Climate Change Informed Species Selection (CCISS) Expert Review

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Executive Summary

Climate Change Informed Species Selection (CCISS) is a Biogeoclimatic Ecosystem Classification-based analysis framework built to anticipate the change climate implications to tree species environmental suitability. The CCISS tool projects changes to species' environmental suitability at a site series level across the province and estimates the future suitability of a tree species to this changing climate. To account for future climate uncertainty, CCISS uses an ensemble of global climate change models and emissions scenarios to capture the range of plausible climate futures for any location in BC in 20-year periods out to 2100.

Review by subject matter experts is a critical component to the development and implementation of CCISS. This report describes the CCISS expert review process undertaken in fiscal year 2024-25. We engaged the BC Ministry of Forests Ecology Team in the CCISS review process as key subject matter experts to conduct an initial review. The Ecology Team was asked review and provide feedback on the following aspects of CCISS: definitions and supporting documentation of species environmental suitability, environmental suitability ratings, CCISS model results, and CCISS tool layout and information presentation. This report describes the objectives of the review, methods followed, and results of the review process thus far.

The expert review process has resulted in significant improvement to the environmental suitability definitions and workflow, as well as improvement to the accuracy of species environmental suitability ratings. The review of CCISS results provided insight into the tool's ecological accuracy and alignment with current ecological knowledge, actionable updates to the CCISS tool, and additional policy implementation considerations, including best practices on the appropriate use of CCISS.

Acknowledgements

Thank you to Will MacKenzie and Colin Mahony for their leadership of the CCISS team, involvement in the expert review process and revision of an early version of this report. Thank you to the following members of the CCISS team for their assistance with CCISS review; Kiri Daust, Destany Crane and Debora Obrist. Thank you to the following members of the Provincial FOR Ecologist team for their participation in the expert review: Deb MacKillop, Mike Ryan, Sari Saunders, Heather Klassen, Dan Sklar, and Kristi Iverson. Thank you to Lisa Gibson and Olive Dempsey from Shift Collaborative for their work facilitating the review process. Finally, thank you to everyone who has interacted with the CCISS tool and provided feedback both formally and informally.

Definitions

BEC – Biogeoclimatic Ecosystem Classification; **BGC** – Biogeoclimatic; **CCISS** – Climate Change Informed Species Selection; **CFRG** – Chief Forester's Reference Guide; **FFEC** – Future Forest Ecosystem Centre; **FOR** – BC Ministry of Forests.

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Introduction

The expert review process is a critical component of the Climate Change Informed Species Selection (CCISS) implementation plan, ensuring that the CCISS tool is technically sound and effective. Given the complexity of forest ecosystems and climate change impacts on tree species, it is essential that the CCISS tool undergoes evaluation by experts. The expert review leverages the knowledge and experience of ecologists, silviculturists, forest health specialists, tree breeders, and other subject matter experts.

FOR Ecologists are core subject matter experts for CCISS and we have engaged this group to perform an initial review of tree species environmental suitability and CCISS tool results. The Ecologist review provides insight into the CCISS tool's ecological accuracy and alignment with current ecological knowledge, helps identify issues and inform readiness for broader implementation.

The Future Forest Ecosystem Centre (FFEC) has brought the CCISS suite of products to a common standard of functionality, documentation, expert review, and open data access. This will be the foundation for FFEC to shift its focus towards engagement and extension in FY26. While the expert review of CCISS will continue into the future, the goal for FY25 was to complete an initial review by FOR Ecologists and to establish an effective system for ongoing expert review.

The FOR Ecology team have provided a review of:

1. **Species Environmental Suitability**
    a. **Definitions and workflow** – Documentation outlining the creation and evaluation of environmental suitability ratings for tree species in British Columbia and adjacent jurisdictions at a site series level. This is essential for establishing a baseline from which to develop and update suitability ratings in a consistent manner across BC and adjacent jurisdictions.
    b. **Environmental suitability ratings** – Historical (reference period 1961-1990) tree species environmental suitability by site series is a key component of the CCISS tool. Future species suitability is predicted based on the historical species suitability within the site series of the biogeoclimatic (BGC) units that are projected to occur in a given location under a future climate. Environmental suitability ratings were originally derived from the CFRG suitability ratings and modified through expert opinion and review, based on clear and agreed-upon definitions and rating process (See; Ratings of Tree Species Environmental Suitability, Collins et al. 2025).
2. **CCISS Tool**
    a. **CCISS model results** – The CCISS tool is an analysis framework built to anticipate the climate change implications to tree species environmental suitability based on Biogeoclimatic Ecosystem Classification at the site level.

