Oral Presentations**

WOLF COUNTS IN THE SOUTHERN SUBCARPATHIAN FOREST (ESTIMATES OF POPULATION VARIATIONS BASED ON A NON-INVASIVE INTEGRATED SURVEYING METHOD)

**Monitoring** by Dr. Andrea Gárdonyi, Gábor Mihály K. and Ábrahám Zs. from the Veszprém University and the Hungarian Game and Fauna Protection Authority.

**Support** by the European Commission through the LIFE Programme.

**Participants**

- Andrea Gárdonyi
- Gábor Mihály K.
- Ábrahám Zs.
- Veszprém University
- Hungarian Game and Fauna Protection Authority
Officially reported data unable to assist management

- Growth rate for Romanian bear population is biologically unrealistic
Knowledge gaps towards coexistence and sustainable decision making in Romania

- Robust population estimates
- Assess effects of supplemental feeding in species ecology, behavior, population structure
- Effects of extracting or relocating conflictual individuals
Long term monitoring of populations

• Non-invasive DNA samples

• Systematic camera trapping
Concept of mark-recapture

\[
\frac{n_3}{n_2} = \frac{n_1}{n_{\text{total}}}
\]
Monitoring area

8 hunting concessions ~1200 sqkm

Natura 2000 SCIs

a National Park
Data collected so far

- 780 samples (Aug - Nov 2017)
- 23 samples (Feb - Mar 2018)
- 720 samples (Aug - Nov 2018)
- 147 samples (Oct 2017 - Mar 2018)
- 40 samples (Dec 2018 - Apr 2019)

Work in progress:
- 720 samples (Aug - Nov 2018)

Analysis:
- 147 samples (Dec 2019 - Apr 2020)
Brown bear

Results for 2017 season

- Number of genotyped individuals
- Sex ratio
- Detection probability
- Recapture rate
- Abundance
- Density
Brown bear

01 780 non-invasive DNA samples:

→ 536 feces

→ 238 hair samples

→ 6 urine & tissue

genotyping success = 68.7%

02 The number of successfully genotyped individuals = 173 (83♀, 91♂)

03 ~ 2.8 recaptures / individual
Brown bear

Higher detection probability and recapture rates for males

Bear males have higher detectability at rubbing trees.
Estimated number of individuals revealed a sex ratio biased towards females - a hunted population

<table>
<thead>
<tr>
<th>Model</th>
<th>Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capwire PART</td>
<td></td>
</tr>
<tr>
<td>Capwire TIRM</td>
<td></td>
</tr>
<tr>
<td>Darroch</td>
<td></td>
</tr>
<tr>
<td>MhChao</td>
<td></td>
</tr>
<tr>
<td>MARK</td>
<td></td>
</tr>
<tr>
<td>MARK g*Mh</td>
<td></td>
</tr>
<tr>
<td>MhChao MARK</td>
<td></td>
</tr>
</tbody>
</table>

- 290 Total
- 162 F
- 128 M

Brown bear
Brown bear

06 Final numbers – density estimates

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Cid</th>
<th>Ciu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superpopulation Size</td>
<td>290</td>
<td>258</td>
<td>345</td>
</tr>
<tr>
<td>Local Population Size</td>
<td>152</td>
<td>123</td>
<td>202</td>
</tr>
<tr>
<td>Population Density [bears/100 km2]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Density</td>
<td>16.9</td>
<td>13.6</td>
<td>22.4</td>
</tr>
<tr>
<td>Density Males</td>
<td>6.5</td>
<td>5.4</td>
<td>8.0</td>
</tr>
<tr>
<td>Density Females</td>
<td>10.3</td>
<td>8.2</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Officially reported data for 2017 show a total density of 21.9 bears / 100 sqkm for the 8 GMUs overlapping the monitoring area.
Brown bear

07 Long distance moves
Wolf

Results for winter 2017-2018

- Number of genotyped individuals
- Sex ratio
- Size and pack structure (pedigree reconstruction)
- Abundance
Wolf

01 147 non-invasive DNA samples:
   → 53.7% wolf samples
   → 6.8% dog or fox samples
   → 8.2% mixt samples (urine)
   → 31.3% degraded DNA samples (scat and hair)

02 The number of successfully genotyped individuals = 26

03 **Sex ratio**: 11♂ and 15♀

04 21 individuals belong to 4 packs (pack size = ~5 individuals)
Wolf
Wolf

05 Pedigree reconstruction → identified parental relations between individuals and assigned individuals to four different packs.

