Allegato 2a_3

Monitoring spatial distribution and behaviour of tagged animals

Swiss National Park

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Introduction

Several ibex, chamois and red deer have been ear-tagged in the Swiss National park over the last years. Different colour combinations of ear tags have been used, so that different individuals can be identified in the field by telescope. This point summarises sightings of ear-tagged individuals in general, and their distribution with respect to environmental factors such as habitat type elevation and slope.

Methods

Swiss National Park rangers are in the field almost daily and record all sightings of ear-tagged individuals on a map. These data are subsequently digitised in the office. Data from the following periods have been available:

Ibex	sighting period: 25.06.1992 - 13.11.2013
Chamois	sighting period: 27.06.1996 - 19.11.2013
Red deer	sighting period: 18.07.1992 - 21.10.2013

Only data within the perimeter of Val Trupchun were selected for this analysis. All 3 species can be found within this perimeter, which is therefore suitable for a direct interspecific comparison. However, the number of ear-tagged animals has varied between species, season and different years over the available time period.

Total number of ear-tagged animals:

Ibex:	195
Chamois:	63
Red deer:	28

A general analysis of sighting frequencies of all three species was carried out first. Then an analysis of the sightings with respect to habitat type, elevation, aspect and slope was performed. To investigate habitat type, the sighting locations were intersected with a habitat map (HABITALP[1]). Sightings were also intersected with a digital elevation model (2 m resolution), as well as with a map of aspect and slope in order to obtain a value of each parameter per sighting. Sighting periods were divided into winter (january, february, march), spring (april, may, june), summer (july, august, september) and autumn (october, november, december).

Results and discussion

General

The maximum, minimum and median number of sightings of a single individual was 282, 1, 58 for ibex, 351, 1, 47 for chamois and 439, 1, 71 for red deer during their total sighting period (Figure 1).

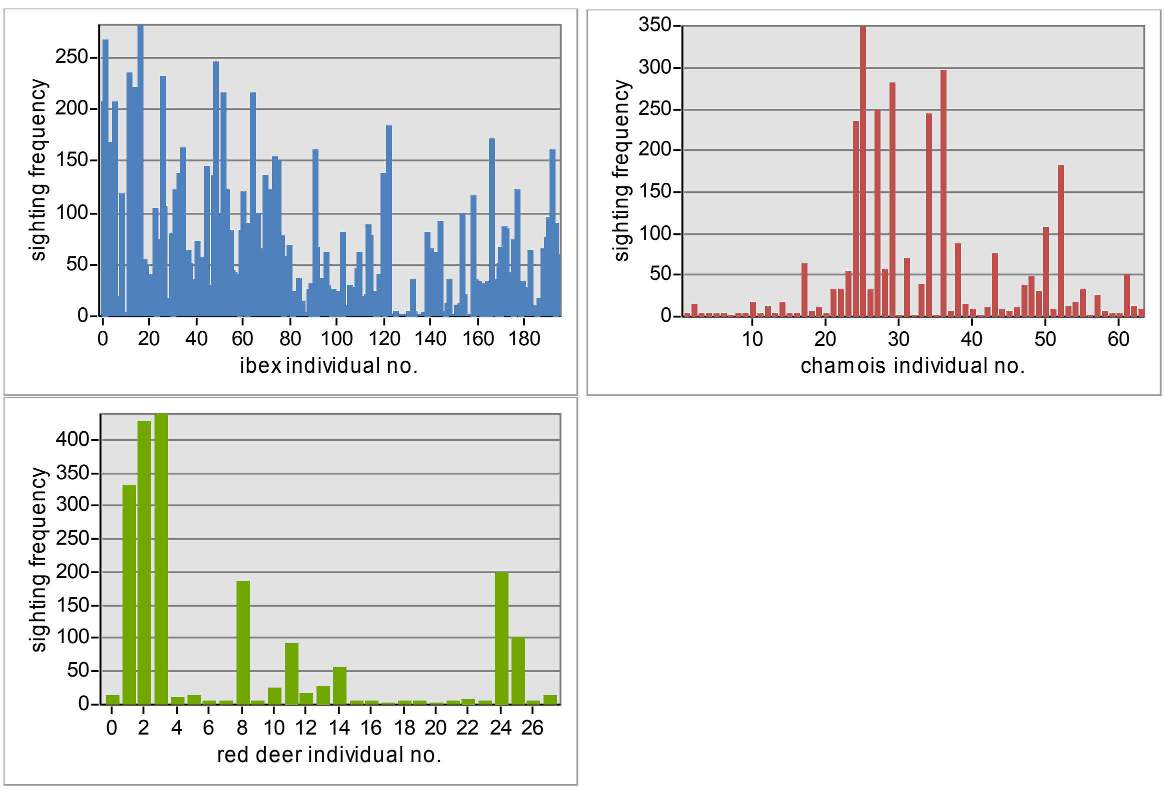

Figure 1: Overall sighting frequencies of Ibex, chamois and red deer in Val Trupchun.

