

The Hoary Marmot of the North Cascades in Western Washington



Kingdom...Animalia
Phylum...Chordata
Class...Mammalia
Order...Rodentia
Family...Sciuridae
Genus...Marmota
Species...Caligata

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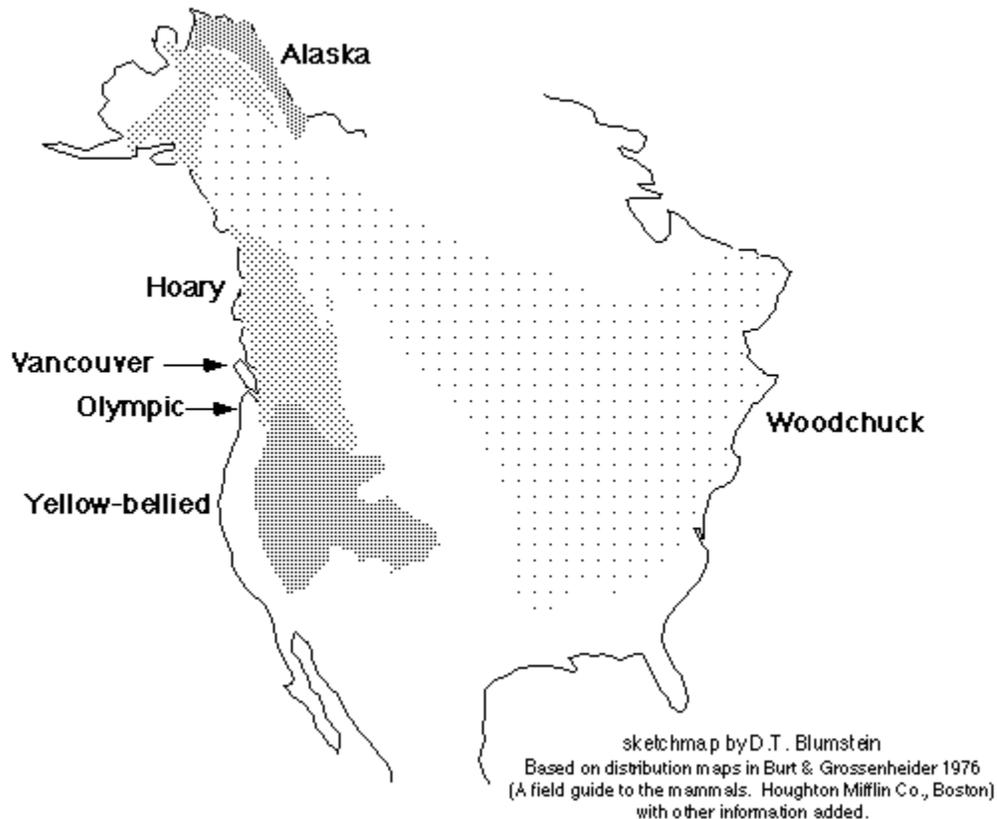
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Introduction

The name *marmot* has transcended from Latin *mures montani*, and from Old Franco-Provencal *marmotaine* both meaning mountain mouse. Worldwide, fourteen species of marmots exist. Six species are present in North America and two exist in the mountains of the North Cascades in Washington – the hoary marmot and the yellow-bellied marmot. The focus of this discussion will be on the biology and behavior of the hoary marmot (*marmota caligata*).

Ranges of North American marmots (approximate)



Despite the extensive range of marmots, there is little known about the status of these alpine mammals in the Washington Cascades.

Marmots as rodents are closely related to ground squirrels and prairie dogs belonging to the sciurid family, meaning squirrels. Marmots though, are the kings of sciurid rodents. All rodents share these characteristics 1) Spacing between single pair of incisors and molars, 2) hind feet are larger than front feet and 3) are plantigrade or semi-plantigrade.

Historically, marmots occupy regions where there are few human inhabitants. In the far north, incidences have been recorded of arctic native hunting marmots. Previous Indians and Inuits hunted them for their fur to make parkas as well as to eat the meat. Over time, marmot fur was dyed and sold as mink or sable for economic gain. Currently, marmots are no longer hunted by humans.

