



Assessing connectivity in a fragmented landscape by monitoring the long-distance movements of mountain Galliformes in the French Alps

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Context and aims

- Mountains are essentially a fragmented environment with deep valleys alternating with high altitude ridges.
- Most mountain animals therefore have a more or less fragmented distribution controlled by their preferences for altitude and exposure.
- Black grouse, Rock ptarmigan and Rock partridge: galliform species whose conservation is of concern and whose ecological niche partially overlap in the Alps at certain seasons.
- Aims: compare the characteristics of the long-distance movements of the 3 species and analyze the **role of topography** in the routes taken during these trips



Supervision of captures and monitoring of GPS-tagged galliforms in the French and Italian Alps

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- **PN de la Vanoise:** Jérôme Cavailhes, Maxime Chaussinand, Nicolas Gomez, Maxime Marini
- **PN des Ecrins:** Tommy Bulle, Narcisse Certain, Lucien Chaillot, Marc Corail, Etienne Dupuis, Emmanuel Evin, Florence Huchon Thierry Maillet, Vincent Nobili, Rodolphe Papet, Olivier Warluzelle
- **PN du Mercantour:** Eric Belleau, Marion Bensa, Giorgio Ficetto Omar Giordano, Ludovic Klein, Jérôme Mansons, Laurent Martin-Dhermont, Sophie Roux
- **Birdski:** Thierry Arsac, Justine Coulombier, Laurent Perier-Muzet



Dataset

81 GPS-tagged individuals, sub-adults and adults, monitored for more than 6 months over 2017-2022, from 10 capture areas.

47 black grouses marked in the northern and southern Alps (360 movements)

- 40 individuals from Savoie (les Trois Vallées 29, Valcenis 6, Les Arcs 5)
- 7 individuals from the southern Alps (Le Fournel 1, Orcières 1, Risoul 5)

25 rock ptarmigans marked in the northern and southern Alps (253 movements)

- 11 individuals from the Arve valley
- 7 individuals from the Dévoluy massif
- 11 individuals from the Mercantour massif

9 rock partridges marked in the northern Alps (889 movements)

- 4 individuals from the Aravis massif
- 5 individuals from les Trois Vallées



Movement analysis

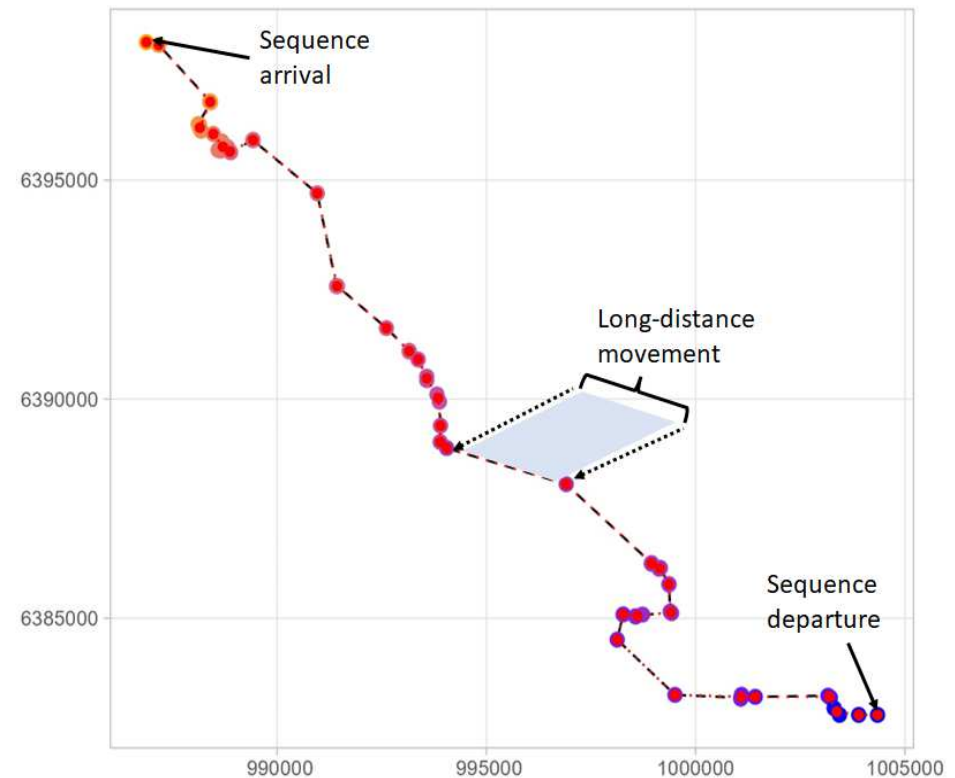
For the analysis, small movements < 200 m within stops were removed.

For each movement between 2 successive GPS locations, we recorded: length, elevation, departure and arrival times, and whether or not a valley or ridge was crossed.

