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Long-term ecological research in protected areas: the example of Alpine ibex in the Gran Paradiso National Park

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Abstract

As an example of a successful Long Term Ecological Research (LTER) in a protected alpine area, here we present the main results of the long term researches on Alpine ibex (Capra ibex) in the Gran Paradiso National Park (GPNP). More than 45 years of regular censuses permitted to test the relative importance of density-dependence and climatic factors on ibex population dynamics. Using an out-of-sample prediction test it was possible to assess the long-term predictive power of a simple model incorporating snow depth and population density. The long-term systematic collection of ibex skulls, found dead for winter starvation, permitted the discovery that horn growth is a good predictor of the onset of senescence in males. The repeated measurement of body weights of individually tagged ibex, using a remotely controlled platform scale, and the regular monitoring of fecal egg counts of nematode parasites over many years, are providing new insight on the-individual variability in these life-history traits. The ongoing LTERs on Alpine ibex in the GPNP are providing essential information on the factors influencing the population dynamics and life history of this species.

Keywords

Long term research, LTER, Alpine ibex, Gran Paradiso National Park, Population dynamics, survival, senescence

Project aims and duration

Long term data on population dynamics and life history of large herbivores are essential for their conservation and management. Alpine ibex (*Capra ibex*) is the flagship species of the Gran Paradiso National Park where it has been the subject of ongoing long term ecological researches (LTER) with the aim of understanding the main factors regulation the population dynamics and the life history of this species. Regular censuses have been conducted in the GPNP since 1956. We examined ibex skulls collected between 1988 and 1997. The ongoing Alpine ibex life history research project started in 2000.

Area of study

The GPNP was established in 1922 in northwestern Italy (45° 25'N, 7° 34'E), in part to protect the only surviving population of Alpine ibex. The park is bounded on the west by the Parc National de la Vanoise in France. The GPNP is composed entirely of mountainous terrain and is sparsely populated by humans. Alpine pastures, moraines, cliffs, glaciers and rock account for 59% of its 720 km^2 area. Ibex use elevations ranging from about 800m above sea level to beyond the upper limit of vegetation at about 3200 m. Long term data on the life history of individual ibex are being collected on free-ranging individually tagged alpine ibex males (N = 83), in the study area of Levionaz, Valsavaranche (GPNP). Most of the Levionaz study area lies above the tree line, above 2300 m a.s.l.

Methods

A total count of alpine ibex is conducted in the GPNP each year at the beginning of September, along trails and from fixed locations within each surveillance area. Ibex skulls of animals found dead for winter starvation, are systematically collected and conserved in the GPNP. The exact age at death in years was determined by counting the clearly separated growth annuli. The length of each annulus was measured for both horns, along a central line on the back of the horn. Alpine ibex males aged 3-16 years were life-captured with a dart-gun in the study area of Levionaz (GPNP). The captured individuals were marked uniquely with different combinations of coloured ear-tags or with differently coloured radio-collars. Individual males in Levionaz were repeatedly weighed from June to September each year with an electronic platform scale baited with salt

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(BASSANO et al. 2003). Faecal egg counts of nematode parasites (FEC) were estimated twice a month from all individually tagged males in Levionaz in 2000-2004. Survival of each individually tagged ibex is monitored every year.

Results

More than 45 years of regular censuses permitted to test the relative importance of density-dependence and climatic factors on ibex population dynamics. Yearly changes in total population were correlated with seasonal average snow depth and population density over the 39 years for which climate data were available. Our results show that the ibex population size was limited by both density dependence and deep snow. A model based on these factors fit to the first 19 years of data was used to forecast subsequent changes in total population based on initial population size and yearly snow depth. The model was able to predict the increase and subsequent decline in total population size over the final 20 years of the study (JACOBSON et al. 2004).The long-term systematic collection of ibex skulls, found dead for winter starvation, permitted to test the hypothesis if the size of horn annuli predicted annual survival probabilities in males. Between 5 and 11 years of age, individuals that grew shorter annuli than the population average had a greater probability of mortality over the following years than males with greater rates of horn growth. Annulus size, reflecting the onset of senescence, appeared to be a good indicator of individual quality in Alpine ibex males (VON HARDENBERG et al. 2004). The long term Alpine ibex life-history research project conducted in Levionaz showed that between-individual variability in FEC was higher than within-individual variability in all five years of study suggesting individual differences in parasite resistance, possibly of genetic origin. Body mass increased with age peaking at 12 years, suggesting late maturity in this population. The number of nematode eggs in faeces also increased with ibex age but appeared to peak after 12 year of age. Reduced parasite resistance may be a cost of reproduction for older males or a sign of senescence (VON HARDENBERG, 2005).

Discussion

Many ecological processes can only be fully understood if studied over long temporal scales. Also ecological changes, crucial for conservation, can only be detected with adeguate long term monitoring. Despite their importance, however, long-term ecological researches (LTER) are not common because they require the long-term commitment of human and financial resources. The lack if immediate short-term benefits of LTER may have further discouraged their implementation.

The LTERs and monitoring prjects on Alpine ibex in the GPNP are providing essential information on the factors influencing the population dynamics and life history of this species. We believe that this knowledge will be useful for ibex conservation and management beyond the borders of the GPNP. Protected areas in the Alps offer great opportunities for LTER. National and natural parks typically can rely on the long-term work of qualified park wardens. Furthermore parks generally have a tradition in the long-term monitoring of species and habitats.

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