STAND-LEVEL RETENTION GUIDELINES FOR BEAR DENS

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INTENT

This document provides guidance to help forest managers and field crews to:

1. identify black bear dens in coastal forestry operations,
2. develop effective prescriptions for retaining these critical habitat features within operational harvest units (i.e., cutblocks), and
3. provide on-going management of retention areas.

It specifically focuses on providing the scientific basis for strategies and options to ensure that retention prescriptions at the cutblock level retain the function of den trees into the future and does not address landscape-level supply issues.

A supply of den trees is needed at both stand and landscape levels to sustain populations of black bears. Because of this, an adequate supply of dens to sustain black bear populations through forest management can only be met through 1) retention of individual den trees in and around cutblocks, AND, 2) recruitment of new denning habitat at the landscape scale. The guidance in this document focuses on the first part of this equation. Landscape-level planning to provide a sustainable supply of dens will be addressed in a separate document.

Target Audience

This document is intended to help forest professionals and others that develop harvest units in old-growth and older second-growth forests (e.g., >60 years old) with considerable legacy structures in the Coastal Western Hemlock and Mountain Hemlock biogeoclimatic zones. Specifically, this includes:

- Planning foresters
- Operational foresters
- Reconnaissance crews
- Layout crews (blocks and roads)
- Migratory bird and wildlife habitat surveyors
- Cultural feature inventory surveyors
- Timber cruisers
- Logging supervisors

BACKGROUND

Black bears are a key charismatic species of coastal forests in British Columbia that require undisturbed, secure winter den sites to successfully survive the critical winter denning period and to reproduce. Bears can only use sites that provide a dry and defendable cavity, and in coastal BC, these features are usually associated with standing and downed large-diameter trees that occur primarily in old growth forests. Conflict with forest development occurs because these same forests are the target of forest harvesting operations. In addition to standing trees, dens can occur in large stumps and logs left over after historic old growth harvesting, although increases in utilization standards over the past 40 years and current old growth harvesting methods results in fewer structures suitable for dens remain after harvest. Not only is less volume left behind, but coarse woody debris and residual structures that remain decay over time and are sometimes removed through salvage logging.

Whether in hollow trees or under large woody debris, den structures are important legacy elements for black bear populations because these dens are frequently reused by individuals and generations of bears. Forest harvesting not only reduces the supply and quality of black bear dens through direct removal of den structures but, because trees large enough to contain den cavities take an exceptionally long time to grow (i.e., hundreds of years), current forest management does not allow sufficient time between rotations for new den features to develop. The decreasing supply and recruitment of these vitally important structures may negatively affect black bear populations because bear cubs

are only born in dens and need these dens for shelter while developing. Dens in old growth trees are a finite resource necessary for population recruitment (Forest Practices Board 2020).

Bear dens in British Columbia are protected through legislation in Haida Gwaii and the Great Bear Rainforest but only through voluntary measures in the rest of coastal BC (e.g., BC Timber Sales Best Management Practices for Bear Dens, Western Forest Product's Bear Den Standard and Mosaic Forest Management's Bear Den Recommendations).

Best-Available Information

These management recommendations are based upon both peer-reviewed scientific publications (e.g., Davis et al. 2012, Porter et al. 2020) and independent empirical data collected specifically from coastal British Columbia. Helen Davis (R.P.Bio.) is a recognized authority on the denning ecology of black bears in coastal British Columbia and has conducted the only radiotelemetry research study to date on the denning ecology of black bears in natural settings in BC (Davis 1996). As such, the management recommendations contained in this document represents the best-available information synthesized from independent (i.e., not incidental) empirical data on dens and den management collected over the past 25 years. In 2020, the BC Ministry of Forests, Lands and Natural Resource Operations initiated a research project examining the efficacy of forest management prescriptions for retaining bear dens on Vancouver Island. Results of this study will help refine management approaches to best ensure the provision of dens for bears into the future.

STAND-LEVEL MANAGEMENT

This document describes approaches that forest licensees and their contractors can follow to achieve effective conservation of black bear dens within or near forest harvest units (i.e., cutblocks) in coastal forests of British Columbia. It does not specify planning needed at the landscape scale to provide a sustainable supply of dens that is needed to support viable populations of black bears, but instead focuses on the development of strategies to conserve individual dens on a case-by-case basis.

Den Conservation – A Step By Step Process

Effective conservation of dens within or near proposed cutblocks is a multi-step process. There are 3 distinct phases to the appropriate management of existing black bear dens in coastal forest development:

1) Identification of dens within or near proposed harvest units through pre-harvest surveys,
2) Implementation of within-stand retention prescriptions, and
3) On-going management of retention patches: minimizing disturbance, managing salvage and response to den loss.

STEP 1: Finding Dens - Pre-Harvest Surveys

The objective of Pre-Harvest Surveys is to identify bear dens within or immediately adjacent to proposed harvest units prior to finalization of block boundaries and harvesting plans. Identification of dens at early stages of cutblock development (i.e., reconnaissance phase) provides the most flexibility in options for the planning or operations forester to effectively retain den trees with minimal effect on harvest efficiencies. Management options for conserving dens identified later in the development process or found during harvesting become considerably more limited and may negatively affect the effectiveness of both den retention and harvesting practices.

