Change Monitoring Inventory – British Columbia

Addendum to Ground Sampling Procedures

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First Version – 2020

This document is new for the 2020 field season, and it is intended to be an exhaustive addendum of changes to the *Change Monitoring Inventory – British Columbia – Ground Sampling Procedures* (hereafter referred to as the CMI Procedures manual) starting with the 2020 field season. The intent is to incorporate all these changes into the main CMI Procedures manual at some point in the near future. However, until that time, the CMI Procedures manual must be referenced and interpreted together with this Addendum.

Along with the significant changes to the 2020 CMI ground sampling procedures, there has also been a change in the data collection platform from TimVeg to ISMC (*Inventory Sample Management Consolidation*), and all of the changes to the 2020 CMI ground sampling procedures detailed in this addendum have been implemented in the new suite of ISMC data collection software (EFR data logger, BASE, and HOST).

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Introduction

The following sections discuss the changes to the CMI ground sampling procedures starting with the 2020 field season, and apply to the CMI, YSM, and L-type ("light") samples. Some changes also apply to NFI. They are arranged in an order that closely follows the layout of the CMI Procedures manual as well as the logical order of data collection. There is no implied hierarchy of importance, as all changes detailed here need to be understood and adhered to. In some instances, the rationale for the change is explained as well. Refer to the document version comments on Page *v* for further details.

1. General Items

Non-Representative IPC Pin Location

This is in relation to Section 2.4 (Establishing the Integrated Plot Centre) of the CMI Procedures manual. *[FAIB 2020 C.M. #46]*

Clarity is needed around what to do when an IPC pin falls in non-standard situations (e.g., a hole in an otherwise stocked stand, a residual tree patch, or when the IPC for a YSM sample is inside the target polygon according to the inventory linework, but outside the target population on the ground because it is at the edge of the polygon). Does the sample get measured or dropped? How does this impact the walkthrough methodology?

CMI sampling is based on a 20 km by 20 km grid. There is no target population or sampling ages, and polygon boundaries do not impact sample location or sampling procedures in any way. Some of the anomalous locations that may arise for a CMI sample include the following:

- The CMI IPC lands in an unmapped young patch in an otherwise mature polygon.
- The CMI IPC lands in an unmapped area void of trees (e.g., secondary road, wet patch, rock outcrop, etc.) in an otherwise stocked polygon.
- The CMI IPC lands in an unmapped mature reserve patch in the middle of an otherwise young stand.
- The CMI IPC lands in a mapped inventory polygon that is not a stand of trees (e.g., meadow, wetland, FSR right-of-way, etc.).
    - In all these situations, the sample must be measured. In fact, **there is no circumstance (aside from safety issues) where a CMI sample is to be dropped. The IPC is never moved, and the sample will measure whatever is there (or not there) in the plot.**

YSM sampling is based on a defined population (15-50 years *total* age – defined from the VRI VEGCOMP Poly Rank 1 Layer, where the attribute PROJ_AGE_1 is between 15 and 50 years old, using the current published VRI at time of sample plan completion), and selection of samples is based on the current mapped inventory. The actual age on the ground might differ from the mapped inventory age, putting the sample outside the target population, yet the sampling must occur based on the mapped inventory to be statistically valid. This discrepancy in age can occur for several reasons:

- The YSM IPC lands in an unmapped portion of the target polygon (e.g., secondary road, rock outcrop, mature wildlife patch) that is younger or older than the target population age (i.e., <15 or >50 years).
    - In this instance, the sample should be measured. The IPC location and the plot are simply capturing within-polygon variation that is inherently part of the target population and must be sampled if encountered.
    - Since there are no mapped inventory polygon lines involved, the walkthrough methodology does not apply.
- The YSM IPC lands within but near the edge of the target polygon, and a portion of the plot extends into the neighbouring mapped inventory polygon that is either younger or older than the target population age (i.e., <15 or >50 years).
    - In this instance, the sample should be measured.
    - If the mapped inventory polygon line is closer than 22.56 m to the IPC, the walkthrough methodology must be employed.
- The YSM target IPC is at the extreme edge of the target polygon, but the actual IPC pin lands just into the neighbouring mapped inventory polygon that is either younger or older than the target population age (i.e., <15 or >50 years). (This is likely due to either inherent errors in GPS, poor inventory mapping, or just a diffuse or wavy polygon edge).
    - In this instance, the sample should still be measured. This is a very borderline situation, so the final call will be made during the data analysis. It is better to have the data and decide to exclude it than to drop the sample and end up needing the missing data.
    - Note that if the actual IPC pin lands in the neighbouring polygon, there is no ability to use the walkthrough methodology as it does not work with a negative distance.
    - The crew must record notes describing the IPC location and notify the Contract Manager.
- The YSM IPC lands in the middle of an inventory polygon away from all edges, but the average age of the target polygon on the ground turns out to be clearly significantly older than the target population age (i.e., >75 years BH age). (*Note that samples younger than the target population will always be sampled as intended in this scenario*).
    - If, in this instance, the sample is a required CMI sample as well (i.e., it's on the 20 km grid; a CMI-YSM sample), it will be measured regardless of the age of the stand. The sample will be compiled for CMI but not YSM. Since there are no mapped inventory polygon lines involved (and also because it will not be a YSM sample), the walkthrough methodology does not apply.
    - If, however, the sample is <u>not</u> also a required CMI sample (i.e., it's on an intensified grid; a YSM sample only), the sample should be dropped. This sample will not be used in the data analysis as it is clearly outside the target population.