CCISS model results include projected future tree species suitability and projected future BGCs based on subject matter experts' knowledge and their interaction with the tool.

b. **CCISS tool layout and information presentation** – FOR Ecologists have also provided feedback on the layout of the CCISS tool, user experience (UX), information presentation, and supporting documentation.

Objectives

The primary objectives of the FOR Ecologist review are:

- Ecologists' review of tree species environmental suitability ratings (1961-1990 climate) by site series. With emphasis on identifying missing suitable species and consistent application of updated definitions.
- Ecologists gain experience with using the CCISS tool and familiarity with its key data inputs/outputs.
- Ecologists identify and document known issues with biogeoclimatic and species environmental suitability projections to assist in improving CCISS model inputs (climate surface issues, climate projection issues, suitability ratings, or other).
- Knowledge transfer from the FFEC about the modeling approach and methods, particularly the application of site series overlap concepts and climate modeling uncertainty.
- Ecologist input on user guidance to appropriate/best practices application of CCISS.
- Discussions on risk management and uncertainty for the implementation of the decision aids between FFEC and FOR Ecology teams.

Methodology and Timeline

Initial briefing

An in-person workshop with the FOR Ecology and FFEC teams took place in November 2024 to review the historical species suitability ratings and CCISS tool model results, outline the objectives of the review, and the methodology of the review process (**Figure 1**).

Figure 1. Attendees of the November 2024 CCISS expert review workshop in Victoria, BC. Top row left to right: Travis Heckford, Dan Sklar, Kristi Iverson, Colin Mahony, Heather Klassen, Will MacKenzie, Kiri Daust, Vanessa Comeau, Deb MacKillop, Jackie Churchill. Bottom row left to right: Iraleigh Anderson, Courtney Collins, Sari Saunders, Mike Ryan.

Review materials

Experts were provided with:

1. Forest Ecology & Management CCISS paper with supplementals (MacKenzie & Mahony 2021)
2. Environmental Suitability Definitions and rating process documentation

3. Spreadsheet matrix (i.e. table) of tree species CFRG suitability, expert environmental suitability, and model predicted environmental suitability ratings by site series
4. The By-BEC app providing visualization of the tree species suitability ratings provincially (Appendix A)
5. The CCISS tool (Appendix A)
6. CCISS spatial app providing maps of biogeoclimatic projections and future tree species suitability projections (Appendix A)
7. Supporting documentation, the CCISS tool methodology, known issues, and "how-to" guides for the tools available
8. The CCISS_Review GitHub repository to track and review issues

Environmental suitability documentation

As requested by the Ecology Team in November, the CCISS team developed new documentation outlining definitions and a multi-step rating process for Species Environmental Suitability ratings. The CCISS team presented the new documentation for Species Environmental Suitability ratings in December 2024 at two virtual meetings with the 1) silviculture and forest health teams (Forest Science, Planning and Practices Branch) and 2) the FOR Ecology team. A first round of feedback was received and incorporated from both the silviculture and forest health team, and the ecology team, presented back in January 2025. A second round of feedback from the Ecology team was incorporated and the document was finalized in April 2025 (Ratings of Tree Species Environmental Suitability, Collins et al. 2025).

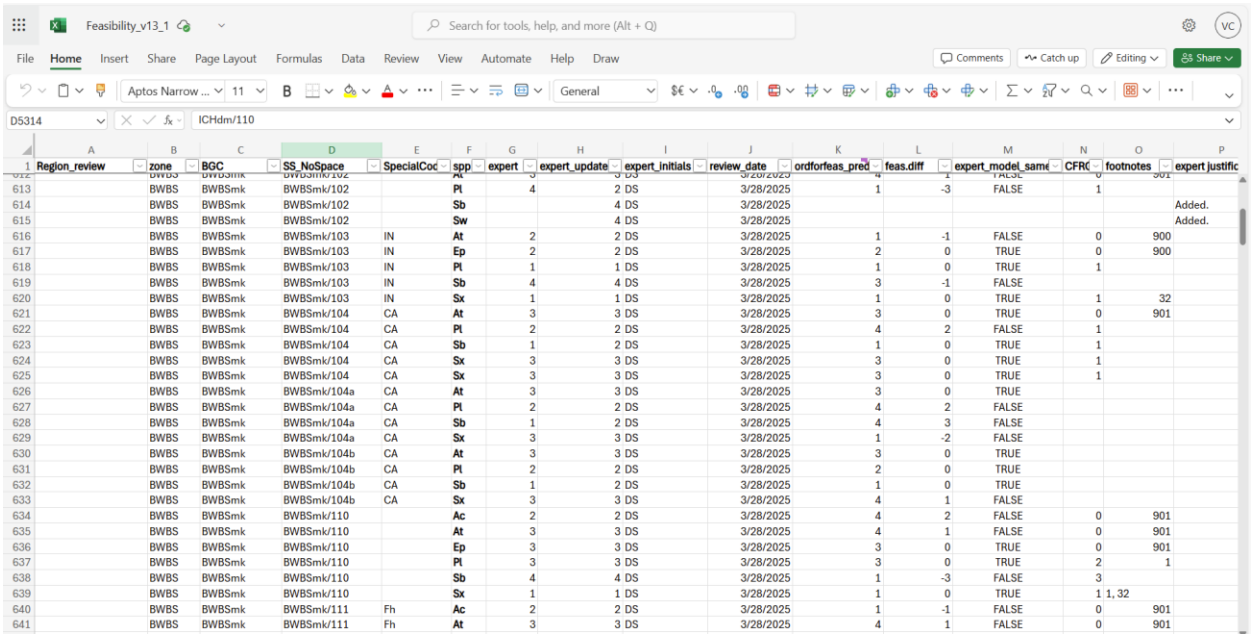
Environmental suitability ratings review

