A GUIDEBOOK FOR GRIZZLY BEAR WILDLIFE HABITAT FEATURES IN COASTAL BRITISH COLUMBIA

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Prepared for:

The Ministry of Water, Land, and Air Protection
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&
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1. INTRODUCTION

Under the British Columbia Forest Practices Code (FPC) the designation of Wildlife Habitat Features (WHF) is the responsibility of the Ministry of Water, Land and Air Protection (WLAP) and the Ministry of Forests jointly. Under section 51 (1) of the Operational Practices Regulation under the Forest Practices Code of British Columbia Act a "resource feature" includes - wildlife habitat features, as agreed to by the District Manager and a Designated Environment Official. The Ministry of Water, Land and Air Protection (WLAP) Designated Environmental Official, and the Mid-Coast Forest District Manager have agreed that the following five localized features are to be considered as Wildlife Habitat Features under the Forest Practices Code of British Columbia Act, within the Mid Coast Forest District, i.e.: well-established bear trails and well-defined bear marked/rub trees; well-established bear trails; bear wallows and bear beds and dens. This guidebook has been written to guide foresters and others in the identification of these features.

The ability to read wildlife tracks and sign assists with determining the presence, distribution, abundance and habitat use of species that are inconspicuous or secretive and are therefore difficult to detect using other methods. Tracking an animal teaches you much about its biology, including its foraging habits, preferred foods, denning or resting sites, extent of its home range, periods of activity, and relations with other species. Tracks and sign can also alert you to the presence of potentially dangerous species in the area, such as bears, thus allowing you to take steps to avoid a negative encounter.

For optimum safety in bear country it is necessary to use all of one's senses. Sight, hearing, smell, and touch all come into play, sometimes individually and sometimes in combination. It is necessary to be able to recognize all of the signs associated with bear activities (tracks, scat, mark trees, mark trails, wallows, dens, digs, scrapes, feeding etc.) to differentiate between signs of grizzlies and black bears; and the signs of other species (e.g. moose, deer, wolverines, wolves, cougars) which may, at times be confused with those of bears. While some bear signs are conspicuous to even the casual observer, many other signs are subtle and easily overlooked.

Much of the discussion of wildlife habitat features for grizzly bears is also applicable to black bears. In fact, it is sometimes very difficult, even for seasoned bear researchers, to distinguish between the sign of black and grizzly bears. Therefore, we use the term bear where it applies to both species and whenever possible discuss the differences between grizzly and black bear sign.

1.1. Tracking Techniques and Sign Interpretation

If following tracks or a trail, walk slowly, with all senses alert, pausing frequently. Whenever possible, try not to walk directly on the tracks but instead, walk slightly off to one side. Do not concentrate so much on the ground at your feet that you walk into a bear on the trail! Avoid travelling alone in bear country. It is best to work in teams. That way, one person can interpret and record sign while the other person remains vigilant and alerts his or her partner to the presence of bears. The best times for tracking

are early morning and late afternoon when the sun is at a low angle to the horizon. At these times, the low-angled light emphasizes any unevenness' in the surface of the ground, and throws details of tracks into sharp relief. However, this also the time when bears appear to be most active so extra precautions should be taken if travelling around dawn and dusk (MacHutchon et al. 1998). Tracks show up best when tracking towards the light. When this is not possible, make a point of looking frequently at tracks from a position where they are backlit by the sun. Tracks also show up clearer if they have been made after frost or dew has fallen. After dew, grass holds down when trodden. If following a trail across a dew-laden meadow, tracks will show up light if the animal is being followed, but if you are moving in the opposite direction to the animal the tracks show up darker (Taylor Page 1966).

Carefully examine the ground surface from all angles; crouch low or on hands and knees, peer carefully at tracks from a distance of a few centimetres; alter your viewing angle and eye-distance by looking directly down upon the tracks from an elevated position (e.g. while standing on a log or a rock). Droplets from trees or windblown debris can leave a variety of marks on the ground, which can be mistaken for animal tracks.

Do not concentrate only on tracks/sign at your feet but remember to look in all directions or further along the trail. Try to visualize an animal such as a bear moving through the terrain. Be constantly aware of the lay of the land, the slope, aspect, and obstacles to travel like logs, rocks, trees and shrubs. Note where a bear may have passed close to these obstacles and left some loose hairs.

Look for trampled vegetation, bent grass blades, broken twigs, disturbed leaves or dislodged stones. In the absence of tracks, the impression of the stone's former, relative to its present, position may give a clue as to the direction the animal which disturbed it, was travelling, likewise, for disturbed herbage, twigs, or other debris. If the trail passes under a log, look for snagged hairs on the underside, especially on twigs or broken stubs, or on the ground beneath. If you lose the trail, use your observations of the animal's length of stride and track patterns to locate where the next set of tracks should be. Alternatively, mark the last track seen (e.g. with an upright stick) and then walk slowly in widening circles around the fixed point until more tracks are encountered. In ground vegetated with low-growing grass, moss etc. bear tracks may only be discernible as flattened depressions. By gentling patting the ground with your palms and fingertips, you may be able to discern details of the tracks, including individual toe and claw marks, providing possible clues as to the species involved.

While approaching individual trees look for signs of worn, smooth bark, claw marks on trunks, running sap on conifer tree species, trampled or worn vegetation about the base, soil scuffs on exposed roots or rocks, hairs snagged on pitch, twigs, limb stubs, or shrubs. Conifers, which have been marked by bears, are easier to notice than are marked hardwood tree species. Damaged conifers exude free-flowing sap, which runs down the trunk. When a bear then rubs against the tree the loose hairs tend to stick to the sap. When examining trees or shrubs for snagged hairs, it is helpful to use a light-coloured surface, such as the palm of your hand, or a piece of paper, as a "back-ground" to silhouette any hairs which might be present.

Be alert for auditory signs of possible bear activity: snapping twigs, rustling vegetation, or bear vocalizations. The sight and/or sounds of angry bees or hornets may mean that a bear has recently disturbed their nest. This happens most commonly in late summer and fall. Signs of crows, ravens, or other avian scavengers may indicate the presence of carrion, possibly an animal carcass either predated or scavenged by a bear. Grizzly bears, in particular, can be very aggressive in defence of such a rich source of protein.

BEWARE! ***If you think there may be a carcass or carrion in the area, don't linger to investigate! Leave as quickly, and as unobtrusively as possible to avoid a possible bear attack!***

For more detailed descriptions of animal tracks and sign interpretation in general see: ***A field guide to animal tracks*** by Olaus J. Murie and ***Tracking and the art of seeing: how to read animal tracks and sign*** by P. Rezendes.

2. KINDS OF BEAR SIGN

Two important types of bear sign, tracks and hair, are introduced first to aid the reader in the proper identification of bear wildlife habitat features and to assist in distinguishing whether the use of these features is by grizzly or black bears or both.

