

## ENVIRONMENTAL MANAGEMENT IN PARKS

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(Published Version)

June 11, 1992

Eagles, P. F. J. 1993. Environmental Management in Parks. Pages 154-184 in P. Dearden and R. Rollins, Parks and Protected Areas in Canada: Planning and Management, Oxford University Press, Toronto, Ontario. 336 pp.

## INTRODUCTION

Management of the natural environment of a park is an essential aspect of park administration. Parks are often, but not always, established because of a natural resource that attracted attention. For example, the creation of a provincial park in 1970 in Ontario's Hudson Bay Lowlands was for the protection of significant, low arctic tundra ecosystems (Ministry of Natural Resources, 1977). The presence of an impressive population of polar bears gave the park its name. However, some significant natural ecosystems have been protected in parks almost by accident. The land for Kootenay National Park was given by the province of British Columbia to Canada in return for the building of a highway, resulting in the corridor shape of the park, five miles each side of the highway (Boissonneault, pers. comm.). In later years, after establishment, the importance of the forest and grassland ecosystems that occur in the park became known.

The significance assigned to a natural environment during the early years of a park often guides management policies for many years. In addition, after park establishment the value of the resources is frequently increased by a heightened level of knowledge.

It is important to recognize that the phrase - natural resource management - is value laden. A resource is something that is seen to be of value to people. Following that concept then, a natural resource is a part of nature that is seen to be of value. For example, trees are usually considered to be a natural resource because of the valuable products that they contain, such as wood and fibre.

Conversely, parts of nature that people do not see to be of immediate use are not

considered natural resources. Is the squirrel that lives in the tree a natural resource? Not usually, unless someone wants to hunt it, to eat it or to view it. The concept of a natural resource, then, is inherently anthropocentric. Something achieves this status when people decide that it is of use and therefore of value.

In recent decades, the term natural resources management has been broadened as the changing philosophy of nature starts to include more concern for the processes and all elements of the environment, whether or not they are of immediate use to humans. Within most parks all living and non-living features are given value. This value is ascribed because all elements of nature are seen as being part of the biosphere and therefore part of functioning ecosystems. And since all people depend upon the biosphere for survival, the essential parts of the biosphere are important. The phrase environmental management is now being used to indicate a broader emphasis on all aspects of the environment, not just those seen as natural resources.

Dorney (1989) points out that this change in emphasis is due to a change from a *market point of view*, based upon growth and progress, to an *ecological point of view*, based upon the maintenance of equilibrium between humans and nature. This later view is emerging with the notion that all of nature is of value because it exists. It does not have to be of use to human kind, or even to be known. It simply has to be.

The concept of management is also value laden. To manage is to guide or to control. Typically, it involves the setting of goals, the marshalling of resources, and the taking of actions to fulfil those goals. It is inherently manipulative. Some managers feel that they must interfere, must change the environment or they are not properly fulfilling their management

role. They also argue that given the global forces which negatively impact on the world's environment that: "too many ecosystems need help to survive, or get back into a healthy, functioning, self-sustaining balance. This will require increasingly, active management." (Watson, pers. comm.).

## ENVIRONMENTAL MANAGEMENT

It is instructive to consider typical natural resource management outside parks. A forester, who is managing a woods, sees the trees as the primary focus of attention. Those trees that produce the most valuable commodity for the market are given the highest importance. The goal of management is to produce as many of those trees in as short a time as possible. The entire ecosystem is manipulated towards that goal. Species that interfere with the resource tree are persecuted. Tree herbivores are killed. Competing plants are defined as being weeds and are removed if possible. Abiotic (non-living) elements of the environment are manipulated to produce maximum growth. Fertilizers are added. Water is sometimes added. Imperfect individuals of the important species are culled so only the best remain.

This type of management regime is inherently simple. The goals are clear and unambiguous - to produce the maximum of a particular species as quickly as possible. This is a typical approach to resource management.

What are the implications of such an approach? The value of the elements of the ecosystem is determined by the market place. Those with the highest monetary value are

given an elevated stature within the management regime. This concept is ecologically illiterate. The value of each element to the functioning of the natural environment is not taken into account in the assessment of importance.

The Spotted Owl controversy is an example of the clash of values between those of the resource management and the environmental management approaches. The rain forests of western North America extend from northern California along the Pacific coast through Oregon, Washington, British Columbia and Alaska. This area of rich soils, abundant moisture and temperate climate encourages the growth of magnificent forests of very old, very large trees. Douglas Fir, Giant Sequoia and Western Red Cedar trees attain a magnificence of size and form. The trunks of these trees produce valuable wood products. Therefore, the trees have become a much sought natural resource. The trees have been cut since the last century at a prodigious rate and the amount of old growth forest remaining is shrinking rapidly.

The Spotted Owl lives in these forests, as far north as south-western British Columbia (Godfrey, 1986). The Owl has a large territory of several hundred hectares and is dependent upon the old growth trees. As the forests go, so goes the bird. The bird has no commercial value. It is not made into any household product and is presumably not very good to eat. Therefore, the market place sees it as being an externality, an irrelevance.

The question now asked in the United States and Canada is: "How many Spotted Owls should be allowed to live in the world?" Every Spotted Owl pair that survives takes valuable timber production out of the natural resource economy. The timber industry views the idea of preserving millions of dollars worth of trees for a few owls as being, at the very

least, silly, and more appropriately, as capitalistic heresy.

However, the naturalist community sees the issue differently. One line of their argument is that the owl has a role to play in the ecosystem and it thus achieves value. Another line of thought is that the owl exists and therefore is of value. It achieves its right to exist by being. Humans have no right to destroy this species. Another line of argument is that the owl is an indicator of a mature ecosystem that should be preserved because of the age and stability of that system.

The debate is now in the highest level of officialdom in the United States and Canada. Recent discussions in the U.S. involve the listing of the bird as an endangered species under national endangered species legislation. A hard fought debate between short term economics and long term species preservation is underway. In Canada, the issues are similar. However, Canada does not have national endangered species legislation so this forum is not available for the discussion of the species' future in this country.

Throughout the world similar debates to that over the Spotted Owl are raging around the allocation of the few remaining natural areas. The protection of some of these areas as parks is one of the options, along with agriculture, forestry and urbanisation as other options (Eagles, 1984).

The understanding of the ecosystem and the values placed on this knowledge are inherent parts of management. The values being placed on the ecosystem and its parts are the conceptual underpinning for all the resource allocation decisions.

## ECOLOGICAL FUNCTIONS OF PARKS

Many significant ecological functions are fulfilled by parks. It is important that the associated concepts be understood by both the park visitors and the park administrators. Any management policy must take such functions into account.

### Preservation of Genetic Diversity

Parks play a critical role in the preservation of representative samples of the plant and animal populations that occur on the earth. The system of parks that occurs in Canada protects many samples of different ecosystems. A long term goal is the preservation of samples of every major ecosystem type that occurs in the country.

The parks also protect multiple copies of similar ecosystems in various areas. In this case, each park may capture a slightly different ecotype of a species. For example, across the range of a species there may be different genetic compositions due to varying environmental influences. For example, Peregrine Falcons have several subspecies in the western mountains, the arctic and the eastern forests of Canada (Weir, 1987). It is important, that all the genetic diversity of a species be conserved. Therefore, parks need to be established throughout the country, for the protection of breeding sites of each subspecies of this falcon.

Parks play a very special role when they help conserve the last few members of an endangered species and their habitat. In recent years, it has become clear that parks are too few and too small to fulfil the role of genetic preservation on their own. Other categories of land must also be used in such a way as to serve a conservation function. Forest reserves, cottage country, and farm lands contribute to regional ecological diversity. They must be

managed in the future to continue this contribution.

