VOICES FOR GOOD AIR

SCIENTIFIC METHODS OF MEASURING SLASH VOLUME AND WEIGHT

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Measurement of logging slash in North America seems to have begun during the 1950s, probably in response to the rapid expansion of clearcutting. Clearcutting of evergreens, and especially old-growth evergreens, results in vast amounts of needles, limbs, tops, roots, bark, defective stems, deadwood, crushed brush, and stumps lying across a cutblock. This material was considered to invite wildfire, to interfere with optimum tree regrowth, and to pose a hazard to planters. Research foresters at the USDA Forest Service experiment stations consequently performed some basic studies intended to ascertain just how much of this unwanted byproduct of logging required disposal. Much more recently, interest in quantifying slash has revived as concern has grown about the effects burning so much wood has on the health of those who breathe slash smoke, the wastefulness of burning a potentially valuable resource, and the contributions slash burning makes to climate change.

Weighing

The simplest, though not easiest, method of quantifying slash is to weigh it. An early example is a study done in the Challenge Experimental Forest, Yuba, California:

> Sundahl, William E. 1966. *Slash and Litter Weight after Clearcut Logging in Two Young-Growth Timber Stands.* Berkeley, CA: U.S. Forest Service, Forest and Range Experiment Station.
> https://www.fs.fed.us/psw/publications/documents/psw_rn124/psw_rn124.pdf

Results from that study were that "Ninety-year-old stands of the Pacific ponderosa pine and Pacific ponderosa pine-Douglas-fir types yielded 53 to 110 tons of slash to the acre [= 119 to 246 tonnes/hectare] after logging.

In a surprisingly early study of logging slash in British Columbia, at a site near Merritt, S.J. Muraro (1966) felled about 300 lodgepole pine and weighed 5-ft. dried lengths of the trees. Muraro then defined as "slash" only the portion of the trees above the non-merchantable top – the 4-in. diameter. By this definition, his study resulted in about 47,000 lb./acre of slash **(= 52.6 tonnes/hectare)**. If non-merchantable trees, bushes, deadfall, bark, and so on were included, the total amount of slash might be roughly 40% larger. (Virkkula et al. (2014), cited below, measured organic litter and humus layer and surface vegetation as 36% of the material burned in their experimental Finnish cutblock as 36% of the total slash burned.) If so, Muraro's lodgepole pine study plots would have yielded over **70 tonnes of slash per hectare**. On the other hand, pine killed by mountain pine beetle might produce less slash if it were ten years old or more and fine materials had oxidized. For the Muraro paper, see:

Muraro, S.J. 1966. *Lodgepole Pine Logging Slash.* Ottawa: Department of Forestry (Publication No. 1153)

http://www.cfs.nrcan.gc.ca/pubwarehouse/pdfs/27552.pdf

Muraro, by the way, offered three reasons for burning forestry slash: for sanitation; regeneration; and hazard abatement.

Modern reports quantifying the weight of slash tend to do so incidentally to more complicated research questions. The major atmospheric experiment Virkkula and his many colleagues conducted at a site in Finland a few years ago involved weighing the biomass of a forested tract of land before harvesting merchantable timber and after burning the slash. Virkkula et al. (2014) reported that the burnt slash weighed about 60 tonnes per hectare:

> Virkkula, A., et al. 2014. Prescribed burning of logging slash in the boreal forest of Finland: Emissions and effects on meteorological quantities and soil properties. *Atmospheric Chemistry and Physics 14:* 4473-4502.
>
> https://www.atmos-chem-phys.net/14/4473/2014/acp-14-4473-2014.pdf

Where industrial forestry is being done, it should be relatively easy, if not cheap, to sample slash weight per hectare by loading piled slash on trucks, carrying the loads to a mill, and using scales. No doubt there are places where this procedure is being conducted, but Voices has located no pertinent research published on the Internet. Still another possibility is using "in-woods scales" such as wireless crane scales. See:

Hill, Kevin. 2017. How do in-woods scales help optimize logistics in logging? *Wood Business* ("The online reach of *Canadian Forest Industries* magazine"):

https://www.woodbusiness.ca/harvesting/transportation/how-do-in-woods-scales-help-optimize-logistics-in-logging-4282

In-woods scales should make it relatively easy to match slash-to-merchantable timber with specific site characteristics in the field.