There are numerous points during forest development at which field staff can identify and mark den trees. Because of this, all field staff that conducts groundwork in the proposed cutblock and retention areas should be trained to identify bear dens[1]. Most importantly, reconnaissance crews and timber cruisers conducting preliminary surveys of the block to verify timber quality and volume as well as initial operational constraints may encounter den trees. Surveyors conducting ecological assessments (i.e., ecoplots) to verify site conditions may also notice den trees during their surveys.

[1] See the Coastal Bear Den Identification Manual (Davis 2020) available at http://artemiswildlife.com/bear-dens

Essentially, every field staff that conducts groundwork prior to and during block layout will be the primary identifiers that will help the planning and development foresters incorporate retention of den structures most easily into development plans for the block. Early identification of these features and communication back to these foresters is crucial as this will make it easier to implement effective retention prescriptions that reduce impacts to volume. Surveys of cutblocks by First Nations surveyors looking for culturally modified trees, culturally important plants and archaeology sites are particularly useful for identifying bear dens because these surveys conduct detailed evaluations of individual cedar trees that may form bear dens.

Dens should be permanently marked with signs, tags, spray paint or flagging tape so that these trees can clearly be identified by layout crews and operators. Additionally, information on the location of den trees should be submitted to government data repositories (e.g., Wildlife Species Inventory Portal, regional den inventories) for tracking purposes.[2]

STEP 2: Prescriptions to Maintain Den Function

Once dens have been identified within or near proposed harvest units, there are several options for effectively retaining the effectiveness of these critical habitat features. As mentioned above, the options that are available are often dependent upon when in the development process the den tree is identified.

The following management prescriptions were developed using the best-available information to ensure that 1) the den feature remains usable by black bears into the future, 2) bears that attempt to use the den are not disturbed or displaced by forest harvesting activities, and, 3) female bears that reproduce in dens have access to secure escape cover upon den emergence.

For structures to retain their efficacy as winter dens for black bears, the following needs to be achieved (Figure 1):

A. The structure is retained in its unmodified form.
B. At least 30 m of undisturbed forest is retained around the den within a windfirm legal reserve (e.g., Wildlife Tree Retention Area, Old Growth Management Area) of contiguous mature or old forest or a windfirm patch ≥1 ha.
C. The edge of road rights-of-way are more than 75 m from dens.

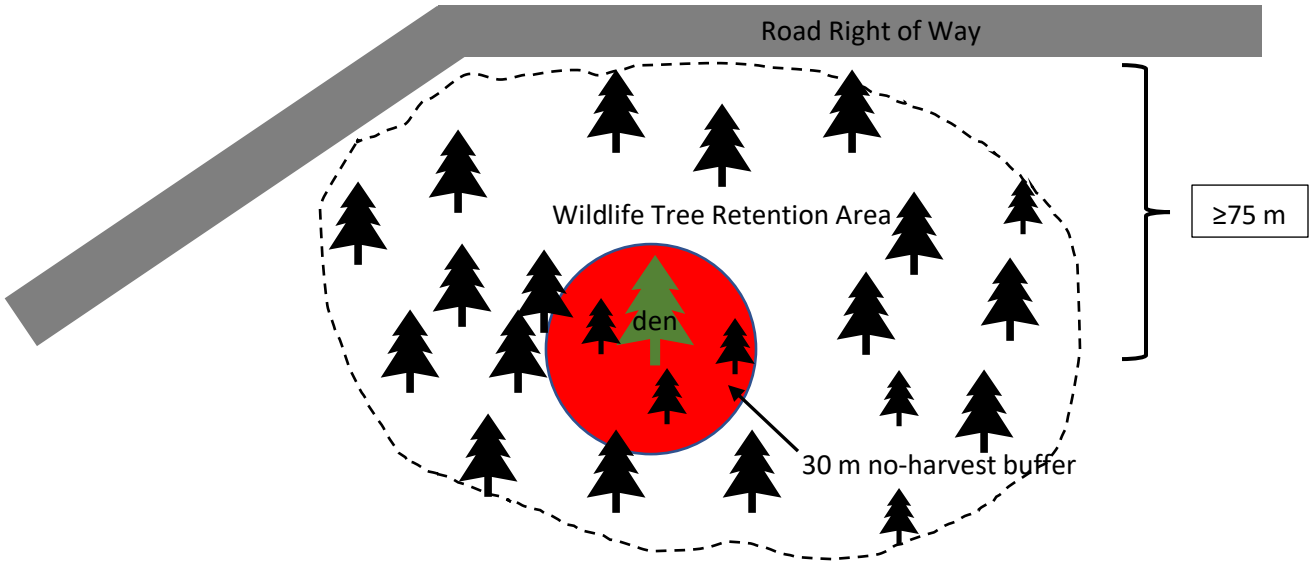

Figure 1. A den contained within a 30 m no-harvest buffer in a 1 ha Wildlife Tree Retention Area. The den is >75 m from the edge of the road right of way.

[2] Data from applications of the den retention guidance will be especially useful to help update and refine strategies to ensure effective den retention and minimization of operational constraints.