Plot Photos

This is in relation to Section 3.2 (Taking Ground Photographs) of the CMI Procedures manual. *[FAIB 2020 C.M. #20,31]*

Ground photos are required for all samples of all sample types. If a sample is rejected or not completed for some reason, but the IPC pin has been established, ground photos are still useful and should still be collected as part of the Record of Plot Non-Completion if possible to do so safely.

One of two different sets of photos is required (Table 1, Table 2), depending on whether CWD is required for the sample type.

Table 1. Ground photos required for samples that include CWD measurements.

Code Value	Code Description	Details
PP	Plot Pin	Ground shot of the plot pin and surrounding area
T1S	Transect 1 Start	From IPC looking out, along Transect 1
T2S	Transect 2 Start	From IPC looking out, along Transect 2
T1M	Transect 1 Mirrored	From IPC looking out, 180 deg. from Transect 1 bearing
T2M	Transect 2 Mirrored	From IPC looking out, 180 deg. from Transect 2 bearing
T1E	Transect 1 End	From end of Transect 1, looking in towards IPC
T2E	Transect 2 End	From end of Transect 2, looking in towards IPC
REP	Representative	Could be from outside of plot looking in, or vice versa
CAN	Canopy	Vertical, above IPC
SOIL	Soil Profile	All excavated soil horizons (only if required)
OTH	Other	Path, damage, unknowns, etc. (optional)

Table 2. Ground photos required for samples that do <u>not</u> include CWD measurements.

Code Value	Code Description	Details
PP	Plot Pin	Ground shot of the plot pin and surrounding area
N	North	From IPC looking out, along North cardinal direction
E	East	From IPC looking out, along East cardinal direction
S	South	From IPC looking out, along South cardinal direction
W	West	From IPC looking out, along West cardinal direction
REP	Representative	Could be from outside of plot looking in, or vice versa
CAN	Canopy	Vertical, above IPC
SOIL	Soil Profile	All excavated soil horizons (only if required)
OTH	Other	Path, damage, unknowns, etc. (optional)

As a guideline, photos should be taken with a camera setting of 5 to 8 megapixels. This should result in a maximum target file size for individual pictures of approximately 6 MB.

Photos must be delivered in digital format, and named as follows:

- Project ID – Sample ID – Plot Type – Code Value
- For example: “039M-1458816-MO1-PP.jpg”

Required vs. Optional Data

This is in relation to Table 3.1 in Section 3.3 (Completing the Header Card) of the CMI Procedures manual. *[FAIB 2020 C.M. #11]*

The CMI sample type ('M') has been solidified such that there is no longer any optional data. All data displayed in Table 3.1 of the CMI Procedures manual as "optional" is no longer required:

- Range (shrub transects and forage production) – cards 4/5
- Coarse woody debris (two transects) – cards 6/7
- Ecology (site features, classification, and soils) – cards 12/13
- Vegetation (trees, shrubs, herbs, mosses, and bryoids) – cards 14/15
- Succession (succession and old growth interpretation) – card 16

As this data has not been collected on CMI samples for several years now, this is only a formalization, and does not amount to a change in the type or amount of work required to complete CMI samples as compared to those over the past several years.

2. Basic Mensuration

Nail & DBH Location

This is in relation to the "Attaching Tags to Trees" subsection of Section 4.1 (Establishing Plot Layout) and the "Diameter Breast Height (DBH)" subsection of Section 4.2 (Identifying and Recording Tree Attributes) of the CMI Procedures manual. *[FAIB 2020 C.M. #37]*

Further clarification is needed on the process of determining the placement of the nail on a tagged plot tree and the resulting measurement of DBH. The placement of the nail is directly tied to the DBH of the tree, as the correct procedure for measuring DBH is to place the diameter tape directly above (and touching) the nail. This ensures repeated measurements of DBH over time are taken at the very same location.

The ideal height of the nail is at exactly 1.30 m above high side (breast height). However, there is some allowance for moving the nail from this ideal location in order to achieve a better measure of DBH. If 1.30 m would result in a DBH measurement skewed by a branch whorl, stem swelling, or other abnormality causing a non-representative diameter, the nail should first be move either up or down by a maximum of 10 cm in order to avoid the anomaly (the direction chosen should be the one that achieves the best compromise of shortest distance moved and most representative diameter. If the nail can be placed between 1.20 m and 1.40 m and result in a representative diameter when the diameter tape is placed directly above the nail, then that is all that needs to be done (Figure 1). No comment is needed about the nail moving up to 10 cm away from breast height, and no adjustment needs to be made when measuring the tree height (i.e., still just accept the vertex default of adding 1.3 m in the height calculation).