Volume measurements

Because the weight of wood has a fairly constant relationship to volume (dry wood of coniferous species in Canada tends to weigh a little less than water), and it is much easier to estimate the volume of a slash pile than its weight, volumetric measurements of forestry slash have always been popular. Current methods of making those measurements rely more heavily on technology than used to be the case. A Web article by the Northwest Advanced Renewables Alliance (NARA) describes three of those methods: (1) Terrestrial LiDAR to establish baseline analysis; (2) The geometric method; (3) Laser rangefinder. The NARA article is at:

https://nararenewables.org/2014/03/24/smart-tools-to-measure-slash-pile-volumes/

The abstract for the original peer-reviewed journal article on which the NARA article is based can be accessed at:

http://www.ingentaconnect.com/content/saf/fs/2014/00000060/00000001/art00021

Why is it important to quantify logging slash production?

In coming years, knowing exactly how much slash eventuates from forested landscapes of different kinds will be important to governments, industry, and humanity as a whole. As for governments, the Government of Canada and the Government of British Columbia both have legal obligations to carry out accurate and transparent inventories of greenhouse gas emissions from forestry. At the moment the evidence is that they are not doing so, because their sophisticated models receive unrealistic data about amounts of slash burnt in the course of logging. More positively, the Government of British Columbia has expressed an intention to impose the B.C. Carbon Tax on wood burned as slash. If that measure becomes law, fairly precise measurement of slash will have large tax implications.

Industry in British Columbia, at least, will have two reasons to require accurate measurement of logging slash. On the one hand, as just mentioned, before long logging slash in British Columbia may soon be subject to the Carbon Tax. If taxed on the slash they burn, wood industries will have a strong incentive to avoid forest tracts which would produce a great deal of slash (for example, higher elevation forest) and to concentrate their attentions on low-slash tracts. Again more positively, if logging slash acquires cash value, for instance by becoming feedstock for biochar production, then wood industries will want to know the amounts of slash because they will be buying and selling it.

Proper quantification is important also because numbers improve rational thinking. Voices for Good Air has done some simple calculations in arriving at conclusions about the proper management of forestry slash. According to industry sources, logging operations in the Bulkley and Lakes Timber Supply Areas (TSAs) burn about 20,000 nominal "slash piles" a year. (See the Voices *Position Paper*.) The "slash piles" are nominal because it seems no one actually counts them or attempts to standardize their volume, much less their weight. Instead, the assumption is made that one hectare of clearcut produces two slash piles. At a conservative estimate of 50 tonnes of slash for two "slash piles" – see discussion of Muraro (1966) above – logging in the Bulkley and Lakes TSAs then burns off roughly 20,000/2 x 50 = 500,000 tonnes of slash per year. Now consider that it takes about 5 cords of lodgepole pine to heat an average house in the Bulkley Valley for a year, and a cord of dry pine weighs at least one tonne (see the University of Nebraska Web site "Heating with Wood," Table 1, for the weight of a cord of jackpine, 3200 lb. green, 2488 lb. dry). Therefore the 500,000 tonnes of slash now going into forestry bonfires in the Valley, harming the health of thousands of people and contributing uselessly to global warming, could heat roughly 500,000/5 = 100,000 houses a year. Is it rational to burn masses of slash which, converted in situ to biochar, might heat 100,000 houses a

year? Even allowing for energy costs and losses along the way from slash piles through in situ biochar conversion to BC Hydro generators to home furnaces, the numbers make a person wonder.

At present the scale of the forestry slash burning problem is minimized through unrealistic quantification ("slash piles") and the very existence of slash greenhouse gas contributions is wished away with insupportable notions that replanting logged-over cutblocks will take care of them. So long as that remains the case, Canadian publics and the governments they elect will make climate change policy on the basis of ignorance and illusions.