The Wolves of Algonquin Park PHVA Final Report

From the Workshop held in
Dorset, Ontario
15-18 February 2000

Ontario
Ministry of Natural Resources

Environment Canada
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WWF

THE WILD DOG FOUNDATION

The Wolves of Algonquin Park

Population & Habitat Viability Assessment (PHVA)

FINAL REPORT

15-18 February 2000
Leslie M. Frost Center
Minden, Ontario, Canada

A Report Prepared For:
The Algonquin Wolf Advisory Group

Sponsored By:
World Wildlife Fund Canada
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A contribution of the IUCN/SSC Conservation Breeding Specialist Group.

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Additional copies of *Population and Habitat Viability Assessment Workshop for the Wolves of Algonquin Park*: *Final Report* can be ordered through the IUCN/SSC Conservation Breeding Specialist Group, 12101 Johnny Cake Ridge Road, Apple Valley, MN 55124.

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Executive Summary

Introduction

During the 1990s, there has been a considerable increase in public concern for the survival of the wolves of Algonquin Provincial Park. Much of this concern stems from the results of the radio-tracking and ecological studies of John and Mary Theberge and their students. This research revealed that many of the collared wolves from the eastern part of the park moved outside the park in the winter to feed on deer in surrounding deer yards. Some of these collared wolves were killed in these areas through hunting, trapping and persecution.

In the summer of 1998, the Honourable John C. Snobelen, Minister of Natural Resources, announced the establishment of the Algonquin Wolf Advisory Group (AWAG) to provide recommendations for an Adaptive Management Plan to ensure the long-term conservation of wolves of Algonquin Provincial Park and surrounding areas. The AWAG includes representatives from local communities, government, trappers, hunters, environmental conservation organizations and the science community.

Initiation of the PHVA Process for Wolves of Algonquin Provincial Park

To help the Advisory Group assess the status of the wolves of Algonquin Provincial Park and the many issues related to their management, the Ontario Ministry of Natural Resources, the World Wildlife Fund (Canada) and the Canadian Wildlife Service of Environment Canada offered to sponsor a PHVA workshop. In November of 1999, a planning meeting took place between the Advisory Group and the Conservation Breeding Specialist Group (CBSG) of IUCN - World Conservation Union's Species Survival Commission at Algonquin Provincial Park. This type of workshop has proved to be a major tool to help resolve societal-wildlife conservation issues of this kind in over 50 countries and, to date, over 200 workshops of this type have been conducted worldwide in diverse situations.

The Advisory Group hosted the PHVA workshop for wolves of Algonquin Provincial Park from February 15-18, 2000, at the Leslie M. Frost Natural Resources Center near Dorset, Ontario, just outside Algonquin Provincial Park. The Advisory Group was determined to include a broad range of local stakeholders and scientific experts in the workshop. The diverse group of over 60 people that participated in the PHVA workshop included biologists, researchers and geneticists from universities, colleges, and provincial and federal government agencies (see Appendix II). A large number of participants represented the many interests concerned with the survival and management of these wolves. These included local communities, Algonquin First Nations, private conservation organizations, hunting, trapping, outfitting and agricultural interests among many.

The meeting was opened with welcoming comments by John Winters, Superintendent of Algonquin Provincial Park, and Dr. Onnie Byers of CBSG. The following three summary background reports were also presented: (1) A century of wolves in Algonquin Provincial Park by Dennis Voigt, retired Ontario Ministry of Natural Resources research biologist and Dan Strickland, Chief Naturalist for Algonquin Park; (2) a genetic analysis of Ontario wolves by Dr. Bradley White of McMaster and Trent Universities; and (3) Algonquin wolf research from 1987-1999 by John and Mary Theberge of the University of Waterloo. The Voigt/Strickland paper can be found in Appendix III of this report.

The PHVA Process

Effective conservation action is best built upon critical examination and use of available biological information, but also very much depends upon the actions of humans living within the range of the threatened species. Motivation for organising and participating in a PHVA comes from fear of loss as well as a hope for the recovery of a particular species.

At the beginning of each PHVA workshop, there is agreement among the participants that the general desired outcome is to maintain a viable population(s) of the species. The workshop process takes an in-depth look at the species' life history, population history, status, and dynamics, and assesses the threats that may put the species at risk.

One crucial by-product of a PHVA workshop is that an enormous amount of information can be gathered and considered that, to date, has not been published. This information can be from many sources; the contributions of all people with a stake in the future of the species are considered. Information contributed by hunters, trappers, park managers, scientists, and field biologists all carry equal importance.

To obtain the entire picture concerning a species, all the information that can be gathered is discussed by the workshop participants with the aim of first reaching agreement on the state of current information. These data then are incorporated into a computer simulation model to determine: (1) risk of extinction under current conditions; (2) those factors that make the species vulnerable to extinction; and (3) which factors, if changed or manipulated, may have the greatest effect on preventing extinction. In essence, these computer-modelling activities provide a neutral way to examine the current situation and what needs to be changed to prevent extinction.

Complementary to the modelling process is a communication process, or deliberation, that takes place during a PHVA. Workshop participants work together to identify the key issues affecting the conservation of the species. During the PHVA process, participants work in small groups to discuss key identified issues. Each working group produces a report on their topic, which is included in the PHVA document resulting from the meeting. A successful PHVA workshop depends on determining an outcome where all participants, coming to the workshop with different interests and needs, "win" in developing a management strategy for the species in question. Local solutions take priority. Workshop report recommendations are developed by, and are the property of, all participants.

At the beginning of the workshop, the participants worked together in plenary to identify the major impacts affecting the conservation of wolves in Algonquin Park. Using the technique of mind mapping, these issues were identified and themed into five main topics, which then became the focus of the working groups: Taxonomic Status, Population Dynamics and Modeling, Prey Habitat, Landscape Ecology and Human Values. In addition, all groups were asked to consider the unthemed, over-arching issues of: Uncertainty of knowledge, Populations outside the park; Research/monitoring; Partnering with local groups; Funding (time/money); Testing of conventional wisdom; and Public consultation/public buy-in.

Each working group was asked to:

- Examine the list of impacts affecting the survival of wolves in Algonquin Park as they fell out under each working group topic, and expand upon that list, if needed.
- Identify and amplify the most important issues.
- Develop recommendations and strategies to address the key issues.
- Specify the action steps necessary to implement each of the recommendations.

Each group presented the results of their work in daily plenary sessions to make sure that everyone had an opportunity to contribute to the work of the other groups and to assure that issues were carefully reviewed and discussed by all workshop participants. The majority of the recommendations coming from the workshop were accepted by all participants. While recommendations were based on as much common ground as possible, time did not allow building consensus on every proposed action. Participants who could not agree with the recommendations and actions of the group were offered the option of writing dissenting opinion pieces which can be found in Appendix IV. Working group reports can be found in sections 3-7 of this document.

Working Group Conclusions and Recommendations

Taxonomic Status

A. Conclusions

i. The wolf that occupies central Ontario, including Algonquin Park, was identified as being morphologically distinct as early as 1970. Genetic work now in progress confirms this distinctiveness and suggests that these smaller, uniformly coloured animals should not be considered as a subspecies of the Gray Wolf (*Canis lupus lycaon*) but, rather, along with the Red Wolves (*Canis rufus*) of the southeastern U.S., that they may be a single species (*Canis lycaon*) (Eastern Canadian Wolf) more closely related to the Coyote (*Canis latrans*) than to the Gray Wolf. Pending publication, and general acceptance of this idea among the scientific community, we note the distinctiveness of the wolves of Central Ontario without implying acceptance or rejection of their proposed new status.

ii. Independent of its subspecific or specific status, the wolf taxon that now occurs in Algonquin Park is known also to occupy northwestern Ontario, northeastern Ontario and southern Ontario west of Algonquin Park with significant gene flow among all those areas. The taxon is also deemed or suspected to occur in Southern Manitoba, Minnesota and southern Quebec as far as the Laurentides Game Preserve although it is not now known how much gene flow occurs between these and other parts of the population. The total number of individual animals comprising the taxon may number in the thousands and it is therefore premature to propose that these animals are currently at risk of extinction because of stochastic events.

iii. Despite some introgression of coyote genetic material, at present there are very low levels of gene flow between Eastern Canadian Wolves in Algonquin Park and coyote-like animals outside of the Park to the south.

iv. If the recently proposed taxonomic revision is accepted (i.e. that the small Eastern Canadian Wolves and the endangered Red Wolves of the U.S. may belong to the same species) the Algonquin Park population might be considered as a potential source for the Red Wolf recovery program in the U.S. Acceptance of the proposed taxonomic revision would also make conservation action more acceptable to the Ontario public if future events should cause Eastern Canadian Wolves to decline to the point of becoming a species of concern.

B. Recommendations

1. Organize a meeting of wolf taxonomists and geneticists to discuss and resolve the classification of North American wolves.
2. Obtain and analyze genetic samples (in order of priority) from wolves in: a) southwestern Québec; b) the region west of Algonquin Park; c) west side of Algonquin Park; d) northeastern Ontario; and e) the region southwest of Algonquin Park.
3. Obtain and analyze morphological samples from same specimens as described above to compare with genetic information.
4. Design and implement a genetic monitoring program to assess changes in coyote introgression into the Eastern Canadian Wolf population, including the Algonquin Park population.
5. In the event of acceptance of the proposed reclassification of *Canis lupus lycaon* to *Canis lycaon*, there should be communication to the public, government agencies and other appropriate audiences.

Population Dynamics and Modeling

A. Summary and Conclusions

i. The working group used stochastic simulation models and diffusion models to evaluate the possible future for wolves living within and around Algonquin Provincial Park, and to identify additional research needs for a better understanding of wolf population dynamics in the area. Much of the data used to parameterize these models comes from the long-term dataset of John and Mary Theberge and their ongoing study (now encompassing 11 years) of a group of packs on the eastern side of Algonquin Provincial Park. The group modeled Algonquin Park as a closed system, with no exchange of individuals from outside the Park habitat. This was done in order to look more closely at the specific demographic dynamics of the Park population, with the understanding that detailed interpretation of the modeling results in the context of total population extinction was not fully justified.

ii. Under the conditions modeled in the group's baseline scenario, the larger Algonquin Park region appears to be acting as a demographic sink in which mortality is outpacing reproduction on a local scale. As simulated here, the wolf population appears to be unsustainable; under current conditions, a population of wolves inside Algonquin Park will likely persist only because of continued influx of individuals from the surrounding region.

iii. The models demonstrated annual fluctuations in population birth and death rates, caused both by variation in the environment and by random processes intrinsic to the population, can put a population at risk of decline – even if the long-term expectation describes a population that is growing in size. Stated another way, if the variation from year to year in rates of mortality and reproduction is relatively high, there is a marked chance that the population could decline rapidly in size if bad luck conspires to limit the number of adult females that breed over a given period of time and/or to reduce the survival of animals across age and sex classes.

B. Recommendations

Adaptive management plan recommendations

1. Use Adaptive Management to determine whether changing levels of hunting and trapping mortality outside of Algonquin Park will affect the population of wolves in the Park.

   The use of an Adaptive Management (AM) model was in the Terms of Reference of the Algonquin Wolf Advisory Committee; as such, it is not specifically a recommendation of our working group. While at least two group members questioned whether it was the most appropriate approach for this case, we concurred that the above recommendation would be the appropriate course of action in the context of the AM directive.

2. Convene a 1-2 day meeting of a small group to discuss the scientific merits of model options for an Adaptive Management strategy designed to stabilize the population of wolves in Algonquin Park through reducing human-induced mortality.

Additional recommendations

1. Reanalyze selected population demographic data obtained by the Theberges since 1987. Specifically, determine the potentially confounding effect of variable population size on temporal trends in population density. In addition, extract the recruitment rate from data on the "2-cohort recruitment rate."

2. In order to construct more realistic models of wolf population dynamics that rely on a pack-based spatial structure, additional data on pack-specific characteristics are required. Such data may include the specifics of within-pack breeding characteristics, and the nature and extent of dispersal between packs.

3. Develop programs to collect demographic and habitat data for wolves occupying the western portion of Algonquin Park. A complete picture of the growth dynamics of the wolves within the Park requires field data across the entire region.

4. In order to lift the restriction of modeling the Park wolf population as a closed system, a metapopulation model would require knowledge of the population dynamics of wolves elsewhere in Ontario that border the Park itself. Long-term field studies patterned after the current Theberge effort would be the most effective method of collecting data on both mean parameter values as well as temporal variation in those parameters.

Prey Habitat

A. Conclusions

The Prey Habitat Working Group agreed that:

i. A wolf population should be maintained in Algonquin Provincial Park to conserve biodiversity and retain a functional ecosystem;

ii. The genetic data (B.N. White and P.J. Wilson, pers. comm.; Wilson *et al*., in prep.) indicate the wolf in Algonquin Park is part of a wide-ranging connected population of the Eastern Canadian Wolf, which is more closely related to the coyote than the grey wolf; and

iii. The Eastern Canadian Wolf population appears stable and perhaps expanding across its range and, recognising that the wolf population responds to prey availability, park staff have no evidence indicating the population inside the park is declining at this time.

Given this, the group concluded that there is no current need for habitat modification for the purpose of increasing prey populations for the wolf in Algonquin Park. However, the group outlined a strategy to be considered if there comes a time when manipulating habitat in an effort to increase the prey species for wolves within the park is deemed necessary

B. Recommendations:

Top priority was given to the development of a Wildlife Management Plan (WMP) for the Park as part of the Algonquin Provincial Park Management Plan which includes plans for monitoring, research, habitat and fire, taking into account past practices, past history of species and habitat management etc., and building on the existing deer management, Algonquin Park Management and the Forest Management Plans, and incorporating public consultation.

If, at some time in the future, it is deemed necessary to manage for optimum, healthy sustainable prey populations, it is recommended that the following actions be implemented.

Action 1. Modify timber harvesting procedures with regard for all Provincial Guidelines such as: Forest Management Plan Guidelines for the Provision of Moose Habitat; Code of Riparian Practices; Forest Management Guidelines for the Protection of Fish Habitat; etc.

Action 2: Expand the resource knowledge base to assist in the management of habitat for optimum healthy, sustainable prey populations.

Additional recommendations outlined by this group include:

1. Support the human values working group recommendation (see below) concerning establishment of a group to discuss and analyze the issue of trapping in the Park. This group would include stakeholder involvement and public consultation. Since 1994 there has been an informal "zero harvest agreement" with the Algonquin First Nations on wolves in Algonquin Park, as well as a zero quota on the registered Algonquin traplines in the Park.

2. Enshrine/formalize the current informal agreements to not take wolves inside the Park and ensure enforcement of the agreement. Confirm that there are no mortalities inside the park due to hunting and trapping unless on an incidental basis.

3. Develop a public education program with specific focus on real practices of Aboriginal people inside the Park (Park management and Aboriginal people to collaborate).

Landscape Ecology

A. Conclusions
The Landscape Ecology Working group concluded that:

i. While the AWAG has a mandate to develop a plan for management of wolves in Algonquin Park, a regional focus beyond the boundaries of Algonquin Provincial Park and consideration of ecological connectivity to adjacent areas is necessary to address the wolf issue.

ii. The scientific evidence regarding taxonomy of the wolf found in Algonquin Park is unclear making it difficult to make management decisions for Park wolves in isolation. Regardless of the taxonomic designation of the wolf, there is value in Algonquin Park providing an anchor or benchmark related to wolf protection. The working group agreed that there is a need to preserve some form of the wolf in Algonquin Provincial Park "in perpetuity."

iii. Wolf population persistence does not appear to be undermined by the hunting activities undertaken within Algonquin Park.

iv. Human-induced mortality of wolves migrating from their territories in transboundary deer-foraging excursions is reported to be a significant limiting factor to the viability of the wolf population on the east side of Algonquin Park[1]. Regardless of the ecological explanations for such excursions, this is a behavioural reality that must be recognized.

v. The demonstrated traditional migratory[2] dynamics of packs from eastern Algonquin Park show that the hunting ban in the three townships adjoining the Round Lake deer yard must be maintained to protect migrant wolves. If the migrant wolf population using the yard recovers to a sustainably exploitable level the ban could be lifted.

B. Recommendations
1a. Connectivity and Fragmentation
1. Adjoining districts to consider existing resource and land use planning on crown land to promote connectivity. Request districts to address wolves as a feature species during the FMP process.
2. Encourage stewardship councils, private land forestry and farming communities adjacent to the Park to consider best efforts to ensure connectivity.

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[1] The Population Dynamics and Modelling Working Group stated that "killing of wolves of Algonquin Park (that leave the Park) outside the Park has the effect of increasing the long-term risk of unsustainability" but it also pointed out that the "Theberges' recent data from the eastern segment of the Park cannot allow us to unequivocally conclude that the population declined in the period of their recent studies (1987-1999)".
[2] The Landscape Ecology Working Group used the term 'migratory' to refer to wolves that leave the Park seasonally in search of deer yarding outside the Park.

3. Municipalities to address connectivity and fragmentation as significant wildlife habitat under the Natural Heritage Features of the Provincial Policy Statement.
4. Educate on the biology of wolves and the potential impacts of connectivity and fragmentation on coyote introgression and genetic drift.

1b. Habitat and Land Cover

Try strategies other than altering habitat first and use this alternative as a last resort if conditions warrant (refer to Prey Habitat Working Group Report for details). Approach on an adaptive management basis.

2a. Road Density

1. Strongly encourage continuation of current Algonquin Forestry Authority (AFA) practices to abandon secondary and tertiary roads when logging and silvicultural activities are concluded and insure protection of waterways.
2. Develop crown land policy in the construction of roads, road density and the upgrade to minimize the impact on wolf population.
3. Consult with MTO, counties, municipalities and Algonquin First Nations on road upgrades, signage, and new construction.
4. Facility planning and management should be sensitive to new road construction, grade and traffic and the impacts on wolf populations.
5. Explore the opportunity and need to decommission the remaining roads that are inactive in Algonquin Park.
6. Monitor trends in road density and traffic conducted by AFA and Algonquin Park.

2b. Studied System extends beyond the Park

1. See human induced mortality issue strategies (section 3a).
2. Adhere to the principles of ecosystem management.
3. In future research, ensure compliance with provincial trapping standards. Animal care committees that review protocol should be expanded to include a representative from the trapping community. Researchers should be certified under Ontario Fur Harvester and Conservation Course.

2c. Industrial Impacts

1. Determine the predator/prey requirements and determine the impacts of forest management on prey and subsequent changes to sustainable wolf populations.
2. Consider prescribed burns and silvicultural techniques to emulate disturbance.
3. Develop guidelines when conducting forest management in the vicinity of den sites; encourage tree markers to report den sites; researchers to review annual work schedule to identify sensitive areas within proposed operations.
4. Add to Algonquin Park research strategy the increased encouragement and opportunity for academic research.
5. Researchers are to inform AFA where work is being conducted so AFA can plan to avoid the research site.

3a. Human induced mortality for eastern park wolves inside and outside of the Park (and possibly for western park wolves).

1. MNR to explore licensing process for hunting wolves in WMU`s adjacent to the Park. Through an adaptive management approach, adjust seasons and quotas to ensure protection of the wolf of Algonquin Park in consultation with local hunt camp associations, Algonquin First Nations, and other stakeholders.
2. Consult the trapping council, MNR, Algonquin First Nations and Algonquin Park to establish seasons within WMU`s adjacent to the Park that are timed to minimize the harvest of migratory Algonquin Park wolves.
3. Approach trappers and Algonquin First Nations to adjust harvest of wolves in areas adjacent to the Park to address transboundary wolf packs.
4. Educate on the biology of wolves, extent of time in the yard and impacts on deer populations.

3b. Role of Algonquin Provincial Park

1. Increase research and monitoring in other areas of the Park to increase knowledge of these wolves as a benchmark.
2. Minimize human disturbance of the wolves in the Park, and monitor human-wolf interactions.
3. Protect integrity of the landscape, broader ecosystem.
4. Apply the strategies outlined in the above section 3a.
5. Adjacent districts to inform Park Superintendent on pending large-scale developments that may have an impact on wolf populations.

Human Values

A. Conclusions

The Human Values Working Group concluded that societal values concerning wolves are not necessarily based on the taxonomic designation given to the wolf in Algonquin Park. The group developed an overview statement to summarize the overarching importance of the issue of societal values to the goal of this workshop:
The social /human equation and its subsequent values are crucial and determining elements in the issue of survival of wolves in and around Algonquin Park.

B. Recommendations

To achieve buy-in for long term survival of wolves in and around Algonquin Park, there is a need to:

a) create a mechanism to bring all information together and come to consensus to produce a consistent message to provide to the public and politicians.

b) undertake more thorough discussions of data among scientists, among “non-scientists” and between scientists and “non-scientists” to achieve understanding and interpretation of the available information.

c) have agreement on the data, issues and solutions to achieve societal buy-in, which will be politically saleable and simple, deliverable and workable by people.

d) have scientific peer review to establish credibility or point out weaknesses in studies relating to wolves in and around Algonquin Park.

e) deliver/convey consistent, constant messages regarding wolf numbers in and around Algonquin Park.

f) recognize and respect the emotional issues around wolves.

1. As a result of the above stated needs, establish a collaborative, stakeholder inclusive Communications Working Group, under the umbrella of the Algonquin Wolf Advisory Group, to develop a comprehensive Communications Plan, in consultation with a communications specialist.

2. Obtain actual numbers of wolves harvested or taken by hunting, and reduce the incidence of incidental or gratuitous wolf deaths. Options discussed for implementing this recommendation included:
   Trappers' quotas
   Invoke mandatory reporting
   Seasons for hunting/trapping could be established
   Explore the possibility of using wildlife management units (WMU's) to develop hunting zones/no hunt zones
   Change status of wolf from fur bearing mammal to game species
   Develop criteria related to protection of property
   Establish a separate wolf license
   Create or increase a "wolf protection zone" around the park, zero quota inside the park
   Monitor results e.g. harvest of other furbearers to see if wolf ban affects other furbearers.

3. Gather information on the location of wolves harvested from trappers, within all traplines within 2 townships of Algonquin Park boundaries.

4. Change the licensing status of wolves for hunting to protect Algonquin Park wolves from opportunistic killing by hunters.

5. Establish a closed season on hunting and trapping of wolves. This closed season may allow recognition of a "status" for this wolf, rather than an unwritten vermin designation and recognized fur value during different times of the year.

6. Require mandatory reporting of wolf takes for all hunters who buy a wolf license in the area south of the Mattawa river and in the following Wildlife Management Units: 48, 50, 54, 55a, 55b, 57, and possibly 56.

7. Discuss the concept of a wolf management zone around Algonquin Provincial Park (that could contain a number of different options to manage wolves) to further limit the numbers of wolves taken by hunting and trapping. There is a need to consult with trappers to discuss wolf-related matters of concern to them. Steps proposed for Algonquin wolves may be perceived to influence all trapping throughout the Province. Many trappers perceive that a wolf protection zone is a potential first step toward eliminating trapping throughout Ontario. There is some belief that a closed season January 1 to March 31 may be acceptable to trappers if there is proper consultation with trappers and hunters.

8. Enter into negotiations to formalize the current informal agreement to maintain zero quota on wolves for aboriginal trapping within Algonquin Provincial Park. This would apply to

harvest for sale but there should be some allowance for cultural, social, and ceremonial purposes.

9. If a ban on trapping wolves is implemented, then consideration should be given to compensating trappers for loss of fur production. This compensation should be based on a designated past level of harvest. There was some dispute as to at what point this kicks in, as quotas are an integral component of trapline management.
10. Compensation within the wolf management zone should be adequate for all livestock loss as a result of wolf protection, and farmers should not be subjected to the same level of subsequent (preventative) protection standards as applied outside the buffer (as it may be cheaper to pay for compensation rather than protection). There was discussion as to whether this should apply to townships or to WMU's. The group decided to use townships.

Disclaimer: The contents of this report have no effect on the on-going land claim negotiation process between the Algonquin Nation and Canada and Ontario.

The Wolves of Algonquin Park

Population & Habitat Viability Assessment (PHVA)

FINAL REPORT

SECTION 2

Taxonomic Status Working Group Report

Taxonomic Status Working Group Report

Introduction

The working group considered the various issues related to the taxonomy of the wolf in Algonquin Provincial Park and condensed them into four major issues for further discussion:

1. Taxonomic designation and characteristics of wolves in Algonquin Park
2. Geographic extent and numeric abundance of this canid taxon
3. Introgression of genetic material from other canids into this population
4. Implications of the taxonomic designation of this wolf for both management and for public perception

The group then considered each topic and outlined recommendations and associated actions to address these issues.

Taxonomic Designation and Characteristics

The wolf that occupies central Ontario, including Algonquin Provincial Park, was identified as a morphologically recognizable type of *Canis lupus lycaon* (the "Algonquin-type") by Standfield (1970a), Standfield (1970b), Kolenosky and Standfield (1975), and Schmitz and Kolenosky (1985). Later, Nowak (1995) proposed a reduction of the number of subspecies of *Canis lupus* in North America from 26 to 5. One of these five, the "Algonquin-type" of Kolenosky and Standfield, retained the name *Canis lupus lycaon* while the more northerly "Ontario-type" of former *Canis lupus lycaon* was subsumed under a redefined *Canis lupus nubilus*. Under this classification, the taxon defined as *Canis lupus lycaon* historically would have been replaced in the forested southeast United States by the Red Wolf (*Canis rufus*), a taxon retained by Nowak (1995).

Using DNA analyses, Wilson *et al*. (in prep.) have most recently proposed that *C. l. lycaon* (*sensu* Nowak) and *C. rufus* should be considered a single species – *C. lycaon* – and referred to as the Eastern Canadian Wolf. Pending publication and general acceptance of this reclassification, and for purposes of this report, we shall refer to the northern extant population of the proposed *Canis lycaon* as the "Eastern Canadian Wolf" without implying acceptance or rejection of its specific or subspecific status.

The Eastern Canadian Wolf, as defined by possession of *lycaon* genetic material (*sensu* Wilson *et al*., in prep.), includes not only animals defined as "Algonquin-type" wolves by Kolenosky and Standfield, but also larger animals found in northwestern Ontario. It also includes animals to the north of the range of the "Algonquin-type" animals as defined by Kolenosky and Standfield and to the northeast as far as Laurentides Game Preserve in Québec [i.e., east of smaller animals living in southwestern Québec that are comparable to the Algonquin-type animals of Kolenosky and Standfield in Ontario (Crête, pers. comm.)].

Unlike *Canis lupus*, the Eastern Canadian Wolf can hybridize with coyotes (*Canis latrans*).

Recommendation: There is a need for evaluation of North American canid taxonomy by the scientific community, particularly in view of the most recent genetic analysis (Grewal *et al*., in prep.; Wilson *et al*., in prep.).

Action: Organize a meeting of wolf taxonomists and geneticists to discuss and resolve the classification of North American wolves. This could occur at the wolf taxonomy meeting to be held in Denver, CO, USA in May 2000 (or arrangements could be made at that time for a later meeting). Participants may include the U.S. Fish and Wildlife Service, Defenders of Wildlife, Robert Wayne, Ron Nowak, Brad White, Paul Wilson and others.

Outcome: Publication of meeting proceedings or journal section of papers (peer reviewed) regarding taxonomy.

Geographic Extent of Taxon

It is crucial to know the extent of the present-day range, and the abundance within that range, of the "Eastern Canadian Wolf" – be it a race of *Canis lupus* or a species in its own right. If the population is small and/or isolated within Algonquin Park, it will be correspondingly more vulnerable to extinction than if it is part of a much larger population.

When the taxon was originally recognized as the "Algonquin-type" of nominal *C. lupus lycaon* (Standfield, 1970a, 1970b; Kolenosky and Standfield, 1975), it was deemed to occupy all of central Ontario from the southern edge of the Canadian Shield and the Québec border, west to Lake Superior and north approximately to Timmins. Based on more recent work (Grewal *et al*., in prep; Wilson, pers. comm.) the taxon is also deemed to occur in northwestern and northeastern Ontario, southern Manitoba and southern Québec as far east as Laurentides Game Preserve. It is potentially also present in Minnesota (Wilson, pers. comm.) but this requires additional genetic testing.

According to Grewal *et al.* (in prep.), the populations in northeastern Ontario, northwestern Ontario and the Magnetawan area west of Algonquin Park are all genetically connected with the Algonquin Park population (Fig. 1). It is not now known how much, if any, gene flow occurs between Algonquin Park wolves and those of southern Québec. Grewal *et al.* (in prep.) suggest, and we concur, that the "total number of animals may number in the thousands." According to B.N. White and P.J. Wilson (pers. comm.) there is no individual population within the larger metapopulation of "eastern Canadian wolves" (or "lycaon complex") that is genetically "pure." Algonquin Park animals show some introgression of coyote mitochondrial DNA and animals in northeastern and northwestern Ontario show limited introgression of both coyote and Grey Wolf material.

Summary: We recognize that the wolf population in Algonquin Park is part of a "*lycaon* metapopulation complex" that is genetically connected to surrounding wolf populations to the north, west and possibly to the east. Subpopulations within this metapopulation share genetic characteristics and may provide evolutionary potential for wolves to adapt to changing ecological conditions in the park. The size of the metapopulation is estimated to be in the low thousands of animals (Grewal *et al*., in prep.).

Recommendation: A more complete understanding of the metapopulation structure is needed to determine connectivity, viability, abundance and appropriate management strategies.

Action 1: Obtain and analyze genetic samples (in order of priority) from wolves in: a) southwestern Québec; b) the region west of Algonquin Park; c) west side of Algonquin Park; d) northeastern Ontario; and e) the region southwest of Algonquin Park.

Responsibility: MNR facilitates obtaining samples, analysis performed by wildlife forensic lab (three-year contract currently in place).

Resources needed: Samples to be obtained from the Fur Auction House, trappers, AlgonquinPark staff, Québec government (contact is Hélène Jolicoeur).

Timeline: As soon as possible. Many samples should potentially be available within the next few months; all should be available within one year.

Outcome: Results that will give better understanding of the *lycaon* complex and range.

Action 2: Obtain and analyze morphological samples from same specimens as Action 1 to compare with genetic information.

Responsibility, Timeline, Outcomes: Same as for Action 1.

