ENHANCEMENT OF PREDICTIVE ECOSYSTEM MAPPING FOR TFL23

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TABLE OF CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

Predictive Ecosystem Mapping (PEM) was recently completed for TFL23 (Ketchenson et al 2001). This classification provides the ecosystem-based framework to support a number of inventories and planning initiatives for TFL23, including the spatial analysis pilot project and ungulate winter range and caribou wildlife habitat ratings and mapping. However, the state of the existing PEM requires additional assessment and modification in order to be integrated with these other initiatives.

1.1 OBJECTIVES

The existing TFL23 predictive ecosystem map was re-processed in order to meet the following objectives.

1. To generate a digital product that can be used in other projects without additional post-processing.
2. To provide a digital PEM product that incorporates a number of enhancements that can be made within a short time frame.
3. To provide an assessment of PEM accuracy based on independent plot data.
4. To provide options and recommendations for improvement to the PEM methodology.

1.2 ASSESSMENT OF ORIGINAL PEM

The following issues emerged regarding TFL23 PEM.

- The file was in Arc/Info Grid format only, not a polygon coverage.
- There was no associated metadata listing date, creator, etc.
- There were over 500,000 records in the Grid Value Attribute Table (VAT); however, there were only 392 unique ecosystem instances. The extremely large number of unnecessary VAT records made the file large and difficult to use.
- Ecosystem attributes were not in a useable format; the values had been concatenated into one field. This did not conform to RIC (2000) standards for capturing ecosystem attributes.
- Ecosections were absent from the ecosystem attributes. This is a standard attribute of a PEM/TEM database (RIC 2000).
- The avalanche chute layer poorly represented actual avalanche chutes because it was based on Landsat classification, which has proven to be imprecise.
- The PEM grid was built from input layers with a 50-metre pixel size; however, a 25-metre pixel should be the maximum size used in order to preserve the spatial integrity of narrow, complex, or small ecosystems. For example, at a 50-metre resolution, narrow avalanche chutes and wetlands are dissolved or pixelated to a degree that poorly represents the sites.
- Site series were assigned to pixels based on a “winner-take-all” algorithm. This ignored similar and identical knowledge table scores for polygons.

1.3 PROPOSED DIGITAL ENHANCEMENTS

- Add avalanche chute mapping from manual delineation conducted by Smith and Hamilton (2001).
- Re-run PEM overlay with input layers at a 25-metre resolution.
- Accommodate ties and similar scores among site series for polygons.
- Produce digital data in compliance with RIC (2000) standards.

2.0 METHODS

2.1 AVALANCHE CHUTES

Smith and Hamilton (2001) conducted a pilot project to delineate avalanche chute tracks using Landsat multispectral imagery. Manual delineation of avalanche chutes proved to be a more robust method because it eliminated the exclusion/inclusion classification errors of image analysis. The area covered by this mapping was within TFL23 north of Nakusp and east of Arrow Lake. A mask was used to remove the existing avalanche chute data from the original satellite classification input layer. The avalanche chutes mapped from the manual delineation were then added. In the remainder of the TFL, the original satellite classification was used.

2.2 INPUT LAYER RESOLUTION

More recent PEM projects use a 25-metre pixel resolution because it retains a higher level of detail. Terrain based layers, including toe slope, slope, aspect, and solar radiation were resampled to 25-metre and edge-smoothed with a modal filter. Polygon based layers (i.e., from forest cover) were converted from the source polygons to 25-metre raster layers.

2.3 PEM DATABASE AND SITE SERIES RANKING

Considerable information that may be important to the end user is lost when PEM pixels are assigned a single site series when scores are similar or even identical for >1 site series. To accommodate these additional site series calls in the revised PEM, the database was expanded to include a TEM-like "decile" classification system. Site series scores that were tied or within 75% of the highest score were standardized and expressed as integer scores summing to 10. A maximum of three site series were reported. In the case of a three-way tie, each site series was assigned a score of 3. This is the only case were the sum of scores did not equal 10.