The objective of this review is to refine the environmental suitability ratings using expert knowledge and available information sources, assist with filling in gaps if any, and document known issues for further follow-up. The resulting suitability ratings will provide a strong scientific foundation and provide a consistent baseline for further refinement using quantitative methods. The initial environmental suitability ratings were assigned in 2017 by A. Banner (Coast and North Area), T. Braumandl (Kootenay-Boundary, Thompson-Okanagan), W. MacKenzie (Alberta), and D. Meidinger (USA). A subsequent review of this output in 2018-2019 led to some clarification of definitions and modifications of initial ratings. The initial ratings were reviewed in 2021 by regional experts. See Ratings of Tree Species Environmental Suitability (Collins et al. 2025) for a full overview of the suitability rating and review process to date. The FY24/25 review of environmental suitability ratings began in November 2024 at the in-person Ecologist meeting. Ecologists were provided with background and definitions of species environmental suitability, as well as a table with the following information (**Figure 2**):

- Biogeoclimatic zone and subzone-variant
- Site series
- Tree species

- Current environmental suitability rating
- Predicted suitability rating from an ordinal model
- Chief Forester's Reference Guide (CFRG) ecological suitability for a timber objective
- CFRG footnotes
- Mean species cover and frequency by site series from BEC plot data
- A suite of average climate variables for that subzone-variant
- Space to fill in an expert update suitability rating, expert initials and review date

Ecologists were introduced to the review process and each reviewed two subzone-variants in their region, adding their ratings and initials to the spreadsheet. Based on this exercise and a review of documentation we revised the environmental suitability rating definitions and introduced a workflow, as described above. Using the updated documentation and rating process, Ecologists began reviewing species suitability ratings for their entire region in February 2025. Revisions to the suitability ratings reflect updates to the BEC classification (BEC13), improvements to the environmental suitability ratings definitions, and revision by experts drawing from a combination of knowledge and experience, BEC guides, literature review, BEC plot data, and other sources. This review is complete for the Coast Area, Omineca, Cariboo, and Thompson-Okanagan regions as of March 2025, and in progress for the Kootenay Boundary, Skeena and Northeast regions as of May 2025.



