

Research Summary

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From 14 - 20 August 1995 an assistant (J.C. Daniel) and I spent a total of 29 h observing the alarm calling behavior of yellow-bellied marmots at the Cunningham property, and additional time looking for observable marmots at White Rocks. I am very grateful for permission to conduct marmot work in the City of Boulder Open Space parks and appreciate your logistical support of this study.

Marmot Alarm Calling Behavior

While the "Cunningham" marmots were easily observable, four things cut short our study. First, we were unable to find easily-observable marmots elsewhere--I had hoped to compare the behavior of marmots living in different areas. Second, house construction noise at the Cunningham property limited our ability to record alarm calls. Third, the location wasn't ideal for our manipulations--the model eagle hit rocks and the trails were too steep for the motorized badger. Fourth, we had conducted a tremendous amount of work at other sites and the limited observations in Boulder re-confirmed conclusions based on work at the other study sites.

We had planned to conduct a number of simulated predator attacks: in fact we conducted a single "robo-badger" probe and three model eagle flybys. Marmots responded by alarm calling to the simulated predators. None of our manipulations appeared to adversely influence the marmots--following the completion of an experiment, marmots quickly resumed "normal" activity. Marmots naturally encountered dogs and we recorded alarm calls in response to dogs, humans, a turkey vulture, and unidentified stimuli.

Included with this final report is a "Yellow-Bellied Marmot Alarm Calling Factsheet" that summarizes the results from my alarm calling work. Briefly:

- 1) Yellow-bellied marmots do not have "words" for predators.
- 2) Yellow-bellied marmot alarm calls communicate the degree of risk a caller experiences: as alarm increases, marmots call faster and more.

3) Yellow-bellied marmots sound like yellow-bellied marmots pretty much where-ever you go: they do not have obvious dialects, and all evidence suggests that they communicate risk the same way.

How does human disturbance influence marmots?

Methods

One of the objectives of the study was to collect information on how marmots respond to different levels of human disturbance. Because there is likely to be individual variation in marmot's responses to stimuli, and because we did not identify individual marmots in Boulder, I report conclusions based on studies of individually identified marmots at Capitol Reef National Park, Utah, and Rocky Mt. Biological Lab., Colorado.

For five marmot social groups at Capitol Reef and five marmot social groups at RMBL, assistants and I recorded the number of passes of cars, people, bicycles, and dogs ≤ 100 m and the number of passes > 100 m from marmot's main burrows. From these observations, I calculated the rate (n/hr) of each type of "disturbance".

Assistants and I walked towards marmots to alarm them and encourage them to alarm call; I refer to these experiments as "predation-probes". For each predation probe, we recorded the distance the marmot first responded, whether or not it alarm called, the distance it alarm called, and the distance it disappeared into its burrow. Individual marmots were "probed" multiple times, results were averaged within individuals and then within social groups to generate four variables:

- 1) the percent of predation probes that elicited alarm calls,
- 2) the average distance marmots first oriented to the human,
- 3) the average distance marmots disappeared into their burrow,
- 4) the average distance that marmots alarm called (if they called).

I correlated (Spearman rank correlations) each of the four variables with the rate of each type of disturbance to investigate how human disturbances influence some marmot antipredatory behaviors and, more generally, caution.

Results

In general, there was a positive association between the amount of "distant" (i.e., >100 m) disturbances and marmot wariness (Table 1). Marmots oriented, first called, and

disappeared at greater distances as a function of increased "distant" disturbance. While not always significant, the opposite trend seemed apparent as a function of "close" (i.e., ≤ 100 m) disturbances. Marmots seemed to habituate to close disturbances, in that they tended to wait until the person got much closer before orienting towards them, alarm calling, and/or going out of sight.

Interestingly, disturbance typically had little influence on the probability of alarm calling. The one exception to this generalization is that marmots had a higher probability of calling in the predation probe experiment if they lived in a group that had higher rates of "close" (≤ 100 m) dog interactions: dogs appeared to sensitize marmots to humans.

Management Implications

Marmots habituate to or ignore close humans, cars, bicycles, but not dogs. The presence of dogs seems to sensitize marmots and make them more aware of potential threatening stimuli. This may not be a bad response: if marmots are more aware of what is around them, they may be more aware of natural predators. Marmots spend much of their time vigilant. Future analyses will examine the patterns of vigilance behavior in these different groups to determine the relationship between disturbance and vigilance.

Publications

1) The enclosed "Yellow-bellied Marmot Alarm Calling Factsheet" concisely summarizes research results and can be used to brief interpretive rangers.

2) Two papers on the meaning and function of yellow-bellied marmot alarm calls have been written and will be submitted in the near future:

Blumstein & Armitage--Alarm calling in yellow-bellied marmots: I. The meaning of situationally variable alarm calls.

Blumstein, Steinmetz, Armitage & Daniel--Alarm calling in yellow-bellied marmots: II. Kin selection or parental care?

I will send reprints from any and all published work that stemmed from this research.

