

## Where do red deer come from and where do they go?

Thomas Rempfler

### Keywords

red deer, GPS collar, migration, protected area, management

### Introduction

At the end of the 19th century, red deer (*Cervus elaphus*) immigrated into the Engadine from Austria (HALLER 2002). The population grew rapidly. Repeated occurrences of extreme winter mortality in the 1950's to 1970's indicated high numbers of red deer in the region of the Swiss National Park (SNP). Adaptations in management strategies were adopted including red deer being strictly protected inside the SNP and the hunting season outside the protected area being limited to 21 days in September.

For red deer, the SNP is well suited as a summer habitat, but not as a winter habitat (BLANKENHORN et al. 1979). Since the 1990's, small protection areas around the SNP were implemented to encourage more even red deer dispersal. In that way, other attractive summer habitats were created besides the SNP (HALLER & JENNY 2014). A second main adaptation was an additional hunting period in winter habitats for a maximum of 10 half days in November and December to fulfil the annual hunting quota.

In the project 'Ingio via?' the Hunting and Fisheries Department of the canton of Grisons in collaboration with the SNP maps home ranges and migration routes in the Lower Engadine based on telemetry data. Modern wildlife management requires knowledge about seasonal red deer habitats, the routes they use to reach their summer feeding grounds, the exchange across country borders, the use of protected areas and traditional behaviour year after year.

### Method

Since 2015, we have radio-collared 32 red deer (14 male, 18 female) with locations recorded every hour (GPS Plus collars, VECTRONIC Aerospace GmbH). In anticipation of traditional behaviour, we captured them in 5 different winter habitats. This way, we expected to capture the highest variability in habitat use. In this analyses, we focused on the use of 4 types of protection areas. The first type is areas without any protection. The second is 'Swiss National Park', where no management is allowed, i.e. neither hunting nor any disturbance of wildlife. The third type is 'Wildlife Protection Areas', where hunting is generally prohibited. The fourth type is non-hunting zones, where hunting is prohibited in September, but allowed on the additional hunting days in November and December.

### Results

In 2 years, we collected a total of 239'411 validated GPS 3-D positions. Of these locations, 81 % were outside any protection area, 10 % inside the SNP, 8 % inside a Wildlife Protection Area and 2 % inside a September non-hunting zone. However, when relative use was corrected for the total area of each protection category, red deer used non-protected areas only 0.88x as often as would be expected if relative use was distributed randomly. On the other hand, the SNP was used 1.91x as often as expected by chance, Wildlife Protection Areas 3.2x and September non-hunting zones 3.57x. Relative use of the SNP was high from June to September and peaked in July, while use of Wildlife Protection Areas was low from January to March, peaked in September and decreased towards the end of the year. As only a few individuals used the September non-hunting zones, no trend was apparent here.

For 19 individuals (7 males, 12 females) data were available for at least 1 year. All of these individuals returned to the same wintering areas where they had been captured the year before. Migration routes were repeated the following year and some migration dates were almost identical. Collared red deer from Martina – Seraplana (2 male, 2 female) did not migrate over long distances, but crossed country borders. They did not use protection areas except for one non-hunting zone, mainly from May to July. Collared red deer from Ramosch – Vnà (2 male, 2 female) showed different habitat use between sexes. Males migrated over long distances and crossed country borders to Austria in the north and east, while females migrated over shorter distances and stayed in Switzerland. They all used protection areas, but not the SNP. All collared red deer from Sent – Scuol (3 male, 3 female) migrated to summer habitats in the SNP. They remained there mainly from June to September and also showed intensive use of the Wildlife Protection Areas, but individually for different periods of time. Collared red deer from Ftan – Tarasp (4 female) showed varying habitat use. Two females used their habitats homogeneously and did not migrate. One of them used a Wildlife Protection area in November and December, while the other repeatedly used a part in the north of the SNP throughout the year. This was not the typical summer habitat inside the SNP that other individuals used during this study, among these the two remaining females of this group. A collared red deer from S-charl (1 female) was captured next to the SNP and used it also mainly as a summer habitat from June to September. In that season she used a Wildlife Protection Area too.

All in all, red deer seasonally preferred protected areas. Relative abundance of locations in September showed at an hourly scale that red deer preferred protected areas especially during daytime. However, all individuals remained outside protected areas during daytime too, except for one individual out of ten.

## Discussion

Our data show that individuals from the same winter habitat migrate to different summer habitats and vice versa. Exchange between red deer occurs at a large scale and across country borders. This has to be considered in terms of diseases such as the currently occurring tuberculosis in western Austria, caused by *Mycobacterium bovis* or *Mycobacterium caprae*. Data show further that the mosaic of protected areas stimulates the summer dispersal of red deer. In addition, migration dates and routes of some individuals remain the same between years. This means that traditional behaviour exists. Based on the fact that red deer seasonally prefer protected areas and are distributed both inside and outside them during the hunting season in September, and also outside during daytime, we conclude that management adaptations since the 1990's have been successful. However, management strategies have to remain adaptive because new traditions in red deer behaviour can develop over the years. Therefore, red deer management is optimised by a network of protected areas, as well as short and flexible hunting seasons, but they have to be based on knowledge about species and locally specific behaviour.

## References

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## Contact

Thomas Rempfler  
[thomas.rempfler@nationalpark.ch](mailto:thomas.rempfler@nationalpark.ch)  
Swiss National Park