Borrowing from Burrowers: Conservation Lessons from Alpine-Dwelling Marmots

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Figure 1. Adult male Vancouver Island marmot (Marmota vancouverensis) *at Haley Lake Ecological Reserve on Vancouver Island, British Columbia, Canada, 1998.*

Alpine dwelling marmots across the northern hemisphere face a variety of pressures influencing their populations. Eurasian marmot species face direct threats such as hunting and agriculture while North American species face indirect and subtle threats such as landscape alteration and climate change. Studies on three marmot species in North America (yellow-bellied, hoary, and Vancouver Island marmots) have shown that indirect anthropogenic impacts from landscape and climate change on alpine ecosystems have been detected and can easily be measured in marmot annual cycles, demographics and changes in abundance. These characteristics are suitable criteria supporting the role of marmots as a model taxonomic group to serve as indicators of change in alpine ecosystems.

Mountain ecosystems are characteristically both spatially and temporally variable owing to extreme topography and weather, making detection of subtle and long term effects of climate and landscape change is difficult. Alpine species that display easily measured responses to environmental change may serve as useful indicators of long term change in alpine ecosystems.

Marmot Ecology, Value, and Threats

Marmots *(Marmota spp.)* are large (2-10 kg), burrowing squirrels with 12 of 14 species occurring in the mountain areas of North America, Europe, and Asia [1]. Marmots spend about eight months of the year in winter hibernation, emerging in spring often before snows have melted and there is access to vegetation. Due to the constraints of a short growing season, marmots reproduce soon after emergence from hibernation and give birth to a single litter per year. Pups emerge above ground in time for peak vegetation production and have only a few weeks to accumulate sufficient fat reserves before entering hibernation with other marmots in fall.

Marmots in Europe and Asia have been directly impacted by human activities for centuries. Agricultural practices, subsistence and commercial hunting, and pest control have severely reduced marmot populations both historically and currently. Several species are currently threatened and others are recovering from historical impacts following reintroduction and relocations efforts that began nearly 200 years ago [2].

In North America, marmots have little economic or cultural value and have therefore little direct impact from humans. Instead, human impacts on North American marmots appear to be largely indirect. For example, long-term studies of yellow-bellied marmots in Colorado show that climate change may be influencing the annual cycle of hibernation [5]. Yellow-bellied marmots are emerging 23 days earlier than they were 25 years ago, and are also emerging in deeper snow, which delays their access to spring vegetation.

Case Study 1: Landscape Change and the Vancouver Island Marmot

Lower-elevation human activities may have had severe impacts on the subalpine dwelling Vancouver Island marmot (Fig. 1), an endangered marmot, endemic to Vancouver Island, Canada [6]. Marmot populations increased following a burst of forest harvesting during the

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Figure 2. Hoary marmot (Marmota caligata) *near Moraine Lake in Banff National Park, Alberta, Canada, 1992.*

1980s as marmots colonized clearcuts. Marmots in natural subalpine meadows began rapidly declining in the early 1990s followed by declines in clearcuts [3, 4]. The Vancouver Island Marmot is the most endangered mammal in North America. Only 25 known wild marmots were alive before entering hibernation in the fall of 2002. Another 63 marmots are distributed among four captive breeding facilities across Canada with the goal of eventually repopulating alpine areas in the near future.

Case Study 2: Climate and the Hoary Marmot

Hoary marmots (Fig. 2) in the southwest Yukon also show demographic sensitivity to temporal variation in climate. A population study of hoary marmots has been conducted since 1999 in an alpine valley near Kluane National Park. The timing of snowmelt is highly variable (up to one month difference among years) and is reflected in reproduction and survival of marmots. Birth rates, weaning rates, litter size, and pup survival are lower when snowmelt is earlier (Karels and Hik, unpublished data). Understanding these short-term responses to climate allow us to make predictions about the long-term effects of changes in snowmelt as a consequences of climate change.

Marmots as an Indicator of Change in Alpine Ecosystems

Other alpine species may also be influenced by environmental change induced by the indirect effects of human activities. The responses of marmots to environmental variation and change are readily detected, and, therefore, marmots meet the basic criterion of an indicator of change in alpine ecosystems. Marmots are easy to observe, census, and have high site fidelity. Their circumpolar distribution facilitates the establishment of long term monitoring sites throughout the alpine regions of the northern hemisphere to serve as indicators of the state of mountain ecosystems.

References

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Information on the history, status and recovery efforts for the Vancouver Island marmots is available from the Marmot Recovery Foundation (www.marmots.org) and from the Centre for Biodiversity Research, University of British Columbia (www.biodiv.ca/marmot).