Resources needed: Skulls are primary data available.
For Québec, source is the same as in Action 1. For Ontario, MNR will obtain information directly from trappers.

Introgression of Genetic Material from Other Canids

Most of the ancestral range of the Eastern Canadian Wolf (that part of forested northeastern North America coincident with white-tailed deer range) is now occupied by coyotes. Eastern Canadian wolves occupy the northern part of the deer's current range (in some cases, beyond it as well) in areas still covered with largely unbroken forest. The "Tweed-type wolf," which exists immediately south of Algonquin Park, is a hybrid between the Eastern Canadian Wolf and the coyote and cannot be distinguished from eastern coyotes based on DNA analyses.

Eastern Canadian wolves could be at risk of increased genetic introgression to the north by *Canis lupus* and to the south by Tweed-type wolves or coyotes.

North: The wolves of Algonquin Park demonstrate gene flow with wolves from the north. These wolves are part of the "*lycaon* complex" and pose no short-term threat to the genetic integrity of wolves in Algonquin Park.

South: Despite some introgression of coyote genetic material, at present there are very low levels of gene flow between eastern Canadian wolves in Algonquin Park and coyote-like animals outside of the park to the south (Wilson *et al*., in prep). However, future introgression may be dependent upon factors such as changes in prey base, climatic conditions and landscape fragmentation. Less is known about the introgression of coyote genes into the Eastern Canadian Wolf metapopulation in regions to the east and west of Algonquin Park.

Recommendation: Periodic monitoring of gene flow along the southern interface between the Eastern Canadian Wolf and *C. latrans*.

Action: Design and implement a genetic monitoring program to assess changes in coyote introgression into the Eastern Canadian Wolf population, including the Algonquin Park population.

Responsibility: MNR

Resources: Long-term funding will be needed.

Timeline: To be determined by researcher.

Outcome: Assessment of coyote introgression

Implications of the Taxonomic Designation

Since it is apparent that the population of the Eastern Canadian Wolf consists of a metapopulation of thousands stretching from northwestern Ontario into western Québec, rather than being restricted to Algonquin Park, it would be premature to propose that the wolf population within Algonquin Park is currently at risk of permanent extinction due to stochastic events.

The proposed designation (presented at this workshop) by Wilson *et al*. (in prep.), if accepted, would change the status from a subspecies level to that of a species. We believe that this would make conservation action more acceptable to the public should future events cause it to decline to the point of becoming a species of concern.

Also, this new designation would have implications to the future management of this wolf and its southern counterpart – currently *Canis rufus* – which is the subject of a recovery program as an endangered species in the United States. This may include the consideration of the Algonquin wolf population as a potential source population for the Red Wolf recovery program.

Summary: Since we have recognized that this population is part of a large metapopulation stretching from NW Ontario into Québec & numbering in the low thousands, rather than a population restricted to Algonquin Park, the taxon in question (Eastern Canadian Wolf) is much less at risk of extinction due to stochastic events than it would be if It were an isolated population.

Recommendation: In the event of acceptance of the proposed reclassification of *Canis lupus lycaon* to *Canis lycaon*, there should be communication to the public, government agencies and other appropriate audiences.

Working Group Members: Maria de Almeida, Bob Chambers, Michel Crête, Nina Fascione, Margaret McLaren, Norm Quinn, Dan Strickland, Paul Wilson, Kathy Traylor-Holzer (facilitator).

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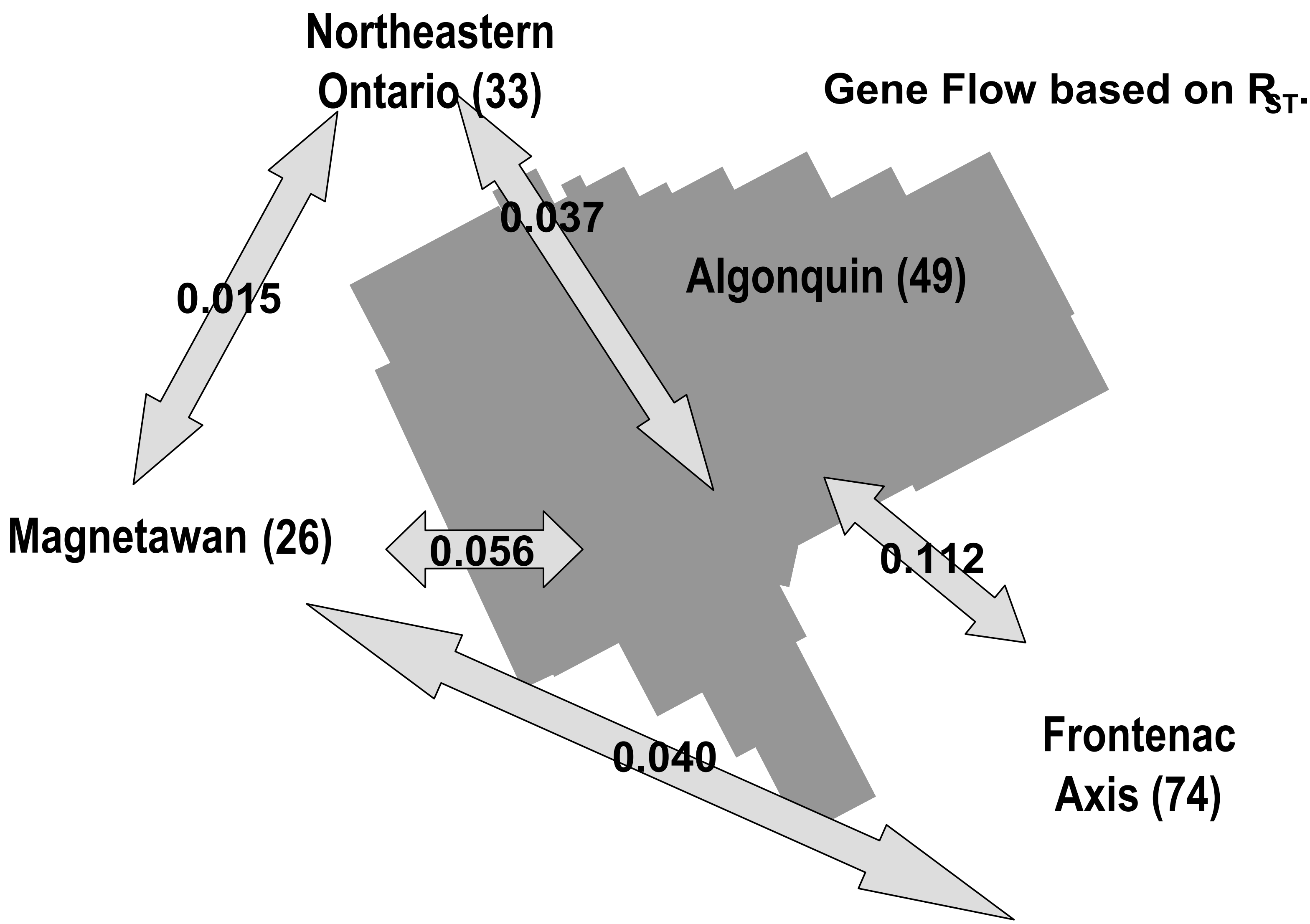


Fig. 1. Estimates of gene flow among canid populations in and surrounding Algonquin Park (Grewal *et al*, in press) based on R_{ST}. R_{ST} is a measure of the amount of genetic variability between populations relative to the variability within populations. Smaller indices indicate relatively little difference between two populations and therefore greater gene flow between them; indices above 0.5 indicate greater differences and structuring between populations and therefore relatively little gene flow. Numbers in parenthesis indicate number of samples.

The Wolves of Algonquin Park

Population & Habitat Viability Assessment (PHVA)

FINAL REPORT

SECTION 3

Population Dynamics and Modeling Working Group Report

Population Biology and Modeling Working Group Report

Introduction

The need for and consequences of alternative management strategies can be modeled to suggest which practices may be the most effective in conserving the wolf in Algonquin Provincial Park. *VORTEX*, a simulation software package written for population viability analysis, was used in this workshop as the primary tool to study the interaction of a number of wolf life history and population parameters treated stochastically, and to explore which demographic parameters may be the most sensitive to alternative management practices.

The *VORTEX* package is a computer simulation of the effects of deterministic forces as well as random demographic, environmental, and genetic events on wild populations. *VORTEX* models population dynamics as discrete sequential events (e.g., births, deaths, sex ratios among offspring, catastrophes, etc.) that occur according to defined probabilities. The probabilities of events are modeled as constants or random variables that follow specified distributions. The package simulates a population by stepping through the series of events that describe the typical life cycles of sexually reproducing organisms such as wolves.

VORTEX is not intended to give absolute answers, since it is projecting stochastically the interactions of the many parameters used as input to the model and because of the random processes involved in nature. Interpretation of the output depends upon our knowledge of the biology of the wolf in Ontario, the environmental conditions affecting the species, and possible future changes in these conditions. To increase our confidence in the model results, we employed a generalized diffusion model to gain additional insight into wolf population dynamics.

For a more detailed explanation of *VORTEX* and its use in population viability analysis, refer to Appendix II of this workshop report as well as Miller and Lacy (1999).

Input Parameters for Simulations

Wolves live in packs that are characterized by reproductive suppression and are affected by complex dispersal rules. Because *VORTEX* is not designed to explicitly account for such a specific and complex social structure, we considered whether alternative modeling strategies within the confines of *VORTEX* could adequately account for wolf social structure. Here, we describe two approaches and then justify the one we chose.

First, consider each pack to be a subpopulation within a metapopulation, or a collection of populations that interact demographically and genetically to varying degrees through the occasional exchange of animals through dispersal. Although this approach may superficially appear to be sensible, a metapopulation model cannot accommodate the details of reproductive suppression or the complex dispersal behavior of wolves. Additionally, this approach would be quite complex as we would be required to construct up to 30 individual populations (packs) and the rules by which each of them interact.

The second approach is to simply assume that the collection of packs that comprise the population are adequately modeled as a single unstructured population. This may potentially be our best available option since the extent of exchange between near-neighbour packs is likely to be fairly significant over time so that, in a simplified demographic system, the overall population may act as one larger unit. However, this approach also does not account for complexities in the pack-based breeding system that may lead to a more fine-scale extinction dynamic which is lost in the larger, single-population modeling approach. After some discussion and consideration, the group chose the unstructured population approach as the most effective method for exploring the large field dataset in the time period making up this workshop.

Much of the data used to parameterize our models comes from the long-term dataset of John and Mary Theberge and their ongoing study (now encompassing 11 years) of a group of packs on the eastern side of Algonquin Provincial Park. While portions of these data have been published in the past, this workshop provided a forum for initiating an intensive review of the field data, its analysis, and its incorporation into a demographic population projection framework. Because the wolf population resides in a protected area, we adopted the philosophy that the study population should be, on average, a source population (i.e., should not be a sink). As a reference point for population integrity we also considered the current available ungulate biomass available to the study population and Keith's (1983) North American ungulate biomass-wolf density regression. If our model results are expected to apply to the entire park, it requires assuming that the east and west populations are demographically similar. At present the data are inadequate to determine the validity of this assumption.

Finally, it is important to recognize that we modeled Algonquin Park as a closed system, with no exchange of individuals from outside the Park habitat. We did this in order to look more closely at the specific demographic dynamics of the Park population, with the understanding that detailed interpretation of the modeling results in the context of total population extinction was not fully justified. In addition, since specific data on the demographic characteristics of wolves outside the Park and the rates of dispersal are not known, a detailed open-population model structure was, at best, very difficult to construct.

Breeding System: Monogamous. Under this assumption, an adult male will breed only once per year, but is allowed to breed with a different female the following year.

Age of First Reproduction: *VORTEX* precisely defines reproduction as the time at which offspring are born, not simply the age of sexual maturity. In addition, the program uses the mean age rather than the earliest recorded age of offspring production. While some wolves have been observed to produce a litter before reaching two years of age, most wolves begin litter production at two years of age. We used this figure for both females and males in all simulations.

Age of Reproductive Senescence: *VORTEX* assumes that animals can reproduce (at the normal rate) throughout their adult life. Observations from the wolf literature suggest that wolves will not reproduce beyond about ten years of age. This value was used in all subsequent models.

Density-Dependent Reproduction: Density dependence in reproduction (proportion of females breeding in a given year) is modeled in *VORTEX* according to the following equation:

$$P(N) = \left(P(0) - \left[(P(0) - P(K))(\frac{N}{K})^B \right] \right) \frac{N}{N + A}$$

in which $P(N)$ is the percent of females that breed when the population size is N, $P(K)$ is the percent that breed when the population is at carrying capacity (K, to be entered later), and $P(0)$ is the percent of females breeding when the population is close to 0 (in the absence of any Allee effect). B can be any positive number. The exponent B determines the shape of the curve relating percent breeding to population size, as population size gets large. If B is 1, the percent breeding changes linearly with population size. If B is 2, $P(N)$ is a quadratic function of N. The term A in the density-dependence equation defines the Allee effect, in which reproduction can be reduced in a low-density population simply because of difficulty in finding suitable mates across the landscape. One can think of A as the population size at which the percent of females breeding falls to half of its value in the absence of an Allee effect (Akçakaya 1997).

While the Theberge data do not indicate a strong relationship between population density and rates of annual recruitment, the group felt that reproduction would overall show some level of density dependence. Under the conditions modeled here, this relationship would be significant only at higher densities, i.e., there would be no Allee effect at low wolf population densities. At lower densities, we assumed that as many as P(0) = 80% of the adult females would produce a litter in a given year. When population densities approached the carrying capacity of the Park and surrounding habitat, we assumed this figure would decline to about P(K) = 33%. To achieve the desired functional relationship, we set the exponential steepness parameter B to 8.0. This combination of parameters gives the relationship plotted below in Figure 1.

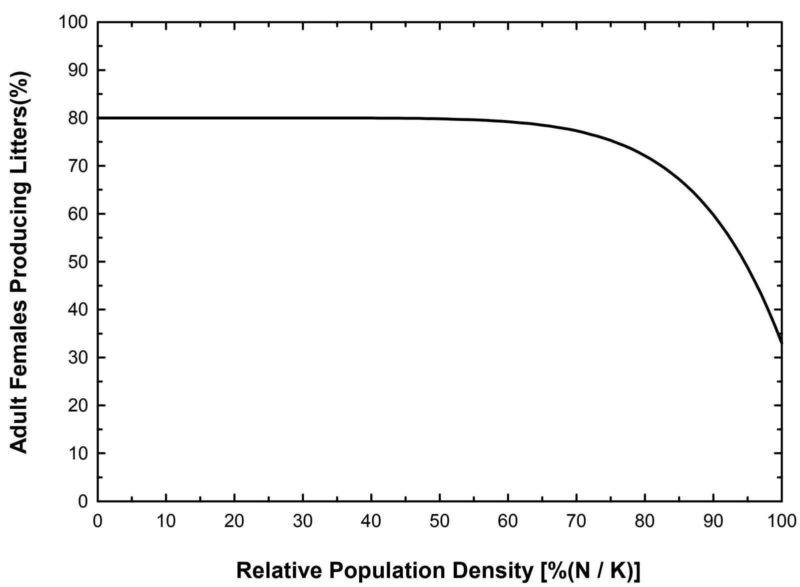


Figure 1. Functional relationship of density-dependence in litter production assumed for Algonquin Park wolf population simulation models. See text for details.

Additional analysis of field data suggests that this rate of breeding success may be as low as about 60% or less. We calculated values for P(0) that would reflect actual field observations of the proportion of adult females breeding in a year. We know that under normal conditions only one female (or slightly more in some cases) breeds in each pack. From Pimlot's estimates of 50 packs in Algonquin Park with an average pack size of 6.0 wolves, we estimate 50 breeding females from among 100 adult females for a proportion of 50%. From the Theberges' estimates of 30 to 35 packs in Algonquin Park with an average pack size of 4.6 wolves, we estimate 32 breeding females from among 50 adult females for a proportion of 64%. The average of these two estimates is P(0) = 57%. In order to test the sensitivity of our simulated population to uncertainty in this parameter, we ran a set of additional models with P(0) = 57%.

Annual variation in female reproduction is modeled in *VORTEX* by specifying a standard deviation (SD) for the proportion of adult females that reproduce within a given year. We assumed a standard deviation in this parameter of 10%; this level of annual variability translates in a range of breeding success from one year to the next from roughly 60% to 100% over time.

We recognized that density dependence of reproduction may also act through effects on litter size but we have assumed that those effects are simulated in the % females breeding relationship. In reality, different results may occur due to stochastic events if litter sizes at high densities are uniformly smaller (as opposed to fewer breeders but similar litter sizes.)

Offspring Production: While precise estimates for mean litter sizes do not exist for wolves in the Park, we assumed that, on average, five pups would be born to the average adult female that breeds in a given year. We constructed a simple distribution of possible litter sizes to generate such a mean value, and one that we thought spanned the range of plausible litter sizes across all adult females in a population over time:

Litter Size	Frequency
1	0.0
2	2.0
3	3.0
4	20.0
5	50.0
6	20.0
7	3.0
8	2.0

The Theberge data suggest a sex ratio (percent males) among yearlings of 48%. As this is essentially indistinguishable from an equal sex ratio among newborn pups, we used an equal sex ratio in all simulations.

Male Breeding Pool: In many species, some adult males may be socially restricted from breeding despite being physiologically capable. This can be modeled in *VORTEX* by specifying a portion of the total pool of adult males that may be considered "available" for breeding each year. Given the pack structure of wolves in the Park, we estimated that about 80% of the pool of all adult males are considered to be available for breeding each year.

Mortality: With the exception of pups, age-sex specific mortality rates have been estimated directly from the Theberges' radio-telemetry data. These data suggest that mortality rates are independent of age and sex, so subadult and annual adult mortality was set at 33.4% for each age-sex class. Field data on pup mortality do not exist for this population; therefore, based on general work on other wolf populations, we estimated pup mortality to be 70% for each sex.

[Note: A detailed analysis of the sex-age mortality rates including variance estimates based on radio-collared wolves remains to be done. In addition, the mortality estimates used here included samples from a period of partial protection and no protection. Further analysis of the Theberges' data will be important for future modeling of this important parameter.]

Estimates of mortality across years suggests significant variation in these rates from one year to the next. As a result, we included fairly substantial estimates of environmental variation (as standard deviations) for each rate, especially among pups. Mean mortality rates and standard deviations are given in the table below.

Age class	Mortality (%)	SD (Mortality)
0 - 1	70.0	30.0
1 - 2	33.4	10.1
2 -	33.4	10.1

It is important to remember that these mortality rates include all sources of mortality, both natural and human-mediated. In order to investigate the impact of reducing mortality rates to those more reflective of a situation involving minimal human interference, a number of models were developed with mortality reduced to 50% for pups and incrementally to 20% for subadults and adults.

[Note: in this model mortality was not simulated as density dependent except when populations were above carrying capacity.]

<u>Inbreeding Depression</u>: *VORTEX* includes the ability to model the detrimental effects of inbreeding through reduced survival of pups through their first year. Initial attempts to model the wolf population within Algonquin Park focus here on the demographic characteristics of the population and, as such, did not incorporate inbreeding depression in the models described here. Further modeling efforts may benefit from an inclusion of this factor, especially if the wolf population declines significantly below current levels.

<u>Catastrophes</u>: Catastrophes are singular environmental events that are outside the bounds of normal environmental variation affecting reproduction and/or survival. Natural catastrophes can be tornadoes, floods, droughts, disease, or similar events. These events are modeled in *VORTEX* by assigning an annual probability of occurrence and a pair of severity factors describing their impact on mortality (across all age-sex classes) and the proportion of females successfully breeding in a given year. These factors range from 0.0 (maximum or absolute effect) to 1.0 (no effect), and are imposed during the single year of the catastrophe, after which time the demographic rates rebound to their baseline values.

We identified a general type of catastrophic event that would likely simulate a disease episode. We estimated that such an event would occur, on average, once every 50 years (in other words, a 2% annual probability of occurrence). Moreover, in the year that the event occurred, both reproductive success (proportion of adult females breeding) and survivorship across all age-sex classes would be reduced by 50%.

Initial Population Size: Current estimates put the total population of wolves within the Park at about 150 animals at the end of the winter. This figure was used in all models discussed here. In addition, *VORTEX* distributes this initial population among age-sex classes according to the stable age distribution that is characteristic of the mortality and reproductive schedule input previously.

Carrying Capacity: The carrying capacity, K, for a given habitat patch defines an upper limit for the population size, above which additional mortality is imposed randomly across all age classes in order to return the population to the value set for K.

Historical data from Pimlott's study in the 1950's indicates that the wolf population within the Park was perhaps as large as 300. If we assume that this was an ecologically stable population, we may conclude that this could represent a reasonable estimate of a habitat carrying capacity for the habitat under study. Consequently, we initialized our model with a carrying capacity equal to 300. Since there was considerable uncertainty about this parameter, we ran additional models in which K was reduced to 200, perhaps suggestive of a habitat that has been altered from that which existed four to five decades ago.

Iterations and Years of Projection: All scenarios were simulated 250 times, with population projections extending to 100 years. This time period is roughly equivalent to about 25 effective wolf generations. Output results were summarized at 10-year intervals for use in the tables and figures that follow. All simulations were conducted using *VORTEX* version 8.21 (June 1999).

Results of *VORTEX* Simulation Modeling

Output Table Information

The tables that follow present the numerical results from the different models developed during this workshop. For detailed information on the characteristics of the input data used for each set of models, reference must be made to the verbal descriptions of the input found in the preceding pages. The results of the models are described in terms of the following:

r_s(SD) Mean (standard deviation) stochastic growth rate, calculated directly from the observed annual population sizes across the simulations;

P(E) The probability of population extinction, determined by the proportion of simulated populations within a given model that become extinct during the model's 100-year time frame.

N_{100} (SD) Mean (standard deviation) population size across all simulated populations, includiing those that become extinct within 100 years;

H_{100} Expected heterozygosity (gene diversity) in the simulated populations after 100 years;

T(E) The median time to extinction for those populations becoming extinct during the simulation. For statistical rigor, the median time is included in only those models for which P(E) exceeded 0.5.

Demographic Sensitivity Analysis

Initial modeling efforts were directed at investigating population size over time under a set of alternative mortality conditions relative to our baseline model developed above. The results of these models are shown in Table 1 and Figures 2 and 3.

Results for our "baseline" model – including our best estimates of the demographic parameters deemed appropriate for the wolves of Algonquin Park – are shown in Figure 2 as a plot depicting 100 replicate iterations of this input demographic dataset. In addition, the average result from the iterations is tabulated in bold in Table 1. Under these conditions, the population is expected to decline at a very rapid rate in the absence of immigration of animals from outside the Park. It is clear that, under these conditions, the larger Algonquin Park region is acting as a demographic sink in which mortality is outpacing reproduction on a local scale. As simulated here, the wolf population appears to be unsustainable; under current conditions, a population of wolves inside Algonquin Park will likely persist only because of continued influx of individuals from the surrounding region.

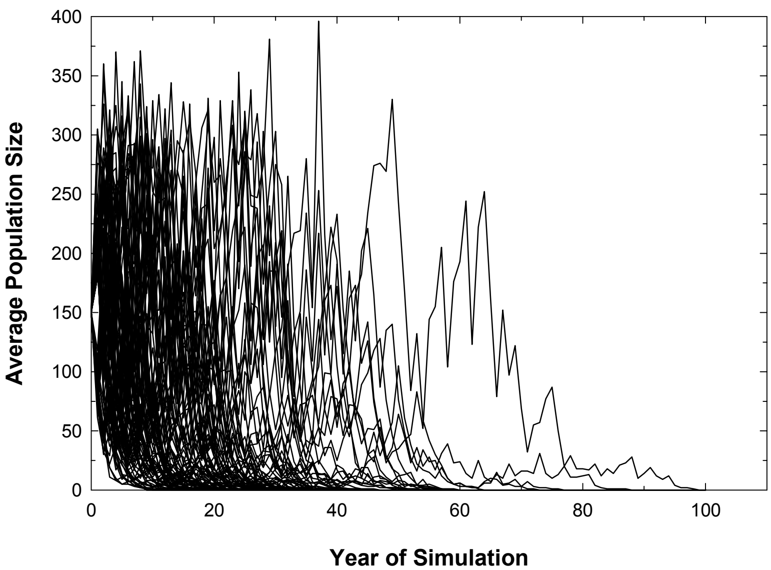


Figure 2. Population trajectories for 100 replicate iterations of the baseline dataset for the simulated closed Algonquin park wolf population. Each line represents one "run" of the model; differences between lines reflect the impact of stochastic (random) variation in the rates of birth and death from year to year and from iteration to iteration as imposed by the model (and, in the case of annual variation, as is seen in actual field observation data). As this is a subset of the total set of replicates used in the tabulated data below, the proportion of simulated populations declining to extinction is different from Table 1.

Table 1. Mortality analysis for the wolves of Algonquin Park. Baseline model results tabulated in bold. See text for additional information on input parameters.

Mortality$_{1+}$ (%)	r_s (SD)	P(E)*	T(E)	N_{100} (SD)	H_{100}
Pup mortality = 70%					
20	0.033 (0.441)	0.360	—	107 (112)	0.794
28	-0.047 (0.490)	0.880	40	11 (42)	0.681
33	**-0.107 (0.529)**	**0.988**	**26**	**2 (22)**	**0.597**
Pup mortality = 50%					
20	0.146 (0.331)	0.000	—	271 (50)	0.899
28	0.096 (0.361)	0.004	—	244 (63)	0.877
33	0.060 (0.373)	0.020	—	209 (79)	0.840

* Extinction probabilities are for a closed population only; actual conditions existing in Algonquin Park represent a more open system in which immigration from the larger region is allowed.

Under conditions of 70% pup mortality, simulated wolf populations decline in size at a rapid rate when the mortality rates of yearlings and adults is set to 28% or 33%. This rapid rate of decline is accompanied by a very high risk of population extinction within 100 years in the absence of immigration and a significant loss of overall population heterozygosity. It is important to note that, even at 20% mortality of yearlings and adults, the risk of population extinction is rather high despite an average population growth rate that is positive. This is most likely due to the high variability in population growth rate (expressed here as the standard deviation, SD) shown in column 2 of Table 1. Stated another way, if the variation from year to year in rates of mortality and reproduction is relatively high, there is a marked chance that the population could decline rapidly in size if bad luck conspires to limit the number of adult females that breed over a given period of time and/or to reduce the survival of animals across age and sex classes. This can happen in spite of the fact that, over long periods of time, the relative rates of birth and death to produce a population that is expected to increase in size. The impact of random variation in rates of birth and death, especially in smaller populations, should not be underestimated. It is also worth noting here that field data from the Theberge studies support high levels of annual variation in birth and death rates as defined in our simulation models.

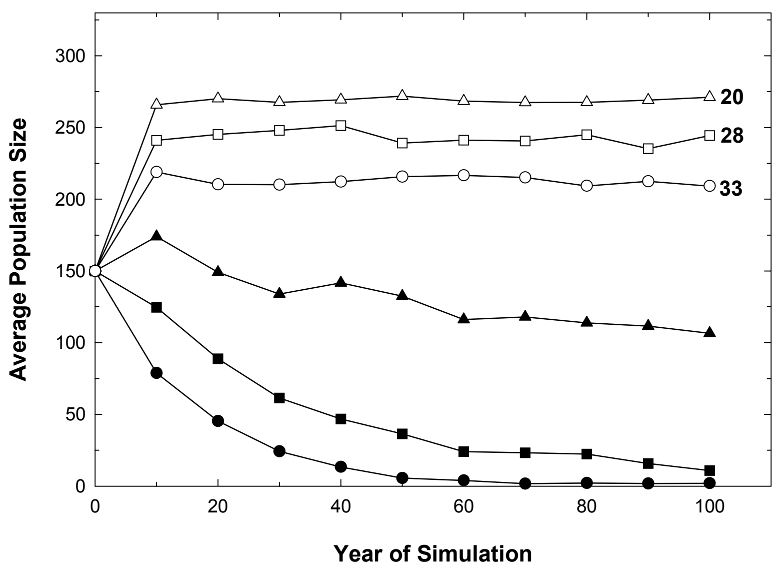


Figure 3. Population projections for simulated wolf populations within a closed Algonquin Park habitat under variable mortality. The set of curves with open symbols includes annual pup mortality of 50%, while the black symbols indicate models with pup mortality at 70%. The numbers at the far right of the curves indicate mortality rates of individuals age one year and older. The curve with black circles represents mean trajectory of baseline model. Averages include those populations that have become extinct. See text for further details.

It is also important to note that a decrease in mortality in yearlings and adults of about 10% in this model leads to a transition from a strongly negative population growth rate to one that is positive (see top two rows of Table 1). Acknowledging the inherent uncertainties and limitations of the model we have produced in this report, we can nevertheless suggest that a population reduced in numbers by perhaps as little as 10% may become highly destabilized and subject to significant risk of a continued rapid decline unless the source of the mortality is identified and reduced.

When pup mortality is reduced to 50%, the population shows strong positive growth at all levels of yearling and adult mortality. Moreover, extinction risk is very low and a large proportion of the total population heterozygosity is retained. These data indicate that a simulated wolf population inhabiting Algonquin Park may be highly sensitive to changes in mortality of both pups and yearlings/adults. While initial inspection of these results suggest that the population may be slightly more sensitive to changes in adult mortality, additional sensitivity analysis will be required to substantiate this claim.

We extended our mortality analysis to help us determine the set of mortality values that would result in a positive population growth rate. Additionally, we wanted to assess the role that annual variability in population growth rate plays in the estimation of mean growth rate and, by extension, the risk of population decline. In this analysis, pup mortality ranged from 60% to 90% while that for subadults and adults was varied from 20% to 50%. In all, a total of 49 models were developed to study all possible combinations of these mortality rates. The results from these models are shown in Figure 4. Deterministic model results are calculated from the average rates of mortality and reproduction in the absence of annual variability in those rates due to environmental variation. In contrast, stochastic growth rates incorporate the annual variability in rates of reproduction and mortality.

