THE USE OF A BIOPHYSICAL (ECOLOGICAL) DATA BASE FOR PARK PLANNING

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INTRODUCTION

A number of biophysical data bases have been established on the Canada Geographic Information System (CGIS) of Environment Canada at the request of Parks Canada. Two such data bases exist for the Atlantic region, one for Gros Morne National Park and one for Terra Nova National Park. Both of these parks are located in Newfoundland. Data bases such as the ones that exist for these parks can be of considerable use in the planning and management of the park. This paper describes a particular application of CGIS and a biophysical data base to planning in Gros Morne National Park.

The exercise was initiated in response to a request from Parks Canada planners. A means of rapidly evaluating the landscapes of the park for their suitability for use as campground areas was required by the planners. The exercise is in itself straight forward; however, considerable emphasis is placed on deciding what to do, or what is required before approaching the computer for analysis. Experience indicates that much time and expense is saved by formulating a clear definition of the problem and the development of a careful plan of attack prior to retrieving the information from this or other Geographic Information Systems (G.I.S.).

THE STUDY AREA

Gros Morne is located on the west coast of Newfoundland in an area of dramatic differences in terrain, climate and vegetation. In general, the park area can be separated into lowland coastal areas and highland plateaus. In the lowland areas there are several major physiographic types. These include beach ridges and cliffs along the shore, raised beaches inland, active dune systems and coastal plains. In the highlands there are the long range fault scarp, the upland plateau, and the serpentine hills.[1] The climate ranges from cool temperate along the coast, with fog and frequent strong winds to subarctic conditions with extremes of temperature and wind in the highlands. Vegetation types range from bog and fen to balsam fir forest and the very unusual tuckamoor.

The conditions in Gros Morne make selection of appropriate sites difficult. It is a very large park, over 198,000 ha. Due to the variability of conditions, the data base is very complex. At present there are more than 30,000 pieces of information in this data base. Sorting out areas which meet certain criteria based on five or six variables from this data base is so time-consuming as to be practically impossible. In fact, this overload of information creates a problem. It is too complex and ponderous for most planners to dig through such a pile of data. Subsequently, the information is left unused and as a result, some planning decisions must be made on less than satisfactory data. This problem can be solved through the use of an automated G.I.S. which allows for the rapid analysis of large volumes of data and the selective retrieval of such data in a realistic time frame. This is especially relevant when dealing with spatial data, i.e., mapped information. Complex maps, particularly those which contain complexed classifications are visually confusing and present considerable difficulty to the person attempting to evaluate different areas relative to each other. The CGIS is capable of providing the capabilities needed for planners to properly utilize the data which is now available from the many surveys completed.

THE DATA BASE

The data base utilized in this study is based on a Biophysical Land Classification now more popularly referred to as Ecological Land Survey (E.L.S.)[2] This survey technique produces an integrated classification of the land based on physical parameters such as physiography, soils, geology, drainage etc. and biological

factors describing vegetation and wildlife. The data base for Gros Morne contains the following list of variables:

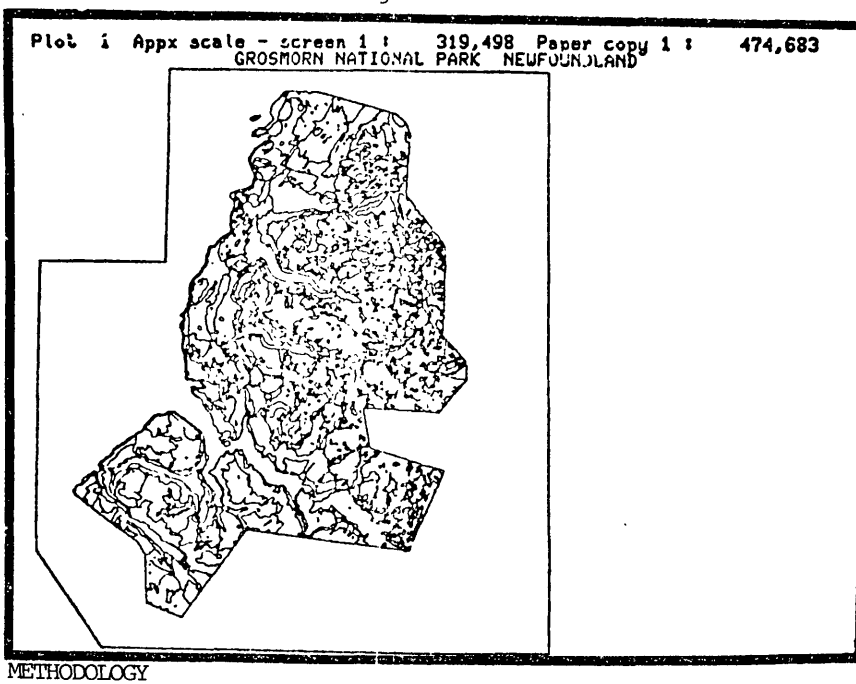
1. ORIGX - Origin of Materials
2. FRMTX - Form and Materials
3. GEONM - Geological Formation or Group Name
4. GEOAG - Geological Age or Era
5. GEOCL - Origin class or rock
6. GEOMA - Major Geological Material
7. GEOMB - Secondary or Associated Geological Materials
8. SOLRD - Soil order per CSSC
9. SOLGG - Soil great group per CSSC
10. SOLPA - Soil phase characteristics A per CSSC
11. SOLGB - Soil phase characteristic B per CSSC
12. SOLGP - Soil subgroup per CSSC
13. VGNUM - Number of Vegetation types in Legend
14. VGDS1 - Vegetation Distribution (Primary)
15. VGTP1 - Vegetation Type (Primary)
16. VGMD1 - Vegetation Modifier (Primary)
17. VGDS2 - Vegetation Distribution (Secondary)
18. VGTP2 - Vegetation Type (Secondary)
19. VGMD2 - Vegetation Modifier (Secondary)
20. DRAIN - Drainage per CSSC Classification
21. TOPOG - Topography
22. SLOTP - Slope Type
23. SLOMN - Minimum Slope
24. SLOMX - Maximum Slope
25. SLOSP - Aspect
26. UNIT# - Map Unit number

The E.L.S. maps of Gros Morne, compiled at the scale of 1:50,000, have been input to the system at that scale. The Land Systems maps form the basis for this data retrieval, (Figure 1).

OBJECTIVES

In April of 1979 Parks Canada Planners from the Atlantic Region office in Halifax, approached the Lands Directorate for assistance in utilizing the CGIS and the Gros Morne data base. The objective of the task was to identify areas most suitable for campground use. The exercise was to be completed within two months. It is significant in that it is one of the first honest attempts to incorporate the capabilities of the CGIS into the planning for a major park.

Figure 1



METHODOLOGY

The approach taken in this study is very straight forward. The analysis is performed using Version 3.1 of the Interactive Graphics Subsystem of the Canada Geographic Information System.[3] Results were obtained using a Tektronix 4014-1 graphics display terminal and a Tektronix 4631 hard copy unit.

ANALYSIS

The most important step to be followed before making the selections is the identification of the criteria upon which the planning decision is to be made. In this study the criteria for locating major campgrounds had already been established by Parks Canada staff.[4] Thus it was a fairly straight forward exercise to extract the information from the CGIS data base. The general criteria variables and values are shown in Table 1.

TABLE 1 Criteria for Campground Selection

Criteria	Variable	Value
Slope and Aspect: The general area requires suitable slopes 2-10%, marginal slopes 0-2% and 10-15% and unsuitable slopes > 15%. The campground road requires 0-5%. Desirable east facing slope.	SLOMN SLOMX SLOSP	003 010 EE
Soils: Desirable, dry, gravel soil with rapid percolation; undesirable, low wetlands or rock outcrops.	ORIGX SOLRD DRAIN	GMF PB 123
Forest Cover: Desirable, a mixed forest of young to mature Fir, Spruce or Maple and grasses. Understory density 50%. Overstory 30-60%. Size of tree 6-12" D.B.H. Undesirable-mature dense Balsam Fir.	VGDS1 VGTP1	FH 34 01 02 09 04 05 06

The criteria are as set out by Parks Canada staff. The variables and values were obtained by searching the data base to determine which pieces of information could be used as a measure against the criteria. This part of the procedure pointed out emphatically the requirement that the user know and understand their data base, otherwise, they may be using the inappropriate variable to represent the criteria.

