The CAFF Flora Group

Synthesis of the Circumboreal Vegetation Mapping (CBVM) legend discussion in Vladivostok, Russia, September 23-October 4, 2012
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- Environment Canada, Ottawa, Canada
- Faroese Museum of Natural History, Tórshavn, Faroe Islands (Kingdom of Denmark)
- Finnish Ministry of the Environment, Helsinki, Finland
- Icelandic Institute of Natural History, Reykjavik, Iceland
- Russian Federation Ministry of Natural Resources, Moscow, Russia
- Swedish Environmental Protection Agency, Stockholm, Sweden
- United States Department of the Interior, Fish and Wildlife Service, Anchorage, Alaska

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- Aleut International Association (AIA)
- Arctic Athabaskan Council (AAC)
- Gwich’in Council International (GCI)
- Inuit Circumpolar Council (ICC) – Greenland, Alaska and Canada
- Russian Indigenous Peoples of the North (RAIPON)
- Saami Council


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The CAFF Flora Group (CFG) is proud to reveal its new logo. The CFG wishes to thank Sandra Looman Talbot and Megan Fowler for their design.
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As part of the East Asian Flora Symposium, that took place in Vladivostok, Russia, from September 23 to 27 in 2012, a CBVM session was held on Thursday September 27. The theme of the symposium was «The East Asian Flora and its role in the formation of the world’s vegetation». Agenda of the Symposium appears in Appendix A. The symposium was followed by an excursion in temperate and boreal ecosystems, from September 28 to October 4, which provided occasion for discussion about the CBVM legend and for comparison of concepts and classification methods between Russia and North America.

The main objective of the meeting was:
- To share views of participants regarding the organisation of the legend for the Circumboreal Vegetation Mapping project (CBVM) and compare concepts and their application between the Canadian team and the Russian team in order to develop a common legend.

1. CBVM session (September 27th)
The CBVM session took place with around 80 attendees. Participants directly involved in one or the other of the CBVM teams were quite few. From the leading team: Stephen Talbot. From the Eurasian regional team: Nikolai Ermakov. Pavel Krestov, Teuvo Ahti. From the Canadian Team: André Robitaille, Jean-Pierre Saucier. Because of the absence of some expected participants, the number and order of presentations was modified.

Presentations and abstracts can be found at: [http://www.geobotanica.ru/symposium/pr_e.html](http://www.geobotanica.ru/symposium/pr_e.html)

1.1. Stephen Talbot’s presentation

Dr. Talbot introduced the CBVM to the participants by presenting the organisation of the CBVM project, under the umbrella of the Arctic council, and main steps followed up to now. Dr. Talbot insisted on the science driven approach of the project that is exposed in the concept paper. He also presented the concepts of the map, its scale and the tools that were agreed on, reminding the efforts done to come to a common legend, mapping method and database. He finished by noting that Torre Jorgensen, who was unable to make it to Vladivostok, was under contract to finish the mapping of the Alaska, according to the CBVM legend, by the end of 2013.

1.2. Jean-Pierre Saucier’s presentation

Dr. Saucier was presenting on behalf of the Canadian team. The presentation can be found in Appendix B.

The presentation first exposed the milestones for the CBVM in Canada: 1) Canadian involvement at the 2007 meeting in the Faeroes; 2) participation in the organisation of the Helsinki meeting (2008) where the principles of CBVM were adopted; 3) acceptance of the project by the Canadian team in Sault Ste-Marie (2009); 4) first draft of the legend in Helsinki (2010); 5) presentation of the regional pilots and discussion in Akureyri (2011); 6) second pilots for BC, QC and ON and second draft of the legend populated with ecosystems from Canada (2011-2012); and finally 7) the Vladivostok meeting in 2012.
Then the structure of the CBVM legend was exposed with examples of its application in the Canadian context at the different levels of the hierarchy. Examples of the populated legend for Canada were given and discussed. Particular emphasis was put on level 4–Bioclimatic Subdivision and 5–Geographic variant. A map of bioclimatic subdivisions for Canada was proposed with four subdivisions for the boreal: thermoboreal, mesoboreal, supraboreal and oroboral. A map of preliminary geographic variants for Canada was also proposed. Geographic variants are based on species or ecosystem distribution in order to express differences in flora (biogeography, species). They may also express maritime influence or continentality gradients. The preliminary zonation counts three zonal subdivisions: eastern variant, central variant and western variant. Also, three azonal subdivisions are recognized up to now for the boreal: Peace Athabasca delta, Peatlands (with several occurrences) and Atlantic maritime barrens.

A statement about the difference between a more traditional land cover map and the CBVM map was made. While a land cover map shows what is visible on the imagery used with little or no interpretation of the state of the vegetation or other features at the moment the picture was taken, the CBVM map integrates: land cover polygons (vegetated, non vegetated) but also broad ecological knowledge about: vegetation geographical distribution; vegetation dynamics (by the use of the concept of potential vegetation) and interaction of climate and site characteristics with vegetation (in order to discriminate zonal and azonal vegetation). Therefore, CBVM map builds from land cover mapping capabilities, that are necessary to synthesize ecosystems over large area at a small scale like 1:7 500 000, and ecological knowledge of vegetation. While in Europe and Russia this ecological knowledge comes mostly from phytosociological classification work, in Canada and USA, it comes mainly from ecological land classification. In Canada, the ongoing work of the Canadian National Vegetation Classification (CNVC) is the most valuable tool to inform the CBVM legend and support the mapping process. Particularly, the levels of the Group and the Alliance, in the CNVC hierarchy are identified as the concepts that are closer to the potential vegetation that is intended to be mapped in the CBVM.