Two major observations are immediately apparent from the graphs:

- In deterministic and stochastic cases, population growth rates decline as mortality of both pups and (sub)adults increases. Moreover, it appears that the relative changes in growth rates for a given change in pup or (sub)adult mortality rate are fairly similar, providing additional support for our earlier conclusions.
- The set of mortality values that results in a positive stochastic growth rate are considerably more restricted than those producing a positive deterministic growth rate. This underscores the importance that annual variability in vital rates can play in determining population dynamics.

While annual variation in demographic rates can make it difficult to detect long-term trends in population growth characteristics, it is precisely this same variability that can put the population at risk of a decline from which it becomes increasingly difficult to recover.

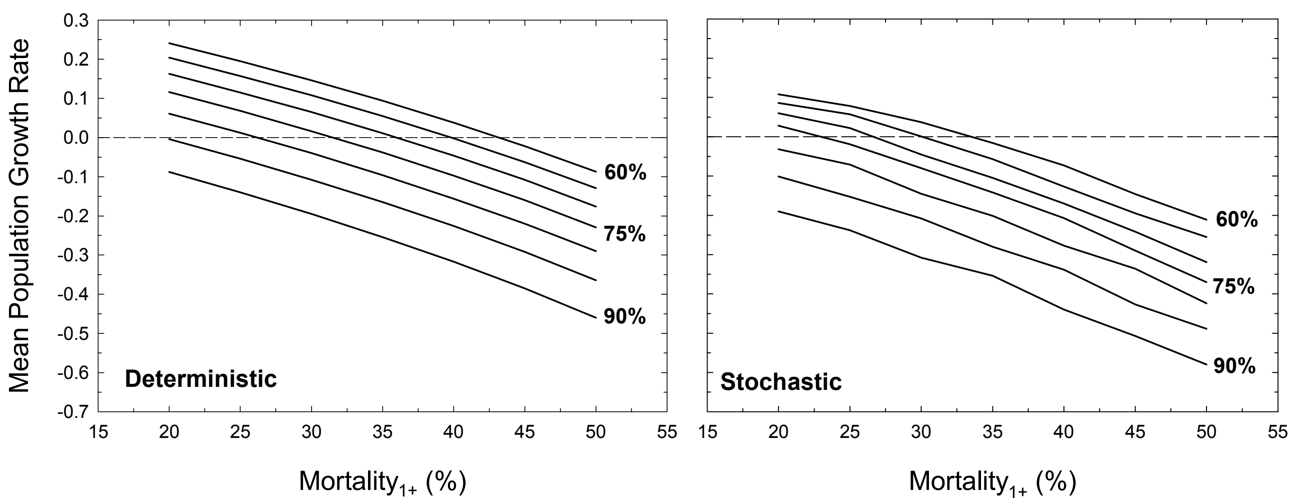


Figure 4. Mortality analysis for a simulated wolf population in Algonquin Park. Deterministic (left panel) and stochastic (right panel) population growth rates as a function of (sub)adult mortality under variable levels of pup mortality (indicated by values to the right of selected curves). Positive growth rates are indicative of populations expected to increase in size over time.

Finally, we briefly evaluated the impact of reduced female reproductive success as well as the effect of a reduced habitat carrying capacity for wolves in the Park. These results are presented in Figure 5 and Table 2. As expected, a reduction in the average reproductive output among adult females leads to a marked decline in population growth rate. In fact, under conditions of higher pup mortality (70%) and lower (sub)adult mortality (20%), a reduction in this parameter can result in a major shift in population growth dynamics from one with mean r > 0 (0.033) to one with mean r < 0 (-0.010) (Table 2). From this type of analysis, it is clear that greater confidence in Park wolf population projections using simulation models can be obtained through more precise estimates of female breeding success. In addition, a reduction in this breeding success is likely to result in a significant decline in population growth rates and could further destabilize the wolf population within and surrounding the Park.

In addition to adult female breeding success, a reduction in habitat carrying capacity can lead to a reduced wolf population growth rate in the Park. However, the overall impact of this type of reduction appears to be relatively less severe than a direct perturbation to the population demographics. [This may result in part from the type of model used which only affects mortality when the population is above the carrying capacity and only affects reproduction at high densities.] In a similar vein, this analysis can lead to the conclusion that measurement uncertainty in specific population demographic parameters may have a more profound impact on the development of meaningful population models than for those parameters more directly related to habitat characteristics.

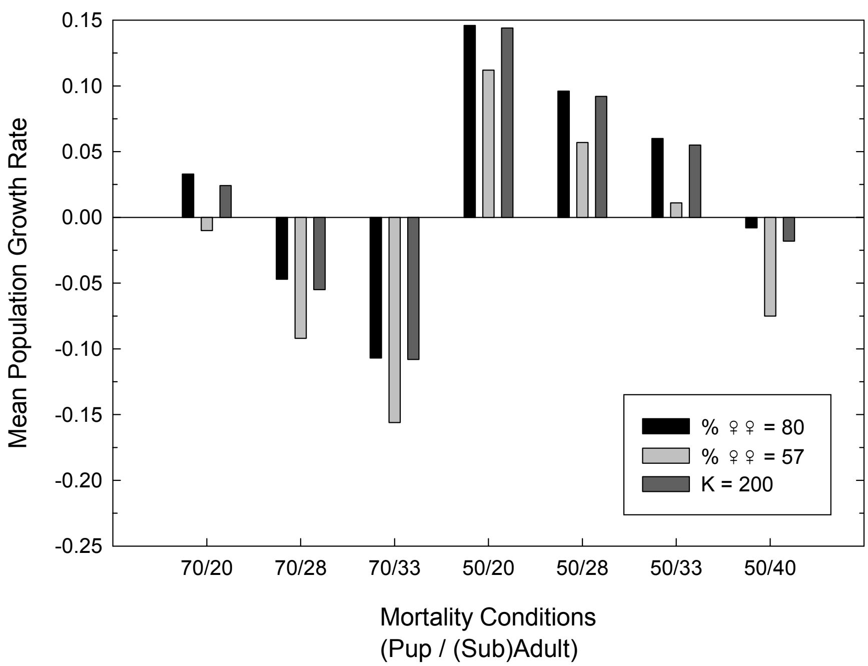


Figure 5. Generalized sensitivity analysis for a simulated wolf population in Algonquin Park. Effects of uncertainty in female reproductive success (mean % adult females producing litters annually) and carrying capacity on population growth rate under variable levels of pup and (sub)adult mortality. See text for further details.

Table 2. Generalized sensitivity analysis for the wolves of Algonquin Park. Baseline model results tabulated in bold. See text for information on input parameters.

Mortality (%)*	% ♀♀	r_s (SD)	P(E)**	T(E)	N_{100} (SD)	H_{100}
K = 300						
70 / 20	80.0	0.033 (0.441)	0.360	—	107 (112)	0.794
70 / 28	80.0	-0.047 (0.490)	0.880	40	11 (42)	0.681
70 / 33	**80.0**	**-0.107 (0.529)**	**0.988**	**26**	**2 (22)**	**0.597**
50 / 20	80.0	0.146 (0.331)	0.000	—	271 (50)	0.899
50 / 28	80.0	0.096 (0.361)	0.004	—	244 (63)	0.877
50 / 33	80.0	0.060 (0.373)	0.020	—	209 (79)	0.840
50 / 40	80.0	-0.008 (0.405)	0.544	92	53 (85)	0.704
70 / 20	57.8	-0.010 (0.399)	0.584	87	44 (82)	0.710
70 / 28	57.8	-0.092 (0.453)	0.984	31	1 (8)	0.512
70 / 33	57.8	-0.156 (0.484)	1.000	21	—	—
50 / 20	57.8	0.112 (0.282)	0.000	—	261 (53)	0.892
50 / 28	57.8	0.057 (0.321)	0.020	—	207 (87)	0.847
50 / 33	57.8	0.011 (0.344)	0.280	—	114 (105)	0.753
50 / 40	57.8	-0.075 (0.397)	0.972	39	4 (28)	0.659
K = 200						
70 / 20	80.0	0.024 (0.441)	0.452	—	56 (70)	0.714
70 / 28	80.0	-0.055 (0.485)	0.936	38	4 (18)	0.589
70 / 33	80.0	-0.108 (0.519)	1.000	25	—	—
50 / 20	80.0	0.144 (0.327)	0.000	—	182 (35)	0.853
50 / 28	80.0	0.092 (0.363)	0.012	—	157 (46)	0.827
50 / 33	80.0	0.055 (0.375)	0.060	—	132 (59)	0.763
50 / 40	80.0	-0.018 (0.410)	0.684	67	27 (51)	0.651

* Figures are given as [pup / (sub)adult] rates.
** Extinction probabilities are for a closed population only.

Assessing Population Viability with a Diffusion Model

Background

We also employed a population viability analysis that has been used to assess the viability of numerous endangered species and small populations including the whooping crane, California condor, Yellowstone grizzly bear and many others (Dennis et al. 1991; Foley 1994). This method also emphasizes an important, but often overlooked component of population viability, namely annual fluctuation in population size (FPS). For example, it is possible for an isolated population with a positive average growth to exhibit high levels of extinction risk, if FPS is too great. Any complete assessment of population viability must consider the impact of FPS. In addition, this method provides an independent means of evaluating the results obtained from *VORTEX*.

This analysis begins by making the assumption that the study population is isolated from other wolf populations. Although technically incorrect, an analysis based on this assumption reveals what could happen if the study population became isolated. Presumably, if the population were viable it should have reasonably low extinction risk even if isolated from other populations.

Analysis

This population viability model is based on a simple, yet robust, mathematical expression of population dynamics:

$$N_{t+1} = N_t R_t,$$

where N_t is the population size or density in year t and R_t is the annual finite rate of population increase. If R_t is, on average, greater than one, the population grows; and, if R_t is, on average, less than one the population tends to decline. Because the statistical properties of R_t are complex, it is difficult to assess whether R_t tends to be greater than or less than one. The acceptable approach for circumventing these statistical difficulties is to consider the log-transformed population dynamics. Therefore, let the natural logarithm of N_t (i.e., $\ln[N_t]$) be denoted as n_t. By following the algebraic rules for manipulating logarithms, the dynamics of the above equation are equivalently expressed as: $n_{t+1} = n_t + r_t$, where r_t is properly modeled as a normally distributed random variable with mean μ and variance σ^2. If maximum population density or carrying capacity (K) and current population size (N_0) are specified, the mean time to extinction (MTE) can be predicted according to Equation 8 of Foley (1994:126). We use this equation to explore the effect of FPS on the MTE of an isolated population with demographic parameters comparable to that of the study population. In this model, FPS is characterized by σ^2. As σ^2 increases, so does FPS.

Our first step is to derive a series of r_t from the 11-year series of density estimates. Algebraic manipulation of equation (2) indicates that each value of r_t is calculated as $n_{t+1} - n_t$. Next, we estimate μ by calculating the arithmetic mean of the series of r_t. The *estimated* value of μ is -0.113. Then, we estimate the variance of r_t (denoted σ^2) by calculating the unbiased sample variance of the series of r_t. The *estimated* value of σ^2 is 0.128. Based on the observed maximum population density since 1988, we estimate K to be 5.0 wolves/100 km^2. We also used the most recent population density estimate from the study population (1.59 wolves/100 km^2 in 1999) as an estimate of N_0.

Figure 6 details the results of our calculations that highlight the importance of FPS in the viability of the study population. As the average growth increases (moving from left to right along the *x*-axis), the mean time to extinction increases. Specifically, the model predicts that the MTE would increase by a factor of 2.6 if the average growth rate increased from -0.113 (its current predicted value) to zero. Thus, the model demonstrates that increasing the average growth rate can increase the viability on the population. However, of comparable importance is FPS. For example, if the estimated level of FPS (i.e, $\sigma^2 = 0.128$) were decreased by 50% the MTE is predicted to decrease by a factor of 2 (when the average growth rate is zero). Alternatively, if the estimated level of FPS were increased by 50% the MTE is predicted to decrease by a 67% (when the average growth rate is zero).

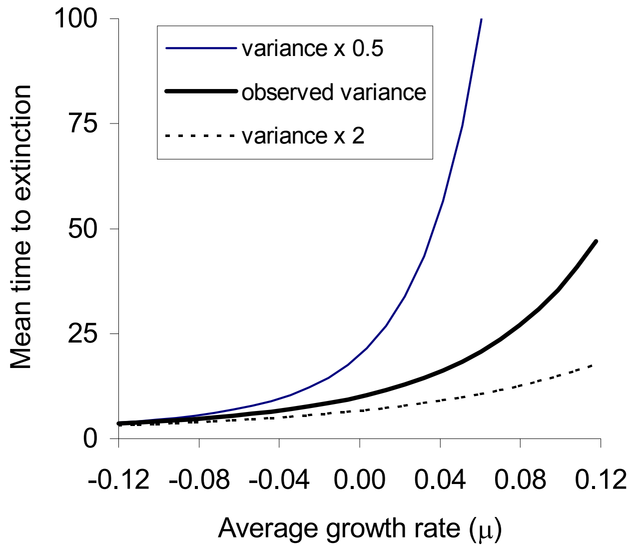


Figure 6. Generalized diffusion model analysis for wolves of Algonquin Park. The predicted effect of average population growth rate and the variance in that growth rate on the mean time to population extinction. See text for further details.

It is critical to recognize that the results of Figure 6 are best interpreted qualitatively (e.g., increasing σ^2 leads to a decrease in MTE). Without expert knowledge of population biology, it may be misleading to focus on the quantitative results presented in the figure (e.g., the mean time to extinction is 20 years when $\mu = 0$ and $\sigma^2 = 0.06$). Thus, the critical messages of this analysis are: 1) fluctuations in population size may be sufficiently large to make the Algonquin wolf population inviable, and 2) a reduction in population fluctuations could be important for increasing the viability of the population.

These results highlight the value of considering if and how FPS can be reduced through management action. Because sufficiently little is known about the population biology of wolves, general principles of population biology will provide the best motivation for understanding how potential management action could reduce FPS. The variance in growth rate (one measure of FPS) is roughly the sum of the variances of the processes that comprise the growth rate (minus a covariance component that may be demonstrated to be relatively small). For example, because the growth rate is the difference between mortality and recruitment, the variance in growth rate is approximately the sum of the variances of recruitment and mortality. Similarly, the variance of mortality is the sum of the variances of the components of mortality. Specifically, the variance of mortality is approximately the sum of the variance in human-caused mortality and natural-caused mortality. Therefore, a reasonable (but untested) hypothesis is that a reduction in human-caused mortality would reduce the variance of mortality and the variance in growth rate, and thus reduce FPS and increase population viability.

A General Discussion of Data Availability and Quality

In addition to using field data to develop the *VORTEX* simulation model and the generalized diffusion model discussed above, the working group addressed a number of general statements made historically about the population of wolves in Algonquin Park in the context of the available data that could be brought to bear on these issues.

Four sources of data were available to the working group. These sources, and the group's evaluation of the utility of these data, are enumerated below:

- Public wolf howls along Highway 60 from 1969-1999.

  The nature of these data do not lend themselves to making inferences about wolf numbers, population density, or trends thereof, or demographic vulnerability. However, they do tell us that wolves have been present and reproducing and that the number of packs recorded from 1985 to 1999 has been consistent at four (or five) packs along the Highway whereas smaller numbers were detected in the late 1970s and early 1980s. This information can not be extrapolated to the rest of Algonquin Park.

- Aerial surveys conducted over an area of 2447 Km^2 in the south-central region of Algonquin Park from 1967 to 1988, and in 2000.

  Again, these data allow us to conclude that wolves were present in all years, but they do not allow us to make inferences about population density or trends, or demographic vulnerability.

- Pimlott et al. (1969), data collected from western side of Algonquin Park, 1959-1965; John and Mary Theberge, eastern side of Algonquin Park, 1987 - 1999

  Although these studies were conducted in different areas and at different times, by extrapolating their results to the entire park we are able to cautiously compare average pack size and number of packs. Based on this extrapolation, there appear to be fewer packs and individual wolves in Algonquin Park at present than in the early 1960s and, based on data in Theberge and Strickland (1978), the decline appears to have occurred in the late 1960s coincident with the decline in the Park deer population. These data do lend themselves to making inferences about wolf numbers, population density, trends, and demographic vulnerability.

One of the more frequently-debated questions surrounding the wolves of Algonquin Park concerns whether the population is currently declining in numbers. While it appears quite likely that the population has declined markedly since the time of Pimlott's studies in the early 1960s, the Theberges' recent data from the eastern segment of the Park cannot allow us to unequivocally conclude that the population declined in the period of their recent studies (1987-1999). By the same token, we cannot conclude with any confidence that the population is currently stable. Additional analysis of the demographic data collected by the Theberges – in particular, radio-telemetry data used to calculate annual recruitment rates – is required before more definitive statements can be made.

Additional questions addressed by the group are listed below.

- Is the wolf that resides in Algonquin Park adaptable to changing environmental conditions and/or a changing prey base?

  Yes, the wolf population is expected to be adaptable. However, as with any species there are limits to this adaptability. For example, the wolf has not been adaptable enough in the northeastern United States to avoid extirpation there. We do not fully know the limits of adaptability for this population.

- Is the population density of wolves dependent on prey abundance?

  Yes. However, this is not the only factor that affects wolf density.

- With regards to the Algonquin wolf population, what is the purpose of Algonquin Park? Is it to provide a natural population of wolves, or is it acceptable to manage the wolf population?

  As a working group focused on the scientific aspects of the population biology of the wolf, we have no statement on this subject.

- Will natural or prescribed burning of forest lands lead to an increase in prey abundance?

  No statement. Extensive natural disturbances including fire that create extensive younger forests can foster large increases in prey populations. We did not believe the nature of these disturbances was ever likely to be as broad scale and intense as had occurred earlier this century when prey populations irrupted.

- Will a more natural system be associated with lower wolf densities?

  Current knowledge about natural wolf populations is too limited to answer this question. However, key factors influencing this issue would be the size of prey populations and the size and spatial distribution of the wolf population.

- Are wolf populations at lower densities at greater risk of local extinction?

  Yes.

- Does wolf killing outside the park affect the wolf population inside the Park?

  The effect of killing wolves of Algonquin Park (that leave the Park) outside the Park has the effect of increasing the long-term risk of unsustainability.

- At the current time, is Algonquin Park acting as a population source or a sink?

  Based on our analyses and deliberations, we conclude that there is a high probability that the studied population (i.e., the East Side of Algonquin Park) is acting as a population sink. This population could be made to behave as a source if (sub)adult mortality were reduced and possibly if recruitment were increased. In the absence of knowledge about reproduction and the effects of increasing prey populations, there is evidence that reduced mortality could improve recruitment and population growth rate.

- Should we be concerned about *lycaon*/*latrans* identification/introgression?

  Yes.

- Are we concerned about the external view of the adaptive management plan?

  Yes.

Reasons for Increased Protection of the Wolves of Algonquin Park

Based on general discussions during the workshop, and after analysis of results from the *VORTEX* simulation and generalized diffusion models, the working group developed a set of criteria that, taken together, provide justification for increased protection of the wolf population in and around Algonquin Park.

- The population of wolves in Algonquin Park is part of the core of the taxon's range because it is the largest protected area occupied by this taxon. At the same time the population may be vulnerable because it is at the edge of its range. The geographic range of many threatened populations collapses inward from the edge.
- The Algonquin Park population represents the largest unharvested segment in the region.
- The Algonquin Park population represents an unmatched opportunity for public education in wolf biology and conservation. More people have been educated about wolves in Algonquin than in any other place and, as a result, the population is highly valued by the public.
- Currently, the areas surrounding Algonquin Park are unlikely to have better conditions than inside the Park and therefore may be unreliable sources for viable/healthy wolf populations.
- The dataset analyzed at this workshop represents the longest wolf population study in Canada. As a result, continued protection of the population provides unparalleled opportunities for additional research into wolf biology and conservation science.
- Because the Park is close to a large urban center, the wolf population in the area may be impacted by additional pressures brought about by the increasing human population in the region.

Recommendations for an Adaptive Management Plan To Conserve the Wolves of Algonquin Park

There is considerable controversy concerning whether a special management area around Algonquin Park is necessary to reduce the risk of decline of wolves within the Park boundary. Annual (sub)adult mortality is the strongest correlate with annual population change. Currently wolves are leaving the east side of Algonquin Park and entering an area where they are subjected to high mortality. Humans outside Algonquin Park cause two-thirds of the total annual population mortality (~ 33% total mortality in the studied population annually). Of that human-caused mortality, hunting and trapping can be most easily regulated. These observations suggest the following hypothesis to be tested.

It has been proposed that this high level of mortality is causally linked to a decline of wolves on the east side of the Park. Larger populations can withstand higher variation in mortality and fluctuations and are therefore at less risk of extinction. Based on our understanding of wolf biology, pack sizes provide a simple surrogate for population size.

The suggestions above lead to the following prediction:

> Assuming adequate prey biomass, when mortality is reduced pack size will increase, and the risk of population decline will also be reduced.

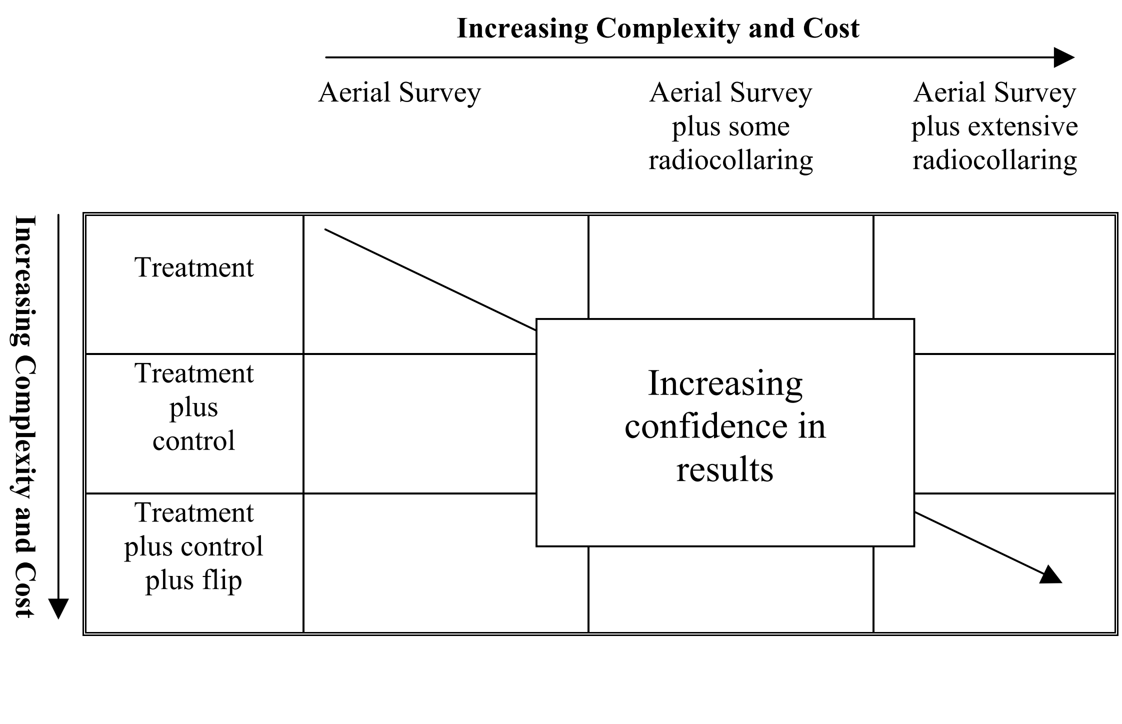
Recommendations

1. **Use Adaptive Management to determine whether changing levels of hunting and trapping mortality outside of Algonquin Park will affect the population of wolves in the Park.**

   The use of an Adaptive Management (AM) model was in the Terms of Reference of the Algonquin Wolf Advisory Committee; as such, it is not specifically a recommendation of our working group. While at least two group members questioned whether it was the most appropriate approach for this case, we concurred that the above recommendation would be the appropriate course of action in the context of the AM directive.

2. **Convene a 1-2 day meeting of a small group to discuss the scientific merits of model options for an Adaptive Management strategy designed to stabilize the population of wolves in Algonquin Park through reducing human-induced mortality.**

A suite of study designs ranging from least to most expensive, and from simplest to most complex can be envisioned as in the figure below. Confidence in the results of the study design increases both with increasing cost and increasing complexity.



Example Adaptive Management Plan
We should stress that the suggestions provided here regarding adaptive management are simply an illustration of the sort of approaches that *could* be discussed. This document should not imply that our group is suggesting that future discussions should be *limited* to these ideas.

An example of an Adaptive Management Plan that might be implemented to test whether changing levels of hunting and trapping mortality will affect the population of wolves in Algonquin Park is presented below.

This plan would establish seasons and quotas for hunting and trapping for designated townships bordering the Park.

1. <u>Southeast Management Area:</u> Nine townships would be selected on the East Side. Six new townships would be added to the existing 3-Township ban area (Richards, Hagarty and Burns) southeast of Algonquin Park.
2. <u>Southwest Management Area:</u> Nine townships would be selected on the southwest side of Algonquin Park.
3. In 2001, 2002, and 2003 a quota of zero for trapping wolves from 1 October until 31 March would be implemented in the Southeast Management Area. Furthermore, a closed season for hunting wolves from 1 October until 31 March would be put into place.
4. In 2001, 2002, and 2003 trapping and hunting would continue with current regulations in the Southwest Management Area. (no quotas, no seasons).
5. In 2004, 2005, and 2006 the trapping and hunting regulations would be reversed so that in the Southeast Management Area there would be no restrictions on trapping or hunting harvest of wolves. Additionally, in the Southwest Management Area there will be a zero quota for trapping and closed hunting season from 1 October to 31 March.

Evaluation of management

1. The response of wolves in the Park to the treatments outside will be monitored for all six years in both Management Areas.
2. Ten packs in each Management Area will be monitored annually.
3. Data about a number of response variables will be collected, depending on the level of investment in the program. However, the data, which will be least expensive to collect, will be least definitive to answer the research questions. Greater levels of investment will result in answers with greater certainty. For example, the simplest variable to monitor will be pack size as a surrogate for population size as estimated from several winter aerial surveys annually. At the other extreme, one or more members of each pack could be radio-collared to collect data comparable to that collected from 1988-1999 by J. and M. Theberge; that is, data adequate for determining pack size, territory size, and population growth rate.
4. After the first 3-year period, average pack size in the Southeast Management Area will be compared to that in the Southwest Management Area. Average pack size will be compared between the two areas again after the second 3-year period.

5. Experience with these systems shows that the variability of pack sizes will preclude statistical detection of differences using parametric tests. This plan will use tests which rely on differences in the numbers of packs showing changes in the predicted direction (e.g. 9 of 10 packs that increased in size in the treatment area versus 3 of 10 in the control area would be tested for significance).
6. All carcasses from trapped and hunted wolves will be collected for supplemental data. These data will enable an evaluation of additional population parameters (age and sex structure, natality, and population growth rates from life table analysis), and genetic and morphological information.
7. In addition, surveys will be conducted for deer, moose, and beaver and winter severity.

Implications for issue

Increased pack sizes in the treatment area after the period of reduced harvest will be consistent with the idea that a special management area will benefit Algonquin Park's wolf population and will reduce the risk of serious population decline or even extinction.

Alternatively, no change or smaller pack sizes in the face of reduced harvest would be consistent with the idea that the tested special management area adjacent to the Park will not increase the probability of persistence of the wolf population.

For an Adaptive Management Plan such as the type proposed here to be ultimately successful, all parties involved in and perhaps affected by the management of wolves within Algonquin Park must realize that concessions must be made. A simple way of showing this may be exemplified by the following diagram:

	Management Zone Size		
	Full	Partial	Absent
Supporters of increased wolf protection	get	give/get	give
Opponents of increased wolf protection	give	give/get	get

Appreciation of the need for constructive collaboration is vital if additional information relevant to continued management of the wolves within Algonquin Park is to be gleaned from an adaptive approach to conservation management.

It should be stressed that the group discussed other adaptive management models, with the plan above listed simply as one example that received the greatest degree of attention and discussion.

Additional Recommendations

- Reanalyze selected population demographic data obtained by the Theberges since 1987. Specifically, determine the potentially confounding effect of variable population size on temporal trends in population density. In addition, extract the recruitment rate from data on the “2-cohort recruitment rate.” (A reanalysis of these data was conducted by John Vucetich and Paul Paquet and provided to AWAG members. The report is available from the authors or AWAG.)

- In order to construct more realistic models of wolf population dynamics that rely on a pack-based spatial structure, additional data on pack-specific characteristics are required. Such data may include the specifics of within-pack breeding characteristics, and the nature and extent of dispersal between packs.
- Develop programs to collect demographic and habitat data for wolves occupying the western portion of Algonquin Park. A complete picture of the growth dynamics of the wolves within the Park requires field data across the entire region.
- In order to lift the restriction of modeling the Park wolf population as a closed system, a metapopulation model would require knowledge of the population dynamics of wolves elsewhere in Ontario that border the Park itself. Long-term field studies would be the most effective method of collecting data on both mean parameter values as well as temporal variation in those parameters.

Working Group Members: Lu Carbyn, Peter Ewins, Brian Kelly, Jean Langlois, Ernie Martelle, Tom Nudds, Martyn Obbard, Paul Paquet, William Rapley, Ed Reid, Michael Runtz, Claude Samson, John Theberge, Dennis Voigt, John Vucetich, Stephen Woodley, Philip Miller (facilitator).

