By Robert W. Gray, and
Bruce Blackwell, RPF, RBio.

How Fire Behaviour and Fire Effects Models are Used for Fuel Management in BC

There's a long, simmering and misinformed debate in British Columbia over the use of fire behaviour and fire effects models developed in the United States.

Some, such as Marty Alexander, PhD, RPF, argue it is unsafe to use such models to predict crown fire movement of an active fire in BC. Rarely, however, are the models used by professionals in BC to predict fire behaviour on active wildfires.[1] Instead the models are used for stand- and landscape-level fuels management planning as well as some fire behaviour and fire effects prediction on prescribed fires. The models of concern include: NEXUS, BehavePlus, Farsite, FlamMap, FVS-FFE, and FMAPlus.

In an effort to explain how fire behaviour and fire effects models are used in BC, we will review the development of a typical stand- and landscape-level fuels management plan.

In the absence of a provincial standard, several communities in BC have adopted a set of wildfire hazard assessment standards based on potential fire behaviour and fire effects.[2] These standards focus on three key hazard reduction objectives:

- Reduce the probability of crown fire propagation,
- Reduce surface fire intensity and long-range spotting potential,
- Increase the resilience of the treated stand.

Developing stand-level prescriptions that address these three objectives is an iterative process that begins with an accurate inventory of both surface and aerial fuels.

- The aerial fuel inventory is combined with species specific canopy fuel loading tables in order to compute Canopy Bulk Density (CBD) and Canopy Base Height (CBH).
- Aerial fuels and surface fuels, combined with the appropriate fire environment parameters, are then input to a fire behaviour prediction system or model and a fire effects prediction model.
- The model outputs include current condition (pre-treatment) for our three objectives: potential for crown fire propagation, surface fire intensity, and overstory mortality.

Now the professional can start the process of gaming to develop a prescription by thinning certain components of the stand, treating surface fuels if required, and running the new stand through the same fire behaviour/fire effects modeling system. This step may be repeated several times in order to arrive at the best prescription. Whatever treatment is being considered, an analysis of environmental consequences is warranted. For example, what are the potential impacts to air quality, soils or residual trees from the treatment?

Once the thinning prescription has been decided upon, the resulting stand and stock table can be used in an appraisal of treatment cost. The project budget relies on input from the thinning prescription and the surface fuel treatment prescription. The target thinning stand and stock table in the Ministry of Forest and Range's fuel management prescription template is also a key component of tender packages for contract work. The variability in stand types and productivity in many wildland-urban interface stands makes appraisal and bidding difficult. Having a very clear picture of how much material needs to be removed is critical.

The final stage in the project is the post-treatment effectiveness monitoring. The same inventory plots used at the outset of the project can be re-visited and re-measured. The post-treatment stand inventory information is then input into the decision aids to determine if the decision aids need to be re-calibrated or if future prescriptions need to be altered.

The advantage of using US-developed decision aids is the dynamic nature of the models and their linkages. Aerial and surface fuels are entered into one of several models, the most flexible being Fuels Management Analyst Plus. Internal algorithms for computing crown and canopy bulk density and base height use the raw stand inventory data. Similar models use the same input data for suppression modeling, as well as fire effects (smoke emissions, soil heating, etc.).

The initial inventory and its various products can also be linked to economic models, spatial fire spread models and fuel succession models. At the landscape level these models can provide direction for the community wildfire protection plan by identifying and prioritizing treatment units based on landscape-level hazard and fireshed patterns, developing long-term fuels program budgets and anticipating fuel changes over time.

The Canadian models Canadian Forest Fire Danger Rating System (CFFDRS) and Canadian Fire Behaviour Prediction System (CFBPS) have great utility for what they were developed to do: predict regional fire danger (CFFDRS) and predict fire behaviour on active wildfires (CFBPS). They are not as useful for developing wildfire hazard abatement prescriptions in southern BC, for predicting fire effects or for hazardous fuel treatment program planning. They do link well with fire growth models (P3 and Prometheus) but not with economics or fuel succession dynamics models.

For the purposes of hazardous fuels prescription development and planning, we suggest that a number of US models are appropriate for use in British Columbia as long as the user is aware of the models' limitations. Training courses are available for most models and professionals should show due diligence by attending a training session before using these models. ❧

See **page 28** for footnotes and references

Robert W. Gray is a consultant fire ecologist with over 27 years experience in fire history and fire effects research, prescribed fire, fuel management and wildfire suppression. His undergraduate degree is in Forest Resource Management from the University of Montana. He is currently completing a master's degree at the University of Victoria.

Bruce Blackwell, RPF, RPBio, is a principal of B.A. Blackwell and Associates Ltd, in North Vancouver with over 20 years of forestry and environmental consulting experience related to forestry and land management.

STRATEGIC continued from **Page 20**

diversify Canada's trade relations away from its singular focus with the United States. While Ottawa's efforts were aimed at developing links with Europe, British Columbia followed a different tack. The province made a concerted effort to increase forestry exports into the Asia Pacific, which was experiencing unprecedented growth. The policy quickly bore fruit, as Japan became the second largest importer of British Columbian forest products. Likewise, China also emerged an important export market due to its impressive economic progress and voracious appetite for raw materials. Canada routinely showcases forestry products inside the country, while supports trade and technology programs to facilitate their use.

The flexibility of the federalist system has become apparent with these relationships with Japan and China. British Columbia's autonomy has allowed it to press ahead with its own trade efforts, despite a general chill in Ottawa's relationship with Beijing. Moreover the province is better placed to leverage linkages with local Chinese communities in order to cultivate economic links. The diversification of Canada's trade relations has become a major boon for the country and the province. It has partially supported the industry despite the prolonged economic downturn in the United States, while providing an avenue for dialogue and cooperation with an emerging superpower.

In short, it's fairly clear the important, and sometimes critical, role forest products have played in determining Canada's position within the international sphere. It has assisted in growing the country's prosperity, while strengthening its relations with the predominant superpower of the time. British Columbia has become increasingly important part of this equation, establishing trade links with foreign countries directly. All of these factors bode well for Canada, British Columbia and the forest industry's health now and in the future. ❧

Richard Shimooka is a research associate in the Defence Management Studies program at Queen's University. He has a Masters of Strategic Studies from the University of Wales, Abersytwyth.

FOOTNOTES and **REFERENCES** from **Page 21**

References

Brown, J.K. 2000. Introduction and fire regimes. in: J.K. Brown and J. Kapler Smith (edits.). Wildland fire in ecosystems: effects of fire on flora. U.S. Dep. Agric. For. Serv. Gen. Tech. Rep. RMRS-GTR-42. Ogden, UT.

Cruz, M.G. and M.A. Alexander. 2010. Assessing crown fire potential in coniferous forests of western North America: a critique of current approaches and recent simulation studies. International Journal of Wildland Fire. 19(4):377-398.

Sando, R.W. and C.H. Wick. 1972. A method of evaluating crown fuels in forest stands. U.S. Dep. Agric. For. Serv. Res. Pap. NC-84. St. Paul, MN.

Footnotes

[1] United States wildfire suppression personnel, including Fire Behaviour Analysts, typically rely on their own decision aids for tactical planning purposes when serving on fire assignments in Canada.

[2] Based on principles outlined in peer-reviewed literature and previously reported in **BC Forest Professional** (July-August 2008).