Protected Area Networks: Assessment of Ontario's 'Nature's Best' Action Plan and Recommendations*

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Introduction

Protected natural areas are deemed important for a variety of reasons including economic, ecological, ethical, and aesthetic. A great deal of discussion has focused on the last three of these. Ironically, less work has foccused on the economic justification for conservation of natural areas even though many consider this aspect to be a primary concern. The *Lands for Life* planning initiative must deal, fundamentally, with the sustainability of economic activity in northern communities and how to balance that with conservation of nature in protected areas.

In this paper, we first develop an economic rationale for a system of protected areas in Northern Ontario and point out that the protection of natural areas is not incompatible with the objective of sustained resource extraction and economic activity. Rather, we argue that protected areas can enhance progress to that objective. Then, we address whether the current methodogy for selecting protected areas is likely to result in a reserve network adequate to the task. Finally, we propose some refinements to current methodologies that underpin proposals currently under consideration by the round tables.[*]

An Economic Rationale for Protected Areas in Northern Ontario

Northern Ontario's economic viability and social stability will continue to depend, in large part, on the sustainability of resource-based industries – that is, forestry, fisheries, wildlife, and ecotourism. In turn, sustainable resource extraction and other uses are only compatible with the persistence of the ecosystems in which they are situated. That is, without a healthy ecosystem, there cannot be a healthy economy. Parks and protected areas, representative of unimpaired, natural ecosystems, should play a stronger and more important role in sustaining resource-based industries than they do presently, particularly by providing "targets and indicators to determine the long-term health of the resources" (Ontario Ministry of Natural Resources 1997a, 3). This is paramount if the parks system is to live up to its greatest potential for contributing to the viability of Ontario's resource-based industries, and to government's commitment to its "overriding principle" to ensure ecosystem health and to be accountable to that principle (Ontario Ministry of Natural Resources 1997b, 4).

How protection from resource extraction can contribute to sustainability of resource extraction is perhaps best illustrated by analogy. A factory wants to stay in business – that is, be sustained. It has to produce quality products. To

[*] Based on an original paper by C. P. Henschel (Department of Zoology, University of Guelph, Guelph, ON N1G 2W1). This paper is available on request from the author and contains full reference citations.

ensure that the products are sound, the plant devotes a portion of its productive space to quality control, where parts are periodically checked against standards. The factory could forego quality control and devote maximum floor space to production of more parts, but that would entail a great deal of risk. Floor space not devoted to production in the short term, nevertheless makes a substantial contribution to the long-term sustainability of the factory. Similarly, parks and protected areas are important, not just because they contribute to Ontario's international reputation and obligations to the Man in the Biosphere Program, the Convention on Biological Diversity, the Convention Concerning the Protection of the World Cultural and Natural Heritage, and the World Conservation Union, nor just because of the revenue they provide the government, but also because they can act as "quality control sites" against which to measure the persistance, stability, and sustainability of Ontario's renewable resource-based industries.

Sustainability depends on reliable information about the ecological processes that underpin the productivity of ecosystems and, in turn, the economic viability of resource-based industries. This information must be collected from an ecologically intact and functional natural site, hence a protected area. In some cases, obtaining International Standards Organization (ISO) certification, on which marketing success will depend, will in turn depend on the ability to properly assess the extent to which human activities are meeting the criterion of sustainability. Recent experience in New Brunswick showed that an unsuccessful bid for ISO certification by a large forestry company resulted in renewed political will to design and implement a protected areas system. Similarly, the Crown Forest Sustainability Act of Ontario sets out the legal requirement to practise forestry in a manner that emulates natural forest dynamics. Such assessments require that comparisons be conducted between areas in which resource extraction such as forestry and fish harvesting is practised and where it is either not practised or its effects appear minimal. For example, though extremely degraded by the turn of this century, and presently logged and used extensively for recreation, Algonquin Provincial Park currently shows little evidence overall of extinctions of vertebrate species. An important role for parks and other protected areas is to serve as these reference areas, or baselines, against which to assess the degree to which industries' activities may be unsustainable, leading to their own demise, and the demise of the ecosystems in which they operate.

In Ontario, resource extraction is carried out in a variety of terrestrial ecoregions and ecodistricts – by definition, each is unique. Thus, the completed parks and protected areas system should encompass the variety of ecological systems in Ontario. It would be as difficult to compare areas with and without resource extraction, if those areas were in different regions of the province, as it would be to check the quality of parts from one factory to standards for different parts in a different factory!

