Alpine habitats and species – an outstanding but threatened world. Impacts of global change, adaption strategies, wildlife management Case studies from Alpine mammal movement ecology

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# EUROMAMMALS

- I. Human impacts on Alpine mammals: an ecological niche perspective
- II. Study case: indirect human impacts climate change
- III. Study case: direct x indirect human impact climate change & wildlife management



### **Resources/Fitness, Movement/Population dynamics**





## **Dolomites mountains: UNESCO World Heritage Site**





### Human impacts on Alpine ecosystems



I. Human impacts

### Humans can go almost anywhere...



# ...and what about the other animals?



A world filled up with infrastructures and resourceand energy-hungry human activities have a *huge impact* on species distribution and persistence

## Human impacts on ecosystems

Anthropic perturbation of ecosytems (animal movement)

#### direct

Habitat loss and fragmentation Over-harvesting Pollution Invasive species Cimate and global change





Ecosystems represent ecological functions linking communities of species → anthropic impacts alter these relations → exctinction vortex



# Resources/Fitness, Movement/Population dynamics



## II. Climate change and highaltitude animals (Alpine ibex)

#### II. Indirect impacts: climate change



### Typical ibex day in Alpine summers: climate change early to bed, early to rise makes the ibex wise...or not?



# Compensation: from 12h to 12h32' time spent foraging

Heat-stress > 14°C

Semenzato et al, in review

**II. Indirect impacts:** 

#### Typical ibex day in Alpine summers: going for cool air at high altitudes



IPCC-RCP 8.5: +24m/°C \* 4.5°C= 108m



#### Alpine summers outlook under climate change...



Year

IPCC-RCP 8.5: #days >14°C *to double* 



#### Adaptations to heat...until when?





#### Adaptations to heat...to where?



- Species with abiotic constraints may have **compensatory mechanisms**
- Compensation might be insufficient in the current outlook of change...
- ...or literally be limited by biogeographic reasons or lack of connectivity (i.e., range shift)

# III. Interplay btw snow cover and supplemental feeding under climate change (roe deer)



III. Direct impacts x indirect impacts (wildlife management x climate change)

![](_page_19_Picture_1.jpeg)

Steady increase of temperature: +2°C already!

![](_page_19_Figure_3.jpeg)

![](_page_19_Figure_4.jpeg)

Inter-decadal observations/Predictions:

less and more variable snow cover at low/intermediate altitudes

Bright-Ross et al. 2021 December 2015, 1300 m a.s.l., West Trentino

December 2017, aerial photo of Dolomites

![](_page_20_Picture_2.jpeg)

- Alteration of resource distribution and phenology
- Decreased winter severity and increased snow variability

COMPLICATING FACTOR: pervasive deployment of supplemental feeding

![](_page_20_Picture_6.jpeg)

What is the interplay between these two impacts?

### **Movement across time:**

III. Direct impacts x indirect impacts (wildlife management x climate change)

![](_page_21_Picture_2.jpeg)

- **Historical** population (VHF data): 1999 2002
- **Contemporary** population (GPS data): 2012 2015
- Strong **development of supplemental feeding** from historical to contemporary

period

# Increasing amount of feeding sites *decreases* the compensatory effect with deep snow

III. Direct impacts x indirect impacts (wildlife management x climate change)

![](_page_22_Figure_2.jpeg)

# Roe deer distribution in the Alps can rapidly change ('winner' species)

III. Direct impacts x indirect impacts (wildlife management x climate change)

Historical → Contemporary

Increased suitability, but feeding sites are trecherous attrating point

![](_page_23_Figure_4.jpeg)

Contemporary→CC Scenarios

Increased suitability, no alterations (no snow)

- Roe deer track snow line changes (high plasticity), and habitat suitability increases with decreasing winter severity
- Availability of supplemental feeding has a paradox effect in presence of deep snow, by inducing a strong **functional response**, overruling the snow effect.
- Management concern 1: Snow variability is not equal to better conditions: see extreme events!
- Management concern 2: Effect of altered resource availability (f.s.)
  - Why in general, and if winter severity is decreasing... why again?

# Conclusions

- Consider human disturbance from animals' perspective
- Abiotic factors shift shrinks the possibility of adaptation under direct human competition
- Direct and indirect human disturbance may combine, with foreseeable eco-evolutionary consequences
- Movement ecology suggests areas of possible 'easy' intervention, to ease the constraints wild populations are under.

# Thank you!

![](_page_26_Picture_1.jpeg)

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# ...and mostly thanks to them! Questions?

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