A composite map showing the results of the three pilots made for Canada was presented to show the advancement of the CBVM project. Questions resulting from the work done on Canada's pilot maps where then submitted for discussion. Those questions are:

1. How to treat the oroboreal?
During work on BC pilot mapping, it was observed that rapid change in elevation causes some complexes of formation groups that were often covering too small area to be mapped at the intended CBVM scale. Del Meidinger and Will MacKenzie proposed two potion to deal with altitudinal belts that are expressing at a scale larger than 1:7 500 000. The first option, called the “Orodominant option”, is to tag the polygon with the dominant vegetation of the complex. The second option, called the “Sequence option”, is to characterise the sequence of the elevation belts. For example, a sequence going from forest to subalpine forest to alpine meadows would be classified differently than a sequence going from forest to subalpine woodlands to alpine meadows.

2. How to deal with formations that result from recurring disturbance?
Boreal forest dynamics are driven by disturbance processes and ecosystems are adapted, and most of the time resilient, to recurring disturbance. However in some landscapes ecosystems that represent early successional stages are dominant. If the site conditions are extreme, those formations can be considered as azonal. But with site conditions that are not extreme, if the recurrence of the disturbance is short, the late successional stages cannot be reached. In such cases, should this be considered an alternate steady state that needs to be mapped as a potential vegetation class? For example in the QC pilot some areas in the mesoboreal, with no soil limitation, are largely dominated by woodlands despite the fact that most climatic indices are similar to areas where spruce/feathermoss formation dominates. Because of the short fire cycle and regeneration failures, there was a degradation from a forested ecosystem to a woodland. Should it be mapped as fire driven woodlands and considered azonal or as potential vegetation of spruce/feathermoss formation?
3. How to deal with complexes caused by heterogeneous site conditions?

When zonal and azonal vegetation intermix intimately, should we use the spatial dominance to characterize the polygon and keep the description of complexes at level 6 or at a different (more detailed) scale?

The presentation was concluded by outlining the proposed next steps for CBVM in Canada and a look at the actualized view of the CBVM project timeframe (see Figure 1). The project is still mainly respecting the timeframe that was proposed at the Helsinki meeting in 2008. For the CBVM project, as well as for the Canadian part of the project, capacity to obtain funding is crucial for the completion of the map. With funding, motivated teams can achieve the goal to publish the map and descriptions documents for 2016.

Figure 1 - CBVM actualized timeframe as of 2012

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<td>2 Biogeoclimatic framework</td>
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<td>3 Base image products</td>
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<td>5 2nd CBVM workshop (decision)</td>
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<td>9 3rd CBVM workshop (results)</td>
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<td>10 CBVM map publication</td>
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<td>11 CBVM map description</td>
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IAVS meetings

- Greece
- Mexico
- Lyon
- Akureyri

Other international meetings (special sessions for CBVM)

- Iceland

1.3. André Robitaille’s presentation

Pr. Robitaille presented the «Role of wind activity in opening up the forest in the southern portion of the spruce-lichen woodland, Québec, Canada». The presentation can be found at: http://botsad.ru/pp/pp_robitaille.pdf.

Evidence of strong wind activity in certain areas of the boreal forest takes two forms: 1) deflation pavements, which are made by a process of wind erosion that prevents recolonisation by vegetation after a wildfire for instance; and 2) blowouts, made by a process of erosion/deposition of sand dunes that take place in sandy soils. Those wind-made landforms are more frequent in well drained soils with sandy texture (moraine or outwashes) in areas with strong and frequent winds. Fire in forest or woodlands acts as a trigger by removing the humus layer over the mineral soil. The erosion and deposition by wind takes back the site to a primary succession. Large areas with extensive deflation pavements and blowouts have been mapped in boreal parts of Québec.

Pr. Robitaille suggested including information about the disturbance pattern to the CBVM map legend. It could be done at level 5 identifying azonal vegetation types that dominate certain areas.
1.4. Pavel Krestov’s presentation

Dr. Krestov’s presentation was entitled « Mapping boreal vegetation under conditions of a disturbance regime: a case from the southern boreal subzone in the Russian Far East ». The presentation can be found at: http://botsad.ru/pp/pp_krestov_cbvm.pdf.

Large parts of the Russian boreal have been extensively affected by wildfires since settlement in the 1800’s. Some of those areas were also subject to permafrost. Research work suggests that interaction of fire regime and soil freezing regime affect the specific successions and may lead to a long term secondary succession. For example, the Larix forest in the far eastern boreal is an alternate steady state to the spruce forest.