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613		BWBS	BWBSmk	BWBSmk/102		Pl	4	2	DS	3/28/2025	1	-3	FALSE	1		
614		BWBS	BWBSmk	BWBSmk/102		Sb		4	DS	3/28/2025						Added.
615		BWBS	BWBSmk	BWBSmk/102		Sw		4	DS	3/28/2025						Added.
616		BWBS	BWBSmk	BWBSmk/103	IN	At	2	2	DS	3/28/2025	1	-1	FALSE	0	900	
617		BWBS	BWBSmk	BWBSmk/103	IN	Ep	2	2	DS	3/28/2025	2	0	TRUE	0	900	
618		BWBS	BWBSmk	BWBSmk/103	IN	Pl	1	1	DS	3/28/2025	1	0	TRUE	1		
619		BWBS	BWBSmk	BWBSmk/103	IN	Sb	4	4	DS	3/28/2025	3	-1	FALSE			
620		BWBS	BWBSmk	BWBSmk/103	IN	Sx	1	1	DS	3/28/2025	1	0	TRUE	1	32	
621		BWBS	BWBSmk	BWBSmk/104	CA	At	3	3	DS	3/28/2025	3	0	TRUE	0	901	
622		BWBS	BWBSmk	BWBSmk/104	CA	Pl	2	2	DS	3/28/2025	4	2	FALSE	1		
623		BWBS	BWBSmk	BWBSmk/104	CA	Sb	1	2	DS	3/28/2025	1	0	TRUE	1		
624		BWBS	BWBSmk	BWBSmk/104	CA	Sx	3	3	DS	3/28/2025	3	0	TRUE	1		
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627		BWBS	BWBSmk	BWBSmk/104a	CA	Pl	2	2	DS	3/28/2025	4	2	FALSE			
628		BWBS	BWBSmk	BWBSmk/104a	CA	Sb	1	2	DS	3/28/2025	4	3	FALSE			
629		BWBS	BWBSmk	BWBSmk/104a	CA	Sx	3	3	DS	3/28/2025	1	-2	FALSE			
630		BWBS	BWBSmk	BWBSmk/104b	CA	At	3	3	DS	3/28/2025	3	0	TRUE			
631		BWBS	BWBSmk	BWBSmk/104b	CA	Pl	2	2	DS	3/28/2025	2	0	TRUE			
632		BWBS	BWBSmk	BWBSmk/104b	CA	Sb	1	2	DS	3/28/2025	1	0	TRUE			
633		BWBS	BWBSmk	BWBSmk/104b	CA	Sx	3	3	DS	3/28/2025	4	1	FALSE			
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639		BWBS	BWBSmk	BWBSmk/110		Sx	1	1	DS	3/28/2025	1	0	TRUE	1	1, 32	
640		BWBS	BWBSmk	BWBSmk/111	Fh	Ac	2	2	DS	3/28/2025	1	-1	FALSE	0	901	
641		BWBS	BWBSmk	BWBSmk/111	Fh	At	3	3	DS	3/28/2025	4	1	FALSE	0	901	

Figure 2. Screenshot of the species environmental suitability ratings (formerly feasibility) table used for review.

CCISS tool review

At the in-person meeting with the Provincial Ecology team in November 2024 the CCISS team presented an overview of the CCISS framework analysis, the CCISS tool interface, the CCISS

spatial tool, the CCISS review process and GitHub repository to track issues. GitHub issues allows for experts/reviewers and CCISS team members to have a conversation, assign someone on the CCISS and/or FOR Ecology team to review the issue, work through an issue and mark the issue as closed when resolved. The meeting included time to interact with the CCISS tool products and begin the CCISS review process. All Ecology team members created GitHub accounts and documented issues they identified with CCISS model results and/or CCISS tool layout and documentation via GitHub issues. Experts were provided with a response to their issues in the comments where appropriate. In addition to feedback provided through GitHub, we held individual meetings for each Forest Region to gather an initial round feedback in March 2025. This review is ongoing and iterative as we incorporate updates to the inputs (e.g. suitability ratings) and models (e.g. BGC model).

Expert review is an iterative process as updates and improvements are made to the tool and/or new information is incorporated into CCISS. GitHub and by-BEC allow for continuous review and feedback as experts and users continue to interact with the tool.