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Red deer have mainly been sighted during summer months. This is due to the fact that red deer stay above the forest line during these months and are therefore more conspicuous (Figure 2).

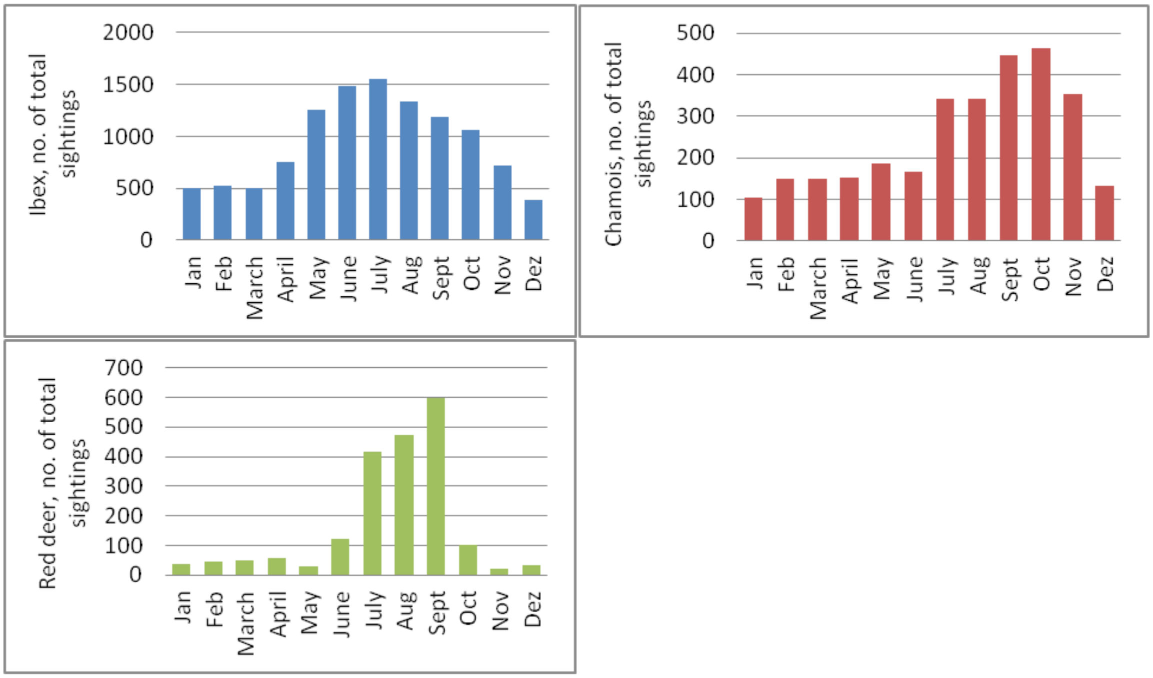

Figure2: Total number of ibex, chamois and red deer sightings per month in Val Trupchun.

The re-sighting rates of individual tagged animals tended to be highest for red deer except in the early (when it was higher for ibex) and most recent three years of the study (Figure 3).

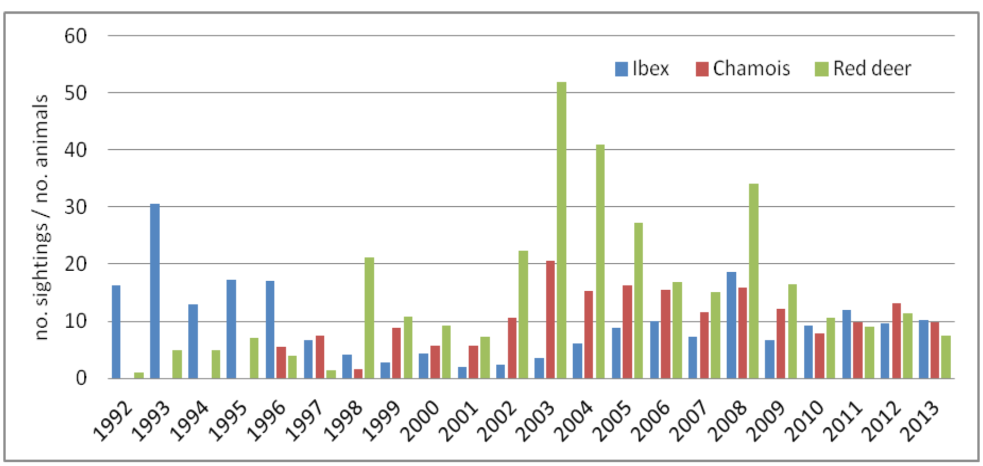

Figure 3: Number of total sightings per number of ear-tagged animal per year

Analysis of habitat type

Figure 4, 5 and 6 show that all three species are most frequently sighted on habitat type 4240, which is subalpine / alpine grassland. Type 5701 (fine boulder) also occurs frequently. The predominance of these habitat types in the dataset may be due to the relative ease of visually detecting animals there (e.g. by comparison to forest).