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Sample *VORTEX* Input File

```
APW108.OUT     ***Output Filename***
Y     ***Graphing Files?***
N     ***Details each Iteration?***
250     ***Simulations***
100     ***Years***
10     ***Reporting Interval***
0     ***Definition of Extinction***
1     ***Populations***
N     ***Inbreeding Depression?***
N     ***EV concordance between repro and surv?***
1     ***Types Of Catastrophes***
M     ***Monogamous, Polygynous, or Hermaphroditic***
2     ***Female Breeding Age***
2     ***Male Breeding Age***
10     ***Maximum Breeding Age***
50.000000     ***Sex Ratio (percent males)***
8     ***Maximum Litter Size (0 = normal distribution) *****
Y     ***Density Dependent Breeding?***
Algonquin
80.000000     ***Density dependence term P(0)***
33.000000     ***Density dependence term P(K)***
8.000000     ***Density dependence term B***
0.000000     ***Density dependence term A***
10.00  **EV-breeding
0.000000     ***Algonquin: Percent Litter Size 1***
2.000000     ***Algonquin: Percent Litter Size 2***
3.000000     ***Algonquin: Percent Litter Size 3***
20.000000     ***Algonquin: Percent Litter Size 4***
50.000000     ***Algonquin: Percent Litter Size 5***
20.000000     ***Algonquin: Percent Litter Size 6***
3.000000     ***Algonquin: Percent Litter Size 7***
50.000000  *FMort age 0
20.000000  ***EV
40.000000  *FMort age 1
12.000000  ***EV
40.000000  *Adult FMort
12.000000  ***EV
50.000000  *MMort age 0
20.000000  ***EV
40.000000  *MMort age 1
12.000000  ***EV
40.000000  *Adult MMort
12.000000  ***EV
2.000000     ***Probability Of Catastrophe 1***
0.500000  ***Severity--Reproduction***
0.500000  ***Severity--Survival***
N     ***All Males Breeders?***
80.000000     ***Percent Males In Breeding Pool***
Y     ***Start At Stable Age Distribution?***
150     ***Initial Population Size***
300     ***K***
50.000000     ***EV--K***
N     ***Trend In K?***
N     ***Harvest?***
N     ***Supplement?***
Y     ***AnotherSimulation?***
```

Sample *VORTEX* Output File

```
VORTEX 8.21 -- simulation of genetic and demographic stochasticity

1 population(s) simulated for 100 years, 250 iterations

  Extinction is defined as no animals of one or both sexes.

  No inbreeding depression

  First age of reproduction for females: 2   for males: 2
  Maximum breeding age (senescence): 10
  Sex ratio at birth (percent males): 50.000000

Population: Algonquin
  Monogamous mating;
    80.00 percent of adult males in the breeding pool.

  Reproduction is assumed to be density dependent, according to:
  % breeding = ((80.00*[1-((N/K)^8.00)])+(33.00*[(N/K)^8.00]))*(N/(0.00+N))
   EV in % adult females breeding = 10.00 SD

   Of those females producing litters, ...
      0.00 percent of females produce litters of size 1
      2.00 percent of females produce litters of size 2
      3.00 percent of females produce litters of size 3
     20.00 percent of females produce litters of size 4
     50.00 percent of females produce litters of size 5
     20.00 percent of females produce litters of size 6
      3.00 percent of females produce litters of size 7
      2.00 percent of females produce litters of size 8

   50.00 percent mortality of females between ages 0 and 1
    EV in % mortality = 20.000000 SD
   40.00 percent mortality of females between ages 1 and 2
    EV in % mortality = 12.000000 SD
   40.00 percent mortality of adult females (2<=age<=10)
    EV in % mortality = 12.000000 SD
   50.00 percent mortality of males between ages 0 and 1
    EV in % mortality = 20.000000 SD
   40.00 percent mortality of males between ages 1 and 2
    EV in % mortality = 12.000000 SD
   40.00 percent mortality of adult males (2<=age<=10)
    EV in % mortality = 12.000000 SD

    EVs may be adjusted to closest values possible for binomial distribution.
    EV in mortality will be concordant among age-sex classes
       but independent from EV in reproduction.

  Frequency of type 1 catastrophes: 2.000 percent
    multiplicative effect on reproduction = 0.500000
    multiplicative effect on survival = 0.500000

  Initial size of Algonquin:      150
    (set to reflect stable age distribution)
 Age 1     2     3     4     5     6     7     8     9    10    Total
    35    19    10     5     3     1     1     1     0     0      75  Males
    35    19    10     5     3     1     1     1     0     0      75  Females

  Carrying capacity = 300
    EV in Carrying capacity = 50.00 SD
```

Sample *VORTEX* Output File (Contd.)

```
Deterministic population growth rate
  (based on females, with assumptions of no limitation of mates, no density
dependence, no functional dependencies, and no inbreeding depression)

     r =  0.108     lambda = 1.115     R0 =     1.421
   Generation time for:  females = 3.24    males = 3.24

Stable age distribution:  Age class    females    males
                              0        0.257      0.257
                              1        0.114      0.114
                              2        0.061      0.061
                              3        0.032      0.032
                              4        0.017      0.017
                              5        0.009      0.009
                              6        0.005      0.005
                              7        0.003      0.003
                              8        0.001      0.001
                              9        0.001      0.001
                             10        0.000      0.000

Ratio of adult (>= 2) males to adult (>= 2) females: 1.000

Population 1: Algonquin

Year 10
     N[Extinct] =       3, P[E] =  0.012
     N[Surviving] =   247, P[S] =  0.988
     Mean size (all populations) =  165.98 (   5.69 SE,   89.99 SD)
  Means across extant populations only:
     Population size =          167.97 (   5.64 SE,   88.68 SD)
     Expected heterozygosity =    0.969 (  0.002 SE,   0.026 SD)
     Observed heterozygosity =    0.985 (  0.001 SE,   0.018 SD)
     Number of extant alleles =   66.10 (   1.59 SE,   25.01 SD)

Year 20
     N[Extinct] =      10, P[E] =  0.040
     N[Surviving] =   240, P[S] =  0.960
     Mean size (all populations) =  135.81 (   5.67 SE,   89.68 SD)
  Means across extant populations only:
     Population size =          141.46 (   5.62 SE,   87.04 SD)
     Expected heterozygosity =    0.932 (  0.004 SE,   0.065 SD)
     Observed heterozygosity =    0.954 (  0.003 SE,   0.050 SD)
     Number of extant alleles =   34.60 (   0.98 SE,   15.22 SD)

Year 30
     N[Extinct] =      25, P[E] =  0.100
     N[Surviving] =   225, P[S] =  0.900
     Mean size (all populations) =  120.32 (   6.07 SE,   96.01 SD)
  Means across extant populations only:
     Population size =          133.64 (   6.13 SE,   92.00 SD)
     Expected heterozygosity =    0.902 (  0.005 SE,   0.081 SD)
     Observed heterozygosity =    0.927 (  0.006 SE,   0.086 SD)
     Number of extant alleles =   23.45 (   0.72 SE,   10.85 SD)
```

Sample *VORTEX* Output File (Contd.)

```
Year 40
     N[Extinct] =      40, P[E] =  0.160
     N[Surviving] =   210, P[S] =  0.840
     Mean size (all populations) =  117.55 (   6.43 SE,  101.67 SD)
  Means across extant populations only:
     Population size =          139.90 (   6.61 SE,   95.79 SD)
     Expected heterozygosity =    0.870 (  0.007 SE,   0.097 SD)
     Observed heterozygosity =    0.899 (  0.007 SE,   0.095 SD)
     Number of extant alleles =   17.83 (   0.59 SE,    8.48 SD)
Year 50
     N[Extinct] =      55, P[E] =  0.220
     N[Surviving] =   195, P[S] =  0.780
     Mean size (all populations) =  104.75 (   6.36 SE,  100.63 SD)
  Means across extant populations only:
     Population size =          134.28 (   6.80 SE,   94.94 SD)
     Expected heterozygosity =    0.830 (  0.009 SE,   0.129 SD)
     Observed heterozygosity =    0.857 (  0.009 SE,   0.125 SD)
     Number of extant alleles =   14.02 (   0.51 SE,    7.16 SD)

Year 60
     N[Extinct] =      76, P[E] =  0.304
     N[Surviving] =   174, P[S] =  0.696
     Mean size (all populations) =   87.20 (   5.95 SE,   94.10 SD)
  Means across extant populations only:
     Population size =          125.26 (   6.76 SE,   89.17 SD)
     Expected heterozygosity =    0.807 (  0.012 SE,   0.155 SD)
     Observed heterozygosity =    0.829 (  0.011 SE,   0.151 SD)
     Number of extant alleles =   11.91 (   0.44 SE,    5.79 SD)

Year 70
     N[Extinct] =      92, P[E] =  0.368
     N[Surviving] =   158, P[S] =  0.632
     Mean size (all populations) =   75.28 (   5.92 SE,   93.57 SD)
  Means across extant populations only:
     Population size =          119.04 (   7.40 SE,   92.99 SD)
     Expected heterozygosity =    0.776 (  0.013 SE,   0.166 SD)
     Observed heterozygosity =    0.799 (  0.013 SE,   0.165 SD)
     Number of extant alleles =   10.01 (   0.38 SE,    4.80 SD)

Year 80
     N[Extinct] =     105, P[E] =  0.420
     N[Surviving] =   145, P[S] =  0.580
     Mean size (all populations) =   69.54 (   5.73 SE,   90.55 SD)
  Means across extant populations only:
     Population size =          119.82 (   7.48 SE,   90.10 SD)
     Expected heterozygosity =    0.755 (  0.013 SE,   0.153 SD)
     Observed heterozygosity =    0.783 (  0.013 SE,   0.157 SD)
     Number of extant alleles =    8.54 (   0.34 SE,    4.04 SD)

Year 90
     N[Extinct] =     122, P[E] =  0.488
     N[Surviving] =   128, P[S] =  0.512
     Mean size (all populations) =   56.88 (   5.31 SE,   83.96 SD)
  Means across extant populations only:
     Population size =          110.95 (   7.80 SE,   88.22 SD)
     Expected heterozygosity =    0.725 (  0.015 SE,   0.165 SD)
     Observed heterozygosity =    0.756 (  0.016 SE,   0.179 SD)
     Number of extant alleles =    7.53 (   0.33 SE,    3.69 SD)
```