### Benchmark Protection

The impact of humans on an environment can only be fully understood if there are some relatively unchanged areas for comparative purposes. This pristine area is a benchmark, a term derived from the starting point used by land surveyors when laying out property lines. Parks that have minimum human impacts serve vital roles as ecological benchmarks.

Pristine parks serve as the benchmarks for the measurement of ecological change both within the parks and in nearby areas. A classic example of this has occurred in Killarney Provincial Park in Ontario. Dr. Harvey of the University of Toronto, while conducting research on the fish populations of the park in the 1960's, noticed that the fish were becoming scarce in certain lakes. He noticed that these lakes occurred on the quartzite rocks found in the La Cloche mountains part of the park. Further, the pH concentration of the water in these lakes was decreasing. He postulated that the chemical fallout from the nearby Sudbury refineries might be a cause. The quartzite rocks have very low pH buffering capacity and any deposited acid accumulates in the park's waters.

It has been subsequently discovered that Harvey was essentially correct in his hypothesis; wind borne acids were deposited in the lakes and caused the loss of the fish. However, the source of the acid was industrial activity throughout central North America, not just Sudbury. His work was one of the first examples found of the now well known phenomenon - acid rain. Killarney Park had inadvertently served as a very important water

quality benchmark.

### Conservation of Critical Ecological Processes

Parks often play important roles in the conservation of ecological processes. For example, a park may be an area where water and air are cleaned by the natural ecological processes. The clean air or water is then available for use in areas outside the park. A park may allow for the natural functioning of nutrient cycles and energy flows. The products of these cycles, such as a portion of a wildlife population, will go outside the park.

Many ecological processes are heavily altered by human activities outside parks. It is virtually impossible to study natural ecological relationships within an ecosystem that is under constant stress from human activities. For example, some of the most significant long term population studies of Timber Wolf populations have been in parks, with Algonquin Provincial Park in Ontario a prime example. In this park the wolf and its prey animals, beaver, deer and moose, have not been hunted by humans for many decades, until very recently. However, the logging in Algonquin, which has large impacts on the natural ecological processes, may affect the wolf populations in many ways that are not well understood. Similar long-term Timber Wolf population studies have been carried out in Isle Royale National Park on the U.S. side of Lake Superior. This park has no logging and therefore is probably a better example, than Algonquin, of naturally functioning ecological processes (Watson, pers. comm.).

## Production of Products

Most parks have a role in producing products that are desired by people. These can be consumptively used products, such as a duck hunted in a wildlife preserve, or appreciatively used, such as a duck viewed in a provincial park.

The products can also be clean air and clean water that flow out of the park. One of the justifications for the establishment of Algonquin Provincial Park in 1893 was the retention of forest in the headwater areas of this part of Ontario. The rivers downstream were of critical importance as transportation corridors and the water flow needed to be retained for this purpose. The establishment of the park was the method used for the protection of the water flow. In essence the park 'produces' water flows throughout the year for the use of downstream users.

In recent years it has been recognized that the natural environment contains many undiscovered drugs and medicines. For example, many of the common antibiotics are simply chemical weapons that have been developed by fungi against bacteria. We have taken these drugs and used their bacterial toxicity for our own benefits. The soils, fungi, plants and animals of nature contain countless chemicals that could be of use in the future. Parks can play a vital role by serving as conservatories for these products that are yet to be discovered.

## Sustainable Utilization

Human society has not learned how to live within its environment, in a long-term sustainable way. We, as a species, continue to use up the earth's capital. The production

processes in parks can be used as models for the development of sustainable utilization strategies outside parks. For example, the natural flow of energy through an ecosystem is the result of millennia of evolutionary experimentation. The study of such processes can provide vital insight into how nature has solved the problem of the sustainable utilization of resources (World Conservation Union, et. al., 1991).

### Protection of Unique Features

Through time the diversity of nature's influences has produced unique landscape features. Many parks protect such features. Examples include the massive erosional feature of the Nahanni National Park gorges in the Northwest Territories, the impressive waterfalls at Niagara in Ontario, the valuable fossils exposed in the Burgess Shale in Yoho National Park in British Columbia, the diverse populations of migrating birds at Point Pelee National Park and the very old trees in the Cathedral Grove Provincial Park in British Columbia. It is important to recognize that some of the unique features found in parks were discovered or recognized after the park was created (Boissonneault, pers. comm.).

## ENVIRONMENTAL MANAGEMENT IN PARKS

Environmental resources within parks are seen as being any feature or element of nature. This can be a community type such as a forest, a species such as a Timber Wolf, an individual such as a particular old tree, or an inanimate object such as a fossil. The

assessment of value to the environmental resources in a park is a vital underpinning to all management. Environmental protection policy will depend upon the values of the resources assigned by the managers. The level of recreational use that is allowed will depend upon the resource value ascribed by both the park visitors and the managers.

### Assessing Value in a Park

The setting of value to the environmental resources in a park is done by a variety of means. Ecological value is considered. The role in the ecosystem is assessed. Scarcity of the resource is important. The aesthetic value of a feature is often important. In the mind of the public the aesthetically pleasing Grizzly Bear is seen as being more valuable than the not so beautiful Black Widow Spider.

Commercial value in the market place is usually not the first priority, but is nevertheless important in parks. However, the market for parks has some different characteristics from that used in general resource exploitation. Within parks, nature does not have to be removed from its natural surroundings and modified to become part of the market. There is a market for nature observation *in situ*. Some people do wish to see big trees, alive and growing in the forest. Some wish to see the Spotted Owls and other creatures that live amongst the big trees. These folks are willing to travel to the park to see nature. Others will pay for books with stories and pictures of the trees and owls. Others will purchase videos and watch television shows. Some just wish to know that the trees and the owls exist, even if they never see them in real life. Some will join groups that study trees and owls. Others will

join groups that take political action in regard to lobbying for tree and owl preservation. All of these desires create a market for the products that a park has to offer - observation, learning, reflection and conservation action.

The determination of value to an element of nature in a park is important, but difficult. A discussion of some of the various factors used in determining such value may help to reveal some of the nuances in this debate.

There is a strain of thought that states that **all aspects of a park are of value**, simply because they exist. All species, all landscapes and all ecological processes have inherent value. This concept has recently been recognized as being part of the environmental management activities in Canadian National Parks.

This concept is taken one step further in the use of process management as the underlying philosophy of national parks management. The ecological processes that flow naturally through an ecosystem are the determiners of value. The concept recognizes that we know little of how ecosystems function and that the most prudent course of action is to study and follow the ebb and flow of nature as it exists. This leads to a policy of non-interference in the affairs of nature. Management is typically hands-off nature as much as possible. Therefore environmental management in this context means a study of nature and the management of the park visitor as first priorities. Study is done to better understand the processes. The visitors must be directed so they do not interfere with the natural processes.

There is a strain of thought that states that **all aspects of a park are of value, but not of equal value**. An endangered species is of higher value than a common species. A species at the edge of its range is of higher value than a species in the centre of its range. A

species, landscape or natural phenomenon that is attractive to visitors is of higher value. A beautiful scene is more important than a plain scene. There are many such examples of the assessment of value during the design of park facilities.

An example of the determination of such value can be seen when a visitor facility is conceived. The building of a road to a point of interest in a park is a typical action. The assignment of significance to an area of a park so it becomes a point of interest is a determination of value. One place in nature is given more value than some other place. Therefore, other points become less valuable. The road is destructive to some feature of the park. The location of the road will be on areas that have been determined to be of less value.