Eco-tourism within protected areas, done right, may be compatible with the objective of maintaining protected areas as ecological reference sites. From a scientific perspective, if the objective is to obtain reliable knowledge about the effects of resource extraction for the sake of sustaining it, then a reference area with little human influence is crucial.

Selecting *Nature's Best* for Economic Vitality

Here, we analyze the methodology for selecting 'Nature's Best' for protection and ask a simple question: is the selection procedure for protected areas likely to meet the objective of providing for "targets and indicators to determine the long-term health of the resources" (Ontario Ministry of Natural Resources 1997a, 3). To achieve this goal, a network of protected natural areas must be based on our best current understanding of ecological principles, and be sensitive and adaptive to any new developments in this understanding. We first provide an explanation of the most relevant ecological concepts. Based on current knowledge about each of these concepts, we propose a minimal set of criteria for designing a protected natural area network. Finally, we evaluate the methodology in use by the Ontario Ministry of Natural Resources (OMNR) in the *Nature's Best* action plan in light of these criteria, and provide recommendations for improvement.

Relevant Ecological Concepts: Our Current and Best Understanding

Representation. -- The numbers of species, and the types of species in any particular area, varies widely across the province. Hot spots are regions with relatively large numbers of species. Protecting these areas will ensure that the maximum number of species is represented in the minimum possible area. This is called a coarse filter technique. In addition to these hot spots, however, locations of endemic species, or rare and endangered species may also be identified. Identifying these areas is called a fine filter technique. GAP analysis employs both coarse and fine filters. Areas important for the representation of diversity that are not contained by existing protected areas are gaps which need to be added to the reserve network.

GAP analysis can be effective at identifying candidate areas for protection based on representation, but issues of *what* is represented must also be considered. There are two issues that are important. First, wildlands that exist now are not the only areas that should be considered for inclusion in a network of protected areas that is meant to be functional and successful well into the future. For instance, at the turn of the century, Algonquin Provincial Park was heavily disturbed by forestry activity, and would not have been a likely candidate for a nature reserve if only the most undisturbed areas had been considered. Today, however, it is a flagship of Ontario Parks, and protects an intact collection of mammals and birds. Algonquin Park teaches the important lesson that reserves need not be constrained to the least disturbed areas. Though less likely to be recognized in a search for 'nature's best', such areas may be nevertheless crucial in achieving minimum size and connectivity goals for reserves. Likewise, neither should the sizes of potential reserves, and the degree of connectivity (see below) among them, be limited by the absence of adjacent, undisturbed land.

Second, enduring geological features can be represented in very small areas, and so can areas rich in plant species, but it is well known that areas in which plant species are well represented may nevertheless be devoid of many other invertebrate and vertebrate species. For example, though plant species diversity may be a good indicator of overall diversity in natural, intact ecosystems, these species are also much better able to persist than others such as large-bodied mammals as the natural ecosystems are decreased in size through human disturbance. Thus, GAP analyses that only identify hot spots of diversity for conservation may be wholly incapable of allowing what is represented to actually persist, especially if these hot spots are too small. GAP analyses are most properly used to identify the location of candidate reserves, but not the reserves' shape, size, or boundaries. Protected areas selected solely on the basis of GAP analysis will give a false sense of inclusion and representation, and will not be able to provide targets and indicators for the health of the resources because they will not be ‘healthy’ themselves. Thus, once establishing the location of a candidate reserve, it's minimum size, boundaries, and connections must also be considered.

Size. -- The numbers of species in protected areas varies with size of the area. Minimum reserve sizes have been estimated in a number of ways, none of which, from a scientific perspective, is foolproof and all of which are potentially controversial. Together, however, they do represent the best attempts to establish a biologically meaningful, and effective reserve size. These are:

Minimum Critical Area (MCA), which is the smallest size of a reserve that would ensure persistence of a particular species, calculated using genetic or demographic criteria;

Minimum Dynamic Area (MDA), which is several times larger than the largest, foreseeable disturbance, such as fire and insect attack; and

Minimum Reserve Area (MRA), which is the size above which a protected area surrounded by a greatly altered landscape would nevertheless contain similar numbers of species as it would contain if it were not an isolated reserve.

MCAs are problematic to apply because they assume that protection of the single, target species will ensure protection of the rest. Such “umbrella species” have had limited testing in this regard, and may not function as such. MDAs may be impractical at large spatial scales, such as would be required in northern Ontario where natural, historical fires covered extensive areas.

