Allegato 3a_2

Spatial distribution and space use of three ungulate species

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Introduction

As an IUCN (International Union for the Conservation of Nature) category 1a nature reserve (strict nature reserve), the Swiss National Park (SNP) represents an area where nature has been left to itself for a century. Due to its strong protection status, the SNP and, in particular, the valley of Trupchun is known for its remarkably high densities of ibex, chamois, and red deer. Since the year 1997 population sizes and distributions of the three ungulate species have been intensively monitored. In the SNP it is possible to gain relevant location data from visual observations due to of several reasons. First, since the observation points are exposed landmarks, they can be clearly identified every year. Second, the observation points of the observers are distributed over the research area so that the fields of view of the observers overlap. Therefore, a group of five observers is able to map the entire research area simultaneously. Third, the observations take place in the early mornings when the animals predominantly graze the high lying alpine meadows and are thus relatively easy to observe. Additionally, due to the parks' strict regulations, the animals´ flight distances are very low compared to other areas in the Alps making it relatively easy to reach the observation points without disturbing the animals.

Methods

Four times each year, every January, May, August and November the SNP´s park rangers simultaneously locate and count all ungulates. These quarterly observations are representative for the spatial distribution in winter, spring, summer and autumn, respectively. In the field, the observers locate each group of animals on a map with the scale of 1:18 000. They record the

number of individuals and distinguish them according to species, sex and age classes. After that, the hand-drawn maps get digitalised using ArcGIS. For analysis, where plotted the data on a biyearly basis from 1997 - 2013 at a scale of 1: 20 000 using ArcGIS (version 10.1). For each animal group we extracted the altitude using the SNP´s DTM (digital terrain model) with a spatial resolution of 2 x 2 m. Next, we compared the medians of each season and year using the pairwise Wilcoxon rank sum test. Red deer are present in Val Trupchun only during the summer months and spend the winter in more low lying areas. Usually, the first individuals appear in mid May and start leaving again in mid September. Therefore, the number of observations for winter, spring and autumn were not enough for a statistical analysis and we compared red deer positions only for the summer observations (August). For statistical analysis we used R (version 3.0.1).

Results

When visually comparing the animals' positions over the course years, their seasonal patterns remained quite stable (compare Figures 1-9 for ibex, Figures 10-18 for chamois and Figures 19-27 for red deer, respectively). The same was true, when statistically comparing the animals' positions in terms of altitude. While ibex and chamois used similar altitudes in each season, the distribution of red deer was quite different. Although some significant differences between single years where found for all species and almost every season, no clear patterns or trends emerged (see Figures 28 a-d for ibex, Figures 29 a-d for chamois and Figure 30 for red deer, respectively).

Fig. 1-9: Spatial distribution of ibex in the Val Trupchun. Spring data were collected in May, summer data in August, autumn data in November and winter data in January. “No records” means the mapping did not take place, maps without diamonds indicate that no animals where observed.

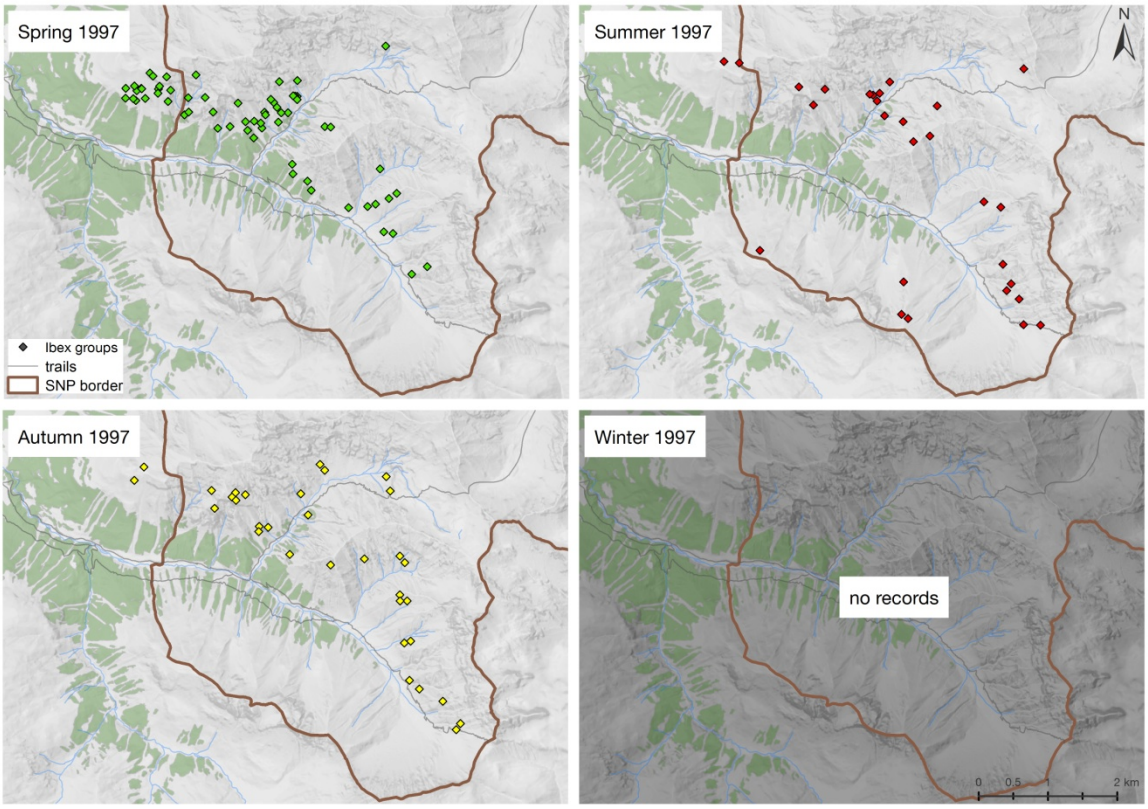

Fig. 1

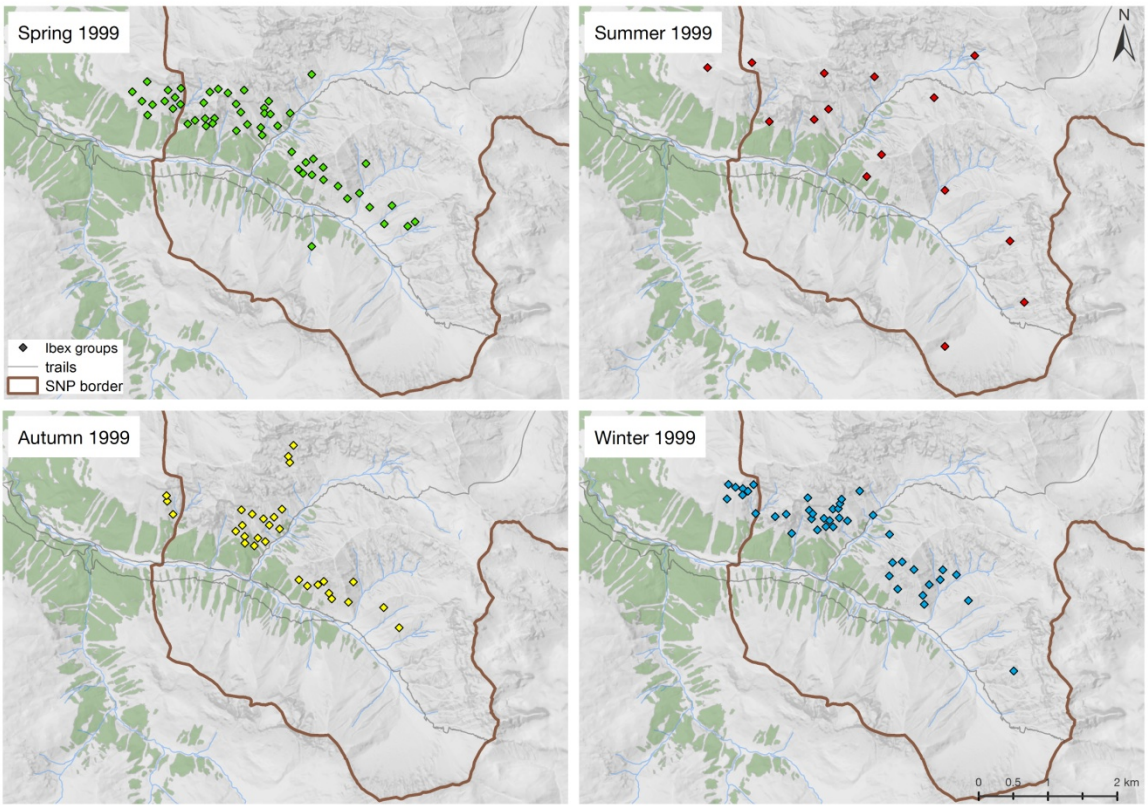
Spring 1999
Summer 1999
N
Ibex groups
trails
SNP border
Autumn 1999
Winter 1999
0
0.5
1
2 km

Fig. 2

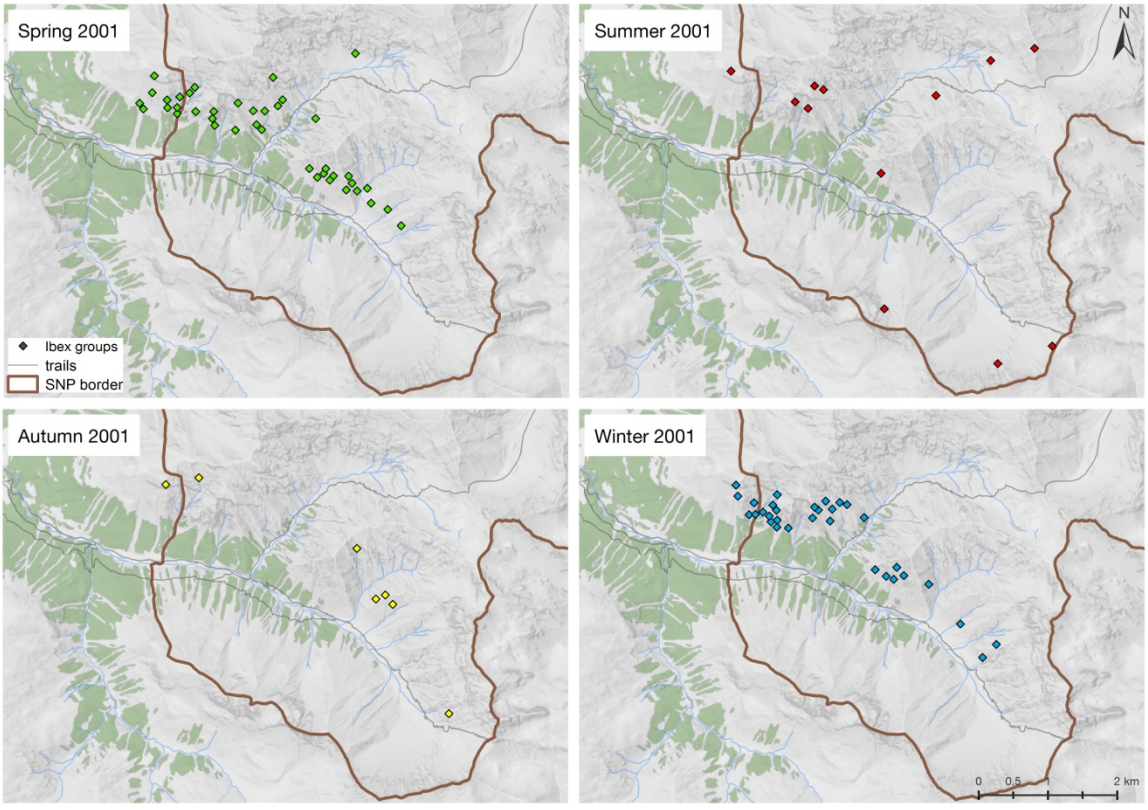
Spring 2001
Summer 2001
N
Ibex groups
trails
SNP border
Autumn 2001
Winter 2001
0
0.5
1
2 km