Guidance Details

A. Retaining the structure

Retaining the den structure is clearly needed to conserve denning habitat within operational forests. Dens in standing hollow trees with entrances through the base of the tree or through an above ground opening in the side of the tree, often in western redcedar and yellow-cedar trees, will likely be the most commonly encountered type of bear den in old-growth coastal forests. These trees provide the most secure and thermally advantageous dens for bears and contribute significantly to the survival and reproduction of the population. Furthermore, these den trees persist for many generations of bears and are key habitat features that can be lost without adequate forest management consideration. **Hollow trees are the priority features to strive to retain as dens for black bears**. Dens that occur in fallen or harvested trees (i.e., stumps, root boles and logs; Davis 2020) are structures often found in second growth forests and are important to conserve to bridge the gap until there is sufficient recruitment of new hollow-tree denning habitat at the landscape scale.

B. Creating a resilient patch

A resilient patch of unharvested forest is needed around the den structure to provide structural stability to den retention patches, visual screening for den trees with above-ground entrances and escape trees for reproductive females and their cubs. Individual dens can be retained using several approaches, but all should include a minimum 30 m no-harvest buffer (i.e., no harvesting within 30 m of a den, however, wind-firming treatments may be done within the buffer). Whenever possible, standing den trees should be retained further than 30 m into the forest from a cutblock edge to minimize windthrow. Windthrow damage dissipates rapidly with distance from the edge, even on exposures facing strong prevailing winds (Maxwell et al. 2010). In addition to the no-harvest buffer, dens in hollow trees near the edges of proposed cutblocks are best retained in contiguous forest through adjustments to the cutblock boundaries, if that is not possible then they should be retained within windfirm legal reserves such as Wildlife Tree Retention Areas, Old Growth Management Areas, riparian management areas or gully buffers. Den retention areas should be ≥1 ha with a minimized edge exposure to prevailing winds and include trees with future den potential (e.g., large trees with structural defects).

Windthrow of retained hollow trees can be a considerable risk that can negate all positive actions taken to retain dens if not managed for. Crown modification techniques such as edge-feathering, pruning and topping to reduce the effective crown size and density can considerably reduce the risk of windthrow of den trees. Further research is needed on the factors affecting persistence of den retention areas in coastal forests to validate the most effective management prescriptions for long-term retention of dens in standing hollow trees.

Outside the 30 m no-harvest zone but within the den retention area, alteration or removal of trees may occur (outside of the winter denning season) to: 1) accommodate operational requirements for road and bridge construction where no practicable alternative exists, 2) accommodate road maintenance and deactivation, the removal of danger trees (except for those identified as bear dens) and brushing and clearing within the right-of-way, for safety purposes, on any existing road or, 3) mitigate the impact of windthrow.

C. Distance to roads

Retaining dens in close proximity to roads can render them ineffective because bears will abandon dens if too much human activity occurs nearby. The edge of the rights-of-way (not the centreline) of new roads should be located ≥75 m from dens, although the rights-of-way of tertiary or terminal roads in cutblocks that will be deactivated may be within 50 m. If there is no option to relocate roads away from a known den, then deactivation of such roads after harvesting should be a high priority. Road deactivation will also aid in reducing salvage of structures that were specifically retained for denning. Activities on roads that are in use prior to and through the start of the den season do not need to be restricted if a bear establishes a den closer to a road than 75 m, as the bear selected the site despite the activity. Figures 8-11 show roads built much too close to dens.

STEP 3: On-going Management

Once den trees are conserved within retention patches there needs to be on-going management in terms of minimizing disturbance to denned bears during the den season, minimizing impacts of salvage operations and response to den structures blowing down, dying or decaying.

Disturbance of Denned Bears

Female black bears with cubs may den as long as 6 months (between October 21-May 15) and disturbance during this period has tremendous physiological impact (e.g., a 56% increase in weight loss) and can prove fatal if newborn cubs abandon a den site. Research has shown that even minor activity that occurs off road surfaces is likely to cause greater negative effects on denned bears than predictable-route (e.g., roads) activity and operational activity should not occur within 1 km of occupied bear dens (Linnell et al. 2000). However, the displacement potential of industrial activity has not been well studied and more empirical information is needed to determine whether the buffers suggested in the BC Timber Sales "Best Management Practices" (2020; Table 1) are appropriate.

Table 1. Suggested activity restrictions October 21-May 15 near occupied bear dens (from BC Timber Sales 2020).

Disturbance Type	**Minimum Suggested Distance (m)**
Primary harvesting, falling	200
Road construction (no blasting)	200
Blasting, heli-yarding	1000
Hauling	200

Before conducting potentially disruptive activities near a known bear den, a Qualified Environmental Professional should asses whether a den is occupied. Preferably, monitoring would be set-up in advance of the start of the den season either by installing a motion-sensitive trail camera or by placing string or sticks across the entrance so that potential disturbance/entry could be determined at a safe distance. Bears are most prone to den abandonment at the start of the denning period so this should be taken into consideration when deciding on when to check dens for occupancy.

The timing and continuity of forest operations also affect the disturbance potential at dens. If activities, such as hauling, begin prior to the start of denning season (i.e., before Oct. 21) and are continuous (no break greater than 5 days) and a bear chooses to use a den structure within the recommended disturbance distances then no changes to activities are needed. If, however, disruptive activities are initiated after the denning season start then the den needs to be checked for occupancy and timing of activities may need to be adjusted to avoid displacing bears that are denned. If potentially disruptive activities are discontinuous (i.e., a break in activity longer than 5 days), the den should be rechecked before restarting operations and timing of activities may need to be adjusted accordingly.

