Ecosite Mapping of Pukaskwa National Park

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Abstract

An ecosite inventory of Pukaskwa National Park has recently been completed using the Northwestern Ontario Forest Ecosystem Classification and the Northwestern Ontario Forested and Wetland Ecosite Classification. This is one of the first such inventories in Ontario and was one of the most extensive fieldwork efforts ever undertaken in the Park. This paper describes the methodology, logistics, and some of the challenges encountered in the completion of this inventory and the application of the classifications in Pukaskwa National Park.

One role of protected areas is to act as an ecological baseline. Ecosystems are maintained in as natural a state as possible. One of the basic elements of ecosystem management is a comprehensive biophysical inventory. A Biophysical Resources Study (BRS) by Gimbarzevsky et al. (1978) was the first broad scale biophysical inventory of the Pukaskwa National Park. This study was a pioneering effort in that it used physiography as the basic mapping unit. A similar technique, now called ecosite mapping, is now gaining prominence in Ontario as the Ontario Ministry of Natural Resources moves from the traditional stand mapping approach to include ecosite designations in the Forest Resources Inventory (FRI). The BRS first created a map of the land units in the park, and then described the vegetation communities occupying these land types. The land types are relatively stable over time while the vegetation communities change through dynamic successional processes and in response to natural disturbances such as fire, windthrow, insects and flooding. An extensive field survey was undertaken over two field seasons in 1976 and 1977. Polygons were delineated on 1:15 840 scale air photos and a set of 1:25 000 scale maps were produced. A complex annotation including over storey and under storey descriptions, land type and soil texture attributes, accompanied each polygon. These maps and associated data have formed an important basis for park management since 1978.

A current vegetation community inventory is a critical component of park management. New inventories must be undertaken periodically to maintain this currency. This basic fact, and the major changes wrought on the forest by spruce budworm infestations in the mid 1980s caused park management to begin to lay the groundwork for an updated inventory. Concurrently, as Parks Canada was emphasizing ecosystem integrity, forestry operations were accelerating landscape change in the greater park area. Recommendations in the Park's Ecosystem Conservation Plan (Geomatics, 1996) emphasized the need for park inventory techniques to be compatible with those used by adjacent land management agencies. Park staff investigated several inventory options and selected the Terrestrial and Wetland Ecosites of Northwestern Ontario (Racey *et al.* 1996), in combination with forest stand mapping, as the most appropriate inventory and mapping system.

Racey *et al.* (1996) define an ecosite as "a mapping unit integrating a consistent set of environmental factors and vegetation conditions". Environmental factors include soil depth, soil texture, moisture regime, hydrology and nutrient regime. Vegetation conditions include plant community structure and composition.

Stratification and Plot Layout

The decision to use the Northwestern Ontario Forest Ecosystem Classification (NWO-FEC) and Northwestern Ontario Forested and Wetland Ecosite Classification (NWO-ES) tools was supported by findings from field work undertaken in the Park in 1995. A stratification of the park forest communities by NWO-FEC types was completed in 1994 to support this field program (Magee, 1994). Based on this experience it was decided that the Northwestern Ontario FEC (Sims, 1997) was more appropriate to the park than the Northeastern Ontario Forest Ecosystem Classification (McCarthy, 1994). Sampling continued in 1996. Sampling primarily occurred in portions of the park which were accessible to float equipped aircraft. A call for proposals to undertake the inventory was issued in January 1997. ESG International Inc. (formerly Ecological Services for Planning) were contracted. Seymour Forestry Services was subcontracted by ESG to complete the air photo interpretation.

Survey Intensity

Park staff was assisted by ESG in developing a predictive algorithm specific to Pukaskwa National Park based upon the specific polygon attributes in the BRS. The resulting map was used to predict the spatial distribution of ecosites to assist in the optimum location of field sampling transects. This work predicted 26 forested ecosite conditions in the park. An ideal sampling regime would have been 30 samples per condition (780 transects total) for statistically sound evaluation of reliability of all ecosite conditions. Given the difficulty and the extreme cost of access, the sampling was focused on ecosites that were more variable and difficult to photo interpret.

