Remotely sensed variables explain microhabitat selection and reveal buffering behaviours against warming in a climate-sensitive bird species

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Target species: White-Winged Snowfinch (Montifringilla nivalis L.)
Location: European Alps, June-July 2017
Modelling framework: Conditional logistic regression (clogit)

Dependent variable: Presence-absence of foraging events around the nest
Predictors: Remotely sensed (daily) estimates at 10 meters/pixel

Question: Can RS variables build predictive, ecologically-sound fine-scale SDMs?

In a nutshell...

- Foraging habitat selection
- Remotely-sensed habitat descriptors
- On-field observations of nestling-rearing snowfinches

Results: • Consistent with those derived from on-field predictors
• Confirm the species’ dependance on climate-sensitive microhabitats
• Disclose behavioural buffering adopted while foraging in warmest conditions
**INTRODUCTION**

White-winged Snowfinch (*Montifringilla nivalis*) – a Palaeartic mountain-specialist

Despite IUCN’s «Least Concern» label, previous studies both on fine-scale habitat selection and on broad-scale breeding distribution reveal the species’ sensitivity to the ongoing climate change.

**Fine-scale SDMs** provide pivotal insights to guide vulnerable species’ management, but time-consuming, intensive fieldwork drastically limits their extrapolation over different areas or periods.

Providing uniform and scalable data at high spatio-temporal resolutions and over large extents, **could Remote Sensing bridge this gap?**

**METHODS**

Occurrence data: 15 pairs (some surveyed twice)

- 391 foraging points + 391 pseudoabsences

(random points being within 300m around each nest AND at least 25m far from a foraging p.)

Environmental predictors:

- **Land-cover** ESA’s *Sentinel-2* multispectral images - Spectral indices, Tasseled Cap Transf., Rao’s Q index

- **Topography** Italian DEM *TINITALY* - altitude, slope, roughness, aspect, daily solar radiation

- **Microclimate** ‘*microclima*’/’*NicheMapR*’ R-packages - daily min, mean, and max air-temperature

Derived both as absolute values and as heterogeneity measures of fine-scale variation (st.dev. in a 3x3-pixels window)

Study area

Example of foraging (blue) and control (orange) points
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**RESULTS**

Fine scale foraging patterns

- Adult snowfinches foraged at locations with intermediate vegetation cover and higher snow heterogeneity, avoiding rocky/anthropized areas and extreme microclimates (both warm or cold)

**DISCUSSION**

- These results are highly consistent with those from previous studies where environmental predictors were mainly recorded by researchers in the field
- Snowfinches strictly depend on climate-sensitive foraging microhabitats
- RS can provide ecologically sound insights
- **Habitat heterogeneity** is a key feature

Temperature effect on foraging behaviour

- Temperature interacted with other environmental drivers in shaping foraging behaviour: snowfinches selected for cooler, shaded and more snowy foraging grounds at higher temperatures

- This could represent a mechanism of **behavioural buffering** against physiologically stressful conditions that leads snowfinches to select for thermically-less stressful (but still energetically-profitable) foraging grounds
- Snow patches could serve simultaneously as foraging and **relief habitat**
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**FUTURE RESEARCH**

This Remotely-Sensed Fine-scale Approach could:

- **Be the quantitative basis for model-informed grassland management** (this and other alpine species would benefit)
- **Be extended to other life-stages in order to provide a year-round outlook** of the most critical factors affecting the species’ distribution (and survival)
- **Investigate other temperature-mediated behaviours** in such a cold-adapted, climate-sensitive species by means of RS microclimatic models

**TAKE-HOME MESSAGES**

**White-winged Snowfinch**

- Vulnerable to climate change due to its dependence on climate-sensitive foraging microhabitats
- Thermal conditions shapes its foraging behaviour during nestling-rearing stage
- Foraging suitability maps could be implemented over the entire Alpine region to monitor the species during this critical life stage

**Remote Sensing**

- An ever-increasing amount of useful data: Open-source, uniform, scalable, at high resolutions, over continental extents
- Provided relevant predictors to build ecologically-sound, predictive models

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Good birding to everyone!!