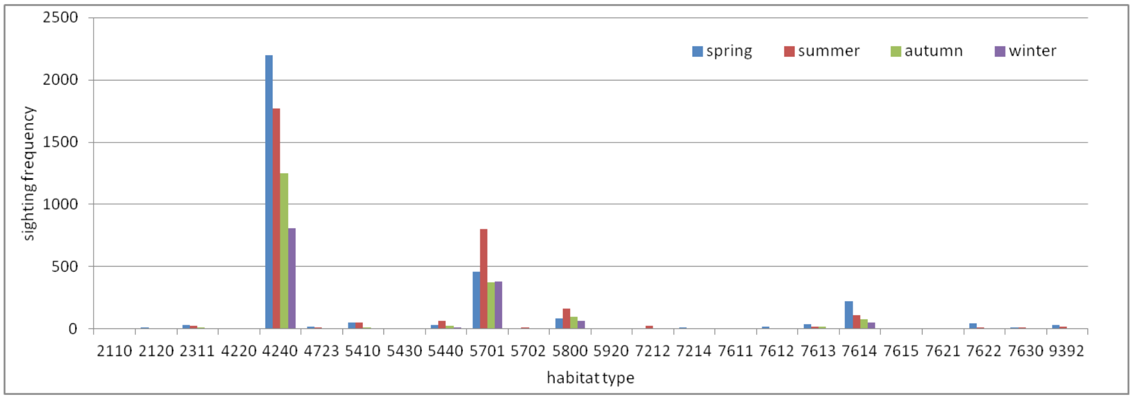

Figure 4: Sighting frequencies of ibex for each habitat type and season in Val Trupchun.

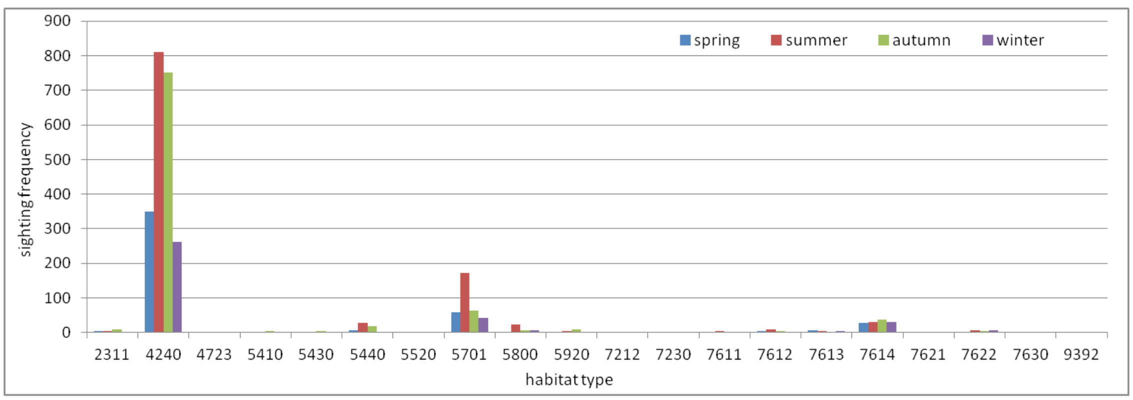

Figure 5: Sighting frequencies of chamois for each habitat type and season in Val Trupchun.

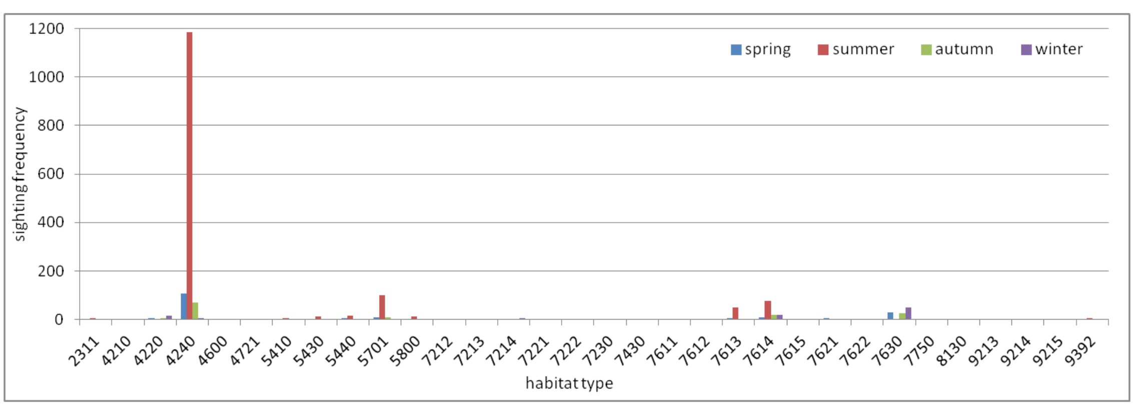

Figure 6: Sighting frequencies of red deer for each habitat type and season in Val Trupchun.

Analysis of elevation

Red deer shows the greatest range in distribution with respect to altitude amongst the three species during spring and autumn. It occurs at somewhat lower altitudes than chamois and ibex, but particularly so in winter. Ibex and chamois occur at similar altitudes, particularly during summer, but with ibex apparently preferring higher altitudes compared to chamois in winter (Figure 7).