ESG and Seymour Forestry Services designed a sampling program to complete the field work during the summer of 1997. All transects were marked on the photos by the photo interpreter. We completed 327 transects—some 65 linear kilometers of sampling effort—which equates to a sampling intensity of one plot per 580 ha. The OMNR uses one ground truth plot per 260 ha as a rule of thumb for sampling intensity (cited in Arnup, 1997). The value of the BRS was realized at this point in the project as well. ESG examined the data cards from the BRS and allocated an ecosite based on the soils and vegetation information recorded on the cards. While these tally cards did not exactly fit the ecosite data collection protocol, they did give us some very valuable additional sample points.

Park staff did much of the ground truthing for the inventory. This was an incredible experience for us since the enhanced knowledge of the park far outweighed any technical advantage possibly gained by contracting all of the fieldwork. Many other observations of such things as flora, fauna and fire history were made and recorded in other park databases.

Survey Methodology

A tally sheet was adapted from an OMNR FRI/Ecosite tally (Racey, pers. comm. 1997) which the OMNR had tested during operational cruising in northwestern Ontario in 1996. We adapted the tally as the project progressed in response to interests of staff and the suggestions of the consultant. A Hughes 500D helicopter was used for the bulk of the project. This aircraft, while expensive—$675.00 per hour—was superb for landing in tight spots, saving a great deal of walking time. A float plane was used to access the larger lakes. Twenty plots along the Pukaskwa River were accessed by canoe.

At each of ten stations along each 200m transect the species composition of the forest community was assessed. The age, height and diameter of certain representative trees and soil depth, texture and moisture regime were recorded at three stations. The forest community was classified as one or more of 36 vegetation types, one or more of 15 soil types (Sims, 1997) and one of 40 terrestrial ecosites (Racey, 1996).

The classification of soils was a very interesting and challenging part of the inventory due to the very wide variety of soil conditions found in the park. Silty very fine sands (sivfS) were prevalent in many top and side slope positions, not the coarse sands (cS), medium sands (mS) and fine sands (fS) which we had expected. The high silt content is evidenced by an almost talcum powder like texture. We suspect an aeolian origin for this fine material.

Generally the NWO-ES system worked well. We did adapt the NWO-ES key (Figure 1) and individual ecosite descriptions to describe unique conditions The original OMNR key was adapted to guide fieldwork and photointerpretation in the Pukaskwa National Park inventory.

Photo Interpretation and Ecosite Mapping

The mapping of forest stands does not necessarily equate to mapping ecosites. The interpreter enhanced his knowledge of surficial geology with the help of ESG. Resources such as soil survey maps (Duff, *1985),* NOEGTS maps and various publications (Simms, 1991) were assembled to form a foundation of knowledge about the surficial geology of the park and area. The OMNR held several training sessions to train their staff, and private contractors in the art of interpreting ecosites. Pukaskwa Park staff attended one of these sessions held in Sault Ste. Marie, Ontario in February, 1997. Several publications describe this procedure (Arnup, 1996a and 1996b; Johnson, 1997). A summary of the ecosite mapping process is described in the Ecological Land Classification for Southern Ontario (Lee, 1998).

The park landscape is very complex. For example, most upland coastal ecosites with very shallow soils and dominated by conifer mixedwoods (ES 12) are dissected by wide faults containing deeper soils supporting hardwood dominated communities (ES 16). Since the map scale for the project was 1:20 000 (ecosite mapping in Southern Ontario will be done at a scale of 1:10 000) we had to be realistic about the amount of detail which could be captured. In some cases two ecosite descriptions were given to a single polygon.