2.1. Bear Hair

Bear hairs may be found stuck to the pitch of conifers, snagged on bark, twigs, logs, fence posts or barbed wire, and in beds and wallows. The fine, wavy hair of bears is readily distinguishable from the coarse, hollow, often crinkled hair of ungulates. Ungulate hairs kink sharply when bent and are easily broken by pulling at either end.

Distinguishing between the hairs of grizzlies and black bears is not as simple as one might think. Although glossy black hairs from a bear can usually be assumed to be from "black" bears, hair colour alone is not sufficient for differentiation: Some grizzlies have black hair, and hair colour may vary greatly for both species. In addition, old shed hairs may become bleached over time. However, grizzlies tend to have banded, light-tipped hairs and this can be used to differentiate them from light-coloured "black" bears. Light-coloured black bears are less common on the coast compared with the interior of the province.

The guard hairs, or long coarse outer hairs, of coastal black bears are very straight, glossy and much thicker when compared to grizzly bear guard hairs. Grizzly bear guard hairs also always have a lighter tip that is usually never found in black bears. Black bear underfur is dark brown or black and much more kinky than the white, blonde, or light brown, straighter underfur of grizzly bears.

2.2. Bear Tracks

Bear tracks are easily distinguished from those of most other wildlife species because they walk on the palms of their front feet and the soles of their hind feet and are referred to as plantigrade walkers. The only other plantigrades, whose range overlaps with bears, in coastal BC, are wolverines and racoons. The tracks of racoons can usually be distinguished from bear tracks by size alone.

While the paw print of a wolverine is about 10 cm wide, or less, an adult grizzly leaves tracks of at least 13 cm wide, and often larger. However, in forested habitat, size alone is not sufficient to differentiate between the tracks of a wolverine and those of a black bear; the tracks of both species may measure 10 cm across the pad. But, when the tracks are clear, there need be no confusion between the two: There are many differences between their track characteristics such as gait, trail width, length of stride, and shape of the pads (see track guides such as Murie 1954; Rezendes 1999; and Herrero 1985). The significant weight difference between the two species can also be useful in differentiating their tracks. As the small inner toe in wolverine tracks sometimes does not register, they are more likely to be confused with those of a wolf than with a black bear. If in doubt, look for additional evidence (e.g. scat and hair) to differentiate tracks.

Track size alone is not a good criterion to distinguish between bear species. The track size of large male black bears may overlap or even exceed those of adult female grizzlies. The size and shape of the track impression left by the same bear may be different in mud, snow or dry sand and may also be different depending on whether the bear was walking or running.

Lloyd (1979) conducted detailed investigations of the differences in grizzly and black bear track characteristics. Herrero (1985) also discussed differences between grizzly and black bear tracks. They both suggested that the best way to distinguish between black bear and grizzly tracks was by comparing the arc of the toes and whether or not the toe imprints are joined. These characteristics are present in both young and adult bears and on front and hind feet. The toes of black bears are more arced and further apart than the straighter and more joined grizzly bear toes (Figure 1 and Figure 2). The claws of adult grizzly bears usually appear further from the toes than in black bear. Aging Tracks

The quality of definition and detail of a particular track, and the track's duration, depends largely on the nature of the substrate in which it is made. Mud, clay, wet sand, and snow provide the best mediums for registering detailed tracks, while dry sand, dust, and vegetation register tracks poorly. Tracks in clay or mud can persist for a long time while tracks in snow, dust, or sand are short-lived. Knowledge of this may aid in aging tracks.

To gauge the age of a track in any medium, make an impression beside it with your foot or hand and then compare your mark with that of the animal. Over time, tracks lose their definition due to erosion by weather (rain, snow, wind), and through gravity. The edges of the tracks gradually crumble and fall into the print. Tracks under cover of trees or shrubs age more slowly than those in open, exposed areas. Be aware of recent weather events. Raindrops may pockmark the surface of the tracks and wind may have blown dust, leaves and other debris into them. Dew, frost, or cobwebs in the prints or across the

trails, can also provide clues as to when the animal passed. Tracks made early in the morning may have damp soil thrown up next to them. In sand wetted by early morning dew, tracks show up clearer than later in the day when the moisture has evaporated, likewise, if the animal has passed by soon after rainfall. Trampled vegetation which has not yet regained its former upright position may, depending on weather conditions, indicate that it has been trodden on fairly recently.

A bear moving from wet soil or vegetation onto bedrock or asphalt may leave moist imprints or scuff marks on the hard surface. The moisture soon evaporates, but will often leave a residue of sand or soil particles, visible to the discerning eye. If on a road surface, knowledge of local road traffic patterns may help to more accurately estimate the time the bear passed. The upper surface of a stone becomes bleached over time, so if the darker surface is exposed, it indicates that it has recently been moved. Likewise, if a stone is disturbed after precipitation has fallen, the drier underside may give a clue as to when it occurred.

Bear tracks may sometimes be found in snow, especially in early or late winter. Moist snow, a few centimetres deep is best for registering detailed tracks. In these conditions, a fresh bear track is crisp, and the species easy to identify. Tracks in snow are also easier to age than are tracks in most other mediums. A bear's warm pads may cause slight melting underfoot. This warmed snow gradually (depending on temperature) refreezes, leaving an icy glaze. Thus, if the snow at the bottom of the track feels soft to your touch, it may indicate that the track is quite fresh whereas if it is frozen it may indicate that it was made some time ago (Stokes 1986).

The presence of loose debris, rain or fresh snow in the tracks, combined with the effects of wind and sun on the tracks, can be very useful in determining their age. Occasionally, the tracks of other species crossing that of the bear (e.g. diurnal birds such as ravens or crows) may narrow down the time-line as well. Wind and sun can cause snow to slough off tree branches onto tracks beneath. The sun causes melting and enlarging of tracks in snow. In open areas, wind-driven snow can cause tracks to fill in, and cornices to form on their edges. Sometimes, the wind may move loose snow from around the tracks and this, combined with differential melting of compressed versus uncompressed snow, can leave the tracks as a staggered series of large prints raised above the surrounding surface.

Figure 1. Left front paw of a young adult male grizzly. Note how the toes are close together and that the claw tips are almost 3 cm from the ends of the toes. The small round dew pad does not always show in track impressions.

