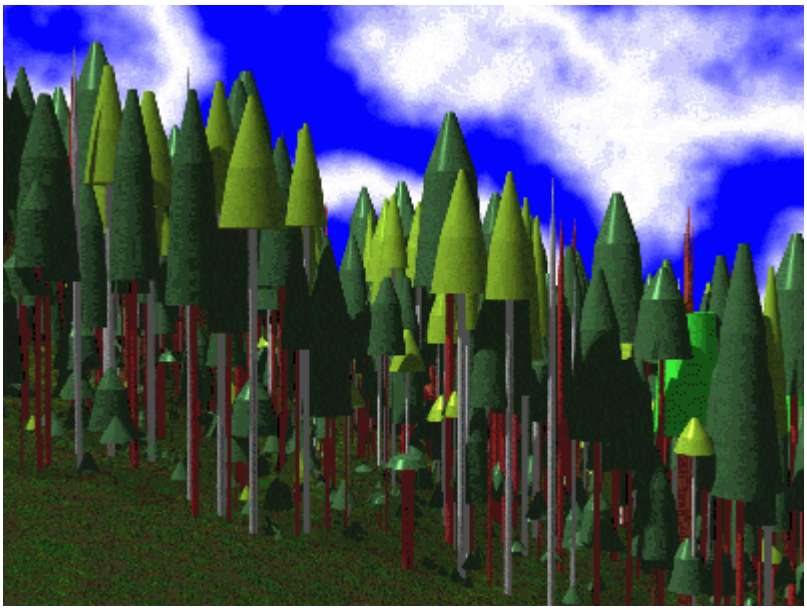
Forest Stand Data Visualization with POVRAY and VRML



The SFF uses the ray tracing program POVRAY and the Virtual Reality Modelling Language (VRML) as data visualization tools.

This page explains how and why we are processing field infomration with these visualization tools, and presents a series of POVRAY images. The VRML page provides a gateway to VRML forests we have created.

POVRAY is 3D rendering software which uses scene description files written in the POVRAY language and emits beautifully rendered, photorealistic images. Our usage of POVRAY is somewhat unconventional. All POVRAY output we know of is oriented towards artistic expression. We used the program to solve a communication problem using data visualization.

The SFF foresters collect a large amount of data about forest stands when we do field work. Like all foresters, we record the species, height and diameter of trees within our sample plots, to enable us to calculate timber volume. However, we also measure crown class, the amount of living crown, the width of the tree crown, tree age and radial growth rates. This is because our timber management prescriptions are for partial cutting. We are interested in the way each tree is growing, and its relationship with the rest of the forest stand. Unlike clearcutters, we need to decide which trees to cut and which trees to leave, based on the dynamics of the stand and each tree. Only healthy trees with good growth potential should be left on a site after logging -- partial cutting must not equate to highgrading.

Over the years, we have developed a custom stand information summary program. The program produces tabular summaries of our field data, like the one shown below. This summary is for a patchy, old growth forest in the Rolling Stone Creek watershed in Clayoquot Sound. We studied this stand while preparing a presentation for the Clayoquot Symposium on Alternative Silvicultural Systems in March 1996.

Stand Profile for Rolling Stone Block R20, South Portion

Height Class	Species	Stems/Ha	Net Usable Volume (m3/ha)		Height (m)	DBH (cm)	Age	Rings Last 2 cm	% Live Crown	Crown Width (m)	% Good Vigor	% Fair Vigor	% Poor Vigor
Dominant	Hemlock	7	161	Avg		125		35	35	8.0		100%	
Codominant	Hemlock	59	727	Min Avg Max	43.5 49.0 55.0	66 95 131	102 235 432	8 14 18	25 39 50	5.0 6.0 8.0	38%	50%	12%
Codominant	Balsam	74	618	Min Avg Max	44.9 49.7 53.6	72 85 106	116 207 261	5 16 26	20 33 50	2.5 5.4 7.0	10%	60%	30%
Intermediate	Hemlock	22	25	Min Avg Max	21.3 32.1 42.8	23 34 43	90	28	40 50 60	4.0 4.3 5.0	33%	67%	
Intermediate	Balsam	37	80	Min Avg Max	37.4	34 47 56			10 21 30	2.5 3.0 4.0		20%	80%
Suppressed	Hemlock	156	9	Min Avg Max	7.0 12.3 23.4	8 17 24			5 24 50	1.5 3.0 4.0	14%	24%	62%
Understory	Hemlock	169	0	Min Avg Max	2.0 5.0 8.0	2.0 4.0 6.0			5 60 80			30%	70%
Regeneration	Hemlock	236	0	Min Avg Max	1.0	1.0			80 85 90	1.0			100%
TOTAL	ALL	760	1,620										

Our problem was that while the Silva staff have learned to read these complex tables fluently, we have found that the tables often communicate less effectively to our clients.