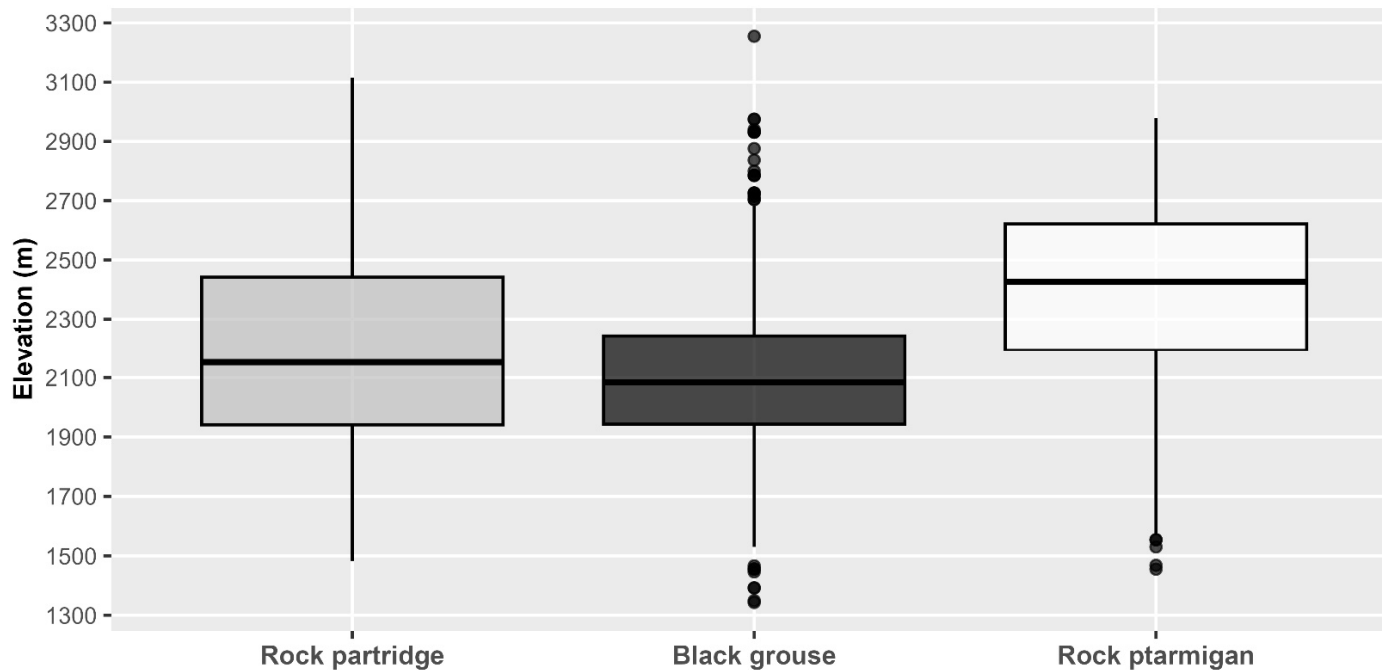
Here we focus on :

- The **sequences** of movements made between 2 stopover areas, defined as the grouping of successive movements made by each bird over 1 to several days,
- The characteristics of **long-distance movements**, i.e. movements > 1 km long made in one go between 2 successive locations and where the duration between the dates of arrival and departure is less than 30 min apart. It can therefore be assumed that these movements include a significant flight phase.

Example of a movement sequence and of a long-distance movement



Description of species distributions according to elevation



	Median elevation (m)
Rock partridge	2152
Black grouse	2084
Rock ptarmigan	2427

I. Characteristics of sequences:

Distance (in km) of movement sequences

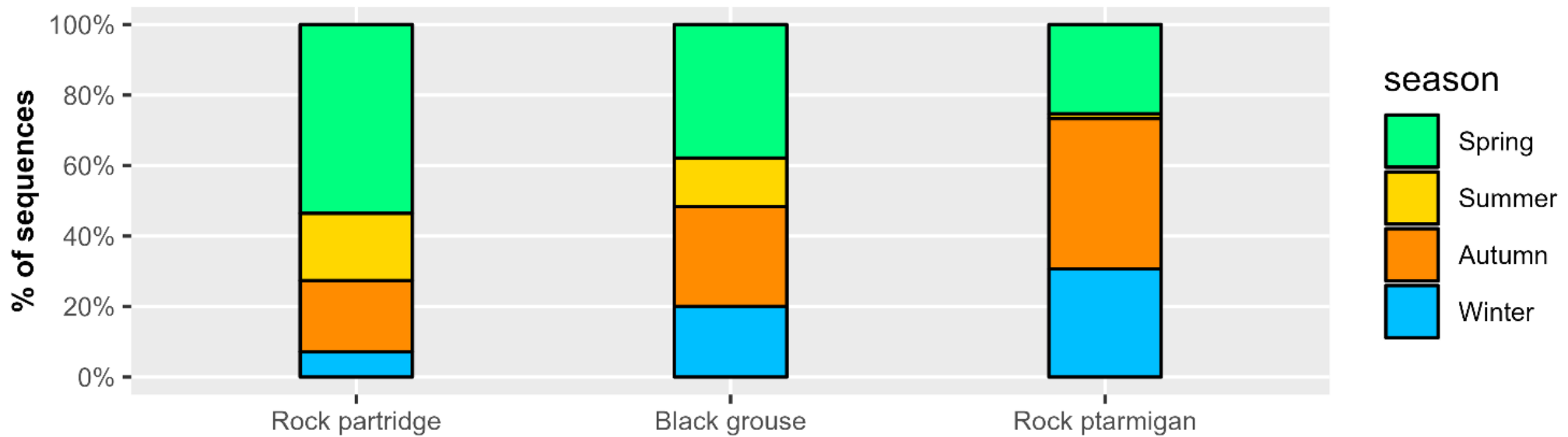
Species	min	median	max	Nb of sequences
Rock partridge	1	5	46	84
Black grouse	1	5	82	95
Rock ptarmigan	2	7	73	75

Duration of movement sequences

Species	min	median	max	Nb of sequences
Rock partridge	10 min	5 h	3 days and 21 hours	84
Black grouse	9 min	6 h	7 days and 8 hours	95
Rock ptarmigan	20 min	10 h	2 days and 4 hours	75