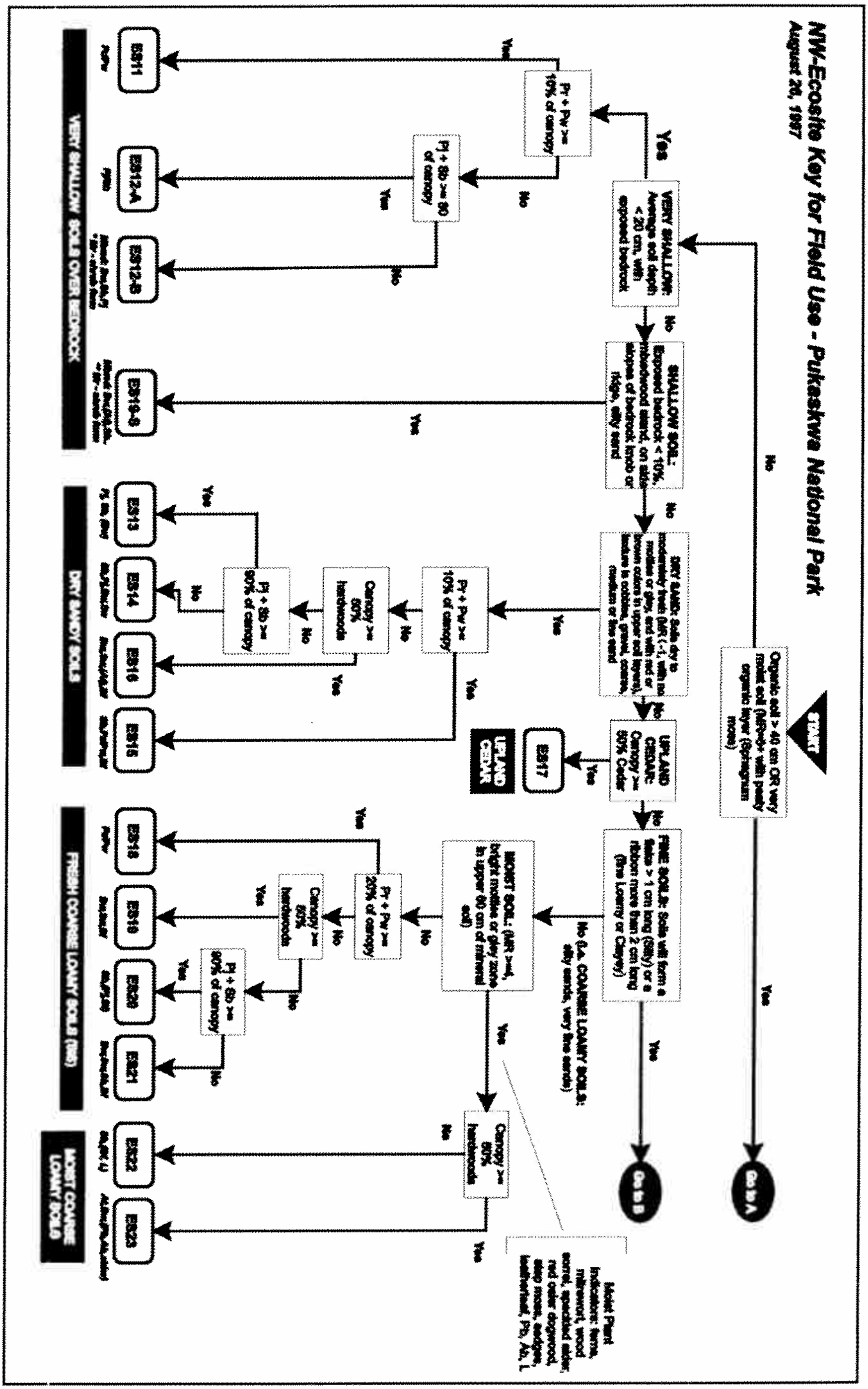


Figure 1: Ecosite key for Pukaskwa National Park (Arnupp 1997)

We estimate that there are about 800 polygons per flight line which equates to about 13,000 polygons in total. Polygons are larger in the north east corner and smaller along the coast.

Automation

The automation contract was tendered in January 1999. QSP Geographics Inc. was contracted to complete the work. On April 1, 1999, the Park took delivery of