If moving the nail by a maximum of 10 cm does not provide for a good DBH measurement, then it needs to be determined if moving the nail further would improve the DBH measurement enough to warrant that move (Figure 2). In this case, a comment should be made, and the nail height needs to be taken into account with the tree height.

Another option for recording the DBH continues to be taking an average of the diameter above and below breast height and recording that as an estimate (Figure 2). However, a repeatable directly measured diameter is preferred to an averaged or estimated diameter.

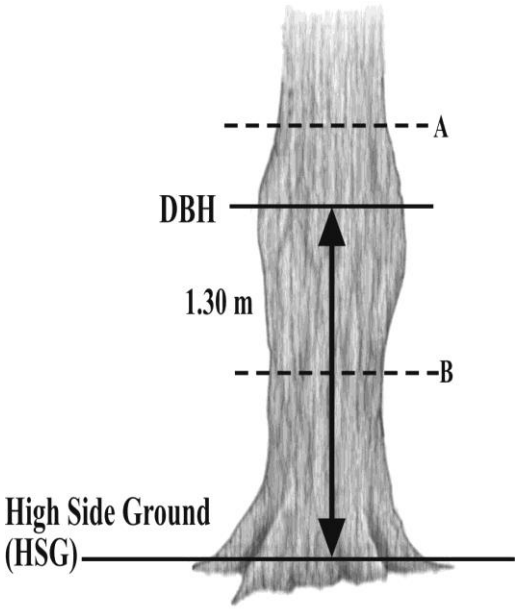

Figure 1. Stem swelling requiring nail and DBH measurement to be moved to location A.

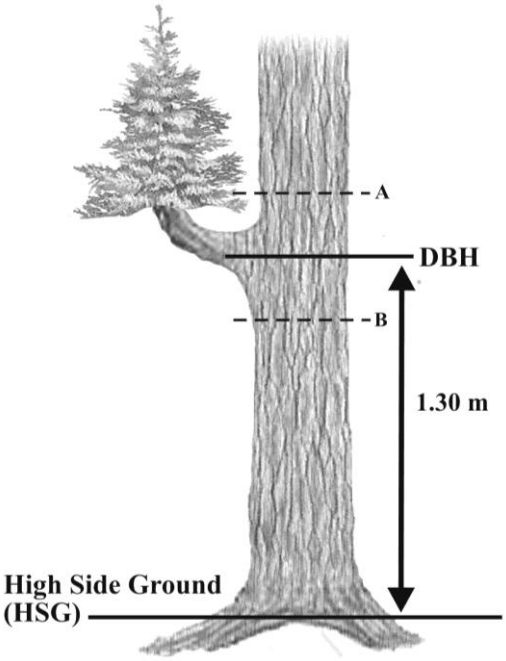

Figure 2. Branch whorl requiring nail and DBH measurement to be moved to location A or B, or averaged from A and B.

One exception to the description above is for samples at NFI locations. These samples have the nail and tag placed at high side (i.e., 0.0 m) rather than at breast height. When remeasuring these samples, the nails should never be moved to 1.3 m unless directed by the Contract Manager. All the same principles apply, however (e.g., changing the height at which DBH is measured or taking an averaged DBH from above and below), with the difference being that there won't be a nail to mark exactly where DBH was measured.

Species

This is in reference to the "Tree Attributes" table of the Critical Pass/Fail Standards section of the *Change Monitoring Inventory – British Columbia – Quality Assurance Procedures & Standards for Ground Sampling. [FAIB 2020 C.M. #36]*

The crew standard for tree genus, tree species, and live/dead is changed from "1 error maximum" to "1 error allowed per 40 trees". This is in order to bring these in line with the standard for tree count, as a missed tree should be considered a more serious error than a species or live/dead error, and yet the old standard was more stringent for species and live/dead errors.

Dead Fallen Trees

This is in relation to all sections of the CMI Procedures manual that detail measurement of tree attributes, although this applies specifically to remeasurement samples only. *[FAIB 2020 C.M. #6]*

For remeasurement samples, previously tagged trees that are now found to be dead fallen will be measured in full (i.e., all attributes). Any dead fallen tree will only ever be measured once – trees in the ISMC database as having been measured as "dead fallen" will not be included in the tree list for the next remeasurement.

One of the primary reasons for measuring dead fallen trees is to capture the cause of mortality (especially if it was live at the previous measurement); therefore, damage agents should be paid particular attention for dead fallen trees, to the extent practicable. Likewise, although loss indicators are optional for dead trees, any significant loss indicators that are thought to be associated with the damage agent(s) leading to the tree's mortality should be recorded.

