

Wolverine, *Gulo gulo luscus*, Resting Sites and Caching Behavior in the Boreal Forest

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Wolverine (*Gulo gulo luscus*) caches and resting sites were examined in a study area in the boreal upland forests of northwestern Alberta and northeastern British Columbia (approximately 57°N). Cache sites were in climax, or "overmature" stands of Black Spruce (*Picea mariana*) or mixed-wood of high complexity, dominated by conifers, and in which the Trembling Aspen (*Populus tremuloides*) and Balsam Poplar (*Populus balsamifera*) component consisted of mostly dead or dying trees characteristic of such old growth in the boreal uplands. Sites offered relatively good visibility of the surrounding stand. Sites were never located in the dense to extremely dense homogenous spruce stands documented as being favored for travel by Wolverines in the study area. The better used cache complexes were accessed by numerous well-used trails made by the Wolverines themselves. Caches consisted of the bones, hide and hair of Moose (*Alces alces*) believed to have been killed by Grey Wolves (*Canis lupus*). Caches were classified as "simple caches" composed of a single feeding site and/or excavation and "cache complexes" involving one or more feeding "stations", latrines, resting sites, and climbing trees that may have been used as avenues of escape from competitors/predators. Resting sites were located atop the snow in relatively open locations that offered good visibility of the surroundings. Climax stands were implicated as being of importance to Wolverine caching behavior. Conservation implications include the detrimental effect on Wolverine populations likely to result from current timber harvesting practices in the boreal forest.

Key words: Wolverine, *Gulo gulo luscus*, cache, resting site, climax, boreal forest, stand, Alberta, British Columbia.

Knowledge gaps exist involving many aspects of Wolverine life history in forests, including caching behavior and selection of resting sites (Banci 1994). This paper presents observations of these aspects of Wolverine activities as documented over three winters (1997-2000) of snow-tracking efforts in the boreal upland forests of the border between northwestern Alberta and northeastern British Columbia, at approximately 57°N.

Methods

Wolverine and other furbearer activities were monitored during three winter seasons (1997-2000) utilizing snow-tracking methods. The tracking efforts covered approximately 1100 km² in the region of the border country of Alberta and British Columbia known as "Chinchaga" (after the Chinchaga River). Tracking is being increasingly recognized as a useful scientific tool in wildlife studies, management and conservation, with efforts being made to establish standardized terminology, to institute university courses on the subject, and to establish networks of trackers throughout the North American continent (Rezendes 1999; Zielinski and Kucera 1995). Snow tracking may be the only practical way of learning details of Wolverine habits and habitat use, as such details are not adequately provided by radio-telemetry studies (Eric Lofroth, personal communication).

Approximately 34 000 km were traveled by truck, snowmobile, cross-country skis and on foot, in search

of furbearer tracks over the course of the three winters, with an emphasis on locating Wolverines. Markedly different and readily divisible stand characteristics are a feature of the area as a result of the "Great Chinchaga Fire" which blanketed the region during the 1950s (Don Williams, personal communication), burning all but the upland ridges. Fifty years following the fire, two distinct forest types predominate: early-to-mid seral second growth of predominantly aspen or pine in the lowlands, with more limited late-seral, climax or "overmature" stands predominated by White Spruce and Black Spruce (*Picea* spp.), and mostly dead and dying *Populus* spp. in the uplands. The lowland forest may be further characterized as forming a mosaic broken by broad expanses of relatively open Black Spruce fen and open Willow (*Salix* spp.) muskeg. The upland forest cover is by comparison more continuous.

Moose (*Alces alces*) reach some of their highest densities in North America in the area (Brody 1981), being most heavily distributed in the lowlands, and frequent in the uplands. Groups of Woodland Caribou (*Rangifer tarandus caribou*) are frequent at low densities in the lowlands. These ungulates offer a generous prey base for the area's healthy Grey Wolf (*Canis lupus*) population, whose kills in turn offer a ready food source for the infrequent Wolverines.

When Wolverine tracks were located, the individuals were fore-tracked (older trails) or back-tracked (fresh trails) in order to gain insights into important and little-known details of the creatures' use of the

boreal forest, including landscape and stand use. Tracks were accessed in the morning by snowmobile or truck, and followed on foot as long as daylight permitted, with the exception of one overnight excursion conducted in order to assess advantages and disadvantages to the tracking process of remaining *in situ*. Pertinent details of the Wolverines' behavior were logged in field notebooks during the tracking event as well as being photographed.

Results

Wolverine tracks were located on ten occasions over three winters (for a mean of one Wolverine track encountered per 3400 km of searching). Thirteen separate tracking events resulted, each lasting approximately six hours, and totaling 20 linear km of off-corridor (forest) tracking, or 26.6 total off-corridor km using Magoun's (1985) estimate of adding 33% to arrive at non-linear distance traveled. Wolverines were tracked for an additional 12.3 km on linear corridors offering conditions of compacted snow, for a total estimated tracking distance of 38.9 km. Five cache sites and three resting sites were encountered and documented using a GPS unit, camera, and sketches in field notebooks.