In this case the variables SLOMN, SLOMX and SLOSP are obvious measures of the slope and aspect. A more difficult choice exists for the soils criteria. The data base does not contain a direct reference to the texture of the soils. Therefore, it is necessary to use variables that indicate certain textural types. In this case ORIGX is used and all materials that are of glacial, marine and fluvial origin are selected. These are chosen in the context of Gros Morne where such genetic types will likely be sandy or gravelly. In other areas these values would not be applicable. The drainage characteristics are most obviously defined by DRAIN, with 1 referring to rapidly drained, 2 being well drained and 3 moderately well drained. The forest cover is best described by the two variables VGDS1 and VGTP1. The first provides a general description of vegetative covers. In this case forest and heath are the most applicable. The second variable VGTP1 can be used to define more specifically the vegetation types. The criteria require areas of mixed forest of

young to mature Fir, Spruce and Maple or semi-open or cleared areas. The only values which could be found to reflect these types of characteristics defined areas of Balsam Fir, White Birch forest and cleared or agricultural areas.

The analysis procedure involves the incorporation of human judgement into the iterative process of selection used by the computer. This is only possible through the use of an interactive package such as CGIS. The evaluation is initiated using the command SELECT. This command generates a series of prompts which guide the analyst. The system requests what variables are to be used and subsequently which values. A tabular report is produced defining the map units selected, the areas in acres and hectares, the percentage of the selection and total area that each unit occupies.

The human judgement aspect of this process involves the ability of the user to define his problem, perform the selections, preview the results on the CRT and then adjust his rules or criteria and perform another selection thus using his own experiences to enhance the capabilities of the computer and vice versa.

The application here involved two selections in which criteria are adjusted and variables changed to provide results which also fitted with the planners overall judgement of the area. Selection 1 is designed to locate areas which meet the basic criteria in terms of the physical characteristics and fall into the general vegetation category of forest and heath.

The results of the selection are listed below:

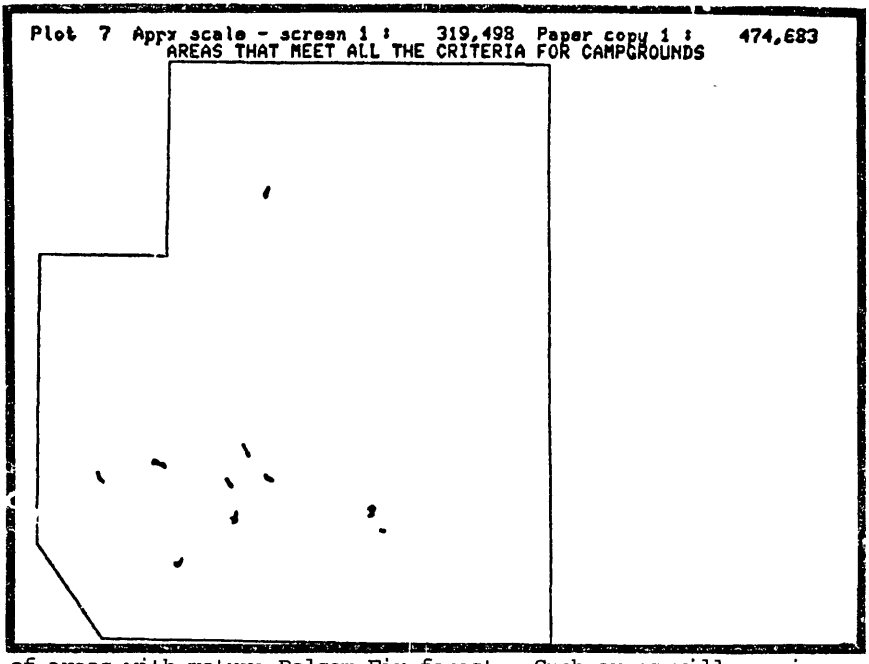
CAMPGROUND SELECTION 1

XXX	Selection	Aug. 10/79	Page 1	XXX
Variable:	ORIGX-values selected: GHF			
Value	Acres	Hectares	% Selection	% Study
G	455.8	184.6	53.3	0.0
H	155.5	63.0	18.2	0.0
F	243.3	98.5	28.4	0.0
Variable:	SOLRD-values selected: FB			
Value	Acres	Hectares	% Selection	% Study
F	701.3	284.0	82.0	0.1
B	153.4	62.1	17.9	0.0
Variable:	VGDSI-values selected: FH			
Value	Acres	Hectares	% Selection	% Study
F	701.3	284.0	82.0	0.1
H	153.4	62.1	17.9	0.0
Variable:	DRAIN-values selected 123			
Value	Acres	Hectares	% Selection	% Study
3	786.8	318.6	92.0	0.1
2	67.9	27.5	7.9	0.0
Variable:	SLOMN-values selected: 003			
Value	Acres	Hectares	% Selection	% Study
003	854.8	361.1	100.0	0.1

Thus 361.1 ha of the park meet the basic criteria for campground use. The areas selected were displayed through the simple command PLOT. The result is shown in Figure 2.