Fig. 3

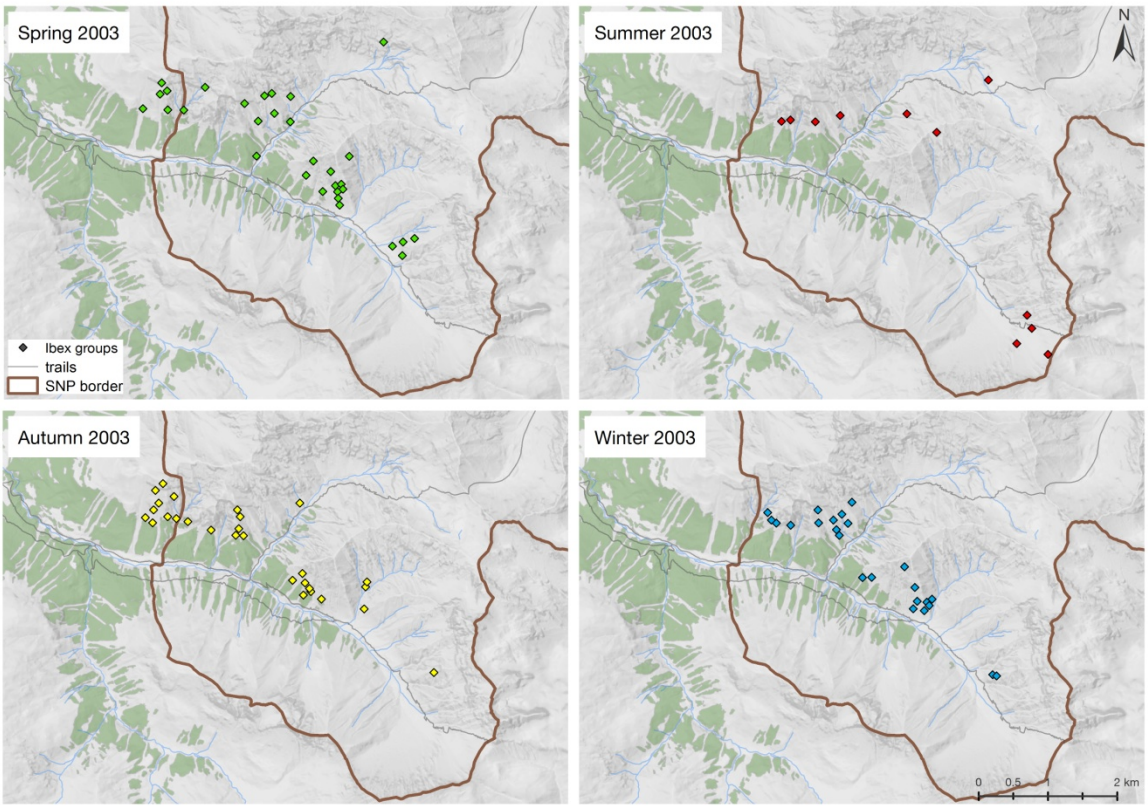
Spring 2003
Summer 2003
Autumn 2003
Winter 2003
Ibex groups
trails
SNP border
N
0
0.5
1
2 km

Fig. 4

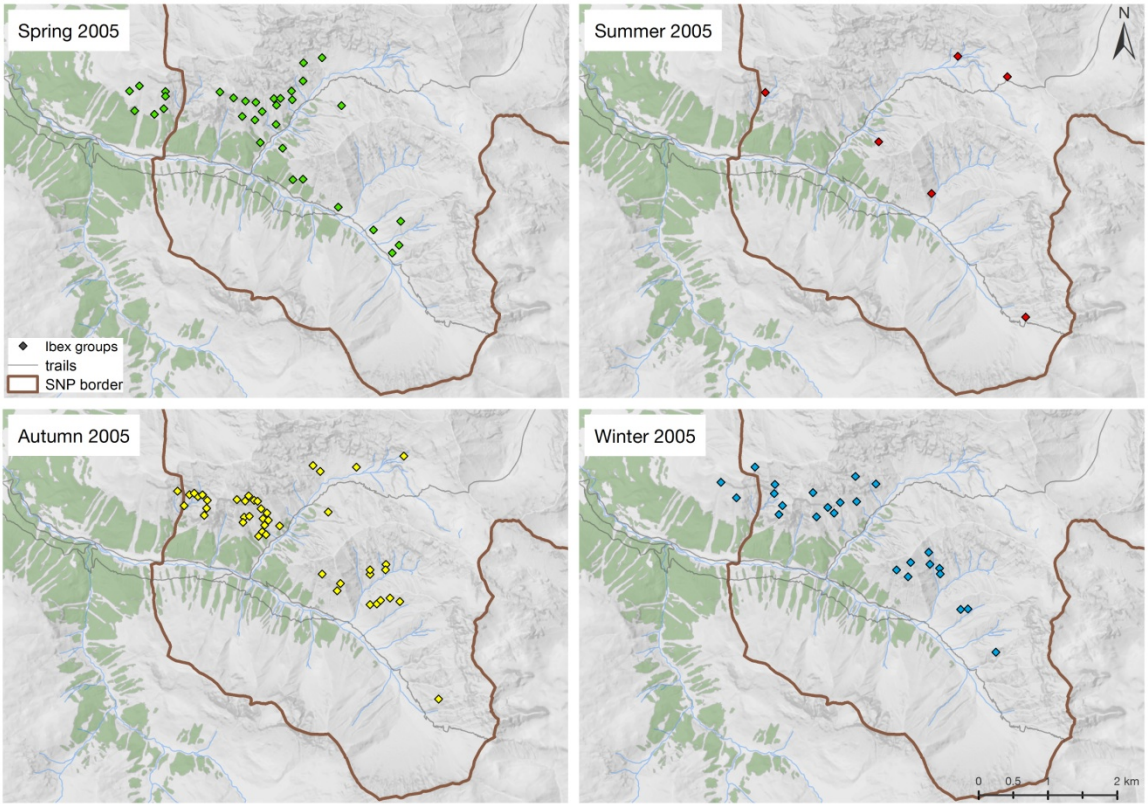
Spring 2005
Summer 2005
Autumn 2005
Winter 2005
Ibex groups
trails
SNP border
N
0
0.5
1
2 km

Fig. 5

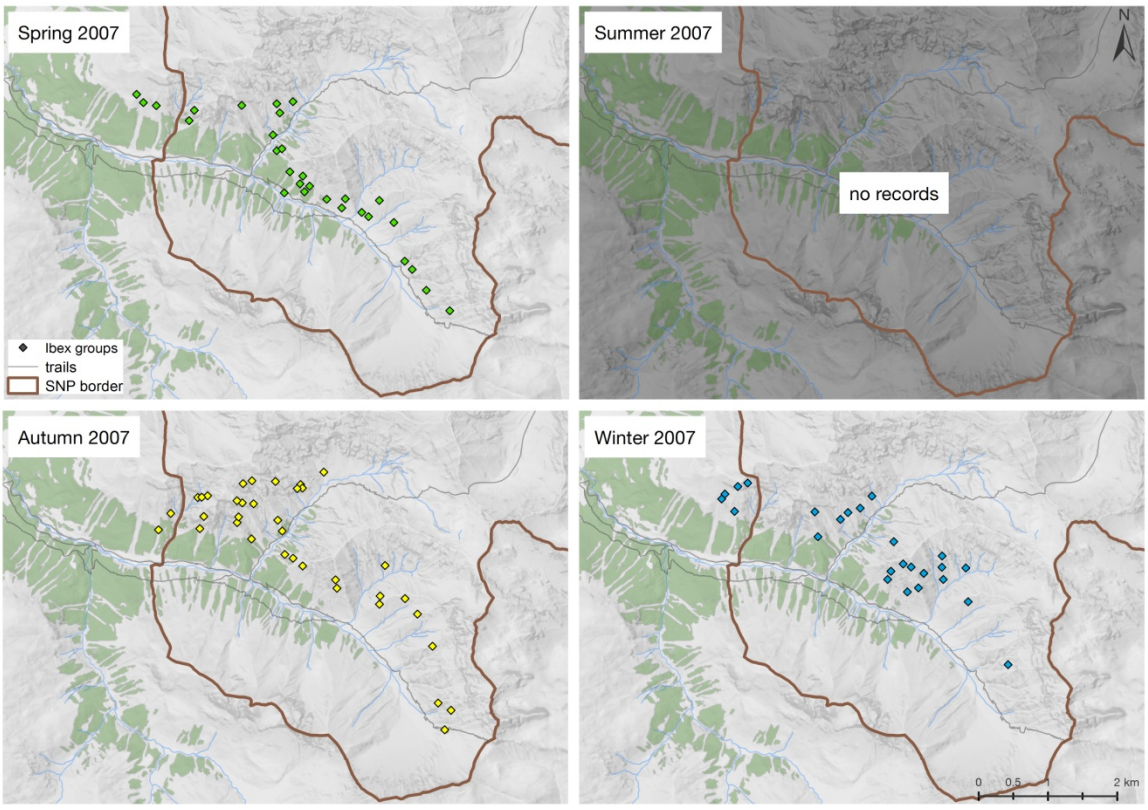
Spring 2007
Summer 2007
N
no records
Ibex groups
trails
SNP border
Autumn 2007
Winter 2007
0
0.5
1
2 km

Fig. 6

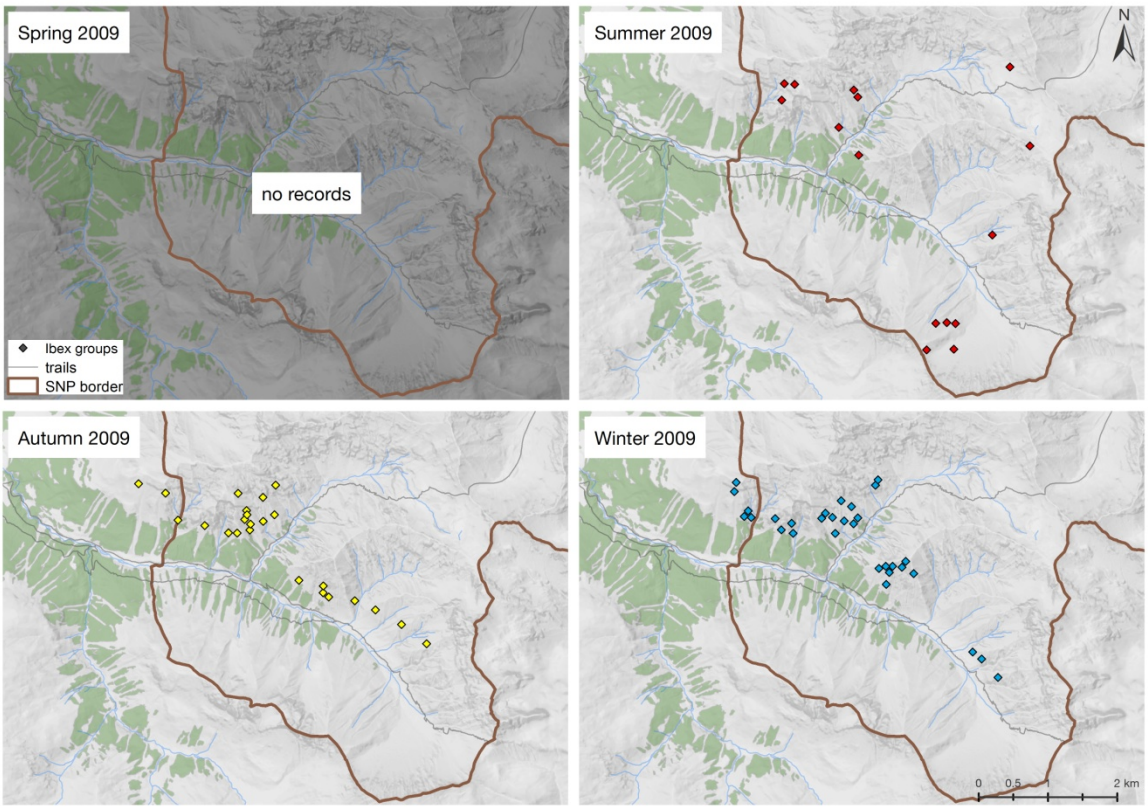
Spring 2009
Summer 2009
N
no records
Ibex groups
trails
SNP border
Autumn 2009
Winter 2009
0
0.5
1
2 km