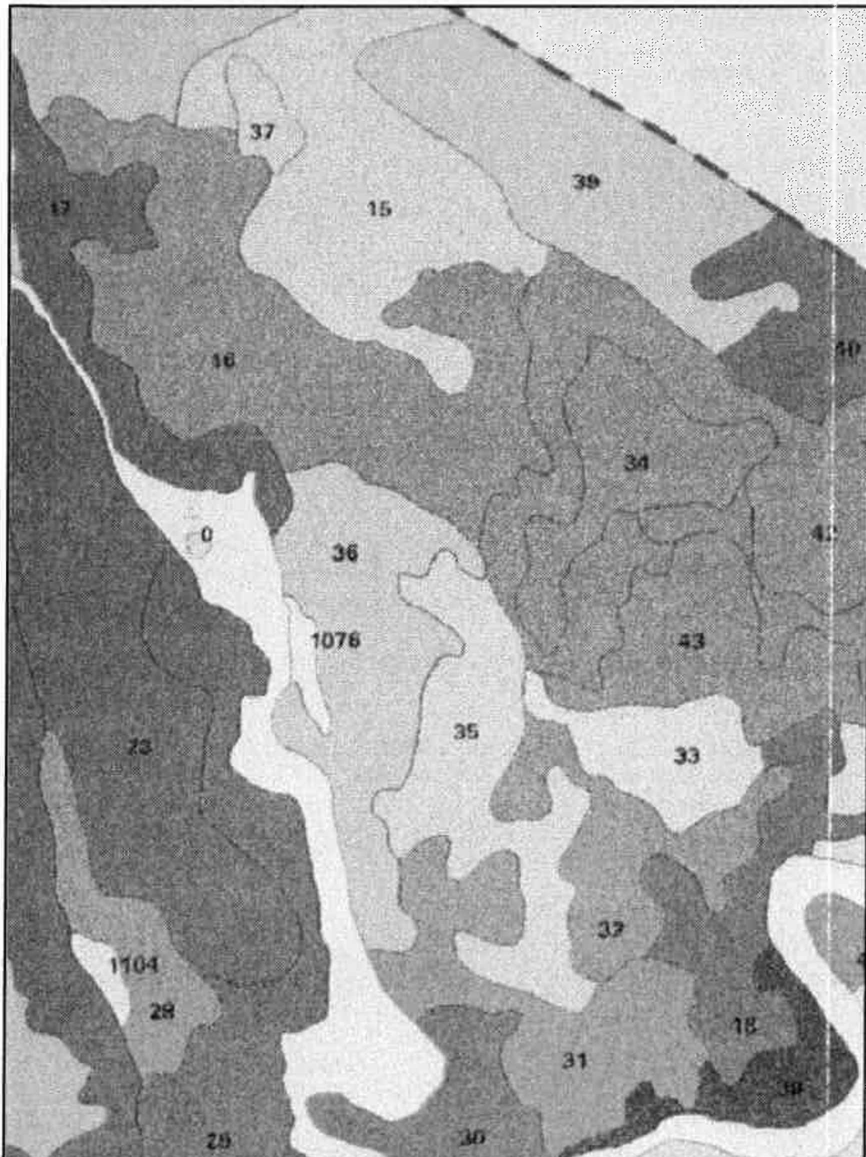


Figure 2: A portion of the ecosite map for the White River area in Pukaskwa National Park. Numbers and shading refer to different ecosites.

the first three of 22 Ontario Base Map sheets. Figure 2 shows an example of the completed map. QSP reports that the automation of this inventory is slightly more complex than traditional FRI work due to the increased number of polygons and the specialized stand attributes (F. Sadonis, pers. comm.).

A requirement of the project was that polygons containing white pine and other special species be so noted on the attribute table. The attributes for each polygon description include: polygon number; species composition including species of interest occuring in less than 10% of the stand; age, height and stocking; site class; polygon area (ha); primary vegetation types; primary soil types; and ecosite number. This data will provide park managers with very high resolution and comprehensive stand level information.

Sample Results and Refinements

The BRS recorded some 2258 water polygons, 804 of which were less than one hectare. This study reported that beaver activity was "ubiquitous" but that often "they [beaver] were traveling a great distance from water for food". Northern Bio-science was contracted to ground truth the wetlands. They visited the park in the fall of 1997 and surveyed 45 wetland complexes (Harris, 1997).

The most common wetland ecosite was Ecosite 46 (Meadow Marsh). Many of the ponds/marshes documented by the Biophysical Resources Study are now meadows. We attribute this change to a collapse of the beaver population as we noted very little evidence of recent beaver activity. White pine regeneration was noted on the margins of many meadow marshes in the southern part of the park.

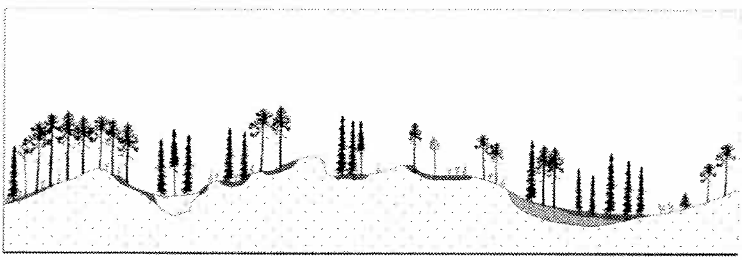
Ecosite 19 proved to be one of the most common in the park. This ecosite describes a hardwood community, usually trembling aspen (Vegetation Types 5 through 11) and white birch (Vegetation Type 4) on fresh coarse loamy soils (sivfS). In the park, this ecosite is dominated by white birch (V-4) and red maple (V-3) with white spruce, upland black spruce, eastern white cedar and white pine as minor components.