Parks are not isolated islands in a sea of tranquillity, as some romantics would like to believe, but they are part of the world's biosphere. This biosphere is under assault by humans and their activities. Therefore, it is not possible to leave nature to its own purposes in a park because the influences coming from outside the park are too big and too important to be ignored. **Active management intervention in nature is inevitable.**

An example of the differing philosophies involved in management might be illustrated by the issue of beach management in Point Pelee National Park. This park is a long funnel-shaped sand spit sticking south into Lake Erie. The entire length of the peninsula is outlined by sandy beaches. The northern edge of the park abuts up against farm fields that were once extensive marshes, but were all drained for the specialty vegetable products that they could produce. In recent years the lake level has fluctuated widely. In the late 1980's the water hit record high levels. During periods of storm, the wave damage was extensive as the waters swept into the dryland forests at the tip and also eroded areas of marshlands that had

been previously protected behind barrier beaches.

Some people felt that the water level changes were a natural phenomenon of nature and that remedial action was inappropriate. Others pointed out that Point Pelee was made entirely of sand that has been deposited by the lake currents. The source of this sand is eroded cliffs elsewhere along the shore. In recent decades this sand source was altered as engineering works were erected to stop this erosion, thereby depriving the park of its continuous source of sand. Part of the beach erosion in the park was therefore the result of interference in a natural system outside the park. Therefore, remedial action was an alternative as the changes were not entirely natural. A third line of argument stated that no matter what the reasons for the changes were, the entire system was too poorly known for accurate predictions to be made.

Here we have a classic example of the types of questions that must be faced. What is causing the change? Is the change natural or caused by humans? If intervention is anticipated, what kinds of alternatives are available? What is the probability of failure or unanticipated consequences of any management action?

What was done at Pelee? The managers stuck to the non-interference philosophy as much as they could, however some action was taken to reduce erosion. Various mechanical means were employed, including rock rip-rap, offshore pilings and concrete structures embedded offshore. These were used to trap moving sand and create shoreline deposition. Unfortunately, the shoreline erosion increased in scope. Beach erosion necessitated the removal of several damaged structures and their replacement by buildings in areas out of harm's way, but at the expense of other park land.

During the same period the U.S. Corps of Engineers were taking a very active intervention approach towards reducing the impacts of high lake level at Presque Isle State Park in Pennsylvania on the south shore of Lake Erie. This park is also a forest sand spit projecting out into the lake. The high water level was affecting this park as well. The Corps dumped millions of tonnes of sand onto the exposed beaches and let the currents move the deposit along the sand spit. This new sand beach acted as a buffer from the action of the lake waves. As a result, this park suffered little from beach erosion. However, the park did not escape unscathed. The high lake level raised the ground water level in the forests thereby flooding the roots of the trees. An extensive forest dieback resulted (Eagles, 1988a).

In 1988 the lake levels started to drop dramatically, thereby removing much of the erosion problem. If the lake level had stayed high, would the park managers at Pelee have allowed the forests to be destroyed? Even if the managers decided to interfere would they have been able to find the money to engineer on a big scale?

The Pelee and Presque Isle examples show that many managers feel that given the vagaries of nature and the omnipresent actions of human society the active intervention in parks is inevitable.

There is a strain of thought that states that it is **our duty to manage nature**. This philosophy holds that man was given domination over the earth and has the right and indeed the obligation to manage nature. This approach is very widely held in many resource extraction communities and in some resource development professions, especially by the older people (Bos, et. al., 1977; Eagles, 1980).

There are many examples of this type of attitude in parks management in Canada.

Rondeau Provincial Park is on the north shore of Lake Erie, half way between Windsor and Niagara Falls (Ministry of Natural Resources, 1991a). This park contains 2500 hectares of mature, southern forest of a type found in Canada only in south-western Ontario (Allen, et. al., 1990). The forest has never been cleared. Early in the 1800's the British military took large quantities of white pine and various oaks but the amount is not known (Woodliffe, pers. comm.). In adjacent areas outside the park, the forests have virtually ceased to exist due to the clearing for agriculture. During the 1930's crews of men were sent into the parks on make-work projects. They set about 'cleaning up' the parks. They removed dead trees and brush. They removed some massive, but imperfect, trees. They removed a tulip tree that was three metres in diameter because it was hollow (North, pers. comm.). Such interference within a natural ecosystem can have negative environmental impacts.

This active interference with the natural environment of a park, based upon some fussy concept of man cleaning up, civilizing or beautifying nature, is still practised in some parks. It is frequent in municipal parks, especially when the grounds management is operated from a horticultural perspective.

### Who Determines Value?

The determination of value is a major part of natural resource management in parks. Who assigns the value is a central issue. A number of possible options are presented.

A typical approach is to let the park staff do it. Most park agencies have highly trained staff who have spent years in the study of natural resources. They are familiar with the agency policies. They may have specialized knowledge. They are often emotionally

involved with park. They often feel very strongly about the significance of various park resources. Maybe they should be given the job.

Possibly, it is best to let independent experts do it. Canadian society is blessed with a high degree of expertise in many fields. Many aspects of natural resource concerns, for example botany, zoology or ecology, are known to highly trained people in universities, in schools, in government and in industry. These people have valuable information and insight that can be brought to bear on a natural resource issue. Maybe they should be given this job because of the strong technical component.

Another approach is to let the politicians do it. In our democratic system of government all park managers have a political master. These people were elected to represent a group of people in a ward or a riding. These politicians are popular in their community. They were elected to carry out certain policies and are quite familiar with the views of their constituents. They are possibly in the best position to do the job. However, it is extremely rare in Canada for any person to be elected directly to a board or commission that governs parks. Such positions are almost always assigned through appointment.

Maybe it is best to let the local community do it. The people immediately around a park are directly affected by whatever policies are put into place. Other resource uses, such as those that are extractive, are often forgone with the establishment of the park thereby impacting the local economy. The park visitors will travel through, visit and will impact on the local community. The local people may know the area well. They have probably lived there for a long time and have seen nature in its many seasons. They are probably already demanding a say in any resource policy. Maybe they should assign the value to the

resources.

Possibly it is best to let the park visitors do it. The visitors are keenly interested in the park. They have taken their valuable leisure time to come to the park. They pay for the privilege of visiting. They may have been visiting the park for many years and have developed unique perspectives. A visitor is often very appreciative of the park and its unique features. Visitors are very willing to give their opinions and often demand to be heard. Some might argue that the park has been established for the use of the visitors. The visitors have a unique position from which to determine resource value.

The potential park visitors form an important group. There are many people inclined to visit but have not been able to visit the park. It is distinctly possible that the park policies are creating an impediment to their visit. Maybe the fees are too high. Maybe the activities that they most desire are not allowed. Maybe they are physically challenged and need special facilities. Maybe they want a more relaxed atmosphere and fewer crowds. Such people are often interested in providing their ideas on how the natural resources should be valued and managed. The potential park visitors might wish to dictate the values.

Parks are often run by large governments, such as the provincial and federal governments. These parks cater to a wide geographical area. The argument can be made that provincial park policies should reflect the view of the people across the entire province. Correspondingly, national park policies should reflect policies of the entire country. Many parks have resources that are of world-wide significance and are in essence important to all people. Therefore, possibly all people should have a say in the assessment of value to park resources.

In practice, park management is influenced by the all of the above constituencies. Natural resource decision-making must be considered within such a context. A decision-making system must be developed that realistically and effectively provides an opportunity for all people in all constituencies to participate. No one group should dominate.

It is worth mentioning that the ecological soundness of the decisions will be largely determined by the values and knowledge of the public. It is therefore critically important that the ecological roles of parks be communicated to and understood by the public.