Table 1. Spearman rank correlation coefficients between the rate of disturbances and four measures of responsiveness: P-AC (the probability of alarm calling during a predation probe); d-1st (the distance a marmot first oriented to the human); d-OS (the distance the marmot disappeared into its burrow); d-AC (the distance the marmot alarm called, if it called). $P \leq 0.05$ for **bold coefficients**; $0.10 > P > 0.05$ for *italicized coefficients*. Significant negative coefficients suggest habituation to humans as a function of disturbance; significant positive estimates suggest sensitization to humans as a function of disturbance. For all correlations but d-AC, $n = 10$ social groups; for d-AC, $n = 8$ social groups.

	P-AC	d-1st	d-OS	d-AC
Cars \leq 100 m	0.055	0.103	-0.152	-0.500
Cars $>$ 100 m	0.278	0.546	0.655	0.736
People \leq 100 m	0.043	<i>-0.648</i>	-0.515	-0.738
People $>$ 100 m	0.213	0.874	0.888	0.791
Bikes \leq 100 m	0.309	-0.140	-0.116	-0.190
Bikes $>$ 100 m	0.137	0.860	0.874	0.791
Dogs \leq 100 m	0.843	0.388	0.313	0.491
Dogs $>$ 100 m	0.274	0.701	0.683	<i>0.655</i>

Yellow-bellied Marmot Alarm Calling Factsheet

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What are marmot alarm calls?

Yellow-bellied marmots (*Marmota flaviventris*) are sciurid rodents who are related to ground squirrels and prairie dogs. Like all other marmots, yellow-bellied marmots whistle or chirp when alarmed by a variety of predators, hence a common name "whistle pig". Sometimes, they make a "chucking" sound, perhaps the impetus for another common name, "rock chuck". When marmots are very scared, the pace of their chirps quickens producing a "trill". Collectively, these vocalizations are referred to as "alarm calls" and individuals who hear them respond by immediately looking around and returning to their burrows if they are not already at one.

When do marmots call?

Marmots typically alarm call when they see natural predators, such as coyotes, foxes, badgers, and sometimes when they see eagles and other large birds. Depending upon where marmots live and how used they are to people, marmots may alarm call when they see a person. In areas where people are common (e.g., parks, hiking trails, popular mountain summits), marmots may not alarm call and in fact may pay little attention to people (or they may view people as sources of food!). Marmots seem not to lose their fear of dogs though, and even in places where dogs are common, dogs tend to scare marmots into calling. Other more natural stimuli such as deer have different effects depending upon the marmots' history of association with them. At Capitol Reef National Park, marmots live cheek to jowl with numerous deer and virtually ignore them. In Colorado, marmots may call hundreds of times to a deer foraging quietly nearby.

Why do marmots call?

By calling, animals make themselves more obvious to a potential predator: a good way to find marmots is to scare them into calling and then locate the caller. In making themselves more obvious, animals may make themselves more likely to get caught. Thus, there is an evolutionary quandary: how can alarm calling evolve if it's risky to the caller?

In some species of ground squirrels, individuals alarm call to warn their genetic relatives: old individuals (usually females) who have many relatives around call more than

younger individuals. Thus, by warning their descendants, callers are helping to preserve their genes.

Alarm calling in yellow-bellied marmots is somewhat different. Adult females with newly emergent pups call much more than all other marmots. Other animals without newly emergent pups don't call that much even if they have a lot of genetic relatives around. Thus a considerable amount of alarm calling is a type of direct parental care where mothers call to protect their offspring. When marmots do call, they seem to minimize the risk of calling whenever possible. Most alarm calls are given by marmots who have already run back to their burrow before calling.

What do alarm calls mean?

Some species of animals produce different types of calls in different situations. Many ground squirrels "whistle" when they see a hawk and "trill" or "chutter" when they see a coyote. When there is a strong association between the type of stimulus and the type of vocalization, such calls function as rudimentary words: animals hearing them know what type of predator is around and respond accordingly.

Do yellow-bellied marmots have different words for predators?

In a word, no. Yellow-bellied marmot chirps are their most common vocalization (97% of all vocalizations are chirps). Chirps are very short vocalizations (typically 50 milliseconds long) whose pitch, duration, and overall shape varies a bit. Yet, there is no consistent association between the type of the predator and the acoustic structure of their chirps. Yellow-bellied marmots chirp faster and produce more chirps when they see canids (i.e., dogs, coyotes, etc.) and when alarming stimuli get closer. The most extreme form of this is seen when marmots begin trilling: quickly paced chips sometimes given as they disappear into their burrows when being chased by canids or badgers. However, because marmots may give the same number of chirps to different alarming stimuli, yellow-bellied marmot alarm calls can not be said to be like rudimentary words: their calls do convey the degree of risk a caller is experiencing and marmots who hear the calls respond accordingly.

Do marmots sound the same all over?

Yellow-bellied marmots sound like yellow-bellied marmots pretty much wherever you go. Individual marmots may sound slightly different, but there is no evidence of dialects in their alarm calls. Once you learn the distinctive call of the yellow-bellied marmot, you'll be able to identify them throughout their Western North American range.