February 1991

THE QUABBIN RESERVATION WHITE-TAILED DEER IMPACT MANAGEMENT PLAN: A CASE HISTORY

James A. Parkhurst
Cooperative Extension, Department of Forestry and Wildlife Management, University of Massachusetts, Amherst, MA

Robert W. O'Connor
Director of Natural Resources, Metropolitan District Commission

THE QUABBIN RESERVATION WHITE-TAILED DEER IMPACT MANAGEMENT PLAN: A CASE HISTORY

JAMES A. PARKHURST, Cooperative Extension, Department of Forestry and Wildlife Management, University of Massachusetts, Amherst, MA 01003

ROBERT W. O'CONNOR, Director of Natural Resources, Metropolitan District Commission, 20 Somerset Street, Boston, MA 02108

Abstract: Quabbin Reservation, a 22,662-ha watershed management area located in west-central Massachusetts, is experiencing moderate to severe browsing pressure by white-tailed deer *(Odocoileus virginianus)* on much of the reservation's forested land. In many areas, park-like habitat exists where natural regeneration of the dominant mixed oak *(Quercus spp.)* forest has been severely repressed, or outright eliminated, due to repetitive browsing by deer. Understory composition is now dominated by patches of blueberry *(Vaccinium angustifolium),* huckleberry *(Gayl ussacia baccata),* thick carpets of hay-scented fern *(Dennstaedtia punctilobula),* and grasses. Managers are concerned that as the forest ages without replacement, and transition from forest cover to predominantly herbaceous covercontinues, thepotential of significant site disturbance from other natural causes (e.g., fire, wind throw, insect or disease outbreak) may accelerate this process. Because the reservation protects a major portion of the watershed for the 10,117-ha Quabbin Reservoir, loss of forest cover may potentially jeopardize the supply of potable water for the 2.4 million residents of metropolitan Boston and other eastern Massachusetts communities. A 3-year decision-making process that incorporated research studies, user-group workshops, and open public participation has produced a management plan that seeks to reduce the effects of deer browsing on natural regeneration, yet fulfills existing mandates that regulate use and protection of the reservation. Although this plan has yet to be implemented, it proposes the control of deer numbers, use of electric fencing, creation of a "nature preserve," and modification of existing forest management programs as means to re-establish natural regeneration and ensure protection of water and habitat quality.

Proc. East. Wildl. Damage Control Conf. 5:173-181. 1992.

As white-tailed deer numbers increase throughout many portions of theNortheast (Flygeretal.1983), damage caused by deer feeding is becoming a common dilemma faced by homeowners, agricultural producers, foresters, and wildlife managers. Although browsing damage occurs where deer herds are managed (i.e., exploited), damage often is most acute where deer populations are protected. Presently, many urban deer populations in the East are relatively free from predators (except dogs or coyote *[Cams latrans]),* their supply of food is plentiful, and as the amount of posted lands increases, ample suitable habitat remains. Thus, many factors that typically would "regulate" deer numbers are limited or lacking altogether.

To bring expanding, deer populations into balance with their habitats and to minimize the damage deer cause to property, many wildlife professionals recommend culling excess deer as one component of an integrated damage management program, and cite use of public hunts as economical and humane (Ellingwood and Caturano 1988). Numerous examples of herd reduction programs exist here in the East, some of which were quite successful in achieving stated objectives (e.g., Crane's Beach, Mass. [R. Deblinger, Trustees of Reservations, pers. commun.]; Cary Arboretum, N. Y.; Huntington Forest, N. Y.; Seneca Army Depot, N. Y. [Hesselton et al. 1965]) whereas success of others is open to debate (e.g., Yale Forest, Conn.; West Point Military Academy, N. Y.; Great Swamp National Wildlife Refuge, N. J.) (Metropolitan District Commission 1989). Many factors, such as hunter density, distribution, success, and attitude, weather conditions, and size of area involved, can influence significantly the outcome of such reduction programs. However, where proposed herd reduction objectives are clearly defined, detailed operational or logistic plans are formulated well in advance, and cooperation of all parties involved is attained, hunting programs have been an efficient and economical damage management technique.