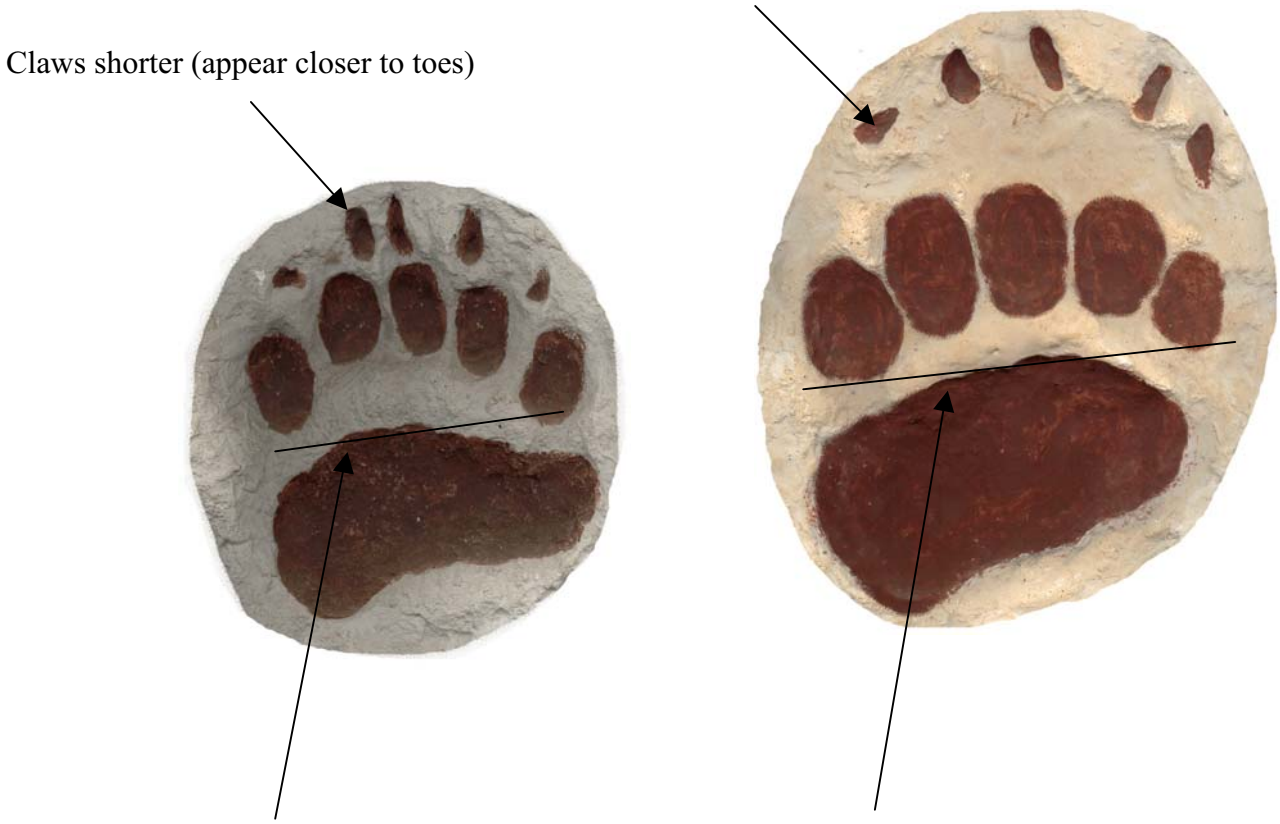

Figure 2. Plaster casts of black and grizzly front paw tracks showing the differences in claw length and foot structure. (Plaster casts courtesy of Ron Mayo, Stuie, BC)

2.3. Bear Trails

Some bear trails may be so well used that they can be mistaken for human hiking trails. For example, trails along salmon streams or across mountain passes. Bears, like humans and other animals, take the easiest route from point A to point B. Many hiking trails, and even logging roads, were probably bear or other wildlife trails before humans developed them. We have often observed this, when on logging development plan field reviews the road layout ribbons have followed an existing bear trail for several hundred meters. On the other hand, bears may readily use abandoned industrial roads or abandoned rural routes even if they were not trails before. In areas of low bear density bears may use the trails of other wildlife rather than producing their own and bear presence may be difficult to detect. In some substrates such as talus slopes it may also be difficult to discern trails; look for even patterns in the distribution of rocks. In open habitats such as alpine areas easy travel may preclude trail establishment, although grizzlies may make well-defined trails even on open tundra (Murie 1954).

Well-established bear trails are about 30-60 cm wide, often undulating and worn down to bare soil (Murie 1954; Smith 1982; Whitaker 1996). Other carnivores, ungulates and many other wildlife species also use these trails. Bears often go under or over obstacles (e.g. logs) that ungulates would have to go around (Murie 1954). Where the bear trails enter thickets of dense shrubs, they sometimes form tunnels through them, 1-1.2 m high. On temporary bear trails, where only recent movement can be detected, grass and other low-growing vegetation is often trampled flat by the bear's plantigrade feet. The movement sign appears wider than that of most other wildlife and may take the form of two parallel ruts in soft substrates because of the wide gait of bears.

Bear trails may be found in many different types of habitat and often link several habitat types; they allow movement between important feeding and bedding areas, allow seasonal movements between spring, summer and fall ranges or lead to denning areas. Bear trails may pass through specific habitat types, skirt the edges of habitats or go round around them and because they are linear features they are difficult to link to specific habitat types or site series. Therefore it is important to look at how the trail links the potential feeding and security habitats for bears rather than what habitat the trail is in. To judge the importance of a bear trail it is important to assess the amount of bear sign on or near the trail such as mark trails, mark trees, wallows, scats, tracks in soft substrate, feeding sign etc.

2.3.1. Bear Trail Characteristics

- Bears generally take the easiest route from point A to point B; so keep the lay of the land in mind.
- Bear trails commonly run along rivers and creeks, across mountain passes, through open forests and through or around shrub thickets and avalanche chutes.
- Well-established bear trails are about 30-60 cm wide, often undulating and worn down to bare soil.

- Where the bear trails enter thickets of dense shrubs, they sometimes form tunnels through them, 1-1.2 m high.
- Bear trails may take the form of two parallel ruts in soft substrates because of the wide gait of bears.
- To judge the importance of a bear trail it is important to assess the amount of bear sign on or near the trail such as mark trails, mark trees, wallows, scats, tracks, feeding sign, etc.
- Bear trails link several important bear habitat types; allowing movement between important feeding and bedding areas; and allowing seasonal movements between spring, summer and fall ranges and denning areas.

2.3.2. Bear Trail Photos

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An adult male grizzly on a well-worn bear trail (above) passing through an open Douglas-fir forest near Bella Coola, BC. Note how this trail could easily be confused with a maintained hiking trail. The bear is rubbing a fir mark tree. Trails are also common along rivers, (right) especially salmon rivers like the Atnarko in Tweedsmuir Park.