Salvage

Salvage operations may further reduce the availability of retained structures. After clearcutting, firewood cutting and the salvage of cedar stumps and logs for shakes must be controlled and monitored so as not to remove structures that were purposefully retained to provide habitat for bears. Restricting access and conducting awareness programs may help reduce post-harvest removal of elements retained for wildlife. Operators salvaging cedar shakes need to be regulated because workers often use helicopters to access harvested areas that have closed roads. Regulations must be enforced to ensure that salvage activities do not significantly deplete denning capability in harvested areas.

Response to Den Loss

In the event a retained den becoming unusable due to blowdown, death or decay there should be no salvage of the retention patch unless a forest patch of equivalent age and structure within 1 km receives equivalent legal protection.

DEN RETENTION IN PRACTICE

The following descriptive photographs illustrate varying management prescriptions and their effectiveness at meeting the objectives of den retention: maintaining den effectiveness, avoiding den disturbance, and providing escape cover for females and cubs (Figures 2-11).

'Preferred' prescriptions will ensure retention of the den into the future (barring stochastic events), minimize disturbance to bears, and provide the best escape habitat for females with cubs; 'Preferred' prescriptions follow all 3 management guidelines (patch size, distance to edge and distance to road). Preferred prescriptions are, by their very nature, difficult to photograph because the den is not visible from any distance.

'Acceptable' prescriptions achieve 2 of the 3 management objectives, and

'Vulnerable' meet 1 of the 3 management objectives, whereas

'Inadequate' prescriptions achieve none of the 3 management objectives.

Figure 2. A root bole den retained in a 1 ha Wildlife Tree Retention Area. The den is 50 m from edge of the road right-of-way, but this non-permanent road was deactivated after planting. The den in the patch was used by a female with a yearling cub the next den season after harvesting.