In actual fact, every major decision in parks or environmental management is ultimately subject to determination by our formal political process. How many people support a particular decision is the telling point for democratic governments. All park managers must be aware of this fact.

There is not yet an adequate procedure for the participation of all peoples in the determination of resource value. It is an accident of past politics that a certain ecosystem is found in a particular country. The survival of the world's genetic diversity is important to all people. Why should not Canadians be involved in the management of parks elsewhere in the world? Why should not people elsewhere have a say in the management of Canadian parks?

Practically, it will be some time until the ecological recognition of parks as part of the world's biosphere affects the functioning of political systems. For the foreseeable future most of the environmental management decisions will be made within the context of the state. Maybe at some time in the future the context will be broadened to include a broader, world-wide constituency.

## EXAMPLES OF ENVIRONMENTAL MANAGEMENT IN CANADIAN PARKS

The best way to understand environmental management in parks is to study practical examples. There are discrete areas of environmental management that have a body of literature and a depth of practical experience. Several of these have been chosen for a fuller discussion along with an example from a Canadian park. These areas of management are: fire, endangered species, vegetation, fish and wildlife, and paleontological resources. Each topic is discussed with a similar format; first an outline of issue, then a range of possible management actions, some relevant examples and finally a few concluding statements.

### Fire Management in Parks

#### Outline of the Issue

Those who value wood products from forests see fire as a negative influence. A forester wants a log and has little use for the tree as ash. Fire can be dangerous to people. Its impact is often dramatic and easily observable. Therefore, fire within a natural ecosystem is seen as being bad. As a result, fire suppression became a common management action. However, in recent decades, ecologists have started to recognize that fire is a natural component of most terrestrial ecosystems. Some species are dependent upon fire. The cone of the Jack Pine does not open to release its seed until heated by a fire. Such an adaptation is advantageous to a species frequently exposed to fire. It is now recognized that the boreal forest, of which Jack Pine is an important part in Canada, is a fire-adapted ecosystem. These forests burn at frequent intervals and have done so for millennia.

The suppression of fire can cause unanticipated results. In a forest without fire a deep

layer of leaves, branches and other organic litter develops on the ground, creating a fuel inventory. When a fire does occur it may be very extensive and very hot. As a result the impacts may be stronger than the ecosystem normally encounters. The massive fires in the forests of Yellowstone National Park in the summer of 1989 are an example. Almost one half of the park's forest burned in one short period of intense fire (Jeffery, 1989). This fire occurred during a very dry period and fed on fuel created by decades of low fire occurrence. Many parks are now developing new policies that recognize fire as part of the ecosystem functioning (Canadian Parks Service, 1986; Day, et. al., 1990).

#### Possible Management Actions

The modern fire management policy in parks attempts to mimic the natural fire regime. However, since fire has been suppressed for decades the natural regime is not known. The fuel load is often large and the forests are ready for a heavy, intensive burn. Before any management action is taken, an assessment of the frequency and role of fire must be done. How often do fires normally occur? How do they burn? Are they small, local fires? Are they large, intensive burns? What kinds of impacts are anticipated? Once the research has been done and the questions answered a fire management regime is developed (Hawkes, 1990).

Many managers now face the difficult proposition of reintroducing fire into the ecosystem. This has to be done under very carefully controlled conditions. There are often buildings, trails and other facilities that are too valuable to lose to fire. The forests are ready to burn and when ignited might burn out of control. There may be forests outside the park

that are valuable for timber. Public safety is also a major concern. An important consideration for the introduction of fire into an area is the fire control capability of the park management.

It is possible to alter the ecosystem by physical manipulation, instead of allowing fire. For example, fuel loads can be picked up and removed. This may be necessary in areas of heavy fuel load around sensitive features, such as buildings or prize trees.

### The Banff National Park Case Study

Banff National Park started planning for the use of fire in 1979, followed by the other national parks in the system. The 1989 policy provided a national direction for fire management (Canadian Parks Service, 1989). In Banff the decision was made to concentrate the early planning in the lower Bow River Valley. Any fire planning here had to deal with a complicated and challenging situation. The forests in this area are prone to fire, surround the Town of Banff and constitute one of the most heavily used portions of any Canadian national park. Fire had been suppressed for a long time.

One of the first jobs was to try to discover the past periodicity of forest fire. This was done by looking at fire scars on old trees and at information from other, similar locations. The size and intensity of past fires was estimated. Out of this came a simulation of past forest fire behaviour (Lopoukhine and White, 1985).

The planners then developed a vegetation plan. This outlined what kind of vegetation communities that the Bow Valley should have. The valley vegetation was mapped into vegetation ignition units. A time for the burning of each unit was chosen randomly. A plan

was put into place for the burning of the various units at different times up to the year 2035 (Lopoukhine and White, 1985; REMS Research Ltd., 1988).

### Concluding Remarks

Fire management is now a well accepted concept by most ecologists. However, the Smokey the Bear anti-fire campaign of the U.S. Forest Service and similar efforts in Canada have made their impact on public opinion across North America. Many of the public are against burning the forests, for any purpose. This can be a stumbling block to the purposeful introduction of fire. Many managers are finding that they can overcome this reticence with a carefully conceived public education program before any fire introduction program starts.

### Endangered Species Management in Parks

#### Outline of the Issue

A species is endangered when its numbers are so low there is a real possibility of extinction in the immediate future. Typically, such species have reached this level due to loss of habitat and the loss of many individuals from an earlier, larger population. Most frequently, this loss has been due to landscape and population modification by humans. Some of the causative factors include over-hunting, habitat clearance for agriculture and urban development, the introduction of foreign competitor species, the introduction of a disease, the loss of a food species or the inadvertent killing of individuals during industrial or commercial activities. Whatever the reason, the result is the same - a population in such low

numbers that a permanent loss is imminent.

There are many examples in Canada. The Passenger Pigeon was extirpated due to a combination of hunting overkill and the loss of its broad-leaved forest habitat in eastern North America. The Great Auk, a flightless, fish-eating bird, was the North Atlantic ecological equivalent of the penguin of the South Atlantic. This bird nested on islands and was routinely killed by sailors. The species was wiped out by 1844 (Burnett, et. al., 1989). The Gravel Chub was eliminated when its habitat, the Thames River in southern Ontario, was polluted by the silt from agricultural operations. The wildflower, known as the Blue-eyed Mary, was eliminated as its forest habitat in southern Ontario was cleared for agriculture (Burnett, et. al., 1989). Many species of plant and animals were lost from Canada due to the destruction of forests, prairies and wetlands across the country.

Endangerment is increasing. As natural lands throughout the world are modified, many species are becoming rare. King (1981) lists 437 species of birds as endangered. This is 4.7% of the 9250 species that occur in the world. A similar situation occurs for most other groups of animals and for plants. The Global Diversity Strategy (World Resources Institute, et. al., 1992) estimates that over the next 3 decades as many as 60,000 plant species, or 25% of the world's total, may become extinct if the present rate of deforestation continues.

### Possible Management Actions

Many parks in Canada play a critical role in protecting the populations of endangered species and the habitat on which they depend, as described by Theberge in Chapter \_\_. In recent years, the protection of critical ecosystems for rare species has been a major emphasis

for the establishing of many new parks and reserves. The Committee on the Status of Endangered Wildlife in Canada has the job of assessing the rarity of Canada's flora and fauna. Before a species' status is determined, sufficient information must be collected on its past and present geographical distribution. The current range is then compared to the historical range to obtain an idea of the extent of change that may have occurred.

The Breeding Bird Atlas of Ontario is an example of a document that assesses the geographical distribution of every bird that currently breeds in Ontario (Cadman et. al., 1985). Similar compilations are underway in other provinces. This type of data shows the existing range, and is very useful as a benchmark for the determination of future changes.