2.4. Bear Mark Trails

"Mark trails" are short sections of bear trails where (often numerous) bears have repeatedly stepped in the same spots. Mark trails can be seen as a series of staggered elliptical bare depressions, which we'll call mark pads, each mark pad measuring about 18-25 cm by 15-30 cm (Lloyd 1979; Murie 1981). The mark pads appear in a typical stride sequence but are often deeper (2-5 cm or more) than those made by a normal foot imprint. Grizzly bears have been observed in the process of marking these trails, walking in a deliberate swaggering manner, vigorously twisting their feet in the mark pads.

Mark trails range from 4 or 5 pad marks on less than 10m of trail to over 100 metres in length. One mark trail, in the Khutzeymateen Valley in north coastal British Columbia, had continuous padding for more than 150m with over 100 individual pad marks S. Himmer pers. obs.). This mark trail leads over a pass into another major valley.

Mark trails are often, but not always, associated with mark trees. The reason for marking is still open to speculation; however, it is probably associated with communication among males during the mating season (LeFranc et al. 1987). This is discussed in more detail in the mark tree section. We speculate that it may also serve as displaced aggressive behaviour on the part of adult males. Typically, the distance between pad marks (stride length) is about 1 metre or more, indicating that adult bears, and most likely adult male bears, initiate mark trails. Both black and grizzly bears make mark trails.

If mark trail behaviour has occurred recently, the observer may be able to detect urine on the shrub foliage, and in a good tracking substrate the twisting motion of the feet is clearly discernible (pers. obs.). When bears make mark trails in snow, their urination is obvious. However, look closely, as sometimes the drip from the foliage and limbs of trees and shrubs overhanging a trail may discolour the snow and can be mistaken for a urine stain.

In North America, mark trails are unique to bears; no similar wildlife sign exists for other species.

2.4.1. Bear Mark Trail Characteristics

- Mark trails can be seen as a series of staggered elliptical bare depressions called mark pads, each mark pad measuring about 18-25 cm by 15-30 cm and 2-5 cm deep.
- The mark pads appear in a typical stride sequence with the distance between pad marks about 1 metre apart.
- Mark trails range from 4 or 5 pad marks on less than 10m of trail to tens of pad marks and over 100 metres in length.
- Mark trails are often, but not always, associated with mark trees and wallows.
- Both black and grizzly bears make mark trails.

2.4.2. Aging Mark Trails

Recently used mark trails may have disturbed soil and flattened vegetation in the pad marks. Sometimes wilting green vegetation may give a relatively accurate indication of the last use of the mark trail. Old and disused bear mark trails can be evident for many years after use by a more vigorous growth of vegetation, especially moss, in the foot depressions, compared with the rest of the trail. This is the result of water collecting in the depressions. Another technique for aging mark trails is to put twigs or grass stems across the pad marks and look for their absence or condition on the next visit to the area.

2.4.3. Bear Mark Trail Photos

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Mark trails are a made up of a series of staggered elliptical depressions, called mark pads, made when a bear deliberately twists it's feet in a regular stride sequence. Mark trails may lead to a mark tree (above) or an estuary wallow, just out the photo (right). Some mark trails are so distinctive that they can be spotted from the air (left) such as this one in *Stereocholon* lichen on a dry river channel.

2.5. Bear Mark Trees

Mark trees are trees (both coniferous and hardwood species) that bears create by rubbing, biting, scratching, and scent marking. Two types of mark trees have been identified: "scratch" trees with claw marks and/or tooth marks, and "rub" trees with little or no scratching of the bark (Hamilton and Archibald 1985). However, many mark trees may exhibit signs of scratching, biting as well as rubbing. Tree marking is practised by both black and grizzly bears and appears to serve several purposes. The main theories for marking include use as information signposts, small-scale territory definition, sexual advertisement, and comfort and grooming (LeFranc et al. 1987).

Marking is not only confined to trees, as boulders, shrubs, logs, large roots, trail signs, fence posts, cabin corners, and outhouses may also be used (Herrero 1985). Marking is more obvious on conifers than on hardwoods, due to the large amounts of pitch on some conifer species and the subsequent adherence of loose hairs to the exuded pitch. However, this does not mean that coniferous trees are more important than deciduous trees for marking; it just means that coniferous mark trees are more readily identified.

When marking trees, bears generally stand up to their full height and then bite, scratch, or rub against the trunk. Therefore, the height of marks above ground may give an indication of the size of the largest bears using the mark tree. Adult male bears sometimes straddle low shrubs or young conifers breaking their tops and urinating on them in the process. Look for bite marks and hair near the break.

Mark trees are generally found on bear trails or trail systems, often near the junction of two or more trails. They are most commonly located near creeks and streams, near important feeding and bedding habitats, or at topographic constrictions (e.g. a bottleneck in a narrow valley or in a mountain pass). Often, but not always, mark trees, mark trails and wallows are associated with one another (MacHutchon 2000).

The trunks of mark trees usually have a general polished appearance, lack lower branches, have smooth rounded branch stubs, broken or bent upper branches (up to a height of 3-4 m), a lack of moss and lichen growth, and may show signs of claw and/or bite marks. Claw slashes are usually diagonally, but sometimes vertically or horizontally, orientated. Bite marks are generally horizontal. Soil and vegetation at the base of a bear mark tree is often trampled and traces of mud or sand may be visible, on the tree and at its base from the fur of bears that have been rolling on the ground or wallowing. Mark trees and mark trails are indicative of bear travel routes or indicate that important feeding areas are nearby. Therefore, trails that are well rutted and have several mark trees and mark trails along them indicate well-used bear travel routes (MacHutchon 2000).

Male ungulates, such as moose, may also fray and tear bark with their antlers, generally on small diameter saplings ($\leq$17.5 cm) during the rutting season (Rezendes 1999). This behaviour is known as "antler rubbing". Moose antler rubs range in height from about 45 to 250 cm while deer rubs range from about 25 to 120 cm (Rezendes 1999). Large bears may mark trees to a height of 3.5 m. To distinguish claw marks from antler rubbing, look

for indications of 4-5 claws starting high on the trunk and being raked downwards. Claw marks tend to leave a relatively clean cut in the bark when compared to the frayed edges of antler rubs. Antler rubs also leave frayed bark at both ends of the rub, indicative of an up-and-down movement of the animal's head. Ungulates also scar trees by bark stripping upwards with the lower incisors to feed on the cambium underneath. The lower edge of the scar tends to be sharply cut and the upper edge more ragged (Halfpenny 1986). Incisors widths vary from about 12.5 mm for deer and 12.5-25.0 mm for moose (Stokes 1986). Bears may also feed on cambium (Herrero 1985). The width of adult black bear incisors range from 3-4 mm while adult grizzly bear incisors range from 5-10 mm.