The process of succession after intense fire can be depicted as this:
1. Soil mineralization after forest fire.
2. Soil frost insulation by the quick extension of lichen and dwarf shrub cover.
3. Shortening of the growing season because soils stay cold longer in the spring (insulation by pillows of lichens or mosses).
4. Creation of a permafrost layer that melts only at the surface and keeps spruce forest from establishing.
5. Shift to larch forest and woodlands that can tolerate lower soil temperature and thinner active soil layers than spruce.

The resulting larch secondary forest (Lathyro-Larycetalia and Ledo-Laricetalia) is able to maintain itself over several generations of larch and forms an alternative steady state to the spruce forest on Abieti-Piceetalia sites.
Considering that the CBVM map legend is able to represent the primary climatic climax vegetation (the potential vegetation) or the actual vegetation, Dr Krestov suggested that we find a way to express long-term secondary successions in the map legend. His proposal is to show on the map where potential vegetation dominated area is replaced by a long-term secondary succession. He showed some examples of maps where the primary potential vegetation appears in colours and the presence of a secondary succession is shown by crosshatching.

Figure 3 - Example of cross-hatching to show the extent of long-term secondary succession over primary potential vegetation (extracted from Pavel Krestov’s presentation)

1.5. Galina Ogureeva’s presentation

Dr. Ogureeva’s presentation was entitled «Modern vegetation mapping of the boreal forest biome of Eastern European Russia». The presentation can be found at: http://www.geobotanica.ru/symposium/pp_ogureeva.pdf

Dr. Ogureeva presented results of several mapping initiatives that can be used, according to her, as a basis for the CBVM map. Many of those maps are land cover maps based on MODIS imagery. For level 4 of CBVM, bioclimatic subdivision, she proposes to use the map «Ecoregions of Russia» (Ogureeva 2010) and synthesize it. This map was made by allocation of smaller physiographic units into ecoregions on the basis of a complete set of climatic indices. For level 5 of CBVM, geographic variants, she proposes to use already known regional complexes of plant formations. She gave examples of classification for level 4 and 5 of Western Europe and Russia using national and regional scale variants (Table 1). Based on the work of her team she proposes to create a model for mapping the boreal using climatic indices and species distribution as covariates. Use of numerical methods will result in objectivity in the classification, and adding expert knowledge could lead to the hierarchical levels of classifications.
### Table 1 – Example of level 4 and level 5 classification from Ogureeva

<table>
<thead>
<tr>
<th>V.I.1.1. European north boreal types</th>
<th>Draft of legend for Eurasian boreal vegetation (CBVM)</th>
<th>Offered variants</th>
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<tr>
<td><strong>V.I.1.2. European middle boreal types</strong></td>
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<tr>
<td><strong>V.I.1.2.1. North European</strong> spruce forests</td>
<td><strong>East Scandinavian (Karelia)</strong></td>
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<tr>
<td><strong>V.I.1.2.2. Northeast European</strong> hygrophilous spruce forests</td>
<td><strong>East European (Lagoda-Vychegda r.)</strong></td>
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<td><strong>V.I.1.2.3. Northeast European</strong> spruce f.</td>
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<td><strong>V.I.1.3. European south boreal types</strong></td>
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<tr>
<td><strong>V.I.1.3.1. Fennoscandinavian</strong> moss-rich spruce forests (<em>Picea abies</em>) with dwarf shrubs and herbaceous plants, locally alternating with pine and spruce mires</td>
<td><strong>East Scandinavian</strong> moss-rich spruce forests (<em>Picea abies</em>) with dwarf shrubs and herbaceous plants</td>
<td></td>
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<tr>
<td><strong>V.I.1.3.2. Scandinavian-east European</strong> spruce forests (<em>Picea abies</em>, in the east <em>Picea abies</em> x <em>P. obovata</em>), partly with <em>Tilia cordata</em> and <em>Corylus avelliana</em>, with herbs, dwarf shrubs and mosses</td>
<td><strong>East European (pre-Baltic-Vetluga)</strong> taiga of spruce (<em>Picea abies</em>) and pine (<em>Pinus sylvestris</em>) forests with <em>Oxalis acetosella</em> and nemoral herb species (<em>Galeobdolon luteum</em>, <em>Hepatica nobilis</em>, <em>Stellaria holostea</em>, <em>Pulmonaria obscura</em>)</td>
<td><strong>Pre-Ural</strong> taiga consists of spruce and fir-spruce (<em>Picea obovata</em>, <em>Abies sibirica</em>) forests with nemoral herbs (<em>Pulmonaria obscura</em>, <em>Asarum europaeum</em>, <em>Aegopodium podagraria</em>) and Siberian tall forb species (<em>Aconitum septentrionale</em>, <em>Crepis sibirica</em>, <em>Cacalia hastata</em>)</td>
</tr>
</tbody>
</table>

### 1.6. Nadezhda Sinelnikova’s presentation (made by Nikolai Ermakov)

On behalf of Dr. Nadezhda Sinelnikova, Dr. Nikolai Ermakov presented a mapping exercise for to far eastern Russian regions: «A boreal vegetation map of Magadan region and Chukotka as a part of CBVM project». The classification shows three level 2 zonal units: A) hypoarctic tundras; B) alpine vegetation within the boreal; C) Subalpine prostrate trees, shrub vegetation and open woodlands; and three level 2 azonal units: D) Vegetation of plains and lowlands; E) mires; F) Floodplain vegetation.