Physical Description

Both the common name and the Latin name allude to the physical description of this species. The word *hoary* means something that is white, gray, or silvery, as if with age. Indeed this accurately depicts the fur color of an adult hoary marmot. The coloring has been described as grizzled-gray brown, icy-grey, or silvery. These descriptions fit the front half of the back, the bridge of the nose, and around the lips. The remainder of the body ranges from brown to black fur depending on the individual and its age. The Latin word *caligata* means booted in reference to their dark feet. The front feet have five hairless pads, two of which are from the heel. The front feet also have five toes with slightly curved claws. The first toe is a vestigial thumb and rarely registers in tracks. The hind feet are similar, hairless but with six pads. Two of the pads form the heel which may or may not register. The hind feet also have five clawed toes that all register. The claws are heavier on their front feet compared to their hind feet. Another distinguishing feature of marmots is their tail. While the body length of hoary marmots averages 20 inches or 50 cm, tail length averages 9 inches or 22.5cm. This is equal to approximately 40% of their body length. Their tails also range in color between black and brown depending mostly on age. Lastly, marmots have small and circular eyes located on the sides of their heads and their ears are short and rounded.

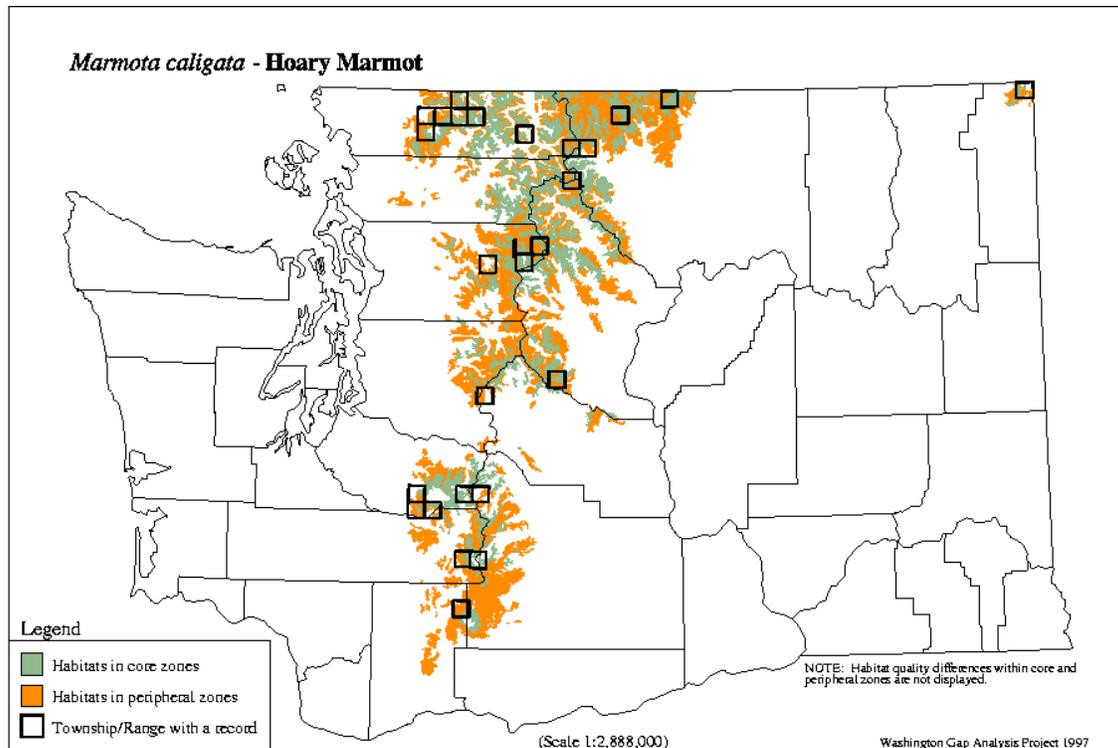
Diet

Hoary marmots are predominantly herbivores, aside from the occasional insect. In the spring and early summer, they eat the leaves and blossoms of different plants and grasses. In the fall, they eat seeds. During these active seasons, marmots pile on layers of fat accumulating up to ½ of its body weight (average weight range is between 10-20lbs). These animals also demonstrate a food preference for particular plants. Olympic marmots are said to feed most on claytonia diffusa, a purslane, and polygonum bistortoides commonly known as american bistort. Marmots in British Columbia consumed vetches, sedges, fleabanes, and fescues for 80% percent of their diet, even in consideration of the other abundant foods available. The foods selected by marmots are typically stable and unaffected by changes in biomass of plant species. Hoary marmots in the Cascades have been observed eating sitka valerian (valeriana sitchensis), alaska saxifrage (saxifrage ferruginea), and red-stemmed saxifrage (saxifrage lyallii). Other plant species may be harvested for denning purposes.

Hoary marmots also intake water daily, mostly by eating snow. As the snow melts, pools of standing water become available for drinking. Once these become scarce, marmots get what they need from the morning dew and the vegetation they eat.

