In recent decades we have learned how to manage forests while maintaining habitat for wildlife species, but what about the human species? When wildlife biologists study the mating habits of birds, they sometimes draw conclusions about attractive and colorful tail feathers and mating success – and call that science. So, we should not call it *voodoo science* when we discover that the human species has certain habitat requirements also – requirements that include retaining nature’s beauty, often expressed through the political process.

I shall draw on the remarks made by the other speakers and include some thoughts of my own, especially with regard to consideration of edges in seeking to emulate natural disturbance patterns in ways that are *naturalistic* in appearance.

As Stephen Sheppard indicated we have to seek the common ground that exists between, as he put it, what makes the public happy and what makes ecologists happy. Despite the fears of some ecologists, there must surely be considerable overlap – after all, we cannot really imagine that so-called pre-settlement conditions were actually ugly can we? Of course, some natural events are ugly in the short run, or even for decades if the disturbance is catastrophic. But, as Steve McCool indicated, there can be considerable difference between what is natural and what is naturalistic. We are not likely to get away with simulating natural catastrophes, no matter how realistic. Burton Litton spoke about “ephemeral landscapes” in reference to things that change quickly, like sunsets, but of course nature is always changing; it is all a matter of scale. Some changes are faster than others. Eventually we can expect another ice-age, and in just over 4 billion years, astronomers expect the earth to disappear with the end of our sun. It is perhaps true that the public are not accustomed to seeing ecological change over a few years or decades – which is where the role for ecological education comes in. Hamish Kimmins has a good idea in suggesting simulated time-lapse movies to show how ecosystems change – and to show how ecosystems respond favorably to disturbance. Thus, we might hope that the public will come to accept visually unattractive disturbance if it brings about attractive and ecologically-sustainable changes within say 5 or 10 years (but not 50 or 100 years, which is beyond most people's lifetimes). After all, people already accept the bandages that go along with plastic surgery, or the appearance of their dog after its annual haircut!

This venn diagram of three overlapping circles suggests how we must manage at the intersection of what is visually

![Venn Diagram](image)
acceptable, what is ecologically sustainable, and what is economically feasible.

This Scottish environmentalist brochure complains, not about the tree-less landscape, but about the re-afforestation! As Oliver Lucas pointed out, things are sometimes reversed in Britain. But the general complaint is the same everywhere – the straight lines. As William Kent said over 200 years ago, “nature abhors a straight line.” And that is one thing that VQO managers and ecologists can surely agree on. There is no ecological principle that says we must manage in straight lines or with square corners!

The BC visual design manual adopts the methods laid out by Oliver Lucas and his colleagues, and it does a superb job of matching overall shape to terrain at the landscape scale. . .

Although it can lead to something like a jigsaw puzzle effect (from Oliver Lucas’ book *The Design of Forest Landscapes*). . .

As, for example, here on Vancouver Island (near Port Renfrew). Although these blocks have shapes that match the terrain, they do not look natural because of their clean edges.
We need to acknowledge that nature does not create openings in the same way that a child cuts out paper shapes with scissors. Natural openings seldom have clean edges. Edges tend to be fuzzy, with wiggly lines. And trees exist in the openings – not evenly spaced, but in clumps of different shapes and sizes. Besides looking good, these kind of openings offer edge for different species of wildlife at multiple scales.

These edges are best described as fractal -- meaning that, if we zoom in on them, we see still more edge and more openings and more clumps at smaller scales. Fractal edges are complex in terms of pattern.

This illustration is from Oliver’s book. In designing or leaving corridors, he recommends the appearance of the fuzzy edges at bottom right in preference to the clean edges at top left. The fuzzy edge is fractal, and the ecologist Richard Forman has suggested that these fractal edges have ecological advantages in term of wind firmness. The fractal edge dissipates wind energy without causing as much damage to standing trees.
Fractal dimension is something that can be measured – as here with the coast of Norway. Although there is no stable answer to the question “what is the length of the coastline?” (it depends on the step-length chosen), there is a stable answer regarding its fractal dimension – which is a measure of its *complexity*, or wiggliness if you prefer.

You have probably seen pictures of theoretically-perfect fractals -- in books that have become popular in the last 10-15 years. . .

And explanations of how they relate to real organic things – like cauliflower. . .
At many different scales – from river deltas seen from satellites (here the Ganges River) to frost on the windowpane.

The important thing about real fractal objects is that they contain random elements. No two are ever alike, even though the objects can be named (because we recognize their distinctive patterns). Snowflakes for example.