A variant of Ecosite 19, Ecosite 19S was added to describe a very shallow, coarse loamy to silty soil over bedrock condition (moisture regime generally fresh), dominated by a mixed hardwood forest community. A <10% exposed bedrock proviso was added as a photo interpretation criteria to distinguish this type from other ecosites occurring on very shallow soil conditions.

Ecosite 12 typically describes a conifer dominated community on very shallow soil to bedrock (Figure 3). We noted many mixedwood communities on similar sites. An Ecosite 12B was added to describe the no soil/very shallow soil (coarse sandy, moisture regime q - 1) over bedrock condition, dominated by a mixed forest community with white birch, red maple and conifer species. A "mainly exposed bedrock" proviso (10% to 75%) was later added as a photo interpretation criterion.

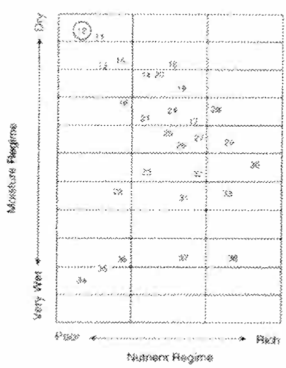
ES 1 describes a sand beach. We developed an ES 1C to describe the cobble beaches which are common in the Park. The famous "Pukaskwa Pits" are found in

ES12 Black Spruce–Jack Pine: Very Shallow Soil



General Description

Overstory open and patchy to close-crowned. Dominated by black spruce and jack pine. Balsam fir and trembling aspen in patches. Shrub- and herb-poor. Soils very shallow (<20 cm) with bedrock outcrops. Bedrock frequently covered only by a shallow litter layer. Ground cover consists of bedrock, needle litter, lichen and feathermoss.



Soil Types
SS1, SS2, SS3, SS4, SS5

Mode of Deposition
bedrock, morainal

Humus Form
fibrimor, humifibrimor

Overstory
black spruce, jack pine, white birch

Shrubs/Trees (<10 m)
Vaccinium myrtilloides, Vaccinium angustifolium, Gaultheria hispidula, black spruce, balsam fir, *Linnaea borealis*

Herbs and Graminoids
Aralia nudicaulis, Cornus canadensis, Trientalis borealis, Clintonia borealis, Maianthemum canadense

Mosses and Lichens
Cladina mitis, Cladina rangiferina, Cladina stellaris, Pleurozium schreberi, Ptilium crista-castrensis, Hylocomium splendens, Dicranum polysetum

Comments

May occur as pure jack pine, pure black spruce or as a mixture. May cover small rock outcrops or extensive open bedrock areas. Forest cover may be patchy, with lichen-covered bedrock knobs and ridges. In addition to the characteristic V30, there may be small patches of a wide variety of other V-types, including V35–V38 where drainage is disrupted. White cedar may be locally abundant, especially in the Atikokan, Fort Frances and Dryden areas. Slow tree growth. S-types SS1 to SS4 are characteristic and dominant (>50% of polygon area), but inclusions of SS5, SS6 and SS9 are frequent

Figure 3: Factsheet describing Ecosite 12 (Racey 1996).

these locations. The ecosite inventory will be useful for the inventory and protection of these features. Large areas of cobble have been colonized by shrub and forest, making mapping of the entire cobble beds impossible. These vegetated cobble beds were given a dual ecosite description ES16/ES1C.

Summary

We are satisfied with the utility and cost effectiveness of the ecosite mapping. The resolution of the mapping, and relatively detailed (stand level) information, together with the comprehensive association of site attributes, provide us with a solid foundation upon which to base management decisions. We have built the project on the foundation provided by the original BRS which provides comparison to early 1970 conditions. The OMNR and co-operators are publishing a very useful and increasing body of practical literature linking the ecosite classifications to fire management applications, silvicultural guides, habitat suitability matrices and so on. We will make immediate use of the inventory for fire management using the polygon descriptions to produce a fuel type map, successional studies, and tree species distributions The ecosite units will also form the basis for more specific fire management zones or units and fire use prescriptions will be developed for each vegetation type. The data will be linked to wildlife telemetry locations to determine wildlife habitat affinities. This baseline inventory data will also contribute to a solid database to test ecological indicators and will contribute to "State of the Park" reports.

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