Felines (cougar, lynx, bobcat) also claw-mark trees and stumps, but mostly hardwood species – they tend to avoid the pitch from conifers (McDougall 1997). Cougars generally claw a tree at a height of 1-1.5 m. Claw marks tend to be vertically oriented and are about 6 mm wide. Bear claw marks are much higher, deeper, and less vertical (McDougall 1997). Lynx and bobcats claw trees at a height of 60-100 cm but their claws often do not expose the inner bark, unlike the deeper marks left by bears (Smith 1982). All of these cats frequently spray very pungent urine at or near the "scratching post." When fresh, this cat smell is very noticeable, even to a human nose.

2.5.1. Bear Mark Tree Characteristics

- Bears use both coniferous and hardwood tree species as mark trees by rubbing, biting, scratching, and scent marking.
- Marking is more obvious on conifers than on hardwoods, due to the large amounts of pitch on some conifer species and the adherence of loose hairs to the exuded pitch.
- Marking is not only confined to trees; boulders, shrubs, logs, large roots, trail signs, fence posts, cabin corners, and outhouses may also be used.
- Young conifers with broken tops may be mark trees. Look for bite marks and hair near the break.
- Mark trees are generally found:
    - on bear trails or other trail systems;
    - near the junction of two or more trails;
    - near rivers creeks;
    - near important feeding and bedding habitats;
    - at topographic constrictions in a valley;
    - where trails cross the tree line.
- The trunks of mark trees usually:
    - have a general polished appearance;
    - lack lower branches;

- have smooth rounded branch stubs;
- broken or bent upper branches (up to a height of 3-4 m);
- lack moss and lichen growth;
- show signs of claw and/or bite marks (claw slashes are usually diagonal and bites horizontal);

- Soil and vegetation at the base of a mark tree is often trampled and traces of mud or sand may be visible, on the tree and at its base from the fur of bears that have been rolling on the ground or wallowing.
- Mark trees are often, but not always, associated with mark trails and wallows.
- Both black and grizzly bears make mark trees.

2.5.2. Aging Mark Tree Sign

When a bear claws deeply into the bark of a conifer such as a spruce, fir or pine, the sap begins to flow freely, pale and honey-like, down the trunk. On exposure to air, the pitch then slowly becomes darker and more viscous, eventually forming a hard crust. The cambium layer appears moist and pale when first exposed but dries and darkens with age. Broken twigs, white and sharp-edged when newly broken, become worn, blunted, and darker from continual rubbing by bears. The pale inner wood is visible on the trunks of freshly clawed aspens but heals over and turns black when the scar is old.

2.5.3. Bear Mark Tree Photos

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The tree species marked by bears is less important than the location of the tree. Conifer mark trees are more obvious than deciduous mark trees because of the large amounts of pitch exuded by species such as subalpine fir (right) and spruce. Note the large clumps of hair and smooth bark on this small mark tree. Cedars (above) also show marking clearly because of the frayed bark. However, be sure to distinguish these from antler rubs, which also have frayed bark, but are usually only found on small trees and also lack bear hair.

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A variety of different mark trees showing distinctive marking characteristics; an estuary willow clump (left) with bite marks, smooth bark and broken branches; a medium sized Sitka spruce (middle) with lots of pitch and snagged hair and smoothed branch stubs; and a large amabalis fir (right) with missing bark, claw marks and very smooth trunk.

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Mark trees are often found near good feeding habitat such as estuaries (left) and skunk cabbage swamps (above). All age classes of grizzly and black bears use mark trees. Sometimes the maximum height marked on a tree will indicate the largest bears in the area. The adult male grizzly on the left is over 2.7 m tall (the biologist is 1.8 m tall).

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Marking is not only confined to trees; trail signs (above) and logs (right) may also be used. The sign is on a trail leading to a popular fishing area for both bears and people (note the signs even says that the area is frequented by bears). The log is at the edge of an estuary and is used by bears to rub their backs while walking under the log (note the well worn under side and end of the log).

2.6. Bear Wallows

Bears dig wallows in seepage areas and then roll in the wet mud. Bears may commonly use wallows in summer, to keep cool and/or obtain relief from insect bites. Wallows may also be used as "scenting" sites for social communication. Bear wallows are usually, but not always, associated with marking behaviour of some sort (e.g. mark trees, mark trails) (MacHutchon 2000).

Wallows are almost always found where there is seepage or the water table is close to the surface. Typical locations are in, or beside, shrubby fringes of estuaries and wetlands, in open forests, where an underground spring comes to the surface, or in small pockets of imperfect drainage. Wallows are often found in proximity to mark trees and well-worn bear trails. Mark trails may also lead to or go around the wallow.

Wallows vary greatly in size and shape depending on site characteristics, amount of water present and the type of soil. Characteristically, wallows have a pool of water in the centre surrounded by freshly churned mud and a sparsely vegetated rim.

Bear wallows are easy to differentiate from those of moose and elk, where these ungulates occur on the BC coast. Bear wallows contain lots of shed hairs and also provide excellent conditions for tracks. The edges of bear wallows may be worn smooth from bears laying and rubbing against them. Tree branches, roots and duff along the edges usually have an abundance of snagged hairs. The fine bear hairs contrast with the coarse hairs of ungulates. Moose and elk urinate in their wallows, leaving a strong and distinctive musky odour. Bear wallows are also often in situations which preclude their use by large ungulates, for example, under low-hanging limbs of trees.

2.6.1. Bear Wallow Characteristics

- Wallows are found where there is seepage or the water table is close to the surface.
- Typical locations for wallows are:
    - in or beside, shrubby fringes of estuaries and wetlands;
    - in open forests, where an underground spring comes to the surface;
    - in small pockets of imperfect drainage.
- Wallows vary greatly in size and shape depending on site characteristics, amount of water present and the type of soil.
- Characteristically, wallows have a pool of water in the centre surrounded by freshly churned mud and a sparsely vegetated rim.
- Wallows are often found in proximity to mark trees and well-worn bear trails.
- Mark trails may lead to or go around the wallow.

2.6.2. Bear Wallow Photos

These are typical locations for wallows: on the edge of an estuary (top – aerial view) and in an open forest, where an underground spring comes to the surface (bottom). Note the mark tree at the edge of the pool in the forest. The mark trail leading to the wallow in the top photo is the same one shown in the mark trail photo section 2.4.3.

This adult male grizzly may be cooling off during a hot day or just enjoying a leisurely mud bath. Note the smooth, worn edge of the wallow and the mud and pitch on the mark tree in the background.

2.7. Bear Beds

When not feeding or travelling, bears bed down to rest and to seek security and thermal benefits. A bear bed may be just a shallow scrape on the ground or a simple depression at the base of a tree. In other cases bears may go to lengths to dig substantial hollows in duff, sand or rotten logs. Some beds are used only once, but others may be used for several days or even weeks, especially when close to a major food source (Lloyd 1979). Bears may also bed on or near a large carcass.

