

AN INVESTIGATION INTO MARMOT MIGRATION IN GRAND TETON NATIONAL PARK



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♦ ABSTRACT

In 1994 and 1995, a high abundant winter snowfall at higher elevations appeared to result in long distance movement patterns by yellow-bellied marmot (*Marmota flaviventris*) over snow to lower, snowfree elevations where food was more available. As the snow melted and food became abundant, the marmots return to higher altitudes. In 1996, we continued to investigate the potential for migrational movements, by studying two study sites at different elevations in the North Fork of Cascade Canyon. Four marmots at each site were implanted with intraperitoneal tracking transmitters. Of eight marmots that were equipped with intraperitoneal transmitters, six demonstrated significant movements of greater than 0.5 km, one did not, and one most likely died as a result of predation before any movement could be observed. Of the six that demonstrated significant movements within the canyon, only one moved distances greater than 1 km. Marmots, after emerging from hibernation, migrated down canyon to snowfree areas as they become available. With progressive snow melt, most marmots move upward to higher elevations, but not to the extent originally expected. Instead, they moved to the first available habitat where food was obtainable, and other (dominant) marmots accepted their presence. This movement is exhibited in both males and females, yearlings and adults, and

melanistic and normal colored marmots.

♦ INTRODUCTION

Heavy snowfall may result in high mortality of marmots which are forced to remain within their burrows for longer than normal periods and who do not have access to food on the snow-covered surface. To increase survival, these animals may travel across the snow to open areas to feed in a communal area and move back to their respective home ranges as snow melt progresses.

In 1994, and then again in 1995, while investigating melanism (black fur coloration) in the yellow-bellied marmot (*Marmota flaviventris*) of Grand Teton National Park, we observed that abundant winter snowfall at higher elevations appeared to cause marmots to move substantial distances over snow to lower, snowfree elevations where food was more available (Montopoli et al 1997; Montopoli et al. 1996). As the snow melted and food became abundant, the marmots appeared to return to higher altitudes. These observations were unique and contrary to previously published accounts of marmot behavior. To further document these observations we implanted telemetry transmitters to track marmots from early spring to late fall.

In 1995, three locations where long distance movement suggestive of migrational travel were selected for an initial observational study (Lower Garnet Trail, Lower Death Canyon, and North Fork of Cascade Canyon). The total number of observed marmots were tabulated in these snowfree locations just below snowline, and then again several weeks after the snow had melted in the general area. Based on data presented in Table 1, we conducted a simple proportion hypothesis test which indicated that a proportionately greater number of marmots were observed in snowfree areas just below snowline than in other adjacent areas within the canyon after snowmelt ($z = 5.33$; $P < 0.0000$).

Table 1. Marmot Counts in Snowfree Areas Just Below Snowline and Several Weeks After Snow Had Melted from the Area

	Lower Garnet Trail	Lower Death Canyon	NF Cascade Canyon	Total
Areas Just Below Snowline	16	20	33	69
Areas After Snow Had Melted	4	8	7	19
Total	20	28	40	88

To further investigate a potential migrational activity, and to document specific movements, we captured and implanted intraperitoneal tracking transmitters in marmots that were located in snowfree areas just below snowline early in the summer season, 1996. We hypothesized that these statistically higher populated areas were composed of nonresidents which would disperse back to their respective home range sites as snow progressively melted.

♦ METHODS

In late May, 1996, the North Fork of Cascade Canyon was selected as the study area. Biweekly trips were made into the North Fork to evaluate snow conditions, the emergence of marmots from hibernation, and any marmot "gatherings" in common, snowfree areas below the snowline.

In order to best document any potential migrational movements up the canyon during snow melt, we selected two study sites within the North Fork of Cascade Canyon: one in the lower canyon (near the Cascade Forks), and one in the upper canyon (at Solitude Lake). These sites were located about 3 km apart and at different elevations (lower

canyon site: 2,450m; upper canyon site: 2,750m). Transmitters were implanted in four marmots at each site.