### 1.7. Nikolai Ermakov’s presentation

Dr. Ermakov’s presentation was entitled «High-rank units of dark coniferous boreal forests of Eastern Europe and Northern Asia ». He stated first that level 4 and 5 of the CBVM are not yet defined for Russia. But generalization of the regional phytosociological systems gives an important knowledge on syntaxonomic status and biogeography of the high-rank dark coniferous forests. The dark coniferous forests of Eastern Europe and Northern Asia show disjunctive ranges. At present, two orders, *Piceetalia excelsae* and *Abieti-neprolepidis–Piceetalia jezoensis* are representing respectively the Western and Eastern geographical subdivisions of these forests.

Plant geographic analyses demonstrated the need to differentiate the *Abieti-Piceetalia* into boreal and hemi-boreal vegetation (the latter should be included in the temperate). Typical boreal East Asian dark-coniferous forests should be included in the Eurasian order – *Piceetalia excelsae* on the basis of a distinct floristic core of species which is stable through their whole range from the Atlantic to Pacific. These are mesic, moderately cold-resistant and shade-tolerant species of Eurasian and Eurasian-North American range: *Athyrium filix-femina* s.l., *Dryopteris expansa* s.l., *Phegopteris connectilis*, *Diplazium sibiricum*, *Gymnogarpium dryopteris*, *Lycopodium annotinum*, *Oxalis acetosella*, *Sorbus sibirica*, *Maianthemum bifolium*, *Vaccinium myrtillus*, *Rhytidiadelphus triquetrus*.

Dr. Ermakov showed with examples that there are close links between the proposed CBVM levels and some of the phytosociological levels. He proposed to work with the levels of Suborder and Alliance. For instance, Alliances demonstrate biogeographical differentiation of dark-coniferous forests that can be use for a Circumboreal vegetation map (Table 2).
Table 2 - Links between Alliances and possible level 4 units for CBVM (from Ermakov’s presentation)

<table>
<thead>
<tr>
<th>Alliance</th>
<th>Level 4 possible unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Piceion excelsae</em> Pawl. et al. 1928</td>
<td>Southern-boreal forests of the main part of Europe</td>
</tr>
<tr>
<td><em>Aconito rubicundi–Abietion sibiricae</em></td>
<td>Southern-boreal forests of Eastern part of Eastern Europe,</td>
</tr>
<tr>
<td>Anerkhonov &amp; Chytry 1998</td>
<td>Urals, Western and southern Siberia</td>
</tr>
<tr>
<td><em>Pino–Abietion sibiricae</em> Ermakov &amp; Makhatkov 2011 all. prov.</td>
<td>Northern-boreal forests of Siberia;</td>
</tr>
<tr>
<td><em>Pino pumilae–Piceion jezoensis</em> Krestov &amp; Nakamura 2002</td>
<td>Southern and middle-boreal forests of Kamchatka</td>
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<tr>
<td><em>Piceion jezoensis</em> Suzuki-Tokio 1973</td>
<td>Southern boreal forest of Sakhalin and Hokkaido</td>
</tr>
<tr>
<td><em>Abieti–Piceion jezoensis</em> Song 1991</td>
<td>Southern boreal forests of continental part of Far East</td>
</tr>
</tbody>
</table>

1.8. Discussion following the presentations

Following the presentations, there was a discussion among presenters and participants.

Dr. Teuvo Ahti was in accordance with the existence of a subdivision between temperate and boreal coniferous species in the Canadian Rockies. He suggested that the Canadian colleagues clarify this subdivision and publish it. He also said that he was unsatisfied with the disjunct area of boreal in the Gaspesia Peninsula (Eastern Canada).

Dr. Pavel Krestov made the suggestion for the Canadian team to try using Kira’s warmth index to check the difference between boreal and temperate (including hemiboreal). This index has proven useful in Russia and he suggests that a warmth index >45 is no longer boreal.

There was a discussion whether or not the Braun-Blanquet approach can be linked easily to the CBVM levels. Positions were divided among the participants, some saying that the old classifications were not always grouped into a symphytosociological approach that would be useful to understand dynamics of vegetation, not only to describe it statically.

Dr. Yukito Nakamura, from Tokyo University of Agriculture in Japan, stated that there is presence of boreal vegetation in Japan’s mountains because they served as refuges for vegetation during the last glaciation. CBVM should consider mapping those areas even if they are disjunct.

Dr. Woo-Seok Kung, from Kyung Hee University in Seoul, South Korea, expressed admiration for the CBVM project and the clarity and simplicity of the hierarchy of the legend. He suggested that middle latitude countries should have a similar project because they share many species. He finished the discussion by inviting colleagues from Russia, Korea, China and Japan working in the temperate to join in a discussion to start a project for this East Asian region.

