Avenues for integration of IF3 modeling results with the Fire Effects Planning Framework, FEPF

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June 2009

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INTRODUCTION

The Fire Effects Planning Framework (FEPF) was designed to integrate GIS-based information on vegetation and species of interest with potential wildfire activity, and fire effects to produce landscape-scale data on the potential benefits and risk of fire to resources of interest using state-of-the-art vegetation simulation and fire effects models (Black and Opperman 2005). It is possible through FEPF to identify ecological risks and benefits related to wildfire activity as well as fire-related management such as fuels treatments or prescribed fire pre-,during- or post-fire. IF3 models parallel that of FEPF. IF3 integrates spatial analysis of critical terrestrial and aquatic habitat parameters for fisheries, a distribution-based approach to predicting fire severity with a population persistence model to produce landscape-scale data outlining risks and opportunities for maintenance and restoration of fish populations. As such, both are frameworks that integrate outputs from several GIS-based tools as part of the modeling process.

We began this study thinking to use the FEPF framework as the basis for developing a fisheries-oriented management tool. We realized, however, that the critical pieces for this project were developing the algorithms to drive both a population persistence model and identify post-fire factors that impact fish populations (stream temperature and sediment). For this purpose, it made more sense to uses fire information in a slightly different manner than FEPF originally envisioned. However, the intentions and flexibility inherent in both approaches highlights several pathways by which the two models could be integrated. Here we discuss how IF3 and FEPF may be used together for mutual benefit. The first illustrates how specific data layers from IF3's spatial analysis (that precedes persistence modeling) could be used to refine risk and benefit

quantification, as well as prioritization decisions, using FEPF. In the second we demonstrate how pairing IF3 persistence predictions with FEPF-based fire effects predictions enhances the spatial resolution of potential risks and benefits in landscapes supporting sensitive fish habitat. In both examples, it is evident data produced using each modeling framework may improve predictions made using the other framework. We highlight such synergies below.

INTEGRATION PATHWAY 1 – IF3 contributions to FEPF

Wildfires do kill fish directly (e.g. Rieman et al. 1997); however, indirect effects of wildfire may be more of a concern for resource managers (Rinne 1996, Rieman et al. 1997, Dunham et al. 2003, 2007). IF3 persistence models consider two potential post-fire threats to fish habitat: debris flows and stream temperature changes resulting from riparian burning. The distribution of potential debris flows and sensitive riparian corridors varies throughout a watershed based on topography and vegetation type, and not all fish habitat is equally vulnerable to these effects.

Within FEPF, potential fire activity and vegetation changes can be mapped with a resolution of at least 30 m^2. However, simply knowing that potentially deleterious fire activity based on effects to dominant vegetation, as coded in coverages derived from satellite imagery, is spatially coincident with sensitive fish habitat preserves a large amount of uncertainty related to post-fire affects on stream-fish populations for the manager to address (Figure 1). Work conducted under this JFSP project has produced methods for refining identification of critical riparian vegetation for fisheries and aquatic organisms, basic algorithms for identifying thermally sensitive stream habitats, and more

sophisticated algorithms for mapping post-fire disturbance potential. All of these could be seamlessly melded into FEPF. Applications include:

1) higher resolution definition of at-risk riparian vegetation adjacent to thermally sensitive stream habitat;
2) identification of stream segments at thermal risk post-fire;
3) more precise identification of upland areas at risk from post-fire soil disturbance and subsequent debris flow;
4) provision of a conceptual framework for assessing trade-offs in possible management activities, and identification of 'best value' activities to facilitate fire reintroduction to forest stands adjacent to sensitive aquatic habitat where fire exclusion has altered vegetation composition; and
5) investigation of using IF3s approach to fire – drawing from probability distributions based on historic fire size and severity - to refine the existing aspatial quality of fire predictions at a landscape scale.

INTEGRATION PATHWAY 2 – FEPF contributions to IF3

The treatment of wildfire within IF3 is greatly simplified relative to wildfire simulation in FEPF. Additional resolution in defining the potential for large, uncharacteristic wildfire could improve persistence predictions made using IF3. Integrating fire behavior predictions made using FEPF with patch condition and persistence inferences drawn from IF3 could reduce uncertainty in IF3 predictions of impact to aquatic species. The primary application is the creation of high-resolution, spatially explicit maps of potential fire behavior in FEPF to refine IF3 model inputs.

CONCLUSIONS

This project has built an analytic framework compatible with FEPF and several sub-modules that can be integrated into future FEPF to enhance analyses. Moreover, we have identified an additional way that integration of FEPF with IF3 can enhance the IF3 analysis as well. As a 'meta-model' the FEPF framework readily accommodates a variety of spatial data. Data layers associated with persistence estimates from IF3 could be easily used within FEPF to increase the spatial resolution of inferences drawn from the models. While the IF3 models are more parochial than the FEPF framework, GIS data layers generated using FEPF would compliment analyses using IF3 by providing a comprehensive and more realistic representation of potential fire activity within a habitat patch.

IF3 outputs can provide a detailed representation of how potential fire activity could affect sensitive aquatic populations. Additionally, IF3 outputs estimates of post-fire population persistence that represent a defensible "currency" of management return, particularly for threatened or endangered species.

Successful land management (maintenance and restoration) requires simultaneous consideration of existing conditions, risks and opportunities posed by management and natural activities, and trade-offs involved in prioritizing scarce resources for management activities. IF3 and FEPF jointly provide managers with state-of-the art tools to support this complex and dynamic environment.

LITERATURE CITED

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Figure 1. Example of original output from FEPF.