The Nature Conservancy of the United States and the Nature Conservancy of Canada have taken on the mammoth task of evaluating and ranking every species in North America. They work within each province and state and provide a rarity ranking for each species. The creatures are ranked within the province, the country and globally (Hoose and Crispin, 1990). The Nature Conservancies use this information to determinate which lands are the most critical sites for acquisition. They then raise the money, purchase the land and either manage the land themselves or give it to a park agency.

Ontario has an Endangered Species Act. This law stipulates that no endangered species or its habitat may be harmed. It applies across the province and to all land owners. It does not apply to Indian Reserves, as they are under federal jurisdiction (Woodliffe, pers. comm.) Each endangered species is placed under the powers of the Act by designation by regulation. The Ontario Act has been limited in its impact by a very restricted designation of endangered species and by spotty enforcement. However, the Act is powerful, and is

potentially very useful for endangered species protection.

To get a fuller understanding of the ability of a species to survive, a wide range of information is needed. The general habitat characteristics of the species must be assessed. This will include information on such things as its preferred climate regime, its interrelationships with other species, its preferred food, and its breeding characteristics. The existing threats to survival must be understood. The possible impacts of conservation actions and outdoor recreation activities must be assessed (Woodliffe, pers. comm.).

Many provinces in Canada have established ecological reserves for the specific purpose of protection of important examples of ecosystems. Taschereau (1985) documents this effort in his excellent summary of the status of ecological reserves in Canada. Ecological or nature reserves have special roles to play in the protection of endangered species. Other parks are also important in this regard, as illustrated by the following examples.

The Whooping Crane is a large, white crane that has been badly affected by over hunting and habitat loss. Wood Buffalo National Park, in northern Alberta and southern Northwest Territories, contains the only nesting area in the world for this endangered species. The park places very high emphasis on keeping disturbance to the nesting areas to a minimum. After nesting, the adults and the young migrate to Aransas National Wildlife Refuge, on the gulf coast of Texas, for the winter (Godfrey, 1986). This species has both its critical breeding and wintering habitats protected in parks.

The protection of endangered plant populations is often the focus of parks establishment efforts. For example, there are only 3 populations of the large Whorled

Pogonia in Canada (Burnett, et. al., 1990). The largest of these is protected in the famous Backus Woods Conservation Area, near Simcoe, Ontario, administered by the Long Point Conservation Authority. All 3 populations in Canada of the endangered Spotted Wintergreen are on protected lands. One is in Wasaga Beach Provincial Park and 2 are in reserves on the St. Williams Provincial Forestry Station. One of the latter areas was bought from a private landowner in 1989 for the specific purpose of protecting several endangered butterfly, wildflower and tree species.

Often the forces causing population reduction are very difficult to stop or deflect. The populations are so low that extreme caution is necessary. All of this is usually complicated by a paucity of biological information. The use of a case study example of the management of an endangered ecosystem type and its associated species can reveal some of the issues surrounding such an activity.

#### The Ojibway Prairie Nature Reserve Case Study

Prairie is an open landscape dominated by herbaceous plants and with few trees. This community type is rare in Ontario, but a few significant remnants have survived agricultural clearance in south-western Ontario. One of these occurs within Windsor. When the rarity of the vegetation in this area became recognized, suggestions were made for the establishment of a park. In 1957 Windsor acquired 44 hectares of oak woods and oak savannah, later named Ojibway Park. Facilities such as a picnic area, 2 parking lots, a nature interpretation centre and many trails were constructed. In 1989 the city purchased an additional 52 hectares of an area known as the Black Oak Woods. As more information was collected on the prairie

communities in the area, the Ministry of Natural Resources became involved. Starting in 1971 the Ministry started an active land purchase program that has continued until the present time. Much of the land purchase has been assisted with funds from the Nature Conservancy of Canada. As of 1990, 81 hectares have been bought for the Ojibway Prairie Provincial Nature Reserve and an additional 25 hectares were under active negotiation (Woodliffe, pers. comm.). In total, the city and the Ministry have 187 hectares of the prairie preserved as parkland.

This type of prairie once covered an estimated 1,000,000 square kilometres of North America (Woodliffe, pers. comm.). As only .16% of the original area is now officially protected, there are vigorous efforts to protect prairie remnants throughout the US midwest (Woodliffe, pers. comm.). Hence, the Ojibway Prairie is of national and international significance. These 2 small parks in Windsor contain half of all the prairie plants known to occur in Ontario. A total of 533 species of plants occur in the area, which is approximately 13% of the flora of Canada (Pratt, 1979). Up to the present time 103 species of plants that are considered to be rare in Canada or Ontario have been found (Woodliffe, pers. Comm.).

The development of management policies for such a unique and interesting area is a considerable challenge. The Ministry of Natural Resources, with the cooperation of the Parks and Recreation Department of the City of Windsor, undertook a detailed investigation of the site. This included: tracing the history of prairie development in Ontario, vegetation community mapping on the site, and detailed inventories of the plants, birds, mammals, reptiles and amphibians. Once the state of the environment had been determined policy development could take place. Detailed recommendations were made for the long-term

maintenance and restoration of the prairie (Pratt, 1979). This was followed by a resource management plan (Ministry of Natural Resources, 1991b) which included directives on land acquisition, recreation use, archaeological and ecological research, derelict site restoration, exotic plant removal, groundwater monitoring, reintroduction of extirpated species, pet control, trail management, environmental education, vegetation management and biological inventories. The goal of the resource management plan is: "to ensure the protection and perpetuation of an outstanding example of tall-grass prairie, oak savannah and prairie ecotone communities within Ojibway Prairie provincial nature reserve through various maintenance, rehabilitation, and restoration management techniques" (Ministry of Natural Resources, 1991b).

The vegetation management section of the plan points out that the maintenance of prairie communities requires active management to keep in check undesirable woody and herbaceous plants. The possibilities for vegetation control include: natural fire, woody stem cutting, artificial fuel burns, herbicides and mowing. Prairies are typically fire succession communities. Fire periodically burns across the grasslands killing most trees and shrubs. A lack of fire allows the woody vegetation to invade and subsequently shade out the herbaceous ground dwelling plants. This ecological succession is now taking place at the Ojibway Prairie. The implementation of a burn policy is difficult because the prairie is now an urban park surrounded by home owners who are not always sympathetic to the thought of a forest fire being encouraged nearby. The policy suggests using very small burns under rigorous control, with lots of fire suppression capability near at hand (Pratt, 1979). Since 1982, the Ministry of Natural Resources has been able to carry out successful prescribed

burns in 5 different years. Approximately 80% of the reserve has been treated in this way. The public opposition appears to be becoming less as the local residents see the results and the professional manner in which it is conducted. Mowing and herbicides have not been used, but herbicides are being considered on persistent foreign species such as Black Locust. Some cutting has been done in areas where the woody thickets are too thick for proper fire action (Woodliffe, pers. comm.).

### Concluding Remarks

The Ojibway Prairie complex is a good example of the role of parklands in protecting endangered species and their habitats. The site also shows municipal and provincial park agencies' cooperation on a joint conservation and environmental education goal. The environmental education program is noteworthy in its goal of fostering a community appreciation for this prairie ecosystem. The role of detailed and thorough research in the development of management policy is clearly visible.

### Vegetation Management in Parks

#### Outline of the Issue

The management of the trees, shrubs, grasses and wildflowers is one of the critical issues in resource management. All wildlife ultimately depend upon the structure, form, distribution and amount of plants. The vegetation is also important to the scenic form of the landscape.