1.9. Opinion on the CBVM session in Vladivostok

Very few partners directly engaged in the CBVM project were present at the East Asian Flora Symposium. However, this session was a good opportunity to expose the CBVM project and try to attract people that can contribute to the project. Many researchers from Russia presented results that can be incorporated into the CBVM legend or be helpful in the mapping process. Besides Nikolai Ermakov and Pavel Krestov, it is unclear who are the actual members of the «Russian» or «Eurasian team of CBVM».
2. Correlation excursion

To allow for discussion among participants of the CBVM project about the conceptual view of the boreal vegetation and for comparison between the methods of classification, an excursion in the Ussuri taiga was planned. Unfortunately, due to ravages made by a typhoon in the area where the excursion was planned, it was not possible to go deep into the boreal biome. The excursion party was joined with another excursion, aimed at temperate forest.

However, due to the diversity of ecosystems visited and the high level of knowledge that was shared by our hosts and many of the participants, the excursion was very interesting. On the occasion of a trek climbing the Pidan mountain, from 370 m at the base to 1130 m elevation, we were able to see different altitudinal belts. The higher elevation was hosting a boreal type dominated by *Abies nephrolepis, Betula ermanii* and *Picea jezoensis*, over an understory of *Microbiota decussata, Vaccinium vitis-idaea, Lycopodium clavatum, Rythidiadelphus triquetrus, Pleurozium schreberi, Hylocomium splendens*.

The excursion was also an occasion to discuss further the CBVM project and determine some next steps.

3. Plan for a CBVM paper comparing bioclimatic indices of alliances from Eurasia and North America

On the evening of September 28th, Stephen Talbot, Nikolai Ermakov, Pavel Krestov and Jean-Pierre Saucier, had a meeting where the plan for a CBVM paper comparing bioclimatic indices of alliances from Eurasia and North America was drawn.

During discussion around the presentations made earlier it became evident that there was a need to better depict and share a common understanding about the subdivisions that we want to express at level 4 of the CBVM hierarchy, the bioclimatic subdivisions. We came out with this proposal of a common paper that could be entitled «**Bioclimatic subdivisions of the circumboreal vegetation (first approximation)**».

3.1. Need for the analysis of bioclimatic indices of circumboreal vegetation and classification level retained

In order to compare what is called thermoboreal, mesoboreal or supraboreal in North America and Eurasia, it is needed to analyse vegetation subdivisions in a North-South axis, and maybe in a East-West axis to express continentality, on a similar basis.

The classification level that seems to be compatible with the scale of the CBVM map and with the concept of potential vegetation is the Alliance level in the phytosociological system, or a compatible level in the vegetation classifications used in North America.

3.2. Objectives of the paper

The objective of data treatment and analysis in order to write down a collaborative paper are to:

1. Analyse bioclimatic indices of zonal Alliances of vegetation (values and mean deviation).
2. Compare bioclimatic ranges or niches of each zonal Alliance.
3. Group Alliances from North America and Eurasia that share similar niches.
4. Lookup their location in the legend and derive their relevance into one or the other of the bioclimatic subdivisions.
5. Discuss the results and identify emerging properties of those groups of alliances.
3.3. Data needed

To compare climatic niches of Alliances, the types of data needed are:

1. **Relevés of zonal vegetation classified into Alliances**
   When original relevés representing zonal vegetation are available they are to be preferred. When not, polygons from a mapping exercise of Alliances can be considered as relevés.

2. **Location for each relevé (latitude, longitude, altitude)**
   The latitude and longitude of each relevé, or polygon centroid, in decimal degrees (48.52789°N; -70.34899°W). Altitude, in meters above sea level, from observation or from a digital elevation model (DEM).

   Nikolai Ermakov and Pavel Krestov will provide relevé data for Russia and Europe. For Canada, the main contact is Ken Baldwin, leader of the Canadian National Vegetation Classification project (CNVC). Access to Canadian data may require the permission of Provinces who provided the data to the CNVC. Data from Alaska could be gathered from Torre Jorgenson. Relevés from oceanic boreal countries can be added if available.

   It may be useful to include also some Alliances from the hemiboreal to explore the climatic thresholds between temperate and boreal biomes.

3. **Data from climatic stations for the period 1930 to 1970**
   The period 1930 to 1970 is preferred by Russian colleagues because most vegetation described by relevés in their country was established during this period, under these climatic conditions. Climatic data from Canadian meteorological stations should be gathered. The period will depend on the availability of the data.

3.4. Data compilation

To compare climatic niches of Alliances, the following scheme is proposed:

1. Pavel Krestov will derive and calculate a set of climatic indices for the entire boreal biome, with a pixel resolution of 90 meter.
2. The climatic indices will be attributed to each relevé according to their location.
3. Participants will perform cluster analysis, or other ordination and grouping analysis, in order to identify alliances that share similar climatic niches.
4. An analysis of the Alliances grouped together, and their location into the CBVM legend will be performed. Key species for those groups of Alliances could be compared between continents or geographic variants.
5. The results of the analysis will be used to fix some principles for discriminating level 4—Bioclimatic Subdivision units. This information could possibly help identify some level 5—Geographic Variant units inside a continental land mass.
6. A paper presenting the methods and discussing the results should be submitted to a Journal to be selected.