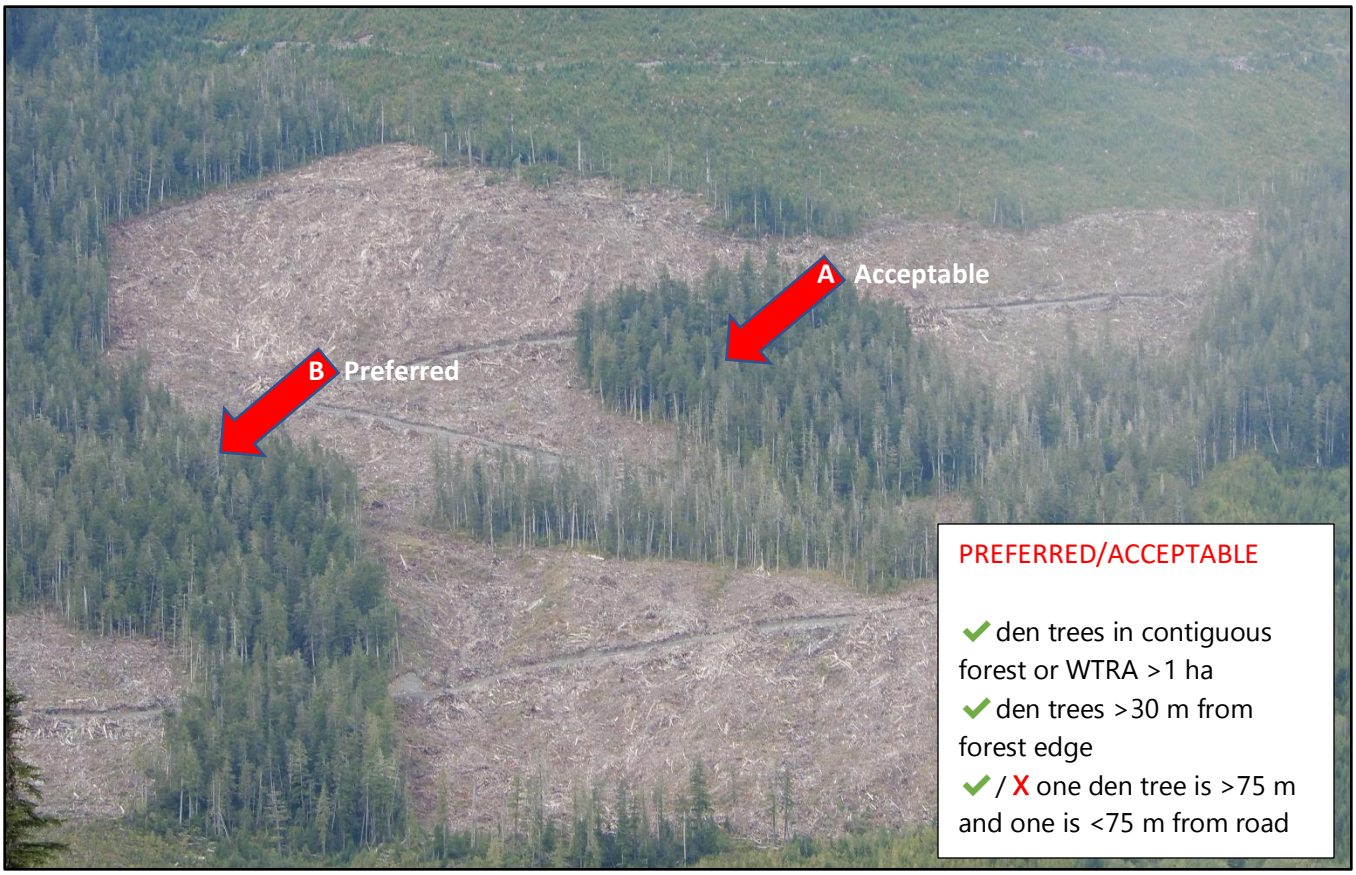

Figure 3. Two den trees retained, one in a 2.2 ha Wildlife Tree Retention Area (red arrow A) is <75 m from the road, the other in a Riparian Management Zone satisfies all the criteria for den retention (red arrow B). If the road above den tree A is deactivated it would also be a "preferred" prescription.

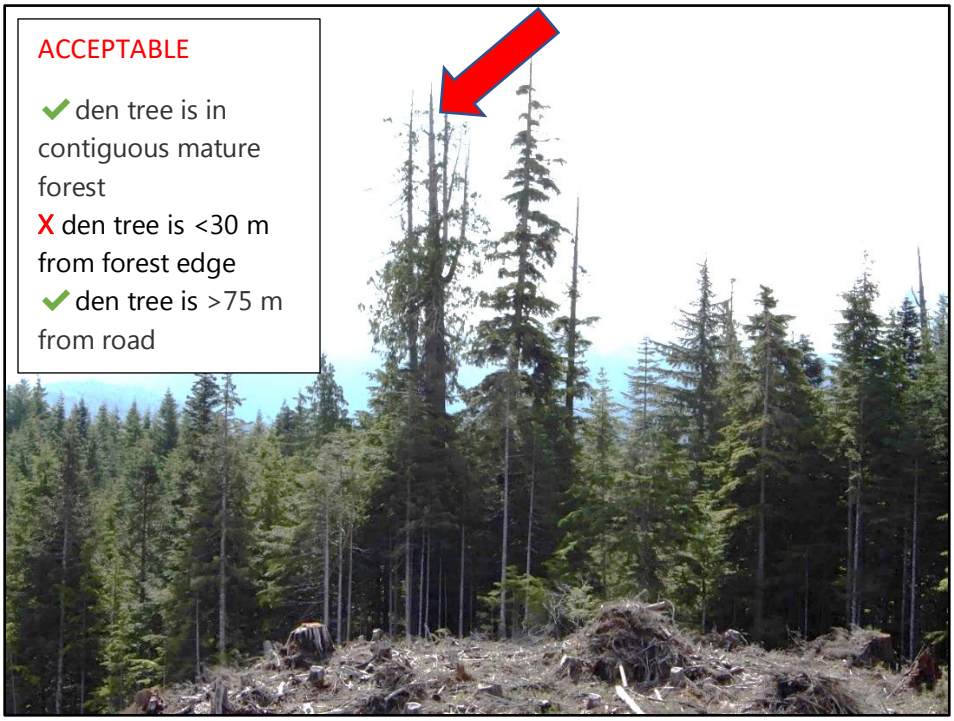

Figure 4. A hollow tree den (red arrow) retained in the contiguous forest next to a clearcut but >75 m from a road. The tree is retained within mature forest but is only 13 m from the clearcut edge. This is an acceptable management prescription.