Fig. 7

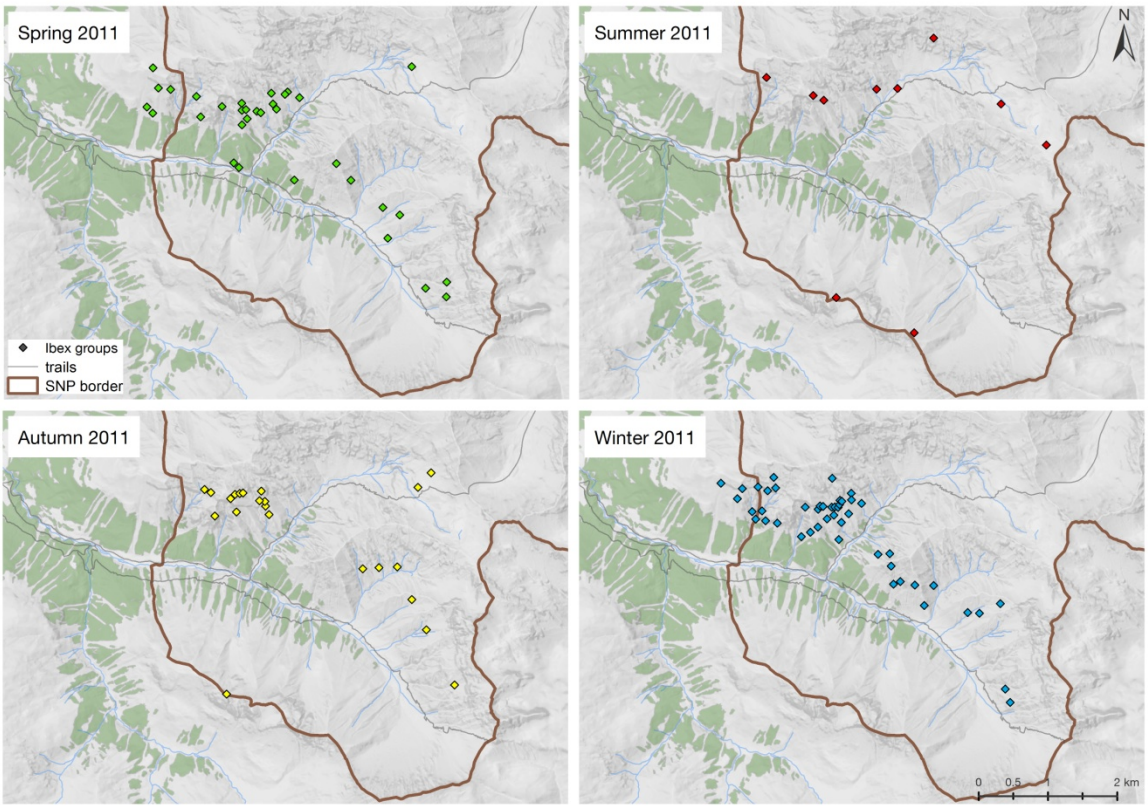
Spring 2011
Summer 2011
Autumn 2011
Winter 2011
Ibex groups
trails
SNP border
N
0
0.5
1
2 km

Fig. 8

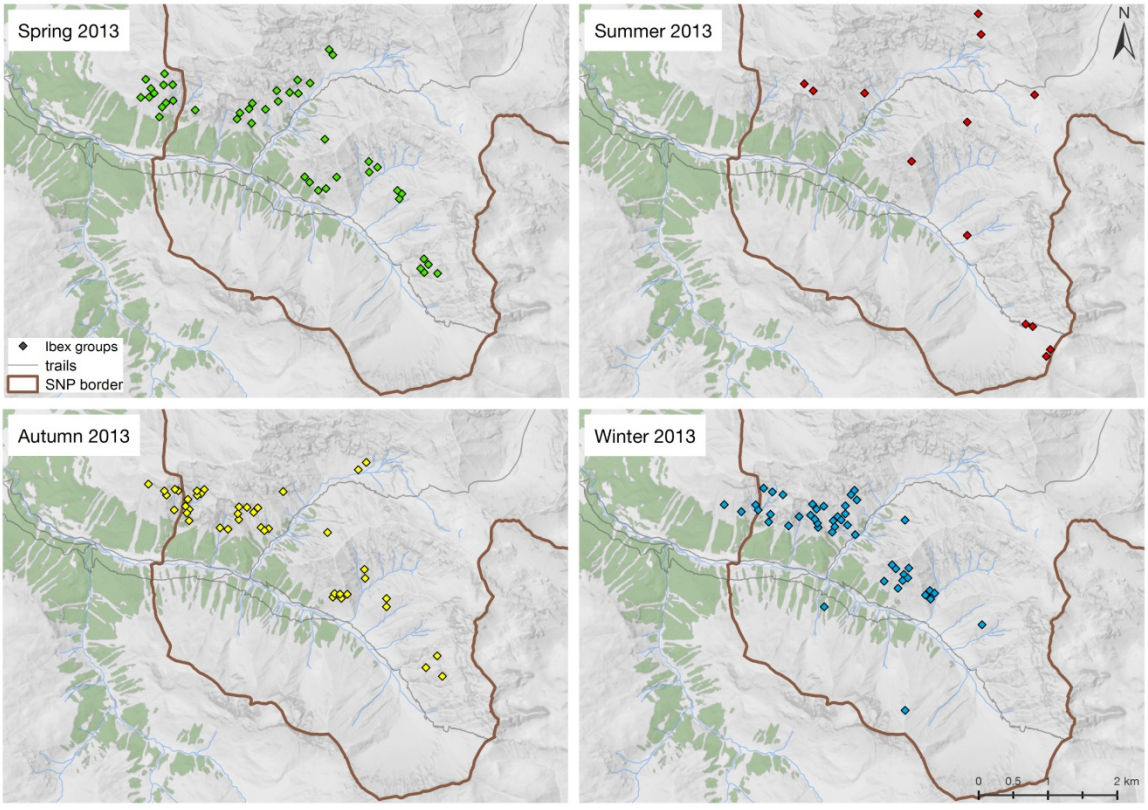
Spring 2013
Summer 2013
Autumn 2013
Winter 2013
Ibex groups
trails
SNP border
N
0
0.5
1
2 km

Fig. 9

Fig. 10-18: Spatial distribution of Alpine chamois in the Val Trupchun. Spring data were collected in May, summer data in August, autumn data in November and winter data in January. “No records” means the mapping did not take place, maps without diamonds indicate that no animals where observed.

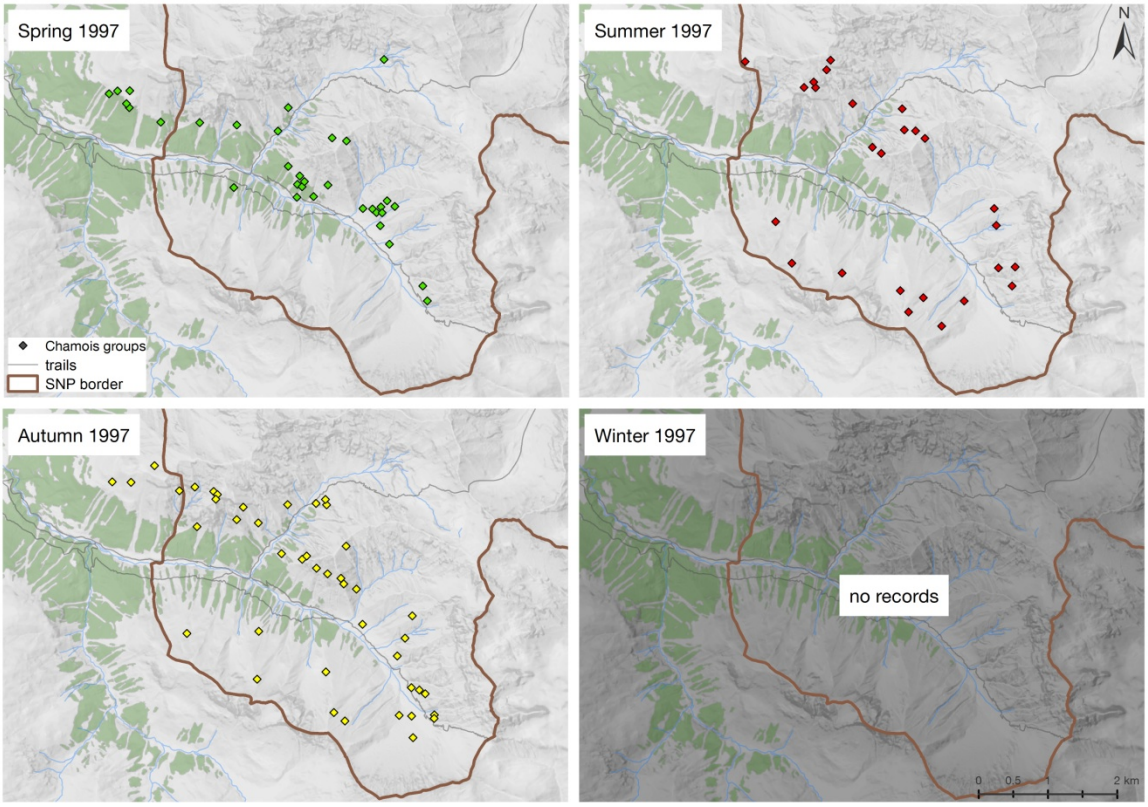

Fig. 10

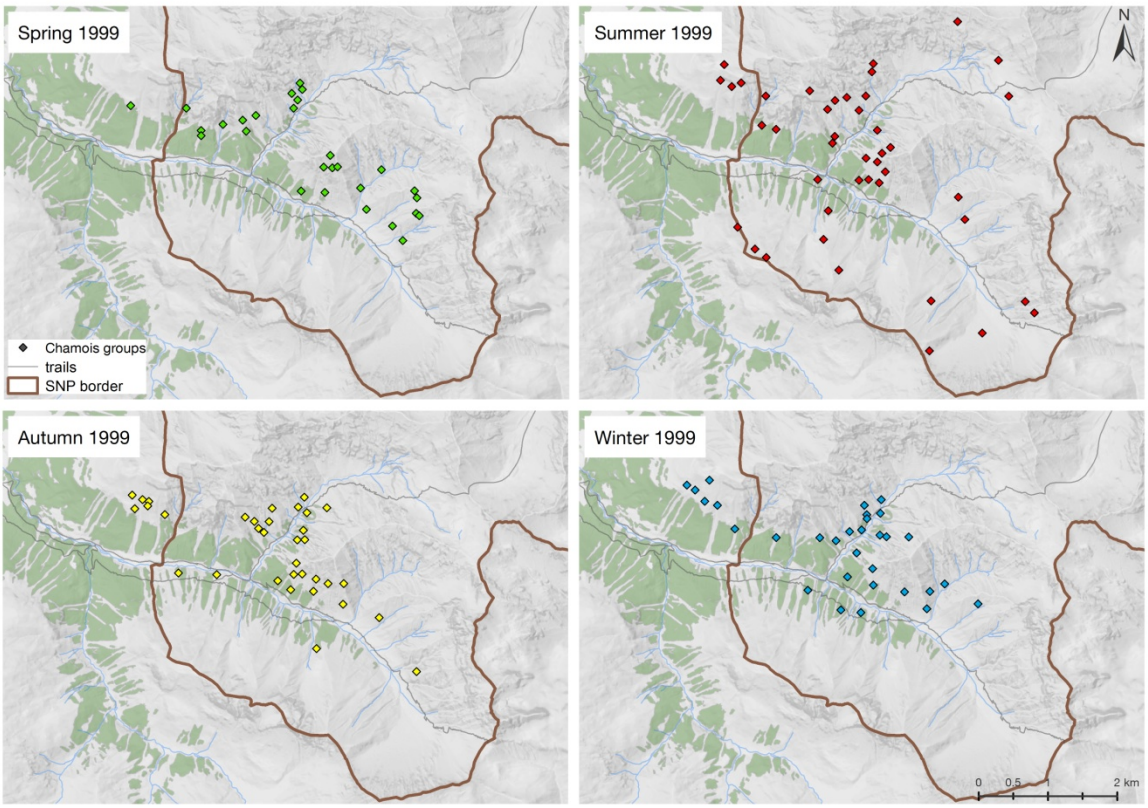
Spring 1999
Summer 1999
Autumn 1999
Winter 1999
Chamois groups
trails
SNP border
N
0
0.5
1
2 km