1 After verification, it seems that the CBVM online forum is not there anymore (JPS).
4. Next steps for CBVM

On the morning of October 4th, Stephen Talbot, Nikolai Ermakov, Pavel Krestov, André Robitaille and Jean-Pierre Saucier discussed the next steps for CBVM. Some ideas were put forward:

4.1. Write down concepts and put together a unified legend

The structure of the CBVM legend is quite well agreed now. The concepts should be written down. Examples from Canada and Russia show that the legend can be adapted to different ecosystems. The next step will be to put together a unified legend using results from the pilot project in Eurasia, Canada, and Alaska. This populated legend should be considered as a first approximation. It will help point out differences in classification, refine the concepts and instigate discussion.

4.2. Reactivate discussion among CBVM partners

The CBVM project is moving forward but at a slow pace. Partners that are engaged in the project should communicate and share their views more frequently. As participants were not numerous to come to Vladivostok, we need to enlarge the discussion to resolve some of the minor issues about the legend, the way to take account of disturbance and the mapping process.

Stephen Talbot suggests making better and more frequent use of the CBVM online discussion forum that is linked to the website1. Pavel Krestov agrees that a forum is a good idea but a moderator should be in charge to ensure that comments are reviewed prior to be posted.

4.3. Prepare a progress map

To see progress of the CBVM project, a small scale map showing the areas that are ready to be incorporated into the CBVM map and the teams responsible for the data. Those areas can belong to one of three categories:

1. Readily available areas
   Areas that are already digitally mapped at the scale of 1:7 000 000 using Modis. The areas covered by the pilot projects should fall in this category.

2. Areas covered by data
   Areas where good classification knowledge is available and which could be integrated into the legend. However, a mapping project should be done to derive polygons at a resolution compatible with the CBVM scale. For those areas, Modis could be used to draw significant polygons.

3. Possibly available areas
   Areas with older maps, with compatible existing concepts that could be reworked to be integrated into the legend. A revision of the polygons using Modis should be performed to ensure unity in the mapping process and compatibility with other adjacent CBVM maps.

This progress map could be updated when other areas become available. It can serve as an index of the regional work going on and be useful to attract other people or groups into the project. It can also serve for fund seeking purposes.
4.4. Mapping tools

In order to ensure compatibility of the digital maps produced by the project, considering that maps from regional teams would have to be grafted together and standardized, ArcGis is the preferred tools. The problem of legality of the ArcGis software license available to some groups was mentioned. Each regional team will have to resolve this issue.

4.5. Project structure and funding

Even if some participants are not very active in the project, possibly because of a lack of funding, there is no need to change the structure. Teams are active in Alaska, Canada and Russia. Before applying for funding to another organisation or foundation, regional teams should make a plan for mapping their jurisdictions and, more important, evaluate the amount of resources they need to be able to complete the task. Only with this information could a good funding proposal be put together. Stephen Talbot suggests completing this evaluation for December 2012 and preparing to apply to National science foundation.

Acknowledgements

This report was funded by Natural Resources Canada. The author wishes to acknowledge the help provided by Ken Baldwin who revised an earlier version of this report.
CONFERENCE HALL MORNING SESSION: Circumboreal Vegetation Map
MODERATORS: Nicolai ERMAKOV & Stephen TALBOT

09:00~09:20
TALBOT Stephen S. Introduction to the Circumboreal vegetation map (CBVM) project
Тэлбот С. С. Проект Карта циркумбореальной растительности (CBVM)

09:20~09:40
SAUCIER Jean-Pierre, BALDWIN Ken, MEADES William B., MEIDINGER Del, MACKENZIE Will, ROBITAILLE Andre, ULIGH Peter. The CBVM legend and its application for mapping the boreal vegetation of Canada
Сосье Ж.-П., Болдвин К., Мидес У., Майдингер Д., Макензи У., Робиталь А., Улих П. Легенда проекта CBVM и ее применение для картирования бореальной растительности Канады

09:40~10:00
JORGENSON M. Torre. Alaskan portion of the Circumboreal Vegetation Map
Йоргенсон М.Т. Аляскинская часть карты циркумбореальной растительности

10:00~10:20
KRESTOV Pavel V. Mapping boreal vegetation in conditions of disturbance regime: a case from the southern boreal subzone in the Russian Far East
Крестов П.В. Картирование бореальной растительности в условиях нарушений на примере южно-бореальной подзоны российского Дальнего Востока

10:20~10:40
NESHATAEVA Valentina Yu. Vegetation map of Kamchatka
Нешатаева В.Ю. Карта растительности Камчатки

10:40~11:00
OGUREEVA Galina N., CHERNENKOVA Tatiana V., PUZACHENKO Michael Yu., MOROZOVA Olga V., TIKHONOVA Elena V. & KADETOV Nikita G. Modern vegetation mapping of the boreal forest biome of the Eastern European Russia
Огуреева Г.Н., Черненкова Т.В., Пузаченко М.Ю., Морозова О.В., Тихонова Е.В., Кадетов Н.Г. Современное картографирование растительности бореального лесного биома восточной европейской России