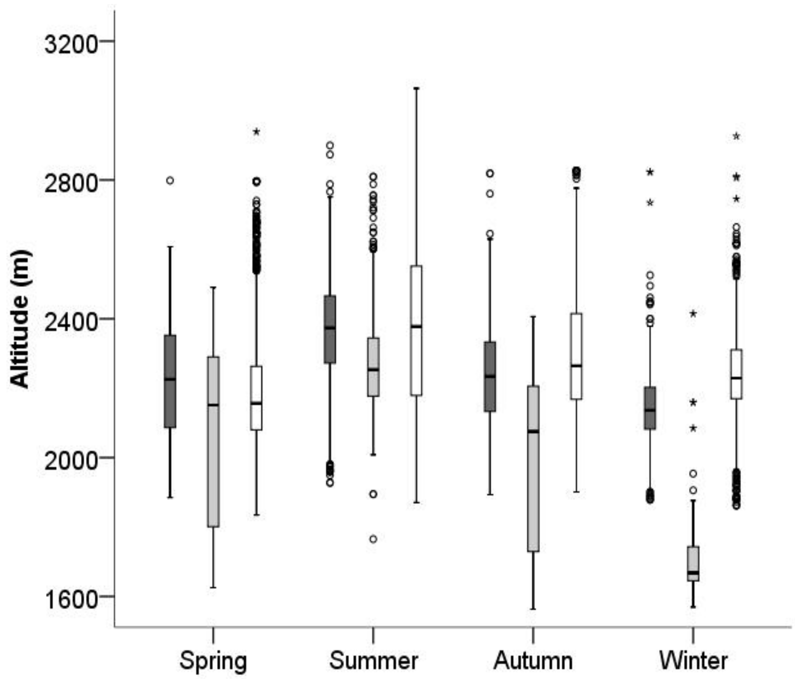

Figure 7: Boxplots of seasonal distribution of chamois (dark grey), red deer (light grey) and ibex (white) according to altitude. Box heights represent values between the 25% and the 75% percentiles, while whiskers represent values within 1.5 x box heights.

The distribution changes to gradually increasing altitudes over the years in summer and autumn, to a lesser extent in spring, but not at all during winter. This may be related to increasing temperatures during summer and autumn and / or diet quality (Figure 8).