Sample *VORTEX* Output File (Contd.)

```
Year 100
     N[Extinct] =     136, P[E] =  0.544
     N[Surviving] =   114, P[S] =  0.456
     Mean size (all populations) =   53.22 (   5.36 SE,   84.69 SD)
  Means across extant populations only:
     Population size =          116.63 (   8.56 SE,   91.36 SD)
     Expected heterozygosity =    0.704 (  0.015 SE,   0.159 SD)
     Observed heterozygosity =    0.729 (  0.016 SE,   0.169 SD)
     Number of extant alleles =    6.75 (   0.30 SE,    3.19 SD)


In 250 simulations of Algonquin for 100 years:
  136 went extinct and 114 survived.

This gives a probability of extinction of 0.5440 (0.0315 SE),
  or a probability of success of          0.4560 (0.0315 SE).

136 simulations went extinct at least once.
Median time to first extinction was 92 years.
Of those going extinct,
    mean time to first extinction was 56.78 years (2.15 SE, 25.05 SD).

Means across all populations (extant and extinct) ...
Mean final population was 53.22 (5.36 SE, 84.69 SD)

   Age 1   Adults    Total
   11.62   14.43     26.05  Males
   11.70   15.46     27.17  Females

Means across extant populations only ...
Mean final population for successful cases was 116.63 (8.56 SE, 91.36 SD)

   Age 1   Adults    Total
   25.00   31.65     57.12  Males
   25.00   33.91     59.58  Females

Across all years, prior to carrying capacity truncation,
  mean growth rate (r) was -0.0083 (0.0029 SE, 0.4048 SD)

Final expected heterozygosity was      0.7043 ( 0.0149 SE,  0.1592 SD)
Final observed heterozygosity was      0.7293 ( 0.0158 SE,  0.1691 SD)
Final number of alleles was              6.75 (   0.30 SE,    3.19 SD)
************************************************************************
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The Wolves of Algonquin Park

Population & Habitat Viability Assessment (PHVA)

FINAL REPORT

SECTION 4

Prey Habitat Working Group Report

Prey Habitat Working Group Report

Introduction

The Prey Habitat Working Group agrees that:

iv. A wolf population should be maintained in Algonquin Provincial Park to conserve biodiversity and retain a functional ecosystem.

v. The genetic data (B.N. White and P.J. Wilson, pers. comm.; Wilson *et al*., in prep.) indicate the wolf in Algonquin Park is part of a wide-ranging connected population of the Eastern Canadian Wolf, which is more closely related to the coyote than the grey wolf.

vi. The Eastern Canadian Wolf population appears stable and perhaps expanding across its range and, recognising that the wolf population responds to prey availability, park staff have no evidence indicating the population inside the park is declining at this time.

The list of issues from the group Mind Map were condensed into the following 13 issues for consideration by our working group:

1. **Degree of use of the available habitat by the prey.**
   Deer are leaving the park for the winter in spite of apparently good habitat inside the park (i.e. move to Round Lake). What are the triggers inducing deer to leave the park? Some of these factors include coniferous canopy cover, browse availability in close proximity to cover, climate etc.

2. **Climate/Geography/Habitat variation/Forest age structure/Browse availability**
   Manage for habitat diversity, include wetland component, and consider both winter and summer range. Wolf densities vary due to Algonquin Dome habitat (fewer deer in the west). In relation to climate and geography, consider the uniqueness of the landform comprising the Algonquin dome, the influence of Georgian Bay, the rain shadow of the east side of the park and colder/deeper snows on the west side of the park. Also, consider the potential for global climate changes to result in habitat changes. Early recognition of the importance of hemlock for deer in Algonquin Park (harvesting).

3. **Role of natural fire cycle and the results of fire suppression on prey habitat.**
   Recognizing that more fires lead to more deer (i.e. new browse and new vegetation), the forest management plan intends to duplicate natural conditions but is not actually doing this because logging practices are being used in place of fire. Existing studies[3] of the effect of logging vs. fire on deer populations should be reviewed and additional studies may be needed. FMPs are designed to manage forests toward more pre-settlement conditions. Is this what is best for the wolf? The opportunity for natural fire to affect vegetation within the Park is small because the tolerant hardwood forest on the west side of Algonquin is difficult, if not almost impossible to burn, and on the east side of the Park all

[3] Runge, R.A., 1976. Deer, fire and logging: resource management and planning in Algonquin Provincial Park. M.A. Thesis, University of Waterloo, Ont. 291pp.

fires are aggressively contained and put out. However, the eastern portion of the Park has a high conifer component, similar to the "pre-settlement" Park forest, and thus vegetation can be impacted if a fire(s) is permitted to burn.

4. **Wolf prey preference.**
   Prey preference is based on energy expenditure. In open water season of May – September, wolves prey on a mix of beaver and deer. Denning sites are often close to high concentrations of beaver. The main issue for discussion is the capability of wolves to take down deer vs. moose. The consensus of the working group is that wolves in Algonquin Park are more capable of taking deer over moose in winter and that moose are scavenged not predated by wolves. This is supported by data in Forbes and Theberge, 1996. However, Theberge's analysis presented in this workshop suggests otherwise (a recognized data need).

5. **Prey mortality.**
   There are general public misperceptions concerning this wolf, the population's uniqueness, Algonquin First Nations and non-native use of resources, forest industry practices, etc. There is a public perception that there is no trapping occurring in Algonquin Park when there are, in fact, Algonquin First Nations trap lines on the east side of the Park (for trapping of all furbearers other than wolves as well as non-native trap lines in the southern "panhandle" of the Park consisting of Clyde and Bruton Townships. These traplines do not appear to be negatively affecting the wolf population. Evaluate cause and effect of fluctuations (both major and minor) in prey populations (deer crash in the '60's; winter tick infestation of moose population) and the possibility of over harvesting of prey by hunters and trappers (Each year a hunting agreement is negotiated between the Algonquin First Nations and the Province to ensure that moose and deer herds are not over harvested). If it is determined at some point that the prey base for Park wolves needs to be increased, an evaluation of harvest may need to be undertaken. If the take is found to be unsustainable then consultation with other harvesters of moose and deer as well as trappers should be undertaken and considered. A related issue of concern to the working group members is that, while the existence of logging in Algonquin Park is clearly and repeatedly pointed out to Park visitors in the exhibits and videos at the Algonquin Logging Museum, the Visitor Centre and in numerous Park publications and verbal communications, there is a perceived lack of information on the part of the general public (non-visitors) regarding the forest harvesting taking place in Algonquin Park.

6. **Prey availability.**
   As goes the habitat so goes so goes the prey (moose, deer, beaver) and as goes the prey so goes the predator. In a bottom up system, we need to manage the prey, as the prey controls the predator. The opposite is true in a top down system and both systems may be at work so management in both contexts must be considered.

7. **Moose/Deer Interaction.**
   Both species can and do coexist and succeed in Algonquin Park (Wilton, 1987). Brainworm may be an important factor regulating the ratio of moose to deer. The working group concluded that we want both moose and deer to remain in the park and that natural

fluctuation should be allowed to take place recognizing that ratio between moose and deer will continue to fluctuate.

8. **Human access.**
   The impacts of logging roads (which are not accessible to public) need to be considered, particularly in light of the fact that there could be an increase in logging roads if increased logging is deemed necessary to in effort to manage for deer. The proposal suggested by this working group, in the event that habitat management for prey is required, does not call for increased logging. The impact of a suggested new road to access the Park from the south (Haliburton) should be evaluated. The impact of ecotourism was considered insignificant by the group with the possible exception of dog sledding (parasites/disease spread) and horses. The fundamental question is: Is it possible to have too many visitors in Algonquin Park?

9. **Scavenging.**
   Scavenging by wolves was identified as an impact of concern. Wolves need to scavenge on moose so road kills should be left up in the bush to feed the wolves. This issue includes consideration of winter ticks, road kills, gut piles, moose and the fact that coyotes are efficient/extreme users of carcasses (pick up road kills).

10. **Private Land Stewardship (outside the park).**
    Effort to generate interest by private land owners adjacent to the park to manage their land/woodlots similar to crown land so that the surrounding habitat is contiguous with the Park.

11. **Elk availability.**
    Elk would be competitive with current native ungulates for food and their presence could present a risk in terms of parasites and disease. The decision to introduce elk is political.

12. **Traplines within Park.**
    There are more beaver outside the park than inside the park and there are peaks and valleys to population size. Will management of the furbearers via trapping improve the populations of beavers? Currently there are 20 Algonquin First Nations traplines in the northeastern part of the Park; and there is additional native hunting. Traplines exist in 2 townships (Bruton and Clyde) and 1/2 of park is open to traplines. Registered traplines on townships adjacent to the park are taking wolves, but it is not known whether or not they are Eastern Canadian Wolves.

13. **Impact of increased wolf populations on wolf-bear interactions.**

Issues, Strategies and Actions

After discussing each of these issues facing our working group, we prioritized them using paired ranking. The seven top ranking issues were:

1. Prey availability
2. Dome effect (climate, landform, forest age structure, browse and winter cover availability)
3. Wolf prey preference
4. Moose/deer interaction
5. Prey mortality
6. Degree of use of habitat by prey
7. Traplines inside the park

In order of priority, the group elaborated on each issue and, in developing a strategy to address each of the top seven issues and a set of specific actions steps designed to implement the strategy, and with valuable input from the larger group of workshop participants in plenary session, recognized that priority issues 1-6 could be best addressed with one Priority Action. Issue 7 receives separate attention and three strategies were identified to address it.

Issues 1-6: Prey availability, Dome effect, Wolf prey preference, Moose/deer interaction, Prey mortality, and Degree of use of habitat by prey

Priority action: Develop a Wildlife Management Plan (WMP) for the Park as part of the Algonquin Provincial Park Management Plan which includes plans for monitoring, research, habitat and fire, taking into account past practices, past history of species and habitat management etc., and building on the existing deer management, Algonquin Park Management and the Forest Management Plans, and incorporating public consultation.

The WMP should include components of research, monitoring, a fire plan and an ecosystem plan. The fire plan should research what the natural forest fire regime has been in the park and what current fire policies are being implemented.

The WMP should include the following strategy and actions to be considered for implementation if there comes a time when manipulating habitat in an effort to increase the prey species for wolves within the park is deemed necessary:

Strategy: to manage for optimum, healthy sustainable prey populations.

Action 1. Modify timber harvesting procedures with regard for all Provincial Guidelines such as: Forest Management Plan Guidelines for the Provision of Moose Habitat; Code of Riparian Practices; Forest Management Guidelines for the Protection of Fish Habitat; etc.

Modify the Area of Concern (AOC) prescriptions, currently in the Forest Management Plan (FMP), at the Annual Work Schedule. This action will not result in any change in the allowable cut but a different distribution of the cutting on the landbase. The cutting will only be proposed for the area that is planned for harvest within the FMP (2% of the landbase per year).

a) Promote beaver habitat by opening up of former beaver habitat to promote aspen and cut within coniferous AOC's surrounding these wetland areas. Aerial photography can help to delineate the former beaver pond areas that have drained. This action should be implemented in recreation/utilization areas of the park but not on canoe routes or hiking trails in recognition of: a) type of water body i.e. cold or warm water, b) existing recreational uses, c) erosion potential, d) existing habitat use i.e. moose aquatic feeding area for cover, (possibility of use of fire as well as cutting prescription). This action does not have to result in increased access, cutting can be undertaken in the winter and/or done with methods which do not create permanent access. Cutting around riparian areas would only create limited openings to encourage poplar growth for beaver forage near the beaver pond. Conifer cover surrounding riparian areas is a natural occurrence, however, a natural process is that fire would go through and disturb these areas to varying degrees randomly across the landscape (cedar, balsam, black spruce, white spruce, tamarack). Due to how some of the AOC guidelines are implemented there is little or no disturbance across the landscape in these conifer belts. The result is reduced diversity within these areas and the resulting decrease of poplar regeneration impacts beaver populations as well as other species associated with these wetland areas. The applicable AOC guidelines allow for this kind of practice with the appropriate rationale.

b) Improve wintering habitat (deer yarding cover) on the east side of the park by striving for 70% coniferous canopy closure from the 40 – 50% optimal for white pine regeneration in both pine and mixed wood working groups by making a prescription that redistributes the white pine harvest within the stand. This could best be accomplished through the use of the Group Shelterwood Method rather than the presently used Uniform Shelterwood Method of harvesting, and need not result in any production loss.

c) Optimize quantity and quality of browse for deer and moose by cutting stands adjacent to conifer cover. To encourage or establish habitual use by deer and/or moose, cutting could occur in winter or in September – November. The fall harvest operation will not interfere with the Algonquin native hunt that takes place in the east side of the park.

d) The practice of not controlling insect infestations should be continued. The only insect outbreaks that have been controlled in recent decades in Algonquin Park have been of spruce budworm and then only in developed campgrounds and through the use of biological agents. Natural disturbance via insect infestations creates natural early successional habitat. If insect infestations are not controlled it should be considered to not conduct salvage logging operations, unless it is only to remove dead balsam fir and leaving the surviving spruce. Refer to the Algonquin Provincial Park Management Plan.

Action 2: Expand the resource knowledge base to assist in the management of habitat for optimum healthy, sustainable prey populations.

a) Collect and analyze GIS information on existing available summer deer habitat (consider addressing the promotion of increased mast production, such as acorns, beech nuts) and refer this information to the Wildlife Management Planning Team.

b) On the west side of the park, conduct research into solutions to the problem of lack of hemlock recruitment and how to prevent moose from browsing the young hemlock.
   - consider the establishment/reintroduction of red spruce/ white spruce to be used as alternate cover types
   - research a scent agent to discourage wildlife browsing (i.e. breed hemlock with scent unpalatable to wildlife)

   Responsible Parties: Algonquin Provincial Park Staff (Ontario Parks), in consultation with Algonquin First Nations representatives, AFA, EBR (environmental bill of rights registry) posting, local citizens committee and public consultation. Request to Park Superintendent that this be made a priority.

   Timeline: To be completed and implemented by February 2002.

   Resources needed: There may be an ability to assist funding of this plan through the FMP process and budget.

   Measurable Outcome: Production and implementation of a Wildlife Management Plan which includes periodic monitoring of the prey base.

Issue 7: Traplines within the Park

Traplines within the Park need to be honestly and openly addressed with respect to the issue of native trapping in the Park. Inside and outside the Park the current furbearer management program is considered reasonable and sustainable. There is trapping within the Park but this does not include trapping of wolves.

Strategy 1: We support the human values working group recommendation concerning establishment of a group to discuss and analyze the issue of trapping in the Park. This group would include stakeholder involvement and public consultation. Since 1994 there has been an informal “zero harvest agreement” with the Algonquin First Nations on wolves in Alonquin Park, as well as a zero quota on the registered Algonquin traplines in the Park.

Strategy 2: Enshrine/formalize the current informal agreements to not take wolves inside the Park and ensure enforcement of the agreement. Confirm that there are no mortalities inside the park due to hunting and trapping unless on an incidental basis.

Strategy 3: Develop a public education program with specific focus on real practices of Aboriginal people inside the Park (Park management and Aboriginal people to collaborate). This strategy should be incorporated into the Algonquin Provincial Park Interpretive Program.

Working Group Members: Alfred Beck, Percy Bresnahan, Onnie Byers (facilitator), Bill Calvert, Mark Downey, Kathy Irwin, Dana Kinsman, Jim Meness, Andy Montreuil, Bill Peneston, Jerome Sernoskie, Rick Stronks, Bradley White, Mike Wilton

The Wolves of Algonquin Park

Population & Habitat Viability Assessment (PHVA)

FINAL REPORT

SECTION 5

Landscape Ecology Working Group Report

Landscape Ecology Working Group Report

Introduction

The Landscape Ecology Working Group began by identifying and discussing various factors related to Landscape Ecology that the group considered important to understanding the wolves in and around Algonquin Park. These were: 1) Geographic area of concern; 2) Taxonomy/ demography; 3) Threats; 4) Wolf movement; 5) Landscape needs; and 6) Research. Notes from the discussions of these topics are provided below.

(1) Geographic area of concern
While the AWAG has a mandate to develop a plan for management of wolves in Algonquin Park, a regional focus beyond the boundaries of Algonquin Provincial Park and consideration of ecological connectivity to adjacent areas is necessary to address the wolf issue. The issue must also 'connect' with human values. The wolf will be conserved if society wants or wills it. Therefore, it is more reasonable to discuss management of the wolf rather than a geographic area.

(2) Taxonomy/demography
The major focus of the discussion was on what kind of wolf are we talking about. The scientific evidence seems unclear on this point. The "Tweed" wolves do not seem different from Park wolves, so it may be difficult to make management decisions for park wolves in isolation. There is little data on whether the packs are intermixing or a mixture of coyotes and wolves. The social structure of wolf packs is definitely affected by the age of the adult wolves. Currently, the packs of wolves in Algonquin Park have an average adult age of 4.5 and 2 is the average age at which wolves are most likely to be killed. In other words, the packs appear unable to sustain an older population and display all the characteristics of an exploited population. Regardless of the taxonomic designation of the wolf, there is value in Algonquin Park providing an anchor or benchmark related to wolf protection. The working group agreed that there is a need to protect some form of the wolf in Algonquin Provincial Park "in perpetuity."

(3) Threats
The group discussed current and future potential threats to the wolves. There may be specific areas of concern. For instance, resident wolf packs make excursions outside the Park to the Round Lake deer yard. It is during these excursions that they are most at risk for being killed. The south and southeast corner around the Park is where the most coyote-wolf hybridization has occurred. The north and northwest area around the Park is where a positive connectivity occurs as there are fewer roads, less human activity and more wolves. Road accesses provide avenues for the intrusion of coyotes and the coyote often fills the niche where wolves once were.

(4) Wolf movement
Deer migration does affect the movements of wolves, but its direct causal effect on Algonquin Park wolves is not known. There is some indication that the wolf of Algonquin Park moves with

the deer movements, and hence their presence at deer yards outside of the Park. However, there is still indication that the Algonquin Park wolves are able to kill and feed off moose. The researchers are not sure why the wolves follow the deer when moose are available and only occasionally move outside the Park to feed rather than extend home territory. There is a phenotypically similar wolf found in Quebec. In fact, the people from Quebec believe their wolf may be genetically related to the wolf of Algonquin Park. Certainly, it would be possible to have movement from Algonquin Park to Quebec across the frozen Ottawa during the winter.

(5) Landscape needs
What should the landscape look like to protect wolves? The discussion focused on a large protected area as core with "buffer" or "management areas" to address specific needs (e.g., excursion from Park for resident packs or transboundary[4] packs). The majority favored the Park as a benchmark for the surrounding areas because the wolves in the Park provide a strong genetic base for the Algonquin wolf and a barrier toward more introgression of a coyote gene.
There is uncertainty about habitat quality. Given the wolves' diet of beaver, deer and moose, there seems to be a variety of prey available within the Park. However, recent fluctuations of deer and beaver populations may be causing some variance within the wolf population.
What exactly is the sustainable number of wolves in Algonquin Park? There is a relatively high biomass within the Park, but there is a difference between level of biomass and availability of prey. Prey can be in existence but not available for the wolves. The number of 1 wolf per 10 square miles was considered as a density for wolves.

(6) Research
It is tough to track wolves with radio collars. They can move outside the range or into other areas where the researchers cannot track them. In those cases, the radio collar may re-appear after the wolf has been killed and, in the intervening time, information is lost. Although information such as weight, skull size, and location of kill can be surmised from trapper information, it needs to be supplemented with behavioural knowledge and genetics.

The issues discussed during the mind mapping exercise, plus those identified above, were combined where appropriate and prioritized using paired ranking. The priority issues were farther defined and strategies developed to achieved the specific conservation outcome identified. The following represents the order of importance of each of the issues.

1. Landscape Management and Coyote introgression

Algonquin Park's position coincides with the current wolf / coyote "ecotone". Genetic introgression will take place at such meeting sites. However, the species "ecotone" was located further south 20 years ago than it is now. Therefore, we should consider minimizing the existing or future habitat fragmentation near the southern boundary of the Park, while maintaining a non-

[4] The Landscape Ecology Working Group used the term 'transboundary' to refer to wolves whose territories cross Park boundaries.

fragmented area within Park boundaries, to ensure that the "coyote-hybrid complex" remains to the south of the park. However, there is a feeling that efforts aimed at stopping and eventually decreasing fragmentation / increasing connectivity to the south of the Park are less feasible than those aimed at maintaining connectivity to the northwest and northeast. We must consider what the landscape matrix will look like in 100 years. Algonquin Park itself is not considered to be fragmented.

Coyotes are currently found around the Park but are not yet a significant presence within it. It is generally accepted that a more wolf-like animal is found inside Algonquin Park than that which is found in areas south of the Park. The Park is considered to be "wolf habitat". This implies that the Park provides wolf habitat and that maintaining more of this habitat outside would contribute to reducing coyote introgression. If the population of wolves was not under any threat, it is thought that they could coexist with coyotes while retaining their species identity. Hybridization is thought to be the product of socially fragmented wolf populations in which lone animals may have no choice but to mate with coyotes.

There is little legislative and policy basis to empower Park managers to reach outside of the Park boundaries to influence or even guide outside management practices that have an influence on the Park. The Park is and must remain an anchor for wolf conservation and, as such, a "greater ecosystem" outlook on the situation should be adopted. The Park's influence could extend to other Crown land outside of its boundaries instead of the "outside's" influence reaching into the Park. This position is unlikely to be supported by the OMNR, because it may appear to be a "Parks takeover" with impacts to land use and resource management outside the Park's boundary. However, an ecosystem approach should be made and include education and work with private land owners. The public may see the existing Park boundary as currently <u>including</u> protection from outside the Park (e.g., buffer zones).

In any case, a decision must be taken on whether the Park's wolf management objective is one of "era management" or one of "ecosystem management". The second position would result in a more mature forest (akin to a pre-settlement forests) that would support a wolf-moose system. Such a change is currently occurring. In either case, there may be a diet plasticity of wolves where they would be able to prey upon available ungulates regardless of species. This would need some research to establish the plasticity over time.

Disregarding the scientific controversy over taxonomic status of the wolves inhabiting the Park, the persistence of a protected viable population centered on the Park is of primal concern. The definition of "protected" should agree with internationally-recognized criteria.

2. Natural resource exploitation

2.1 Forest harvesting

Currently, approximately 7,500 ha are harvested annually in the Park. The main forest management systems are selection and uniform shelterwood. Clearcutting and seed tree harvest account for about 2% of the total annual harvest. Though the harvesting techniques employed do not alter the Park's characteristics as wolf habitat, it is unknown if such techniques are creating better coyote habitat. In the absence of wolves, the eastern coyote has adapted and is now using closed-canopy forests in parts of its range. Habitat alone cannot be relied upon to prevent coyote introgression or reverse the population effects of human induced wolf mortality.

Management for a "human-disturbance-free" buffer area surrounding den sites should be considered. The AFA is open to provincial-level restrictions on operations near den sites. It is recognized that wolves adapt to low intensity vehicular traffic much better than to human disturbance. Den site management should be established in Park regulations and encouraged through educational programs in outside areas.

2.1.1 Effect of Roads

Road creation and associated fragmentation is a potential threat in the area. It is perceived that the long-term threat of "better roads", increased travel, and development pressure over a longer time frame threatens the integrity of the Park interior.

There is a continual concern about ongoing maintenance of water crossings and their environmental impact implications over time.

There was some discussion to recommend that no new primary roads be developed within Algonquin Park. The intent is to decommission and isolate the secondary and tertiary roads where required inside the Park when logging is completed within an area. This is also recommended for areas outside.

The AFA recognizes that rehabilitating water crossings is beneficial for environmental reasons and is of the opinion that this should at least be done inside the Park. It is acknowledged that roads themselves do not lead to coyote introgression but that some further development along them is required to introduce coyotes. This has been shown in the United States (Mech, 1993). There is some concern regarding road density around the Park, but development is not yet a real factor in habitat conversion around the west, north and east sides of the Park. It was suggested that the issue of road use management be brought to the table in the upcoming forest management plan (2001-2006) for the Pembroke Forest Management Area.

Roads are seen as being corridors for the introgression of both coyotes and humans. Human activities can theoretically be controlled by implementing land-use restrictions. Coyotes are not as easily controlled.

An area to the west of the Park has been designated as a "remote access management" area under the "Ontario's Living Legacy Initiative". This effectively restricts further road development. The designation of lands surrounding the Park as such an area is viewed as a possible conservation enhancing action. However, the interspersion of private and public lands would make such regulation efforts difficult, if not impossible.

It is also recognized that forestry roads outside the Park pose a lesser threat to the ecological integrity of the area than roads built for development purposes (housing subdivisions, farming and other recreational and industrial uses).

2.2 Game harvest

Wolf population persistence does not appear to be undermined by the hunting activities undertaken within Algonquin Park. On the east side of the Park, approximately one hundred moose are harvested over five days. In the southern part of the Park about 60 moose are taken during the moose hunt. Trapping activity inside the Park is not as intensive as that observed outside the Park. Trapping occurs for scientific research and Algonquin First Nations people have land claims that include trap lines within the Park. Currently, there is a verbal agreement with the Algonquin First Nations people to not trap any wolves. Any trapping inside or outside of the Park for fur or research will meet international humane trapping standards and be monitored by M.N.R., O.F.M.F., F.I.C., and trapping councils.

2.2.1 Wolf Status under the Fish and Wildlife Conservation Act

This working group accepted that human-induced mortality is a significant limiting factor to the viability of the wolf population on the east side of Algonquin Park[5]. Most human-induced mortality in the study population occurs when packs migrate from their territories in transboundary deer-foraging excursions. Wolves observed by big game hunters are opportunistically taken and may be the primary reason for loss. Trapping accounts for a minority of human-induced mortality. Regardless of the ecological explanations for such excursions, this is a behavioural reality that must be recognized. The wolf's status with regard to the Fish and Wildlife Conservation Act must be changed. It is suggested that it be upgraded to big game status. Currently, there are few regulations for wolf harvest in Ontario with the exception of three townships adjoining the southeast corner of Algonquin Park. It is expected that the listing of the wolf as big game would be beneficial. Reasons for this include:

- Enhanced data collection. If hunting licenses, bag limits, and mandatory reporting were introduced managers would be able to collect geographically referenced data currently unavailable.
- A season system would help reduce the opportunistic take of wolves. Under current regulations, wolves can be harvested by hunters that are pursuing other game. If a wolf specific season were introduced, only hunters specifically pursuing wolves would be allowed to take them.
- Trappers, by and large, do not trap wolves as "vermin". Wolves are currently legally trapped outside of the Park, with the exception of the 3 township closures in the southeast corner. Trapping seasons would be centered outside of the migratory period during the time of peak pelt quality. This would ensure that maximum value for pelts would be obtained.

[5] The Population Dynamics and Modelling Working Group stated that "killing of wolves of Algonquin Park (that leave the Park) outside the Park has the effect of increasing the long-term risk of unsustainability" but it also pointed out that the "Theberges' recent data from the eastern segment of the Park cannot allow us to unequivocally conclude that the population declined in the period of their recent studies (1987-1999)".

- The hope is that such measures would instill an opinion that wolves are a valued species and that killing them outside of the prime pelt period is wasteful and disrespectful of this shared resource. This point should be promoted in educational programs.

Regardless of the status of wolves under the Fish and Wildlife Conservation Act, the demonstrated traditional migratory[6] dynamics of packs from eastern Algonquin Park show that the hunting ban in the three townships adjoining the Round Lake deer yard must be maintained to protect migrant wolves. If the migrant wolf population using the yard recovers to a sustainably exploitable level the ban could be lifted.

It is felt that hunters would be amenable to a wolf hunting season. There is a concern that the farming community would not agree to harvesting controls. However, such controls would not interfere with the area in place and the depredation control privileges conferred to them by the Fish and Wildlife Conservation Act.

Acknowledging that the Park is an anchor for conservation of wolves, it is recommended that there be a gradation of canid management practices from areas adjoining the Park towards outlying areas. Areas farther from the Park would be under less restrictive regulation as distance to the Park increases.

3. Impacts of Human Presence

Ecotourism activities in the Park currently consist of canoeing, hiking, fishing, camping, dog sledding, skiing and snowshoeing. There are positive and negative aspects to all these activities.

Winter use is not occurring at great intensity and is believed to be stable. There is currently no perception of any increasing threat or pressure, although there were no documents such as visitor surveys to support this. Dogsledding is currently restricted to three areas and should remain restricted. Snowmobiling is currently restricted to a powerline corridor and there has been some increase in activity since the Aboriginal land claim was made. Unrestricted snowmobile use is inconsistent with Park values and may cause some impact upon predator/prey dynamics by creating packed trails which facilitate travel in heavy snow conditions. Some concern was expressed over the transmission of disease from dogs to wolves via direct contact or indirect contact via feces.

The front-country campgrounds that line Highway 60 operate at capacity during the peak season and an increase in shoulder season (time before and after the main use periods) use has been observed. Day use of the Park is also increasing, but is restricted to areas bordering Highway 60. Given the acceptance of the current visitor use control system, there is no concern that visitor use will increase to a level that could have an impact on Park-interior wolves in the near future, although factors such as visitor displacement have not been explored.

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[6] The Landscape Ecology Working Group used the term 'migratory' to refer to wolves that leave the Park seasonally in search of deer yarding outside the Park.

Public wolf howls cannot be increased in size. Park visitors have come to expect these to be a part of their “Algonquin experience”. Messages transmitted to visitors during the theatre portion of the wolf howl events do include education on wolves and the effects of outside pressures on wolf populations residing primarily within the Park. The issue of possible risk to the wolf population by the event itself is not covered, and there have been no studies about the wolf howl impact on the wolf populations in Algonquin Park.

Perhaps a survey of visitor’s understanding of wolf ecology would be beneficial. The clientele’s understanding of the Park’s role in wolf conservation has not been quantified. The public’s perception of radio-collaring wolves was explored in the group.

Though the general public’s attitude towards wolves has become more positive in recent years, there is a need to explain the current situation of wolves to surrounding inhabitants and there is a need to develop a stewardship ethic in surrounding landowners and managers. This could be partially implemented by taking advantage of the variety of existing stewardship networks. Hunter groups and landowner associations need to be sensitized to transboundary issues. The public is seen to be receptive to such an initiative. The costs of creating a new stewardship program are likely to be great. To reduce cost and maximize benefits, a “master-steward” approach could be used with members of existing networks; such an approach would have a multiplicative “snowball” effect.

Educational efforts should also be expended towards promoting the fact that many wolves present on the Round Lake deer yard are migrants from the Park and do not reside in the yard. This would help dispel the current misconception that the yard area “is overrun” with wolves. This “overpopulation” is a temporal and site-specific situation and should not be misconstrued to represent the wolf population throughout the greater Park area. An educational program dealing with the various factors limiting deer population levels should also be implemented to decrease a common public misconception that low deer populations are a direct product of wolf predation.

The issue of organized, “do-it-yourself” and research-related howling impacts on wolves was discussed. A territorial response in the form of investigation of the human howling site (i.e. wolves often visit the site where humans have howled to mark the area) sometimes results but is not seen as a significant threat. Soon to be published information from research in Quebec shows that howling results in a form of behavioural response at den sites: on days following human howling activities, the mean numbers of animals at den sites increased significantly. The impacts of this behaviour on the hunting success and physical condition of pups could not be predicted.

The habituation of wolves to humans in campgrounds is not seen as a conservation issue. Educational programs already in place are as effective as possible. There is a feeling that the isolated negative events are caused (directly or indirectly) by the “uneducatable” component of any group. The current liaison with other park users, specifically forestry workers, is effective.

Summary of Issues, Outcomes and Strategies

Issue 1. Landscape Management and Coyote Introgression
1a. Connectivity and Fragmentation

Statement
Coyote range has moved northward primarily because the landscape has become fragmented. Algonquin Park remains as a genetic refuge (southern anchor) for the Eastern Canadian Wolf. There is the threat of coyote introgression on Algonquin wolves on a long-term basis if habitat fragmentation continues. Intact habitat exists north, northeast, and connectivity to these areas is essential for maintenance of the integrity of the population.

Outcome
Maintaining connectivity to the north, north-east preventing coyote introgression into the genome of the wolves of Algonquin Park and thereby ensure sustainability of the wolves. Minimize habitat fragmentation inside and outside of the Park. Large scale development outside of the Park should not have cumulative impact on fragmentation.

Potential Strategies
1. Adjoining districts to consider existing resource and land use planning on crown land to promote connectivity (i.e. all weather roads, crown land disposition, utility corridors, and forest management). Request districts to address wolves as a feature species during the FMP process.
2. Encourage stewardship councils, private land forestry and farming communities adjacent to the Park to consider best efforts to ensure connectivity.
3. Encourage municipalities to address connectivity and fragmentation as significant wildlife habitat under the Natural Heritage Features of the Provincial Policy Statement.
4. Educate on the biology of wolves and the impacts of connectivity and fragmentation on coyote introgression and genetic drift[7].

1b. Habitat and Land Cover

Statement
Wolf and prey habitat exist inside and outside of Algonquin Park. Public objectives to achieve historical forest types must be weighed against intentional creation of wolf and prey habitats to embellish existing wolf populations.

Potential Strategy
Try strategies other than altering habitat first and use this alternative as a last resort if conditions warrant (refer to Prey Habitat Working Group Report for details). Approach on an adaptive management basis.

[7] The taxonomic working group found, based on genetic evidence, that the wolf population in Algonquin Park has high connectivity (gene flow) with similar wolves west of Algonquin Park and in both northeastern and northwestern Ontario. Similar connections are also suspected with wolves in Quebec.

Issue 2. Natural Resource Exploitation

2a. Road Density

Statement

The increase in road density and travel leads to forest fragmentation and extensive use of roads is detrimental to wolf populations.

Outcome

To protect wolf populations, minimize disturbance to wolves.

Potential Strategies

1. Current road system in Algonquin Park has been accessed for logging, research and monitoring and Park management activities. Current Algonquin Forestry Authority (AFA) practices are to abandon secondary and tertiary roads when logging and silvicultural activities conclude and insure protection of waterways. This practice is strongly encouraged. The MNR should consult with the Algonquin First Nations regarding their use of access roads.
2. Develop crown land policy in the construction of roads, road density and upgrade to minimize the impact on wolf population.
3. Consultation with MTO, counties, municipalities and Algonquin First Nations on road upgrades, signage, and new construction.
4. Facility planning and management should be sensitive to new road construction, grade and traffic and the impacts on wolf populations.
5. Explore the opportunity and need to decommission the remaining roads that are inactive in Algonquin Park. The MNR should consult with the Algonquin First Nations regarding their use of access roads.
6. Monitor trends in road density and traffic conducted by AFA and Algonquin Park.

Who

MNR districts, Park Superintendent, AFA

2b. Studied System extends beyond the Park

Statement

The dominant characteristic of the east side predator/prey migratory (outside of Park boundaries) system provides a context for consideration for remaining areas of the Park.

Outcome

Population integrity of wolves of Algonquin Park.

Potential Strategies

1. See human induced mortality issue strategies (section 3a).
2. Adhere to the principles of ecosystem management.

3. In future research, there should be consultation between trapper`s council, MNR and research scientists to ensure compliance with provincial trapping standards. Animal care committees that review protocol should be expanded to include a representative from the trapping community. Researchers should be certified under Ontario Fur Harvester and Conservation Course.

