Island Geoscience

Geoscience issues as they relate to water, land and air protection on Vancouver Island

Vol. 02, No. 03 – Summer 2005

Summer draws closed…

After a late start to summer, it appears that fall is already on its way.

Just when we have begun to wrap our heads around the 2004 Tsunami and the Hurricane season off the coast of Florida (see the previous issue for a write up of last years hurricane damages), we are faced once again with a major disaster in New Orleans. As a geoscientist, it reminds me that one of our important responsibilities is to help people understand the frequency and magnitude of processes at work in the natural world, and how those processes will likely impact or lives, infrastructure and environment. With this knowledge, we can begin to make more informed decisions around risk.

Steve Chatwin at the BC Forest Practices Board recently reported out on landslide frequencies following logging for pre- and post-Code blocks in three watersheds in British Columbia. With a substantial volume of literature suggesting that the post logging landslide rate is increased from the natural rate, Steve tried to answer the important question, "Has the Forest Practices Code reduced the frequency of post logging landslides?" His article is below.

In addition (and ultimately related to the question of frequency) there is an article about expert judgement and probability estimation. Go ahead and take the test, it is remarkably revealing!

The Ministries of WLAP and SRM have once again become the Ministry of Environment, and the amalgamation of the two ministries brings renewed geoscience and hydrology expertise to the ministry.

Many of the provincial hydrologists and geoscientists in the Ministry of Environment meet this month in Vernon, so I look forward to reporting out on that next issue.

As always, if you have any comments on any of the articles, or the newsletter, please contact me at:

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If you have recent work that seems to fit the overall theme of this newsletter, let me know and I'd probably be happy to include it.

Past issues of Island Geoscience are catalogued at the Ministry of Forests Library: http://www.for.gov.bc.ca/hfd/LIBRARY/Island_Geoscience.htm

We're all inundated with Email. If you are getting this newsletter and *do not* want it, please send me an Email at the above address and let me know. I will take you off the list. On the other hand, if you know someone who would like to be on it, again, please let me know.

Continued thanks to all the folks who send me feedback, or pass this newsletter on to a friend or colleague.

Best wishes all,

Rick.

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Managing Landslide Risk in the Forest Sector of BC

Steve Chatwin, MSc PGeo

Landslides are a common natural process in a mountainous province like British Columbia. The frequency of landslides can be increased by forest harvesting and road building on steep-slopes. Landslide reduction was one of the major objectives of the 1995 BC Forest Practices Code. There is a general assumption that the Code successfully reduced the number of landslides, and that professional assessments were a key part of this success, but to date there is no evidence to support these assertions.

Figure 1. A Natural landslide into a cutblock. Photo added by R. Guthrie

To address this gap, the Forest Practices Board undertook a study to examine the management of landslide-prone terrain in three areas: Kyuquot and Gordon River on Vancouver Island and Revelstoke in the Interior, through an airphoto evaluation of landslide rates and examination of terrain stability mapping and terrain stability assessments.

A total of 46 Code road and cutblock landslides were counted in the 455 steep-slope cutblocks in the three study areas, or an average of one landslide every year for every 14 square kilometres of steep-slope cutblocks. This landslide frequency is 1/3 of the pre-Code landslide frequency, but a 3 times increase over natural landslide rates. Code landslides are much less frequent in gullies, along stream escarpments and off roads, compared to pre-Code landslides. Approximately 50 percent of the Code landslides had a potential impact on a fish stream.

"… [the post-Code] landslide frequency is 1/3 of the pre-Code landslide frequency, but a 3 times increase over natural landslide rates"

Many more landslides—164 over the eight year study period—initiated from old roads constructed prior to the Code coming into effect. This was in spite of considerable road deactivation work.

Licensees achieved reduced landslide frequencies in the Code era through a number of measures, including better road locations, improved road building techniques, reserves around stream escarpments and gullies, proactive deactivation and increased use of professional engineers and geoscientists. The significance of professional terrain mapping and assessments in this equation was the subject of the second part of this report.

Reconnaissance terrain stability mapping, prepared by professional geoscientists, correctly identified most cutblock areas that eventually experienced landslides as potentially unstable or unstable. The criteria used for determining landslide hazard class were not always consistent, however, between mappers in the same region. Reconnaissance terrain stability mapping did not appear to be used strategically in planning the location of cutblocks and roads, but rather it was used only for determining where a terrain stability field assessment was needed.

Figure 2. A landslide related to logging and road drainage in a recent block. The post-Code rate of landslides appears to have been reduced (from pre-Code) by increased buffers around streams, escarpments and gullies, better road construction and increased reliance on geoscientists and engineers. Photo added by R. Guthrie.

