ECOLOGICAL INVENTORIES AND APPLICATIONS FOR WILDLIFE HABITAT

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wildlife integration was a secondary objective in many ecological inventories and their utility has been dependent upon the following: ability to discriminate in the land unit separation criteria; land and habitat features significant to wildlife distribution and abundance; inability to account for successional dynamics; our understanding of wildlife/land (habitat) relationships; accommodation of cultural and land use characteristics; and map scale limitations. Future work will link inventories to predictive models and decision support systems in a GIS environment.

INTRODUCTION

The subject of my talk will be of greater importance as forest land management increasingly addresses wildlife resources. In my presentation today, I will speak briefly of the history and evaluation of integrated inventories or ecological land classification, paying particular attention to the factors that influence and methods to assure successful integration of wildlife values. I will also mention some work expressing wildlife habitat as a function of land characteristics using current advances in the information technologies, and will present some examples of these. Finally I will attempt to provide some insight into some of the possible future directions in interpreting ecological land inventories for evaluations of wildlife habitat.

Canada although a relatively young country has made rapid strides in its capability to inventory its land resources. The vast extent of relatively inaccessible land has no doubt provided the impetus to develop innovative, rapid and technologically advanced methods to inventory large areas quickly and at reasonable cost. In this respect Canada is one of the world leaders. Efforts to develop an integrated forest land classification began in 1966 with the inception of the Subcommittee on Biophysical Land Classification within the National Committee on Forest Land. It developed the biophysical land classification system and produced guidelines for biophysical (ecological) land classification in 1969. The first land/wildlife integration meeting held under CCELC auspices took place in Saskatoon in 1979. Much of the innovative work in land/wildlife integration in Canada and in North America has been done in association with this working group. Three proceedings of land/wildland working group meetings have been published (Wildlife Working Group 1980, 1982, 1988). A fourth compendium just printed entitled "Guidelines for the Integration of Wildlife and Habitat Evaluation" by Wildlife Working Group (1991) is the source of some of the material I will present today.

DISCUSSION

Ecological inventory, Ecological Land Classification (ELC) or Ecological Land Survey (ELS) are an interdisciplinary approach to gathering and interpreting environmental data. The environment is considered to be comprised of natural or man-modified ecosystems that are land based. In an ELS context land is referred to in a wholistic manner and includes biotic and abiotic components such as bedrock, landforms (including surficial geological materials), soils, water, vegetation and animals. ELS is a means of integrating diverse land characteristics and known relationships to address complex land use and resource development issues (Ironside 1991).

The integrated approach of ELS has many practical advantages over single discipline surveys (Wiken 1980) including: reduced duplication of effort in data collection; stable aspects of land such as topography and landform are used as a framework; team approach facilitates development of meaningful map units and legends; data are collected in the context of interacting landscape processes and can therefore be used to predict ecological responses to management; the report and maps are integrated into one package; reduced complexity of land-related data; and reduced cost compared to several single theme surveys.

Historically wildlife resources have received little consideration in the development of ecological land surveys and have often been ignored or interpretations for wildlife have been made after the inventory was completed (Kansas 1991, Stelfox 1983) with traditional emphasis on landforms, soil and vegetation. Wildlife resources have been difficult to incorporate into ELS for the following reasons (Kansas 1991): many species are highly mobile over many landscapes; populations can fluctuate greatly over time; wildlife is difficult to observe, and many early wildlife surveys have not included habitat-based assessments thus creating difficulty in reconciling wildlife surveys and ecological land surveys.

It is now generally acknowledged that most wildlife species usually have distribution and use patterns that relate to the traditional foundation for ELS i.e., landform, soils and vegetation or landscapes. In recent years a large body of knowledge has accumulated on wildlife/habitat relationships. Such proceedings have been edited by (Thomas 1979, Verner et al. 1986, Cooperrider et al. 1986). This recent information should facilitate the integration of land features important from a wildlife habitat viewpoint, into new or older ELS.

One of the principal reasons for the lack of satisfactory application of ELS for wildlife purposes has been because wildlife was not considered or given high priority during the survey planning (Kansas 1991). It is important to build a strong, open minded, multidisciplinary team with good communication among team members so that the kinds of data, detail of observations, mapping procedures and temporal limitations important to wildlife distribution can be accommodated.

Ecological inventories have had varying utility in addressing wildlife habitat. Reasons for their failure have been identified by Gray and Stelfox (1991): they were quickly completed and set aside; they were confusing to the user, with imprecise goals and objectives; scale was not appropriate for the use intended; the wrong information was collected; and a lack of rigor in the approach. In addition to these can be added ineffective presentation format and a weak or absent technology transfer effort. Even when the factors mentioned by Gray and Stelfox (1991) above are not limiting, one can be sure that the ELS will not receive its potential use from its intended audience if the information is presented in an awkward format or if the ELS authors have not spent abundant time with the clients in demonstrating how the survey was put together and clarifying perhaps seemingly minor points such as limitations of map scale, similarities and differences between map units and the inherent variability within map units and their central concepts.

The types of wildlife and habitat data required in the ELS will of course be defined by client needs, resources available and mapping scale. Kansas (1991) has identified the measurement types appropriate for interpretations for individual species, wildlife communities and for habitat. A few minutes of additional time per sample plot on the behalf of the vegetation ecologist for example, spent in describing details of the plant community structure including abundance of snags etc. - things that we may not necessarily do as a matter of course, may provide information necessary for interpreting habitat for several bird species. Large increases in the utility of the inventory can often be achieved with little if any additional cost through careful planning and communication during the early proposal development stages.