11:00~11:20 Coffee / Tea break

11:20~11:40
SINELNIKOVA Nadezhda V. A boreal vegetation map of Magadan region and Chukotka as a part of CBVM project
Синельникова Н.В. Карта бореальной растительности Магаданской области и Чукотки как часть проекта «Карта циркумбореальной растительности»

11:40~12:00
ERMAKOV Nikolai B. Subdivisions of dark coniferous forests of North Eurasia for a Circumboreal vegetation map
Ермаков Н.Б. Подразделения темнохвойных лесов северной Евразии для карты циркумбореальной растительности

12:00~12:20
ROBITAILLE Andre. Role of wind activity in the forest opening in Québec’s southern portion of the spruce lichens woodland, Québec, Canada
Робиталь А. Роль ветра в формировании лесных редин в южной части квебекских лишайниковых редкостойных ельников, Квебек, Канада

APPENDIX A
Agenda of the Circumboreal Vegetation Map (CBVM) Session, September 27, 2012, Vladivostok, Russia
APPENDIX B
The CBVM legend and its application for mapping the boreal vegetation of Canada

The CBVM legend and its application for mapping the boreal vegetation of Canada
Jean-Pierre Saucier (Соссе Ж.-П.)
Ken Baldvin (Болдин К.)
William J. Meades (Медес У.)
Del Meininger (Майнингер Д.)
Will MacKenzie (Маккензи У.)
Andre Robitaille (Робитайл А.)
Peter Uhlig (Ухлн П.)

Presentation outline
- Milestones for CBVM in Canada
- Structure of CBVM legend and its application
- Difference between Land cover map and CBVM
- Questions resulting from Canada’s pilot maps
- Goals for Vladivostok meeting

Milestones of CBVM
- Faroe Islands 2007
  - Initiation by CARP group
- Helsinki 2008
  - Principles and structure of the CBVM
- Sault Ste-Marie 2009
  - Acceptance of the project and North American teamwork
- Helsinki 2010
  - First draft of the legend
  - Regional pilot project launched

Milestones for CBVM in Canada
- Iceland 2011
  - Presentation of the regional pilots and discussion
  - Second draft of the legend
- Canada 2011
  - Second pilot for BC, QC and ON
  - Populating the CBVM legend for Canada
- Vladivostok 2012
  - ?

Structure of CBVM legend and its application
- Level 0 — Biome
- Level 1 — Formation Type
- Level 2 — Formation Group
- Level 3 — Formation
- Level 4 — Bioclimatic Subdivision
- Level 5 — Geographic variants
- Level 6 — Plant community
Structure of CBVM legend and its application

- Level 0 — Biome
  - Arctic, Boreal, Temperate...
  - Locates the Boreal in a global context
  - Limits of the CAVM revisited for the frontier with Arctic
  - Limits from ecological land classification for the Temperate
  - Excludes the hemiboreal (or transition zone from the temperate)

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- Level 1 — Formation Type
  - B.0 — Boreal Non-vegetated Formation Type
  - B.1 — Boreal Sparsely vegetated Formation Type
  - B.2 — Boreal Herbaceous Formation Type
  - B.3 — Boreal Shrubland Formation Type
  - B.4 — Boreal Woodland Formation Type
  - B.5 — Boreal Forest Formation Type

Common to all regions of the CBVM

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- Level 2 — Formation Group
  - B.4 — Boreal Woodland Formation Type
    - Boreal Subarctic Woodlands Formation Group
      - B.4.E (including subarctic shrubs and dwarf shrubs)
  - B.5 — Boreal Forest Formation Type
    - B.5.F Boreal Coniferous Forest Formation Group
    - B.5.G Boreal Mixed and Deciduous Forest Formation Group
    - B.5.M Boreal Swamp and Fen Forest Formation Group

Common to all regions of the CBVM

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Structure of CBVM legend and its application

- **Level 3 — Formation**
  - Dominant growth forms
  - Evergreen, deciduous, ...
  - Shade tolerant (dark), shade intolerant (light)
  - Broadleaved, needle leaves

- **Level 4 — Bioclimatic Division**
  - Based on climatic parameters and bioclimatic indices as reflected by vegetation
  - Usually South-North broad zonation
  - Thermoboreal, mesoboreal, supraboreal, oroboreal

- **Level 4 — Bioclimatic Subdivision example**
  - B.S.F.1 Dark Evergreen Needleleaf Boreal Coniferous Forest Formation
    - B.S.F.1.2 Mesoboreal Dark Evergreen Needleleaf Coniferous Forest (Pinus mariana, Picea glauca, Abies balsamea)
    - B.S.F.1.3 Thermoboreal Dark Evergreen Needleleaf Coniferous Forest (Abies balsamea, Abies lasiocarpa, Picea glauca)
  - B.S.F.2 Dark Evergreen Needleleaf and Light Broadleaf Boreal mixedwood Forest Formation
    - B.S.F.2.1a Mesoboreal Dark Evergreen Needleleaf and Light Broadleaf Boreal mixedwood Forest (Picea mariana, Betula papyrifera)
  - B.S.F.2.1b Mesoboreal Light Broadleaf Boreal deciduous Forest (Betula papyrifera, Populus tremuloides)