Broken Tops

This is in relation to the "Broken Tops" subsection of Section 4.2 (Identifying and Recording Tree Attributes) of the CMI Procedures manual. *[FAIB 2020 C.M. #42]*

For every tree, simply indicate 'Y' or 'N' for broken top. There is no longer any need to record a broken top diameter or projected length as this can be done more accurately in the data compilation program by fitting localized height/DBH equations by species to compute estimated unbroken total length. Broken top loss indicators are still required.

Wildlife Codes

This is in relation to Section 4.3 (Assessing Tree Attributes for Wildlife) of the CMI Procedures manual. *[FAIB 2020 C.M. #35]*

Wildlife codes are no longer collected on any sample types. The one exception is the limited wildlife codes that are a part of the stump plot, which will continue to be collected.

Mode

This is a net new attribute for CMI, borrowed from the PSP program, and now synchronized across all sample types. *[FAIB 2020 C.M. #50]*

The Mode codes (Table 3) are a way to flag anomalous situations that have more significance for the overall data and their subsequent compilation and analysis than for individual trees. As such, care should be taken not to miss entering these codes when required.

Note that the D, H, M, and N codes only apply to remeasurement samples. The Z code can apply to establishment and remeasurement samples. See Section 5 (Sample Trees) for a full discussion on non-tally sample trees.

Table 3. Available codes in the Mode field and the corresponding required actions.

Code	Description	Action
D	Dropped – A previously measured tree that is to be dropped because it is outside of the plot	Record "D" in the Mode field, remove the tag and nail, and record tree number and species; no other attributes required

H	Harvested – A previously measured tree that cannot be found and has obviously been harvested	Record "H" in the Mode field, and record tree number and species; no other attributes required
M	Missed – A tree that was obviously missed at the previous measurement	Record "M" in the Mode field, tag the tree with an unused number, and record all attributes
N	Not Found – A previously measured tree that cannot be found	Record "N" in the Mode field, and record tree number and species; no other attributes required
Z	Non-Tally Sample Tree – A tree that is not tallied yet is selected as a sample tree	Record "Z" in the Mode field, tag the tree with an unused number, and record all basic mensuration attributes (i.e., everything except damage agents, loss indicators, and net factoring); finally, record the sample tree data

3. Damage Agents & Severities

Plot-Level Forest Health Comment

This is in relation to a forest health procedure that has been in place for the past several years but has not been incorporated into the CMI Procedures manual. *[FAIB 2020 C.M. #24]*

There is one standardized comment required (for YSM samples only) in the Comments field of the Header Card related to forest health. The procedure to determine the comment is as follows:

- Attempt to identify the leading cause (i.e., damage agent) of fallen trees within the plot. This should consider only trees that are recently fallen and/or are not incorporated into the forest floor (e.g., most of these trees would have an identifiable root collar). Look beyond the plot boundary (but within the target polygon) if needed to help identify the leading damage agent. Be as specific as possible (i.e., 3-letter codes are more desirable than 2-letter codes, especially for root disease).
- Using the exact prescribed format below, record (on its own line) in the Header Card Comments field (replacing the 'X' and '#' symbols with your assessed data) the damage agent code, number of fallen trees attributed to that damage agent, and average age (at time of death) of those fallen trees:
    - "Leading damage agent for fallen trees: XXX, ## fallen trees, ### yrs at death"
- If there are no downed trees, then record the comment as follows:
    - "Leading damage agent for fallen trees: n/a"

If root rot is confirmed in general within the plot, attempt to identify specific root rot infection in individual tagged trees, and record the damage agent code and severity per tree as usual.

Forest Health Resource Reference

This is in relation to the "Procedure" subsection of Section 4.4 (Assessing Damage Agents and Severity) of the CMI Procedures manual. *[FAIB 2020 C.M. #29]*

The reference document noted in the bullet under procedure #1 is outdated. The correct and current reference is the *Field Guide to Forest Damage in BC*, 3rd revised edition (Burleigh et al., 2014- available online).

Major Rusts & Cankers

This is in relation to the "Detailed Rust & Canker Measurements" subsection of Section 4.4 (Assessing Damage Agents and Severity) of the CMI Procedures manual. *[FAIB 2020 C.M. #25]*

Elytroderma stem cankers (DFE) are no longer recorded. The reason for this is that they can be very difficult to detect and correctly identify, leading to many missed and/or erroneous calls, which in turn results in lower confidence in the data for analyzing incidence and impact of DFE as a stem infection. The difficulty of identification is in part due to a significant variation of prevalence, form, and impact of DFE stem cankers between different regions of the province, which also leads to a difference in relative importance of DFE between regions. Elytroderma needle cast (DFE) will continue to be recorded as a branch and foliar infection when present in that form, using the Hawksworth scale to record severity.

