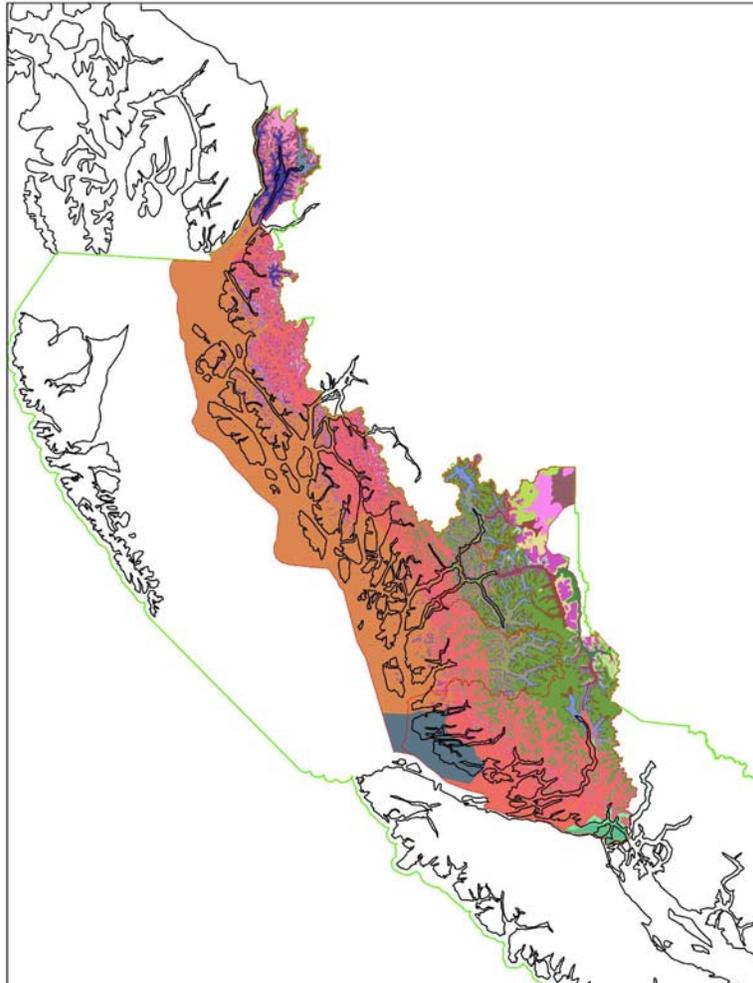


Ecosystems of Central and North Coast and South Central Coast BC

Final Report



Prepared by: Kaeli Stark in co-operation with RCO ecologists
Andy MacKinnon, Sari Saunders, and Heather West

Prepared for: Bulkley Valley Research Centre

March 31, 2009

Table of Contents

1.0 Project Overview

- 1.1 Project Deliverables
- 1.2 Report Outline

2.0 Database

- 2.1 Database Management
- 2.2 Ecosystems of CNCSCC BC – Working Database

3.0 Analytical Procedure

- 3.1 Short Vegetation Summary
- 3.2 Prominence Bar Table
- 3.3 Long Vegetation Report
- 3.4 Ordination
- 3.5 Combine Species Table
- 3.6 Edatopic Grids

4.0 Ecosystems of Central and North Coast and South Central Coast BC: Sub-Regional Guide

5.0 References

6.0 Appendices

1.0 Project Overview

The Ecosystems of Central and North Coast and South Central Coast (CNCSCC) BC Sub-Regional Guide project was initiated to improve ecosystem mapping and classification in coastal BC. Revisions to the current mapping and classification will facilitate ecosystem-based management by allowing managers to utilize the best and most up-to-date information pertaining to coastal ecosystems. Describing ecosystems at a sub-regional scale (rather than using the traditional regional approach) allows for more local detail to be explored and emphasized in BGC unit descriptions.

1.1 Project Deliverables (as noted within Schedules and Approval to Fund documents associated with this Project)

1.1.1 New draft biogeoclimatic unit maps for Central Coast: paper maps and ARC GIS files

Draft mapping to revise the BEC linework for the central coast has been completed. The new linework is based on helicopter flights and ground sampling from the 2006 and 2008 field seasons, and complements historical plot work within the provincial BEC database. The draft map improves resolution of the linework to between 1:200,000 and 1:50,000 and covers the area from the north end of Tweedsmuir Park south to Kingcome Inlet, and from the mainland coast in the west to the Coast Region-Southern Interior Region BC MFR boundary in the east. The final revisions to this map will be completed over the summer, and release for public use is anticipated to be Oct 2009 with the official release of BEC8. Draft mapping is provided with the current report to BVRC and may be requested through the RCO ecologists for specific project work.