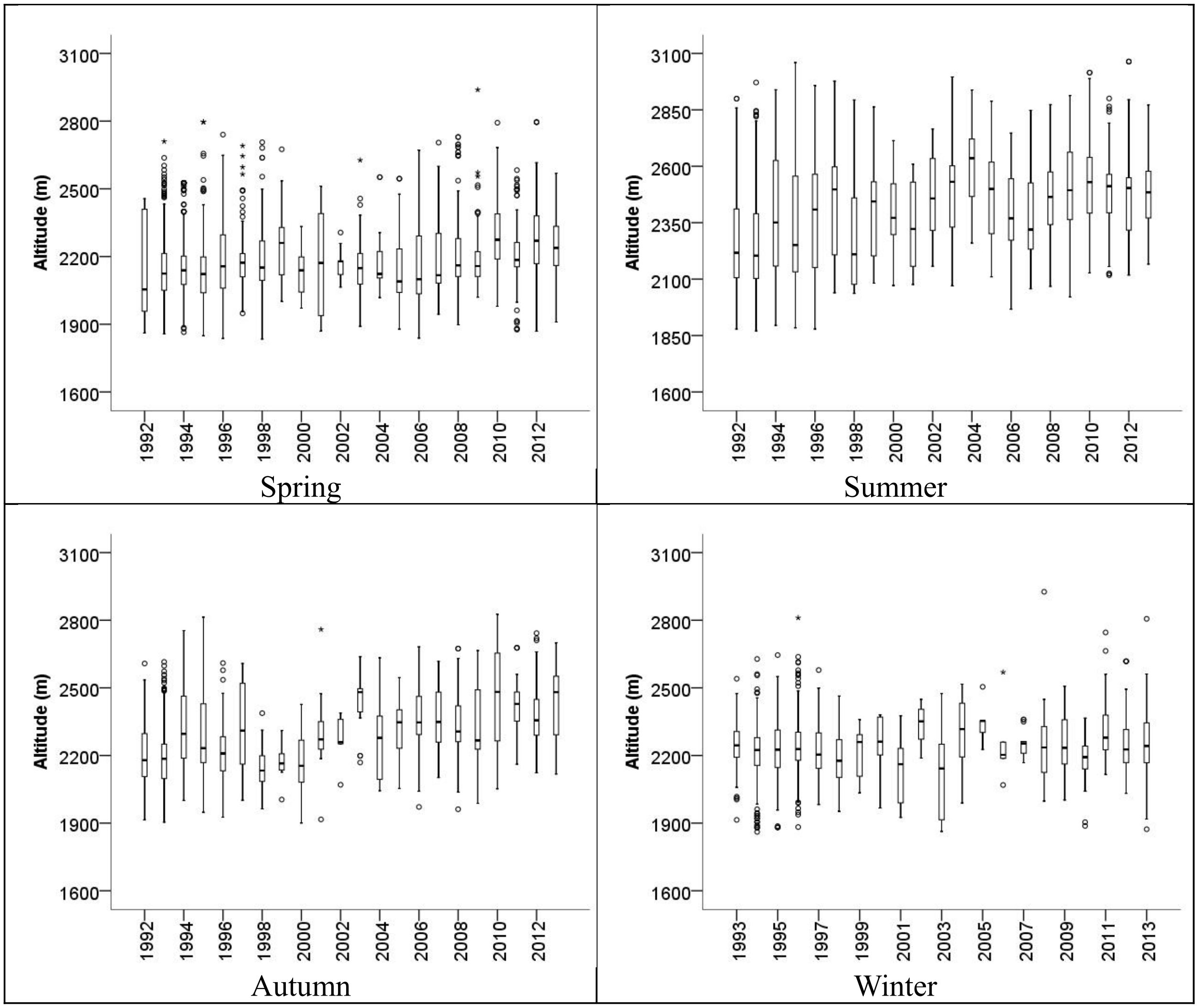

Figure 8: Ibex

As expected, chamois preferred higher altitudes during summer than during winter, with spring and autumn being intermediate. During spring, the animals showed a somewhat cyclical distribution with respect to altitude, with lower altitudes preferred around 2000 and 2009/10 (Figure 9). This may be related to changes in plant phenology.

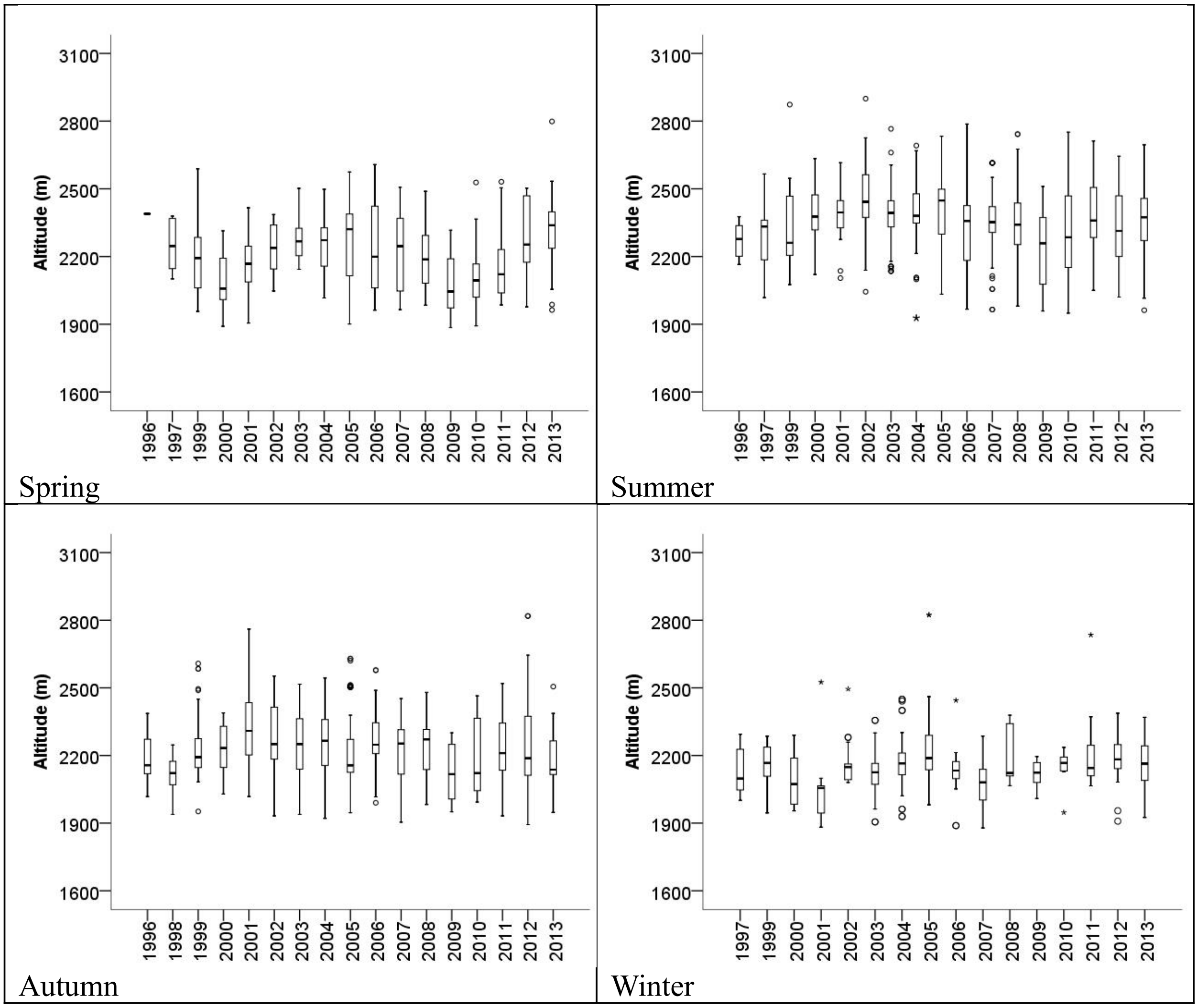

Figure 9: Chamois

For red deer, no obvious temporal pattern could be detected, which may partly be related to lower sample sizes (Figure 10).