Oliver listed 6 principles of design for simulating naturalistic forests, and two of these were diversity and unity. These might sound like contradictions, but they are not – just as snowflake patterns have an essential unity even though no two are alike. Diversity is the opposite of monotony.

In 1725, the Scots philosopher Francis Hutcheson wrote a treatise on “An Inquiry into the Origin of Our Ideas of Beauty” in which he said that we find things beautiful to the extent we find “uniformity amidst variety.” The more the variety, he held, the more the beauty – as long as we still discern some linking unity – as long as things still ‘hang together’ as we might say today.

It was Hutcheson, too, who first wrote about beauty being in the eye of the beholder – and in so doing he created a lot of misunderstanding that persists today. He did not mean by this that beauty is entirely arbitrary or esoteric (like one man’s meat being another’s poison – another aphorism that is frequently wrong, poison after all kills). As his writing makes clear, Hutcheson meant that “Beauty is not any quality that is supposed to be in any object, without relation to any mind that perceives it.” Thus, beauty is not an independently-real thing (like lungs, or a heart, or death), but is a perception of the human mind brought about by seeing (or otherwise sensing) the object considered beautiful – hence in the eye of the beholder. But, he and his successors (like Kant) went on to show that the perception of beauty is often predictable, stable, and widely-shared – people generally like roses, for example, even though some might not like certain colors, etc.

Many recent psychologists and their like (like Stephen Pinker, the Kaplans, etc.) have shown the extent to which our aesthetic sense is deeply psychological – and Roger Ullrich’s work relates to this. Stability of aesthetic judgment generally supports the theory of socio-biology as propounded by ecologist E.O. Wilson. This theory holds that our sense of beauty (and morality too, following Hutcheson) is an evolved human characteristic – something that has aided humans over millennia in our struggle for survival in hostile environments. Bob Ribe has written that the results of perception surveys (regarding nature) are often not very surprising, being just what you would expect intuitively. This makes sense when we realize that our aesthetic sense – in terms of choice of places to live, things to eat, the partners we choose, etc., etc. – must in general be ‘good
for us' or we would not have survived to this point in time. We simply wouldn't be here. On this basis, things like 'anorexic aesthetics,' for example, must be a relatively short-term aberration.

Oliver mentioned Jay Appleton’s “prospect refuge theory” which supports our claim: Given that, for 99 percent of the human species’ existence we have been hunter-gatherers (E.O. Wilson), it is hardly surprising that we find attractive those *edges* that combine good hunting prospects with good refuge for ourselves and our families.

Let’s look at some edges – this is an area burned in the Bitterroot fires of last summer (in Montana).

By playing with Photoshop©, we can bring the burned trees back to life and see the fractal pattern of the pre-burn timber – adapted to the terrain and geology, but with random elements.

If we highlight just the burned trees, we see they have a similar fractal pattern. . .
As do the unburned trees (although harder to see). The fractal pattern of the timber is essentially unchanged by the fire. This is typically the case where we have a fire-adapted ecosystem for the simple reason that the prevailing patterns reflect the occurrence of fire in the first instance (e.g. Glacier National Park, Montana). If we want to mimic natural disturbance, therefore, we should mimic these kinds of fractal patterns.

Fire doesn’t advance in straight lines.

It usually has a wiggly, fractal front.
And fires go out, they typically leave wiggly edges,

And uneven clumps and patches of unburned trees at multiple scales.

These patterns can be difficult to invent by sketching -- because people find randomness rather difficult to invent. The results often don’t look quite natural enough (from Simon Bell's book *Landscape*).
But we can simulate them using simple computerized stochastic processes. These simulated fires are fractal – meaning that, if we zoom in,

We see more of the same pattern at a finer scale.

And more edges and smaller openings (like bays within bays on a coastline).

A few years back, when we were building our house, we wanted a Mexican-tiled dining-room floor with a mixture of one reddish tile for every three yellow-ochre tiles, and we wanted the reddish tiles spaced in a random pattern. We knew that if we tried to do this manually, it would likely look too regular, so I used the computer to produce 25 alternative layouts that were truly random. We selected the one we liked best, and asked the tile-layer to “just do it” exactly as the plan showed. He was skeptical at first, but he liked the results so well that he took several photos to show other clients! In a similar way, statisticians have used this phenomenon to catch embezzlers – no one making up phony financial data would ever put down seven sevens in a row, for example. Since such weird combinations do actually happen, and with known probability, experts have used the absence of this kind of numerical clumping to screen financial data and identify suspected crooks!