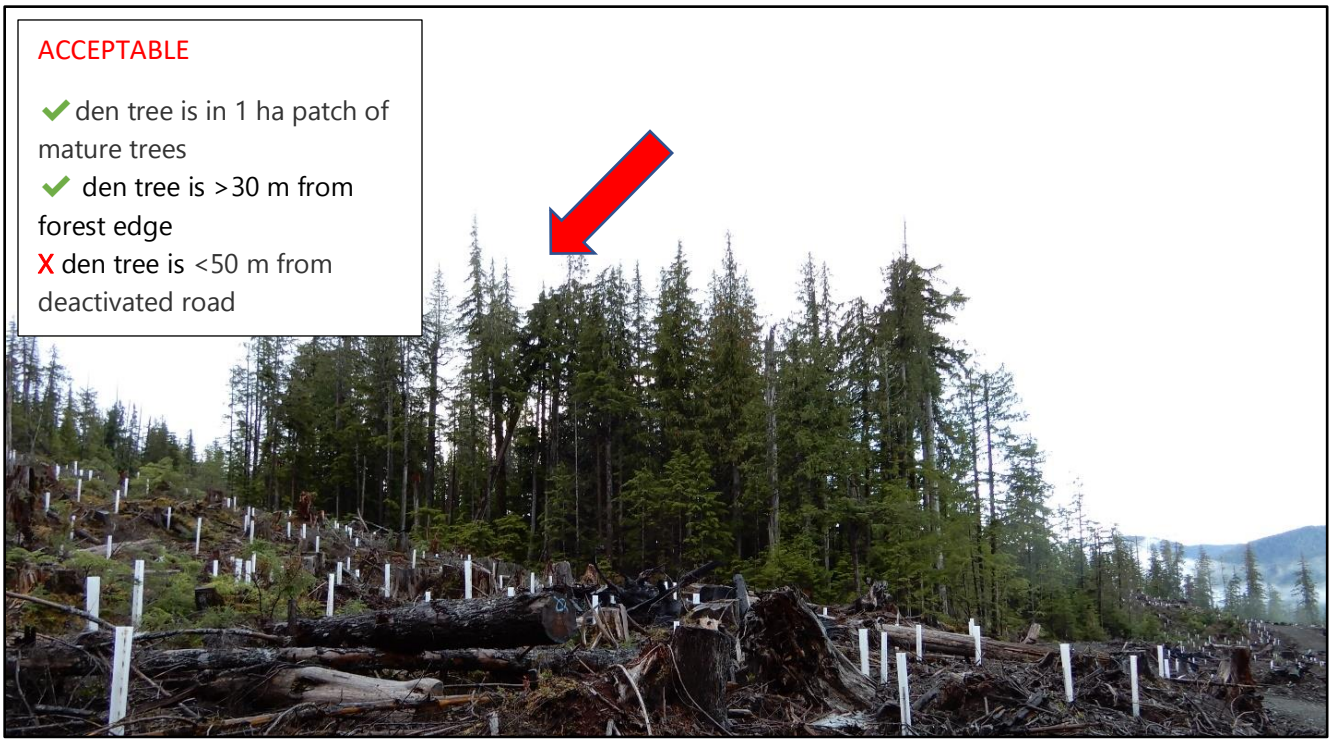

Figure 5. An example of a 1 ha leave patch around a black bear den tree (red arrow) in Haida Gwaii. The den tree is >30 m from the forest edge but is only 42 m from the road (which has been deactivated). This is an acceptable management prescription.

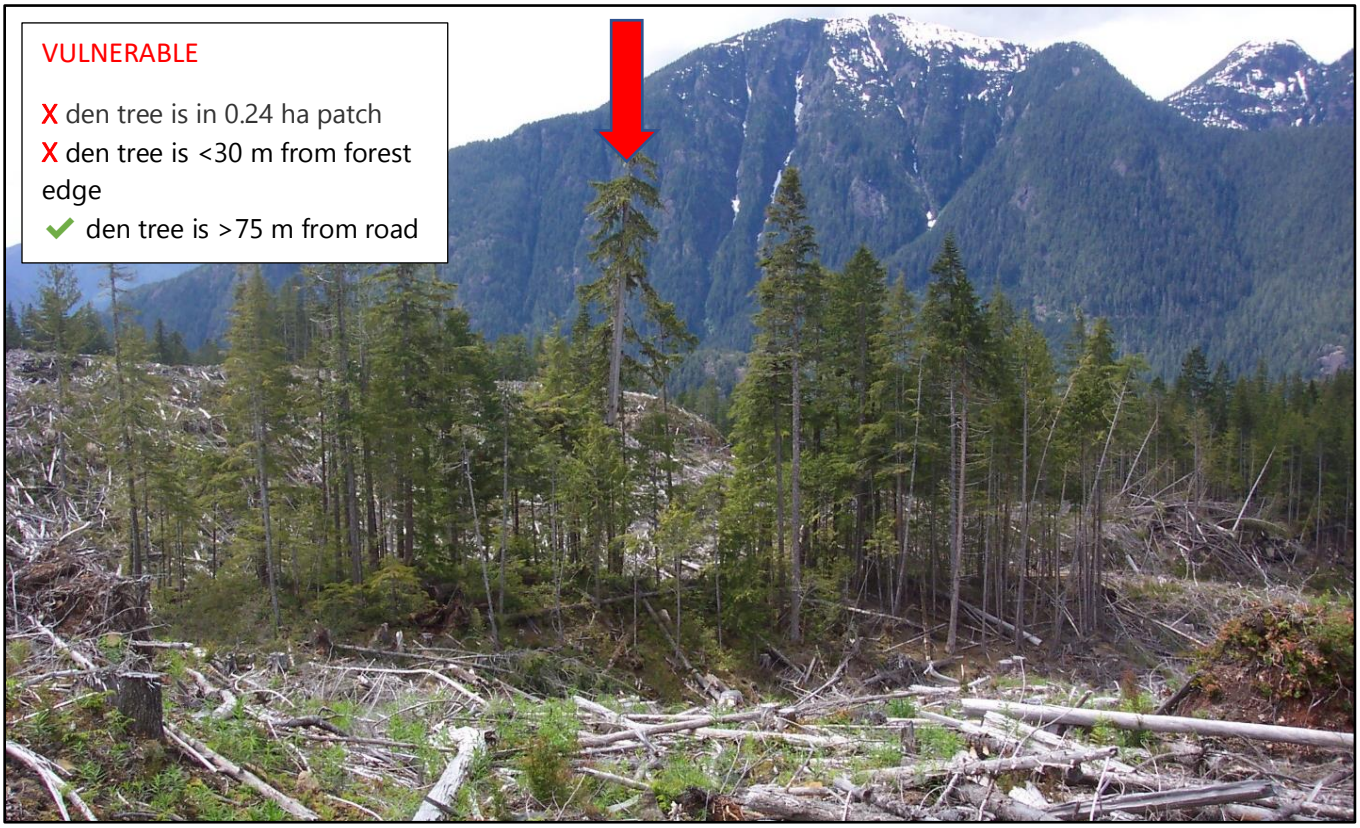

Figure 6. A retention patch with a hollow yellow-cedar den tree (red arrow). The patch contains mature escape trees but is only 0.24 ha and the den is <30 m from the patch edge.