## Possible Management Actions

There are three levels of intervention in vegetation management theory. One is the hands off approach. The forces of nature determine the vegetation structure and the manager should try to have as little impact as possible. A second is that some minor management is necessary. For example, dangerous trees pose a safety hazard and are removed. Fertilizers may be needed in areas of heavy visitor use. Some plants must be removed when facilities are constructed. The third is that major intervention is necessary. This approach argues there may be good reasons for changing the vegetation. It might be desirable to reintroduce an extirpated plant species. A rapidly invading foreign plant may need to be aggressively fought. It may be desirable to change the habitat to create ideal conditions for an endangered wildlife species.

The amount and direction of plant community manipulation is under constant debate. Canadian National Parks and many provincial parks often attempt to follow the first of these approaches - as little intervention as possible. However, as the fire management policies in Banff show, active intervention through the introduction of burning is contemplated in order to correct the past intervention of fire suppression. Wilderness parks, nature reserves, natural environment parks and ecological reserves usually have hands-off approaches.

Many provincial parks follow the second of these approaches - medium amounts of intervention. Parks that have many visitors and intensive visitor facilities will have unavoidable impacts on the vegetation. Heavy use areas may require turf management. Trail and roads are constructed and will drastically change the vegetation in their immediate

presence. However, when the visitors use the constructed rights of way the traffic pressure on nearby areas will likely be reduced. The restoration of derelict sites, such as old farms, may be encouraged.

Some provincial parks, many wildlife areas and most municipal parks follow the last of these approaches - major intervention. Two Ontario provincial parks, Algonquin and Lake Superior, are logged, along with extensive road construction for logging access. The official government policy allows this logging because the economic impact of logging is large. Active recreation sites, such as the golf course in Turkey Point Provincial Park on Lake Erie, results in extensive ecosystem change. In Pinery Provincial Park on Lake Huron a forest burning program occurs to remove thousands of White Pine trees that were planted, mistakenly, during the 1950's and 1960's.

Wildlife area managers actively and aggressively change the vegetation to enhance wildlife habitat. In the Long Point National Wildlife Area in Lake Erie the lake shore marshes were extensively dyked. This was done so the water levels could be manipulated to create ideal conditions for the maximum production of huntable waterfowl. In Luther Marsh Conservation Area north of Arthur Ontario, extensive damming of creeks has resulted in the creation of large, rich wetland communities on the site of former farm lands. These wetlands are valued for the ducks that breed and stop here during migration. In Killarney Provincial Park along the shore of Georgian Bay, the forests in the park were extensively cut to produce shrubby conditions for the winter browse of huntable White-tailed Deer populations. This type of manipulation for the encouragement of a particular species is quite common for managers who service the needs of the hunting community.

All vegetation management should be based upon a thorough knowledge of the plants that occur in the park, and their distribution. The basic life cycle of each plant should be known. The dynamics of the vegetation communities must be understood. Any active intervention without this information is blind and will have unanticipated and possibly disastrous consequences.

### The Long Point Wildlife Area Case Study

Long Point is a peninsula in the eastern reaches of Lake Erie. On the north-eastern side of the point, in the lee of the winds and lake currents, extensive marshes have developed. These have been known to hunters and fishers for centuries. In the last century a private company, the Long Point Company, started operating the majority of the point as a private hunting preserve.

In 1973 the Big Creek National Wildlife Area was established at the base of the peninsula. In 1979 a large portion of the Long Point Peninsula was donated to the Canadian Wildlife Service by the Long Point Company and the Nature Conservancy of the United States. This became the Long Point National Wildlife Area. These two areas are now part of a system of over 40 Canadian National Wildlife Areas (McKeating, 1982)

The management plan for the Big Creek National Wildlife Area states several management goals. Goal number 3 speaks directly about management of the site for waterfowl. Management goal number 3 states:

To create, maintain or enhance a high quality habitat complex for waterfowl and other marsh-dependent wildlife species with emphasis on the provision of staging habitat during the spring and autumn waterfowl migrations (McKeating and Dewey, 1984).

This goal was the basis for a proposal to manipulate the marsh vegetation in the wetlands. The 1982 management plan stated that:

Management of the National Wildlife Area will be undertaken to provide optimum habitat diversity for the benefit of all wetland dependant wildlife. An ideal marsh environment is one that approximates a 50/50 ratio of open water and vegetation.

CWS has concluded that the marsh will be greatly enhanced for wildlife purposes if it actively intervened in the natural processes of the marsh (McKeating and Dewey, 1984).

Management actions have included the construction of large water control dykes, the mechanical removal of stands of emergent vegetation, the manipulation of water levels, the creation of open water areas, channelization, dredging of ponds and channels and the stabilization of the barrier beach along Lake Erie.

Ducks Unlimited, a duck-hunter lobby group, agreed provided financial help for the site manipulation. This conservation group raises its funds from interested hunters throughout the United States and Canada. This money pays for the acquisition and management of wetlands. The primary purpose of the work is the production of waterfowl for hunting, but many other wetland species benefit from the wetland protection.

However, alterations that suit one species will not suit all species. There is a rare species, the Prothonotary Warbler, that breeds in the woodlands near the marshes (Eagles and McCauley, 1982; Eagles, 1988b; McColeman and Eagles, 1990). Will its habitat be flooded or changed so that the trees die? If this happens, the Warbler breeding habitat will cease to exist and with it the warbler. Will the dykes affect the ability of the Northern Pike to move from the lake to the marshes to breed each spring? These types of impacts on non-

target species are often controversial spin offs from any single species management program.

### Concluding Remarks

The development of vegetation management policy is fraught with challenge. The basic policy of the park will determine the range of options that are considered. Past landscape management actions have created the canvas upon which new policies must be painted. An understanding of the existing vegetation conditions and their history is needed before any changes are considered. Any active intervention will have considerable amounts of anticipated and unanticipated outcomes. All actions must be carefully monitored to measure the changes.

### Fish and Wildlife Management in Parks

#### Outline of the Issue

The animals that live in, on and over the park are an essential component of natural ecosystems. Wildlife viewing is one of the most valued experiences by many park visitors.

All parks play a role in the maintenance of fish and wildlife populations. Some parks play critical roles for some species. Canadian parks play important roles in the protection and maintenance of fish and wildlife populations on a global scale. A few of these roles are worthy of discussion.

Large species of wildlife typically require extensive habitat areas. The Grizzly, the Wolverine and the Timber Wolf are upper level predators that need large territories. Some

Canadian parks protect sufficiently large areas that these species can fulfil all of their life cycle requirements without leaving the parks. In addition, many of the parks are remote and there is acceptable habitat in areas next to the parks.

In recent decades parks have become the only safe refuge for large animal species. For example, in the U.S. the Grizzly Bear and the Timber Wolf are almost extinct from the lower 48 states. The Bear is only found in the Yellowstone National Park ecosystem and in Glacier National Park. The wolf is largely eliminated from the lower 48 states except for Minnesota, Wisconsin, upper Michigan, Glacier National Park and the Flathead National Forest in Idaho (Savage, 1988). Even here, the few remaining animals are under constant hunting attack (Anon, 1990).

Fortunately, the four contiguous Canadian National Parks in the Rocky Mountains, Banff, Jasper, Kootenay and Yoho, have populations of the complete complement of the big predators that occurred at the time of the European invasion. Mountain Lion, Grizzly Bear, Black Bear and Timber Wolf still occur. No parks in the United States, south of Alaska, still contain all of these species. This fact gives these parks a vital wildlife conservation role of considerable international significance.