Habitat

Hoary marmots live at high elevations above timberline in the sub-alpine and alpine zones. They burrow in moist, lush parkland meadows near talus slopes. Most often marmots are observed on slopes south to west facing. Criteria that have been observed as critical to hoary marmot habitat are moist cool soils soft enough for burrowing, meadows filled with forbs, and next to the meadow is a talus field with large rocks used as sentinels and for sunning.



The Washington GAP Analysis model illustrates marmot habitat in the Cascades.

The harsh conditions of an alpine environment dictate much of the marmot lifestyle. There are high energetic costs for survival during both summer and winter. Factors to consider are: 1) temperature fluctuations that occur both seasonally and daily, 2) precipitation and the duration of snow cover, 3) availability of a food source from alpine plants and soils, 4) competition, and 5) predation. When combining these factors, both advantages and disadvantages exist.

There has been little change in alpine habitat in the last 150 years. It is relatively stable with native species. The vegetation has a simple structure; however, slight variations in slope and aspect significantly impact changes in habitat types throughout the alpine zone. These small and drastic changes demonstrate the sensitivity of the alpine environment. Precipitation and temperature are the major factors as these vary the most through the seasons. In the end, precipitation is more important than temperature in regard to alpine plant growth. Steep gradients in snow cover and soil moisture govern the productivity and distribution of alpine plants. While alpine soils are therefore cold, daily temperatures on the ground change and can cause mid-day overheating during the summer months. As a result, thermoregulation and heat stress greatly influence marmot habitat selection. From the other perspective, winter months also offer thermal advantages as snow cover insulates warmth providing a consistent temperature all day.

Of the two remaining alpine factors which influence the lives of marmots, competition has no role – a significant negative. This is an advantage as virtually no other animal is present that would be seeking the same food source. However, marmots have a disadvantage regarding predation. They have to travel distances for food, sometimes over snow, with minimal cover for safety. This increases their chances of being preyed upon by golden eagles, bears, coyotes, wolves, and wolverines. Marmots

also travel slower than other prey for these predators. To protect each other and themselves, hoary marmots look-up often while feeding. Marmots are also in tune with the warning calls of other species that may be in the area, i.e. squirrels, chipmunks, and pikas. Hoary marmots in the Cascades have been observed to freeze, look-up, and retreat to a burrow in response to vocalizations of chipmunks and pikas.

Vocalizations

Marmots may also be known as rockchucks, whistlepigs, or whistlers. These nicknames refer to their high shriek-like warning call. However, the noise is not a whistle at all; it originates from their vocal chords. Marmots alarm when they see natural predators. There are four alarm calls among hoary marmots – ascending, descending, flat, and a trill. The first three are voiced singly and differ in their ending frequencies. Trills are multi-note calls, a series of short ascending calls voiced together. When any of these alarm calls are heard, other marmots respond by immediately looking around and then return to their burrows. Currently, no relationship exists between particular alarm calls and predators. The only noticeable distinction is that calls tend to be longer and more frequent to terrestrial stimuli as compared to aerial stimuli. Literature hints at the possibility that descending calls seem to elicit greater urgency in returning to burrows whereas ascending calls seem arousing. Lastly, both males and females voice alarm calls.

Colony Activity & Signs

A group of marmots living together is referred to as a colony. Colonies have a complex social system. The social organization resembles living among extended family members. However, this is not always the case because the social system of hoary marmots is not as rigidly defined. They exhibit a loose dominance hierarchy as interactions among males, females, yearlings, and juveniles do not always follow a pattern. The only predictable interactions are those between adult males.

Colonies surrounded by an abundance of food typically contain one dominant male (colony male) and a few females with their offspring, occasionally subordinate males will also be present. This is a polygamous group developed through the recruitment of daughters. In areas where food is scarce, marmots do not live in colonies. Their range for foraging increases and therefore a colony male is not able to guard a female and feed himself at the same time. These circumstances lead to marmots having monogamous relationships. The class structure among colonies is evident through greetings and chasings. Current observations in the Cascades reveal small colony sizes similar to that of Vancouver marmots where most colonies are small and concentrated in small geographic areas containing only 1 to 2 family groups. Recorded observations have also found several solitary marmots.