If we want to mimic natural fractal patterns with random elements, therefore, we might find computer simulations useful.
We don’t need very sophisticated computers or mathematics – a simple routine in Excel©, for example, can draw natural shapes to order.

We can specify that we want the line to go through certain points (here four), and the degree of wiggliness (fractal dimension). Here more wiggly, and below, less so.

And we can easily feed these coordinates to a GPS as a set of 'way points.' Foresters who have tried to mark cutting blocks with feathered edges in the past have often found that, on the ground it is hard to “see the forest for the trees.” With a GPS and this kind of routine, it is no longer difficult.

I believe we can use clearcutting to mimic even rather large natural disturbance patterns. And, if we adapt cut-block shape to the terrain (after Oliver’s principles, using “lines of force” analysis), and “fuzz up” the edges naturalistically, and leave similarly-fractal clumps of uncut trees in the interior, then the results should be, not only aesthetically-acceptable and naturalistic, but also perhaps even desirable from wildlife and silvicultural perspectives.
To wrap up: we can hopefully educate the public about ecological change, but we cannot hope to change some fundamental things about our naturally-evolved aesthetic sensibility. This is a photograph by Christopher Burkett. He sells very large Cibachrome photographs like these for high prices in art and photography galleries (e.g. Photographic Image Gallery, Portland, OR). Ecologists might say these trees look overcrowded, but surely few would deny that the scene is beautiful.

Foresters and ecologists sometimes worry about people not liking messiness in the forest, but I know of no political pressure group of environmentalists that is campaigning to clean up the messiness of old-growth forests, or the messiness of wilderness areas. People do not object to messiness per se. As Sheppard and McCool both point out, people object to messiness when it was created by people who apparently simply did not care. If ecological health calls for a degree of messiness in the woods, then it should appear naturalistic. To the extent that it must appear artificial (which should be minimal), then, as Joan Nassauer has written, people should be given “cues to care” – explanations of why things are the way they are, for ecological reasons.

Above all, we need to overcome the notion – held by many foresters as well as the general public – that forest management is inherently ugly. It doesn’t have to be that way. And, if forestry is to be publicly acceptable (as it must be, if forestry is to endure), then we must demonstrate by our practice that the managed forest can appear natural. The first step is to heed William Kent's observation that "nature abhors a straight line," and I would add that the next step – the direction for the future – is to observe that nature’s wiggliness occurs at all scales. In other words, natural wiggliness is fractal.
Today, I’m going to talk about the small community of Bralorne and the Visual Management work we did.

**Downtown Bralorne ca. 1990**

- Logging in the face of a community
- Controversial
- Visual Management to the forefront

**First Thoughts (ca. 1990)**

The early technology
“design techniques” = awkward

**Enterprise Creek**

- Solution needed
- Enterprise Creek.
- Highly visible along Highway to Whistler
- Just outside of Lillooet 5 minutes

**Narrow Yarding Corridor**

- First Time
- Narrow Corridors
- Lateral Yarding
- Makki II

**MoF Field Trip**

- Understanding the Operational side of Partial Cutting
- Build trust with MoF
- Common goal to meet VQO
Uniform Shelterwood

- Logger ingenuity required.
- No field layout/ guidance for corridors
- Trees had to be left evenly distributed.
- View with logging completed
- Corridors accented by snow
- Lateral yarding was limited
- Difficult to pulling the trees around standing timber towards the yarding road
- Corridors repeating themselves 60 to 80m
- Moving along the highway, the corridors become invisible
- Initial 50% removal
- Unsafe falling and yarding (WCB)
- Increased to 60%
- No impact to the visuals.

Road & Landing Screening

- Visual strategy = screen roads and landings
- Landing located along a terrain break
- Viewed obliquely from the highway,
- This road system and landing not visible
- Herman Dirks self loader
- Bill Qually WestCoast Falcon Yarder

Uniform Shelterwood & Clearcut - Aerial View

- Expanding our view out
- Snow covered conditions
- Extent of our operations in Enterprise over 20 years
- Lower clearcut areas = Armillaria root rot
- Upper clearcut = not visible
- Notice the Greened-up area

20 Year Old Douglas-fir Forest

- That Clearcut area
- Regen Performance = best in our area.
- Kevin Raynes is next to a 20 year old Douglas-fir forest.
- The mean annual increment is estimated to be 1/8 of an inch/ year.
Regen Comparison

- Clearcut in foreground
- Uniform Shelterwood in the background
- Both logged at the same time
- Significant difference in regen performance
- Santok Atwall - Plant Committee

Clearcut vs Shelterwood

Clearcut
- Ecologically Suitable
- Excellent leader & diameter growth
- Excellent densities
- Achieves “Visual” green-up rapidly

Shelterwood
- Intense moisture competition
- Poor leader growth
- Lower densities
- Long time for Visual green-up

Example:

Clearcut
- 4 year old larch seedling
- 10 feet

Shelterwood
- 3 year old pine seedling
- 1 foot

Second Pass???