Parks play an important role in the conservation of all wildlife species, whether large or small. However, the land use around the park is often critical to the survival of the wildlife in the park. Most wildlife move in and out of the park during various parts of the year. When a park becomes a green island in a sea of hostile habitat, such as an urban park surrounded by houses, some species are unable to cope.

Those parks that do not allow hunting are particularly important, as virtually all other

public lands all subject to hunting. Only here can wildlife research be done on populations that are subject to relatively natural ecological forces. The lack of hunting is critically important to wildlife viewing as the animals do not fear people and therefore relatively easy to observe. However, it must be recognized that the lack of hunting does not ensure a pristine condition. Most wildlife populations are exposed to hunting and other influences in the part of their life cycle that take them out of the parks.

The lack of hunting can cause interesting results. In smaller parks, the predators of large herbivores are often absent. As a result, the herbivore populations can build up to very high levels. An example of this phenomenon can be found in the 3 sand spit parks on the Canadian side of Lake Erie. Long Point National Wildlife Area, Rondeau Provincial Park and Point Pelee National Park all experienced very high populations of White-tailed Deer in the 1980's. The deer numbers got so high that major negative impacts on the forest vegetation started to occur. Tree species with edible seedlings stopped reproducing as all seedlings were devoured. Some species of very rare herbaceous plants were harmed by the deer browsing. The park managers contemplated deer removal approaches. In Long Point a recreational hunt was introduced. At Pelee the park wardens culled the herd. No action at Rondeau was undertaken due to conflicting public pressures.

#### Possible Management Actions

There are many management actions commonly used for fish and wildlife management in parks. Any management must start with knowledge of the numbers and range of the species in question. All parks should have information collected on the flora and fauna

that occur in the park. This varies from the informal recording of observations by staff and visitors to highly sophisticated research programs using computer data base management and geographical information systems. Parks develop fish and wildlife management policy based upon knowledge of the resource, incorporating the legal mandate of the park system and using the policy framework of the park. Parks have an administrative arm that implements the policy. It is important to have a policing function that enforces the rules. And finally there is a monitoring need to measure the sufficiency of the policies and their implementation impacts.

#### The Fundy National Park Case Study

Salmon, in the Pacific, Atlantic and Arctic oceans, migrate into freshwater for spawning. Fundy National Park is located in New Brunswick on the shore of the Bay of Fundy. The park contains clear, freshwater streams that attract spawning Atlantic Salmon. The Salmon spend three years of their life in the streams, then go to sea for one or two years. When they reach breeding age they migrate back to their ancestral river to spawn.

Fundy National Park policies recognize the significance of the park's streams to the salmon. The Canadian Parks Service tries to maintain the water quality to the highest possible standard. The Service has a research program aimed at measuring the number of spawning salmon and the survival rates of the young. In recent years park officials have found a decrease in the numbers of spawning salmon. The park has been instituting a catch and release program in an attempt to avoid harming the population. The fishermen in the park are not allowed to keep any fish that are caught.

In 1986, Atlantic Salmon returned to the Point Wolf River for the first time in over 100 years. A logging dam that had prevented salmon from entering the river had been removed. For three years prior to the removal, the river had been stocked with juvenile salmon obtained from adjacent rivers. The juveniles were able to go downstream, over the dam. After one year in salt water, the first grilse salmon returned to attempt to spawn in the river (Woodley, pers. comm.).

This reintroduction program was successful, but the rate of return was much lower than anticipated (Woodley, pers. comm.). The reasons are unclear but the low return rate occurs in all local rivers, not just Point Wolf. It is possible that survivorship at sea is low due to overfishing, or other, unknown factors. These Atlantic Salmon reveal an important ecological fact - parks are connected with the environment around them. Fundy provides critical spawning habitat. However, this is not sufficient to totally protect the salmon populations. The fish population is being heavily exploited in the open ocean and therefore has a reduced opportunity to renew itself.

#### The Algonquin Provincial Park Case Study

The Black Bear is a common inhabitant of the forests of central Canada. Algonquin Provincial Park in Ontario has a robust population of these animals. The chance of seeing a Black Bear is of importance to many of the visitors to this park. Black Bears are hunted everywhere in Canada, except in most parks. As a result, most are wary of contact with people. However, in a park as large as Algonquin it is possible for the majority of the bears to live their life without being subject to hunting. As a result, the animals have little fear of

people.

Black Bears are large and potentially dangerous animals. They are omnivorous animals, eating copious amounts of berries and seeds, but are quite willing to take a meat meal if presented with the opportunity. Algonquin has many canoe campers each year. Bears have learned that campers carry food that is usually quite easy to get. As a result a bear 'problem' has developed as the campers' food is stolen, often with equipment damage during the theft.

Typically, the bears do not bother the people directly, as long as the people stay out of the bears' way. Atypically, Black Bears attack people. Herrero (1985) has documented the death of 26 people caused by Black Bears in North America from 1900 to 1983. On May 13, 1978 three teenaged boys on a fishing trip in Algonquin were killed. One other boy survived and provided details. A 276 pound male bear was later shot and positively linked to the boys' deaths. Herrero (1985) concluded that this bear killed the boys as food. There was no evidence that the bear was old or diseased, two factors often thought to drive bears to attack people. It was a healthy male that decided to stalk human prey.

The management of the interactions between park visitors and dangerous animals is a special and important concern. The management response of the park to such a situation has several options.

Bears that develop dangerous habits are often killed to avoid the chance of dangerous interactions. This approach has become less acceptable in recent years as the concept that the animal has a right to exist, became prevalent. The practice now is to only kill specific animals that pose a strong threat. This might apply to aggressive, injured or diseased

animals. Animals that actually injure or kill people are usually killed. The public is informed, through the interpretive program of the park, of the danger of bears. Appropriate camping procedures are encouraged to lessen the potential of attracting bears to a campsite. Education of visitors about the danger and means of minimizing the danger has become widespread. The restriction of visitor activities is also becoming common and accepted. In some parks, visitors are not allowed to enter certain areas when grizzly sows with cubs are present. In other parks, visitors must be accompanied by guards when they visit locales that have dangerous animals. In parks where visitors travel by vehicle, no egress from the vehicle is allowed.

It is generally accepted that in parks the visitors have to learn to accept the environment as it is. They must learn to adapt to the ways of nature, and not to have nature changed for their needs. Not all visitors agree that they should take the environment as they find it. Some feel that all dangerous animals should be removed. Others feel that the park management has a duty to protect the visitor from any harm that might come their way from such animals. The Canadian Park Service has been sued by a park visitor that was injured by a bear in a mountain national park.

### Concluding Remarks

In the Fundy and Algonquin examples, the fish and the wildlife management problems are actually human management problems. The salmon do not need management, except that people are killing so many individuals that the population is declining. The bears do not need management, except that people are going into bear habitat and negative

interactions sometimes take place.

## Paleontological Resource Management in Parks

### Outline of the Issue

Parks often have significant abiotic resources. Mountains, rivers, rocks and fossils are all examples of non-living resources that occur in parks and require special consideration. Canada has important fossil occurrences in some parks. The Burgess Shale in Yoho National Park is a World Heritage Site. This shale contains the most significant early Cambrian fossils found in the world. Their analysis has fundamentally altered our understanding of the earliest evolution of soft bodied animals (Gould, 1990).

The collection of fossils is important to the science of palaeontology. In addition, the private collector is often quite willing to pay large sums for prize fossil specimens. The methods of determining who can collect fossils and under what conditions is a vital aspect of management since some methods can be destructive of the remaining resources. Some of early collection practises at the Burgess shale were very destructive to the resources collected and to the surrounding landscape.