I. Characteristics of sequences:

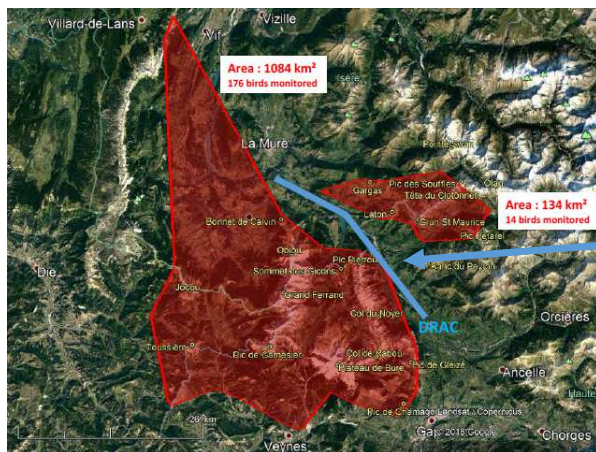
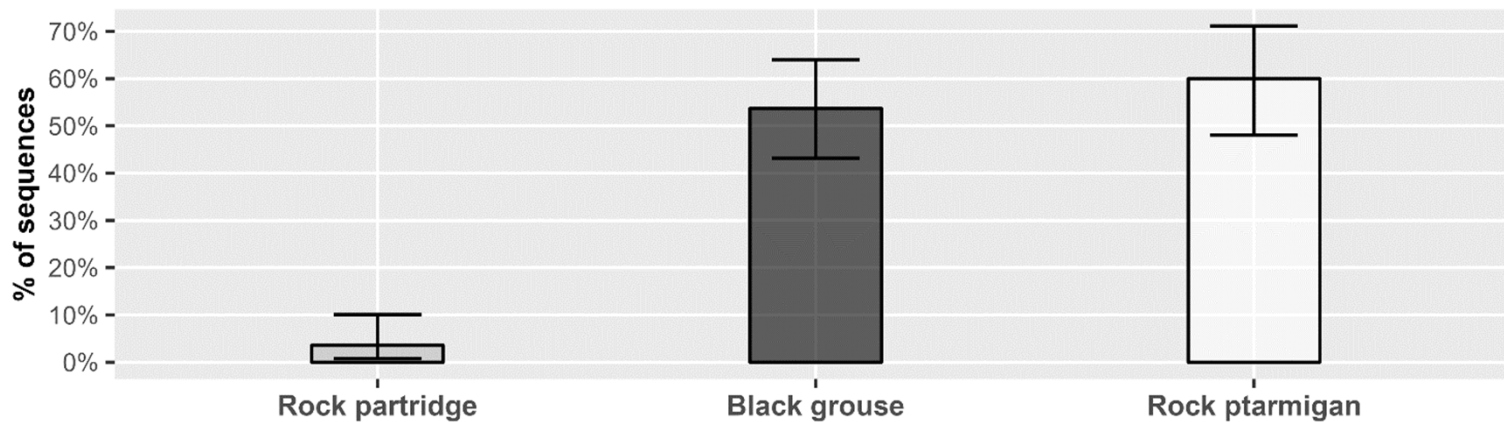
Seasonal distribution by species



Characteristics of sequences

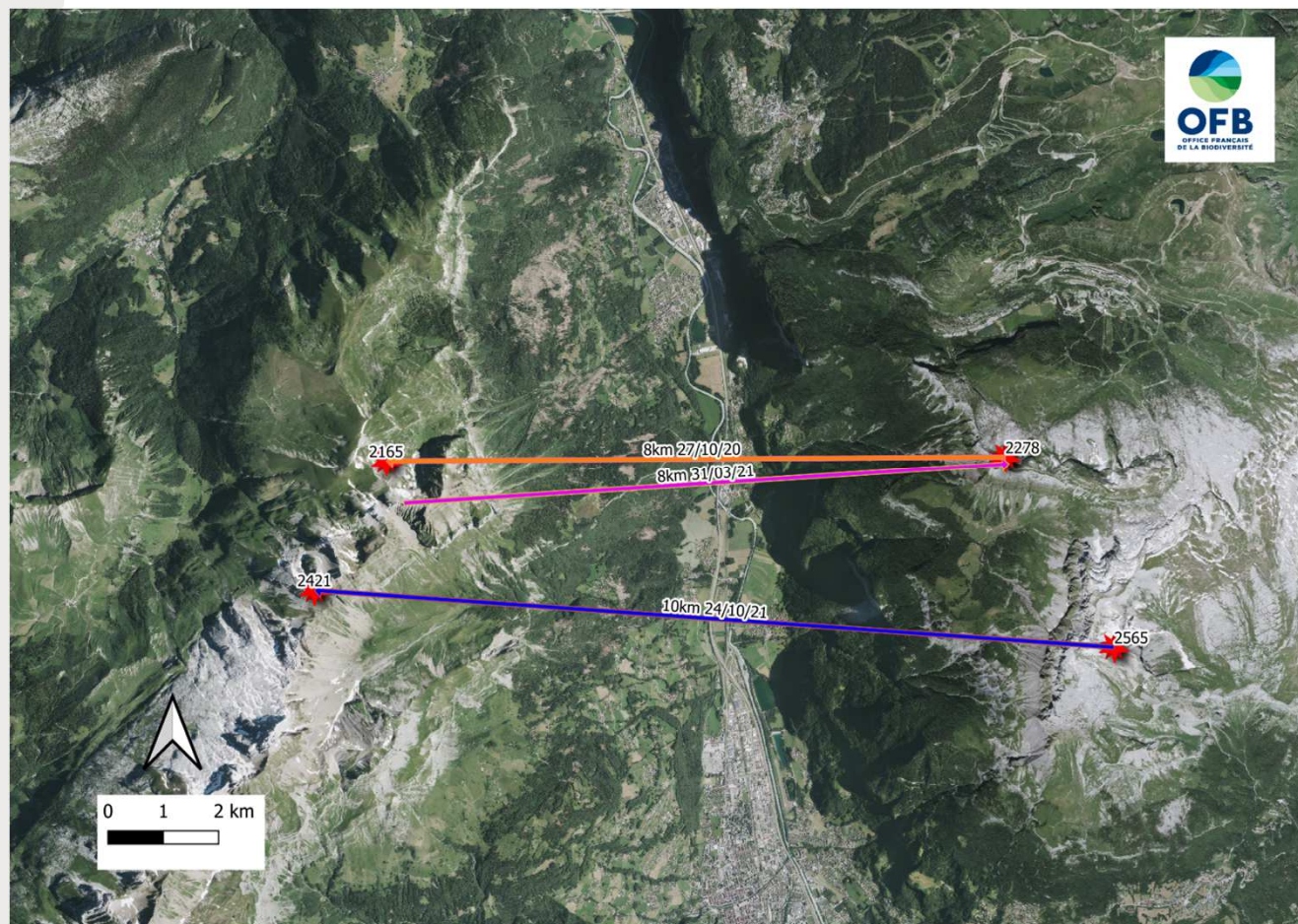
I. Characteristics of sequences:

Valley crossings during a movement sequence, by species



The Drac valley has never been crossed by the rock partridges living in the Devoluy and Beaumont massifs

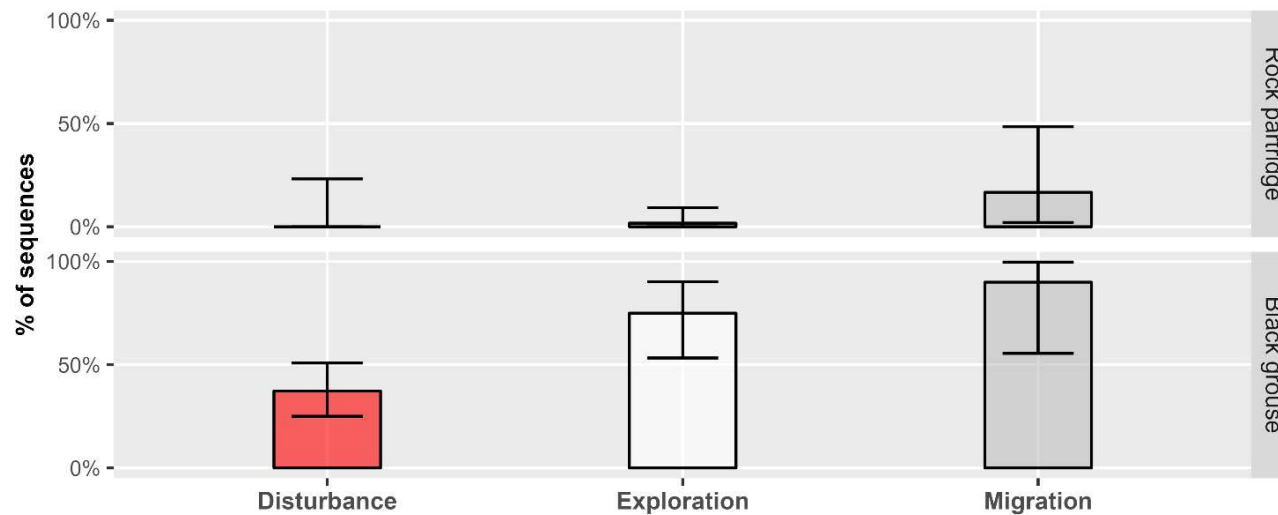
The example of 3 crossings of the Arve valley (~ 4 km wide) by a female Rock ptarmigan



Muffat-Joly et al. 2022. *Biodiversité, des clés pour agir*, 2: 48-50.

I. Characteristics of movement sequences:

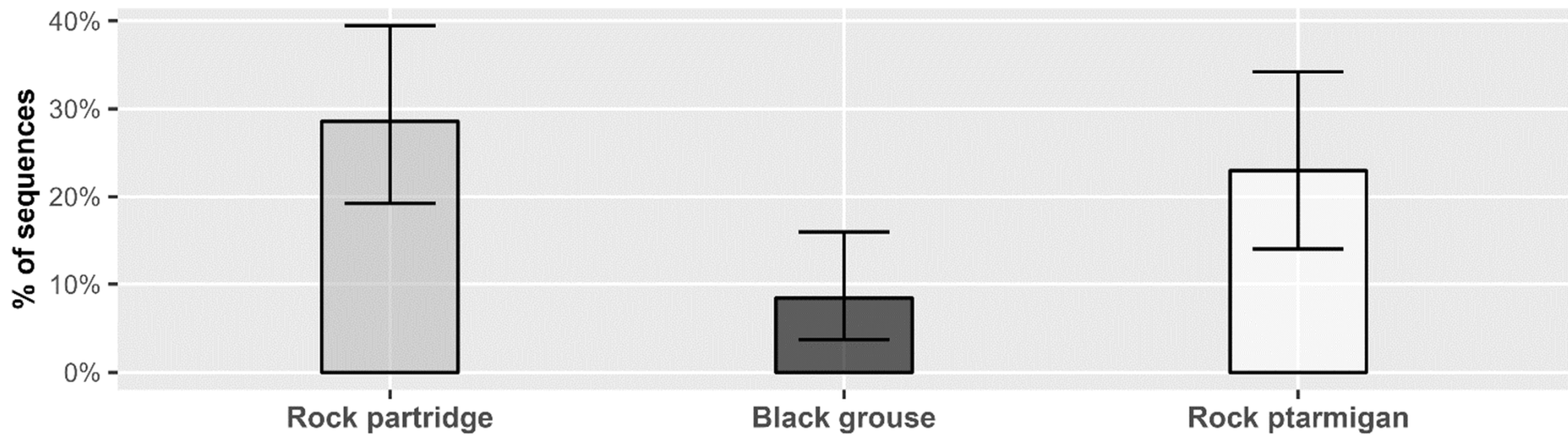
% of sequences including valley crossing according to nature of sequence and species