***BEWARE!** If you think there may be a carcass or carrion in the area, don't linger to investigate! Leave as quickly, and as unobtrusively as possible!*

Bear beds are generally oval in shape. A typical black bear bed measures about 80 cm by 75 cm and about 30 cm deep (Stokes 1986). Grizzly bear beds are usually, but not always, bigger than those of black bear, which typically measure about 1 m by 1.3 m and are from about 25 to 60 cm deep (Lloyd 1979). Hamilton and Archibald (1985) reported the average measurement of 75 grizzly beds, in the Kimsquit River valley, were 109 cm long, 95 cm wide, and 25 cm deep.

Bear beds are often found at the bases of large trees, especially spruce and fir, which have dense, lower branches, providing good cover from precipitation and wind. In drier habitat types, bears may make beds in rotten stumps and logs, especially Douglas-fir, which breaks into small chunks and powder when rotten.

Bedding areas provide security and thermal cover (keeping warm or cooling off) when the bears are inactive. Beds are frequently in dense shrub cover, under logs or brush piles, at the base of large trees, or in tall sedge meadows (Lloyd 1979; Hamilton and Archibald 1985; MacHutchon 2000). In very warm weather, bears may bed in cool sites such as alder thickets, at the base of colluvial slopes in areas of cold air drainage, in moist floodplain silt and in dry run-off channels (Hamilton and Archibald 1985). During salmon spawning, bears often bed down within about 50 m of the river, on the upslope side of large trees, in the relatively flat area formed by the tree roots (Lloyd 1979). Also in the salmon season, bears may bed down in more open areas such as gravel and sand bars (pers. obs.). Prior to salmon spawning, the beds may be located further (> 150 m) from the river in mature or old growth forest and often on steep slopes (Lloyd 1979). Bedding on steep slopes adjacent to important feeding areas provides bears with security and cover. On steep slopes bears may be able to detect other bears or humans more easily because of increased sight lines, and also because sounds and smells may be detected from greater distances. This may allow bears to move off before being detected. Often bear bedding areas may be quite large in size (>1-2 ha) especially when good feeding habitat is nearby such as estuaries, large wetland complexes, skunk cabbage swamps, productive avalanche chutes, berry fields and salmon spawning areas. It is not uncommon to find ten or more recent bear beds adjacent to these types of habitats.

Well-used bear beds usually have many scat piles in close proximity (<2-3 m from bed). An accumulation of scats many indicate the length and timing of use of the bed. For example, many sedge scats may indicate spring use; berry scats summer use and scats

with salmon bones fall use. If the site has been used by a family group of bears this is indicated by the number and sizes of beds, and the presence of very small scats with large scats. In the absence of scat and tracks, look for hairs in the bed and on nearby trees, shrubs, boulders, or logs to determine if it is a bear bed. If hairs are not evident, moisten the palm of your hand and gently pat the surface of the bed. Sometimes hairs will then adhere to your wet palm.

Moose and deer also make beds, which can resemble in size and shape, those of bears. However, bear beds tend to be more circular and deeper than ungulate beds. A typical deer bed measures about 90 cm by 45 cm while moose beds measure 1.2 to 1.5 m long by 60 to 90 cm wide (Claridge and Milligan 1992). In general, moose and deer beds are very shallow and may not even be dug out at all. To determine which species used the bed, you must look for corroborative evidence such as scat, tracks, or hair.

2.7.1. Bear Bed Characteristics

- Bear beds are generally oval or round in shape.
- A typical black bear bed measures about 80 cm by 75 cm and is around 30 cm deep.
- Grizzly bear beds are usually, but not always, bigger than those of black bears, and measure about 1 m by 1.3 m and are from 25 to 60 cm deep.
- In flat terrain, bear beds can be found at the bases of large trees, which have dense, lower branches, providing good cover from precipitation and wind.
- On steep slopes, bears may bed on the upslope side of large trees, in the relatively flat area formed by the tree roots.
- Bears may make beds in rotten stumps and logs, especially Douglas-fir, which breaks into small chunks and powder when rotten.
- Beds can also be in dense shrub cover, under logs or brush piles, or in tall sedge meadows.
- In very warm weather, bears bed in cool sites such as alder thickets, at the base of colluvial slopes in areas of cold air drainage, in moist floodplain silt and in dry run-off channels.
- During the fall, bears often bed down within 50 m of salmon spawning rivers.
- Also in the fall salmon season, bears may bed down in more open areas such as gravel and sand bars
- Bear bedding areas may be quite large in size (>1-2 ha) especially when good feeding habitat is nearby such as:
    - estuaries;
    - large wetland complexes;
    - skunk cabbage swamps;
    - productive avalanche chutes;

  - berry fields;
  - and salmon spawning areas.
- Well-used bear beds usually have many scat piles in close proximity (<2-3 m from bed).
- Accumulations of scats may indicate the length and timing of use of the bed. For example:
  - Many sedge scats may indicate spring use;
  - Berry scats summer use;
  - And scats with salmon bones fall use;
- Large and small beds together may indicate use by a bear family group.
- In the absence of scat and tracks, look for hairs, in and around the bed, to determine if it is a bear bed.

2.7.2. Bear Bed Photos

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Bears may make beds in rotten stumps and logs, especially Douglas-fir (left), which breaks into small chunks and powder when rotten. As well as providing security cover, beds in moist floodplain silts will keep bears cool (right). This bed even has standing water in it. Note the bear tracks in the silt, identifying this as a grizzly bear bed.

In the fall, when coastal bears feed on salmon, bears may bed down in more open areas such as sand bars (top). The large and small beds seen in the photo, and tracks at the site, indicated use by a grizzly bear family group. In very warm weather, bears may bed in cool sites such old river channels (bottom) in riparian forests.

2.8. Bear Dens

All bears in British Columbia make a winter sleep[1], generally from late October to early May. The exception being rare cases of individual coastal grizzly and black bears that have been reported not to den or to have left their dens for brief periods to feed on winter spawning coho salmon (MacHutchon et al. 1993; Van Daele et al. 1990; Schoen et al. 1987; S. Himmer unpubl. data). Suitable dens for bears are sheltered, dry, and secure. Although grizzly bears sometimes use a natural cavity such as a hollow tree or log, rock crevices, or natural caves for denning, they generally dig their own dens. Some grizzly bears dig dens in alpine and subalpine slopes (Demarchi and Johnson 2000). Many researchers have found that denning under the roots of trees was typical for coastal grizzly bear populations (MacHutchon et al. 1993; Schoen et al. 1987; S. Himmer unpubl. data and A. Hamilton pers. comm.); this has also been described in other areas (Craighead and Craighead 1972; Judd et al. 1986). Tree root den site selection by bears is likely based more on den structure, rather than on a particular tree species. Occasionally, a grizzly bear may excavate a den entirely within a snow bank (Lentfer et al. 1972). While some dens are used for more than one season, most bears probably excavate a new den or re-excavate an existing older den each year (MacHutchon et al. 1993). After emerging in the spring, grizzly bears may often use their dens for bedding for a short time. Female bears with young may remain near their winter dens for 2-3 weeks after emergence, especially if good early spring feeding habitat is located nearby.