### Possible Management Actions

Within Canada, several parks have been established for the specific purpose of conserving and interpreting fossil resources. The park provides a means of assuring constant protection of the fossil resources. Specimen collection, as well as overt vandalism, is a

constant threat to fossils. The park administration can provide a degree of protection. The interpretation of the significance of the fossils to the public is an important facet of park operation. The provision of a site for long-term scientific research and collection can often be done within a park.

### The Dinosaur Provincial Park Case Study

The badlands of southern Alberta are a spectacular series of valleys and hills. They were created over the centuries by water erosion of dry soils. The rainfall and the rivers have carved deep into ancient fossil strata. The resultant exposure of the fossil specimens has created a situation of relatively easy access to the buried specimens.

Dinosaur Provincial Park in Alberta was created for the specific purpose of protecting a large tract of badlands. These areas contain many examples of rare species in the semi-desert environment. Native peoples have used the area for millennia. Most importantly, the badlands contain one of the world's most important deposits of fossilized bone. The fossils are often well preserved specimens of dinosaurs from the upper Cretaceous period.

The park fulfils a vital protection function. The park staff monitor all activities and ensure that no unlicensed fossil collection takes place. In addition, the most important fossils are protected from natural degradation caused by weather until the time they can be studied or removed for museum conservation.

The park plays an important scientific function. Over 300 complete and nearly complete dinosaur skeletons have been found and removed from the general area in the last 80 years. These specimens are found in major museums around the world. Prospecting is

continuing and during an active summer an average of 6 new skeletons will be found, of which 30% are good specimens. Thirty-five different dinosaur species have been found within the park. The bones of hadrosaurs are particularly abundant (Alberta Provincial Parks Service, undated). Excavation of important fossil assemblages is constantly underway. In cooperation with the Tyrell Museum of Palaeontology there is an active field research effort.

The park plays an important educational function. Dinosaur Provincial Park is the best place in Canada for a member of the public to observe fossils *in situ* and to see fossil excavations underway. In addition, interpreters with special paleontological training provide enriching educational programs. The park managers have control over the fossils under two pieces of provincial legislation. The Provincial Parks Act prohibits the collection, removal or damaging of any geological specimen. The Historical Resources Act states that all archaeological and paleontological resources within Alberta are owned by the province. This Act also states that no person shall make an excavation in Alberta for the purpose of collecting historic resources unless the person has a valid permit (Thesen, 1990). In 1987 one person was prosecuted for the unauthorized collection of fossils in the park (Alberta Provincial Parks Service, undated).

To restrict and control access to the most important fossil areas one third of the park has been designated a Natural Preserve. Access is only allowed for specialized uses such as: scientific research and collection, guided interpretive tours, and approved photographic work. However, the enforcement of the restrictions in the Natural Preserve is not as complete as the Parks Service would like. There is a feeling that illegal collection may be occurring because of a lack of staff to maintain a sufficient level of field patrol through the

more remote backcountry areas of the park (Alberta Provincial Parks Service, undated).

### Concluding Remarks

Dinosaur Provincial Park is an example of a specialized environmental management operation. The resource management functions in this park include resource protection, scientific research and public education. These functions are not unique to Dinosaur Park. Similar functions occur in all parks. What is unique is the paleontological subject matter. The significance of the fossil resources was fully recognized when UNESCO placed the park on the World Heritage List in 1979. A World Heritage Site is of such a high level of importance that it is seen to be of value to all of mankind.

## NATIVE RIGHTS AND LAND CLAIMS

In recent years it not uncommon to have new parks established with native peoples' use continued. The Supreme Court of has recently affirmed the hunting and trapping rights of native peoples as found in treaties. Such rights are subject to the requirements of conservation (Bartlet, 1990). What are the implications for environmental management? A primary question involves who determines the amount and location of use.

In some parks it will not be possible to have wildlife populations that are free from hunting and fishing. This has enormous implications for the functioning of the ecosystems in these parks. It will also severely retard the park visitors' ability to view and appreciate the animals. An example is Algonquin Provincial Park in Ontario where some groups of native

people have now gained hunting access to the wildlife.

This issue is under rapid evolution. The next decades will see a considerable amount of debate and change in this aspect of park management. (Both Berg, Fenge and Dearden as well as Eagles discuss this issue elsewhere in this volume.)

## INFORMATION FOR MANAGEMENT

In all environmental management there is a critical need for information. In any decision-making process there are several critical steps where resource information is necessary.

Baseline information is needed on the characteristics of the environment. Before any environmental feature can be assessed the following questions must be answered:

How much is there?

Where is it?

How has it changed over time?

How does it relate to other aspects of the environment?

What types of information should be collected?

How much information is necessary to solve the problem at hand?

Eagles (1987) studied the use of natural resource information in the planning and management in the national parks of Canada. The research found that the Canadian Parks Service has an information base that is adequate for the demands placed upon it, and it is well used. This information has been transferred to computer data base storage and linked to

the impressive manipulation and display capabilities of geographical information systems. This later technological advance allows for the analysis and presentation of mapped information with a computer. It has become very useful for the manager who wants to translate raw, field data into useful, trend information.

Thorsell (1990) has suggested that a manager needs accurate biophysical information on five different areas before management decisions can be made: basic inventory, species needs, ecological relationships, monitoring and dynamics of change and predictive manipulation of ecosystems.

The basic inventory provides estimates of the most important natural features of a park, the plants, animals, soils and geological phenomenon. The inventory should estimate numbers and indicate spatial density. Any threats to the natural environment should be identified.

The special needs of those species that are of special management significance should be identified. This includes rare species and those of particular culture significance.

Information on the ecological relationships of key species is needed. This includes key predators, species of high visibility, endangered species and species with particular importance in the food chain.

It is possible that changes are underway in the ecosystem. The monitoring of such change is necessary. New species may be invading. Erosion may be underway. Water levels may be changing. Such changes might have significant impact on the ecological functioning of the ecosystem.

Where the changes that occurring are counter to the objectives of management then

environmental manipulation may be necessary. The prediction of the environmental impact of manipulative activities must be done.

Once sufficient information is available to provide a level of confidence for the manager that the questions have been answered, then the problem can be properly stated. Under the environmental assessment policy or legislation that is found in many jurisdictions in Canada the manager must look at various alternative ways of solving the problem. These alternatives must be assessed against each other to find a solution that is the most environmentally suitable.

Once a course of action is decided upon, an intervention takes place. It is critically important that the impact of this intervention be measured and monitored down through time.

## SUMMARY

The management of the natural resources of a park is a critically important aspect of park administration. Whether the resources are living creatures, abiotic elements or fossil artifacts the management has several critical components.

First, the resource must be known and understood. Research is a vital aspect in the early stages of all resource management policy making.

Second, the values placed upon the resource must be known and understood. These values will determine the types of options that will be available for the management regime.

Third, the methods used to elicit value determinations from the decision-making constituencies will largely determine the types of policies that will result.

Fourth, there must be a realization that the vast majority of environmental management is really people management. The impact of people on the resources is the largest issue to be tackled and solved.

Fifth, there must be an understanding that the management is undertaken with less than complete knowledge and will involve a significant amount of unpredictable consequences.

The management of the environment in the park must consider the land uses that are occurring in adjacent areas. Very often the surrounding land practices remove or damage key parts of the environment. This impacts on the ability of the species to survive that need the regional environment to survive.

Parks play a major role in the long term protection of the world's genetic diversity. Parks play a major role in the provision of outdoor recreation opportunities to many people. Parks are under constant pressure from nearby influences that tend to degrade environmental quality. The preservation of environmental quality within parks is globally important.

The management of the natural environment along with the facilitation of recreation use is the challenge facing all environmental managers in parks.

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