There is no longer a "ground-up" hierarchy for recording damage agents, regardless of the type of damage agent (rust, cankers, or others) or sample type (YSM or CMI). In all instances, damage agents are to be recorded in order of impact/significance to the tree, up to the maximum of 5 damage agents per tree. All else being equal, the following rust and canker type damage agents are listed in general order of most significant to least significant:

1) Comandra blister rust (DSC)
2) Stalactiform blister rust (DSS)
3) Western gall rust (DSG)
4) Dwarf mistletoe (DM_) (Hawksworth severity)
5) Elytroderma needle cast (DFE) (expressed as branch and foliar infection) (Hawksworth severity)
6) Atropellis canker (DSA)
7) Broom rust (DB_) (Hawksworth severity)

The only difference regarding rusts and cankers for YSM vs. CMI is the severity code used. For YSM samples for DSC, DSS, DSG, and DSA, the severity to be used is the 2-digit code for infection height and % encirclement, as outlined in the CMI Procedures manual. For other rusts and cankers in YSM samples or for all rusts and cankers in CMI samples, the severity is SC (stem canker) or TK (top kill) or the Hawksworth scale (as noted above). Note that branch cankers are never recorded.

In the past, an atropellis canker (DSA) -specific procedure required a minimum 30% encirclement before a DSA stem canker could be recorded. This is not a current requirement; a DSA canker of any encirclement can be recorded. However, as DSA is less likely to cause mortality in trees than some other rusts and cankers (e.g., DSC, DSS), it is expected that other damage agents will be recorded for a tree before a small DSA canker (as the above bullet list suggests).

NY Damage Agents

This is in reference to Appendix C (Damage Agent Codes) of the *Change Monitoring Inventory – British Columbia – Appendices to Ground Sampling Procedures. [FAIB 2020 C.M. #27]*

Two subtypes of damage agent are added to the NY ("snow or ice [includes snow press]") damage agent:

- NYB ("snow or ice breakage"): Breakage of the top in older stands due to snow and/or ice loading, typically resulting in a crook, fork, or broken top
- NYP ("snow press"): Snow press at the base of younger smaller trees, typically resulting in sweep or crook

Wherever possible, the more precise 3-letter damage agent codes should be used rather than the more generic 2-letter code.

Fire Severity

This is in reference to Appendix D (Damage Severity and Mortality Condition Codes and Standards) of the *Change Monitoring Inventory – British Columbia – Appendices to Ground Sampling Procedures. [FAIB 2020 C.M. #26]*

There are two existing damage agents related to fire: NB ("fire") and NBP ("post burn mortality"). NBP should be used if the tree has died due to fire, whereas NB should be used if the tree has sustained fire damage but remains alive. The SCA loss indicator also applies where appropriate.

There is a new 2-part severity code that applies to the fire related damage agents above. The first column reflects the extent of wood fibre damage (adapted from the cruising manual), and the second column records percent scorch (in deciles) of pre-fire foliage by volume that is dead, burnt, or dropped as a direct result of fire. The valid severity codes for both columns are described below (Table 4).

Table 4. Severity codes and descriptions for fire related damage agents.

Wood Fibre Damage (1st column)		% Scorch (2nd column)	
Code	**Description**	**Code**	**Description**
A	Cambial damage (i.e., more than scorched bark, but less than charred wood of a significant depth)	0	0% (no foliar scorch)
		1	1 - 15%
		2	16 - 25%
B	Minor wood fibre damage (i.e., localized shallow charring)	3	26 - 35%
		4	36 - 45%
		5	46 - 55%
C	Major wood fibre damage (i.e., extensive shallow charring or localized or extensive deep charring)	6	56 - 65%
		7	66 - 75%
		8	76 - 85%
		9	86 - 100%

Abiotic Severity

This is in reference to Appendix D (Damage Severity and Mortality Condition Codes and Standards) of the *Change Monitoring Inventory – British Columbia – Appendices to Ground Sampling Procedures. [FAIB 2020 C.M. #27,47]*

Severities for abiotic damage agents (N_ _) fall under the category of "mortality conditions for all agents" in the Appendix D table. These include the following pre-existing codes:

- SR: standing recent
- SO: standing old
- WR: windthrow – root and butt rot
- WS: windthrow – soil failure
- WA: windthrow – management/soil related
- BD: breakage – stem decay (stubs and snags)
- BS: breakage – stem shear

The valid abiotic severity codes have now been expanded to also include % defoliation (recorded as 1-100). The procedure for determining the severity of an abiotic damage agent (except for NB/NBP, as fire has its own severities, detailed above) is as follows:

- If the tree is live and intact, the severity will be an estimate of % defoliation
- If the tree is dead, windthrown, or broken, one of the original 2-letter codes will be applied

Note that a severity will not necessarily apply to all abiotic damage agents in all instances, and in such a case the damage agent may be recorded without a severity. For example, a scar (NX) will not typically cause defoliation (unless a live branch has broken off in the process), nor would it typically cause death, windthrow, or breakage.

4. Call Grade Net Factoring

Call Grading

This is in relation to Section 6 (Call Grading) of the CMI Procedures manual. *[FAIB 2020 C.M. #5]*

Log grades are no longer recorded for any sample types. Although log grades can be set to be "required" on a project-by-project basis, it is not anticipated to be used going forward.