Marmot colonies live in burrows underground. Burrows are fairly obvious with large throw mounds of fresh soil in front of their entrance. Hoary marmot burrows are also typically found in groups because of their gregarious nature. A habit of these marmots is to lounge at the immediate entrances of their burrows before and after periods of activity. This may translate to safety precautions. Another habit of marmots is to line the den with clean dry grass and change it frequently. When natural crevices are used, grasses for nesting are visibly peeking out. From these burrows, well-worn paths and

tunnels radiate to perches, latrines, or nearby meadows for foraging. Perches are where sunning is best in addition to providing optimal surveillance. Hoary marmots have latrine sites near burrow entrances or perches. These latrines are used regularly and can contain up to 100 scats. Marmot scat can range from sausage shaped pellets to folded chords, but the color is usually black.

Studies in Glacier National Park in Montana found that there was high burrow fidelity and burrow use patterns showed preferential use by particular animals. While this information is still being collected in the Cascades, a claim can be made that burrow sites are limited to areas with large boulders which can dictate seasonal movements to obtain food.

Marmots have a highly developed sense of place as a result of social colony living. This lifestyle helps explain many other behaviors of marmots, such as playing, greeting, feeding, reproduction, and movement patterns.

Play & Greetings

Often as marmots play, observers can confuse this behavior with fighting. However, marmots rarely fight, even their predators. Upright play fights occur when two animals are facing each other balanced on their haunches and appear to be boxing with their forefeet and trying pushing one other over backward. This most frequently occurs between yearlings and two year olds. During these wrestling matches, one may also see lunging toward an exposed chest or belly. Other play behaviors include rolling over together, nipping at tails or legs, and prancing stiff legged toward each other. This social and less aggressive behavior is due yearlings urge to disperse and set up new sites. Tussles mostly occur, as mentioned, between youngsters. If a one-sided chase occurs, it is likely an adult making a yearling or two year old unwelcome with aggressive behavior.

Observable behaviors could also be greetings which have a presumed association with individual recognition. Stimuli which aid recognition are both olfactory and tactile. These include sniffing from a distance, superficial nose contact, extensive open mouth with locking teeth, and chewing the face, neck, or back of the individual being greeted.

Foraging

Food distribution and risk of predation are heavily correlated. The marmot diet eats selective plants. Therefore, these animals have to go farther from their den to forage because they crop vegetation faster than it grows. As marmots forage farther away from their home and the meadow patch increases in size, the number of burrows in these feeding patches increases. Seventy-seven percent of patch use behavior can be explained by food abundance, refuge burrow density, and distance to home burrow near talus (Holmes, 1984). The risk marmots feel while foraging is evident through increased look-ups, standing on hind legs, and vocalizations. These behaviors lessen when marmots live within a colony because they are distinctly social eating in groups of three or four marmots in the area.

Reproductive females have an even bigger energetic cost from parental investment. Their nutrition is critical to the health of their young. In addition, her young do not travel far from the home den site. As a response, reproductive females forage more in the evening and in bad weather. They also forage farther away from home than

other marmots typically would. This behavior may reduce competition for food among her and her offspring or it may provide cover for them while out of the den.

Foraging distances among marmots averages 50m from home. This distance increases with age. How far a marmot travels may or may not be indicative of a “home range.” Conflicting literature exists which state that home ranges are absent due to all animals having equal access to colony living versus marmots being territorial enough to chase other marmots from its feeding range. Further observation of hoary marmots in the Cascades is required to make any claim. It can be stated, though, that marmots wander around much of the day and during peak summer months may travel quite far.

The selective use of foraging area suggests marmots are sensitive to variations in habitat quality, meaning the amount of plants available. However, another possible conclusion is that marmots shift their feeding locations between years to allow for regrowth.

Hibernation & Aestivation

Extreme food preferences by marmots limit competition, yet this also results in hibernation. During winter they drop their body temperature a few degrees. Colonies then snuggle together to conserve heat. Dr. Daniel Blumstein states that “they don’t keep their body temperature down all winter, rather, they wake up (arousal) every week or so for a bit and then go back into deep torpor.” Hoary marmots hibernate for 8 ½ months underground in a year beginning in mid-September. The remainder of the year for 4 ½ months, marmots are active. This short active season is when these animals grow, feed, reproduce, and prepare for winter survival during hibernation. Marmots will gain ½ of their body weight in fat during this time. However, they rarely venture out in the rain to pack on fat because their thick coat loses its insulating ability when wet.

During the summer season hoary marmots aestivate. This is an inactive state of dormancy similar to hibernation. Marmots retreat to their burrows at mid-day to protect themselves from increasing temperatures and overheating. Burrows are cool with their shade and moist soils. This behavior is confirmed from studies and personal observations which record bimodal activity periods in the morning and evening during July and August. Unimodal behavior is more present in June.