**Pattern common to most regions of the CBVM but indicator species will differ regionally**

Structure of CBVM legend and its application

- **Level 5 — Geographic variants**
  - Based on species or ecosystem distribution
  - Usually West-East broad zonation
  - Express differences in flora (biogeography, species)
  - May express maritime influence or continentality gradients

**Most detailed level at the scale of 1:7.5 million**

**Specific to each region of the CBVM because meaning of the variants differ regionally**

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Structure of CBVM legend and its application

- Level 6 — Plant community:
  - Species composition of potential vegetation (site specific)
  - Dominant species within a landscape unit
  - Can be mapped at a finer scale (1:4 000 000 in Canada)
  - Can be linked with one of the levels of the Canadian Vegetation Classification (CNVC)

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Canadian National Vegetation Classification (CNVC) and CBVM

- CBVM is building on:
  - Land cover capabilities
    - Necessary to synthesize ecosystems over large area at a small scale like 17,500,000
  - Different forms of ecological knowledge
    - Phytosociological classification (Europe and Russia)
    - Ecological land classification (USA and Canada)

In Canada, the link with CNVC informs the CBVM legend

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CNVC hierarchy (under revision)

- Group
  - Broad vegetation patterns on circum-mesic sites reflecting 1) the influence of secondary regional gradients of climate (latitude, altitude, continentality gradients), or intra-regional non-climatic ecological gradients (geology, geomorphology, soils); or regionally consistent disturbance regimes and successional trajectories on similar site conditions.
- Alliance
  - An aggregation of Associations, with consistency in dominant and/or diagnostic species, describing regionally consistent vegetation patterns at the local to sub-regional scale.

Closer to concept of potential vegetation used in CBVM

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Results of the Pilot projects in Canada

Questions arising from the Pilot projects

- **How to treat the oroboreal?**
  - Rapid change in elevation causes some complexes of formation groups
  - Alitudinal belts expressing at a scale larger than 17,500,000
  - Example from BC pilot (two options)
    - Orodominant option (dominant vegetation of the complex)
    - Characterisation of the sequence of the elevation belts
      - forest-subalpine forest-alpine

Questions arising from the Pilot projects

- How to deal with formations that results from recurring disturbance?
  - If the site condition are extreme, it can be considered as azonal
  - But with similar site conditions, is it an alternate steady state that needs to be mapped as a potential vegetation?
  - Example from QC pilot
    - Fire driven woodlands in the mesoboreal

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Questions arising from the Pilot projects

- How to deal with complexes caused by heterogeneous site conditions?
  - When azonal and azonal vegetation intermix intimately, use the dominance to characterize the polygon
  - Keep the description of complexes at level 5, or at a different scale (more precise)

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Next steps for CBVM in Canada

- Methods are developed
  - Necessity to build capacity for mapping the whole boreal
  - Unequal information between provinces and along a South-North gradient
- Obtain funding in order to map the whole boreal of Canada?

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Initial CBVM planning

<table>
<thead>
<tr>
<th>CBVM project organisation</th>
<th>2008 planning</th>
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<tbody>
<tr>
<td>Biosystematic framework</td>
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<td>Base image products</td>
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<td>CBVM map publication</td>
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<tr>
<td>CBVM map description</td>
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</tbody>
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Where are we at in 2012?

<table>
<thead>
<tr>
<th>CBVM project organisation</th>
<th>2012 state</th>
</tr>
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<tbody>
<tr>
<td>Legend development</td>
<td>2012</td>
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<tr>
<td>Biosystematic framework</td>
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Conclusion

- For the CBVM project as well as for the Canadian part of the project, capacity to obtain funding is crucial for the completion of the map.
- With funding, motivated teams can achieve the goal

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Acknowledgments

- Université Laval, Québec, QC, Canada (for funding)
- NRCAN, GLFC, Sault Sainte-Marie, ON, Canada
- MedFlinger Ecological Consultants Ltd., Victoria, BC, Canada
- British Columbia Ministry of Natural Resource Operations, Smithers, BC, Canada
- Ontario Ministry of Natural Resources, Sault Sainte-Marie, ON, Canada
- Québec Ministry of Natural Resources and Wildlife, Québec, QC, Canada

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Any questions?

Supplemental material

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CBVM Hierarchy

<table>
<thead>
<tr>
<th>Level</th>
<th>Main Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Formation Type</td>
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<tr>
<td>2</td>
<td>Formation Group</td>
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<td>Formation</td>
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<tr>
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<td>Bioclimatic Subdivision</td>
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<td>5</td>
<td>Geographic variants</td>
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<tr>
<td>6</td>
<td>Plant community</td>
</tr>
</tbody>
</table>

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CNVC Hierarchy (under revision)

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<th>Criteria</th>
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</thead>
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<tr>
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<td>Formation Class</td>
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<td>2</td>
<td>Formation Series</td>
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