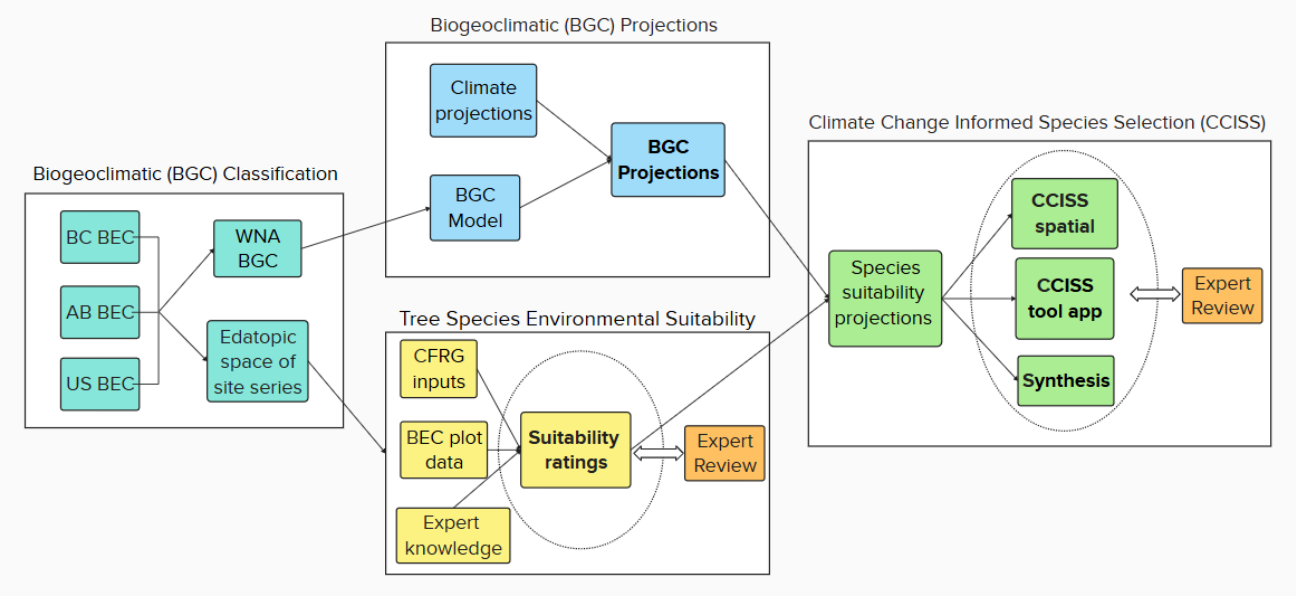

Figure 3. CCISS workflow. The foundation of the CCISS framework is Biogeoclimatic Ecosystem Classification (BEC). The full suite of Western North America (WNA) BEC is built from BC BEC, adapted Alberta BEC and modelled US BEC, represented in teal. The baseline (1961-1990) climate of each biogeoclimatic (BGC) unit is used to create the BGC model, this is then combined with future climate projections to make BGC projections (1st input to CCISS results), represented in blue. BEC classification also contains site series and their associated edatopic space which is then aligned with tree species environmental suitability ratings (2nd input to CCISS results). Suitability ratings are informed by Chief Foresters Reference Guide (CFRG) ratings, BEC plot data and expert knowledge, represented in yellow. BGC projections and environmental suitability ratings are combined to create species suitability projections (i.e. CCISS tool results), which are displayed on the CCISS tool app and inform CCISS synthesis materials, represented in green. We are undergoing expert review and seeking feedback on the environmental suitability ratings and CCISS tool products, represented in orange. See the documentation in the CCISS tool for more detail on CCISS methods.

Results – summary of feedback

Environmental suitability documentation feedback

We have identified the following major themes from the feedback gathered on the environmental suitability documentation (Current version; Ratings of Tree Species Environmental Suitability, Collins et al. 2025).

1. **Definitions of suitability vs feasibility**: The original documentation referred to these ratings as "environmental feasibility". Feedback was that definitions needed to be clarified and that the term "feasibility" is associated with the CFRG silvicultural feasibility. We changed the name to "environmental suitability" to better reflect the intent of these ratings and clarified definitions.
2. **Historical reference period (1961-1990)**: There was some confusion about how to assign suitability ratings for performance during the historical reference period. Additional information was added to the guidance documentation clarifying that if a species has exhibited changes in recent years due to the warmer, drier climate of the last decade, this should not influence the environmental suitability rating assigned.
3. **Suitability ratings definitions and logic flow**: Definitions were clarified and improved based on feedback, and a decision logic flow was developed describing a process for assigning/reviewing environmental suitability ratings and integrating multiple lines of evidence.
4. **E4 rating**: The definition and use of an E4 rating was clarified (minimal environmental suitability). This rating has been assigned to species in the master suitability dataset and included in the ecologist review. E4 ratings are not currently incorporated into CCISS projections, i.e. E4 and E5 are both treated as not suitable in CCISS.
5. **Seral stages**: We added guidance on how to consider species present during different seral stages with some examples, relevant for many broadleaved species.
6. **Offsite or Outside Home Range (OHR) species**: There was hesitation around projecting the success of offsite species into future climates and questions about how offsite species have been incorporated thus far. We added additional information about OHR suitability ratings included in CCISS and the process for assigning OHR ratings. In response to this feedback, the current version of CCISS has the option to include/exclude OHR suitability ratings from projections.
7. **Silvicultural systems**: We received questions about how to incorporate information about silvicultural systems when assigning a suitability rating. The suitability ratings are impartial to the silvicultural system in use and instead reflect suitability to environmental (climate + site/edaphic) conditions. We added

additional information describing how to assign a rating to species that regenerate in the open vs only under shade, and for species that are early seral.

8. **Examples**: We added more examples of environmental suitability ratings decisions and rationale.
9. **Footnotes**: Guidance on how to think about footnotes when assigning suitability was included in the logic flow. Feedback on tracking footnotes as BGCs are projected forward was recorded in the GitHub issues. This functionality has not been included in the current version of CCISS but is in our workplan for consideration.

Environmental suitability ratings updates

Revision of environmental suitability ratings reflected improvements to the environmental suitability ratings definitions, updates to BEC mapping and site series designations (BEC v13), and additional thorough review by experts supported by a combination of knowledge and experience, BEC guides, literature review, BEC plot data, and other sources.