On June 20, 1996, the first site in the lower canyon became snowfree, which was approximately 1 km north-northwest of the Cascade Canyon Forks. On June 22, two marmots (L1 and L2) were captured and equipped with intraperitoneal Advanced Telemetry Systems (ATS) model tracking transmitters. On June 23 and 29, two other marmots (L3 and L4) were captured and equipped with transmitters (see Table 2 for specifics). Marmots were anesthetized using Ketamine Hydrochloride (0.2mg/kg) and surgery was performed in the field employing aseptic techniques.

Table 2. A Summary of Marmots Captured in the Lower North Fork of Cascade Canyon

Marmot	Capture Date	Relative Age	Gender	Skin Pelage	Frequency (MHz)
L1	June 22	Adult	Female	Melanistic	150.832
L2	June 22	Yearling	Male	Normal	150.893
L3	June 23	Adult	Male	Normal	150.913
L4	June 29	Adult	Male	Normal	150.871

All lower canyon marmots were subsequently located at least once a week and their movements documented. Trips were also made to Solitude Lake (upper North Fork of Cascade Canyon) to evaluate snow conditions, the emergence of marmots from hibernation, and any marmot occurrences.

On July 3, the Solitude Lake area was completely snow-covered, and no signs of marmots, including tracks or scat, were observed. On July 10 for the first time, numerous marmot tracks were observed leading to the Solitude Lake area from below (east). No marmots or tracks were observed at the lake. On July 11, marmots and numerous tracks were first observed at the lake, which was characterized by a few open patches of bare ground (personal comments, Helen Larson).

On July 21, four marmots were captured in the vicinity of Solitude Lake and implanted with intraperitoneal ATS tracking transmitters. Two trapsites were utilized. The first three marmots (U1, U2, and U3) were captured at the first trapsite, located at the Surprise Lake outlet, about 100m from the shore at the south end of the lake. The last marmot (U4) was trapped at the second trapsite,

located at the northeast corner of the lake, about 50m from the shore (see Table 3 for specifics). Table 3 provides a summary of the information pertinent to those marmots.

Table 3. A Summary of Marmots Captured in the Solitude Lake Area

Marmot	Capture Date	Relative Age	Gender	Skin Pelage	Frequency (MHz)
U1	July 21	Adult	Female	Melanistic	150.933
U2	July 21	Adult	Female	Normal	150.794
U3	July 21	Yearling	Female	Melanistic	150.814
U4	July 21	Adult	Female	Normal	150.852

Through August, all marmots at the Solitude Lake area and in the lower canyon were located at least once a week and their movements documented. Three trips were made in September (about 10 days apart), with the last on September 26. At this time, due to heavy snowfall and accumulated, deep snow, we felt that the marmots had begun hibernating. Their locations were documented, and no subsequent trips were made in 1996. In early May, 1997, we plan to locate all marmots prior to their emergence from hibernation, to substantiate if these animals move from their winter hibernation sites down the canyon to open feeding areas.

◆ RESULTS

The following is a brief summary of movements for each marmot after their capture and implantation (see the Appendix for topographical maps with detailed information for each marmot):

- L1 was a melanistic female which remained in an area immediately to the north of where she was trapped. On one occasion (July 8), she was found 400m north of the trap site. Her last known location was 100m north of the trap site (September 26). Her boundary of travel was in the shape of a north-south oriented "V" with the bottom of the V located at the trap site. The dimensions of the V were 400m long (north-south) by 300m wide (at the top of the V).
- L2 was a normal colored male which relocated to an area 700m to the north of the trap site that also was snowfree. He remained there for the duration of the summer, but in late July, exhibited a movement back towards the trap site. At this site, which was 500m north of the trap site, he died from predation, suggested by

the presence of pelage remains and a nicked transmitter suggestive of an American marten (*Martes americana*) (September 25). His boundary of travel was somewhat oval, about 250m by 100m, with the longitudinal axis oriented east-west.