1.1.2 Revised, final biogeoclimatic unit maps for Central Coast: paper maps and ARC GIS files

One set of revisions has been completed by RCO ecologists MacKinnon, Saunders, and West. Revisions included refinement and application of spatial rule polygons at the sub-regional scale. This work was completed in coordination with Coastal Resource Mapping Ltd. (Nanaimo, BC) and the BC MFR Research Branch landscape ecologists (Chen and Walton). Further revisions cannot be completed this fiscal year due to unanticipated issues with mapping cold air drainage and other valley pinchings. Historical files must be re-evaluated to determine where plot and aerial coverage produced a scale of mapping sufficient to remain in this revision and where coverage was limited enough that current ecologists must revise these lines. Maps provided are not final (as per above) and will not be incorporated into the provincial database in current form.

1.1.3 Updated Access database containing all CNCSCC ecoplots in clean state (BEC Master files)

A Site Unit table of plots within the CNCSCC working database is provided with this report. This database includes plots within the planning area and plots outside the area within the same biogeoclimatic units; the latter are used for classification but not mapping. A site unit table consists of a listing of plot number (within the provincial BECMaster database) with associated, current BEC site series assignment. A full database of vegetation, site, soils, and mensurational data for these plots is available by request; request by any researcher can be made officially to the BECMaster through the provincial BECWeb or through the RCO ecologists. Because the assignment of site series classification to these plots and membership of plots within the final database to be used for final BEC unit descriptions is still in flux, these data do not accompany the current report. An account of database refinement and data development to this point is provided with the report. Changes to classification are anticipated based on further vegetation description and correlative site-soil-vegetation analyses. Descriptions and examples of these ongoing analyses (including summary and long vegetation tables and ordination work) are provided with this report.

1.1.4 Compilation of data (spatial and aspatial) for use in development of research design and associated metadata

A description of mapped (spatial) information and BEC plot data provided is given in the previous and subsequent annotated bullets.

1.1.5 Draft report outlining progress on analyzing vegetation and environment data – initiation of site series characterization

An annotated description of the steps to develop the final site series classification, with brief descriptions and examples of these steps using our data, is provided within this report. Appendices include examples of short and long vegetation tables and ordination plots. Examples of approaches for determining the level of floristic differentiation are also provided using coloured vegetation tables and prominence analysis. These examples illustrate the issues now being evaluated relative to acceptable levels of differentiation within the provincial hierarchy for final naming and spatial delineation of BEC units.

1.1.6 Stand tables for site series

Mensuration data are available for a portion of the plots within the working database. These data are primarily from the 2008 field season and some historical thesis information. We expect to incorporate this information into final summaries that will also utilize the existing publications on mensuration data from the provincial ecology programme (<http://www.for.gov.bc.ca/hfd/pubs/Docs/Wp/Wp62.htm>). Due to internal budget changes, we were not able to complete standardized cruise compilation summaries for our new data during the time frame of this project; this is a priority for final guide publication.

1.1.7 Outline for report on “Ecosystems of the Central and North Coast and South Central Coast BC”

This report contains an outline of the guide that will be completed for the CNCSCC sub-region. This outline parallels materials being produced for a sub-regional guide to Ecosystems of Haida Gwaii to ensure consistency of new coastal analyses and extension materials. The outline provides information regarding the source of guide materials and explanations of where format will differ from existing BEC guides (i.e., Red Vancouver Region¹ or Orange Prince Rupert Region² Guides) to provide additional sub-regional-level information and examples.

1.1.8 Final Report incorporating above deliverables and revisions thereof based on (1) review comments from and discussion with Project coordinators; (2) external peer review to be arranged by project coordinators.

We anticipate final report to be developed more fully after further database analysis. More detailed information on these analyses can be provided on request. We do not expect to conduct external review within the time frame of this project or within the time frame of the existing EBMWG structure. We are continuing with the classification process, and are expecting to utilize the remainder of funds available through BVRC specific to this guide. Development of written materials to accompany numerical analysis has begun along with consideration of specific sub-regional illustrations and figures (e.g., new landscape cross sections, photographic illustrations, new BEC flowchart, and classification approach materials).

1.2 Report Outline

This report has been subdivided into three parts. In the first part, the status of the working database is described and criteria for plot inclusion/exclusion are summarized. In the second part, a synopsis of the ecosystem classification procedure is outlined, and examples from the CNCSCC working database are given. In the third part, an outline to the Sub-Regional Guide is provided along with notes on expected content and deviations from the standard formatting and content of the Regional Guides.

2.0 Database

Prior to the initiation of this project, the plots in the Coast Forest Region's BEC database had not been examined in detail to determine their potential utility for ecosystem classification. Much of the data in the database was collected for purposes other than BEC (e.g. graduate theses, research projects), and certain components of the data pertinent to classification were not collected consistently (e.g. detailed soils information that allows interpretation of moisture and nutrient regimes; accurate plot locations to assist with mapping). While much of the plot data extant in the database will ultimately be useful for classification, it has been necessary to assess the quality and utility of each plot for classification and description of forested units in CNCSCC BC, and to remove unsuitable plot data from the working database according to a dynamic set of plot selection criteria.

