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## Mountain Marmots of the Karakoram

Daniel T. Blumstein<sup>i</sup>

As I cycled around Khunjerab Pass in July 1987, I was struck by the large numbers of easily observed marmots. Marmots are large (3-5kg.) ground squirrels found throughout the Northern Hemisphere. "Like prairie dogs in Colorado," I remarked to my cycling companion. We stopped and watched golden eagles, Tibetan red foxes, and bearded vultures unsuccessfully hunt the marmots. At that time I promised myself that I would try to return and study the behavior of the heretofore unstudied golden marmot (*Marmota caudata aurea*).

I have spent the summers of 1989 to 1991, at a 4,300 m. (about 14,000 ft.) high alpine meadow called Dhee Sar, studying the behavioral ecology of golden marmots. Dhee Sar is located in Pakistan's rugged, remote and beautiful Khunjerab National Park. In addition to 150 to 200 marmots, Dhee Sar has healthy populations of easily observed Himalayan snowcock, Himalayan ibex, and a variety of non-game birds and mammals. Tibetan red foxes, snow leopards, wolves, golden eagles, and bearded vultures occasionally visit Dhee Sar and may eat marmots.

Behavioral ecologists attempt to study how animals are adapted to their environments. In doing so, we take an economic approach when studying animal behavior: attempting to study the costs and benefits of particular

behaviors. We assume that behaviors will evolve or be performed when costs outweigh benefits.

My focus is on studying how golden marmots assess and manage predation risk, as well as studying their social behavior. Khunjerab National Park has a remarkably intact predator community. Preliminary results suggest that perhaps as much as 33 per cent of wolf diet, 25 per cent of snow leopard diet, and 19 per cent of fox diet at my study site consists of marmot. Considering the marmots are only active a few months each year (they hibernate between 7 to 8 months each year), predation may exert a significant selective force.

Many animals emit alarm vocalisations when scared. Students of animal communication have proposed that some animals may use these signals as we use words. For instance, a certain sound might signify "eagle", while another may signify "fox". Alternately, the sounds may simply reflect the internal state of the signaller. Thus, a very scared animal might emit one sound while a less scared animal might emit another sound.

Golden marmots whistle when alarmed. Preliminary results suggest the number of whistles in a series seems to be inversely

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Ashiq Ahmed

*Golden Marmot in its Karakoram habitat.*

related to the intensity of the predation risk. Thus, an individual who calls in a high risk situation might whistle only 1 to 4 times, while a less risky situation might elicit 7 to 12 whistles at a time. Thus, golden marmots appear to communicate their perception of predation risk vocally and may not have "words" for eagles and foxes. Not all individuals whistle when alarmed. This and other questions about the vocalisations of golden marmots are currently under study.

Marmots respond to alarm calls by looking up and/or running to a burrow. I use this response to try to quantify the predation risks of different behaviors. Behavioral ecologists think that behaviors may have 3 types of costs. First, behaviors may have time costs: an animal engaged in one behavior cannot do another. Second, behaviors may have energetic costs: performing different behaviors use different amounts of calories. Third, behaviors may have predation costs: behaviors may expose animals to different risks of

predation. I am currently trying to quantify the predation risks of different behaviors. By video-taping their responses and measuring their response time from the video, I should be able to see how much time a given behavior adds onto some baseline response time. Behaviors which increase response time would be more risky than behaviors which add little to the minimum response time. This is the first time anyone has attempted to systematically quantify predation risks of different behaviors this way, and the technique seems promising.

Behaviors might also be risky if they are performed far from a refuge. Golden marmots appear to have the highest density of escape burrows (places they run to when alarmed), than any other marmot studied. In some places there are over 500 burrows per hectare. This observation supports my assumption that the marmots are subjected to strong selective pressure from predation — digging burrows is both time consuming and energetically expensive! By

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documenting the distribution of behaviors in space with respect to the marmot's burrows, I will be able to see if the marmots have adapted their behavior to the different predation costs of behaviors.

However, the time it takes a marmot to travel a certain distance is influenced by several factors. By studying how fast the marmots can run, I have determined that the sex of the marmot, the surface of the ground it runs over, the incline it runs on, and the distance the marmot runs, all influence how fast it can reach a refuge. Thus, habitat and individual characteristics will be integrated with the space use data to study the adaptiveness of their behavior.

The social behavior of the golden marmot continues to interest and confuse me, and may require several more years of study to elucidate. Behavioral ecologists usually think of social systems (e.g., how many males and females live together, whether the animals defend a territory, etc.), as being shaped by ecological factors. Thus, certain ecological factors may favour a monogamous mating system (1 male and 1 female), while other factors may favour a polygamous mating system (1 male with several females). At Dhee Sar marmots live in groups of 2 to 12 plus? individuals. Some of these groups have several adult males and females. The marmots appear to live in harmony with one another. Group members rarely are observed fighting and animals of all ages may vigorously play together. Preliminary results suggest that there is no relationship between the amount of food in a marmot group size; (because this is a startling finding, I am trying to replicate this finding). Furthermore, marmots seem to move between groups with some frequency. Such findings raise some important questions about golden marmot social behavior and are under current study.

I have enjoyed my time spent studying marmot behavior, and plan to return for additional field seasons. Thus, these results are mostly preliminary findings. Scientific

research is about asking questions. The more questions I answer, the more questions arise!

In addition to my marmot research, I have been studying the general ecology of Dhee Sar and been observing snowcock and ibex behavior. I plan to report these findings in the future. ■

Behavior

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