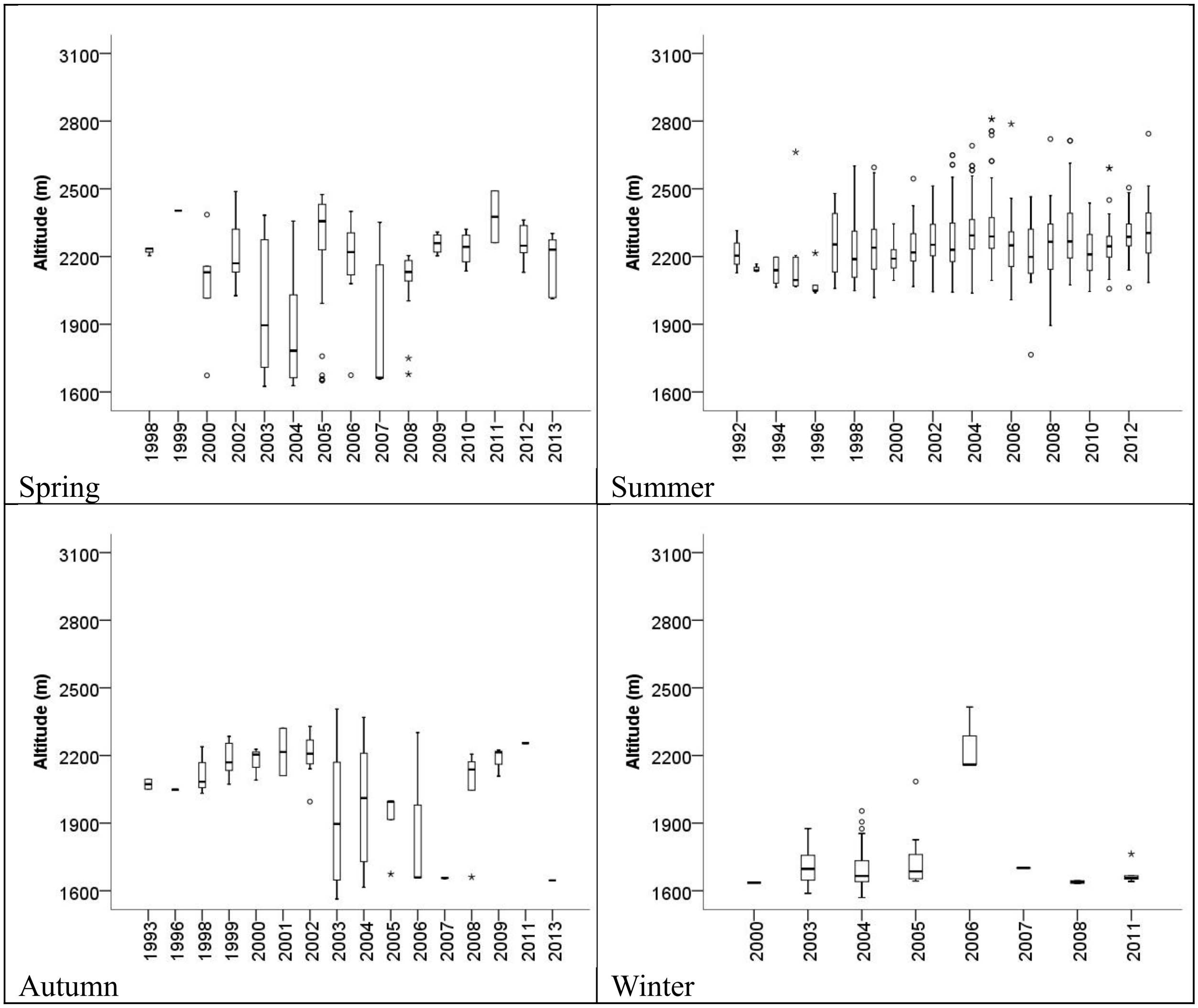

Figure 10: Red deer

Analysis of aspect

While ibex showed a general preference for south and southwest facing slopes throughout the year, both chamois and red deer also used northeast facing slopes extensively during the summer. However, during spring, autumn and winter, chamois also seemed to prefer particularly southwest facing slopes and avoided slopes with a northern or eastern exposure, where the snow remains for longer, during spring and winter (Figure 11).