2c. Industrial Impacts

Statement
Historical logging activity has changed the cover, composition, age and distribution of forests across the landscape and the impact on the integrity of wolf populations. Current industrial activity and associated human presence may affect individuals within the wolf population.

Outcomes
Minimize negative industrial impacts on composition, age and distribution of forests on the landscape.

Potential Strategies
1. Determine the predator/prey requirements and determine the impacts of forest management on prey and subsequent changes to sustainable wolf populations.
2. Consider prescribed burns and silvicultural techniques to emulate disturbance.
3. Develop guidelines when conducting forest management in the vicinity of den sites; encourage tree markers to report den sites; researchers to review annual work schedule to identify sensitive areas within proposed operations.
4. Add to Algonquin Park research strategy the increased opportunity for academic research.
5. Researchers are to inform AFA where work is being conducted so AFA can plan to avoid the research site.

Who
MNR lead role; tree marking course, AFA.

Issue 3. Impacts of Human Presence
3a. Human induced mortality for eastern park wolves inside and outside of the Park (and possibly for western[8] park wolves).

Statement
The issue is the integrity of the wolf population in the eastern portion of Algonquin Park. Integrity includes genetic integrity, ecological function, movements, re-use of den sites, size of populations and minimum viable populations. Sources of significant mortality include trapping inside the Park; hunting and trapping of Algonquin Park migrating wolves outside of the Park; road kills; and poison.

[8] The working group is not suggesting there are two distinct populations in Algonquin Park, but that the wolf packs in the eastern side of the Park are well studied whereas inferences can only be made for the western side of the Park.

Outcome

Reduce the human induced mortality of migrating wolves from eastern Algonquin Park and therefore possibly decrease the variations in the wolf populations and ensure sustainability. Further effort will be made with stakeholders (particularly trappers) to encourage awareness of wolves that have territories that straddle the Park boundary.

Potential Strategies

1. MNR to explore licensing process for hunting wolves in WMU`s adjacent to the Park. Through an adaptive management approach, adjust seasons and quotas to ensure protection of the wolf of Algonquin Park in consultation with local hunt camp associations, Algonquin First Nations, and other stakeholders.
2. Consult the trapping council, MNR, Algonquin First Nations and Algonquin Park to establish seasons within WMU`s adjacent to the Park that are timed to minimize the harvest of migratory Algonquin Park wolves.
3. Approach trappers and Algonquin First Nations to adjust harvest of wolves in areas adjacent to the Park to address transboundary wolf packs.
4. Educate on the biology of wolves, extent of time in the yard and impacts on deer populations. To be conducted by MNR, OFMF, stewardship groups, and research groups.

Who

MNR (district, wildlife branch), local trappers council, OFMF, Algonquin First Nations, local hunters, OFAH, hunt camp associations and the scientific community.

3b. Role of Algonquin Provincial Park

Statement

The role of Algonquin Provincial Park is to provide a protected area, benchmark, for a sustainable wolf population, the most southern population (anchor) in Ontario. The existence of the Park has most likely played an instrumental role in the preservation of this wolf and the prevention of influx of coyotes into these areas.

Outcome

To preserve the integrity of the wolf population in Algonquin Park and ensure that humans do not account for a significant portion of the mortality of wolves from Algonquin Park.

Potential Strategies

1. Increased research and monitoring in other areas of the Park to increase knowledge of these wolves as a benchmark.
2. Minimize human disturbance of the wolves in the Park, and monitor human-wolf interactions.
3. Protect integrity of the landscape, broader ecosystem.
4. Apply the strategies outlined in the above section 3a.

5. Adjacent districts to inform Park Superintendent on pending large-scale developments that may have an impact on wolf populations.

<u>Who</u>
To be addressed by the superintendent of Algonquin Park.

Working Group Members: Tom Beechey, Mike Buss, Paul Chamberland, Carl Corbett, Bill Dickinson, Karen Fox (facilitator), Tim Haxton, Irene Heaven, Chris Henschel, Helene Jolicoeur, John Pisapio, Laurie Whyte, John Winters.

The Wolves of Algonquin Park

Population & Habitat Viability Assessment (PHVA)

FINAL REPORT

SECTION 6

Human Values Working Group Report

Human Values Working Group Report

Introduction

The following concepts/issues were generated from the Mind Map exercise and delegated for consideration by this working group:
Human values
Economic values
Local Buy-in
Role of Parks
Role of Government/Legislation
Predator Compensation
Time/money Limitations
Wolf zoning for hunting outside the park
Reporting/tag limits for hunting
Resistance to change
Limited set of approaches for Conservation
Presentation to Public
Education/Communication
Dispelling Wolf Myths
Fundraising for Action

While there was much discussion in this working group (as well as other groups) about the taxonomic identity of the animal we are trying to protect, it was recognized that societal values concerning wolves are not necessarily based on what wolf (i.e. taxonomic designation) is in Algonquin Park. The group developed an overview statement to summarize the overarching importance of the issue of societal values to the goal of this workshop:
The social /human equation and its subsequent values are crucial and determining elements in the issue of survival of wolves in and around Algonquin Park.

In-depth discussion of the above concepts resulted in identification of a complex set of issues which were sorted into 5 categories: regulation, human values, communication, societal buy-in and resource management.

Regulation
<u>Role of Parks</u>- protecting core populations -is park (protected area) big enough?
- different strategies for wolf protection
- effects on other mammal populations
- concerns about long term effects on trapping & hunting
- concern about the "thin edge of the wedge" in protection (i.e. if hunting and trapping are stopped for the wolf, is this just a beginning of an end to hunting and trapping in general?) How far do we go for protection, when does it stop?
- What is the role of Algonquin Park in protecting the central Ontario wolf population? How far do/should the possible protective measures extend beyond the Park?

Role of Government

- There is a perceived lack of confidence in the government to take effective action on this and similar issues.
- Economic safety net for impacted groups- direct economic loss vs. perceived loss of opportunity. No single individual or sector should carry the cost of protecting wolves.
- The government has a responsibility to govern for the good of all.
- Ask Nina Fascione (Defenders of Wildlife) to explain their compensation program and explore accessing the fund.

Human Values

- Local values of rural citizens may differ or be in conflict with urban values of other parts of Ontario and beyond due to differences in lifestyles and cultures.
- There are differences in urban & rural values regarding:
  a. Wasting vs. using products.
  b. Conservation (wise or sustainable use of resources) vs. preservation (keeping the environment just as it is)
  c. Fact vs. values/perceptions
- Values/perceptions may be based on economic losses due to livestock deaths, or deer kills that are perceived to mean fewer deer to be hunted.
- Deer hunting can be seen as more important than many other social issues.
- Views on wolves can be very strong in the local communities.
- Local buy in depends on the perceived credibility of the data available to show the impact of wolf mortality on the long-term survival of wolf populations.
- The types of wolf killing were identified as purposeful vs. gratuitous/opportunistic.
- Hunting and trapping wolves for a purpose is different than gratuitous or opportunistic killing of wolves, just to get rid of as many wolves as possible.

Communications

- There is resistance to change regarding the public perception/ image of wolves.
- The "Big Bad Wolf" myth still exists for some people and should be dispelled.
- Presentation to the public is essential to change public perceptions of the wolf.
- There is a need to deliver/convey consistent, constant messages, regarding wolf numbers and issues in Algonquin Park, so that everyone receives the same message.
- Education regarding wolf issues is necessary, but at times may need to be combined with regulation.
- Fundraising for action may be necessary to reach a desired level of communication and education regarding wolf issues.

Societal Buy-In

- There are different components to society- local and provincial. There may be significant differences in opinions/perceptions regarding wolves and how to achieve buy-in from these two different societal groupings.
- Although there can be/has been considerable vocal opposition to wolf issues (particularly regarding the hunting and trapping ban, it was perceived that there also is/was a good deal of quiet support
- In regard to putting regulations in place, it was felt that most people are law-abiding and will succumb to peer pressure to follow regulations regarding wolves.
- Develop credibility/trust for data and the resulting analyses and conclusions (see " A general Discussion of Data Availability and Quality" on page X). For example: 1) test the hypothesis that the numbers of wolves killed outside the park impact on the survival of wolf populations in Algonquin Park, 2) resolve the conflict regarding wolf numbers in the park based on different reports e.g. stability of populations based on successful howls on Hwy 60 vs. population changes on the east side of the park based on radio collared wolves.
- Ethically, some degree of protection for Algonquin wolves may be appropriate to ensure their survival.
- Protection of wolves may depend on the uniqueness of its status; if it is not threatened, some people will not be motivated to protect them.

Resource Management

- Livestock compensation currently may not adequately cover the small farm operator who can't afford to take steps to avoid further depredation after the first claim that is covered by the present system. Compensation for livestock kills in the 2 townships around Algonquin Park should cover full value (commercial or purebred) for any size operator and any effective, preventative measures.
- Compensation comes out of the agriculture budget (OMAFRA), and perhaps should be out of another pot of money (e.g., MNR or tourism funds). This is Parks issue and compensation should come from the Parks budget, MNR, or Provincial Consolidated Revenue funds.
- Lack of awareness of the economic opportunities possible from the existence of wolf populations. Examples are wolf howling and viewing, and non-resident hunting.
- Management of wolves could be based on fur value issues, with zones, quotas, seasons, etc.
- Wolves are not currently governed by resource management policies.
- Trappers harvest wolves for their economic value as well as to protect the beaver population.

The following criterion, as outlined in the charge of the Algonquin Wolf Advisory Group, was used to prioritize the five categories using a paired ranking procedure:

To provide recommendations to the Minister of MNR on an Adaptive Management Plan to ensure the long-term conservation of the wolves of Algonquin Provincial Park and surrounding areas.

The resulting ranking of categories based on this criterion was:

1. Societal Buy-In
2. Resource Management for Wolves
3. Regulations
4. Human Values

5. Communications

Societal Buy-In
Need Statements & Recommendations
To achieve buy-in for long term survival of wolves in and around Algonquin Park, there is a need to:

a) create a mechanism to bring all information together and come to consensus to produce a consistent message to provide to the public and politicians.

b) undertake more thorough discussions of data among scientists, among "non-scientists" and between scientists and "non-scientists" to achieve understanding and interpretation of the available information.

c) have agreement on the data, issues and solutions to achieve societal buy-in, which will be politically saleable and simple, deliverable and workable by people.

d) have scientific peer review to establish credibility or point out weaknesses in studies relating to wolves in and around Algonquin Park.

e) deliver/convey consistent, constant messages regarding wolf numbers in and around Algonquin Park.

f) recognize and respect the emotional issues around wolves.

Because people value wolves in a variety of ways, there is value in maintaining a sustainable wolf population in and around Algonquin Park. However, there was considerable discussion regarding identification of the species we are trying to protect and it was mentioned that the status or distinction of wolves will have an impact on the saleability of any measures proposed. To have credibility established and to achieve societal buy-in regarding further actions relating to wolves, the people most impacted by these actions will require a greater level of knowledge and will require compensation if adversely affected.

Recommendation: As a result of the above stated needs a mixed working group, consisting of stakeholder and government representatives, should be formulated to develop a comprehensive Communications Plan, in consultation with a communications specialist. The terms of reference for this group would be based upon the above need statements. The responsibilities and actions of this group would include:

- Identifying data sources and providing information to interested parties.
- Collection and preparation of information relating to wolves for presentation to a variety of target audiences.
- Development of a public information and consultation process. This would need to address areas such as: affected/concerned partners, teachers kits, training programs, one-on-one discussions, mail outs, well-mediated open houses, focus groups, contact w/sub groups (this listing should not be considered all-inclusive). Consultation to achieve buy-in during the implementation phase of any actions relating to wolves will be instrumental for

achieving buy-in. It should be recognized that focus groups should come before public forums in this process.

- Ensuring that all interested parties and individuals will receive public information.

Action: Establish a collaborative Communications Working Group under the umbrella of the Algonquin Wolf Advisory Group, with participants to be invited by the AWAG.
Responsibility: Algonquin Wolf Advisory Group
Timeline: Working group to be appointed 2 weeks after the next meeting of the AWAG.
Resources: Because this working group will be representative of numerous organizations, the concept of joint funding was appealing: Possible Funding Sources identified: MNR, Provincial government, NGO's, Federal government, Grants, Foundations, Corporate sponsors, Ontario Parks, Friends of Algonquin Park.

Although this category was initially listed separately from communications, it became apparent through group discussions that communication and agreement between all stakeholders and delivery of consistent messages to society would be essential to achieve local and societal buy-in of issues surrounding wolves. Therefore, some of the issues originally discussed in the communication category were incorporated into the needs and actions statements described above. Other issues described under the Communications category may need to be taken into account by the Communications Working Group.

Resource Management for Wolves
Need Statements & Recommendations
The group discussed the current status of trapping and hunting regulations as they pertain to wolves in Ontario, to gain an overview in the context of a discussion regarding managing wolves as a resource. Below is an overview of current regulations. For details, existing legislation should be consulted:

- Trapping always requires a license and permission of landowners, but is permissible on the Crown land that is assigned on the license.
- An annual report is required from all licensed trappers, but there is no quota.
- Trapping and hunting are authorized in the Bruton & Clyde portion of the Park (southwestern section).
- There are few regulations on the hunting of wolves. Hunting of wolves under a small game license is permitted anywhere on Crown land, except in Parks, protected lands and the ban area in Hagarty, Richards and Burns townships (closed season December 15th to March 31st). Landowners can kill wolves for protection of property.
- There is no separate license designation for the wolf.
- There is no closed season for hunting and trapping wolves (except in the ban area mentioned above); however, the small game license is not valid north of the French-Mattawa Rivers (July 1-August 31).
- No reporting is required for hunting wolves, but hides that are sold or tanned must be reported.

The group perceived that most deaths of wolves were a result of incidental or gratuitous killing and agreed that killing a wolf just to kill it should no longer be acceptable. Based on the information provided regarding numbers of wolves in and around Algonquin Provincial Park, it was felt that there is likelihood that reducing by a small number the taking of wolves by hunting or trapping may have an impact on conservation of the "wolf" within the Park.

Possible options for obtaining actual numbers of wolves harvested or taken by hunting, and reducing the incidence of incidental or gratuitous wolf deaths were discussed and ideas included:
Trappers' quotas
Invoke mandatory reporting
Closed seasons for hunting/trapping could be established
Explore the possibility of using wildlife management units (WMU's) to develop hunting zones/no hunt zones
Change status of wolf from fur bearing mammal to game species
Develop criteria related to protection of property
Establish a separate wolf license
Create or increase a "wolf protection zone" around the park, zero quota inside the park
Monitor results e.g. harvest of other furbearers to see if wolf ban affects other furbearers

It should be noted that many issues regarding role of government and regulation were addressed in this category. Therefore, the role of government and regulations was folded into the discussion and recommendations for resource management. After extensive discussion, the group reached consensus on the following:

Recommendations

1. Gather information on the location of wolves harvested from trappers, on all traplines within 2 townships of Algonquin Park boundaries. This information is collected in mandatory reports filed by trappers which began reporting in 1998.
   Action: Provincial Fur Specialist should issue a yearly report to the Algonquin Wolf Advisory Group based on the required reports filed by registered trappers
   Responsibility: MNR
   Time Line: The yearly report for 1998/99 should be due by March. 31. For 1999/2000 and beyond the reports would be due September 1 each year.
   Measurable outcome: Quantify the number of wolves trapped each year and the location (i.e. trapline) they are harvested from.

2. Change the licensing status of wolves for hunting to protect Algonquin Park wolves from opportunistic killing by hunters outside of the Park.
   Action: Remove wolves as a species hunted under a small game license, and initiate establishment of a wolf license south of the Mattawa river and in the following Wildlife Management Units: 48, 50, 54, 55a, 55b, 57, and possibly 56.
   Responsibility: MNR
   Timeline: 2000/2001 – may be dependent on the efforts of the communications working group in establishing societal buy-in.
   Measurable outcome: Quantify the number of licenses issued to hunters and create a specific hunting designation for the wolf.

3. Establish a closed season on hunting and trapping of wolves. This closed season may allow recognition of a “status” for this wolf, rather than an unwritten vermin designation and recognized fur value during different times of the year.
   Action: Designate a closed hunting and trapping season from April 15 to September 15 in the area south of the Mattawa river and in the following Wildlife Management Units: 48, 50, 54, 55a, 55b, 57, and possibly 56. The closed season on hunting and trapping from December 15th -March 31 in Hagarty, Richards and Burns should continue.
      Responsibility: MNR
      Timeline: 2000/2001 – may be dependent on the efforts of the communications working group in establishing societal buy-in.
      Measurable outcome: Reduce the time period in any given year in which it is legal to take wolves by hunting or trapping.

4. Mandatory reporting of wolf takes for all hunters who buy a wolf license in the area south of the Mattawa river and in the following Wildlife Management Units: 48, 50, 54, 55a, 55b, 57, and possibly 56.
   Action: Include a card or report attachment with the wolf hunting license which would be sent to the MNR at the conclusion of each season.
      Responsibility: MNR
      Measurable outcome: The numbers of wolves taken in each season will be recorded and available for data analysis.

5. Discuss the concept of a wolf management zone around Algonquin Provincial Park (that could contain a number of different options to manage wolves) to further limit the numbers of wolves taken by hunting and trapping. There is a need to consult with trappers to discuss wolf-related matters of concern to them. Steps proposed for Algonquin wolves may be perceived to influence all trapping throughout the Province. Many trappers perceive that a wolf protection zone is a potential first step toward eliminating trapping throughout Ontario. There is some belief that a closed season January 1 to March 31 may be acceptable to trappers given that there is proper consultation with trappers and hunters.
   Action a: Discuss the feasibility of the concept of a wolf management zone around Algonquin Provincial Park with trappers and other impacted parties.
      Responsibility: Algonquin Wolf Advisory Group/MNR
   Action b: During regular trappers council meetings, discuss trends observed in wolf harvest and condition and provide this information to the MNR to gain an idea of the stability of the wolf population in and around Algonquin Park.
      Responsibility: Trapper associations reporting to MNR staff.
      Timeline: Ongoing basis

6. Enter into negotiations to formalize the current informal agreement to maintain zero quota on wolves for aboriginal trapping within Algonquin Provincial Park. This would apply to harvest for sale but there should be some allowance for cultural, social, and ceremonial purposes.

Action: Conduct negotiations with Algonquin peoples to reach an agreement to maintain a zero quota on wolves for aboriginal trapping within Algonquin Provincial Park.

Responsibility: MNR

Measurable outcome: A formalized agreement on aboriginal wolf quotas in Algonquin Provincial Park.

(Note: Consensus to close hunting or trapping in the Bruton-Clyde portion of Algonquin Provincial Park was not reached.)

7. If a ban on trapping wolves is implemented, then consideration should be given to compensating trapper for loss of fur production. This compensation should be based on a designated past level of harvest. There was some dispute as to at what point this kicks in, as quotas are an integral component of trapline management.

8. Compensation within the wolf management zone should be adequate for all livestock loss as a result of wolf protection, and farmers should not be subjected to the same level of subsequent (preventative) protection standards as applied outside the buffer (as it may be cheaper to pay for compensation rather than protection). There was discussion as to whether this should apply to townships or to WMU's. The group decided to use townships.

Action: For an area two townships deep around Algonquin Provincial Park, initiate compensation packages which adequately compensate for all livestock loss from wolves. Because this area will be within a wolf management zone, it should not be incumbent upon the livestock owner to have to pay for preventative protection after a first loss, particularly in cases where compensation payments may be substantially lower than the cost of preventative protection.

Resources needed: Compensation at present appears adequate and presently comes from OMAFRA.

Action a: The budget source should be changed to originate from Provincial Consolidated Revenue Funds, as issue relating to wildlife are more broad-reaching than a single agency.

Action b: Talk to Defenders of Wildlife to determine if they are prepared to supplement funding (Mary Theberge will talk to Nina Fascione and determine this feasibility by March 1, 2000) or assist with establishing a compensation fund.

Measurable outcome: Data generated by reports of kills and compensation to evaluate funds paid out and numbers of animals killed in geographic areas.

Role of Algonquin Provincial park in protecting wolves

The group held a discussion on the role of Algonquin Provincial Park in protecting wolves. All believed that the concept of the park protecting wolf populations is good, but that application is difficult. The statement was made that Parks should act as benchmarks for conservation of wildlife, but there was some feeling that the present classification of Algonquin Provincial Park as a Natural Environment Park doesn't meet this.

There was then considerable discussion about protection being a key mandate for parks. Most believed that the Park is acting to protect wolves inside its boundaries but could perhaps do more for wolves once they leave the park. An apparent problem with wolf mortality on the east side of the Park is mortality outside the Park. This will have an effect on the Park's wolf population, as what happens to wolves outside the Park boundary impacts on wolf populations inside Algonquin Provincial Park.

Given the above discussion, the question was posed as to whether Algonquin Provincial Park should be a population "sink" or "source" for wolves. The group reached consensus that the Park should act as a source for wolves.

Working group members: Ray Bonenberg, Edgar Cornish, George Francis, Deborah Freeman, Karen Goodrowe (facilitator), John Johnson, Rene Lafond, Frank LeFeuvre, Mary Therberge, Ron Tozer

The Wolves of Algonquin Park

Population & Habitat Viability Assessment (PHVA)

FINAL REPORT

APPENDIX I

Workshop Invitation and Invitation List

Algonquin Wolf Advisory Group

c/o Ministry of Natural Resources
Fish and Wildlife Branch
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Dear Sir/Madam:

On behalf of the *Algonquin Wolf Advisory Group*, I would like to invite you to participate in a wolf **Population and Habitat Viability Workshop (PHVA)** sponsored by the Ministry of Natural Resources, World Wildlife Fund (Canada) and Environment Canada.

This workshop will involve a carefully selected and diverse group of participants chosen to provide expert advice and address a variety of issues related to the long-term conservation of wolves in Algonquin Provincial Park and the surrounding area. As this is a very important working workshop, all participants will be engaged for the full three and a half days. Products of the workshop will assist the *Algonquin Wolf Advisory Group* to develop an adaptive management plan for these wolves for recommendation to the Honourable John C. Snobelen, Ontario's Minister of Natural Resources. The Terms of Reference for the task of the Advisory Group are attached for your information.

The workshop will be held at the Leslie M. Frost Centre in Dorset, Ontario, from **February 15 –18, 2000**. The Centre is located southwest of Algonquin Provincial Park at about 2 ½ hours driving distance from Toronto or Pembroke. Accommodation and meals at this facility will be provided by the Ministry of Natural Resources. Travel assistance may be made available to some participants.

The workshop will be facilitated by the Conservation Breeding Specialist Group (CBSG) of the IUCN' s Species Survival Commission (SSC). CBSG' s interactive and participatory workshop approach combines expert knowledge, scientifically based tools and processes. The collaboration of a wide range of stakeholders greatly facilitates the production of practical and agreed upon recommendations for population conservation and management. In the last 10 years, the CBSG has facilitated over 200 conservation planning workshops in about 50 countries. A summary detailing the CSBG' s workshop process is attached for your information.

I hope that you will be able to assist us with this important task and look forward to your response.

Yours truly,

Bill Calvert
Chair

Attachments

Population and Habitat Viability Assessment (PHVA) for the Wolves of the Algonquin Provincial Park

Invitation List

1. Jim Baker, Ontario Ministry of Natural Resources
2. Ian Barker, Ontario Veterinary College/Canadian Cooperative Wildlife Health Centre
3. Sandra Bauer, Canadian Parks and Wilderness Society
4. Alfred Beck, Ontario Federation of Anglers of Hunters
5. Tom Beechey, Ontario Parks
6. Ray Bonenberg, Ontario Ministry of Natural Resources
7. Percy Bresnehan, Allstar Resort
8. Mike Buss
9. Onnie Byers, Conservation Breeding Specialist Group
10. Bill Calvert, District of Muskoka
11. Doug Campbell, Ontario Veterinary College
12. Ludwig Carbyn, Canadian Wildlife Service
13. Paul Chamberland, Canadian Wildlife Service, Environment Canada
14. Bob Chambers, College of Environmental Science/Forestry, State University of New York
15. Brent Connelly, Algonquin Forestry Authority
16. Carl Corbett, Algonquin Forestry Authority
17. Edgar Cornish, Ontario Cattlemen's Association (OCA)
18. Michel Crête, Societé de la faune et des parcs du Québec
19. Maria de Almeida, Fish and Wildlife Branch, Ontario Ministry of Natural Resources
20. Bill Dickinson, Muskoka Heritage Foundation
21. Mark Downey, Fur Harvesters Auction Inc.
22. Vince Ewing, Ontario Ministry of Natural Resources
23. Pete Ewins, Species Program, World Wildlife Fund (Canada)
24. Nina Fascione, Defenders of Wildlife
25. Bart Feilders, Ontario Parks
26. Graham Forbes, University of New Brunswick
27. Charley Foster, Bruton and Clyde Hunters Association
28. John Foster, Bruton and Clyde Hunters Association
29. Karen Fox, University of Alberta
30. George Francis, Department of Environment & Resource Studies, University of Waterloo
31. Debbie Freeman, The Wildlands League
32. Todd Fuller, University of Massachusetts
33. George Garland, The Friends of Algonquin Park
34. Karen Goodrowe, Metro Toronto Zoo
35. Peter Goring, Muskoka Heritage Foundation
36. Tim Haxton, Ontario Ministry of Natural Resources
37. Irene Heaven, Haliburton Forest and Wildlife Reserve
38. Chris Henschel, The Wildlands League
39. Larry Hewitt, Haliburton Highlands Outdoor Association

40. Monte Hummel, World Wildlife Fund (Canada)
41. Robert Inslerman, New York State Department of Environmental Conservation
42. Kathy Irwin, Ontario Ministry of Natural Resources
43. John Johnson, Fish and Wildlife Branch, Ontario Ministry of Natural Resources
44. Hélène Jolicoeur, Societé de la faune et des parcs du Québec
45. Brian Kelly, Red Wolf Recovery, U.S. Fish and Wildlife Service
46. Pat Kennedy, Ontario Fish and Wildlife Advisory Board
47. Dana Kinsman, Ontario Ministry of Natural Resources
48. René Lafond, Societé de la faune et des parcs du Québec
49. Jean Langlois, Canadian Parks and Wilderness Society
50. Frank LeFeuvre, Dwight-Dorset Trappers' Council
51. Ernie Martelle, The Friends of Algonquin Park
52. Margaret McLaren, Ontario Ministry of Natural Resources
53. David Mech, IUCN/SSC Wolf Specialist Group
54. Jim Meness, Algonquians of Pikwakanagan
55. Eric Miglin, Killarney Lodge
56. Phil Miller, Conservation Breeding Specialist Group
57. François Messier, University of Saskatchewan
58. Andy Montreuil, North Bay Algonquins
59. Dennis Murray, University of Idaho
60. Simon Nadeau, Canadian Wildlife Service
61. Ron Nowak, retired, US Fish and Wildlife Service
62. Tom Nudds, Department of Zoology, University of Guelph
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65. Paul Paquet, University of Calgary
66. Bill Peneston, School of Natural Resources, Hocking College
67. Rolf Peterson, University of Michigan
68. John Pisapio
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75. Claude Samson, Dép. de Biologie, Université Laval
76. Jerome Sernoski
77. Doug Smith, Yellowstone Center for Resources
78. Bill Steer, The Canadian Ecology Centre
79. Dan Strickland, Algonquin Provincial Park
80. Rick Stronks, Algonquin Provincial Park
81. Robin Tapley, Grandview Inn
82. John Theberge, Faculty of Environmental Studies, University of Waterloo
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84. Ron Tozer, The Friends of Algonquin Park
85. Kathy Traylor-Holzer, Minnesota Zoological Garden

86. Larry Tupling, Silver Eagle Resort
87. Dennis Voigt
88. John Vucetich, Michigan Technological University
89. Barry Wannamaker, Town of Bancroft
90. Robert Wayne, University of California
91. Bradley White, Department of Biology, McMaster University
92. Kirby Whiteduck, Algonquins of Pikwakanagan
93. Laurie Whyte, Ontario Fur Managers Federation
94. Paul Wilson, Wildlife Forensic DNA Laboratory, Trent University
95. Mike Wilton, Algonquin Eco Watch
96. John Winters, Algonquin Provincial Park
97. Stephen Woodley, Ecosystems Branch, Parks Canada

The Wolves of Algonquin Park

Population & Habitat Viability Assessment (PHVA)

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APPENDIX II

Participant List

Population and Habitat Viability Assessment (PHVA)
for the Wolves of the Algonquin Provincial Park:

List of Workshop Participants

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The Wolves of Algonquin Park

Population & Habitat Viability Assessment (PHVA)

FINAL REPORT

APPENDIX III

Workshop Presentations

A Century of Wolves in Algonquin Park

By Dennis Voigt and Dan Strickland

This paper presents a brief chronological history of the major events affecting wolves and their management in Algonquin Park during the 20th century. We also describe changes in public attitudes and the major issues that have been raised recently concerning wolves in and around the Park. It is a slightly edited version of the paper presented verbally, and distributed in hard copy, at the Population and Habitat Viability Assessment (PHVA) Workshop for the wolves of Algonquin Park held at the Frost Centre, Dorset from Feb 15-18, 2000. For information on a provincial scale, see Buss and de Almeida (1997).

The First Half Century

Wolf and Prey Numbers

Algonquin Park was established in May 1893 on about half its present area, which is 7,725 square km. Little quantitative information is available about the status of wolves and their prey when the Park was established. We do know that deer were relatively plentiful but that moose were not. Beavers were scarce following years of unregulated trapping but they quickly bounced back under the protection of the new Park.

Wolves were common enough that killing them was a major preoccupation of Park staff from the beginning. An 1895 Commissioner of Crown Land report stated, *"Wolves are too numerous for the good of the deer. We are making every effort this year to kill them and shall continue it during the winter."* George Bartlett, Superintendent of Algonquin Park from 1898 to 1923, regularly wrote articles for the outdoor press of the era with titles like *"How shall we kill the wolf".* His men, the Park rangers, were encouraged to kill wolves as part of their duties, with the added incentive of being allowed to collect the provincial bounty for every wolf they killed. We have records for the number they actually did kill in the Park for some years from 1909 to 1958 and the number averaged 55, ranging from 11 in 1938 to 128 wolves killed in 1931.

Table 1. Wolves reported killed in Algonquin Park 1909 to 1958 (Pimlott et al. 1969)

Year	Number Killed	Year	Number Killed	Year	Number Killed
1910	35	1936	27	1951	35
1911	50	1938	11	1952	50
1913	60	1944	36	1953	72
1928	43	1945	35	1954	38
1929	32	1946	57	1955	61
1931	128	1947	30	1956	64
1932	63	1948	39	1957	95
1933	53	1949	33	1958	62
1935	23	1950	41		

Whether the routine killing of wolves had an effect on the numbers of deer is unknown but by all accounts deer were generally very abundant in Algonquin Park from 1893 until the 1960's (ironically when wolves were finally given protection). There was a period of deer scarcity reported in 1933 and, interestingly, fewer wolves were killed in the ensuing years. Certainly during the late 1940s and 1950s tourists flocked to the Park to see the abundant tame deer. It was commonplace to drive along the highway 60 corridor of the Park in the 1950's and see scores of deer. Guesstimates ran from 30,000 to as high as 100,000 deer in the Park's 3,000 square miles. These high numbers are especially significant when we consider that a century earlier deer were virtually absent from Algonquin Park. In 1800, deer were found only much farther south of the Park, closer to Lake Ontario and Lake Erie. At that time, moose were probably the most common ungulate in the Park, with caribou extending in from the north and elk from the south. Beaver numbers remained at high levels during the first half of the century. Consider the myriad of beaver ponds and beaver meadows now encountered in the Algonquin landscape; many were created during this time period.

Attitudes towards Wolves

Despite the apparent wildlife paradise in Algonquin, an almost universally negative attitude towards wolves prevailed. Witness this excerpt from the 1933 Report to the Ontario Government of the Special Committee on the Game Situation. The authors of this report included not only six members of the Ontario Legislative Assembly but also Mr. Jack Miner, regarded by many – certainly at the time – as Canada's greatest conservationist. Under the heading "Ontario's Wolf Problem" they wrote *"No leading deer State or Province has the wolf problem in so menacing a form as Ontario. Our observation of the situation here obliges us to place the wolves prominent among the causes of deer destruction during the past forty years. Today, the wolf problem remains quite as* *menacing to the deer as ever". "What is the explanation of this? We have heard a great deal about it, and can offer at least one explanation: Just as the strength of the wolf is in the pack, so the continuance of the pack depends on the safety of its retreat"*.

The report continues under the bold type heading ***"Algonquin Park Wolf Retreat"*** with *"Throughout Parry Sound, Muskoka, Haliburton and in the eastern hunting districts the story was always the same. The wolves came out of Algonquin Park and went back there again to safety. Out of the Park they tracked the deer in spring into their yards over the snow crust. The she-wolves by this means got blood and food. This is no new story. It was given to the Agricultural Enquiry Committee to account for market scarcity of Muskoka lamb. It was told to the Government in the plainest language back in 1905 by the Ontario Game and Fish Commissioners. The very extent of the Park constitutes its most undeniable security as a wolf retreat…"*

It is sobering to realize that just two years before the good committee members complained so bitterly about what they called the Park's "undeniable security" for wolves, rangers had killed 128 wolves within Park boundaries and no-one knows how many Park wolves may have been killed outside as well. For a while the rangers even used poison and, as an indication of how devastating this was to the Algonquin ecosystem, it was reported that Ravens, now a common Park bird, were then almost nonexistent (MacLulich 1938).

Another revealing example of attitudes towards wolves half a century ago is found in the 1948 book "Joe LaVally and the Paleface", by Bernard Wicksteed. The author, a British army officer stationed in Washington during World War II, came to the Park after the War to go on a canoe trip. He engaged the services of Joe LaVally, a famous, part native woodsman and guide. During the trip they heard a pack of wolves howling and Joe described what he perceived as the true nature of wolves with the following words. *"Mind you, I could have proved I was attacked by a wolf, but I wouldn't have got the money because the wolf was my own. (*Here he is talking about an offer of $1000 supposedly made by the government to anyone who could prove they had been attacked by a wolf). *I dug it out of a hole as a pup and reared it. My grandfather was in hospital and when he came out grandmother said to him, "I don't like Joe's wolf. It always follows him and won't go ahead'. The granddad says, "That's bad, Joe. Youse ought to get rid of him. One day you'll trip and fall and he'll jump on you'. Well, sir, I thought I'd see, and so I took a walk in the woods with the wolf and when he was about 10 yards behind I threw my hat and coat on the ground and hopped behind a hemlock. That wolf was so quick I hardly see'd him move. He just gave one leap and he was on the coat. Then he looked up at me, standing there behind the hemlock with my gun ready. The look in his eyes, sir, wasn't like the pup I reared. It was the look of a wild animal". Joe shot it, right between the eyes, with their foiled traitorous look.*

We quote from these two sources because they do a better job than anything we could say to convey just how much wolves were mistrusted and hated. There is another reason these excerpts are of interest today. Wolves began to be scientifically studied starting in the late 50s and early 60s and a different, more respectful perspective on them soon emerged. It became fashionable, at least in urban-based conservation groups who considered themselves better educated than rural people, to ridicule beliefs about wolves of country folk, trappers, hunters and people like our Special Committee on the Game Situation and Joe LaVally. As it turns out, those guilty of such condescension perhaps owe an apology to the committee and to Joe LaVally. For example, John

Theberge and his students have now proven (Forbes and Theberge 1995) that the 1933 Special Committee on the Game Situation had described the situation of today when they said *"The wolves came out of Algonquin Park and went back there again to safety. Out of the Park they tracked the deer to their yards".* It's also not so easy to entirely dismiss the essence of Joe Lavally's story about his treacherous pet wolf when, 50 years later, we are forced to recognize that fearless, semi-socialized wolves can indeed pose a danger to humans. (See examples later in this paper).

Habitat Conditions

During Algonquin's first 60 years the forests were in a dynamic state following the extensive white pine logging and later, yellow birch and hemlock extraction. The young forests that resulted from both logging and the prevalent fires that followed created habitats that encouraged high numbers of White-tailed Deer and beaver. Forest fires, for example, burned an average of 65 km^2 in the park every year from 1921, when records started to be kept, up to 1936. In that year the introduction of airplanes to fight fires apparently contributed to a major reduction in the annual area burned each year in the Park, from 65 km^2 down to 5 km^2 (Runge 1976). It took 35-40 years before the extensive young forests including those of birch and poplar began to be less suitable for deer and beaver. The wolves continued to prosper during this period thanks to all the deer and beaver our human land practices made available. This occurred despite the fact that the rangers were killing 50-60 wolves every year within the Park – and unknown numbers of park animals outside Park boundaries.

The Early Wolf Research and Protection Years

The Pimlott, Shannon and Kolenosky Study

In 1958, major changes began for the Algonquin Park wolf situation. In that year, following a few earlier studies in Alaska and Minnesota, the Ontario Department of Lands & Forests (forerunner of today's Ministry of Natural Resources) began the first ever serious study of wolves in Ontario. It was led by Department scientist Douglas H. Pimlott and Algonquin Park was chosen as the study area. To achieve more natural, less disturbed conditions, the killing of wolves by Park staff was stopped after 1958. The original intention had been to use the entire Park as the study area but this idea was soon abandoned. In 1959 the study area was reduced to 2,000 square miles, cutting out almost all of the easternmost part of the Park that later became John Theberge's main wolf study area. Then, in 1960, the Pimlott team retrenched even farther west, reducing the study area to 1100 square miles. Almost all of the remainder of the study until 1965 was done, therefore, on the higher western side of the Park which is dominated by hardwoods. The eastern side is dominated by pine species (white, red and jack) and has noticeably more shade intolerant species such as white birch and poplar.