The large front claws of grizzly bears are highly adapted for digging (Figure 1) and are crucial to the excavation of dens under the roots of large trees or on alpine/subalpine slopes. Grizzly bear dens have three main structural features: an entrance, a tunnel, and a chamber. Sizes of dens and den features vary greatly and may be contingent on site conditions more than anything else. However, the size of the den entrance is usually about 75 cm in diameter and the chamber may be roughly 150 – 225 cm in diameter with a height of 125 cm. Bedding material in the chamber may consist of shrub branches, tree boughs, duff, or grass but in some cases dens may not have any bedding material. The bedding material is generally 10-20 cm deep in the chamber. Some bears may also use twigs to plug holes in the sides of the chamber (MacHutchon et al. 1993). In dens that have been excavated, large debris piles of soil material, rocks and wood may be found downslope of the den entrance. Conditions of the debris pile may give some indication of the age of the den. Fresh material with little or no vegetation growing on the debris pile may indicate a freshly dug den or one that has recently been re-excavated. Conversely, herbs, moss and even small trees growing on the debris pile indicate an older den, which may, however, still be used by bears. Conditions in the chamber and tunnel may give a better indication of whether the den is active. Often the roof may have collapsed making the den unusable; in some cases upon closer inspection it may be determined that the excavation may have only been a test digging and was never used as a den; however, in both cases other active dens may be in the vicinity (i.e. within a 100m radius) and further searching may be warranted.

[1] The term hibernation is no longer used for bears because they are not true hibernators.

Typically, grizzly bears dig dens on moderately steep, to steep slopes. A review of the literature on grizzly bear dens sites suggests that the angle of slope in which dens were excavated ranged from about 41% to 90% (LeFranc et. al. 1987). Sloped sites are often selected because they facilitate easier digging and the slope surface is generally stabilized by root systems of herbaceous plants and trees or boulders. Grizzly bears may, on occasion, den on gentle to moderate slopes ($\leq$ 35%) but generally do so only in association with cliffs or rock outcrops (Van Daele et al. 1990).

Elevation is a characteristic of grizzly bear den sites which may vary greatly between geographical regions but which may be uniform within a particular ecosystem or landscape. In coastal British Columbia, most grizzly bear dens are located on steep, well-drained slopes near the transition between the Coastal Western Hemlock and the Mountain Hemlock biogeoclimatic zones (approximately 600-1000 m elevation, depending on latitude and aspect) (Hamilton 1987; MacHutchon et al. 1993). The average elevation and slope at 121 den sites surveyed in south coastal Alaska were 640m and 70% respectively (Schoen et al. 1987). This is comparable to den elevations for coastal grizzly bears in the Kimsquit River valley (A. Hamilton, pers. comm.); Bella Coola River valley (S. Himmer unpubl. data); Kodiak Island (Lentfer et al. 1972; Van Daele et al. 1990); and the Alaska Peninsula (Lentfer et al. 1972). Schoen et al. (1987) speculated that snow was probably less important for insulation in south coastal Alaska where temperatures rarely fell below -20°C. They suggested that bears needed dry, cold sites where temperatures generally remained below freezing and surface water was rare. MacHutchon et al. (1993) suggested that grizzly bears in the Khutzeymateen study area may den above 350 m to avoid winter rainstorms and meltwater seepage. Most Khutzeymateen den sites were in relatively steep (>45%) rugged terrain in stringers of trees at the edge of avalanche tracks or steep-walled gulleys. The use of steep, high-elevation denning sites by grizzly bears has also been reported for Alaska (Lentfer et al. 1972; Schoen et al. 1987; Miller 1990; Van Daele et al. 1990), the Yukon (Pearson 1975), and the Rocky Mountains (Craighead and Craighead 1972; Servheen and Klaver 1983; Judd et at. 1986). In most studies, den aspects were found to be variable and may not be important in determining the suitability of a den site.

Many researchers identified old-growth forest as an important component in grizzly bear den site selection (Craighead and Craighead (1972), Vroom et al. (1980), Judd et al. (1986), MacHutchon et al. 1993, S. Himmer (unpubl. data) and A. Hamilton (pers. comm.)). Schoen et al. (1987) also found that 88% of old-growth forest dens occurred in commercial timber stands. At mid-elevation den sites, the tree species were predominantly western hemlock mixed with either Sitka spruce or western red cedar. At higher-elevation den sites, tree species were dominated by mountain hemlock mixed with Sitka spruce, western hemlock, and, in some cases, yellow-cedar. Grizzly bears may also den in alpine and subalpine habitats such as in patches of krummholz conifers or stands of subalpine timber (Demarchi and Johnson 2000).

While grizzly bears typically den on mountain slopes, black bears normally den on, or close to, the valley bottom (Herrero 1985). Black bears may also den at lower elevations than grizzlies, thus avoiding encounters with them. Black bears sometimes dig dens under the roots of trees, or under logs or brush piles, but their excavations are not as extensive as those of grizzlies. Cavities in old-growth structures, including large old trees, stumps, root masses and logs having a diameter greater than 85 cm are suitable black bear dens (Helen Davis pers. comm.).

In coastal British Columbia, black bear dens have been recorded in or under large trees; mainly red and yellow cedar. Large diameter balsam poplars also provide excellent cavity den sites for bears. However, black bear den sites are likely based on den structure, rather than on a particular tree species. Tree den entrances were sometimes as high as 16m above the ground (Helen Davis pers. comm.). Denning in second growth forest stands is limited by suitable denning locations, unless residual old-growth features such as large logs and stumps are present.

Wolves often dig their own dens into the sandy or gravelly soil of a slope or ridge, and their dens may be mistaken for those of bears. However, although bears sometimes excavate their dens in summer, they only occupy them in winter, while wolf dens are active between April and October, the time for birthing and rearing of pups (Paquet and Darimont 2002). Unlike bear dens, wolf dens may have more than one entrance. The entrance to an excavated wolf den is usually less than 60 cm in diameter. To identify the species involved, look for tracks, scats, and hair, and also for the remains of prey. Wolves, but not bears, regularly bring food to their dens and the site is often littered with evidence of predation. The presence of an anal plug may indicate a bear's den nearby. An anal plug is a bear scat up to 30 cm long, comprised of leaves, pine needles, and bear hair. This results from the bear consuming roughage prior to winter sleep and the anal plug is voided when the bear emerges from the den in the spring (Whitaker 1996).