Wildlife resource evaluation deals with population status assessments (current population, critical or key areas) and habitat status assessments (current habitat suitability, inherent habitat suitability, potential habitat suitability) (Stelfox 1991). Estimates of population potential or carrying capacity are often made for these assessments of land. The habitat suitability index (HSI) used by the U.S. Fish and Wildlife Service is an example of the potential use of ecological inventories. For many wildlife species it is easier to evaluate habitat and population potential than estimate actual populations because of the animals, mobility, their difficulty to observe, and factors that are difficult to account for such as predation and competition (Stelfox 1991). For these reasons, during the past 10-15 years the wildlife community has turned largely to habitat evaluation as opposed to direct population measures to get estimates of population potential. The basic assumption underlying the usefulness of ELS for evaluating wildlife resources is that wildlife selects for specific attributes of their total environment in a reasonably predictable and meaningful manner at different stages of their seasonal and reproductive cycles.

Fundamental to the production and use of ELS is the ability to infer or predict land characteristics or behavior (including wildlife) from other evident and mappable properties. Aerial photo interpretation and predominantly visual interpretation of digital remotely sensed images have been the traditional vehicles used to put the spatial dimension to the ecosystem concepts that we have developed on the ground. In the same manner that we predict or infer soil texture, profile development, plant community type and several management interpretations from landforms delineated on aerial photographs, so can we often infer the presence of several wildlife species from habitat characteristics or from the presence of one key species. These have been referred to as "featured species" (Harcombe 1984), "priority species" or "management indicator species" (Salwasser and Unkel 1981, Bonar *et al*. 1990). The utility of the "indicator species" approach is dependent upon our knowledge of the habitat requirements of species or group of species. Such knowledge comes detailed observations of wildlife and habitat over a long period of time and seldom from ELS alone, and gives an understanding of the importance of various habitat components upon wildlife species distribution. Wildlife and habitat evaluation is the process of assigning value to defined geographic areas based upon the occurrence (potential or actual) of particular wildlife populations.

The process of wildlife habitat evaluation can be expressed quantitatively using algorithms or models. Wildlife habitat modelling is a relatively new field, facilitated by the application of inexpensive, powerful personal computers and software. Land/wildlife relationship models are specifically designed to assess and predict the value of land features (habitat) and land areas to the maintenance and productivity of identified wildlife species (Stelfox 1991). The utility of a model will be no better than our understanding of ecological relationships and probably seldom as good, since models tend to simplify very complex processes and relationships. Important variables are related to cover, food, space and limiting factors. Models will ideally include as principal variables those that will be altered under different management scenarios. A prerequisite to a successful model is the ability to express quantifiable relationships between key, easily measured variables and some expression of habitat quality. A thorough review of several approaches to modelling habitat suitability is given in a publication by the U.S. Fish and Wildlife Division (1981). Verner *et al* (1986) have edited a recent symposium with many excellent examples of wildlife habitat models. Cooperider *et al* (1986) also provides descriptions of similar work.

During the 1970's large areas of land were ecologically inventoried often at relatively large scale, as a foundation for future resource management such as those done for the mountain national parks (Holland and Coen 1981) or for resource development (Jurdant and Gerardin 1977). Jobs for ecologists and pedologists in resource inventory were abundant. These comprehensive multimillion dollar inventories are examples of what some may view as our extravagant past. It appears unlikely that the financial resources will materialize to conduct similar inventories in the near future except on small areas. However, for many forest land areas there are existing maps and inventories of various scales on themes such as geology, soils, forest cover, topography, access etc. There are often also reports and other descriptive information, site classification field guides and/or wildlife survey information. A number of recent studies have successfully integrated geographic information systems (GIS) and habitat models in work done by BEAK and GAIA consultants of Calgary (R. Usher, personal communication).

What does the future hold in store? There exists a significant opportunity to integrate information and knowledge sources applying current and developing information technologies including geographic information systems (GIS), data base management systems (DBMS), expert systems and digital remote sensing. The System of Hierarchical Experts for Resource Inventory (SHERI) being developed in cooperation with the Canadian Centre for Remote Sensing, Forestry Canada, British Columbia Ministry of Forests, University of Montana and University of Toronto for use in British Columbia has already made some significant progress in this area. The NAIA project, a joint research venture between the Alberta Research Council and Hughes Aircraft of Canada, Spatial Data Division with Forestry Canada, Northwest Region as a partner, is developing technology to integrate information sources such as forest cover, soil survey and topographic maps with allocation rules from the Field Guide to Forest Ecosystems of West-Central Alberta (Corns and Annas (1986)) using GIS, DBMS and expert systems to produce predictive site classification maps at 1:20,000 to 1:50,000 scale for pilot areas in west-central Alberta in cooperation with one or two forest companies. Such an approach would integrate several information sources which on their own would have little utility for multiple interpretations. Integration of various knowledge bases including new knowledge of successional relationships by site type, through expert system rules greatly enhances the utility of what may have been regarded as "outdated" inventories. In another major new initiative, the Northern Forestry Centre Forest Resources Program is developing a Decision Support System for Mixedwood Manage-ment, which will be the major Forest Resources Program effort over the next 5-10 years. In addition to including traditional forestry disciplines such as silviculture, and growth and yield, an effort will be made to integrate wildlife values when a wildlife biologist is hired for the program.

SUMMARY

Ecological inventories have the potential to well-serve a number of purposes including interpretations for wildlife habitat. The extent to which they accomplish those purposes will depend upon a number of critical prerequisites including planning, good communication among a strong interdisciplinary team, the ability to integrate old and new knowledge into the definition of map unit concepts and interpretations through appropriate modelling methods and the innovative application of new information technologies to solve old problems. Finally, a comprehensive user training and technology transfer effort is needed, sufficient to allow the user to feel comfortable with the inventory products. There are challenging times ahead!

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