Offspring have genetic traces of two alpha males
Wolf
Wolf
## Abundance estimates

<table>
<thead>
<tr>
<th>Model</th>
<th>Sex</th>
<th>N</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capwire TIRM</td>
<td>All</td>
<td>31</td>
<td>25 - 46</td>
</tr>
<tr>
<td>Capwire TIRM</td>
<td>Males</td>
<td>10</td>
<td>9 - 12</td>
</tr>
<tr>
<td>Capwire TIRM</td>
<td>Females</td>
<td>21</td>
<td>15 - 37</td>
</tr>
<tr>
<td>MhChao</td>
<td>All</td>
<td>32</td>
<td>19 - 44</td>
</tr>
<tr>
<td>MhChao</td>
<td>Males</td>
<td>11</td>
<td>6 - 15</td>
</tr>
<tr>
<td>MhChao</td>
<td>Females</td>
<td>22</td>
<td>9 - 34</td>
</tr>
</tbody>
</table>
Non-invasive DNA sampling
- Lynx samples (especially hair) are degraded

Camera trapping
- Two sessions
  - winter 2017-2018
  - winter 2018-2019
- Number of “captured” individuals
- Number of females with cubs
- Detection probability
- Recapture rate
- Density
Only 4 out of 23 samples were successfully genotyped → 1 female and 3 males → 20% were actually wild cat and fox samples we probably collected “dead” hair left behind with degraded DNA
Lynx – camera trapping

01  Session 1: 47 traps → 40 trap days

02  Lynx detected at 20 traps
    42%

03  37 detections
    not all good enough to identify individuals
Lynx – camera trapping

04 12 unique individuals

05 Recapture rate = 1.4 → not enough for population estimates
Lynx – camera trapping

01 Session 2: 64 traps → 105 trap days

02 Lynx detected at 40 traps
   63.5%
Lynx – camera trapping

03 A catalog of 31 unique individuals
4 females with cubs

04 Average recapture rate per individual = 3.64
Lynx – camera trapping

Examples
Lynx – camera trapping

05

Encounter history

[Graph showing cumulative encounters and number of different lynx per trap occasion]
Lynx – camera trapping

05 Density estimates

<table>
<thead>
<tr>
<th>Local population density (lynx / 100 sqkm)</th>
<th>N</th>
<th>Cid</th>
<th>Ciu</th>
</tr>
</thead>
<tbody>
<tr>
<td>secr.usage</td>
<td>2.02</td>
<td>1.36</td>
<td>2.98</td>
</tr>
<tr>
<td>secr.null</td>
<td>1.91</td>
<td>1.31</td>
<td>2.77</td>
</tr>
<tr>
<td>secr.t</td>
<td>1.91</td>
<td>1.31</td>
<td>2.77</td>
</tr>
</tbody>
</table>
Take home message

Lynx

- Genetics is not working
- Camera trapping works fine – detailed results for decision making
- Byproducts - data on other species (ungulates abundance, predator-prey overlap, human disturbances, etc.)
Take home message

The possibility of using these model studies nationwide

• We need competent lab and scientists (transparency)
• Collaboration between hunters, game wardens and researchers
Thank you!

Acknowledgements

Our monitoring team: Daniel Bârloiu, Liviu Bulgaru, Viorel Ganci, Radu Geantă, Nelu Moșu, Răzvan Rohan, Bogdan Sulică, Călin Șerban, Laviniu Terciu, Claudiu Țoanță

Agreements: Asoc. de Vânătoare Bârsa Brașov, RPL de Adm. a Pădurilor Zărnești, Adm. Parcului Național Piatra Craiului, AVPS Jderul Argeș, AVPS GTS Muntenia Argeș, AV Piatra Craiului Făgăraș Conservation, OS Carpathia
Edge effect – brown bear individuals from outside the monitoring area, those of which home range only partially overlap with our monitoring area

- To calculate local density we applied a spatial correction around our monitoring area.
- This buffer (correction factor) is calculated per sexes based on the distance between recaptures of the same individuals.
Edge effect – brown bear individuals from outside the monitoring area, those of which home range only partially overlap with our monitoring area

- The buffer is bootstrapped around a mean, minimum and a maximum distance moved. The parameter used to calculate this buffer is called **Mean Maximum Distance Moved**
Backup Slide 3

Estimated expenses for genetic monitoring of brown bear
A three month season
At the scale of a hunting concession (10000 ha)

<table>
<thead>
<tr>
<th>Expenses</th>
<th>Amount (lei)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statistical analyses and</td>
<td>23500</td>
<td>Costs do not vary significantly with the surface</td>
</tr>
<tr>
<td>scientific report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop mobile app for</td>
<td>46000</td>
<td>On long term, apply only once independent on the surface</td>
</tr>
<tr>
<td>consistent data collection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs that will vary / surface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field personnel</td>
<td>36000</td>
<td>Salaries and field equipment</td>
</tr>
<tr>
<td>Fuel</td>
<td>1100</td>
<td>Fuel consumption for a car for 30 days in the field</td>
</tr>
<tr>
<td>Genetic analyses</td>
<td>33000</td>
<td>Approx. 100 kits, consumables, transport, lab procedures</td>
</tr>
</tbody>
</table>
Average home range size of lynx in similar study areas in Europe (Alps, Jura, Dinaric, and Carpathians) was around 252.1 km² for males and 146.6 km² for females.

Our trap array can include the entire home ranges of ~6 individuals, with an average 13.6 trap stations per individual home range.

However, edge effect is expected to be high.
Backup Slide 5

- Dealing with edge effect in SECR

- Effective monitoring area affects density estimates
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