A terrain stability field assessment (TSFA) was carried out on 92 percent of the cutblocks where required. However, the results of the TSFA were not always incorporated into the silviculture prescription, as is required. About 45 percent of silviculture prescriptions did not address the results of the TSFA; nor were the results of the TSFA addressed in the cutting permit or road layout and design documents. This means that while TSFAs were being completed where required, in nearly half the cases, the results appear to have been ignored.

Part of the reason for this may have been the utility of the TSFAs themselves. The comprehensiveness of TSFAs examined in this study was quite variable. All TSFAs provided an estimate of the likelihood of a landslide occurrence for the cutblock. Overall, the TSFAs accurately predicted a moderate or high likelihood of a landslide in those cutblocks that later failed. However, half did not stratify the block by hazard class, provide hazard assessments for adjacent areas, or estimate the size, the number or the consequence of the landslides. Some TSFAs provided detailed prescriptions for block adjustment or road construction, while others were silent. The more recent TSFAs were generally the most comprehensive.

"Licensees … reduced landslide frequencies … through … better road locations, improved road building techniques, reserves around stream escarpments and gullies, proactive deactivation and increased use of professional engineers and geoscientists."

The system for management of unstable terrain established under the Code seems to work–the incidence of landslides has been reduced. More thorough professional assessments and more consistent implementation of the recommendations in those assessments should reduce landslide incidence even further.

The full report can be obtained at: http://www.fpb.gov.bc.ca/s_investigations.htm

Steve Chatwin is the Special Projects Manager for the Forest Practices Board in Victoria. He has a long history of looking at landslides in coastal British Columbia as an industry geoscientist, government researcher, private consultant, and finally in his current position with the Forest Practices Board.

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Expert Judgement and Probability Estimation in Geoscience

Expert judgement involves the use of experience, expertise and relevant principles to characterize, assign probabilities or consequences to scenarios. Although it is subjective by nature, expert judgment is ideally explicit and consistent (Lee and Jones, 2004). The expert is any person with specialized knowledge or skill in a field, typically as a result of any combination of education, training and experience.

A critical task when giving or acting upon expert judgement is that of minimizing the amount of bias. Typical biases include:

- Representativeness (Is one thing linked to another based on an appearance of similarity?)
- Availability (Is an estimate influenced by similar examples we can easily recall?)
- Anchoring (Choosing an answer and adjusting for the event in question)
- Motivational (Estimation based on what is good for us, what we care about, or what others want to hear)
- Overconfidence (Claiming a greater degree of confidence than is warranted).

Consider the case for overconfidence. Most scientists are reluctant to commit to a number when they are uncertain, however, if they can be encouraged to commit, they are startlingly overconfident. The following is a de-biasing exercise for overconfidence (from Russo and Schoemaker, 1989). Try it!

Instructions for the test:

The objective is to answer each of the ten questions below by giving a range (a low and a high guess) within which the correct answer lies. You should aim to be neither too narrow (overconfident) nor too wide (underconfident). Note: It is not important that you get the right answer, but that your lows are below the correct answer and your highs above, 90% of the time (one miss in ten). No googling allowed, just your best estimation!

How'd you do? Were you overconfident despite feeling uncomfortable with several of the questions?

Another critical task when giving or acting on expert judgement is to avoid ambiguity. Ambiguity usually arises when experts state probabilities in qualitative terms that are not understood equally among all parties (including, perhaps, the expert his/herself, thus the ambiguity).

Qualitative definitions of probability may be used (and often are); however, they should be explicitly defined so that the user understands the true intent of the definition.

Overconfidence Exercise:

		90 % Confidence Range	
		Low	High
1	Martin Luther King's age at death		
2	Length of the River Nile in miles		
3	Number of Countries that are OPEC members		
4	Number of books in the Old Testament		
5	Diameter of the Moon in miles		
6	Weight of an empty Boeing 747 in pounds		
7	Year that Mozart was born		
8	Gestation period of an Asian Elephant in days		
9	Air distance from London to Tokyo in miles		
10	Deepest known point in the oceans in feet		

Figure 3. De-biasing test for overconfidence. Try and guess the range within which the correct answer must fall (as opposed to guessing the correct answer). The guesses/estimates should be sufficient so that the correct answer falls within that range 9 out of 10 times. Answers are on the last page.