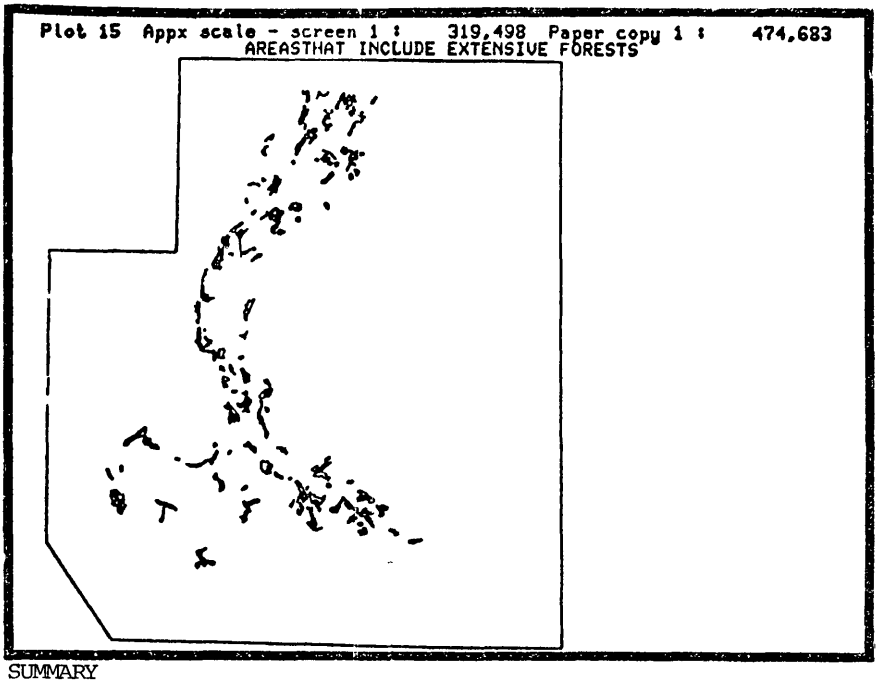
The reaction by park planners was that this produced a very limited number of areas. A judgement was made to delete the limitation on the aspect, to change the slope limitations and to allow for a wider range of vegetation types. The result of this selection produced a total of 7,116.9 ha of potential campground areas. These areas are displayed in Figure 3. The changes in selection criteria means that areas facing west are now chosen even though these are frequently exposed to high wind off the Gulf of St. Lawrence. The changes also allow for the selection

Figure 2



of areas with mature Balsam Fir forest. Such areas will require much more input costs for campground development. Most of the areas selected fall in the coastal area or in the lower portions of many of the valleys. Few of the upland areas are chosen, which is to be expected because of the extremes of temperature and exposure that is found in those areas.

Figure 3



SUMMARY

This study has demonstrated some of the potential that a system such as CGIS has for assisting park planners. It has also demonstrated the utility of E.L.S. data bases for park planning. There is no doubt that the information is of considerable use to planners, and now with the advent of computerized GIS's the vast amount of information contained in the E.L.S. is readily available to planners. In truth, there is a higher capability for analysis and retrieval in the system than there is data available. In the future, almost any amount of data can be input without fear of it becoming overwhelmingly large and unwieldly.

A concern which has arisen out of the exercise though, is the tailoring of data bases to meet the users' needs. In this case the lack of more specific soil texture information was a limitation to the analysis. It is important that considerable attention be paid to setting up the data base to suit the users' needs. The lack of one variable can affect the utility much more than would be expected.

REFERENCES

1 Parks Canada, 1971; Analysis of Existing Factors and Constraints, Gros Morne National Park; Department of Indian Affairs and Northern Development, National and Historic Parks Branch, National Parks Service, Atlantic Region, Halifax, Nova Scotia

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3 Environment Canada 1979; Graphics System Commands; Canada Geographic Information System, Lands Directorate, Environment Canada, Ottawa

4 Lee, S., 1978; Development Criteria for Desirable Visitor User Options; Department of Indian Affairs and Northern Development, National and Historic Parks Branch, National Parks Service, Atlantic Region, Halifax, Nova Scotia