Nevertheless, herd reduction programs consistently foster vocal, and often emotional, public discontent. Resource managers commonly face well-organized and well-financed opposition and disruptions to proposed hunts. To counter such disruptions, many states have filed or passed legislation protecting hunters' rights. Clearly, considerable disagreement remains over the need for, feasibility, humaneness, and economics of such deer control, and it is unlikely this debate will soon subside. However, to improve existing and proposed management programs, avoid potentially lengthy and costly (both economic and environmental) delays in implementing such programs, and enhance agency credibility, public involvement in management plan development and the decisionmaking process should be encouraged. By offering interested parties who hold differing viewpoints an opportunity to present their concerns and become participants in a structured process for shaping the final product, much potential antagonism can be mitigated. Yet, unsubstantiated claims and emotional public displays should not be allowed to deride or ignore hard scientific evidence and sound professional or technical experience.

Such was the situation faced by the managers of Quabbin Reservation in the late 1980s. The Commonwealth of Massa

chuseUs Metropolitan District Commission (MDC) personnel made the decision early on to actively solicit input from a variety of individuals and agencies with differing viewpoints to assist them in determining the scope of the problem, to identify the real causes) of the problem, and to develop potential, workable solutions. We provide a brief history of this issue and review the various steps in this plan formulation and decisionmaking process so it may serve as a potential model of conflict resolution for similar controversial, high-profile situations.

STUDY AREA

Quabbin Reservation is located in west-central Massachusetts (approximately 42° 23' N, 72° 18' W) in portions of the towns of Belchertown, Pelham, and Ware (Hampshire County); Barre, Hardwick, and Petersham (Worcester County); and New Salem, Wendell, and Shutesbury (Franklin County) (Fig. 1). The 32,780-ha reservation (10,117-ha reservoir, 22,662-ha land area), owned and managed by the MDC, is the largest tract of undeveloped public land in southern New England (Healy et al.1987). Defined in terms of mean basal area (%), Quabbin lands presently are dominated by mixed oaks *(Quercus spp.*, 27%) and white pine *(Pines strobes*, 27%). Other tree species include maple *(Acer* spp., 15%), hemlock *(Tsuga canadensis*, 8%), birch *(Betula* spp., 8%), red pine *(P. resinosa*, 8%), ash *(Fraxinus* spp., 3%), and other (4%) (B. Spence, Metropolitan Dist. Comm. forester, unpubl. 1991 forest inventory data). Wildlife species are typical of those endemic to the Northeastern mixed oak-hardwood ecosystem. Potential predators of deer on the reservation include domestic dog, coyote, and bobcat *(Fells rufus)* (Lyons and Rezendes 1988). Quabbin Reservation also was selected as the site for the Massachusetts bald eagle *(Haliaeetus leucocephal us)* restoration program, and from which at least 5 known nesting pairs have formed within the reservation (W. D. Davis, Mass. Div. Fish and Wildl., pers. commun.).

BACKGROUND HISTORY

Quabbin Reservation was established with the passage of the Swift River Act in 1927, which enabled the Metropolitan District Water Supply Commission (now the MDC) to purchase or take by eminent domain most lands within the Swift River Valley (Anon. 1990). Approximately 2,500 inhabitants of the Towns of Dana, Enfield, Greenwich, andPrescott were relocated from the valley between 1927 and 1938 (Conuel 1990). In preparation for reservoir development, all vegetation within and up to 3 m above the flood zone was cleared and removed. With completion of the Goodnough Dike in 1938 and the Winsor Dam in 1939, inundation of the valley began and Quabbin Reservoir first reached capacity during 1946.