The results of this important study are recorded in the "Ecology of the Timber Wolf in Algonquin Provincial Park", 1969, co-authored by Doug Pimlott, John Shannon and George Kolenosky (who replaced Doug when he resigned in 1962). Pimlott continued his wolf studies in Algonquin Park primarily through his graduate students at the University of Toronto. A few results from Pimlott et al (1969) that are relevant to the PHVA workshop are described below.

The number of packs detected in the 1100 square mile West Side study area was about 20. Extrapolating, the whole park would have had 50-55 packs, compared with the 30-35 packs now estimated for the whole Park by John Theberge from his East Side study area. The average pack size in late fall/early winter was 5-6 (range 3 to 9 animals). Pimlott gave his best overall early winter estimate as one wolf per 26 km^2, or one per ten square miles.

Although pack splitting and coalescing, and lone wolves, were observed (as they are now by John Theberge) there was no indication of packs temporarily leaving the Park as later discovered by Theberge and his students on the east side. Pimlott's methods were probably not sensitive enough to detect excursions of wolves from the Park, but he did get evidence from tagging of single wolves dispersing from the Park for long distances.

At the end of the Pimlott study, in 1964 and 1965, trappers were engaged by the research team to collect as many wolves as possible in the 1100 square mile, West Side study area. In 1964 they got 80 wolves and in 1965 another 28, probably about 85% and then 30% of what the original, pre-cull population had been in the study area. While unthinkable in today's climate, the 1964-65 cull of Algonquin Park wolves yielded important genetic, morphological and population dynamics information for before-and-after comparisons. For example, Table 2 shows how the age composition of Park wolves differed after six years of protection in the late 50s and early 60s.

Table 2 Ages of wolves trapped in Algonquin Park, 1957-58 (pre-protection), 1964, 1965, (Pimlott et al 1969)

	1957-58		1964		1965	
	Number	%	Number	%	Number	%
Pup	17	35	25	31	8	31
Yearling	19	40	14	18	4	15
Adult	12	25	41	51	14	54
Pup/Adult	1.4		0.61		0.57	
% Yearlings (Recruitment rate)	0.61		0.25		0.22	

Reproductive studies of females showed that 59% of adult females had borne young and average litter sizes were 4.9 (1965) and 5.3 (1964).

<u>Changes in Wolf Numbers and Prey during the 1960's and 1970's</u>

The winters at the end of the 1950's were among the most severe of the century. They set the stage for a major population decline of deer coincident with maturing, less suitable forests and extensive hemlock extraction in the Park. Severe winters in 1970-72 exerted additional pressure on the already declining deer herds. A decline occurred across the entire northeastern North American range of white-tails and by the end of the 1970s there were very few deer in Algonquin and even fewer yarding in winter concentration areas. Pimlott et al. 1969, had recorded about 35-40 deer per square km in 1960. Studies across central Ontario in 1970 in similar habitat reported densities of about 5 per square kilometre. Moose were gradually increasing in this period and although beaver were still common they were also slowly declining with the maturing forests. Beavers were estimated at 1-2 colonies per square mile. The consequence of all this was a major shift in wolf food habits. Voigt et al 1976 documented a change in summer wolf food habits between 1963 and 1972 from 76% to 33% deer and from 7% to 55% beaver. This same shift appeared to occur all across central Ontario. Concurrently with the decline in favoured prey, wolf numbers also appeared to decline. In 1966 a team of Pimlott's students from the University of Toronto (including Ed Addison, Dennis Voigt, Milan Novak and Alex Hall) surveyed the study area for wolves using wolf howling. Packs were found throughout but they were scattered or in small numbers in some parts of the study area. In the following years until 1970, Voigt (1973) intensively studied two packs in the same portion of the area originally studied by Paul Joslin (1967). Notwithstanding the passage of ten years, the crash in the deer population and the major wolf cull in 1964-65, Voigt found little change in the location of den sites and rendezvous sites over this period. Using summer howling surveys and winter aerial surveys Theberge and Strickland (1978) found that by the early 1970s wolf and pack numbers had recovered to about 75% of the levels seen in the early 1960s and then seemed to decline in the mid 1970s. This accorded with a fall-off in the success of Park staff in finding packs for Public Wolf Howls in the late 1970s and early 1980s (Tozer 1996).

Sorting out the Canis soup

The Pimlott wolf study was concentrated in Algonquin Park, but wolf carcasses were collected from the rest of Ontario as well. Samples from this collection are now being being analyzed for a historical perspective in a cooperative study with Trent University, one of us (DV), and MNR. In 1970, however, using nothing but morphological criteria, the researchers confronted a bewildering array of material and came up with some startling, even daring, conclusions. Thirty years ago, Rod Standfield, then director of the Wildlife Research Branch, George Kolenosky, and others in the branch challenged the then accepted classification of North American wolf races (Young and Goldman 1944) according to whom all the wolves in Ontario except those on the Hudson Bay coast belonged to the subspecies *Canis lupus lycaon*. They stated instead that *lycaon* consists of two distinct forms, a boreal “Ontario-type” which is quite large and ranges in coat colour from black to very light, and a second, smaller “Algonquin-type” of wolf differing in several skeletal characteristics and in being “relatively small and invariably grey-brown in colour”, Standfield, 1970(a), 1970(b), Kolenosky and Standfield 1975. It was unfortunate that Standfield and Kolenosky chose to call the smaller, more southerly form the “Algonquin-type” because it suggests to some people that its discoverers thought it was confined to Algonquin Park. Clearly they did not think that. Kolenosky and Standfield (1975) showed the range within Ontario as including not only Algonquin Park but stretching from the south edge of the Canadian Shield to Lake Superior and as far north as

Timmins (see also Nowak 1995). The northern edge of the range seemed to coincide with the northern edge of White-tailed Deer range, leading to the plausible conjecture that the smaller "Algonquin-type" of wolf was a deer specialist (as opposed to the bigger, presumably moose-eating "Ontario-type" farther north). Given general agreement that White-tailed Deer moved north in Ontario in the 1800s in response to logging and land clearing from their original range in the southwestern part of the province and the area just north of Lake Ontario, there is a strong possibility that the Algonquin type of wolf was not originally found in central Ontario, including Algonquin Park for which it is named. (The present rough coincidence in the northern limits of deer and Algonquin-type wolves is better explained on the basis that the small wolves stopped moving north when they no longer encountered the preferred prey they had been following. The opposing idea, that the small wolves have "always" lived where they now occur, and that the northward moving deer stopped only because they had reached the northern range limit of their traditional predator is obviously much less plausible). The possibility that the Algonquin type of wolf is not native to Algonquin Park is even more startling if we accept the proposal of Brad White and his team that the Algonquin-type of wolf is none other than the Red Wolf. In that case we would have the situation where Algonquin Park had lost its original native wolf (the Gray Wolf) and is now protecting a new, "alien" species!

Rod Standfield, as early as 1970, also pointed out the existence of yet another undescribed canid in Ontario, later referred to as the "Tweed wolf". We now consider it to be a hybrid between the Coyote *(Canis latrans)* and the Algonquin-type of wolf that Kolenosky and Standfield had earlier identified. Standfield correctly perceived that the strange canid was intermediate in all measurable characteristics between *lupus* and *latran*s and then he said (Standfield 1970a,b) a very daring thing, namely that *"Their morphological characteristics suggested that we had remnant populations of niger (the red wolf) in these areas*" (south central Ontario). There was Rod Standfield, 30 years ago, raising the possibility that Ontario had a species never before reported for Canada, although in the next breath he reported that similar intermediate animals had been generated by crossing an Algonquin-type *lupus* with a Coyote (see also Kolenosky 1971, Schmitz and Kolenosky 1985). So Standfield was saying, not that Algonquin-type wolves were similar to Red Wolves, but that the hybrids between Algonquin-type wolves and Coyotes were very reminiscent of Red Wolves. It is fascinating that in 1970, when Standfield went down to the southern U.S. to look at Red Wolves, the animals he would have seen there would not have been pure Red Wolves, but hybrids between coyotes and the last remnant population of southern Red Wolves. Given the "contaminated" state of Red Wolves prevailing in 1970 it is perhaps not surprising that Standfield said that the animals in Ontario that reminded him of Red Wolves were the Tweed hybrids, not the Algonquin-type animals now being proposed by Brad White as a northern race of the Red Wolf.

The Pimlott study had another ironic twist with regard to the identity of Algonquin Park wolves. Because wild wolves are so hard to observe close up, a litter of Gray Wolf pups was obtained from a trapper near Hudson Bay and raised at the Park's Wildlife Research Station at Lake Sasajewun. A popular book, *The World of the Wolf* (Rutter and Pimlott 1968) was illustrated with pictures taken in Algonquin Park of these Hudson Bay animals. Even the cover of the Pimlott study's final report, entitled *The Ecology of the Timber Wolf in Algonquin Provincial Park* was illustrated with a photo showing, if Brad White and company are correct, a species which rarely if ever now occurs in Algonquin! It is also interesting that, at the time of Pimlott's study, many local people were convinced that the government was "bringing in big Siberian and Alaskan wolves to kill all the deer" – a belief that was dismissed by those supposedly in the know as so much nonsense from the unenlightened. Looking back, especially if Brad White is correct about the identity of Algonquin wolves, then we must acknowledge that the views of the locals about Pimlott's captive wolves being very different from Park animals weren't so crazy after all.

The Birth of Public Wolf Howls

The captive litter at the Wildlife Station made another unforeseen contribution to changing human attitudes. Recordings of their howls, and then human imitations, were used in spectacularly successful attempts to get answers from wild wolves. This permitted the researchers to locate and study wolves in summer, the time when they are otherwise invisible in thickly forested country like Algonquin. Among other things, it was found that pups are parked in a series of rendezvous sites (usually beaver meadows or spruce bogs) for days, weeks or months at a time until they are big enough to travel with the pack. Some of Pimlott's graduate students provided the details during the 1960s (Theberge and Falls, 1967, Joslin 1967, Voigt 1973, Voigt et al, 1976).

The discovery of the wolf howling technique also led in 1963 to the first "Public Wolf Howl" where Park staff invited visitors to join them in an attempt to elicit answering howls from wild wolves. Over 600 people showed up at that first event 37 years ago, removing any doubt about whether or not many people would be interested in a chance to hear real wolves. Since then, public wolf howls have grown until they regularly attract over 2,000 people per event and the response leaves no doubt that they have a profound impact on people.

Wolf howls need to be seen in the context of the Park's overall program to educate visitors about wolves. There are seven Park publications with major sections on wolves and 175,000 copies are sold or distributed free every year. There is a major diorama devoted to wolves in the Visitor Centre that is visited by over 220,000 people every year. There are routinely about six or seven talks a year to approximately 2,000 at the outdoor theatre and about 70 groups, totalling 3,500 people a year, are given talks about wolf ecology and are then taken on pre-arranged "private" wolf howling expeditions. Nevertheless, it is the mammoth Public Wolf Howls that have the greatest impact and have done most to change public attitudes about the value of wolves in Algonquin Park.

Thursdays in August are potential wolf howl days but they are held only when wolves are found in an accessible location the night before. The reason is that, with 2,000 people in tow, staff can't actually go out and look for wolves. They can only go to one place and, for there to be any prospect of success, there has to be a good reason to expect an answer at that one place – which means having heard wolves there the night before. Park staff therefore do a complete search of the 65 km of Hwy. 60 and associated secondary roads on Tuesday and Wednesday evenings searching for suitable packs in rendezvous sites, which means there is a good chance they will stay around for at least another day or two. When a pack is found and it is decided to hold a Public Wolf Howl, it is announced only on the morning of the day it will actually occur. It takes 15-20 people, plus 6-8 radio equipped vehicles, and a full day for two people to organize all the details. The actual event starts with a talk at the Park's outdoor theatre. People are told to get there early and staff must work quickly to get the 400-600 cars parked in one main lot and two overflow lots. The talk communicates knowledge of wolf biology and the significance of howling to the audience and constitutes the main educational part of the evening. Human howls are demonstrated to the audience and detailed instructions given before participants get into the vehicles and head out. It is hard to imagine the spectacle of a 25-km line of cars on a wolf howl taking as much as half an hour to pass. The line is almost always split, resulting in two lines of cars (each about 1.5 km long) parked bumper to bumper across the road from each other and with 2,000 people standing by their cars and quietly waiting for the howling attempt to begin.

The interest is huge and the impact is profound. From 1963 to 1999, 84 Public Wolf Howls have been held in Algonquin and there have been slightly more than 110,000 participants. Algonquin Park wolf howls have been featured in at least three TV programs about wolves, including one by BBC-TV and narrated by David Attenborough, and there have been at least 55 newspaper and magazine articles and countless radio interviews. We have no doubt that they have played a big part in changing people's attitudes towards wolves from being universally negative 50 or 60 years ago to being, on average, highly positive today (Strickland 1988). One of the fascinating things about this conversion is that the wolves themselves are mostly responsible. When a normal slide talk on wolves is held at the outdoor theatre, perhaps 300 to 500 people can be expected. When a Public Wolf Howl (which is just a slide talk with the chance – not a guarantee –of hearing real wolves for 20 to 30 seconds later in the evening) is announced, then 2,000 people show up almost immediately. Nothing could be more eloquent testimony of the longing urban man now has for first-hand contact with real wolves, however uncertain and fleeting it may turn out to be, than the response to our Public Wolf Howls. And yet, notwithstanding this apparent Park success story, we should not be complacent about our wolves.

Fearless Wolves

A recently emerging issue with disturbing implications has to do with fearless wolves and the concerns they pose to human safety. For years we have all pooh-poohed the possibility that wolves might be dangerous and, indeed, the dominant reality is that, traditionally, almost all wolves have been so fearful of humans that we hardly ever get to see them. However, we have been seeing more and more fearless wolves in recent years. Mike Runtz, in his 1997 book, *The Howls of August,* documented 10 or 11 fearless wolves over the last 25 years in Algonquin Park and there has been at least one more since then.

In the beginning, we greatly appreciated these fearless animals for the opportunities they provided for Park visitors to see living wild wolves up close and unafraid of people. In 1987, however, one of them bit a 16-year-old girl in the arm, probably as a startle reaction after she shone her flashlight in its eyes from a foot or two away in the dark. It clamped down on her arm inflicting a few scratches through her thick sweatshirt and then let go and started playing with a nearby tennis shoe. The wolf tested negative for rabies and seemed to be a healthy, normal Algonquin wolf – though fearless.

We had two more minor bites from a single fearless wolf in 1994 in the Park Interior and then in 1996, we had a much more serious incident. A fearless wolf in the Interior of the Park bit the face of a 12 year old boy sleeping outside his tent and dragged him 6-7 feet before screams and intervention from the rest of the boy's family drove the wolf away (Strickland 1997b, 1997c). The boy suffered multiple cuts, a broken nose, and a severed tear duct. There was blood everywhere and they had a two-hour paddle in the dark to the nearest place where they could get help. Whatever the exact reason for this attack, the fact is that it did occur, and like all the other bites it involved a fearless wolf that had been associating one way or another with people for weeks beforehand. Most important, it could have easily resulted in more than the physical and emotional scars, which this boy and his family continue to live with. It could have resulted in a death.

So, too, could the fifth and last bite, also involving a fearless wolf. It frequented two of the Park's biggest campgrounds right along the busy Highway 60 corridor for three months, being seen almost daily without incident – except for a few altercations with dogs. Then on September 25, 1998 it seemed to show inordinate interest in a 4-year old girl, even after being pepper sprayed. Park staff were informed about this encounter and they decided the wolf should be removed. Efforts to find it were not successful, however, and two days later, on September 27th, the wolf approached a 19 month-old boy playing in the middle of his campsite under the noses of his parents, seized him by the rib cage and tossed him to one side. The child was immediately rescued (and suffered no great harm) and the wolf was dispatched within the hour (Strickland 1999a, 1999b).

This last incident changed things for us. The fact is that there have been 11 or 12 fearless wolves over the last 25 years and 4 of them have ended up biting 5 people. The two most recent incidents could easily have resulted in human deaths. We submit that permitting the association of fearless wolves with people is running a very high risk and that, in the future, Park staff will have to remove such animals.

The present-day occurrence of fearless wolves and their apparent absence in the past are consistent with the idea that any wolves behaving this way in the past would have been quickly eliminated by our cadre of wolf-hating rangers. They are also consistent with the idea that our population may be at high density and producing dispersing wolves that can no longer find holes in the territorial mosaic where they can establish themselves. Perhaps they come to use protected places with high human densities, be it towns or campgrounds, not already occupied by wolves. There, they eventually learn there is food to be had and that humans are not hostile – as has been proposed for the expanding Minnesota population (Thiel et al. 1998, Hart 1999). In this way, our very protection of wolves in Algonquin may plausibly be a factor contributing to the apparently increasing occurrence of fearless wolves close to human campgrounds and interior campsites.

New Research and New Issues

Although fearless wolves may constitute a significant safety issue and therefore an important problem for park management, several other issues have also been raised that call into question the very integrity and long term viability of the Algonquin Park wolf population.

Status of the Wolf Population Today

John Theberge returned to Algonquin in the late 1980s after an absence of about 10 years and began an intensive study of several aspects of Algonquin Park wolf ecology, behaviour and population biology. He made the unexpected and important discovery that many east side packs would abandon their territories several times a winter and quickly travel out to the Round Lake deeryard for a few days to kill deer. Even more importantly, he quickly found out that humans often killed his radio-collared wolves while they were out of the Park. At first Theberge felt that the Park population might be stable in spite of this killing (Forbes and Theberge 1995) but later was persuaded that the Park population was declining and that human killing outside the Park was responsible. In response to Theberge's concern, the MNR instituted a ban on the killing of wolves from December 15 to March 31 in the three townships (Burns, Richards, Hagarty) containing the deer yard where the radio-collared wolves were being killed in such large numbers (Strickland 1997a).

Notwithstanding the increased protection, Theberge still feels that the Park wolf population is declining or is at risk (Theberge 1998). Our impression from the Highway 60 corridor part of the west side population – which may of course behave differently than the east side animals – is that wolf numbers have been high, and have not declined, since 1985. We have several reasons for saying so. Figure 1 shows the number of successful Public Wolf Howls held since 1969. Although it shows much more consistent success since 1985, it actually minimizes the differences in perceived wolf abundance along Highway 60 before and after 1985. In fact, we sometimes had trouble finding any packs in the late 70s and early 80s whereas, starting in 1985, we have always found 4 packs and sometimes 5 every year up to the present. Similarly, the wolf sighting reports we now record ourselves or get from Park visitors are much more numerous now than in our early days in the Park and are more consistent with the idea of a high population that is not declining. Also, in the course of recent studies on the impacts of logging on forest-wildlife in the Park one of us (DV) has found evidence of wolf packs in all the corridor areas where they were detected in the late 60s. Finally, Park staff did a helicopter survey of the old West Side Pimlott study area on January 27, 2000. From tracks, the minimum estimate in that third of the Park was 43-48 animals – not distinguishably different from the numbers that one of us (DS) detected on winter surveys 30 years ago (Theberge and Strickland 1978).

These observations cannot be used to prove that the density of wolves on the west side of Algonquin has remained stable since 1985 but they do indicate the consistent presence of a similar number of wolf packs and pups along the Highway 60 corridor for at least the last fifteen years.

Nevertheless, there is no reason to expect that packs and pup production must necessarily be the same throughout the Park or that there might not be areas where wolves are declining. Whether they are declining or not, and the long-term viability of the entire wolf population, both within Algonquin Park and in the rest of the taxon's range, are valid questions of wolf conservation and management that are important to address now.

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The Genetics of the Algonquin Wolves

. The cooperative projects using material from many sources and the DNA analysis by the Trent and McMaster teams of Brad White, Paul Wilson and various graduate students are critical to unraveling the complexity of Ontario's *Canis* soup and determining the extent of the introgression of Coyote genes into the Park wolf population. Because rangers annually killed so many Algonquin wolves up until 1958, Coyotes may have found vacant areas or interbreeding opportunities anytime after their move into central Ontario from the west during the 1930s-40s. It is also possible that the 1964-65 wolf cull conducted by the original Algonquin wolf researchers themselves may have allowed a pulse of Coyotes into the Park and at least a brief session of interbreeding before the wolves re-established themselves. We need to know now whether Coyote introgression is an ongoing process or whether present levels of Coyote DNA in our wolves reflect past infiltration and that the situation may now be stable.

A closely related question concerning the health and integrity of Park wolves is just how unique the Algonquin-type of wolf really is. When Standfield and Kolenosky first identified it as a previously undescribed form of *lycaon* they certainly did not mean that it was confined to the Park. Nevertheless, several people have suggested that our Park wolves are special or the purest representative of the strain and are under threat merely because of small population size.

Brad White will be presenting his team's views on this important question and also on a closely-connected question, namely “what are our Algonquin-type wolves anyway?” Are they “merely” a small race of the Gray Wolf *Canis lupus,* a hybrid (Wayne et al. 1995, Theberge et al. 1996), or are they a northern remnant of the endangered Red Wolf? If they are Red Wolves and if they truly are largely restricted to Algonquin Park this would put the need for special extra protection for our wolves on a much higher, more critical plane. The alternatives are that they occur far beyond the boundaries of Algonquin Park and that they are just a race of a species that occurs across much of North America and Eurasia.

Addressing the Issues

In the last decade, there has been considerable debate among various stakeholders about the sustainability of the wolves of Algonquin Park. One of the major proposals has been to ban the killing of wolves in all townships within 10 kilometres of Algonquin Park. The debate has seen demonstrations, pamphlets, newspaper articles, information booklets, articles in the Park newsletter and letters to the Minister. Interest in finding a solution to differing viewpoints and uncertainty about the ecological status and genetics of the Algonquin wolves led to the suggestion of an Adaptive Management approach. In 1999, an Algonquin Wolf Advisory Group appointed by the Minister of Natural Resources began to meet to review the information and prepare a conservation plan for the wolves. This group, chaired by Bill Calvert, represents diverse interest groups and will report its recommendations to the Minister in the summer of 2000. The deliberations and conclusions by the participants of the Algonquin Wolf PHVA workshop and the Conservation Breeding Specialist Group will be providing valuable input for the Advisory Group's report. The Workshop is viewed as a major step in addressing uncertainties while exploring acceptable conservation plans.

General Questions to be Addressed

The appendix to this paper contains a set of questions that systematically consider the major issues about the genetic, ecological, and population status of wolves in and around Algonquin Park. In the following section, we provide a more general discussion of the major questions and hope that it will be helpful to interested parties in organizing their own thoughts on these complex issues.

The first question is inspired by recommendations for increased protection outside Algonquin Park made by several individuals and groups. How we answer the question depends on our individual values. The question is *"Do you think Algonquin Park wolves should be protected when they step outside Park boundaries?* and there are three possible answers: *"Yes", "No",* or *"It All Depends"* (Figure 2). Many people might say they should be protected just because they are Park wolves and deserve that protection even if we believe that there are no problems at all with declining numbers, swamping by coyotes, or vulnerability because of a small population size. With that outlook people might still answer *"yes"* even if the wolves don't actually need extra protection. For those people a *"yes"* answer is just a question of principle and stems from their personal values.

On the other hand, some people – presumably less numerous than 50 to 100 years ago – might answer *"No, they should not be given extra protection",* even if there was incontrovertible evidence that Park wolves are presently endangered. Such people would actually be happy if it were shown that they were declining.

And finally, there are people who would answer *"Maybe, it all depends on whether Algonquin Park wolves are in danger and whether they actually* ***need*** *extra protection".* We propose that there are really at least three questions of fact to be answered if we are going to help the "maybe people." The answers have important implications about what form extra protection should take or even whether it would be useful at all.

The first question of fact *is "Have Algonquin Park wolves declined since 1987 as suggested by John Theberge?* (Theberge 1998). It may be that this question cannot be answered with certainty, even with a very good dataset, because the inevitable ups and downs of any natural population are so great that they conceal the underlying truth. Ideally, however, we would hope that research could answer with a *"Yes"* or *"No".* If the answer is *"Yes"* we could then proceed to ask why. Is it because of human killing outside the Park, because of a lowered prey base, because of disease, or because of some combination of such factors?

These questions are important because the answers have big implications about whether or not extra protection would actually change anything. If wolves have declined because of disease or a lowered prey base, then extra protection is not going to help wolves. Only if wolves have actually declined and only if human killing is responsible for that decline, could we expect extra protection to actually do anything useful for our wolves. In the case of a low prey base, management could be directed at improving habitat to increase carrying capacity of deer and beaver. That would require increased forest ecosystem disturbances (fire and logging) to create more young, second-growth forests. Deer numbers in Algonquin Park appear to be slowly recovering but the habitat is not as suitable as it was earlier this century. Beaver also occur at much lower numbers, especially on the west side. Voigt and Addison (unpubl.) recently surveyed the Park and found densities less than half of those recorded during the 1960s.

Note that there is a definite hierarchy involved in these questions. That is, if the answer to the question about a possible decline *is "No, there has not been a decline in Park wolves"*, it is inappropriate to be debating the demographic fine points about why they have declined!

The second question of fact is *"Are Park wolves being swamped by coyotes?"* (Figure 4). Even if we determine Park wolves are not numerically at risk from human killing when they are outside the Park, they could still be in danger from Coyote swamping – just as the introduced Red Wolves are in North Carolina. In our situation, with our question, two answers are possible and Brad White will be providing evidence that will help choose the one more likely to be correct. The answer could be*, "No, under present conditions, the level of Coyote introgression into Park wolves is negligible"* or *"Yes", Park wolves are now in danger of being transformed into hybrids".* Once again the implications are far-reaching. For example, if Coyotes are indeed a problem, one might propose a canid-killing zone outside the Park to minimize dispersal into the Park by Coyotes. One might argue that even if Park wolves dispersing out to the killing zone were wiped out, so too would be the incoming Coyotes and, by definition in this scenario, the Coyotes are the problem (not lowered numbers of Park wolves). If the answer is *"No, Coyotes are not a problem"* then we don't have to debate the value of a canid-killing zone or other special canid management – at least not on account of Coyotes.

Our third question of fact is whether or not Algonquin-type wolves are largely restricted to the Park (Figure 5). If they are still quite widespread, as indicated by Kolenosky and Standfield 30 years ago, it may suggest they don't actually need any extra protection depending on their population levels in the larger area. If, on the other hand, they really are mostly restricted to the Park, this would be a strong argument for erring on the side of caution. If the population were only a few hundred and the number of breeders below even 100, we would have to be doing everything possible to lower the risk of even one being lost.

It is also important to know more about the identity of the wolves of Algonquin Park. Is the Algonquin-type wolf unique, a hybrid, a pure small eastern race of the Gray Wolf, or the only viable population left on the planet of a different species – the Red Wolf? If the latter, for example, it would place the need to err on the side of caution on an even higher level. That would be true even if Park wolves have not declined in recent years (Question 1) or even if they are not in danger from swamping by coyotes (Question 2. There is no completely objective way of determining the worth of a species as opposed to the worth of a race or sub-species, but we think most people would be more concerned about the fate of a species.

The questions discussed here are difficult to answer. The Theberge and White team studies will provide many clues but there are many complex issues to address. Our history will give you some background but ultimately we will all have to consider many lines of evidence at the workshop,

We end with a few remarks from a local wise man. Some of the workshop participants may not realize that John Kenneth Galbraith, the famous Harvard economist, is a Canadian or that, in fact, he grew up in southern Ontario. He was once confronted by a person upset that Galbraith had completely changed his opinion on some issue. Galbraith is reported to have said: *"Yes, when I am shown new facts that compel me to abandon formerly held opinions and embrace new ones, I change my mind…What do* ***you*** *do?"* History does not record what Galbraith's accuser did at this point, but we might all do well to remember the implied lesson.

Let's do our best for wolves at this workshop and seek a better understanding of them to ensure that Algonquin Park's first century of wolves is not Algonquin Park's only century of wolves. Let us carefully consider the evidence and may the wisdom of Galbraith be with us all.

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About the Authors

Dan Strickland and Dennis Voigt began their careers in association with wolves in Algonquin Park in 1965 and 1966 respectively. Dan's first Public Wolf Howl was in 1969 after the public howls were suspended in 1965 (following the major cull of wolves in the southern part of the Park). The first successful Howl in 1969 was the inauguration of the really large modern day events that have popularized Algonquin's wolves. The responding pack of wolves was one that Dennis had found while researching wolves and he had suggested "revival" of the Public Wolf Howls to Dan.

Dan has spent almost his entire career as Chief Park Naturalist in Algonquin Park. During those 35 years, one of his roles was planning, organizing, and implementing the Park's educational programs about wolves including publications, exhibits, slide talks and the well known Public Wolf Howls. He has much experience with public interest in, and attitudes towards wolves over the last 35 years but he has also done wolf fieldwork in the form of aerial wolf surveys in the 1970s and 80s and ground observations throughout the last three decades. He is the author of the popular Algonquin Park newsletter, *The Raven*. He is also recognized as the world authority on Gray Jays from his studies in Algonquin Park.

Dennis recently retired as a Research Scientist from the Ministry of Natural Resources' Wildlife and Natural Heritage Science Section. He is now a Wildlife Consultant living in Lindsay, Ontario. His research has focused on population dynamics, spatial behavior and management of White-tailed Deer as well as ecological studies of coyotes, foxes, skunks, and raccoons as part Ontario's pioneering rabies vaccination program. His first research was on wolves in Algonquin Park as a M.Sc student of Doug Pimlott and his most recent research found him studying Impacts of logging on forest-wildlife, also in Algonquin Park.

Appendix Questions for Addressing Wolf Management Issues in Algonquin Park

The wolves in Algonquin Park are widely recognized as being of high importance to many Park visitors and the people of Ontario. The Interpretive Program, including the Public Wolf Howls, has an international reputation. In addition, the wolves are recognized as an integral part of the natural Algonquin ecosystem and the top predator in a complex system of predators, prey and diverse habitats. A major issue that has arisen in recent years is whether the wolves of Algonquin Park are adequately protected or whether they need additional protection to ensure their sustainability? The following questions provide a framework to help address the complex nature of this issue. They are designed to help systematically address a variety of management actions. It will still be necessary to determine priorities for each action based on biological, social and economic feasibility.

Question 1: Does it matter which species of wolf occurs in Algonquin Park and whether it is unique?

From a taxonomic consideration, if a species' uniqueness makes it rare, threatened, vulnerable, or of provincial or national significance, the answer is Yes- go to Question2
From an ecological consideration, the answer is No-go to Question 5.

Question 2: Do we know the species or subspecies of wolves in Algonquin Park? Is it a red wolf, a gray wolf or a hybrid between wolves and coyotes or some other Canis spp?

If Yes got to question 3.
If No, then it is important to take steps to acquire this knowledge and then go to Question 3. Without this knowledge there is a risk that the species is rare, threatened or endangered and may need special management to ensure a sustainable population in an area the size of Algonquin Park.

Question 3: Do wolves similar to those in Algonquin occur elsewhere?

If Yes, go to Question 4.
If No, then the Algonquin Park wolf population has special significance because it is rare. There is a high risk that the wolves may need special management to ensure a sustainable population in an area the size of Algonquin Park. Go to Question 5

Question 4. Are the similar wolves outside Algonquin Park, sustainable because of their population size, geographical extent and current management?

If YES, then from a taxonomic perspective, the wolves in Algonquin Park are part of a larger sustainable population and management plans should be focused on wolves within the bounds of Algonquin Park to ensure they continue to play an integral role as a predator. Go to Question 5.
If No, then the wolves of Algonquin Park may have special significance as the largest intact population of these wolves and the core of a larger population under threat. Develop conservation plans for wolves in Algonquin Park in a regional context with special management to ensure a sustainable population in an area the size of Algonquin Park but also in the surrounding region. Go to Question 5.
If the answer to Question 4. is unknown, there is a risk that the species is unsustainable elsewhere and wolves may need special management in Algonquin Park and elsewhere to ensure sustainable populations. Recommend further evaluation of Question 4 then Go to Question 5.

Question 5. Is there evidence of a long-term decline in the population of wolves in Algonquin Park?

If Yes, go to Question 6
If No go to Question 9

Question 6: Is the decline due to factors inside the Park or outside the Park?

For factors inside the Park, Go to Question 7
For factors outside the Park, Go to Question 8

Question 7: Factors inside the Park. This question requires an investigation of whether decline is due to poor reproduction, high mortality, or egress greater than ingress. Proximate factors include availability of various prey species, mortality causes (diseases, parasites, trapping, hunting, accidents), density of wolves inside and outside the Park. Assess each of the following questions.

Question 7a: Are there adequate prey populations available?

Evaluate densities and seasonal distribution of deer, moose and beaver in relation to wolf numbers. Evaluate effects of Park habitat management on prey densities and seasonal distribution.

Question 7b. Is the annual recruitment low (mortality higher than reproduction)?

Evaluate natural and human-caused mortality rates in Algonquin Park for young and mature wolves. Evaluate whether gross reproduction is low due to low conception rate (causes include inbreeding, densities, social factors, nutritional state of breeders etc).

Question 7c. Evaluate whether there is an imbalance in egress vs ingress. Are more wolves leaving the Park than are entering the Park? Is the egress due to relative wolf densities, relative prey densities etc.

For any factors identified as causing a decline in Question 7, develop an Adaptive Management Plan for action inside Algonquin Park. Go to Question 8.

Question 8: Factors outside the Park. This question requires an evaluation of various factors outside the Park that could affect the population growth rate of wolves in Algonquin Park. Assess each of the following questions.

Question 8a. Evaluate the mortality of wolves that leave the Park. What is the level? Does it occur in all areas surrounding the Park? Is it primarily human-caused?

This mortality is believed to occur primarily during excursions by Park wolves to prey on deer in winter concentration areas outside the Park.

Question 8b. Is there ingress of coyotes into Algonquin which changes the reproductive success of Algonquin Park wolves?

Question 8c. Does the ingress of wolves from outside Algonquin replace the egress of wolves as part of natural population dispersal.

Question 8d. Is there a net egress of wolves to areas outside the Park for some reason such as better prey and habitat?

For any factors identified as causing a decline in Question 8, develop an Adaptive Management Plan for actions in the areas outside the Algonquin Park. A critical issue will be whether actions such as mortality control are targeted to specific local sites or universally around the Park. Some actions may involve factors acting at a regional landscape level and beyond the limits of short-term manipulation. In these cases priority areas or transition zones may need to be identified. Go to Question 9.

Question 9. Is there a high probability of change in some condition which will increase risks of sustainability of wolves in Algonquin Park??

If Yes, Include a Monitoring Plan that ensures early warning of sustainability risks in the Conservation Plan for wolves
If No, Recommend status quo management in a Conservation Plan for wolves

The Wolves of Algonquin Park

Population & Habitat Viability Assessment (PHVA)

FINAL REPORT

APPENDIX IV

Dissenting Opinions

Dissenting Opinion Report - Frank LeFeuvre
Dwight-Dorset Trapper's Council

One of the recommendations by the "Public Value Committee" stated that a "wolf-management" zone around the perimeter of Algonquin Provincial Park was recommended for the long-term survival of the wolves of Algonquin. I disagree with this recommendation for the following reasons:

1. Trappers may lose the opportunity of managing the resident wolves on his/her trapline.
2. The number of beaver may decline as the increase in wolf population grows.
3. Habitat variation (decline in beaver ponds) may have a long term impact on the number of aquatic furbearers (mink and muskrat).
4. The economic base for trappers may collapse - reduced number of saleable pelts.
5. Dramatic changes in an individual's way of life if trapping becomes a negative economic activity.