Fig. 11

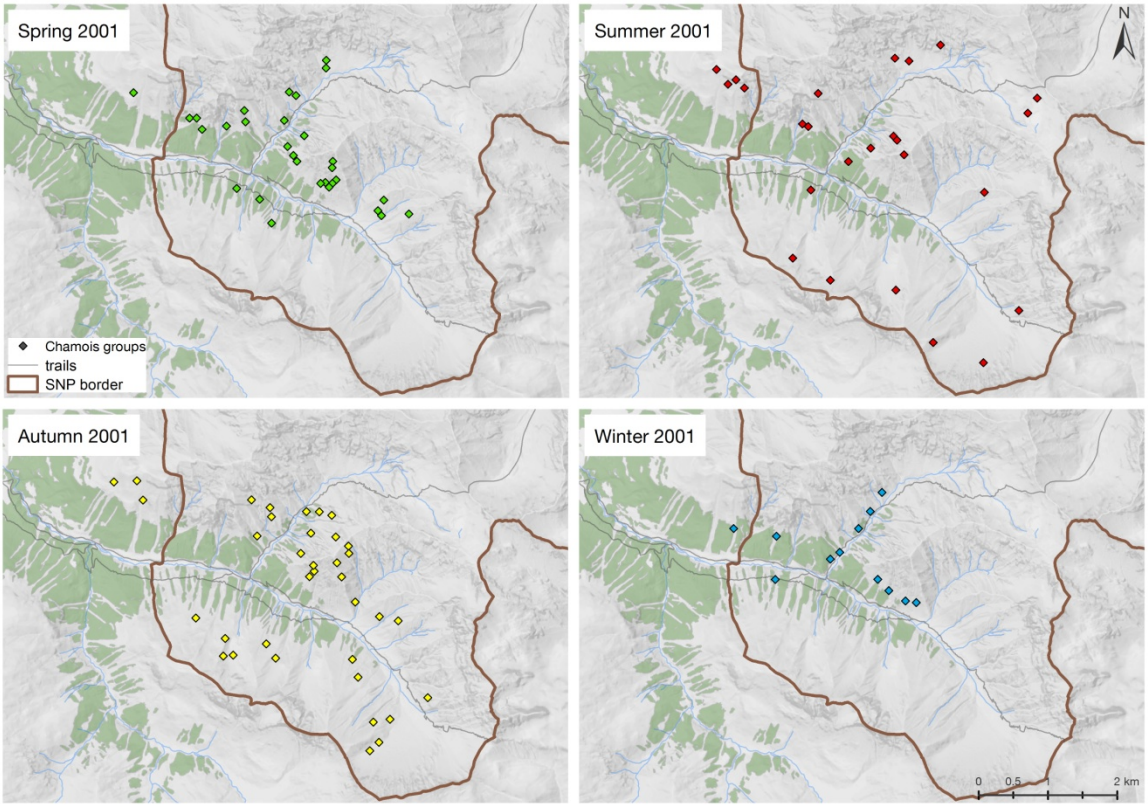
Spring 2001
Summer 2001
Autumn 2001
Winter 2001
Chamois groups
trails
SNP border
N
0
0.5
1
2 km

Fig. 12

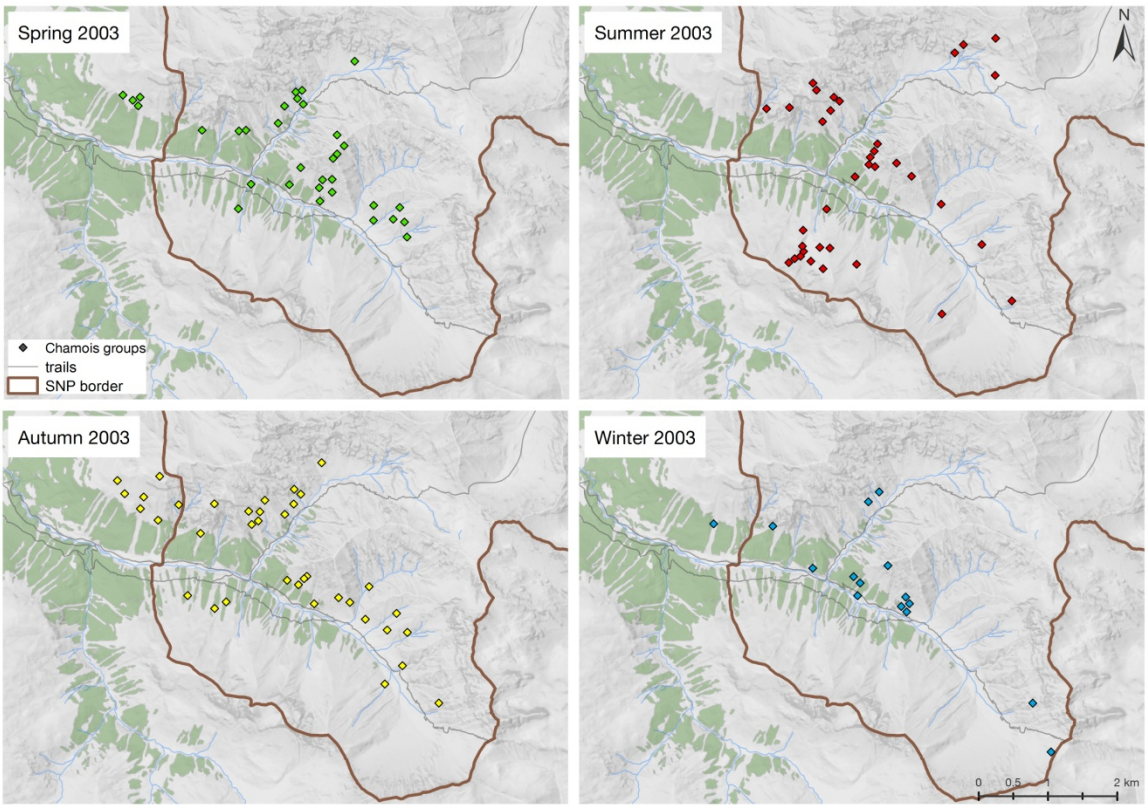
Spring 2003
Summer 2003
Autumn 2003
Winter 2003
Chamois groups
trails
SNP border
N
0
0.5
1
2 km

Fig. 13

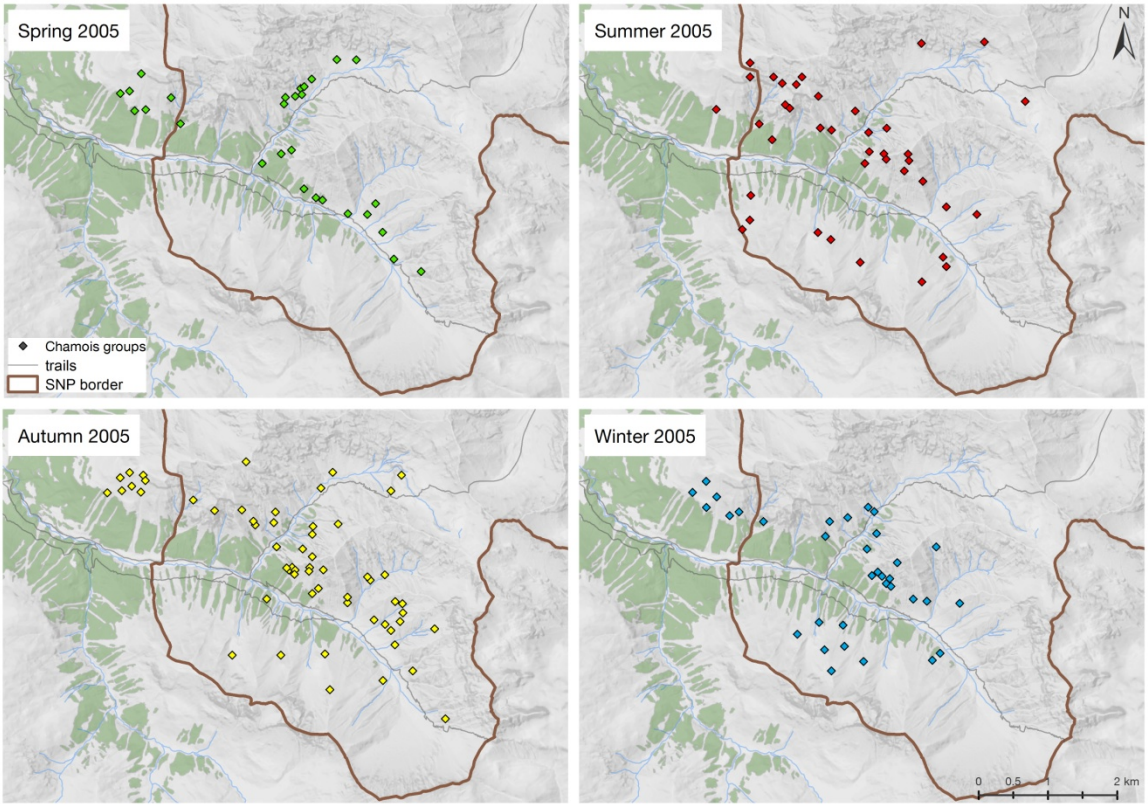
Spring 2005
Summer 2005
Autumn 2005
Winter 2005
Chamois groups
trails
SNP border
N
0
0.5
1
2 km

Fig. 14

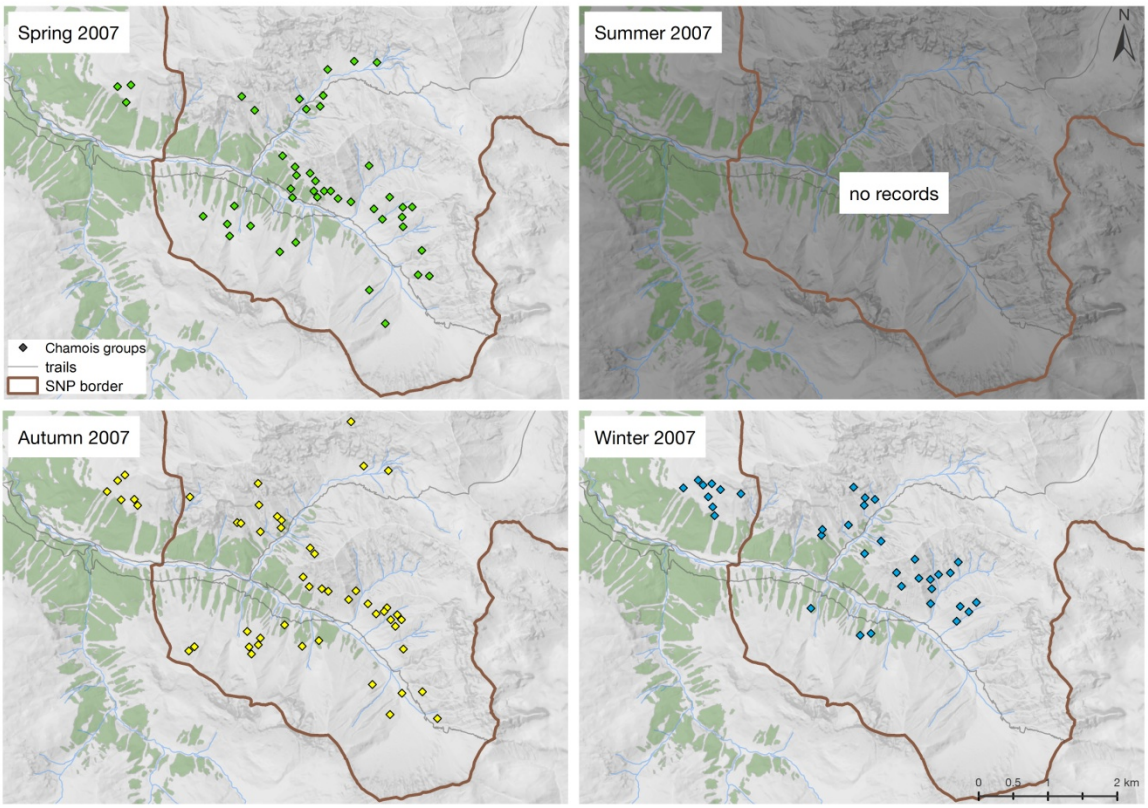
Spring 2007
Summer 2007
no records
N
Chamois groups
trails
SNP border
Autumn 2007
Winter 2007
0
0.5
1
2 km