Rock ptarmigan was excluded due to the uncertain identification of disturbance movements

I. Characteristics of movement sequences:

% of sequences including ridge crossings by species



The example of a male rock partridge crossing several high altitude ridges in a single movement sequence, between 2847 and 3006 m

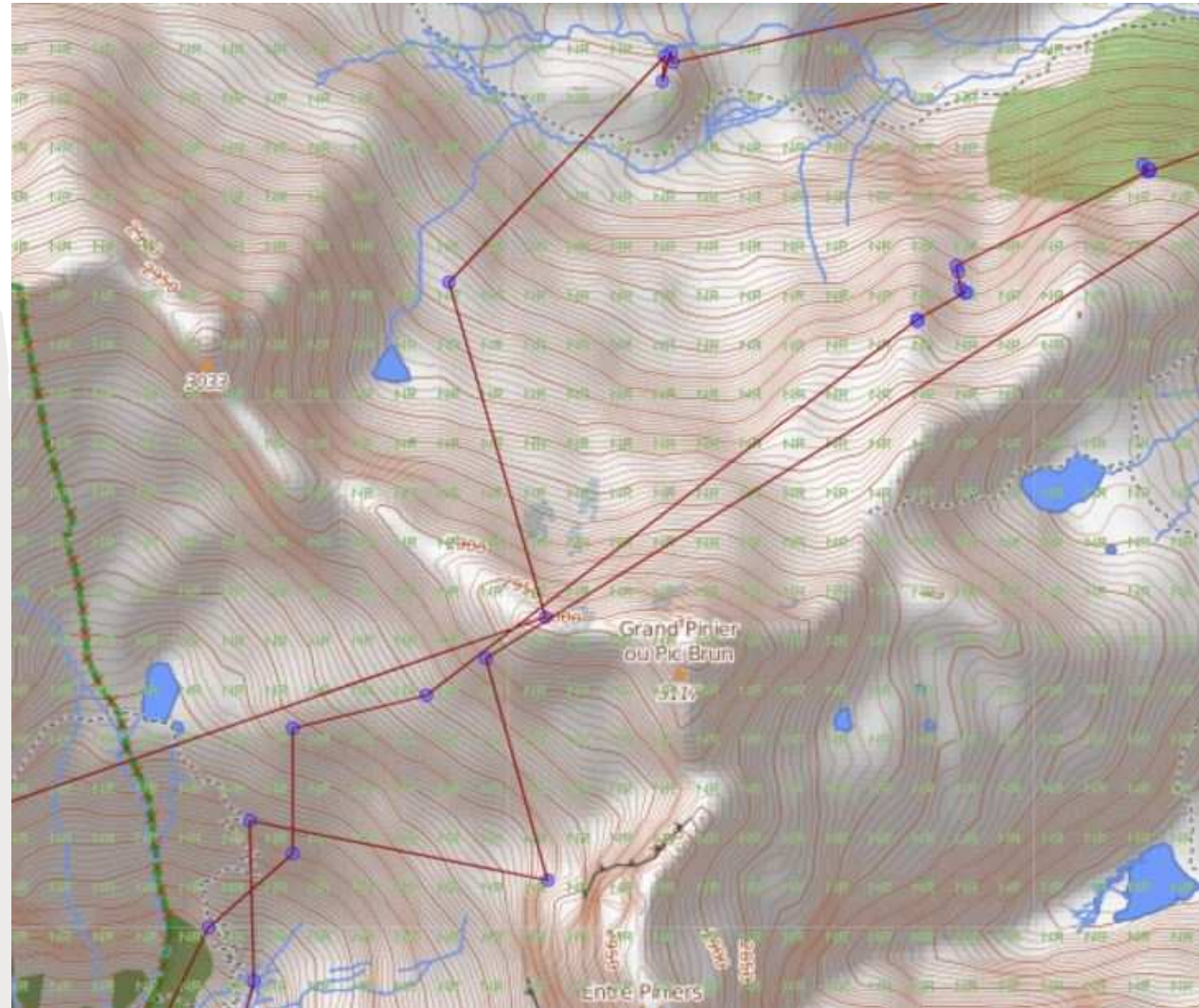


Here is an exploratory sequence of 26,75 km travelled between 30 June and 3 July 2022

The example of a male black grouse «Ascension» crossing a high altitude ridge in the Parc national des Ecrins

3 crossings of a high altitude ridge in one place, the « Grand Pinier » Ridge:

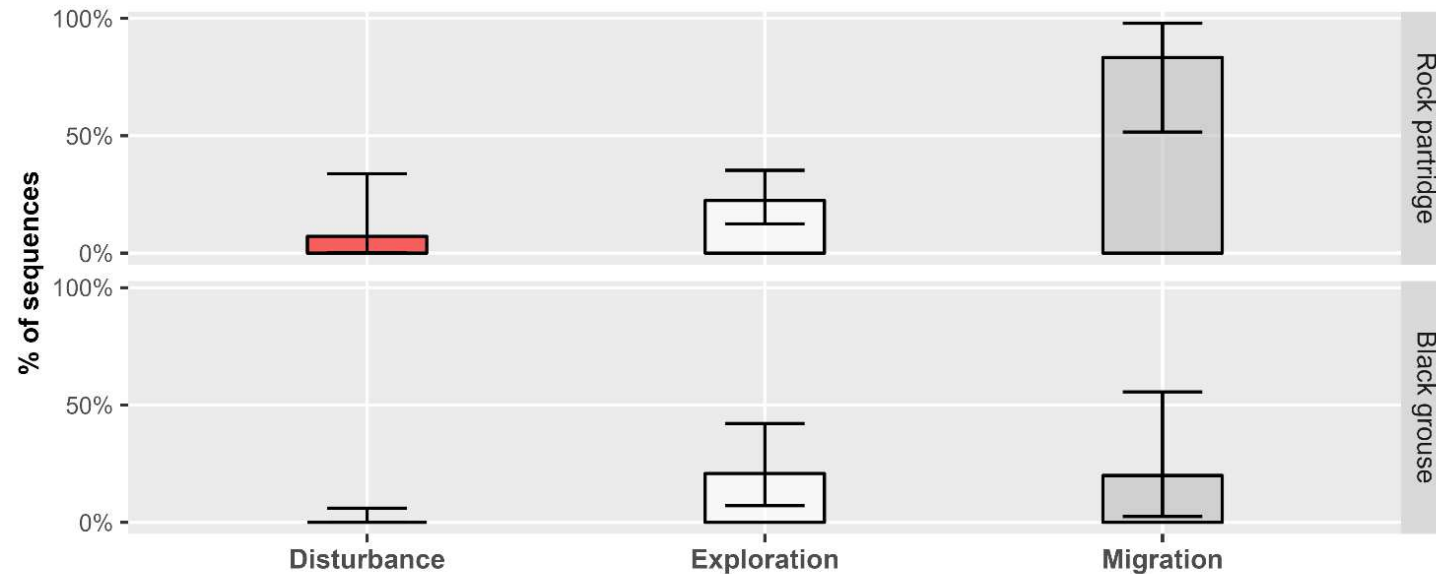
- **2975 m** May 13, 2023
- **2931 m** May 24, 2023
- **2938 m** June 3, 2022



Maillet T. 2023. Etude comportementale du Tétrasyre. Parc national des Ecrins.

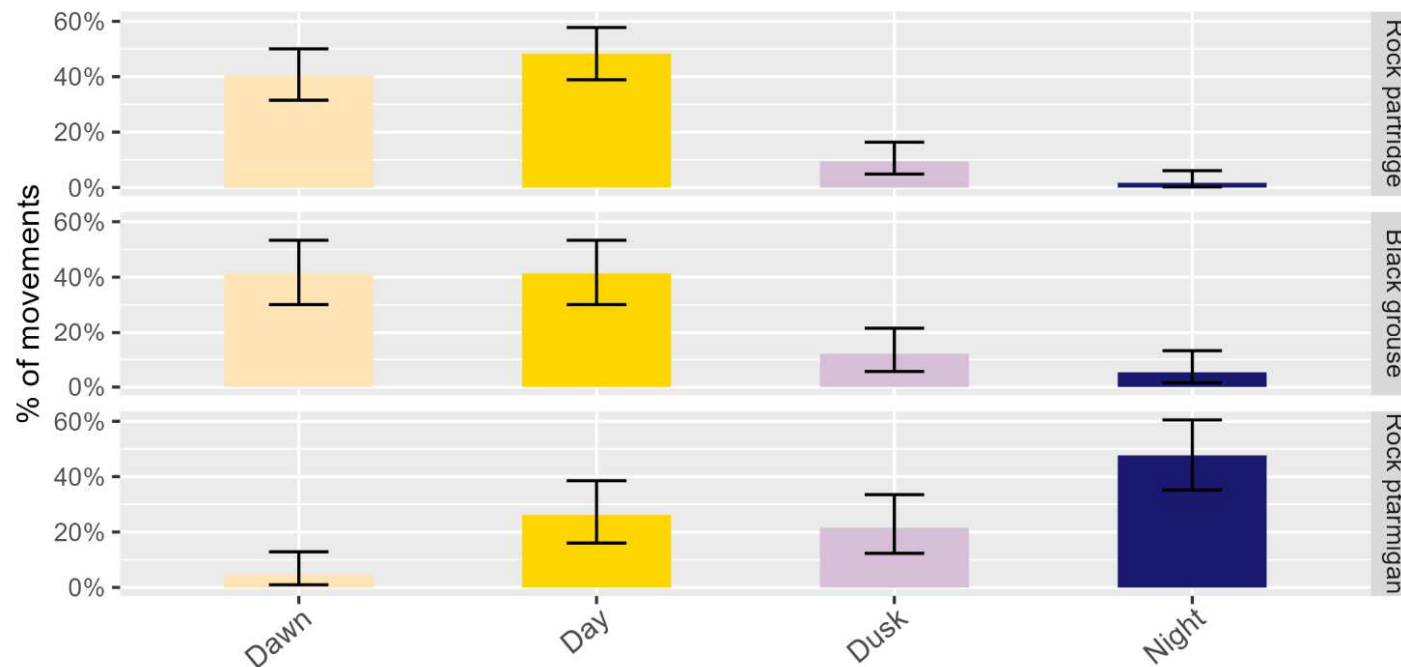
I. Characteristics of movement sequences:

% of sequences including ridge crossings according to the type of sequence and species



II. Characteristics of long-distance movements:

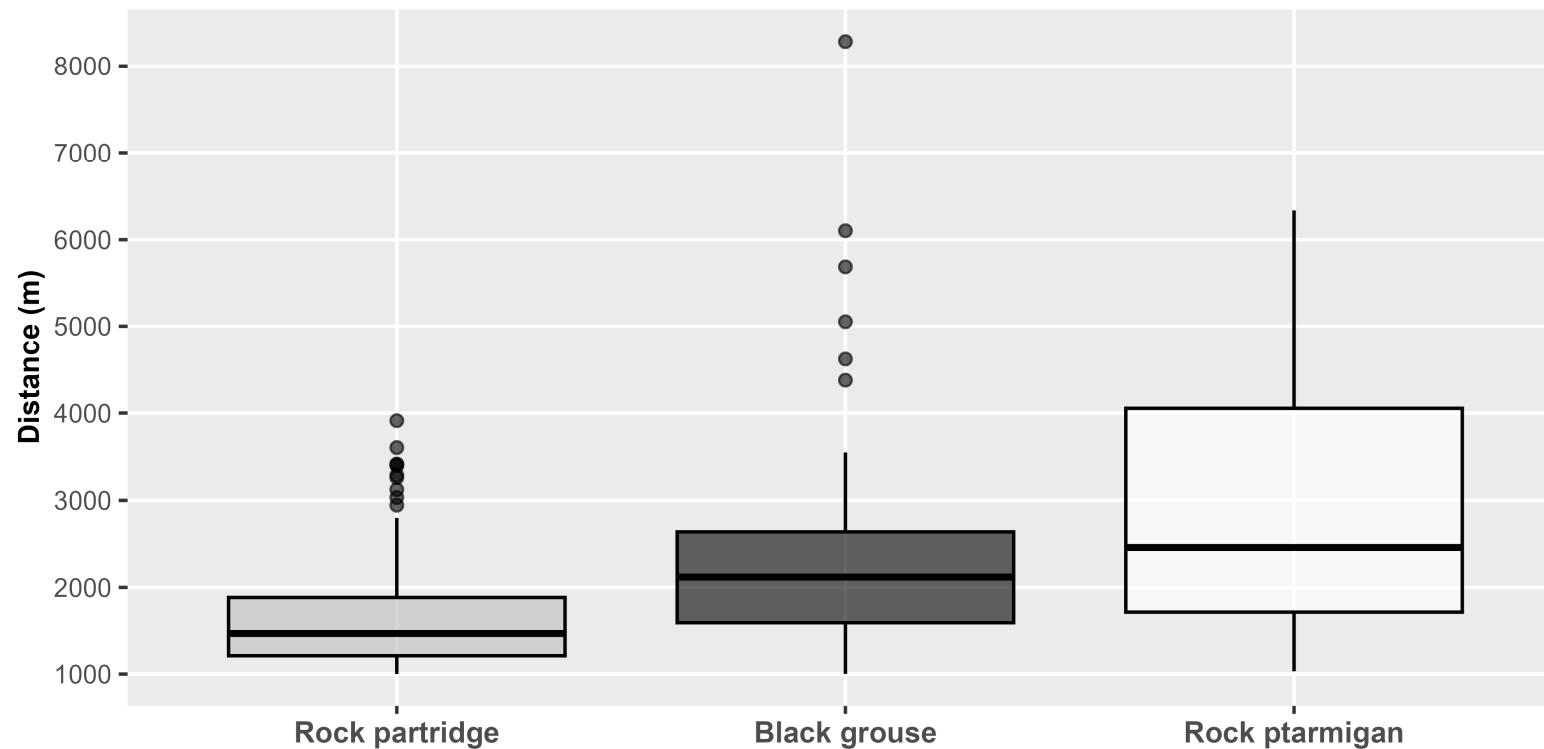
At what time of nycthemer do birds make their long-distance movements ?



Significant differences in movement period between species GLM (night ~ species): $\Delta AICc = 65.7$