As September approaches a shift in behavior occurs due to a hormonal response to body temperature fluctuations prior to hibernation (Taulman, 1990). Above ground time decreases, active times become more erratic, and distances between individuals while foraging decrease. While foraging is the major activity in mid-summer, by September lying at rest is the major activity. During group resting, social grooming also occurs.

Reproduction, Growth, & Dispersal

Reproduction, dispersal, successful immigration, winter starvation, and predation all have population effects. Regional weather patterns have the most significant impact on the quality of reproductive years. Precipitation is the most likely factor. Limited winter precipitation alters alpine plant growth. Excessive summer precipitation limits foraging opportunities. Furthermore, elevation is another environmental factor which regulates breeding time.

Mating begins in early to mid-May after emerging from hibernation. Mating occurs inside burrows, and therefore little is known about mating behaviors. Gestation lasts about 30 days after which a litter of 2-5 pups are born. These babies will remain in the mother's burrow for 3-4 weeks. When these young emerge from the burrow, they are well-furred and ambulatory. Weaning may or may not continue for up to 2 weeks. At two years of age female hoary marmots reach sexual maturity and males will usually disperse. Females have one cycle per year, although they usually only are fertile and breed every other year. This is to restore their metabolic reserves – a reproductive female has to fatten up for the hibernation of herself and her litter.

The delayed dispersal of males allows for an accumulation of body reserves critical to success and reproduction. A long preparation time enhances future independence. However, male dispersal has a high mortality rate. They do not have protective burrows during this time.

Decreased breeding time is the foremost factor to some of the life history traits of marmots. Other factors might include patchy environments and their large body size. Nevertheless, marmot traits consist of more developed social behaviors, delayed maturity of young, longer time to achieve independence, flexible dispersal patterns, recruitment, and longer life spans. Marmot longevity is associated with factors which reduce the risk of predation, such as delayed dispersal, reproductive skipping, or higher sociality.

Ecological Significance

The closest relatives of the hoary marmot are the Olympic marmot and the Vancouver marmot. Both of these species have experienced decline in recent years which is associated with climate change. The issue of climate change has raised concerns about any possible impacts on hoary marmots. Climate change and forest succession following the most recent glacial period has left patches of grass-forb meadow habitat. Marmots now living in patchy environments have presumably adapted highly social behavioral attributes in response. These alpine islands may have created metapopulations from long distance dispersals. Is gene flow restricted? Do sub-species exist? Speciation could be a response imposed by dispersal barriers. Paleophylogeography by Polly has identified morphological differences in molars of marmots between glacial cycles. His research supports the idea that connectivity is the key ecological process to maintain alpine wildlife populations. Global climate change influences alpine wildlife in other ways as well: decreased suitable habitat, decreased duration of food abundance, and the possible increased risk of predation. For example, coyote populations have invaded higher elevations due to changes in snow level and human compaction of snow. Alpine wildlife need to prepare for increased temperatures, competition, and predation. Hoary marmot populations are but one of many natural experiments occurring as a result of climate change.

North Cascades National Park is conducting a systematic inventory collecting data to map colonies and describe minimum population counts. This survey will provide baseline information to monitor and assess future populations.

RESOURCES

General information provided by Washington Trails Association
www.wta.org/~wta/cgi-bin/wtaweb.pl?3+hg+fauna+mammals

General information provided by field researchers
www.marmotburrow.ucla.edu

General marmot information from the University of Michigan
www.animaldiversity.umz.umich.edu/site/accounts/information/marmota_caligata.html

Information on Alpine Ecology
<http://www.reec.nsw.edu.au/geo/alpine/text/alp0.htm>

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North Cascades National Park contains some of America's most beautiful mountain scenery — high jagged peaks, ridges, slopes, and countless cascading waterfalls. On my hike, a ranger tells me there are over 1,700 plant species here — ferns and fungi, hundreds of birds, reptiles, and amphibians, and thousands of insects. The austere grandeur of the North Cascades had me on the fine line between a dream and reality. I didn't know what time it was but neither did I feel any need to know. I just knew that now, then, was mine. And that now is mine. Lake Diablo in the North Cascades National Park, WA. In the moments of distraction, all it takes to bring me back to the present is attention. The Ecology of the North Cascades is heavily influenced by the high elevation and rain shadow effects of the mountain range. The North Cascades is a section of the Cascade Range from the South Fork of the Snoqualmie River in Washington, United States, to the confluence of the Thompson and Fraser Rivers in British Columbia, Canada, where the range is officially called the Cascade Mountains but is usually referred to as the Canadian Cascades. The North Cascades Ecoregion is a Level III ecoregion in the