FOR Ecologists have reviewed 7,810 environmental suitability ratings (i.e. species rating at a site series within a subzone/variant) of 10,301 total ratings in BC. This represents a review of ~80% of ratings in BC. In this most recent round of review 15.7% of ratings were changed and 444 ratings were added (Table 1). Region specific details below (Table 1).

Table 1. Environmental suitability ratings review completed as of May 2025, by region.

Region	Reviewers	No. ratings reviewed	No. ratings changed	Percentage changed	No. ratings added	Percentage added
Coast	Sari Saunders, Heather Klassen	3027	192	6.3%	91	3%
Omineca	Daniel Sklar	339	46	13.6%	0	
Cariboo	Kristi Iverson	1114	170	15.2%	100	9%
Thompson-Okanagan	Mike Ryan	1339	566	42%	66	5%
Kootenay Boundary	Deb MacKillop	764	118	16.3%	0	
Skeena and Northeast	Daniel Sklar, Erica Lilles	1227	135	11%	187	15.2%
BC (total)		**7810**	**1227**	**15.7%**	**444**	**5.7%**

Review is still in progress for the Kootenay-Boundary, Skeena and Northeast regions. Non-forested ecosystems and special sites (e.g. floodplains, wetlands, or grasslands) have been inconsistently reviewed across the province. As review proceeds, additional suitability ratings are likely to still be added, especially for broadleaved species. Suitability ratings outside of BC, in the Northwestern US and Alberta have not been reviewed.

Review status and ratings added/changed are summarized in Figures 4 and 5 by BEC zone and by species. Review of environmental suitability ratings has occurred in all BEC zones. Major areas still requiring review include the ICH (Interior Cedar - Hemlock), ESSF (Engelmann Spruce – Subalpine Fir), IDF (Interior Douglas-fir) and MS (Montane Spruce) zones.

For further information on the development and revisions of environmental suitability ratings refer to Ratings of Tree Species Environmental Suitability (Collins et al. 2025).

Figure 4. Counts and current review status of environmental suitability ratings by BEC zone for broadleaf species. Including ratings not yet reviewed (yellow), ratings added (grey), ratings reviewed and changed (orange), and ratings reviewed but not changed (blue). Note that the scale of the y-axis is not consistent. BG= Bunchgrass, BWBS=Boreal White and Black Spruce, CDF=Coastal Douglas-fir, CWH= Coastal Western Hemlock, ESSF=Engelmann Spruce Subalpine Fir, ICH= Interior Coastal Hemlock, IDF= Interior Douglas-fir, MS= Montane Spruce, PP= Ponderosa Pine, SBPS= Sub-boreal Pine – Spruce, SBS= Sub-boreal Spruce, SWB= Spruce-Willow-Birch.

Figure 5. Counts and current review status of environmental suitability ratings by BEC zone for conifer species. Including ratings not yet reviewed (yellow), ratings added (grey), ratings reviewed and changed (orange), and ratings reviewed but not changed (blue). Note that the scale of the y-axis is not consistent. BG= Bunchgrass, BWBS=Boreal White and Black Spruce, CDF=Coastal Douglas-fir, CWH= Coastal Western Hemlock, ESSF=Engelmann Spruce Subalpine Fir, ICH= Interior Coastal Hemlock, IDF= Interior Douglas-fir, MS= Montane Spruce, PP= Ponderosa Pine, SBPS= Sub-boreal Pine – Spruce, SBS= Sub-boreal Spruce, SWB= Spruce-Willow-Birch.

CCISS tool feedback

Expert reviewers and CCISS team members have entered and tracked CCISS feedback and issues in the CCISS_Review GitHub repository (found here All issues · CCISS Expert Review). As of May 26, 2025, we have received **246 GitHub issues**. By region, we have received 7 GitHub issues for the Cariboo, 12 for Coast, 12 for Kootenay Boundary, 3 for Northeast, 6 for Omineca, 9 for Skeena, and 178 for Thompson Okanagan. The remaining issues apply to all regions or the CCISS tool as a whole. The disproportionate number of issues in the Thompson Okanagan reflects a detailed review of CCISS results performed by Mike Ryan, where he

summarized and provided feedback on the CCISS results for each site series within each subzone variant.

We have identified the following common themes from feedback on GitHub and from our discussions.

