

Spatial and temporal dynamics of the Alpine Rock Ptarmigan in Switzerland

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1 Introduction

The Alpine Rock Ptarmigan (*Lagopus muta helvetica*) is an arctic grouse species which occurs above the tree line in the Alps [1].

A **decline of the population** has been observed in Switzerland [2,3]. It is still not completely clear what factors are causing this decline. **Climate change** however seems to lead to a **reduction of suitable habitat** [4].



Fig. 1. Alpine Rock Ptarmigan in winter plumage.

2 Method overview

Data: Atlas of Swiss breeding birds to **detect long term changes** in the **distribution** of the Rock Ptarmigan. First sampling period between 1993-1996, second one between 2013-2016 [1].

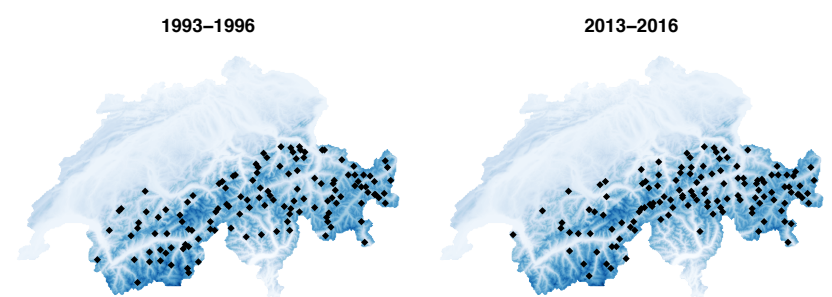


Fig. 2. Observed Ptarmigan occurrence of the atlas of Swiss breeding birds in 1993-1996 and 2013-2016.

Variables:

- summer temperature
- snow cover in spring and in autumn
- number of cold and warm rainy days
- ski lifts
- game reserves
- NDVI
- changes in tree line
- Cantons

Model:

- logistic regression
- response variable: plots where Ptarmigan disappeared in contrast to those where they stayed or colonized

3 Results and discussion

The explained deviance of the model is low ($D^2=0.036$) and the accuracy is moderate ($AUC=0.75$). A **decrease in snow cover in spring** however **correlates positively with Ptarmigan** colonisation or persistence ($\beta=-194$, $p=0.026$). **In Valais Ptarmigan decreased** more than expected by environmental predictors ($\beta=-1.562$, $p=0.068$).

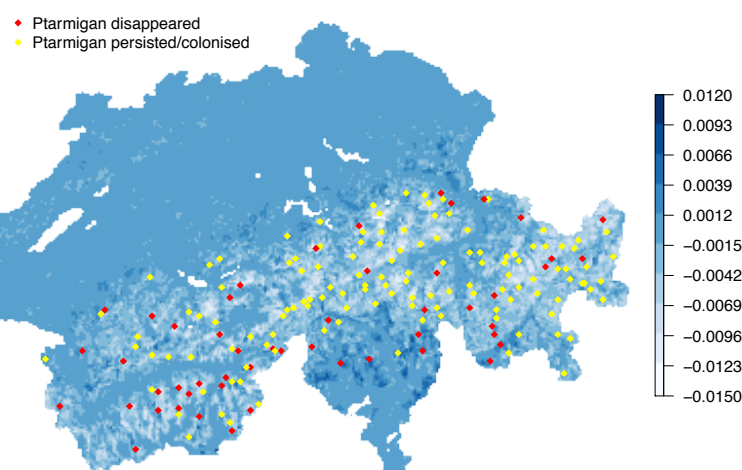


Fig. 3. The points show changes in Ptarmigan occurrence and the map represents changes of snow cover in spring.

The observed effect of snow cover is congruent with other literature which report an **increased breeding success** of the Rock Ptarmigan in years with **earlier snow melt** [5-7]. Hens can then benefit from a **higher food quality** which could lead to a higher reproductive success [8].



4 Conclusion

Changes in snow cover explain part of the changes in the Ptarmigan distribution. An **effect of Canton** can be observed. This could be due to different **cantonal regulations**.

For further studies I propose that the following considerations should be taken into account:

- More and **finer scaled predictors** which would allow to estimate the habitat diversity inside a 1x1km cell might be needed. Webcams and infrared cameras could be used to monitor the environment.
- **Predation** is the main form of adult Ptarmigan mortality [9] and changes in predator distribution should also be considered.
- The Rock Ptarmigan is still being hunted in some Cantons of Switzerland. Assessing the **hunting pressure** in different regions might give insights of how it affects the Ptarmigan population.

5 References

1. Schmid H. et al. Schweizer Brutvogelatlas. Verbreitung der Brutvögel in der Schweiz und im Fürstentum Liechtenstein 1993-1996. 1998.
2. Furrer R. et al. Variable decline of Alpine Rock Ptarmigan (*Lagopus muta helvetica*) in Switzerland between regions and sites. *Journal of Ornithology*. 2016. 157, 3. 787-796.
3. Marti C. et al. Bestand und Verbreitung von Birkhuhn Tetrao tetrix und Alpenschneehuhn *Lagopus muta* im Aletschgebiet von 1970 bis 2015. *Der Ornithologische Beobachter*. 2016. 113.
4. Revermann R. et al. Habitat at the mountain tops: How long can Rock Ptarmigan (*Lagopus muta helvetica*) survive rapid climate change in the Swiss Alps? A multi-scale approach. *Journal of Ornithology*. 2012. 153, 3. 891-905.
5. Novoa C. et al. Effect of weather on the reproductive rate of Rock Ptarmigan *Lagopus muta* in the eastern Pyrenees. *Ibis*. 2008. 150. 270-278.
6. Imperio S. et al. Climate change and human disturbance can lead to local extinction of Alpine rock ptarmigan: New insight from the Western Italian Alps. *PLoS ONE*. 2013. 8, 11. 1-11.
7. Novoa C. et al. No short-term effects of climate change on the breeding of Rock Ptarmigan in the French Alps and Pyrenees. *Journal of Ornithology*. 2016. 157, 3. 797-810.
8. Garcia-gonzalez R. et al. Influence of Snowmelt Timing on the Diet Quality of Pyrenean Rock Ptarmigan (*Lagopus muta pyrenaica*): Implications for Reproductive Success. *PLoS ONE*. 2016. 1-21.
9. Novoa C. et al. Demographic Traits of Two Alpine Populations of Rock Ptarmigan. *Ecology, Conservation, and Management of Grouse*. 2011. 267-280.