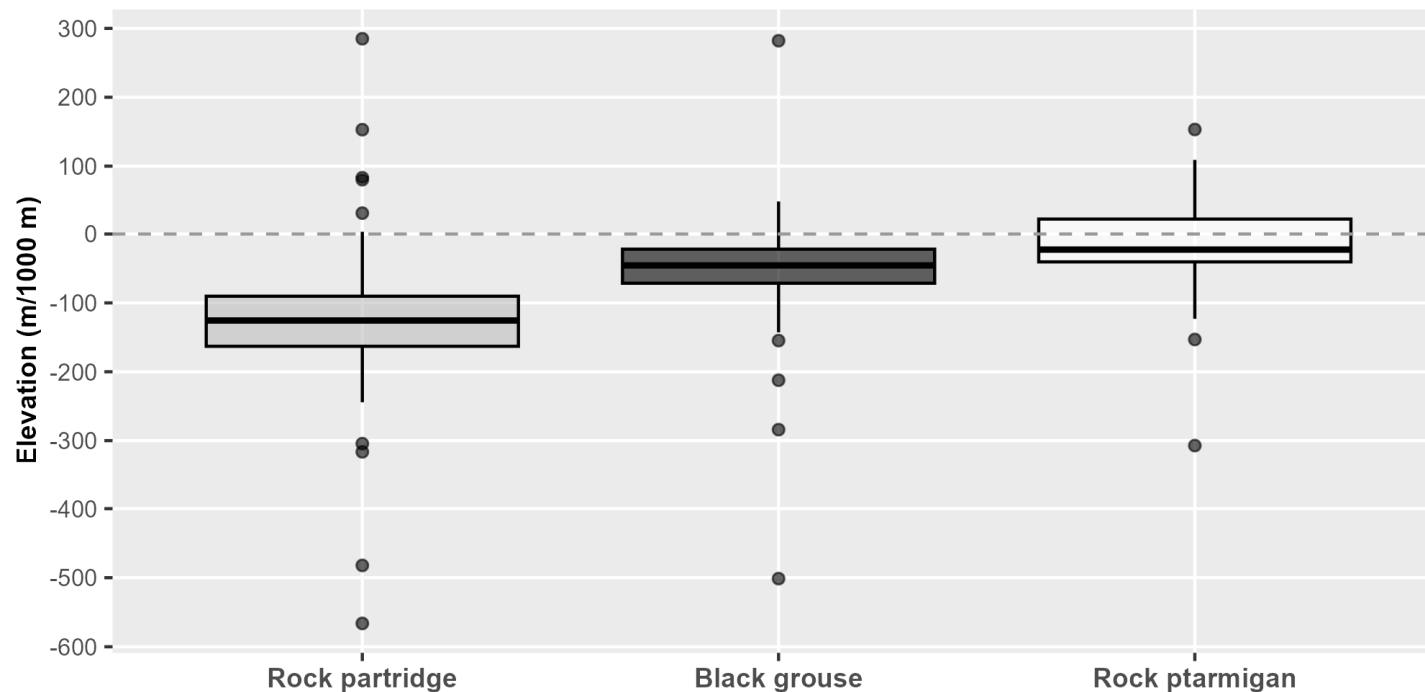
II. Characteristics of long-distance movements:

What are the lengths of long-distance movements ?



II. Characteristics of long-distance movements:

Differences in altitude of long-distance movements, per km traveled, by species



Roles of wing shape and notch size on flight performance

Species	Notch size (% of wing breadth)	Wing length-to-breadth ratio (means)
Chukar partridge (close parent of Rock Partridge)	36.62	1.69
Black grouse	18.87	2.08
Rock ptarmigan	20.68	2.35

Source : Drovetski S.V. 1996. *The Auk*, 113: 802-810

Based on notch size, flight efficiency is as follows for all species:

Black grouse > Rock Ptarmigan > Rock Partridge

Based on wing narrowness ratio, flight efficiency is as follows for all species :

Rock Ptarmigan > Black grouse > Rock partridge



Perspectives

The comparison of movement strategy of the 3 galliforms shows :

- that the Rock ptarmigan has the best ability to cross the geographical barriers of mountain topography:
 - it has the ability to cross deep valleys that constitute habitat breaks, to cross high ridges and to make longer direct flights than Black grouse and Rock partridge.
 - In spite of the current decline in Rock ptarmigan populations, the various ranges containing individuals in the French Alps could still be connected thanks to the species' great capacity for movement.
- The ability of rock partridges to regularly cross high ridges during their movements explains their capacity to recolonize mountain ranges where the species had become extinct, as was observed in the period 1989-1991 in the Alps. However their inability to travel through deep valleys limits this aptitude.
- GPS tracking with a larger number of birds is needed to consolidate these first results and to study movement strategies according to sex and age.

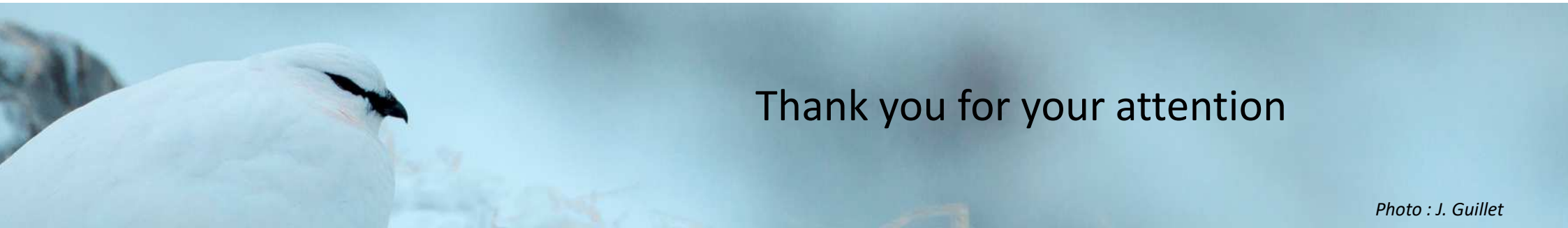
For more information about the movements of mountain galliforms in the French Alps:

Ellison L.E., Menoni E. & Léonard P. 1989. Déplacements de tétras-lyres en automne et en hiver. *Gibier Faune sauvage*, 6: 245-260.

Novoa C., Desmet J.-F., Muffat-Joly B., Arvin-Bérod M., Belleau E., Birck C. & Losinger I. 2014. Le lagopède alpin en Haute-Savoie. *Biologie des populations et impact des activités humaines*. ONCFS/ASTERS/GRIFEM, 64 pages.

Muffat-Joly B., Sabatier C., Fournet Q., Vaisy T. & Barneix G. 2022. Le lagopède alpin, plus mobile qu'on ne le pensait. *Biodiversité, des clés pour agir*, 2: 48-50.

Bernard-Laurent A., Dos Santos V.M. & Chiffard J. 2023. Long-distance and upward elevational movements of a mountain Galliformes species depend on individual's breeding success: implications for adaptive management. *In review Ibis*.



Thank you for your attention

Photo : J. Guillet