1. **Reference period environmental suitability ratings**: Issues stemming from the assigned species environmental suitability ratings for the reference period (1961-1990) or missing suitability ratings for some species. Many of these issues have been (will be) resolved with the ecologist review of these ratings.
2. **BEC mapping**: Outdated mapping in some areas (CCISS is only as good as the baseline ecology/BEC classification and mapping).
3. **Future BGC climate analogs**: 'Weird' future analogs that diverge from what would be expected. This is much improved with the new BGC model (See CCISS tool updates – Improved BGC model, below).
4. **Unexpected species suitability projections**: Species suitability projections that do not make ecological sense or are unexpected (e.g. declining Cw suitability in valley-bottom ICH units in the Robson Valley).
5. **Limitations of model/model design**: Examples include: 1) edatopic overlap assumes equal probability of edatopes into a site series, 2) CCISS does not account for aspect, and 3) limitations of the climate variables chosen (e.g. a summer precipitation value obscures trends in increasing June precip and decreasing July/August precip).
6. **US BGC units**: uncertainty around US BGC units and limitations due to unfamiliarity with US BGC units making interpretation of the accuracy of projections that include US units difficult.
7. **End users**: Feedback on how users will interact with the tool and interpret results from the tool.
8. **Non forested/extra-edatopic sites**: Issues related to projections for non-forested sites (e.g. grassland, rock outcrop), sites with extra edatopic factors (e.g. aspect, cold air, etc.), or conversion of forested sites to non-forested sites (e.g. IDFxh1/102 site projected to convert to grassland because there are no rock outcrop sites in the projected future BGCs).
9. **Novel climate**: Issues related to the fact that future climate is novel (i.e. does not align the historical 1961-1990 climate of any BGC in our dataset) resulting in unexpected and/or inaccurate species suitability projections. Many of these issues have been resolved with the inclusion of a novelty metric (see CCISS tool updates – Novelty layer, below).

CCISS tool layout and documentation feedback

In addition to feedback about CCISS results, we have received feedback on documentation, layout and the tool interface. Some examples of this type of feedback are:

- Include guidance on how to interpret novelty metrics

- Define what edatope refers to on CCISS Spatial
- Document known issues and uncertainty
- Improvement to “find-a-BEC” functionality so the selected BGC is easier to view

CCISS tool updates

Since the review process was initiated in November 2024, the following updates and improvements have been made to the CCISS tool:

- **Improved BGC model**: improved training data selection, higher accuracy baseline predictions, and more credible future projections. CCISS projections resulting from this new BGC model addressed/improved BGC projections from the previous version that did not seem credible. For example, CWH subzone-variants projected as future climate analogs for ICHmw4 in the southern Kootenay region. In the updated version, the CCISS the model selects ICH units from further south as future climate analogs, with CWH making up a much smaller proportion of projections.
- **CCISS Spatial:** displays CCISS tool results geographically, at the provincial scale, for both projected species suitability and future BGC projections. Technical improvements to CCISS Spatial, the addition of a novelty layer, and improvements to the user interface/layout have been made. CCISS Spatial has been added as a tab on the CCISS tool app.
- **OHR suitability toggle**: ability to include or exclude species environmental suitability ratings for “Outside Home Range” species. This functionality is a direct result of feedback received and addresses concerns around future projections resulting from OHR suitability ratings. See “Methods – Outside Home Range” in the CCISS documentation for more information.
- **Novelty layer**: novel climate layer indicating areas of high uncertainty in BGC projections. This addition to the CCISS tool addresses feedback on projections that were an artefact of climate novelty and concerns about providing future species suitability projections in areas where there is a high degree of uncertainty due to novel climate.
- **Added documentation**: additional documentation has been added to the CCISS tool, addressing feedback on instructional materials, guidance and methodology needed.
- **Known issues**: additions of a “known issues” tab on CCISS in response to a request for more information around uncertainty, sources of error and known issues.
- **FAQ tab:** addition of frequently asked questions to CCISS documentation, based on questions that arose during the expert review and questions we have received from users of the CCISS tool.

Next Steps

The CCISS review is ongoing and iterative. FOR Ecologists will provide another round of review to the updated version of CCISS (published March 2025) which incorporates revised species environmental suitability ratings, an improved BGC model, the ability to include/exclude OHR species and a novelty layer. Feedback will be gathered through GitHub, reviewed and incorporated.

Feedback and learnings from the FOR Ecologist review process will inform review by other expert groups. FOR silviculturists and tree breeders can provide important insight into CCISS tool accuracy and alignment with their experience and knowledge, as well as best practices and appropriate use of CCISS. Understanding forest health implications of CCISS tool results and how forest health will be considered alongside CCISS tool results will be essential as we move towards CCISS implementation.

We will expand pool of expert reviewers to the following groups:

1. Provincial silviculture and forest health teams within Forest Science Planning and Practices Branch (FSPPB) and in regions.
2. Provincial tree breeders: The Forest Improvement and Research Management Branch (FIRM).
3. Other experts: We are compiling a list of other experts for review, including foresters and other user groups.