Log Splitting

This is in relation to Section 6 (Call Grading) of the CMI Procedures manual. *[FAIB 2020 C.M. #5]*

Log lengths and net factoring are still required as before (i.e., for CMI, but not for YSM or L-type samples). Trees are split into logs based on the net factoring required for a tree, using the main guiding principle of isolating rot/loss where it makes sense to do so. Form alone (such as forks and crooks) has no bearing on splitting a tree into multiple logs. Some examples follow:

- Butt rot – Use the butt rot table to determine the length of the butt rot cone, set the first log length equal to that, and then calculate the net factor. The second log

continues from the top of the butt rot cone, and if there is no further net factoring required, it will be a 99 length and 100% sound.

- Stem decay – Observe the upper and lower heart rot conks and apply the 4-up 6-down rule to determine that log length (the net factor will be 50%). Depending on where the "conk log" is on the tree, there might be only a meter or two at the bottom of the tree below it, and you might decide to incorporate that into the longer conk log (in which case the net factor of the combined log would be > 50%). Or the sound section at the base might be a bit longer, and then it might make sense to keep the rot isolated in the second log.
- Major fork – If rot is not visible at the fork then there can be no net factoring, and therefore there is no need to split the tree into two logs at that location, even if there is a significant change in diameter that would previously have led to a change in log grade. The entire tree will be one log recorded as 99 (length) 100 (net factor).

5. Sample Trees

Non-Tally Sample Trees

This is in relation to Section 4.8 (Recording Sample Tree Data) of the CMI Procedures manual. Note that this information is missing from the CMI Procedures manual, but it has been part of the procedures since the beginning. *[FAIB 2020 C.M. #34]*

In younger stands with smaller diameter trees close to the 4 cm or 9 cm tagging limit, there is a requirement to check for non-tagged trees within the bounds of each quadrant that might actually be a sample tree. This situation happens when there are no *tagged* trees of a particular species in a quadrant, but one of the smaller diameter trees of that species in that quadrant is still codominant. The largest diameter live codominant tree of that species in that quadrant will be a sample tree.

This type of sample tree is referred to as a "non-tally sample tree". These trees do not factor into the leading species calculation (i.e., basal area calculation), and they do not contribute to the compiled data (i.e., their volume is not included in the total plot volume, etc.).

The procedure for these trees, if present, is as follows:

- Apply a tree tag with a number that is not being used elsewhere in the sample
- Record a "Z" in the Mode field (this is important, as this is the flag that prevents the tree from being "tallied" and contributing to the leading species calculation, plot volume, etc.)
- Record all the basic mensuration attributes (i.e., everything up to and including stem map information, and excluding damage agents, loss indicators, and net factoring)
- Record the sample tree data

Bark Thickness

This is in relation to Section 4.8 (Recording Sample Tree Data) of the CMI Procedures manual. *[FAIB 2020 C.M. #17]*

The measurement of bark thickness on sample trees was removed as a sampling procedure in the past for most sample types, including CMI. Bark thickness is no longer collected on any sample types. This section serves as a reminder of this pre-existing change in procedure.

Measure Codes & Field Ages

This is in relation to the "Measuring Height, Age, and Growth Information" and the "Recording Height, Age, and Growth Information" subsections of Section 4.8 (Recording Sample Tree Data) of the CMI Procedures manual. *[FAIB 2020 C.M. #48]*

There are several methods of acquiring a field age for a sample tree, and each one requires different procedures, measure codes, and complementary attributes (e.g., prorate length). Some of the methods have been removed, others have been modified, some have been added, and some remain unchanged.

The methods and attributes for acquiring various types of ages that are not used for data analysis, or are better calculated during data compilation, have been removed:

- Direct measurement of age correction – This method and attribute is no longer available; years to breast height is calculated during data compilation.
- Physiological age (PHY) – This method and attribute is no longer available; physiological age does not provide useful data.
- Prorate office count – This attribute is no longer available; lab ages for non-full length cores are now simply entered into lab age.
- Total age – This attribute is no longer available; total age is calculated during data compilation.

The most common method of obtaining a field age is to bore the sample tree at breast height. Several situations are possible, listed here by the applicable measure code:

- PTH (pith) –Where a complete core is collected, and it contains pith, simply record the ring count in field age. (This is one instance of the former "---" measure code).
- NOP (no pith) – Where a complete core is collected, but it does not contain pith, record the ring count in field age, and estimate the number of missing rings in "missed years to pith" (see next section for full details on this). (This is the other instance of the former "---" measure code).
- CRC (cannot reach center) – Where the sample tree is too large for the borer to reach the center, record the ring count in field age, and record the length of the core (excluding the bark) in prorate length.
- ROT (rotten core)- Where the sample tree is rotten or has missing wood in the center, record the ring count in field age, and record the length of the core (excluding the bark) in prorate length.