It is important to note that site series scores are not equivalent to the deciles reported in TEM. Rather, the scores provide an indication of what site series might occur at a site and how much confidence one should assign to a given area. If a resulting polygon has two site series, each with a score of 5, it means that the knowledge base was unable to distinguish between the two based on the attributes of the polygon.

2.4 GOODNESS-OF-FIT STATISTICS

Because the revised PEM was based on the original knowledge tables, there was no change in site series classifications, at least among those site series that scored the highest. As a result, classification statistics reported in Ketcheson et al (2001) are valid for the revised PEM. Accommodating multiple site series in classification analyses would result in a trivial improvement in statistics; therefore, we did not reanalyze goodness-of-fit.

3.0 RESULTS

In the original PEM database there were 392 unique combinations of ecosystem occurrences. With the addition of ecosections and site series scores, the number of unique ecosystems increased to 2613 (see Table 1).

Table 1: Frequency of different ecosystem occurrences and associated areas in the revised PEM

CLASSIFICATION	NUMBER OF OCCURRENCES	AREA (HA)
Single site series, 643 unique occurrences	643	412,596
2 or 3 site series	1970	149,230
Residual lakes and double line rivers		1,770
Total TFL23 area mapped by PEM	2613	563,596

Site series varied in the frequency with which they co-occurred with other site series. In some cases >50% of polygons were associated with a second site series in the revised PEM (see Table 2).

Table 2: Pairs of site series most often co-occurring in the revised PEM

BEC SUBZONE VARIANT	FIRST SITE SERIES	NUMBER OF OCCURRENCES	SECOND SITE SERIES	NUMBER OF CO-OCCURRENCES	PERCENT
ESSFwc4	04	88	02	60	68.2
ICHvk1	05	114	06	65	57.0
ESSFwc4	01	100	02	52	52.0
ICHmw2	01	102	02	46	45.1
ESSFwc4	02	118	03	43	36.4

4.0 DISCUSSION

Re-processing the PEM resulted in several improvements that will ease use of the product by end users. In particular, the creation of polygon coverage with a manageable number of ecosystem occurrences will enable efficient analysis.

Identifying and scoring up to three site series for each polygon was a major improvement over the original PEM coverage for a number of reasons. First, it identified inadequacies in the knowledge tables. Knowing which site series are difficult to distinguish will provide a logical basis for modifying the knowledge base. Second, it provided a basis for grouping site series. Huggard (2000) grouped site series among BEC subzone variants based on a cluster analysis of indicator plant species; however, aggregating PEM polygons on this basis will generate misleading results where the PEM fails to distinguish among site series from different clusters. Instead, clusters should be based on the resolution of the PEM. Finally, other applications of the PEM might benefit from the site series scores. The important thing is that the information has not been lost in the analysis and is available to end-users.

5.0 RECOMMENDATIONS

The following are recommendations specifically related to TFL23.

- The avalanche chute layer should be revised for the remainder of the TFL23 in a manner similar to the mapping done in the northeast section, and added to the PEM.
- The knowledge tables should be re-visited. The use of arbitrary and additive scores makes it difficult to compare competing site series in a probabilistic manner.
- Redesigning the knowledge tables would allow confidences to be assigned to each site series classification.
- The PEM should be checked and corrected for “impossible” site series assignments; for example, small polygons of avalanche chutes or unlikely site series with certain slope/aspect modifiers (hygric ecosystems on steep warm aspects, etc.).

The following are general recommendations for the PEM inventory program.

- QA/QC for data capture needs to be tightened, and existing RIC standards enforced so that incoming data conform to a standardized format.
- The QA protocol for PEM needs to be expanded. Plot classification statistics alone are inadequate to reveal problems.
- The methods for creating a raster PEM should be standardized. There is now enough project experience to build a standard approach that leaves room for innovation, but provides a basic set of rules regarding the development and application of a knowledge base, statistical analysis, and input layer preparation.
- Knowledge tables and input layers should be part of the deliverables for PEM projects and should be provided in a standardized format.
- Final deliverables should include data and methods in sufficient detail to recreate the PEM.

LITERATURE CITED

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