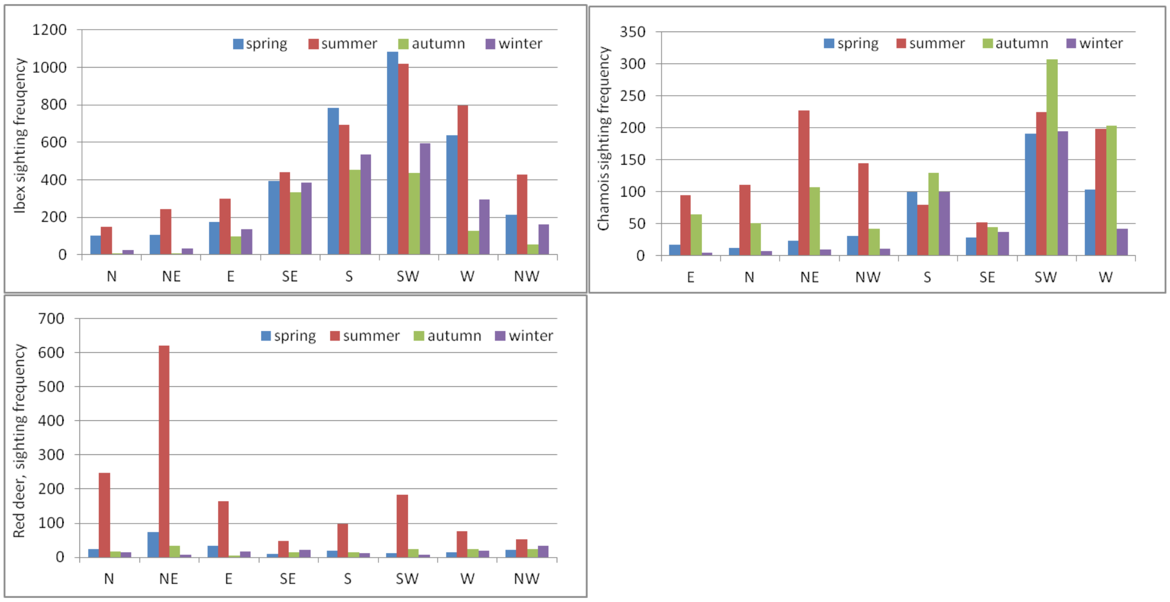

Figure 11: Sighting frequencies of ibex, chamois and red deer by aspect.

Analysis of slope

Ibex preferred steeper slopes in winter compared to spring and summer. In autumn and winter, they also occurred at steeper slopes than chamois. This can be explained by their body shape with its relatively short legs, which is less suited to deep snow than that of chamois. Red deer occurred on the gentlest slopes of all three species throughout the year (Figure 12).

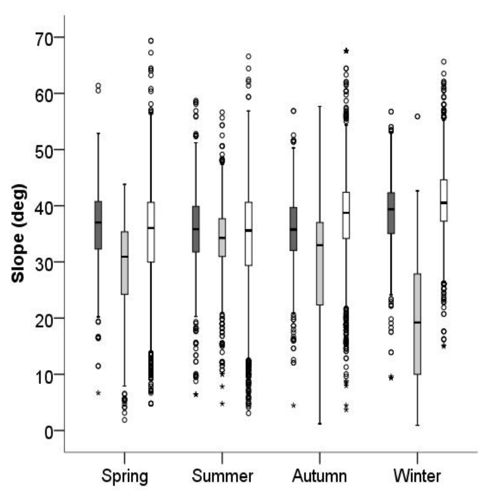

Figure 12: Boxplot of seasonal distribution of chamois (dark grey), red deer (light grey) and ibex (white) according to slope.

Information on species conservation and monitoring

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Ibex are a protected species in Switzerland (Imesch-Bebié et al., 2010), with the conservation and management of populations being specified in the ‚Regulation concerning ibex population management' (SR922.27). The cantons are thus obliged to spatially identify ibex colonies and conduct annual censuses of population size, as well as surveys on age and sex composition. Summer population sizes have to be reported to the federal government.

Errors in population censuses are small (Sæther et al., 2007). Density-dependent regulation of population size, albeit generally weak, has been found in 53.6% of ibex colonies in Switzerland (Sæther et al., 2007). Annual changes in population size of most Swiss ibex colonies are additionally affected by winter climate, as well as precipitation during early summer, though the influence of these factors varies spatially (Grøtan et al., 2008).

Literature

Grøtan, V., Sæther, B.-E., Filli, F. & Engen, S. (2008) Effects of climate on population fluctuations of ibex. Global Change Biology, 14(2): 218-228.

Imesch-Bebié, N., Gander, H. & Schnidrig-Petrig, R. (2010) Ungulates and their management in Switzerland. In: European ungulates and their management in the 21st century (eds: M. Apollonio, R. Andersen & R. Putman). Pp. 357-391. Cambridge University Press, UK.

Sæther, B.-E., Lillegård, M., Grøtan, V., Filli, F. & Engen, S. (2007) Predicting fluctuations of reintroduced ibex populations: the importance of density dependence, environmental stochasticity and uncertain population estimates. Journal of Animal Ecology, 76: 326-336.