Fig. 15

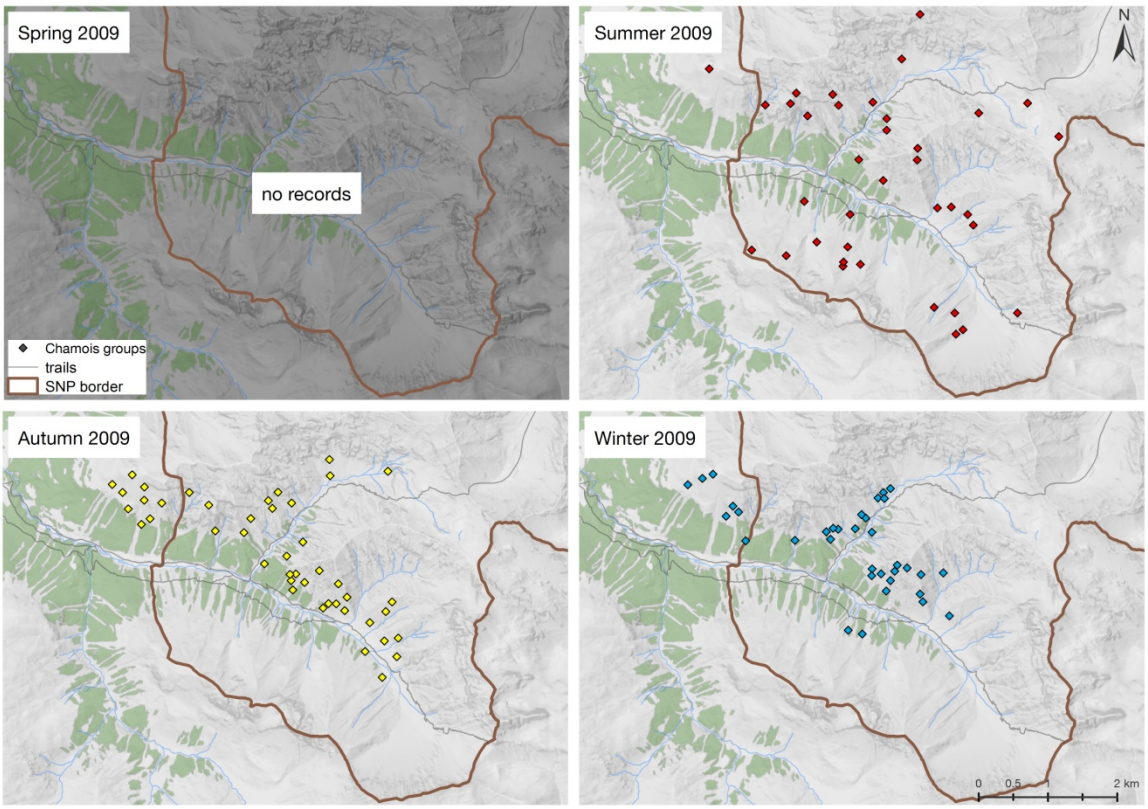
Spring 2009
no records
Summer 2009
N
Chamois groups
trails
SNP border
Autumn 2009
Winter 2009
0
0.5
1
2 km

Fig. 16

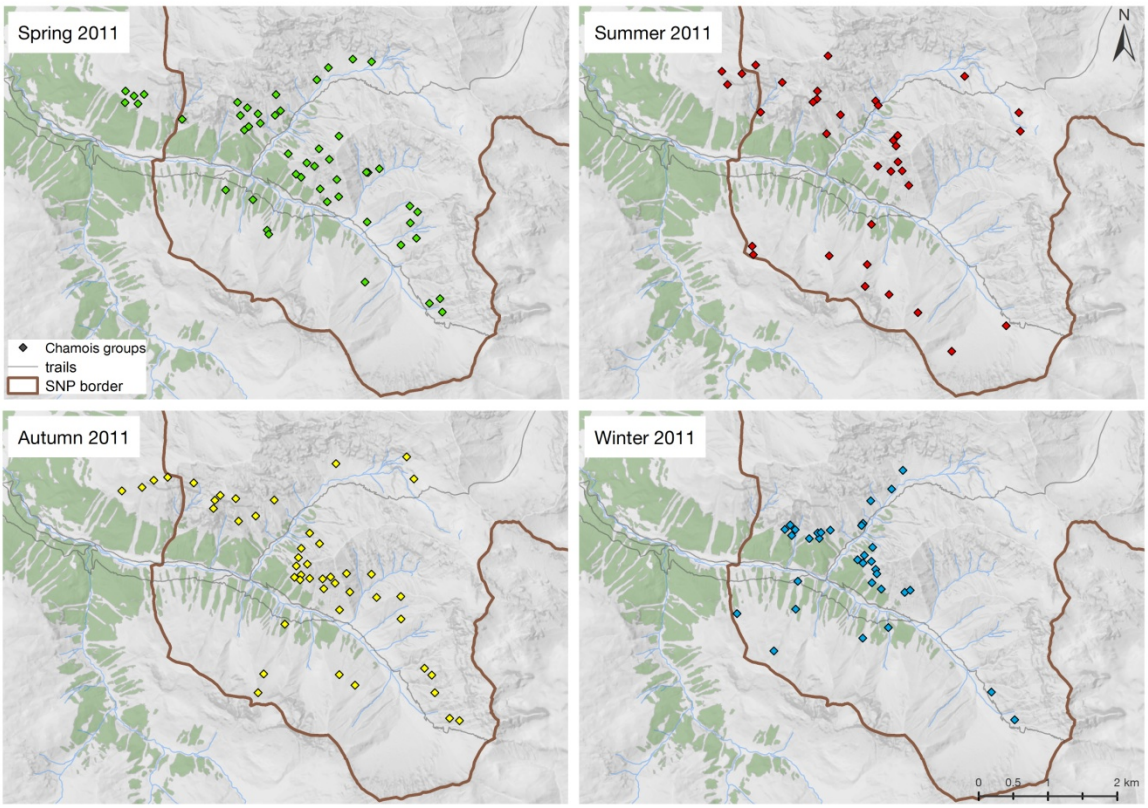
Spring 2011
Summer 2011
N
Chamois groups
trails
SNP border
Autumn 2011
Winter 2011
0
0.5
1
2 km

Fig. 17

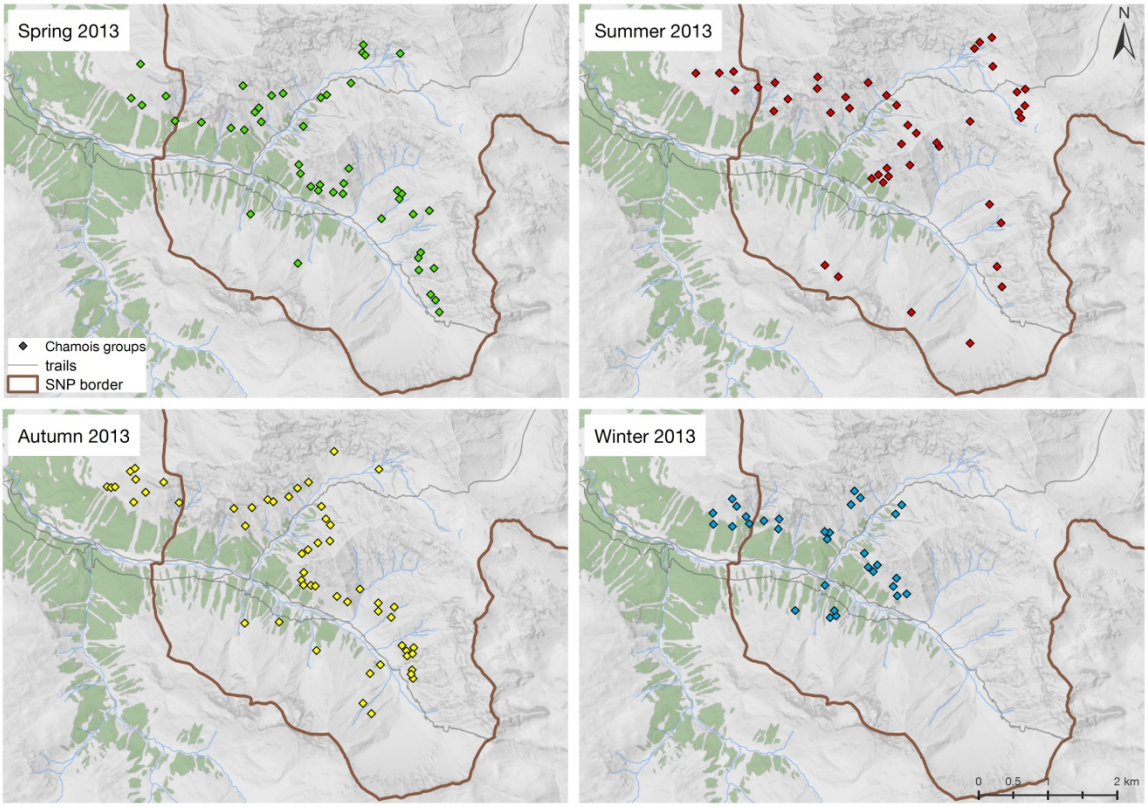
Spring 2013
Summer 2013
N
Chamois groups
trails
SNP border
Autumn 2013
Winter 2013
0
0.5
1
2 km

Fig. 18

Fig. 19-27: Spatial distribution of Red deer in the Val Trupchun. Spring data were collected in May, summer data in August, autumn data in November and winter data in January. “No records” means the mapping did not take place, maps without diamonds indicate that no animals where observed.