If boring the sample tree would risk severe damage or death due to its small size, there are two alternatives in order to obtain a field age:

- WHO (whorl count) – Count the whorls above breast height, and record that in field age. Growth increments are not collected.
- OUT (out-of-plot tree) – Locate a tree outside the plot of similar apparent age to the sample tree, bore it or cut it down at breast height, and record that tree's ring count in field age. Growth increments will also be measured from this "out" tree.

Lastly, there are two special situations related to field age:

- PRE (previously aged) – Where the sample tree was also a sample tree in a previous measurement, do not bore the tree but simply record the PRE measure code and leave field age (and growth increments) blank; the new current age will be calculated during data compilation.
- NOC (not collected) – Where no core is collected and no field age is estimated through a means described above, record the NOC measure code and leave field age (and growth increments) blank. This should be a very rare occurrence, if ever.

Note that all field ages in all instances are now collected at breast height (or at the tagged nail height if it has been shifted from breast height, for example, to avoid a whorl or swelling), never at ground level, and never for a "total age". Years to breast height will be calculated during data compilation.

Missed Years to Pith

This is in relation to the "Measuring Height, Age, and Growth Information" and the "Recording Height, Age, and Growth Information" subsections of Section 4.8 (Recording Sample Tree Data) of the CMI Procedures manual. *[FAIB 2020 C.M. #32]*

This is a new attribute for sample trees, and it is synchronized across all sample types.

If the measure code for a sample tree is NOP, then missed years to pith is required. This is an instance where a solid intact core is collected for a sample tree, yet pith is not included in the core. Typically, this happens if there is some past damage in the tree that causes the pith to "wobble" at the center of the tree, or if the tree is very large with a small pith and it simply can't be found after sufficient attempts. Note that this is a different circumstance than CRC or ROT, in which case prorate length would be recorded rather than missed years to pith.

If the collected core is long enough to pass the location of pith, yet does not contain pith, then the procedure is a follows:

- Record "NOP" for the measure code
- Count the visible rings on the core and record that in field age
- Estimate how many rings are missing between the last visible ring on the core and the missing pith, and record that in missed years to pith

Recording age data in this way provides more clarity, and it also allows a direct comparison of field age to office age, as both will be counting only visible growth rings.

Office Age

This is in relation to the "Procedure for Measuring Age on Bored Trees" subsection of Section 4.8 (Recording Sample Tree Data) of the CMI Procedures manual. *[FAIB 2020 C.M. #21]*

All sample tree cores will be processed and measured by the Ministry of Environment's Technical Services Laboratory. Services will include mounting, sanding, scanning, and making dendrochronology measurements. Due to the specialized equipment used for these processes, extra care should be taken to collect and provide intact cores that include pith in as many cases as possible, which may mean that some sample trees will need to be cored several times. In general, the older the tree, the more attempts can be made to acquire an intact core that includes pith without adversely impacting the tree. However, it is more important to have accurate ages for younger trees since the impact of one missing year on the calculated site index (the main use for collecting ages) increases as tree age decreases.

All sample tree cores will be counted in the field, with the field age and growth increments recorded. If required, missed years to pith and/or prorate length will also be measured and recorded.

Each sample tree core will be placed in its own straw, which will be labelled with the necessary details to uniquely identify the core (i.e., project ID, contract number, sample number, quadrant, tree number, species, and sample tree type). Strips of waterproof paper with labelling done in pencil will ensure the critical information is not smudged or wiped away if wet. Do not write directly on the core as the ink can cause issues for the lab's core analysis. Straws must not be sealed in order to prevent mold growth; stapling the ends (including the waterproof paper strip on one end) is a good solution. If possible, cores should be kept refrigerated while awaiting delivery to the lab to preserve moisture content and overall core integrity. Freezing the cores is not recommended as it can rupture the cells and cause issues for the lab's core analysis.

At the end of each batch (or at a very minimum, once per month), the cores will be securely packaged (bundled by sample) and sent via courier to the Technical Services Laboratory. The current delivery address and contact person's information will be provided by the Contract Manager. It is imperative that this delivery schedule is adhered to in order to ensure the lab has the necessary time and capacity to process the cores in an efficient manner. Delivering all cores in one batch at the end of a project or field season is not acceptable.

A digital sample tree core log will be maintained to list each sample tree core collected. A printout of the core log must be shipped with the cores to avoid any confusion as to the identity of the cores. The updated digital core log file must also be emailed to the lab's contact person whenever cores are couriered to facilitate data entry by the lab.

Office age (previously called office bored height age) will be data entered by the Ministry after the lab's analysis is completed.