6. Long-term investment loss (trail preparation and maintenance, equipment and trapline cabin).
7. Data presented by the scientists didn't convince me that there is a need to alter present legal trapping practices if the object is "to conserve the eastern grey wolves of Algonquin Park and surrounding areas".
8. Wolves are nomadic creatures and have been for centuries. They wander far and wide in search of food. A "wolf management " buffer zone is not a guarantee that they will survive. If they leave the "wolf management" zone, they will become a legal target for trappers.
9. If a park boundary is extended (i.e. wolf management zone) to include one furbearer, what will the next species be?
10. The heritage of a family trapping unit is of great importance to maintain.

Recommendation: I strongly recommend that the MNR/AWAG present any recommendations to local trapper's groups before the AWAG presents recommendations to the minister.

Summary of Workshop Results Compared with our Evidence

John & Mary Theberge

We generated the idea of holding a PHVA workshop with the participation of independent and experienced scientists to counter some years of misinterpretation of our results and their conservation significance that has hindered resolution of a significant conservation issue – namely, overexploitation of the supposedly protected Algonquin Park wolf population – and engage a wide public. We allowed are data to be scrutinized publicly in peer review. Accordingly, we accept the courtesy extended by the sponsors, the World Conservation Union's Conservation Breeding Specialists Group to evaluate the degree of support that has come out of the workshop for the interpretations we presented both orally in the opening plenary and in the Briefing Book, and draw some observations and conclusions.

The workshop involved more than 60 people representing not only a scientific community but public interest groups and independent citizens. Both by virtue of a wide range of backgrounds and ideologies, and a very thick briefing book that contained more information than was easily digestible, there was a certain amount of drift away from the central issues. That drift is reflected in a final report in which it is difficult to distill out the major points of discussion and agreement. Because the individual working groups tackled different topics, only one, named "Population Dynamics and Modeling" directly addressed the quality of our data. Other working groups requested that that working group take on that evaluative responsibility for all. The Population Dynamics and Modeling group consisted of 17 people of whom 10 are research scientists, and 10 hold Ph.D's.

The statements made by that group on the central issue of whether or not there is a demographic problem with the Algonquin Park wolf population include: "Results of our 'baseline model' (which is based on our existing research data) – including our best estimates of the demographic parameters deemed appropriate for the wolves of Algonquin Park – the population is expected to decline at a very rapid rate in the absence of immigration of animals from outside the Park. It is clear that, under these conditions, the larger Algonquin Park region (including Algonquin Park) appears to be acting as a population sink in which mortality is outpacing reproduction on a local scale**. As simulated here, the wolf population appears to be unsustainable.**" And, based upon a second type of simulation, "1) fluctuations in population size may be sufficiently large to make the Algonquin wolf population inviable, and 2) a reduction in population fluctuations could be important in increasing the viability of the population."

The working group registered no objections to our statistically valid evidence that these fluctuations, indeed changes in wolf numbers over the 13 years of our study, have been driven by mortality, of which more than 2/3 is caused by humans, almost all occurring within 10 kilometres of the park boundary. Accepted, too, was the evidence for a variable mortality that averaged 33 percent per year, exceeding annual recruitment of yearlings by at least 10 percent. Accepted, too, was our evidence of low recruitment – which makes the population extra sensitive to decline under low levels of mortality. Low percentages of both the yearling and 2-year-old age cohorts argues against significant immigration into the park (because it is these age cohorts that are expected to make up dispersers that may immigrate in). Under these circumstances, population decline seems inevitable, and when the data were modeled using the Vortex simulation, it indeed failed to persist more than a few decades.

Direct evidence of population decline reflected in annual densities of wolves was handled unevenly, perhaps due to the complexity of the data and lack of time. There was little doubt registered that the population is significantly lower than in the early 1960's, as we had concluded. The working group's statement is that "there appears to be a decline in wolf numbers in Algonquin Park since the 1960s." Nor was there objection to our analysis that indicated that while the ungulate prey base is lower than it was in the early 1960's, the wolf population was even lower than the present prey biomass should support – as detailed graphically and discussed extensively in our presentation and in the briefing book.

Related to support for our contention that the population has declined by about 1/3 since the beginning of the study, the working group concluded that "the Theberge's recent data from the eastern segment of the Park cannot allow us to unequivocally conclude that the population is declining. By the same token, we cannot conclude with any confidence that the population is currently stable. Additional analysis of the demographic data collected by the Theberges' – in particular, radio-telemetry data used to calculate annul recruitment rates – is required before more definitive statements can be made."

Part of the confusion here was that we drew inferential conclusions about a decline after pointing out that the variance in population sizes was so great that the statistical test we used showed non-significance. Not initially recognized by the group, or us, was that the test itself was invalid because population data such as these are not normally distributed, which is one of the necessary assumptions of that particular statistical test. However, the working group's statement about the need for further analysis was based upon this realization. This further analysis, one of the recommendations of the working group was completed after the PHVA. Based upon valid statistical procedure, John Vucetich and Paul Paquet have reported that "From this analysis, **we conclude there is an 84%** chance that the average log-transformed growth rate is less than zero, **and that the Algonquin study population has been declining**. In addition to assessing the probability of decline, it is useful to assess the probability that the population is exhibiting a dramatic decline. Although quantifying what constitutes a dramatic decline is subjective, most if not all population biologists would agree that a population with an average annual change in population size of < = 0.05 (5%) would be at great risk of extinction. This analysis predicts a 71% chance that the population has been characterized by an average annual change of more than 5% per year."

Against these conclusions based on data we generated in the longest intensive wolf research program ever undertaken in Canada, a viewpoint expressed in the PHVA results by the "Prey Habitat Working Group" that "park staff have no evidence indicating the population inside the park is declining," is wishful thinking. The truth is, they have collected no data upon which to draw any conclusion. The Population Biology and Modeling Working Group dealt with this issue, reviewing the data upon which park staff have been making these statements to both the public and in this workshop, and concluded that "The nature of these data (public wolf howls along Highway 60 from 1969-1999) do not lend themselves to making inferences about wolf numbers, population density, or trends thereof, or demographic vulnerability…This information cannot be extrapolated to the rest of Algonquin Park."

We trust, therefore, that the scientific scrutiny given our data at the workshop, and conclusions drawn, will put an end to the long history of Ministry of Natural Resources denial that there is a problem with the wolf population in Algonquin Park. Furthermore, biologist Norm Quinn tabled a report at the workshop detailing high levels of wolf killing in townships adjacent to the park, which collaborates our data based on radio-collared wolves, and supports our conclusions that it occurs not just to the east but all around the park.

Related to the issue of what to do about the evidence that human killing drives population change and decline, the Population Dynamics and Modeling Working Group discussed an "adaptive management" approach. We presented a viewpoint on this approach at the opening plenary. To reiterate, the approach has been long known but not widely practiced in resource management for many reasons, some economic, some practical. The approach involves casting management actions in an experimental mode, and marrying management action with research and monitoring. Some problems just don't lend themselves to adaptive management, especially when ecological systems are complex and interwoven, when measures of environmental and population variability are imprecise, and where data are of an annual nature requiring many years to determine trends. Because of these problems, the Working Group was not unanimous in its support for this approach, and vindicating our assessment of the difficulties with the approach, the working group was unable to define any experimental model that met with any degree of support. The one expressed in the workshop report was far from universally supported. One of its major flaws is that without the infusion of large amounts of research money (we would estimate more than $150,000. per year based upon our research costs for intensive study – for 6 years as designed, equaling about one million dollars), conclusions would have to be drawn based upon some surrogate of wolf population change rather than hard data. The only surrogate the group could come up with was changes in average pack sizes. Ironically, underlining the weakness of this approach, the same people were unwilling to accept the statistically significant decrease in pack sizes in our data as evidence of population decline.

Consequently, in the final plenary, there was discussion about the collection of "crappy data" in an adaptive management approach. And consequently, the working group recommended the need for someone else to do what it failed to do by "Convene a 1-2 day meeting of a small group to discuss the scientific merits for an Adaptive Management strategy designed to stabilize the Algonquin wolf population through reducing human-induced mortality."

It is still our position, expressed in the first plenary, that no model of adaptive management that involves closure and opening of land adjacent to the park for even as long as 3 years each will result in data from which any scientifically valid conclusions can be drawn. Agreeing with us, the Population Modeling Group stated that "Experience with these systems shows that the variability of pack sizes will preclude statistical detection of differences using parametric tests." And furthermore, we already know the influence of human killing on the population, and where it occurs.

There is no need to fake up a hypothesis to test the influence of human killing on this population; to do so is just delaying facing the situation. We again put forward our position that our data right now make the case for management action of a permanent kind – protection in townships adjacent to the park until such time, if and whenever that may be, that someone's research shows that to be unnecessary.

There is a "precautionary principle" in environmental management that should be applied here. At stake is not only the long-term viability of an ecologically important member of a flagship provincial park, but a genetically unique one as well. The genetics data presented graphically on pages 345, 353, 354 and 357 show the Algonquin wolf to be different from populations to the south, west and north (to the east has not been tested). Statements at the PHVA that there are a few thousand lycaon wolves are based upon an unresolved, and unresolvable issue of when is a species not a species by virtue of hybridization? More prevalent coyote alleles cause the differences to the south and west, and gray wolf alleles cause the differences to the north. The wolf population in Ontario most like the only remaining wild red wolf population, in North Carolina, lives in and close to Algonquin Park.

Will we continue to wrangle about these interpretations while irretrievable ecological and biological change may continue to occur, demanding certainty of science before we are willing to act? Global warming is not a statistically proven trend, because of wide annual variance, and yet application of the "precautionary principle" certainly motivates a concern and call to action by many people.

U.S. Vice President Al Gore is reputed as saying words to the effect that we live in this strange age when only about half of what is environmentally necessary is politically possible. For which half will an assured future for the Algonquin Park wolf population fall?

Dissenting Opinion

Prey Habitat Working Group
Strategy: To manage for optimum, healthy sustainable prey populations.

This working group was met with considerable debate when suggesting this strategy in plenary. Although it has ceased to be the priority action recommended by the group, this recommendation inappropriately remains in the text of the group's report. The Federation of Ontario Naturalists (FON) and I feel that it is inappropriate to be managing Algonquin Park for the needs of any particular species or guild. This would run counter to modern concepts of ecosystem management, and is especially inappropriate in the third largest provincial park in Ontario. The trend in the park and forest management has been towards restoring the natural forest condition, and this trend should continue. We also disagree with any text located elsewhere in the report in support of this stated strategy - particularly recommendations to satisfy this strategy through harvest in AOCs.

Landscape Ecology Working Group
Issue 2: Natural Resource Exploitation,
Issue 2b: Studied system extends beyond the Park
Strategy 6: In future research, there will be consultation between trapper's council, MNR, and research scientists to ensure compliance with provincial trapping standards. Animal care committees that review protocol should be expanded to include a representative from the trapping community. Researchers should be certified under Ontario Fur Harvesting and Conservation Course.

Although I have no specific reason or desire to disagree with this recommendation, it was crafted in the last few minutes before the final plenary, and was not subject to adequate discussion. It can therefore not reasonably be stated that consensus exists on this recommendation.

Respectfully yours,

Chris Henschel,
Algonquin Wolf Advisory Group Representative
Federation of Ontario Naturalists

The Wolves of Algonquin Park

Population & Habitat Viability Assessment (PHVA)

FINAL REPORT

APPENDIX V

IUCN Policy Guidelines

IUCN Policy Statement on Captive Breeding

Prepared by the SSC Captive Breeding Specialist Group *
Approved by the 22nd Meeting of the IUCN Council, Gland Switzerland, 4 September 1987

SUMMARY: Habitat protection alone is not sufficient if the expressed goal of the World Conservation Strategy, the maintenance of biotic diversity, is to be achieved. Establishment of self-sustaining captive populations and other supportive intervention will be needed to avoid the loss of many species, especially those at high risk. In greatly reduced, highly fragmented, and disturbed habitats Captive breeding programmes need to be established before species are reduced to critically low numbers, and thereafter need to be co-ordinated internationally according to sound biological principles, with a view to the maintaining or re-establishment of viable populations in the wild.

PROBLEM STATEMENT

IUCN data indicate that abut three per cent of terrestrial Earth is gazetted for protection. Some of this and much of the other 97 per cent is becoming untenable for many species and remaining populations are being greatly reduced and fragmented. From modern population biology one can predict that many species will be lost under these conditions. On average more than one mammal, bird, or reptile species has been lost in each year this century. Since extinctions of most taxa outside these groups are not recorded, the loss rate for all species is much higher.

Certain groups of species are at particularly high risk, especially forms with restricted distribution, those of large body size, those of high economic value, those at the top of food chains, and those which occur only in climax habitats. Species in these categories are likely to be lost first, but a wide range of other forms are also at risk. Conservation over the long term will require management to reduce risk, including ex situ populations which could support and interact demographically and genetically with wild populations.

FEASIBILITY

Over 3,000 vertebrate species are being bred in zoos and other captive animal facilities. When a serious attempt is made, most species breed in captivity, and viable populations can be maintained over the long term. A wealth of experience is available in these institutions, including husbandry, veterinary medicine, reproductive biology, behaviour, and genetics. They offer space for supporting populations of many threatened taxa, using resources not competitive with those for in situ conservation. Such captive stocks have in the past provided critical support for some wild populations (e.g. American bison, *Bison bison*), and have been the sole escape from extinction for others which have since been re-introduced to the wild (e.g. Arabian oryx, *Oryx leucoryx*).

RECOMMENDATION

IUCN urges that those national and international organizations and those individual institutions concerned with maintaining wild animals in captivity commit themselves to a general policy of developing demographically self-sustaining captive populations of endangered species wherever necessary.

SUGGESTED PROTOCOL

WHAT: The specific problems of the species concerned need to be considered, and appropriate aims for a captive breeding programme made explicit.

WHEN: The vulnerability of small populations has been consistently under estimated. This has erroneously shifted the timing of establishment of captive populations to the last moment, when the crisis is enormous and when extinction is probable. Therefore, timely recognition of such situations is critical, and is dependent on information on wild population status, particularly that provided by the IUCN/Conservation Monitoring Centre**. Management to best reduce the risk of extinction requires the establishment of supporting captive populations much earlier, preferably when the wild population is still in the thousands. Vertebrate taxa with a current census below one thousand individuals in the wild require close and swift cooperation between field conservationists and captive breeding specialists, to make their efforts complementary and minimize the likelihood of the extinction of these taxa.

HOW: Captive populations need to be founded and managed according to sound scientific principles for the primary purpose of securing the survival of species through stable, self-sustaining captive populations. Stable captive populations preserve the options of reintroduction and/or supplementation of wild populations. A framework of international cooperation and coordination between captive breeding institutions holding species at risk must be based upon agreement to cooperatively manage such species for demographic security and genetic diversity. The IUCN/SSC Captive Breeding Specialist Group* is an appropriate advisory body concerning captive breeding science and resources.

Captive programmes involving species at risk should be conducted primarily for the benefit of the species and without commercial transactions. Acquisition of animals for such programmed should not encourage commercial ventures or trade. Whenever possible, captive programmed should be carried out in parallel with field studies and conservation efforts aimed at the species in its natural environment.

Notes:
Currently the *Conservation Breeding Specialist Group and the
** World Conservation Monitoring Centre

IUCN/SSC Guidelines For Re-Introductions

Prepared by the SSC Re-introduction Specialist Group *
Approved by the 41st Meeting of the IUCN Council, Gland Switzerland, May 1995

INTRODUCTION

These policy guidelines have been drafted by the Re-introduction Specialist Group of the IUCN's Species Survival Commission (1), in response to the increasing occurrence of re-introduction projects worldwide, and consequently, to the growing need for specific policy guidelines to help ensure that the re-introductions achieve their intended conservation benefit, and do not cause adverse side-effects of greater impact. Although IUCN developed a Position Statement on the Translocation of Living Organisms in 1987, more detailed guidelines were felt to be essential in providing more comprehensive coverage of the various factors involved in re-introduction exercises.

These guidelines are intended to act as a guide for procedures useful to re-introduction programmes and do not represent an inflexible code of conduct. Many of the points are more relevant to re-introductions using captive-bred individuals than to translocations of wild species. Others are especially relevant to globally endangered species with limited numbers of founders. Each re-introduction proposal should be rigorously reviewed on its individual merits. It should be noted that re-introduction is always a very lengthy, complex and expensive process.

Re-introductions or translocations of species for short-term, sporting or commercial purposes - where there is no intention to establish a viable population - are a different issue and beyond the scope of these guidelines. These include fishing and hunting activities.

This document has been written to encompass the full range of plant and animal taxa and is therefore general. It will be regularly revised. Handbooks for re-introducing individual groups of animals and plants will be developed in future.

CONTEXT

The increasing number of re-introductions and translocations led to the establishment of the IUCN/SSC Species Survival Commission's Re-introduction Specialist Group. A priority of the Group has been to update IUCN's 1987 Position Statement on the Translocation of Living Organisms, in consultation with IUCN's other commissions.

It is important that the Guidelines are implemented in the context of IUCN's broader policies pertaining to biodiversity conservation and sustainable management of natural resources. The philosophy for environmental conservation and management of IUCN and other conservation bodies is stated in key documents such as "Caring for the Earth" and "Global Biodiversity Strategy" which cover the broad themes of the need for approaches with community involvement and participation in sustainable natural resource conservation, an overall enhanced quality of human life and the need to conserve and, where necessary, restore ecosystems. With regards to the latter, the re-introduction of a species is one specific instance of restoration where, in general, only this species is missing. Full restoration of an array of plant and animal species has rarely been tried to date.

Restoration of single species of plants and animals is becoming more frequent around the world. Some succeed, many fail. As this form of ecological management is increasingly common, it is a priority for the Species Survival Commission's Re-introduction Specialist Group to develop guidelines so that re-introductions are both justifiable and likely to succeed, and that the conservation world can learn from each initiative, whether successful or not. It is hoped that these Guidelines, based on extensive review of case - histories and wide consultation across a range of disciplines will introduce more rigour into the concepts, design, feasibility and implementation of re-introductions despite the wide diversity of species and conditions involved.

Thus the priority has been to develop guidelines that are of direct, practical assistance to those planning, approving or carrying out re-introductions. The primary audience of these guidelines is, therefore, the practitioners (usually managers or scientists), rather than decision makers in governments. Guidelines directed towards the latter group would inevitably have to go into greater depth on legal and policy issues.

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1. DEFINITION OF TERMS

"Re-introduction": an attempt to establish a species(2) in an area which was once part of its historical range, but from which it has been extirpated or become extinct (3) ("Re-establishment" is a synonym, but implies that the re-introduction has been successful).

"Translocation": deliberate and mediated movement of wild individuals or populations from one part of their range to another.

"Re-inforcement/Supplementation": addition of individuals to an existing population of conspecifics.

"Conservation/Benign Introductions": an attempt to establish a species, for the purpose of conservation, outside its recorded distribution but within an appropriate habitat and eco-geographical area. This is a feasible conservation tool only when there is no remaining area left within a species' historic range.

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2. AIMS AND OBJECTIVES OF RE-INTRODUCTION

a. Aims:
The principle aim of any re-introduction should be to establish a viable, free-ranging population in the wild, of a species, subspecies or race, which has become globally or locally extinct, or extirpated, in the wild. It should be re-introduced within the species' former natural habitat and range and should require minimal long-term management.

b. Objectives:
The objectives of a re-introduction may include: to enhance the long-term survival of a species; to re-establish a keystone species (in the ecological or cultural sense) in an ecosystem; to maintain and/or restore natural biodiversity; to provide long-term economic benefits to the local and/or national economy; to promote conservation awareness; or a combination of these.

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3. MULTIDISCIPLINARY APPROACH

A re-introduction requires a multidisciplinary approach involving a team of persons drawn from a variety of backgrounds. As well as government personnel, they may include persons from governmental natural resource management agencies; non-governmental organisations; funding bodies; universities; veterinary institutions; zoos (and private animal breeders) and/or botanic gardens, with a full range of suitable expertise. Team leaders should be responsible for coordination between the various bodies and provision should be made for publicity and public education about the project.

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4. PRE-PROJECT ACTIVITIES

4a. BIOLOGICAL

(i) Feasibility study and background research

- An assessment should be made of the taxonomic status of individuals to be re-introduced. They should preferably be of the same subspecies or race as those which were extirpated, unless adequate numbers are not available. An investigation of historical information about the loss and fate of individuals from the re-introduction area, as well as molecular genetic studies, should be undertaken in case of doubt as to individuals' taxonomic status. A study of genetic variation within and between populations of this and related taxa can also be helpful. Special care is needed when the population has long been extinct.
- Detailed studies should be made of the status and biology of wild populations(if they exist) to determine the species' critical needs. For animals, this would include descriptions of habitat preferences, intraspecific variation and adaptations to local ecological conditions, social behaviour, group composition, home range size, shelter and food requirements, foraging and feeding behaviour, predators and diseases. For migratory species, studies should include the potential migratory areas. For plants, it would include biotic and abiotic habitat requirements, dispersal mechanisms, reproductive biology, symbiotic relationships (e.g. with mycorrhizae, pollinators), insect pests and diseases. Overall, a firm knowledge of the natural history of the species in question is crucial to the entire re-introduction scheme.
- The species, if any, that has filled the void created by the loss of the species concerned, should be determined; an understanding of the effect the re-introduced species will have on the ecosystem is important for ascertaining the success of the re-introduced population.
- The build-up of the released population should be modelled under various sets of conditions, in order to specify the optimal number and composition of individuals to be released per year and the numbers of years necessary to promote establishment of a viable population.
- A Population and Habitat Viability Analysis will aid in identifying significant environmental and population variables and assessing their potential interactions, which would guide long-term population management.

(ii) Previous Re-introductions

- Thorough research into previous re-introductions of the same or similar species and wide-ranging contacts with persons having relevant expertise should be conducted prior to and while developing re-introduction protocol.

(iii) Choice of release site and type

- Site should be within the historic range of the species. For an initial re-inforcement there should be few remnant wild individuals. For a re-introduction, there should be no remnant population to prevent disease spread, social disruption and introduction of alien genes. In some circumstances, a re-introduction or re-inforcement may have to be made into an area which is fenced or otherwise delimited, but it should be within the species' former natural habitat and range.
- A conservation/ benign introduction should be undertaken only as a last resort when no opportunities for re-introduction into the original site or range exist and only when a significant contribution to the conservation of the species will result.
- The re-introduction area should have assured, long-term protection (whether formal or otherwise).

(iv) Evaluation of re-introduction site

- Availability of suitable habitat: re-introductions should only take place where the habitat and landscape requirements of the species are satisfied, and likely to be sustained for the for-seeable future. The possibility of natural habitat change since extirpation must be considered. Likewise, a change in the legal/ political or cultural environment since species extirpation needs to be ascertained and evaluated as a possible constraint. The area should have sufficient carrying capacity to sustain growth of the re-introduced population and support a viable (self-sustaining) population in the long run.
- Identification and elimination, or reduction to a sufficient level, of previous causes of decline: could include disease; over-hunting; over-collection; pollution; poisoning; competition with or predation by introduced species; habitat loss; adverse effects of earlier research or management programmes; competition with domestic livestock, which may be seasonal. Where the release site has undergone substantial degradation caused by human activity, a habitat restoration programme should be initiated before the re-introduction is carried out.

(v) Availability of suitable release stock

- It is desirable that source animals come from wild populations. If there is a choice of wild populations to supply founder stock for translocation, the source population should ideally be closely related genetically to the original native stock and show similar ecological characteristics (morphology, physiology, behaviour, habitat preference) to the original sub-population.
- Removal of individuals for re-introduction must not endanger the captive stock population or the wild source population. Stock must be guaranteed available on a regular and predictable basis, meeting specifications of the project protocol.
- Individuals should only be removed from a wild population after the effects of translocation on the donor population have been assessed, and after it is guaranteed that these effects will not be negative.
- If captive or artificially propagated stock is to be used, it must be from a population which has been soundly managed both demographically and genetically, according to the principles of contemporary conservation biology.
- Re-introductions should not be carried out merely because captive stocks exist, nor solely as a means of disposing of surplus stock.
- Prospective release stock, including stock that is a gift between governments, must be subjected to a thorough veterinary screening process before shipment from original source. Any animals found to be infected or which test positive for non-endemic or contagious pathogens with a potential impact on population levels, must be removed from the consignment, and the uninfected, negative remainder must be placed in strict quarantine for a suitable period before retest. If clear after retesting, the animals may be placed for shipment.
- Since infection with serious disease can be acquired during shipment, especially if this is intercontinental, great care must be taken to minimize this risk.
- Stock must meet all health regulations prescribed by the veterinary authorities of the recipient country and adequate provisions must be made for quarantine if necessary.

(vi) Release of captive stock

- Most species of mammal and birds rely heavily on individual experience and learning as juveniles for their survival; they should be given the opportunity to acquire the necessary information to enable survival in the wild, through training in their captive environment; a captive bred individual's probability of survival should approximate that of a wild counterpart.

- Care should be taken to ensure that potentially dangerous captive bred animals (such as large carnivores or primates) are not so confident in the presence of humans that they might be a danger to local inhabitants and/or their livestock.

4b. SOCIO-ECONOMIC AND LEGAL REQUIREMENTS

- Re-introductions are generally long-term projects that require the commitment of long-term financial and political support.
- Socio-economic studies should be made to assess impacts, costs and benefits of the re-introduction programme to local human populations.
- A thorough assessment of attitudes of local people to the proposed project is necessary to ensure long term protection of the re-introduced population, especially if the cause of species' decline was due to human factors (e.g. over-hunting, over-collection, loss or alteration of habitat). The programme should be fully understood, accepted and supported by local communities.
- Where the security of the re-introduced population is at risk from human activities, measures should be taken to minimise these in the re-introduction area. If these measures are inadequate, the re-introduction should be abandoned or alternative release areas sought.
- The policy of the country to re-introductions and to the species concerned should be assessed. This might include checking existing provincial, national and international legislation and regulations, and provision of new measures and required permits as necessary.
- Re-introduction must take place with the full permission and involvement of all relevant government agencies of the recipient or host country. This is particularly important in re-introductions in border areas, or involving more than one state or when a re-introduced population can expand into other states, provinces or territories.
- If the species poses potential risk to life or property, these risks should be minimised and adequate provision made for compensation where necessary; where all other solutions fail, removal or destruction of the released individual should be considered. In the case of migratory/mobile species, provisions should be made for crossing of international/state boundaries.

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5. PLANNING, PREPARATION AND RELEASE STAGES

- Approval of relevant government agencies and land owners, and coordination with national and international conservation organizations.
- Construction of a multidisciplinary team with access to expert technical advice for all phases of the programme.
- Identification of short- and long-term success indicators and prediction of programme duration, in context of agreed aims and objectives.
- Securing adequate funding for all programme phases.
- Design of pre- and post- release monitoring programme so that each re-introduction is a carefully designed experiment, with the capability to test methodology with scientifically collected data.

Monitoring the health of individuals, as well as the survival, is important; intervention may be necessary if the situation proves unforseeably favourable.

- Appropriate health and genetic screening of release stock, including stock that is a gift between governments. Health screening of closely related species in the re-introduction area.
- If release stock is wild-caught, care must be taken to ensure that: a) the stock is free from infectious or contagious pathogens and parasites before shipment and b) the stock will not be exposed to vectors of disease agents which may be present at the release site (and absent at the source site) and to which it may have no acquired immunity.
- If vaccination prior to release, against local endemic or epidemic diseases of wild stock or domestic livestock at the release site, is deemed appropriate, this must be carried out during the "Preparation Stage" so as to allow sufficient time for the development of the required immunity.
- Appropriate veterinary or horticultural measures as required to ensure health of released stock throughout the programme. This is to include adequate quarantine arrangements, especially where founder stock travels far or crosses international boundaries to the release site.
- Development of transport plans for delivery of stock to the country and site of re-introduction, with special emphasis on ways to minimize stress on the individuals during transport.
- Determination of release strategy (acclimatization of release stock to release area; behavioural training - including hunting and feeding; group composition, number, release patterns and techniques; timing).
- Establishment of policies on interventions (see below).
- Development of conservation education for long-term support; professional training of individuals involved in the long-term programme; public relations through the mass media and in local community; involvement where possible of local people in the programme.
- The welfare of animals for release is of paramount concern through all these stages.

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6. POST-RELEASE ACTIVITIES

- Post release monitoring is required of all (or sample of) individuals. This most vital aspect may be by direct (e.g. tagging, telemetry) or indirect (e.g. spoor, informants) methods as suitable.
- Demographic, ecological and behavioural studies of released stock must be undertaken.
- Study of processes of long-term adaptation by individuals and the population.
- Collection and investigation of mortalities.
- Interventions (e.g. supplemental feeding; veterinary aid; horticultural aid) when necessary.
- Decisions for revision, rescheduling, or discontinuation of programme where necessary.
- Habitat protection or restoration to continue where necessary.
- Continuing public relations activities, including education and mass media coverage.
- Evaluation of cost-effectiveness and success of re- introduction techniques.
- Regular publications in scientific and popular literature.

Footnotes:

1. Guidelines for determining procedures for disposal of species confiscated in trade are being developed separately by IUCN.
2. The taxonomic unit referred to throughout the document is species; it may be a lower taxonomic unit (e.g. subspecies or race) as long as it can be unambiguously defined.
3. A taxon is extinct when there is no reasonable doubt that the last individual has died

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The IUCN/SSC Re-introduction Specialist Group

The IUCN/SSC Re-introduction Specialist Group (RSG) is a disciplinary group (as opposed to most SSC Specialist Groups which deal with single taxonomic groups), covering a wide range of plant and animal species. The RSG has an extensive international network, a re-introduction projects database and re-introduction library. The RSG publishes a bi-annual newsletter RE-INTRODUCTION NEWS.

If you are a re-introduction practitioner or interested in re-introductions please contact:

IUCN/SSC Re-introduction Specialist Group (RSG),
c/o African Wildlife Foundation (AWF),
P.O. Box 48177,
Nairobi,
Kenya.
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E-Mail: awf.nrb@tt.gn.apc.org

IUCN Policy Statement on Sustainable Use of Wild Living Resources
(2nd Draft -- 2 October, 1997)

1. The use of biological diversity is fundamental to the economy, culture and well being of all nations and people. People should seek to minimize losses of biological diversity when making decisions to use certain wild living resources. Use, if sustainable, can serve human needs on an ongoing basis while contributing to the conservation of biological diversity.

2. At its Session of the General Assembly (Perth, 1990) in Resolution 18.24, IUCN C The World Conservation Union recognized that the ethical, wise and sustainable use of some wildlife can provide an alternative or supplementary means of productive land-use, and can be consistent with and encourage conservation, where such use is in accordance with appropriate safeguards.

3. This position was re-affirmed in Resolution 19.54 at the following Session of the Union's General Assembly in 1994 and subsequently in Resolution 1.39 at the 1st meeting of the World Conservation Congress in 1996.

4. Analyses of uses of wild living resources in a number of different contexts demonstrate that there are many biological, social and economic factors, which combine in a variety of configurations to affect the likelihood that a use may be sustainable.

5. On the basis of these analyses, IUCN concludes that:
   a. The pursuit of sustainability is a process of continuous improvement in the management of wild living resources; and
   b. Adaptive management, which incorporates monitoring and the ability to modify management to take account of risk and uncertainty, will increase the likelihood that any use of a wild living resource will be sustainable.

6. Furthermore, consideration of the following is essential to achieve sustainability:
   a. The supply of biological products and services available for use is limited by the productivity and population fluctuations of species and the stability and resilience of ecosystems.
   b. Institutional structures of management and control require both positive incentives and negative sanctions, good governance and implementation at an appropriate scale. Such structures should include participation of relevant stake-holders and take account of land tenure, access rights, regulatory systems, traditional knowledge and customary law.
   c. Wild living resources have many values which can provide incentives for conservation. Where an economic value can be attached to a wild living resource, perverse incentives removed and costs and benefits internalized, favourable conditions can be created for investment in the conservation and the sustainable use of the resource, thus reducing the risk of resource degradation, depletion and habitat conversion.
   d. Levels and fluctuations of demand for wild living resources are affected by a complex array of social and economic factors, and are likely to increase in coming years. Thus attention to both demand and supply is necessary to ensure sustainability of uses.

7. IUCN is committed to enhancing the sustainability of uses of wild living resources and to this end it has established the Sustainable Use Initiative which incorporates regionally-structured Specialist Groups of the Species Survival Commission to:
   a. to identify, evaluate and promote the principles of management that contribute to sustainability and enhanced efficiency in the use of wild living resources; and
   b. to regularly communicate its findings to members and the broader community.