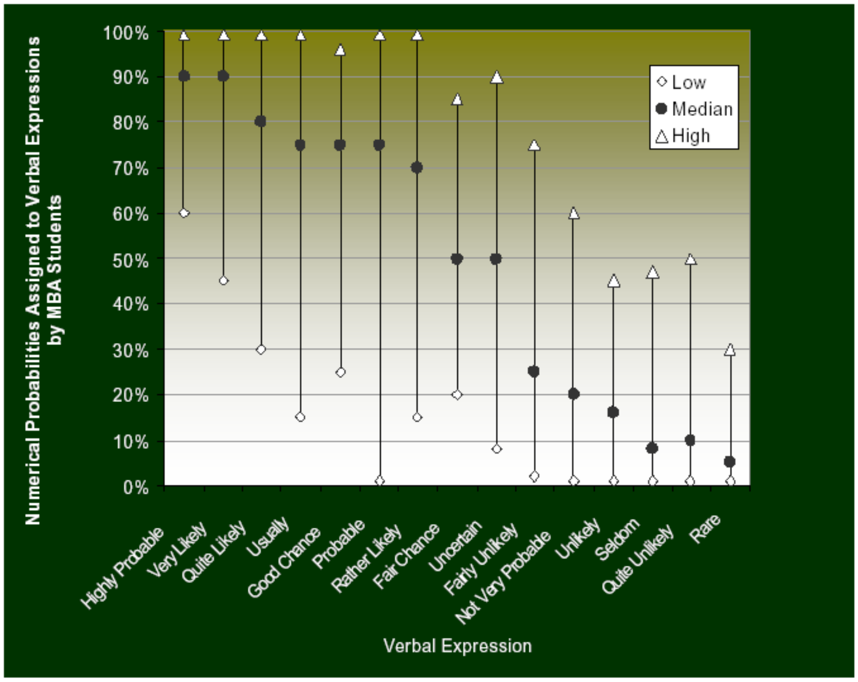

Figure 4. A study of MBA students revealed that undefined verbal expressions of probability were widely interpreted and therefore, ultimately, ambiguous and ineffective (graph from Lichtenstein and Newman, 1967). Qualitative descriptions of probability should be clearly defined so that the user and the expert have similar understandings of meaning.

In landslide hazard assessment for example, we have the following definitions:

Terrain stability class	Interpretation
I	**No** significant stability problems
II	**Very Low** likelihood of landslides following forestry activities; minor slumping at road cuts
III	**Low** likelihood of landslides following forestry activities; minor stability problems can develop
IV_R	**Moderate** likelihood of landslides following road construction, low to very low following harvesting
IV	**Moderate** likelihood of landslides following forestry activities
V	**High** likelihod of landslides following forestry activities

Table 1. Terrain Hazard Stability Classes in British Columbia

A recent internal review of 31 landslide events reported on Vancouver Island revealed that 58% of landslides occurred on terrain marked as hazard class II or III, and 41% on class IV and V terrain. There are several possible explanations, some of which include the ambiguity of the hazard description.

So what can we do to increase clarity? In this specific example there is an excellent growing body of literature on landslide frequencies for coastal BC that will enable experts to develop or place the hazard class into context (Chatwin, 2005; Guthrie, 2002; in press, Guthrie and Evans, 2004; 2005; Rollerson et al., 2002; among others). In addition, we can define where our uncertainties lie, and what is required to reduce them.

One can see that overconfidence and ambiguity are not unrelated. Each bias impairs the usefulness of expert judgement and probability estimation.

This article touches briefly on some of the challenges to overcome when giving or eliciting expert judgement and advice. A much larger body of literature is available on the topic for interested readers.

This article draws heavily from an expert judgement workshop put on by the Science

Committee. The author is indebted to the organizers of that workshop - RHG

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Recent research

The Geomorphology of Vancouver Island Maps (with extended legends) and the Mass Movement Potential (map and report) for Vancouver Island have been reviewed and are in final stages of approval. With luck, they will be available publicly by the next issue.

Next issue:

We will look at a stream crossing monitoring project for Vancouver Island (it wasn't ready for this issue), and report on the meeting in Vernon (Ministry of Environment Ecosystems meeting)
Until then!

-RHG

Editor's note: If you have an article or research paper that you would like to see here next time, please let me know at richard.guthrie@gems6.gov.bc.ca

Answers to De-biasing test:

1. 39 years
2. 4,187 miles
3. 13 countries
4. 39 books
5. 2,160 miles
6. 390,000 pounds
7. 1756
8. 645 days
9. 5,959 miles
10. 36,198 feet

Field work: Landing at the Cape Scott Lighthouse on Northern Vancouver Island