- How are you going to log the remaining trees without wiping out the understory
- Can’t be done economically.
- Helicopter logging in a cable area
- Future… “designer clearcuts”
- While the regen is small = minimize the long term losses
Strip Shelterwood

- Further up the Duffey Lake Highway
- This area is not visible.
- "Long-line" yarding technique introduced
- Converted "Helicopter" wood into "Cable" wood.
- A cost saving of approximately $15/m3

Limitations
- 2800 feet to 2000
- 2 intermediates to 1

Area previously logged in 1988: 3 Clearcuts
1 shelterwood

Rec Site View - Pre Logging

- First test of long-line in Visible area.
- View from Roger’s Creek MoF Rec Site
- Prior to Harvest

Modified Madill 071

- Machine doing our partial cutting

Yarding

- Bringing in a turn
- Clearcuts in the background
- A valuable lesson was learned.
- Too steep and too dangerous for traditional partial cutting
- The fallers = envisioned a R/W width
- Good for visuals
- Good for ecology = shading a dry site
- Excellent deflection is over fish bearing streams.
Narrow Yarding Corridor

- Looking straight down to the landing
- Downhill yarding is difficult
- Skinned up trees
- Start = 6 meters wide
- End = 10 meters wide
- Max lateral distance 50 meters

MoF Field Trip

- MoF field trip to show operation
- The center yarding road is the previous slides perspective
- 80% completed

Contour Shelterwood

- Driving eastbound
- Visible short duration
- Not spend money on simulations
- Clearcut = geometric, I’d like to have back.
- Mental slip = small impact
- High absorption, orientation is natural to surroundings

Clearcut & Shelterwood

- 70% removal
- Second Pass concept
- Minimizes impact to advanced regen

Contour Shelterwood

- Same concept = amphitheater like area
- Prior to harvest

Contour Shelterwood

- Taken this past winter = same location.
- Logging is complete
- Photo under the worst conditions of snow and front lighting
- Long-line and Helicopter yarding used
Contour Shelterwood - Aerial View

- Aerial view
- Also small clearcuts in back

Seed Tree

- Another Seed Tree
- Not located in a visual area
- Yarding Engineers Perspective

Costs:
- Average $5/ m³ more than a clearcut
- 12 ha Block
- 400m³/ ha
- $30,000 extra cost to partial cut
- More than 95% volume harvested
- Re-threading of lines and changing of yarding roads is costly due to lost production.

Partial Cutting Hazard

- The same block
- These trees blew over while the logging crew was there
- Safety always has to be on the mind when partial cutting

Seed Tree - Aerial View

- More than enough visual diversity and texture
- Irregular boundary and leave trees
- Solution = Clump the seed trees versus uniform retention
- Safer and more beneficial to wildlife

Hoe Chuck

- Hoe chuck compatible with clear cut or seed tree
- Clumping of residuals would also increase productivity
- Reduce costs by “day lighting” to the landing.
- In steeper ground, “buddy up” and hand off the wood
- Reduced site disturbance
Public Relations

- We developed Gun Lake
- The long process of building up trust began.
- Many field trips before a single road was built or tree felled
- Being up front with all the issues.
  - Ministry of Forests
  - Ministry of Environment
  - Gun Lake Ratepayers Association
- Getting everyone to the logging site was key
- Understanding and appreciating the efforts we were going through to meet their needs.

Narrow Yarding Corridor

- Our experience payed off
- Lateral yarding to narrow corridors again

Logging Completed – Uneven-aged Selection

- Mt Zola from the highway perspective.
- An interesting point on this slide,
  - The permit only covers the upper portion of what is shown.
  - The lower areas are naturally open due to the mountain pine beetle activities.
- Barely visible is one of the yarding corridors
- Just visible were two yarding corridors.
- Our impression of the permit on Mt Zola was that we did not log enough
- Cautious = wanted to prove we could do it
- Worst conditions of snow cover with front lighting.
- Again, no visible impact and we could have logged more
- Good Behavior = Second Cutting Permit
- North side of the lake = cutting permit 180

Cut-to-length Selection

- Mechanically harvested with a cut-to-length
- Safer than hand falling
- More productive
- Protection of advanced regen
- The CTL equipment - Jim Kopytko
- Uneven-aged management
Gun Lake North Pre & Post

- Only negative feedback from the Public
- When modelled, the block showed more distinct openings versus the final results.
- I personally am satisfied with the results.
- We “agreed to disagree” on this one.