Despite frequent available food in the lowland landscape, Wolverine tracks were located only in the upland landscape. Wolverine were revealed to have remained in the uplands throughout the tracking events.

Wolverine often encountered linear corridors during their travels. Wolverine diverged from their line of travel under the forest canopy to travel on 100% of the linear corridors encountered that offered conditions of compacted snow ($n=17$), for distances ranging from 3 to 3000 m. In one instance, two Wolverines traveling together followed a compacted (snowmobile) trail on a linear corridor for 1270 m to bring them within 150 m of a cache site, at which point they exited the trail at right angles to follow the shortest linear distance directly to the cache.

All five caches observed consisted of bones and/or sections of the hides of Moose (*Alces alces*), all of which were believed to have stemmed from the Wolverine's scavenging of Grey Wolf (*Canis lupus*) kills. Bones and hide are believed to be a very important component of the Wolverine's winter economy (Banci 1994; Haynes 1982). Cache-sites appear to be closely frequented until the nutritive value is exhausted, judging from the well-used system of trails and tracks of varying ages in the vicinity of such sites.

Cache sites encountered ranged from those consisting of a single bone process or an excavation ($n = 2$), to those better described as "cache complexes" ($n = 3$). Such complexes were believed to stem from the scavenging of a single kill, resulting in a series of smaller caches spread over areas which ranged from highly localized to widely radiating. Cache sites were in climax, or "overmature" stands of Black Spruce (*Picea mariana*) or mixed-wood of high complexity, domi-

nated by conifers in which the Trembling Aspen (*Populus tremuloides*) and Balsam Poplar (*Populus balsamifera*) component consisted of mostly dead or dying individuals characteristic of such old growth in the boreal uplands. Sites offered relatively good visibility of the surrounding stand. Sites were never located in the dense to extremely dense homogenous spruce stands documented as being favored for travel by Wolverines in the study area, perhaps because of the limited field of vision in such stands. The better-used cache complexes were accessed by numerous well-used trails made by the Wolverines themselves, and had certain features in common, including:

- a readily accessible spruce tree (*Picea* spp.) of relatively large dbh (diameter at breast height) selected and well-used for climbing (perhaps as refuge from Wolves, or a safe area to digest between feedings);
- a resting site characterized as a depression in the snow formed by the Wolverine's body and with a good view of surroundings;
- one or more latrines – specific off-trail sites the Wolverine visited to eliminate wastes;
- a radiating series of "feeding areas" characterized by areas approximately 1.5 m² of well-compacted snow, on which bones and bone fragments or sections of Moose-hide were found, but not both, and distinguishable from a kill site by the lack of Moose stomach-content remains;
- excavations [often in the snow, but on more than one occasion ($n = 3$) in the earth beneath the overhanging boughs of a very large spruce tree], that likely had contained fragments of cached food.

A detailed description of the cache and resting sites presented on a site-by-site basis follows, in order as encountered.

Cache #1

Cache #1 was a widely radiating cache complex. The original Wolf kill site was believed to have occurred on a linear corridor regenerating to Lodgepole Pine (*Pinus contorta*) located at 57° 27' 20" N and 120° 08' 26" W. Old Wolf tracks lead to and from this central location, and Wolverine trails of varying ages, all apparently more recent than the Wolf tracks, were present. Shards of Moose bone were located at a feeding area here.

Three additional caches connected by Wolverine trails and radiating from the kill site combined to comprise the cache complex.

- (1) At 57° 27' 20" N and 120° 08' 18" W a cache consisting of Moose hide remains and an abundance of Moose hair was located.
- (2) At 57° 27' 17" N and 120° 08' 18" W a fresh excavation in the earth under the boughs of a very large spruce tree was located. This cache was believed to have been visited by a Wolverine within several hours prior of its discovery.
- (3) At 57° 27' 22" N and 120° 08' 06" W a cache consisting of bone shards and fragments was located. The shards were larger than those examined at the kill site. Further components of this cache included an excavation in the snow down to the sphagnum ground-cover and a latrine.

This cache complex was not characterized by a climbing tree, which was a notable component of some other cache sites. The Wolverine tracked to this cache complex was dragging what was believed to be a trap by one of its left feet. This hindrance apparently rendered it incapable of climbing, as nowhere during the tracking event was it observed to have done so, whereas other Wolverines tracked climbed regularly. The trap appeared to affect the individual's locomotion as well; unlike other Wolverines tracked, this individual never varied its gait from a "2× lope" (Zielinski and Kucera 1995).

Cache # II

Cache # II was located 150 m from a linear corridor with compacted access (snowmobile trail) that was followed by two Wolverines traveling together, as mentioned, for 1270 m, before exiting the corridor at a right-angle to head directly to the cache.