Protected areas that are too small, in an otherwise altered landscape, often contain fewer species than they would in an unaltered landscape. Mammals are the vertebrate group most sensitive to area reduction; proportionately more species of mammals are absent from reserves that are too small than other kinds of species, like amphibians, reptiles, birds and plants. This has led to the idea that mammals may be an appropriate taxon on which to focus conservation efforts, and to monitor results of those efforts, since conserving the greatest fraction of mammal species should lead to conservation of the greatest numbers of other species. Conversely, for reasons outlined above, conserving the greatest number of plant species, or types of plant communities, would not ensure that the greatest number of other species is also conserved. The minimum reserve area (MRA) required to include the full complement of mammal species in a protected area is estimated to be 500,000 ha (5,000 km^2), in the neighbourhood of the sizes of Algonquin, Wabakimi and Quetico Provincial Parks and others.

Boundaries. Inspection of the mapped boundaries of most parks and reserves reveals that they are most often artificial, have little to do with real biotic boundaries of the ecosystems involved, and result from the extent of crown ownership, neighbouring private land ownership, mining rights, forestry rights, and human constructs such as roads and railways. Despite the vast sizes of some protected areas set aside for conservation, they are nevertheless unable to meet that goal because they are influenced by events outside of them and sometimes many thousands of kilometres away. Setting appropriate boundaries, perhaps based on inclusion of as much as possible of the watershed in which a protected area is established or expanded, may reduce the influence of transboundary effects on the integrity of the protected area.

Further, intensive land use outside protected areas often occurs right up to their borders, increasing the potential for negative transboundary effects. Thus, reserves should be designed with these components in mind: core areas, buffer zones, and the human-altered landscape. Core reserves are managed for maximum protection, and minimum intensity of human use. Intensity and type of use increases through one or more buffer zones to the landscape managed predominantly for sustainable resource use. This concept provides for better protection of species diversity by decreasing edge effects and human interference, and for managing and controlling disturbances, such as accidental fires.

Ideally, the managed landscape should itself be managed to provide habitat for as many species as possible. In northern Ontario, this would be accomplished by managing the landscape, for example, as dictated by the Crown Forest Sustainability Act to sustain native species and emulate natural disturbances. Again, the extent to which that objective is met could only be gauged against a benchmark for the natural state, namely, representative protected areas that are large enough to conserve natural diversity and dynamics.

Connections. -- Connections refer to the degree to which protected areas are functionally linked to each other. In order to be functional, connections between reserves must provide avenues for dispersal, daily movements, seasonal migration, genetic interchange, range shifts necessitated by changing climatic or environmental conditions, escape to refugia in the case of catastrophic disturbance within reserves, and recolonization following disturbance. Connections could take the form of corridors of similar habitat between reserves, or a hospitable landscape matrix through which flora and fauna can travel and disperse. Little research has actually demonstrated beneficial effects of connections among protected areas; some argue that it is the absolute amount of habitat that is conserved that is important in reserve design, and not necessarily the particular configuration in which natural protected areas might remain. At present, the scientific perspective on this issue is that, until more is known, corridors may be an appropriate precaution against the protected areas being compromised in their role to conserve a natural complement of native species. The extent to which reserves are connected is a measure of the extent to which a protected areas landscape has been conserved, rather than merely a collection of protected islands.

A Checklist of Criteria for State-of-the-Art Reserve Design

From the above discussion of relevant ecological concepts, the following principles are derived to guide a state-of-the-art approach to the design of any protected natural area networks.

Representation. -- A hierarchical approach should be taken to representing biodiversity. The components of this hierarchy are:

a) Major community types should be identified, and more than one example of each should be represented.
b) Within each community type, coarse and fine filter analyses should be used to identify hot spots of diversity.
c) Coarse filters, whenever possible, should be based on the use of several umbrella groups representing different taxa. The most important of these groups to use is plants.
d) Fine filters should identify the locations of rare or endangered species, or species and areas requiring special attention.
e) Disturbed lands should not be excluded from protected natural area networks if they are necessary to meet the design requirements.

Size. -- Core reserves, whose locations are determined by the use of coarse and fine filters should, in general, be large enough to sustain viable populations of all species represented. This should be accomplished by setting minimum reserve size criteria based on one or more the following estimates, in descending order of preference:

a) Minimum Reserve Area for inclusion of native mammal species diversity;
b) Minimum Dynamic Area to include an area several times larger than the largest expected disturbance in the reserve in the foreseeable future.
c) Minimum Critical Area to conserve the minimum viable population of a single species with the largest area requirements.