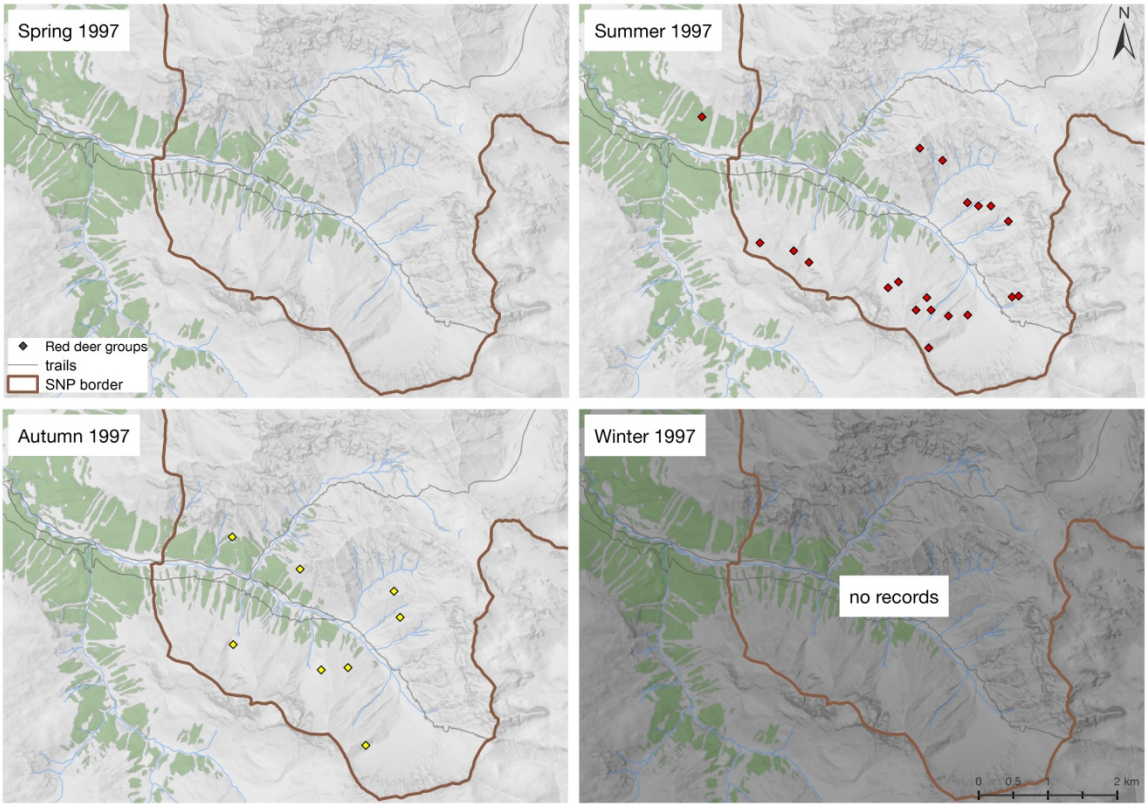

Fig. 19

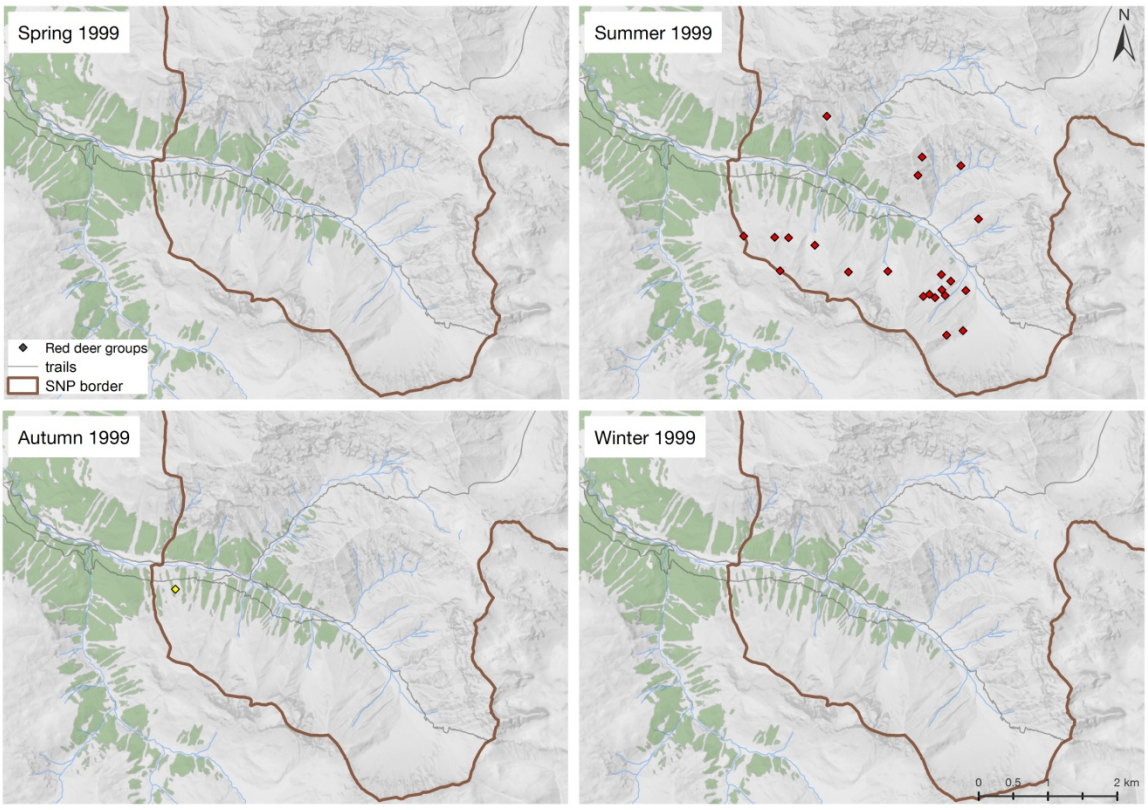
Spring 1999
Summer 1999
N
Red deer groups
trails
SNP border
Autumn 1999
Winter 1999
0
0.5
1
2 km

Fig. 20

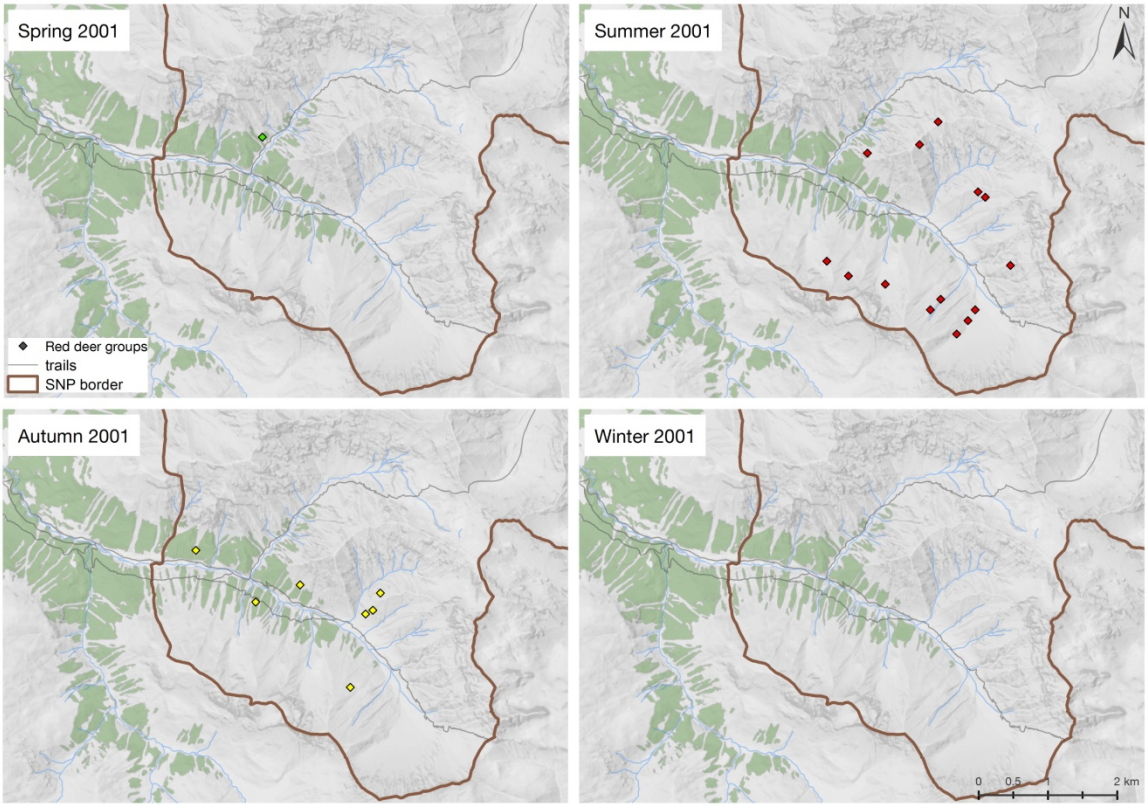
Spring 2001
Summer 2001
N
Red deer groups
trails
SNP border
Autumn 2001
Winter 2001
0
0.5
1
2 km

Fig. 21

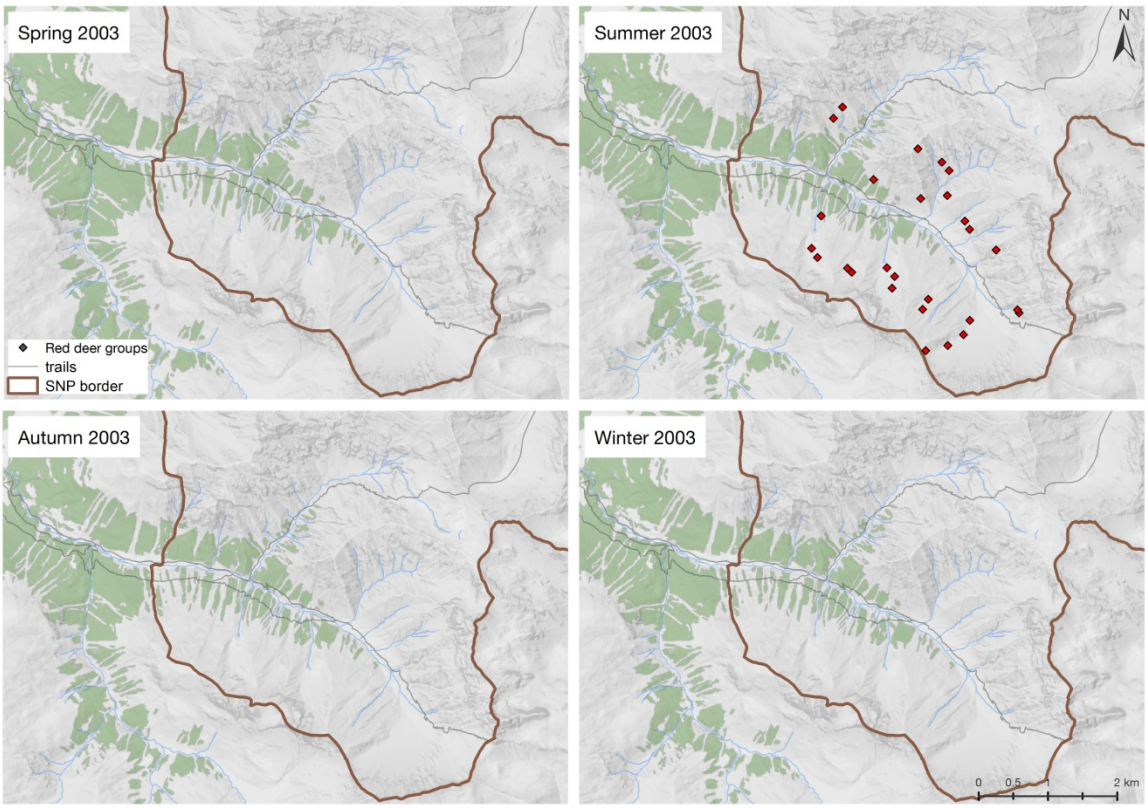
Spring 2003
Summer 2003
N
Red deer groups
trails
SNP border
Autumn 2003
Winter 2003
0
0.5
1
2 km

Fig. 22

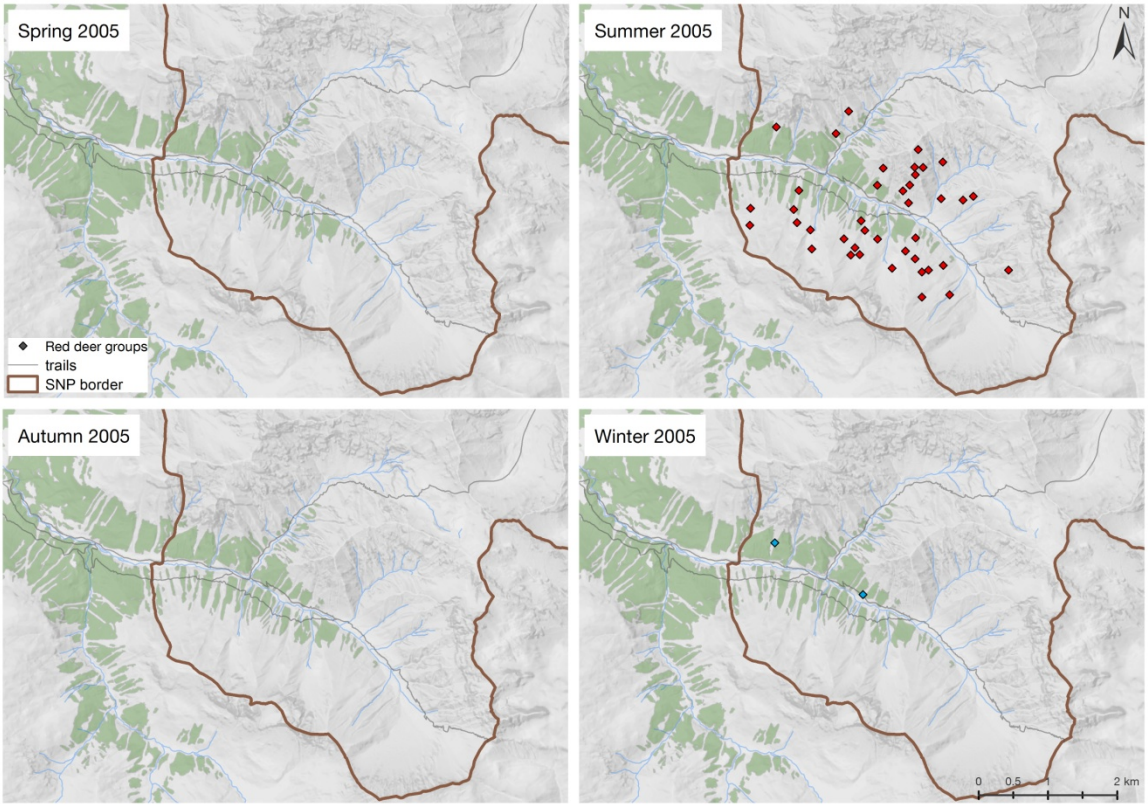
Spring 2005
Summer 2005
N
Red deer groups
trails
SNP border
Autumn 2005
Winter 2005
0
0.5
1
2 km