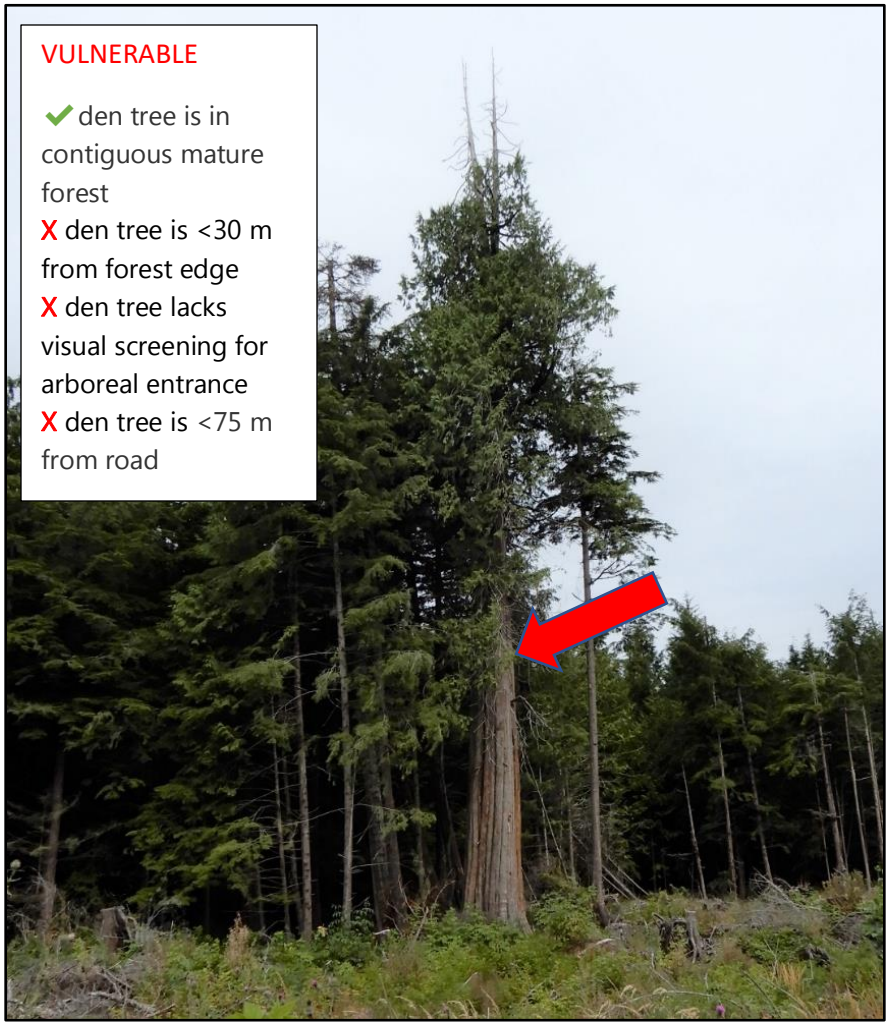

Figure 7. A western redcedar tree on the edge of a clearcut (photo taken from main haul road that is 50 m away) that contains a bear den with an above ground entrance. More visual screening of these structures should occur than was done here.

Figure 8. A bear den in a yellow-cedar (red arrow) retained next to a road junction. Roads should be located farther from dens (≥75 m) and a 30 m no-harvest buffer is needed around the den structure.