Boundaries.

a) Reserves should have biophysical boundaries.
b) Core reserves – that meet the minimum area requirement – should be surrounded by one or more buffer zones to minimize negative transboundary effects.

Connections.

a) Core reserves should be functionally connected by undisturbed corridors.
b) The intervening landscape matrix should be managed as much as possible to provide a hospitable wildlife environment.

Nature's Best? The OMNR Approach to Reserve Selection

The component of the *Lands for Life* initiative that deals with selection/expansion of protected areas is *Nature's Best Action Plan*. *Nature's Best* is OMNR's plan to "preserve our wilderness, landscapes, and natural features for future generations" (Ontario Ministry of Natural Resources 1997a, 4). Specifically, the plan aims to "maintain the health of our ecosystem, [and] provide protection of habitat for wildlife..." by regulating identified areas, [and] establishing new parks and conservation reserves . . . " (Ontario Ministry of Natural Resources 1997a, 5).

Completing a GAP analysis for the planning area is recognized as being a central task to the *Nature's Best Action Plan* . GAP analyses are being done in site districts across the planning area for submission to the round tables in each of three sub-regions: Boreal West; Boreal East; and Great Lakes-St. Lawrence. It is not possible to predict all the considerations that will eventually determine the outcome of the *Action Plan* , but some form of GAP analysis appears to be the primary source of ecological work to inform the planned expansion of the parks and reserves network in Ontario. A review of the ecological foundations for any proposed system of protected areas is therefore afforded by a review of the GAP methodology itself. We had a draft copy of *Natural Heritage Gap Analysis Methodologies Used by the Ontario Ministry of Natural Resources* (Crins and Kor. 1997) at our disposal.

Representation There are two main components of the OMNR GAP analysis: the life science GAP analysis, and the earth science GAP analysis. The earth science GAP analysis is aimed at identifying and representing the physical features of the province's landscape that are most indicative of its past and present environments. These analyses assume that there is a relationship between 'earth science diversity' and 'life science diversity', so that ‘earth science diversity’ might be used as a surrogate for selecting areas significant also for ‘life science diversity’, though OMNR recognizes that it is not the intent of the earth science GAP analysis to identify, represent, or preserve any elements of biodiversity.

The life science GAP analysis used landform units – based on surficial and bedrock geology – for a coarse filter analysis, and vegetation types based on Forest Resource Inventory (FRI) maps for a fine filter analysis. Referring to these two sources of information as coarse and fine filter, respectively, is a misuse of these terms. Indeed, the fine filter referred to by OMNR is even coarser than what is typically referred to in the GAP analysis literature as coarse filter information. Even a coarse filter, conventionally defined, would also use distributions of at least some ‘umbrella taxa’ as potential indicators of total species diversity (but see above).

The OMNR methodology makes no explicit consideration of any species distributions. This is especially inappropriate given that data on species distributions of various taxa are currently available in Ontario from the Atlas of the Breeding Birds of Ontario, the Atlas of the Mammals of Ontario, the Ontario Butterfly Atlas, the Ontario Tree Atlas (still in preparation), the Ontario Herpetofaunal Atlas, and the Atlas of Rare Vascular Plants of Ontario. All of these atlases have extensive coverage of the Great Lakes - St. Lawrence planning region on 10X10 km^2 UTM (Universal Transverse Mercator) grid squares. Though coverage in the two boreal planning regions is generally much more sparse, information combined from these six sources would certainly provide much better information on the representation of species in proposed protected areas than is attainable with the OMNR's methodology. Even the Ontario Tree Atlas, more than a year from completion, has species composition data for over 200 10X10 km^2 UTM grid squares and over 2000 species records from the boreal planning regions combined.

OMNR recognized the importance of special features or species – that is, actual fine-filter information – within the stated selection criteria, and correctly observed that information on rare and endangered species in the boreal planning regions is sparse. Still, there is limited attempt to employ what data are available in geocoded format and amenable to such analyses. The use of these data would move the analysis away from the tenuous assumption that earth science and plant community diversity are sufficient surrogates for the actual information.

Disturbed lands were omitted early in the area selection process, though it was acknowledged that, in some cases, it would mean that relatively small areas would be selected. However, OMNR did suggest that restoration of some areas may lead to their inclusion in a reserve system later.