Factors likely to influence choice of den sites for grizzly bears include:

- ease of accessibility (i.e., sites that are accessible to a bear in regard to distance and topography);
- ease of den construction (i.e., the degree to which the soil or substrate can be excavated);
- stability of terrain (i.e., the probability that the den will not collapse before the bear leaves in the spring),
- good drainage (i.e., the likelihood of rain or meltwater not seeping into the den chamber);
- likelihood of freeze-thaw events during the winter (dens are more likely to be above the freezing elevation for the duration of the winter);
- the extent of snow cover (i.e., the accumulation of an insulating layer of snow over the den entrance);
- seclusion (i.e., the likelihood of not being disturbed by humans or other bears (Demarchi and Johnson 2000).

2.8.1. Grizzly Bear Den Characteristics

- Grizzly bear dens have three main structural features: an entrance, a tunnel, and a chamber.
- Sizes of dens and den features vary greatly. However, the size of the den entrance is usually about 75 cm in diameter and the chamber may be roughly 150 - 225 cm in diameter with a height of 125 cm.
- Bedding material is generally 10 - 20 cm deep in the chamber and may consist of shrub branches, tree boughs, duff, or grass but in some cases dens may not have any bedding material.
- Cavities under old-growth structures, including large old-growth trees and root masses, make suitable den sites for grizzly bears in coastal BC.
- Natural caves, rock crevices and hollow trees or logs are also used by grizzly bears as dens.
- In dens that have been excavated, large debris piles of soil material, rocks and wood may be found downslope of the den entrance.
- Conditions of the debris pile and den chamber may give some indication of the age of the den, for instance:
    - fresh material with little or no vegetation growing on the debris pile may indicate a freshly dug den or one that has recently been re-excavated;
    - conversely, herbs, moss and even small trees growing on the debris pile may indicate an older den, which may, however, still be used by bears.
    - if the roof has collapsed the den may be unusable;
    - in some cases it may be determined that the excavation may have only been a test digging and was never used as a den; however, in both latter cases other active dens may be in the vicinity (i.e. within a 100m radius).
- Typically, grizzly bears dig dens on moderately steep, to steep well-drained slopes. The most common bear dens sites are on slopes ranging from 40% to 90%.
- Elevations of grizzly bear den sites vary greatly between geographical regions. In coastal BC, most grizzly bear dens are located near the transition between the CWH and the MH zones. They are generally not found below 350 m ASL and may rarely ever be found in valley bottoms.

2.8.2. Grizzly Bear Den Photos

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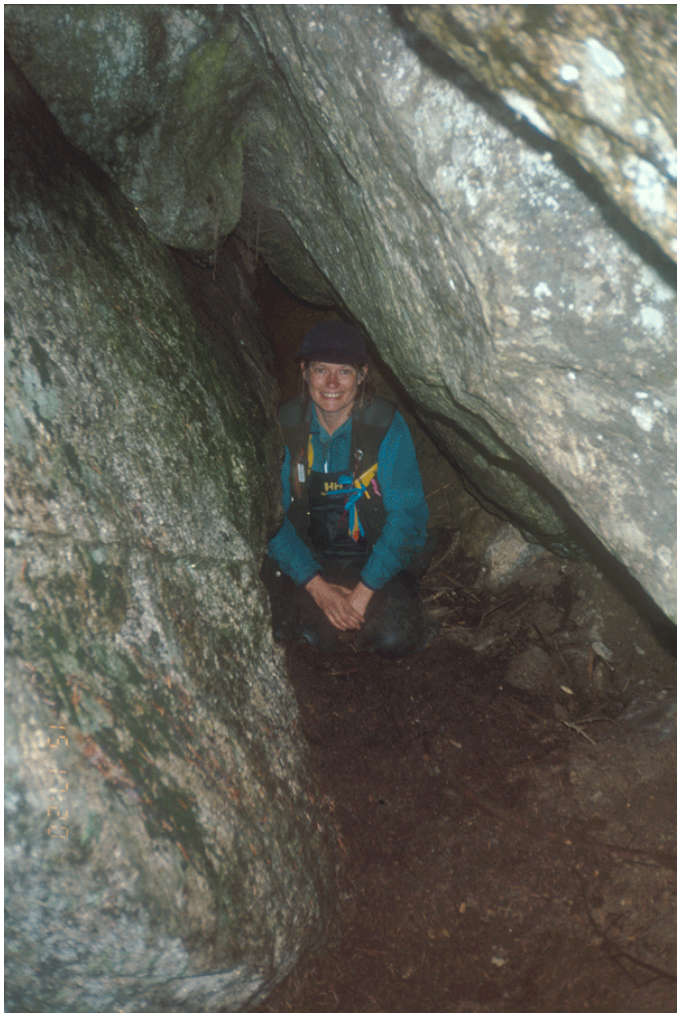
Many bear researchers have found that denning under the roots of trees was typical for coastal grizzly bear populations. The rather unique den, on the left, was created when a grizzly bear dug a natural cavity in the tree possibly as a result of the tree having grown on a nurse log or stump. The den on the right is more typical of tree root dens found on the coast of BC. No new debris piles indicate both dens have existed for several years.



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Some grizzly bears use natural caves or rock crevasses as dens (left) or dig dens in alpine and subalpine slopes (right). Lack of new plant growth on the debris pile in this alpine den suggests this den was recently dug or was an older den that had been re-excavated.

Bedding material is generally 10 - 20 cm deep in the chamber and may consist of shrub branches, tree boughs (above), duff, or grass but in some cases dens may not have any bedding material.

The photo on the left shows where a female grizzly had attempted to use a hollow red cedar as a den. Subsequent searching of the vicinity resulted in the location of another den used by this radio-collared female grizzly. The existing hole in the pictured den was too small for an adult grizzly but with more work may be suitable in the future.

2.8.3. Black Bear Den Characteristics

- Black bears normally den on, or close to, valley bottoms.
- Black bears may den at lower elevations than grizzlies (below 350m ASL).
- Black bears sometimes dig dens under the roots of trees, under logs or under brush piles, but their excavations are not as extensive as those of grizzlies.
- Cavities in old-growth structures, including large old trees, stumps, root masses and logs having a diameter greater than 85 cm may be suitable black bear den sites.
- In coastal British Columbia, black bear dens have been recorded in or under large diameter red and yellow cedar trees.
- Large diameter balsam poplars may also provide excellent cavity den sites for black bears.
- Black bear tree den entrances can range from 0 m to as high as 16 m above the ground.
- Black bear denning in second growth forest stands is limited by suitable denning locations.

2.8.4. Black Bear Den Photo

In coastal BC, black bear dens are commonly found in large diameter red cedar tree cavities (above). This one has been in use for several years.

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