2.1 Database Management

To date, plots have been removed from the working database if:

- Successional Status is young or seral (these plots will be restored to the database in the future for work on the classification of seral stands);
- Stand Age < 80 (minimum age for a stand to be considered mature²);
- Transitional (plot < 90% homogeneous, indicated by TransDistrib code > 2²);
- Soil Moisture Regime (SMR) and/or Soil Nutrient Regime (SNR) fields null and insufficient soils data to derive SMR/SNR *post hoc*;
- Alpine, wetland, other non-forested unit (these plots will be considered separately in the classification of non-forested ecosystems).

In addition, a number of database 'cleaning' exercises have been undertaken to improve the quality of remaining plots. At each iteration of the plot selection process, data quality issues come to light (e.g. plot location does not match with mapped BGC unit; Forest District coding out of date; Zone, SubZone, Variant, Site Series, Assigned Site Unit fields not correctly formatted and therefore not amenable to efficient querying). As issues are recognized, they are corrected if possible (e.g. more than 400 plot locations have been derived or improved using site notes and diagrams found on datasheets). Plot data will be added to and removed from the database as vegetation and environment summarization and analysis proceed, and as such, the working database presented with this report should be recognized as a transitory and dynamic entity, subject to further modifications.

Assignment of Site Series and Assigned Site Unit (ASU) is also an iterative process, and plots might receive various preliminary site series assignments before a final assignment is decided upon. As a consequence, the site series and ASU designations for plots in this working database must NOT be considered final.

2.2 Ecosystems of CNCSCC BC – Working Database

A Site Unit table containing a list of all the plots in the current working database for the Ecosystems of CNCSCC BC has been provided with this report. Access to the plot data in the database is possible through an official request to the BEC Master or RCO ecologists.

3.0 Analytical Procedure

Ecosystem classification is an iterative process that requires a variety of tools and techniques. Plot data are organized in an Access database that is linked to VPro. A suite of vegetation and environment tools that export data summaries to Excel are available in VPro; macros may be applied to the Excel-based summary tables to produce further summaries that facilitate data interpretation. Ordinations may be produced using PC-ORD. Development of an ecosystem classification protocol has been initiated; the procedure is outlined below with examples from the CNCSCC BC working database.

3.1 Short Vegetation Summary

One of the first steps in ecosystem classification is to generate vegetation summaries. The Short Vegetation Summary option in VPro produces a table with variants or site series as columns, species as rows, and mean species constancy and percent cover as values. The short vegetation summary table gives an overview of the data, and important species distribution trends and patterns are often first noticed here.

- The short vegetation summary may be used in conjunction with the long vegetation report: as species with particularly high or low consistency or cover are noted at the site series or variant level in the short vegetation summary, individual plots might be examined in the long vegetation report to determine how widespread and potentially significant a pattern might be.
- One might assess plot groupings in different iterations using a short vegetation summary: plots would be assigned to groups, the short vegetation summary produced, and then plots would be shifted to different groupings based on vegetation and environment characteristics and a subsequent short vegetation summary produced.
- A short vegetation summary showing all site series in the CWH vh 2 is included in Appendix 1.

3.2 Prominence Bar Table

Prominence bars similar to those found in the Field Guides^{1,2} may be produced from the short vegetation summary using a built-in Excel macro. Prominence bars provide a quick visual summary of species trends, and prominence bar tables are used in conjunction with short and long vegetation summaries.

- The prominence bar table contrasting CWH vh 2 /02 and /03 site series (Appendix 2) provides a quick overview of floristic similarities and differences between the two site series. For example, *Juniperus communis*, *Ledum groenlandicum*, *Empetrum nigrum*, *Racomitrium lanuginosum*, and *Cladina* species are clearly important in delineating these site series. One might flag these species and consider them in more detail when using the long vegetation summary to evaluate the site series designation of each plot.

3.3 Long Vegetation Report

Long vegetation reports are often used in conjunction with short vegetation summaries. The long vegetation report groups plots by variant or site series. Each plot is assigned to a separate column, and species percent covers are given in rows. Patterns manifest in the short vegetation summary and prominence bar tables may be explored in detail in the long vegetation report. In addition, a number of macros⁴ that further summarize vegetation and environment data may be applied to the long vegetation report to enhance its ease of use and interpretability.