Summary of Changes

1. **Non-representative IPC pin location** – Clarity has been provided on how to deal with non-representative or anomalous plot locations for CMI and YSM samples. Neither sample type is impacted by unmapped areas of within-polygon variation. CMI samples are not impacted by mapped inventory polygon lines either, and they are always measured where they land; they are never dropped (unless for safety reasons). YSM samples can be impacted by mapped inventory polygon lines within 22.56 m of IPC, causing the need for the walkthrough methodology to be employed. YSM samples that are not on the 20 km grid and that fall in a polygon that is significantly outside of the target population age (as determined on the ground) should be dropped.
2. **Plot photos** – Ground photos are required for all samples, even if they are rejected. There is a different set of photos required depending on whether CWD transects are being measured.
3. Required vs. optional data – CMI samples now officially exclude the measurement of range, CWD, ecology, vegetation, and succession data.
4. **Nail & DBH location** – A tree tag nail should be shifted by up to 10 cm away from BH if doing so will allow for a more representative and repeatable measured DBH. Establishing this type of robust diameter measurement is more important than having the nail at exactly 1.30 m. If the nail needs to be shifted further than 10 cm, that is ok, so long as there is a good rationale for doing so, and a comment to that fact is recorded. Taking an above-and-below averaged diameter is still an option, but it is not as ideal as a repeatable measured diameter.
5. **Species** – The QA standard for incorrect species is changed from "1 error maximum" to "1 error allowed per 40 trees".
6. **Dead fallen trees** – For remeasurement samples, previously tagged trees that are now found to be dead fallen will be measured in full. They will not be measured again in any future remeasurement after that. Record accurate damage agents for the dead fallen trees, as it is the cause of death that is of primary importance.
7. **Broken tops** – Broken top diameter and projected length are no longer required for broken top trees. Only a 'Y' or 'N' is needed, along with the BTP loss indicator.
8. **Wildlife codes** – Wildlife codes are no longer collected on any samples.
9. **Mode** – This is a new attribute designed to flag anomalous situations with plot trees, including: missed (M), dropped (D), harvested (H), not found (N), and non-tally sample tree (Z). It is important to apply these codes as necessary as it has significant implications for the data analysis.
10. **Plot-level forest health comment** – A standardized comment is required on every YSM sample that describes the leading damage agent for fallen trees within the plot, the number of fallen trees attributed to that damage agent, and average age (at time of death) o those fallen trees.
11. **Forest health resource reference** – The recommended resource for forest health information has been updated to the *Field Guide to Forest Damage in BC*, 3rd revised edition, 2014.

12. **Major rusts & cankers** - Elytroderma stem canker (DFE) is no longer recorded; however, DFE will continue to be recorded as a branch and foliar infection using the Hawksworth scale. The ground-up hierarchy of recording the primary rusts and cankers in YSM samples is no longer in place; instead, damage agents are to be recorded in order of significance to the tree, up to the maximum of 5.
13. **NY damage agents** – NY ("snow or ice [includes snow press]") includes two new subtypes of damage agent: NYB ("snow or ice breakage") and NYP ("snow press"). The new more specific damage agents should be used over NY where possible.
14. **Fire severity** – A new 2-part severity code exists for fire damage agents (NB and NBP). The first column reflects the extent of wood fibre damage (cambial [A], minor [B], or major [C]), and the second column records percent scorched foliage (in deciles, 0-9).
15. **Abiotic severity** – Percent defoliation is now available as a new severity for abiotic damage agents, and this should be used if the tree is still alive and intact. The pre-existing mortality condition severities are still valid (e.g., SR, SO, WR, etc.), and those should be used if the tree is dead, windthrown, or broken.
16. **Call grading** - Log grades are no longer recorded for any samples. Log lengths and net factoring are still required for CMI samples, but logs are only split based on net factoring requirements and the principle of isolating rot. Form alone (such as forks and crooks) has no bearing on splitting a tree into multiple logs.
17. **Non-tally sample trees** – In younger stands with smaller diameter trees, it is required to check for non-tally sample trees. These are trees that are too small to be tagged in the sample, but they are nonetheless codominant and are the largest diameter tree of a particular species in a particular quadrant. Tag the tree, record a "Z" in the Mode field, record all basic mensuration attributes up to and including stem map information, and then record the sample tree data.
18. **Bark thickness** - The measurement of bark thickness on sample trees was removed as a sampling procedure for CMI in the past, and it remains so. This is just a reminder.
19. **Measure codes & field ages** – Direct age correction, physiological age (PHY), and total age have been removed. The "---" measure code is split into PTH (pith) and NOP (no pith). The procedure for whorl count (WHO) for small trees is changed from the full tree (total age) to above breast height (BH age). Sample trees that were previous sample trees do not need to be bored, but only need the PRE measure code applied; the new age will be calculated. If for any reason a core is not collected and a field age is not estimated, enter the NOC (not collected) measure code.
20. **Missed years to pith** – If a full-length core does not include pith (i.e., the measure code is NOP), then record the estimated number of rings missing from the core.
21. **Office age** – All cores will be sent to a lab for detailed microscope counting. Extra care should be taken to collect intact cores that contain pith. Field ages and growth increments must still be recorded. A digital sample tree core log must be maintained and provided to the lab with the cores. Office age data will be entered by the Ministry.