Landscape Design Manual

“In this landscape the slope plunges straight down into the water. Apart from extremely short range views the whole slope is constantly visible. As a result a foreground strip is of no use. The whole mountainside must be designed.”

- For the keeners in the crowd - Gun Lake is not new...
- 20 years ago? red trees in the midground.

Completed Cutting Permit

- Here’s what we did with it…
- 5 blocks
- 33,000 m3

Noel Creek Pre & Post

- Back to Bralorne...

Noel Creek

- First Permit = Low Risk = Least Visible
- Pre-logging Picture = 1990
- Conventional clearcut operations
- No increased logging costs linked to visual management.
- Private land = completely blows good visual management
- Second Permit = highlighted area

Clearcut

- 168-17
- Cross stream yarding of Noel Creek
- Yarding good for upper 2/3
- Reserve in way for bottom 1/3 = narrow corridors utilized again
- Reserve for Terrain Stability
Upper (Bradian) Viewpoint

- Notice the natural opening

Cutting Permit 168

- Technology had a chance to catch up.
- Several small blocks with different Silvicultural Systems
- Three options to the Public
- Determined how the third permit was to be done

Pre & Post Logging Map - Third permit

- Appraisal Map versus Actual logged Map
- Smoother edges
- More intermediates used

DEVELOPMENT COSTS:
- Roughly $1,000/ ha additional (bush ribbons) due to very complicated terrain and highly visible

Owner & Operator

Owner/ operator - Kelly Beattie, Hillside Harvesting

The carriage:
- ACME motorized slack pulling carriage
- Approx 1700 lbs
- Approx 300 feet/ min

Tail Spar

- Mobile backspar = cost saver
- Reduces the rigging up time between yarding roads
- Always lots of rigging in a partial cut, good place to reduce time spent
Rigging

- Tough work.
- No one’s happier about a motorized carriage than these folks: Jeff Pfieffer, Kyle Vannuys

Electronic Chokers

- Electronic chokers pay for themselves shortly
- Increased safety around the landing and higher production
- Approx. $18,000 for the whole set-up.
- Increases productivity
- This can’t be done with a running skyline

Yarding

- Bringing in a turn.

Intermediate Tree - “Jack”

- “Jack”

Landing

- Electronic Chokers:
- Allow smaller landings
- Partial cutting will require multiple set-ups.
- Benefits visuals,
- Reduce road building costs
- Less site disturbance.
- Yarder and loader work side by side
- Good productivity = 4 to 5 loads/ day

“Skid” - Gary Ens (Trucker)
Chris Moffat (Loader man)
Albert Fredericks (Yarding Engineer)

Intermediate Tree

- Downtown Bralorne in the back
Wide Corridor

- The same intermediate.
- Learned = placement of I-trees
- Wider = Armillaria root rot
- Something we didn’t do enough of in Enterprise

Narrow Corridor

- Another narrow yarding corridor
- No intermediate

Using the Terrain

- DRY DRAW
- Small terrain features to maximize your yarding
- Minimize disturbance
- Best visual impact results
- Don’t find from an air photo or map.
- Again, the field work up front is key

Clearcut Bench

- Clearcut located on the bench below
- Hoe-chucked

Strip Shelterwood - First Half = Corridors

- Base = clearcut portion
- Strip shelterwood

Strip Shelterwood - Second Half = Clearcut Contours

- What the countour clearcuts look like
- Lateral Deflection required
- Small ridges require a corridor on either side
**Bralorne Summary**

The Bralorne Stats:
- 10 years from planning to planting
- Three cutting permits (TCP - Dave Bedford)
- 23 Blocks
- Total of approx 78,000 m³
- Average block size is 8.6 ha
- Average volume per block approx. 3,400 m³.
- Ranged between 300 to 500 m³/ha

**Parting Thoughts**

- Do your homework...consider the next pass.
- A well designed Clearcut is visually acceptable, economic and ecologically appropriate.
- Involve the People who care.
- Partial cutting is very expensive.
- Use it only where critical.
- Integrate clearcutting into your partial cutting.