- L3 was a normal colored male which remained in an area about 50m northwest of the trap site. We believe he also died as a result of predation suggested by the presence of pelage remains in the area (June 29).
- L4 was a normal colored male which moved approximately 900m to the north-northwest of the trap site and remained there for the duration of the summer. His last known location was found on July 22, about 850m north-northwest of the trap site. Thereafter, no signals were heard either as a result of transmitter failure or movement out of the canyon. His boundary of travel was oval, about 400m by 100m, with the longitudinal axis oriented north-south.
- U1 was a melanistic female which moved about 650m west of the trap site, but ranged along the entire south end of the lake during the summer. Her last known location was about 500m west of the trap site (September 25). Her boundary of travel was oval, about 650m by 200m, with the longitudinal axis oriented east-west.
- U2 was a normal colored female which moved about 650m west of the trap site and remained mostly in this area to the southwest of the lake shore. She returned to the vicinity of the trap site in August, where she was observed on August 11 and 17. Her last known location was about 550m west of the trap site (September 25). Her boundary of travel was oval, about 650m by 200m, with the longitudinal axis oriented east-west.
- U3 was a melanistic female which moved about 600m west of the trap site, and remained in this area throughout the summer. Her last known location was about 500m west of the trap site (September 25). Her boundary of travel was very restricted: she was always encountered in this vicinity (500-600m west of the trap site).
- U4 was a normal colored female which initially moved about 1 km northwest of the trap site at the northeast corner of the lake, and mostly remained in that area. However, she was observed in the vicinity of the trap site on August 1 and September 4. She was last observed on September 14, about 1 km to the west of the trap site. We feel that she may have

moved over the ridge to the west into another canyon; however, we were not able to investigate this in September, 1996, but plan to do so in May, 1997. Her boundary of travel was in the shape of an east-west oriented "V" with the bottom of the V located at the trap site. The dimensions of the V were 1 km long (east-west) by 500 m wide (at the top of the V).

◆ DISCUSSION

We decided *a priori* to consider distances in excess of 400 m from the initial trap site to indicate a significant migratory movement. However, we expected to commonly observe movements in excess of 1 kilometer.

Of eight marmots that were equipped with intraperitoneal transmitters, six (L2, L4, U1, U2, U3, and U4) demonstrated significant migratory movements, one (L1) did not, and one (L3) most likely died as a result of predation before any movement could be observed. Of the six that demonstrated significant migratory movements, only one (U4) exhibited movements involving distances of 1 km or more.

Based on our telemetry tracking observations, we feel that marmots, after emerging from hibernation, do migrate to, and congregate communally in, snowfree areas as they become available. As the snow melts, most marmots move upward to higher elevations, but not to the extent that we originally hypothesized. Instead, they move to the first available habitat where food is obtainable, and they establish a territory with other residents or new immigrants. This movement is exhibited in both males and females, yearlings and adults, and melanistic and normal colored marmots.

An alternative situation that we considered was that marmots migrate in the fall to lower elevations where they "communally" hibernate in areas that become snowfree early in the spring of the following year; then, as the snow melts, they move to higher elevations. The evidence strongly suggests that this is not the case, because a minimum of 0.5 m of snow had accumulated at these higher locations when marmots were last located in late September, 1996. We feel that marmots hibernate at these higher elevations, and migrate over snow to the lower, snowfree areas when they emerge from

hibernation in the spring. The planned survey in May, 1997 to document locations of overwintering telemetered marmots will further support this claim.

Although an abundance of literature has investigated the social structure of marmot colonies, where gender, social status, age, and other considerations physically define the main colony and any satellite colonies, our results suggest that early in the season this structure is limited, if it exists at all. Marmots do congregate in snowfree areas, and as the snow melts, they move into areas where the social structure emerges. This activity may help explain how genetic traits such as melanism may originate in a single location and yet be dispersed throughout an entire range.

Two of the eight marmots died as a result of predation. This fact suggests that marmots are an important food base for many predators, including hawks, eagles, mustelids (such as the pine marten), coyotes, bears, and other mammals (Armitage, 1982). Although marmot predation is not often observed and documented, it nevertheless is common (personal observations by authors, and personal communications with Daniel Blumstein, University of Kansas).

Our study was limited in its sample size, however, the fact that six of eight marmots exhibited substantial movements back up the canyon as snow melts strongly suggest that marmots do travel considerable distances as a survival strategy. Future studies following this population is imperative to verify this claim.

In early May, 1997, marmot hibernation sites will be located, and marmot movements from these locations will be monitored after these animals emerge from hibernation. The additional movements early in the spring/summer should further validate our findings from 1996. The marmots will then be trapped in late summer and the transmitters surgically removed.

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