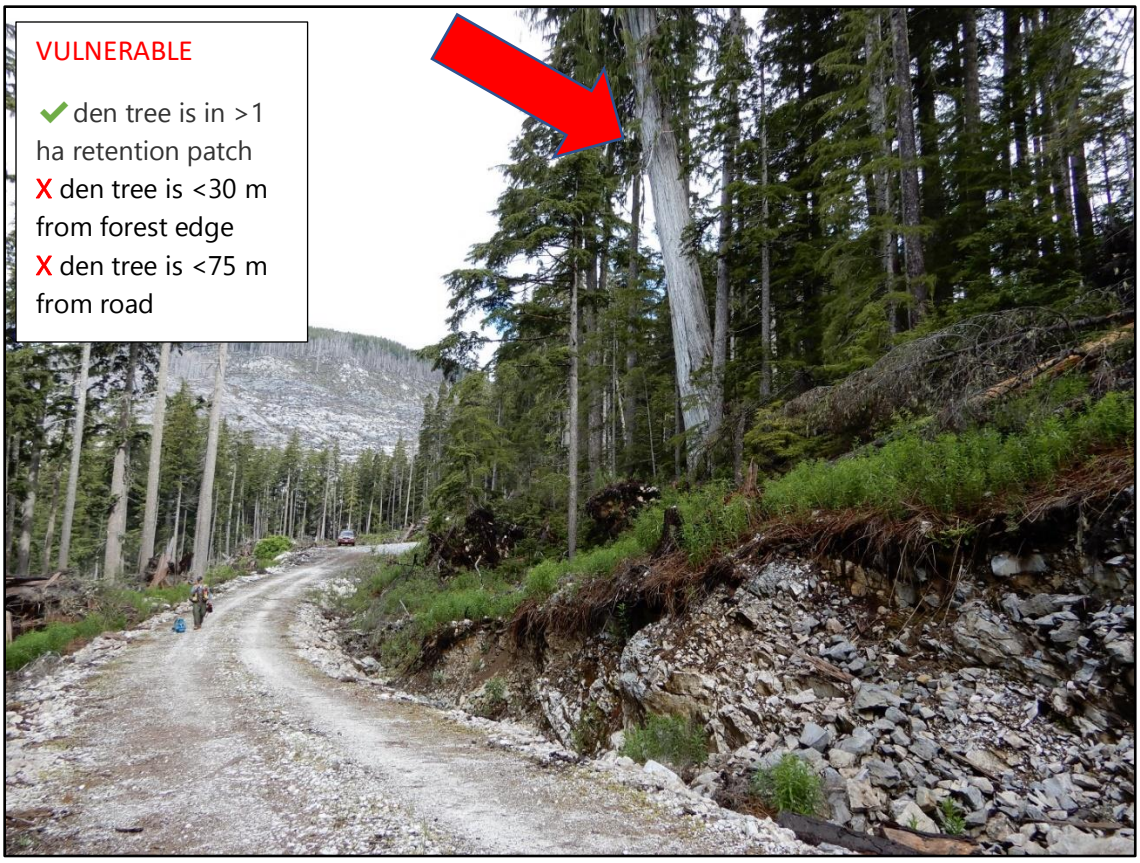

Figure 9. A bear den in a hollow yellow-cedar tree (marked with red arrow). This is an inappropriate management prescription because there is no 30 m no-harvest buffer and the road was built much too close to the den.

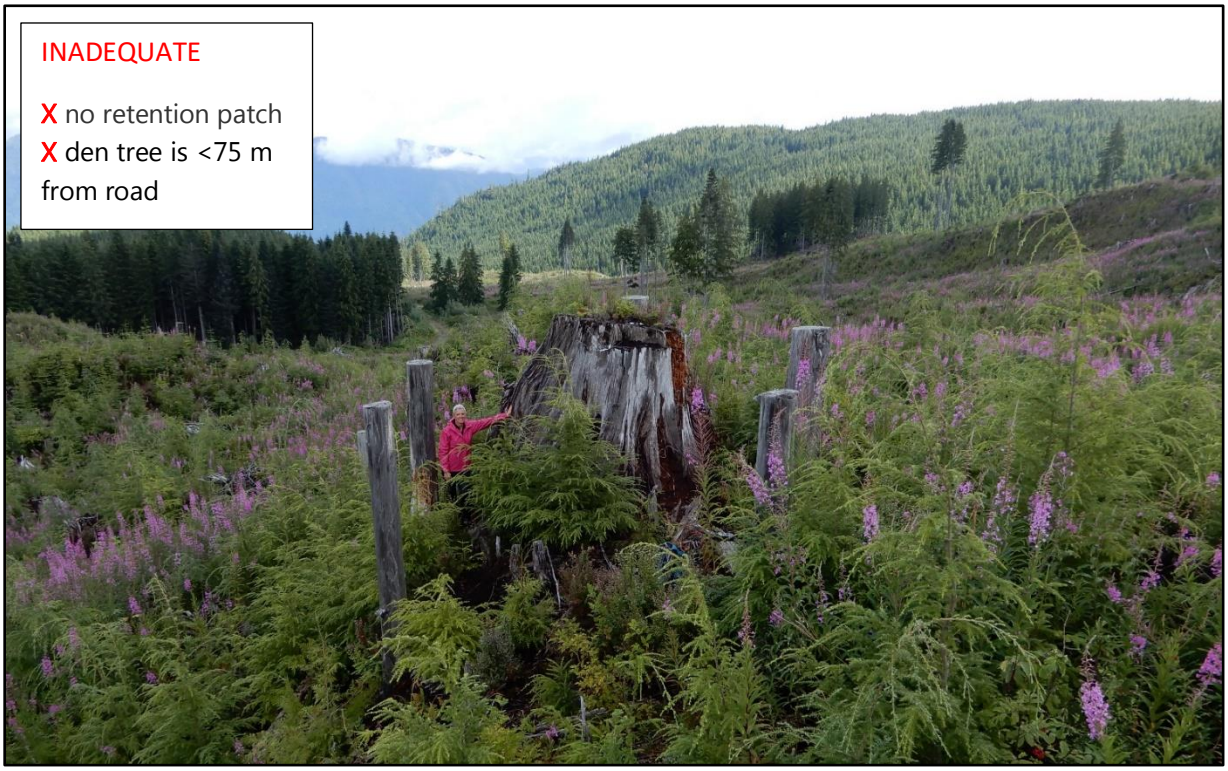

Figure 10. A western hemlock stump used as a den by black bears for decades. This is an inappropriate management prescription because of the lack of mature trees in a retention area around the den and a new road was constructed within 35 m of the structure.

Figure 11. A bear den in a hollow yellow-cedar tree. This management prescription lacks a 30 m no-harvest buffer, has no mature escape trees, a new road was built within 35 m. Because of these issues, this den is unlikely to be useable by female bears until the surrounding forest has reached mature condition.

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