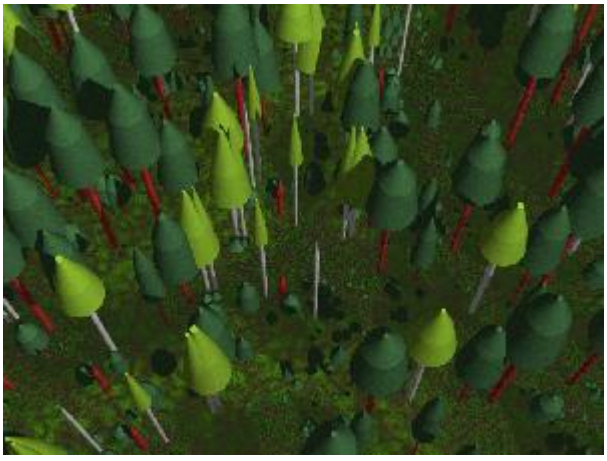
While studying POVRAY for recreational purposes, we hatched the idea: Why not use POVRAY to make diagrams of forest stands? Instead of dry columns of numbers, we could show our clients “pictures” of the forest in question, from any angle. Also, we could “cut” certain trees in the stand, and have before and after views of logging prescriptions. (And of course, after we got the .POV files working, we just had to go for full motion using VRML.)

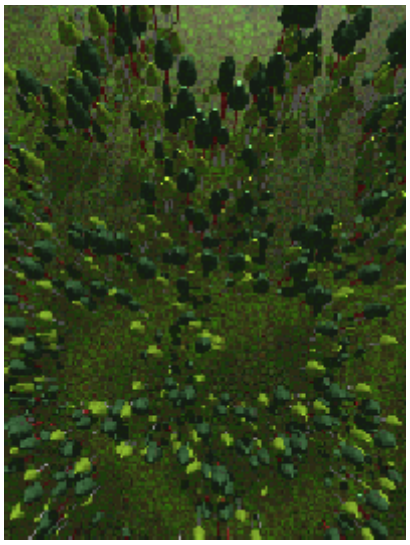
In order to do 3-D modelling, we added one more measurement to our field data collection process: the location of each tree on a sample plot in relation to the plot center. We gather this information using a simple sketch map while doing the plot, and convert it to X,Y coordinates in the office. We wrote a dBase program which reads the species, diameter, height, live crown height, live crown width and X,Y coordinates of each tree in our plots and creates a POVRAY description of each tree. To create a forest effect, we grouped images of our sample plots on a tight grid, and developed an algorithm to fill the small spaces between the grouped circular plots with randomly selected tree data, at the appropriate density. The dBase program creates the scene description files which POVRAY uses to create the images below.

While the scenes certainly have an acrylic feel to them, they enable us to communicate and highlight a wealth of information about a forest to a general audience, without the benefit of a half hour opening lecture on data summaries and interpretations. Each small image below is a different view of the Clayoquot forest described in the table above, and is linked to a larger image. These pictures are not intended to replace photographs. They are graphical presentations of quantitative information, accurate in all spatial dimensions and internally consistent.

These two frames show the Rolling Stone forest at current stand density, prior to any logging. Note the variey of stem sizes and crown sizes. Hemlock trees are shown with dark green crowns and red-brown stem; amabalis fir (balsam) trees have light green crowns and gray stems.

This image shows the Rolling Stone forest after a hypothetical uniform partial cut which removed 61% of the standing timber volume. The proposed cutting concentrated on individual stems with low amounts of live crown and/or poor vigor, well distributed through the stand. This type of logging could only be carried out using a helicopter and full lift logging.





This image shows an aerial view of the Rolling Stone forest, with 33% of standing volume removed using a patch cut system. There is somewhat of a fisheye lens effect in the image, but it is not unlike the view from a helicopter at low altitude.

The final image shows the same patch cut, but from a lower camera angle. This view shows how the patch cuts become less visible as the viewer approaches sea level.