Fig. 23

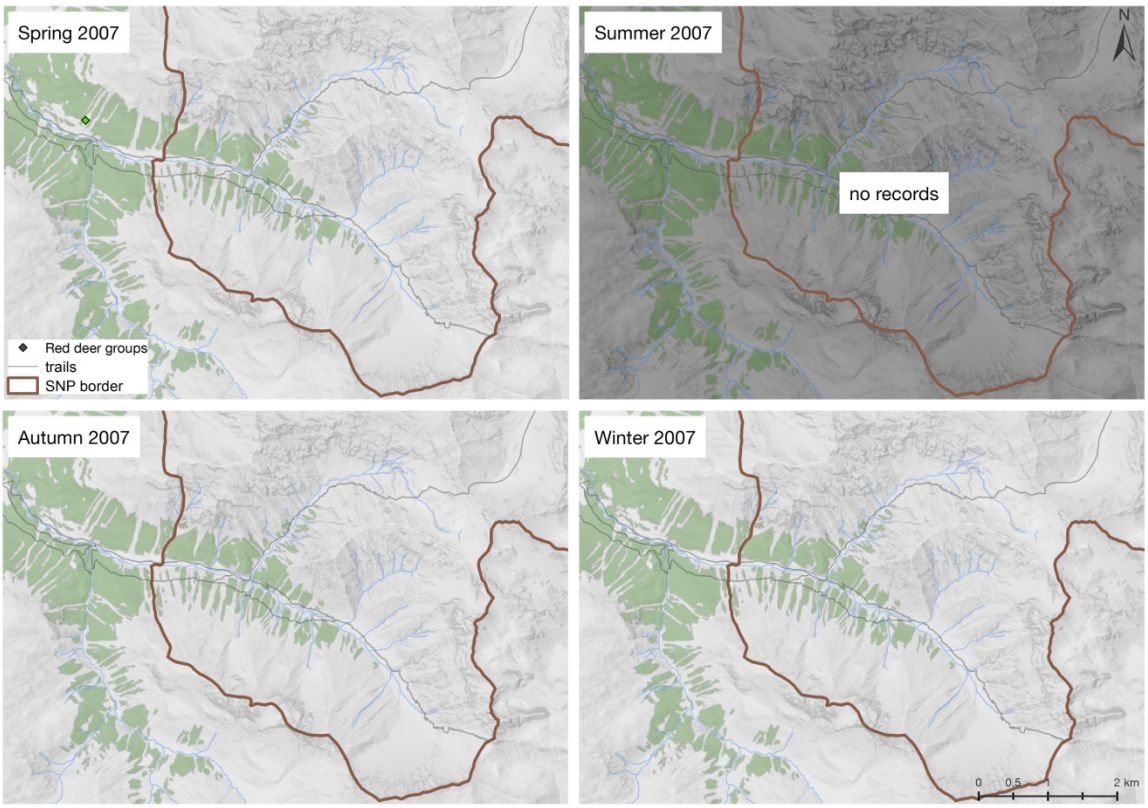
Spring 2007
Summer 2007
N
no records
Red deer groups
trails
SNP border
Autumn 2007
Winter 2007
0
0.5
1
2 km

Fig. 24

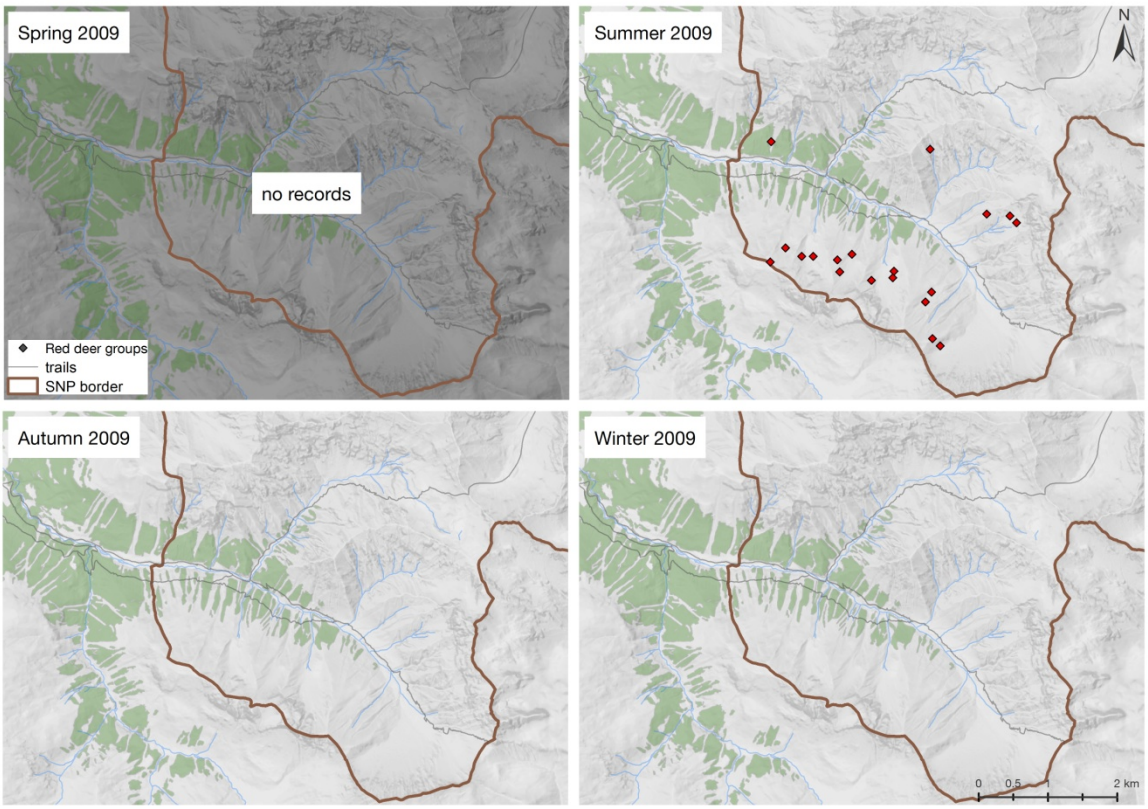
Spring 2009
Summer 2009
N
no records
Red deer groups
trails
SNP border
Autumn 2009
Winter 2009
0
0.5
1
2 km

Fig. 25

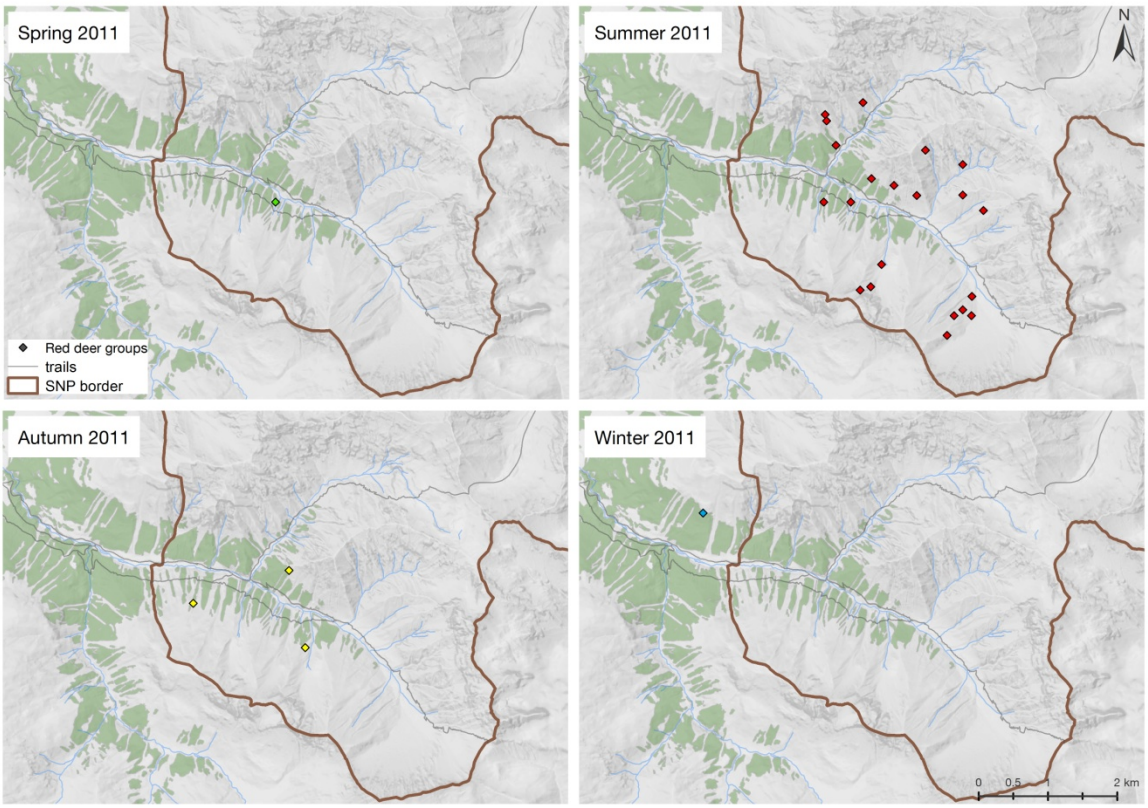
Spring 2011
Summer 2011
N
Red deer groups
trails
SNP border
Autumn 2011
Winter 2011
0
0.5
1
2 km

Fig. 26

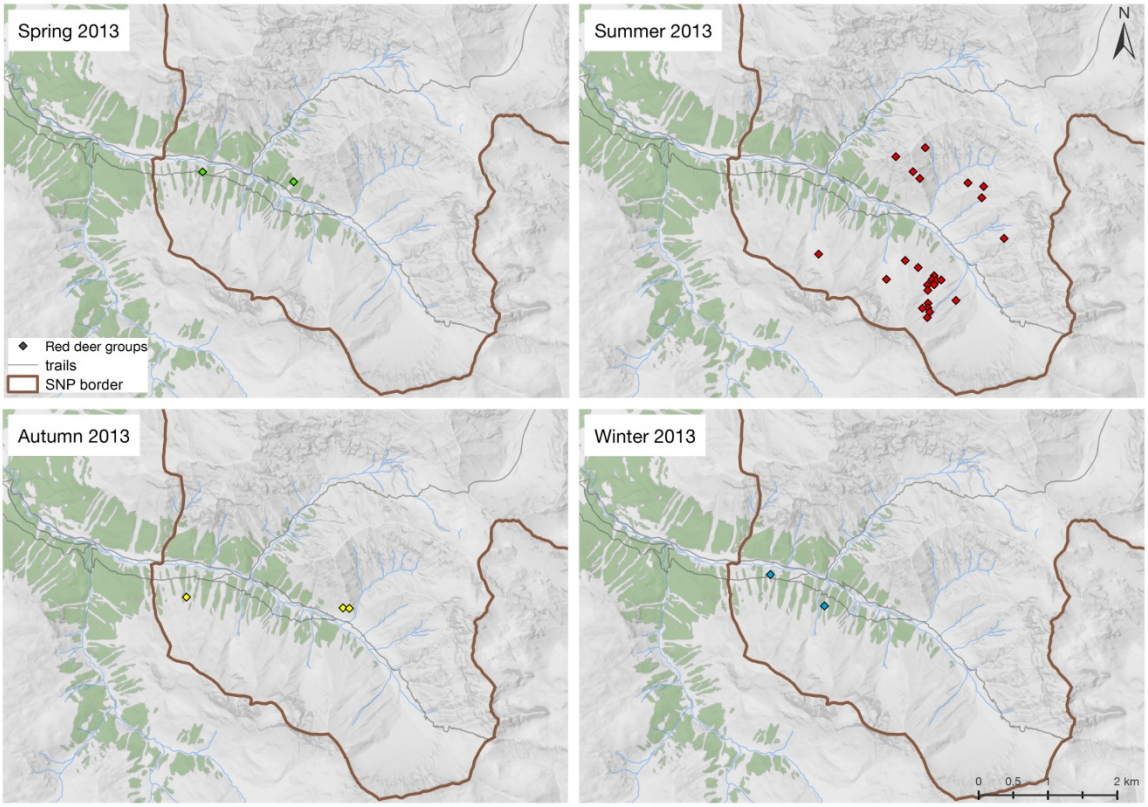
Spring 2013
Summer 2013
N
Red deer groups
trails
SNP border
Autumn 2013
Winter 2013
0
0.5
1
2 km

Fig. 27

Fig. 28 a-d: Boxplots for the altitudes used by ibex in winter (a), spring (b), summer (c) and autumn (d). Horizontal bars represent the median, box heights the interquartile range, and whiskers span 1.5 x interquartile range. Outliers (>1.5 x interquartile range) are not shown. Different letters above the whiskers indicate significant differences ($p < 0.01$) between the groups.