This cache is best described as a localized complex, and appeared to represent the richest of the observed caches as evidenced by heavy use. It was located in a climax stand of somewhat stunted Black Spruce. Four feeding stations were located here, characterized by the existence of bone shards and larger fragments and processes of bone. There were three latrines, two containing white scats and one containing brown scats.

Resting Site # 1

A resting site, slightly elevated, was located at the north edge of the complex. The resting site consisted of a 43 × 35 cm oval depression atop the snow, at the base of the remains of a short (30 cm), well-weathered spruce stump. Snow in the depression was well-compacted. The resting site was relatively open, away from the boles of living trees, and offered a good view of the cache complex and its approaches. It was accessed by four well-used trails, at approximately the four points of the compass. A few guard hairs were present in the depression, along with a few dribbles of urine at the edge of the east access.

A climbing tree (Black Spruce) of approximately 14 m was located in a dense clump of smaller spruce at the southeast edge of the cache complex. The tree was larger than the stand's average and heavily used, as evidenced by claw-marks on the trunk, heavy debris of bark atop the snow at the tree's base, and the degree of trampling of snow within the spruce clump. Climbing on the tree appeared to terminate at a point near its apex where there was a "witches' broom" formation estimated to be large enough to support a resting Wolverine; it may have been an additional resting site. No additional trees in the area of the cache complex bore any evidence of having been climbed by a Wolverine.

Resting Site # 2

A second resting site was discovered by following the trail of the two Wolverines after leaving Cache # 2. Approximately 200 m from the cache, this resting site again consisted of an oval depression (58 × 43 cm)

atop the snow at the base of a relatively large Tamarack (*Larix laricina*) tree. Snow in the depression was well-compacted. This resting site was characterized by having more canopy cover than the previous site, although the cover was by no means dense. There was no cache in the immediate vicinity of this resting site, and no apparent climbing tree.

Cache # III

Cache # III was located at 57° 26' 84" N and 120° 07' 69" W and is best termed a "simple cache", rather than a cache-complex. This cache consisted of a single large bone-process and a well-gnawed Moose's hoof. The cache was located by following the previous two Wolverines, which evidently were aware of, or scented, this cache, as evidenced by their diverting their course of travel by approximately 50 m to reach the cache. There were no other features characteristic of other caches present at Cache # III.

Cache # IV

Cache # IV located at 57° 27' 25" N and 120° 06' 81" W is best termed a cache-complex, although not extensive. Certain features lacking at the last (simple) cache were present at this one. This cache consisted of a collection of bone fragments located on a single feeding platform under a relatively open canopy in a high-complexity climax mixed-wood stand. The cache was accessed by numerous well-used Wolverine trails. No latrines were discovered at this cache.

Approximately 10 m from the main cache was an excavation in the earth under the overhanging boughs of a very large spruce tree, accessed by a Wolverine trail, and virtually identical to the excavation discovered at Cache # I. This excavation, too, was deemed to have contained cached food that had been recently recovered by a Wolverine.

Cache # IV was further characterized by a well-used climbing tree (spruce) of larger than average dbh, located approximately 4 m from the feeding-station. This cache was located approximately 10 m from a linear corridor with compacted access (snowmobile trail) that was used as a conduit for 700 m in a northerly direction by the Wolverine pair upon exiting the cache. This cache had been visited recently by a Marten (*Martes americana*).

Cache # V

Cache # V was located in very large, climax mixed-wood dominated by spruce, near the base of a ridge adjacent to Resting Site # III. This was a simple cache, consisting of a single fresh excavation in the earth beneath the overhanging boughs of a large spruce, much as described for caches I and IV. The excavation was also believed to be for the purpose of recovering cached food.

Resting Site # 3

Resting Site # 3 was located along the Wolverine pair's trail at 57° 27' 72" N and 120° 05' 11" W. As in the case of the other resting sites observed, this

one consisted of an oval depression atop the snow approximately the same dimensions as the last previous two sites (measurements not taken due to this similarity). The site was mid-slope on a prominent ridge covered by a stand of very large mixed-wood dominated by spruce. The site was relatively open, and offered good view down and along-slope, and only slightly less so upslope. Within 1 m of the resting site was a medium-sized pine tree which had been well-climbed to a height of approximately 4 m.

Tracks indicated that this resting site may have been utilized by a third Wolverine which was traveling down slope. It appeared as though this third Wolverine left the resting site to travel approximately 15 m along-slope to meet the Wolverine pair as they traveled upslope. The single Wolverine may have utilized the climbing-tree to observe the approaching pair. A confusion of tracks resulted where the three Wolverines apparently met. It is believed that all three animals subsequently traveled upslope together.

Discussion

Caches were located in climax stands of less density than those apparently favored for travel by Wolverines in the study area. Visibility of approaching competitors/predators (Wolves) may be the deciding factor in both cache-site and above-snow resting-site selection. That the caches were all located in climax timber reinforces the importance of this stand-type to Wolverine. Present forest practices that result in the harvest-

ing of climax stands may negatively impact Wolverine populations.

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