Conclusions

The FY24/25 CCISS review process resulted in significant improvement to the environmental suitability ratings definitions and workflow, as well as improvement to the accuracy of species environmental suitability ratings. The review of CCISS results provided insight into the tool's ecological accuracy and alignment with current ecological knowledge. Feedback through group discussion, one-on-one meetings and input into GitHub resulted in actionable updates to the CCISS tool to address and/or document identified issues, enhance the tool's effectiveness, and assist with providing context for users to the model results. Discussions also provided additional policy implementation considerations, including best practices on the appropriate use of CCISS.

Literature Cited

Collins, C. G., MacKenzie, W. H., Comeau, V. M., and Daust, K. 2025. Ratings of Tree Species Environmental Suitability. Version 1.0.

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Appendix A. Tools available

A1. By-BEC app

Summary: This site houses a collection of apps with the function of geographically displaying and modifying forest information by BGC unit. The site currently has 3 apps: **Tree Feasibility** (i.e. now called tree suitability), which displays environmental suitability by species with various summary types, **Off-site Trials**, which shows trials on a map and is intended as a tool for assessing trials, and **Forest Health**, which displays pest severity by pest and host species.

All three apps are intended to aid expert review and allow updates where necessary. The site also contains 2 utility tools. **Climate summaries** displays summaries of selected climate variables for any BGC in WNA. Summaries can be made of historic normal period and future normal periods. Shows Data is downloadable for the creation of climate summary tables. **'Find a BGC'**, which provides an easy way to select BGCs either by location or name. Each app contains an Instructions button, which will pop-up detailed information about the app.

Link: Power of BEC (thebeczone.ca) https://thebeczone.ca/shiny/bybecmap/

Use during review: Reviewers will interact with the Tree Suitability tab, to view historical species suitability mapped by BGC and modeled tree suitability.

Status: Beta version, intended for internal government use.

A2. CCISS tool

Summary: The CCISS tool projects changes to species environmental suitability at a site series level for any user selected location in the province and estimates the future suitability of a tree species to this changing climate. To account for future climate uncertainty the tool looks at a wide range of global climate change models and emissions scenarios to capture the range of plausible climate futures for any location in BC in 20-year periods through to 2100.

To assist users, the tool compares the current species selection guidance in the Chief Foresters Reference Guide with the future forecast from the CCISS analysis. Reports from the tool highlight where currently acceptable species are stable/improving or declining/unsuitable and where new species have become suitable and could be considered as candidates for assisted range expansion.

Link: Climate Change Informed Species Selection Tool https://bcgov-ffec.ca/cciss/

Use during review: Reviewers will interact directly with the tool reviewing the projected changes in species suitability and future BGCs. Reviewers will flag potential issues and areas for improvement by creating a GitHub issue.

Status: Internal, beta version, shared with a few external collaborators.

A3. CCISS spatial app

Summary: This site displays CCISS tool results geographically, at the provincial scale, for both projected species suitability and future BGC. The tool displays projected species suitability, suitability change, and suitability addition/retreat, across time-period, edatope and species.

Link: Now integrated into the main CCISS webpage.

Use during review: Reviewers will interact with this tool to view CCISS results spatially. This tool will aid in the review of broad species trends and in identification of areas of lower confidence.

Status: Internal, beta version, shared with a few external collaborators.

A4. GitHub issues

Summary: GitHub is a platform for open-source projects, developing code and tracking issues. We will not be using the coding functionality, instead will be interacting only with "GitHub issues" as a platform to track and address feedback and issues raised during the review. Reviewers will need to have or create a GitHub account but will not need to interact with R or other coding for this process. GitHub issues allows for reviewers and the CCISS team to work collaboratively in a shared space, and track ongoing issues, comments, and concerns. It allows each issue created to be tagged by the type of issue, tree species (where relevant) and status. By replying to an existing issue reviewers can provide feedback or add context. The CCISS team will use this platform to track all feedback, follow up where needed and provide updates on an issue as it is addressed. All issues will be stored in the "CCISS_Review" repository. https://github.com/bcgov/CCISS_Review

Link: Regions · CCISS Expert Review https://github.com/orgs/bcgov/projects/207/views/9

Use during review: Reviewers will create a GitHub issue to track feedback or concerns with the CCISS tool encountered during review. Other reviewers and CCISS team members can then interact with the GitHub issue and follow up as needed by replying directly to that GitHub issue. Reviewers will also consider the existing GitHub issues and may reply or add to existing issues that are already being tracked.

Status: External platform supported by BC gov. A GitHub account linked to your IDIR is needed.