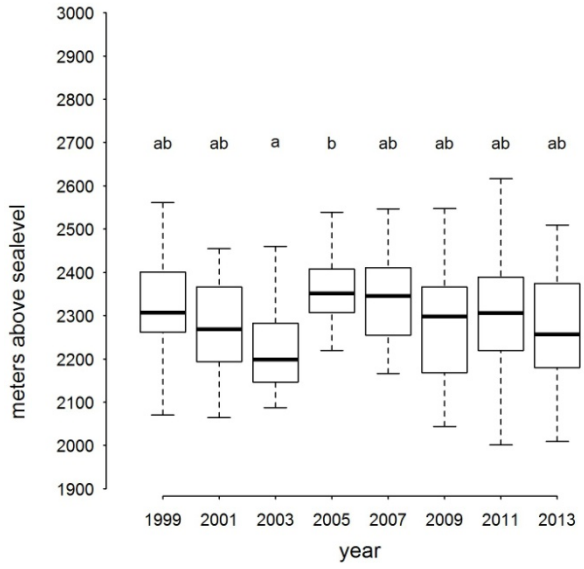

Fig. 28 a

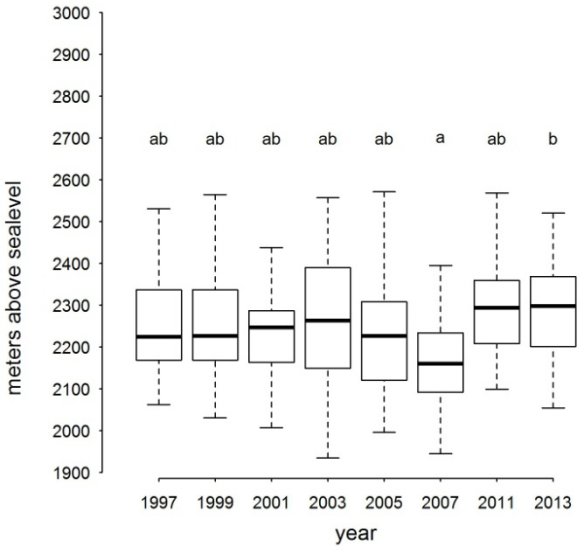

Fig. 28 b

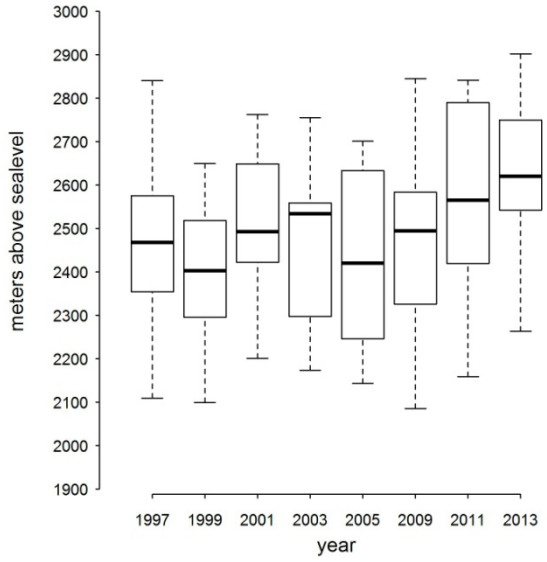

Fig. 28 c

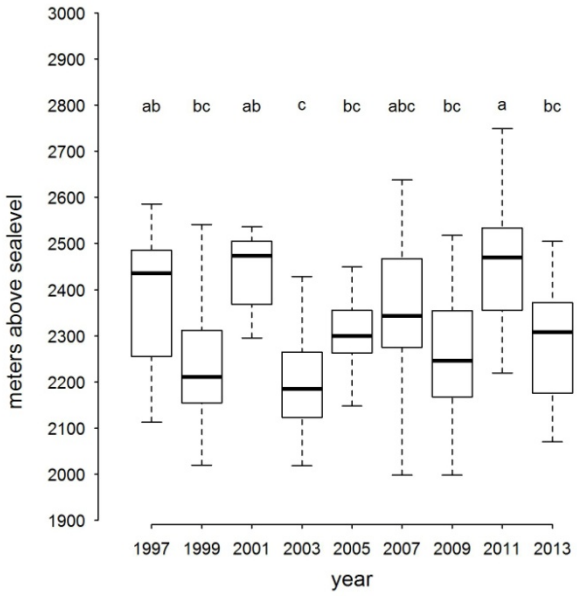

Fig. 28 d

Fig. 29 a-d: Boxplots for the altitudes used by chamois in winter (a), spring (b), summer (c) and autumn (d). Horizontal bars represent the median, box heights the interquartile range, and whiskers span 1.5 x interquartile range. Outliers (>1.5 x interquartile range) are not shown. Different letters above the whiskers indicate significant differences ($p < 0.01$) between the groups.

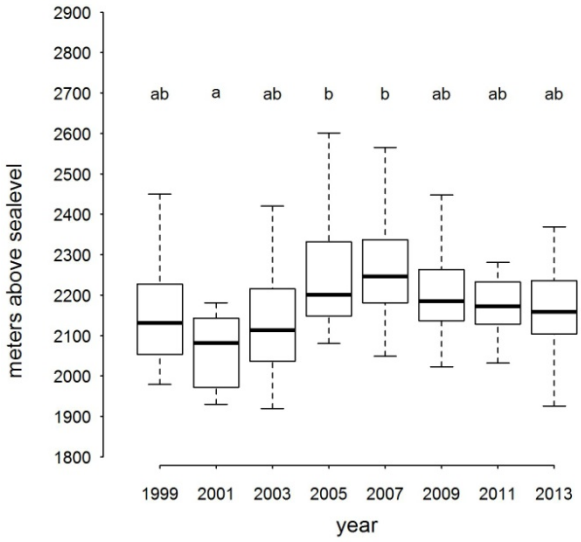

Fig. 29 a

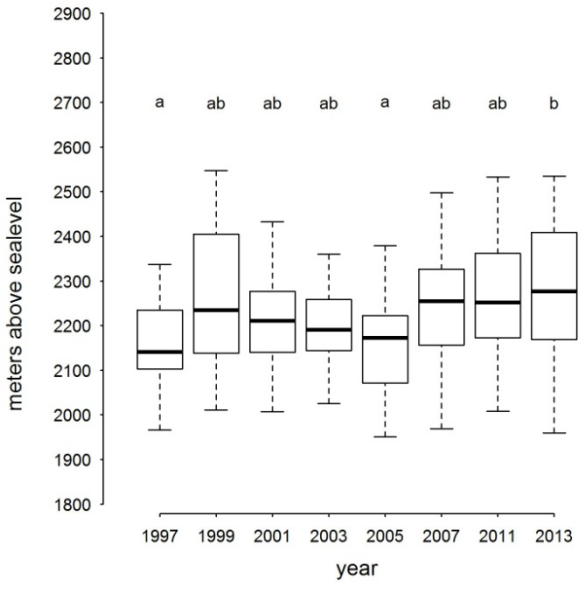

Fig. 29 b

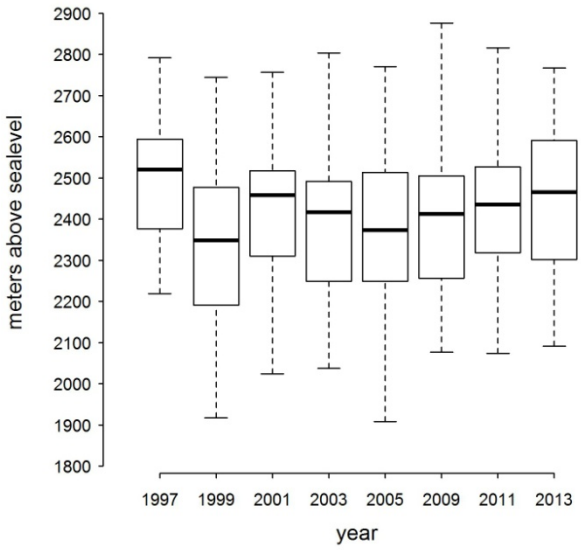

Fig. 29 c

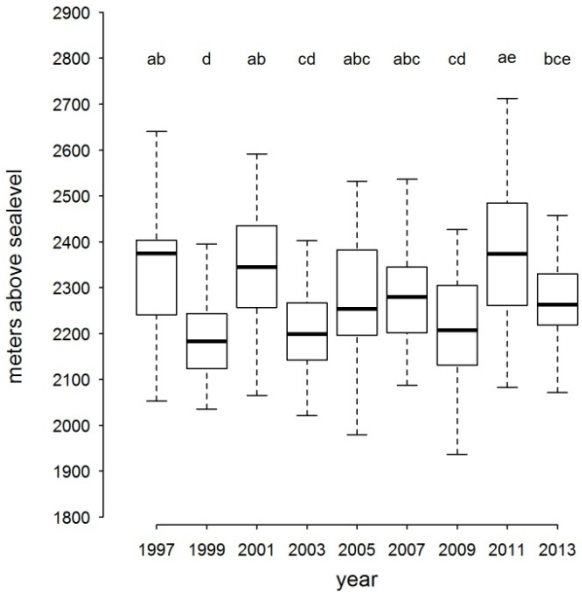

Fig. 29 d

Fig. 30: Boxplot for the altitudes used by red deer in summer. Horizontal bars represent the median, box heights the interquartile range, and whiskers span 1.5 x interquartile range. Outliers (>1.5 x interquartile range) are not shown. Different letters above the whiskers indicate significant differences ($p < 0.01$) between the groups.

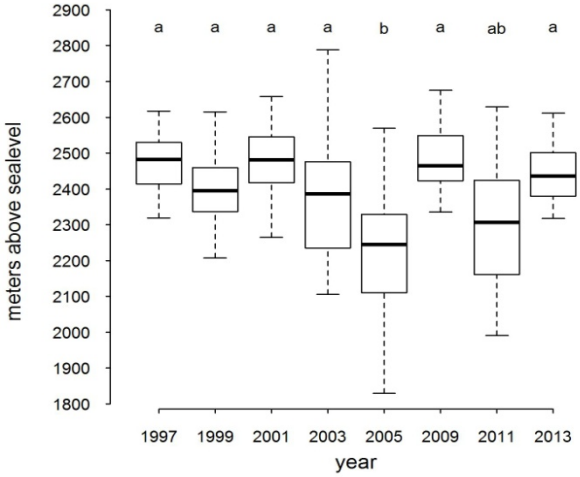

Fig. 30

Discussion

Long term observation data are extremely valuable for the analysis of ungulate space use patterns, given the methodology remains the same over the years. This prerequisite was recognised and considered by the SNP´s management since the beginning of quarterly counting and mapping actions. The procedure follows a standardised protocol ensuring that observation points remain unchanged and the observers count during the same time of the year and the same time of day every season. Furthermore, counting and mapping only takes place in good weather conditions (clear skies, no fog). However, due to weather conditions and logistic reasons (eight observers have to be available) the day of the year does not exactly remain the same. Indeed, the day of the year is only one of several possible standards. The day of the growing season would provide an alternative. Nevertheless, environmental conditions can be quite different between the years and even the day of the growing season can be meaningless, if for example an early onset of spring is followed by cold weather, which is not unusual in Alpine areas. Therefore, it was not surprising to us not to find any trends in altitudinal shift when comparing the animals´ locations during the seasons in different years. In our opinion, small differences in weather conditions and phenological development (reflected in biomass and nutrient content of the vegetation) at the day of the observation are likely more important factors determining the animals' space use. Future studies will focus on quantifying the effects of these factors.