- A particularly useful macro combines environment and vegetation data on one worksheet, orders species according to their moisture regimes, and assigns a colour to each species and every % cover entry for that species across plots. Species associations and groupings are more easily apparent when the long vegetation report is modified in this manner. Work with long vegetation reports in this format might form the basis for site series designations within a given group of plots. An example of a long colour table contrasting CWH vh 2 /02 and /03 site series is provided in Appendix 3.
- The ‘differential species’ macro generates a list of differential species (i.e. species clearly associated with more than one unit in a hierarchy; presence class \geq III and at least two presence classes greater than in other units of the same category and circumscription⁵) and dominant differential species (i.e. species that do not meet the presence criteria of differential species but show clear dominance in more than one unit in a hierarchy; presence class \geq III, mean species significance \geq 5 and two or more significance classes greater than in other units of the same category).

and circumscription⁵). Differential and dominant differential species may assist in the interpretation of group membership and circumscription.

3.4 Ordination

Ordination is an integral component of the ecosystem classification procedure. Non-metric Multidimensional Scaling (NMS) is a non-parametric method that is particularly well-suited to ecological community data, and it is the ordination method of choice for ecosystem classification. Distances among plots in species-space are calculated, and graphical outputs in two or three dimensions are used to identify potential outliers and assess preliminary plot groupings.

- The ordination of CWH v1 2 plots (Appendix 4) shows relationships among plots in the context of their preliminary site series designations. One might identify potential outliers from this ordination by locating plots that are not tightly clustered with the other plots in a given site series grouping. For example, the position of the site series 08 plot in the top-right corner of the ordination relative to the rest of the 08 plots suggests that its vegetation differs from that of the other plots. This plot's environment and vegetation data would be scrutinized in supporting summary tables to determine whether the plot is a true outlier that should not be considered further in the analysis, whether it falls within the expected range of variability for that particular grouping, or whether it might fit better into a different group.
- Because NMS is not constrained by *a priori* plot groupings, two- to three- dimensional graphical outputs may be used to visually interpret preliminary plot groupings and evaluate potential plot inclusions or exclusions to/from a given group.
- Ordination may also be used to identify species of potential significance in delineating site series or other biogeoclimatic groupings. If a species has a strong correlation with one of the ordination axes, it might also be important in separating plot groupings (e.g. site series) correlated with that axis. These species-site series relationships would be explored further in vegetation summary tables.

3.5 Combine Species Table

A list of species to be combined for analysis and classification may be generated following preliminary vegetation analysis. Candidates for combining include groups of species that are difficult to distinguish either in the field or laboratory (e.g. *Cladonia* species, *Dicranum* species, *Sphagnum* species), subspecies/varieties that have not been recognized consistently across studies and surveyors or not entered into the database consistently (e.g. *Tiarella trifoliata* subspecies *unifoliata*, *trifoliata*, and *laciniatus*), or monospecific genera (in our region) not identified to species (e.g. occurrences of *Holodiscus* sp. should be combined with *Holodiscus discolor*). Wherever possible, species groupings should reflect ecological niche (e.g. the *Sphagnum* species might be grouped into those found under tree canopy, those found in non-forested wetland, etc.).

- A 'Combine Species' table for the Coast Forest Region is currently being developed; it will include the species mentioned above, among others.

3.6 Edatopic Grids

Once plots have been organized into site series groupings based on their vegetation and environment characteristics, the soil moisture and soil nutrient regimes of each plot in a given site series would be examined, and edatopic grid lines shifted as necessary to accommodate new site series designations.

4.0 Ecosystems of Central and North Coast and South Central Coast BC: Sub-Regional Guide

A draft outline to the Ecosystems of CNCSCC BC Sub-Regional Guide is provided in Appendix 5. The proposed structure and content of this sub-regional guide differs from that of the regional guides published to date in that it will contain more supporting background information and more local detail about the area. Specifically, the biota, physical environment, climate, and disturbance history of the area will be introduced and described in detail. Following this expanded introductory section, the BEC system will be outlined, then BGC units described. In addition to the vegetation table and edatopic grid given for each site series in the regional guides, detailed site series descriptions (including soil, plant association, and landscape information) and local examples highlighting the variation and extent of the site series on the landscape will be provided in the sub-regional guide.

5.0 References

- ¹Green, RN and K Klinka. 1994. A field guide to site identification and interpretation for the Vancouver Forest Region. BC Min For, Victoria, BC.
- ²Banner, A, W MacKenzie, S Haeussler, S Thomson, J Pojar, and R Trowbridge. 1993. A field guide to site identification and interpretation for the Prince Rupert Forest Region. BC Min For, Victoria, BC.
- ³Resources Inventory Branch. 1998. Field Manual for Describing Terrestrial Ecosystems. BC Min Env and BC Min For, Victoria, BC.
- ⁴All macros described in this section were created by Michael Ryan, Research Ecologist, Southern Interior Forest Region.
- ⁵Pojar, J, K Klinka, and DV Meidinger. 1987. Biogeoclimatic Ecosystem Classification in British Columbia. Forest Ecology and Management 22: 119-154.