Ibex census size

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Introduction

After ibex became extinct in Switzerland by the early 19th century, the first successful reintroductions started in the Swiss National Park in 1920 and continued until 1934. By then, a total of 34 individuals had been released in the park (Nievergelt, 1966). Numerous further reintroductions and translocations have since taken place in other locations in the canton Grison, but also further afield such as e.g. in the cantons of Valais, Bern and Schwyz, and as recently as in 2004 (Imesch-Bebié et al., 2010). The species has now recovered sufficiently in Switzerland to be regionally hunted in limited numbers (Imesch-Bebié et al., 2010).

Methods

Yearly ungulate censuses have been conducted by park rangers in the Swiss National Park since 1918. Ibex surveys were conducted in the first half of August along with censuses for red deer and chamois until 1989. From 1990 onwards, ibex have been counted during the first half of April, coinciding with the maximum number of individuals in the park. The surveys have been carried out from the same observation points each year, and for each sighting, the group size, along with the age and gender of each individual in the group, has been recorded. Errors in census size have been shown to be small for this species in Switzerland (Sæther et al., 2007).

Results

Following the reintroductions, ibex numbers in the SNP steadily increased up to the second half of the 1950‘s, when they plateaued between 250 and 300 individuals and subsequently decreased again to around 150 animals in the mid and late 1970‘s. This was followed by another increase in population size during the 1980’s to a maximum plateau of between 350 and 400 individuals throughout the 1990’s. In the 2000’s, this number has decreased to between 200 and 250 animals again, with the exception of a peak of over 350 and 300 in 2007 and 2008, respectively (Figure 1).

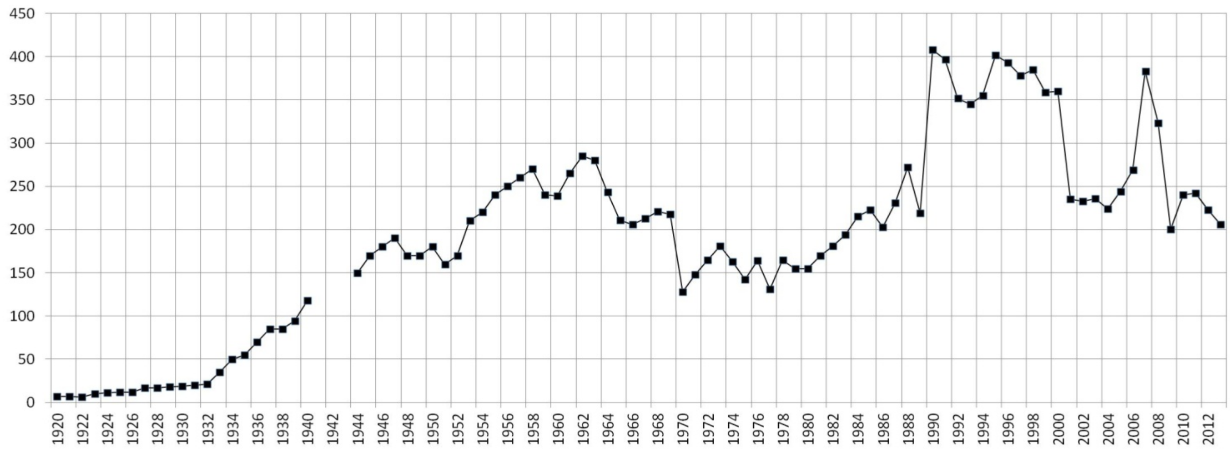

Figure 1. Development of ibex population size in the Swiss National Park from 1920 to 2013. The red vertical broken line indicates the change from summer to spring censuses.

Discussion

The population size increased only slowly in the first years after the reintroductions. However, after the animals had colonised Val Trupchun on their own accord during the 1950's, the population grew more rapidly. The reason was that the valley provided more favourable living conditions than the locations where ibex had originally been reintroduced in the park, particularly with respect to winter habitat (see also 3b3). The change in the timing of counting from summer to spring was responsible for the sudden increase in census size between 1989 and 1990. However, the marked changes in population size between the 1990's and 2000's are real. Population fluctuations of ibex in the Swiss National Park can be explained by a model with theta-logistic density regulation, which happens mainly near the carrying capacity (Sæther et al., 2002). This means that at high densities, population crashes can be severe. Together with the correlation between winter climate and annual variation in population size (Sæther et al., 2002; Grøtan et al., 2008), this explains the marked population declines during the severe winter of 1969/70, as well as the crashes from 2000/01 and 2008/09, when the population size was near its maximum (Figure 1).

References

Grøtan, V., Sæther, B.-E., Filli, F. & Engen, S. (2008) Effects of climate on population fluctuations of ibex. Global Change Biology, 14(2): 218-228.

Sæther, B.-E., Engen, S., Filli, F., Aanes, R., Schröder, W. & Andersen, R. (2007) Stochastic population dynamics of an introduced Swiss population of the ibex. Ecology, 83(12): 3457-3465.