Size. OMNR stated that "[n]o assumptions about minimum size requirements [were made] *a priori*" (Crins and Kor 1997, 2). This, coupled with the stated minimum representation criterion of 50 ha suggests that no consideration of the size requirements for populations (MCAs), sustained disturbance regimes (MDAs), or intact mammal faunas (MRAs) were made.

If the new parks and conservation reserves established in 1997, as a first step in OMNR's commitment to the long-term protection of land are any indication, then their methodology does not adequately address the issue of minimum size criteria. Though Wabakimi Provincial Park is impressively large, and in excess of MCA requirements for mammals, all others fall far below this minimum size criterion. If this trend is continued by the *Lands for Life* process, protected areas in Ontario will only represent a limited fraction of current natural diversity.

Boundaries. No mention of boundaries is made within the OMNR Gap analysis methodology. Most of the 27 new parks and conservation reserves established in 1997 do not have biotic boundaries despite attempts to realize this goal. Once again, the expanded Wabakimi Provincial Park is an exception to this rule. Borders were based on tertiary watershed boundaries and caribou movements, though in some cases adjustments had to be made due to land ownership issues, and human constructs such as railways.

OMNR stated that, despite current debates regarding biological integrity in the discipline of conservation biology, the methodologies described by their report serve to identify core areas only and that the selection of areas must be done within the existing policies and principles. Interestingly however, though hunting, bait-fishing, and ecotourism are prohibited within the boundaries of the old Wabakimi Provincial Park, they are permitted within the park expansion – and within other new Conservation Reserves. Similarly, within the boundaries of the whole of Algonquin Provincial Park, there exist what amount to areas zoned as effectively core, wilderness reserves and other natural environment areas where controlled logging takes place. Insofar as evidence indicates that Algonquin Park appears large enough to have 'absorbed' the local-scale effects of these activities on the integrity of the park as a whole, parks like Algonquin and Wabakimi may serve as valuable models for the establishment of future large protected areas, especially if the alternative is less total land under protection. At any rate, the need for buffers to address boundary issues appears to be able to be well met within current OMNR policies.

Connections. There are no designated connections between any provincial parks, at any scale, and no mention of connectivity within the GAP analysis methodology for area selection.

OMNR advised that "[r]esource management activities on intervening lands must be conducted in a manner that does not compromise the values of these core areas, thereby contributing to the ecological stability of these core areas as well as of the landscape as a whole" (Crins and Kor 1997, 2). This thinking may go a long way to ensuring a hospitable landscape matrix for wildlife, however, it remains to be seen how and to what extent this goal will be accomplished.

Recommendations for *Nature's Best Action Plan*

The following recommendations derive from the foregoing critique of the *Nature's Best Action Plan* based on OMNR life science GAP analysis methodology and the example set by the 27 new parks and conservation reserves in the province:

1. Redo coarse filter analyses for identifying hot spots of species diversity using as many taxa as possible from the list of atlases described above in the section critiquing representation under the action plan. Groups of species within taxa rather than individual species should be used for this purpose. A preference should be given to the use of woody plants as an 'umbrella taxon'. Evaluate the current assumption that 'earth science diversity' and 'life science diversity', delimited presently only by plant community types, are surrogates for evaluating gaps in the distribution of diversity of the many other groups of organisms.

2. Superimpose on the hot spots identified by the coarse filter analysis described above, protected core areas that meet an ecologically-justifiable minimum size criterion. This should be the lower limit of the confidence interval of the estimated MRA for mammals (200,000 ha). The minimum size for at least one protected area in every ecoregion should be based on the estimated MRA for mammals (500,000 ha) of which 200,000 ha could be the core area, and 300,000 ha could be lower-intensity use Conservation Reserves (see 4 below).

3. Areas included in reserves selected by this routine, if previously disturbed, should not be automatically excluded from a protected area network. Nor should they be excluded if they are required to meet adequate boundary or connection requirements.

4. Ensure natural boundaries to parks, and include at least one buffer zone (see 2 above) between the core reserve and the surrounding landscape matrix. Explore the idea of using Conservation Reserves around Provincial Parks in order to accomplish this objective within current OMNR policies.

5. Ensure that protected areas are connected to each other to the greatest possible extent.

6. Monitor the results of the established protected natural area network in terms of population persistence of species, and be flexible to change the network based on these observations.

7. Conduct research to understand the characteristics of a hospitable landscape matrix, and endeavour to achieve this matrix, perhaps through existing policy and law particularly regarding the practice of forestry in Ontario, to emulate natural disturbances.

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