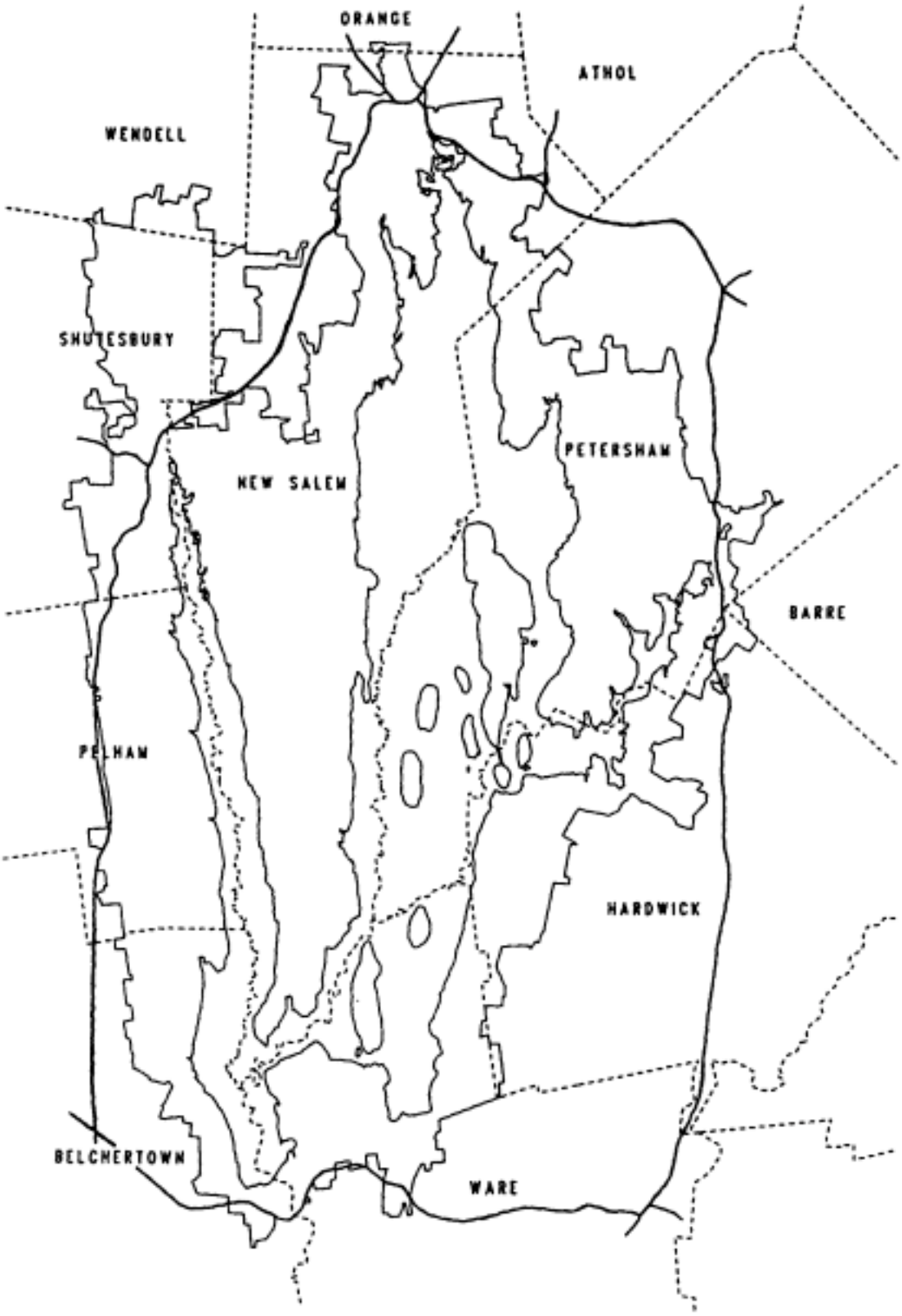
Although legislation was enacted in 1972 to prohibit hunting on most MDC Quabbin lands (Mass. Chapter 737, Acts of 1972), the MDC, by regulation, has not allowed hunting (except for 3,035 ha at the extreme northeastern edge of the watershed) or trapping since 1938. The 4,978-ha Prescott Peninsula, a 19.3 x 3.3-km, north-south oriented arm of land extending south into the reservoir (Fig. 2), was closed entirely to the general public in 1941. A heavy-duty chain-link fence constructed across the entire northern edge of the peninsula provided effective control over all access. In addition to the restrictions on hunting, other regulations have been promulgated to define and limit allowable activities within the reservation's boundaries (e.g., fishing by boat was first allowed in 1952; Mass. Chapter 737, Acts of 1972; Metropolitan Dist. Comm.'s 1988 Recreation and Public Access Plan). At the present time, only fishing, hiking, picknicking, and bicycling (in designated areas) are allowed.

By mandate (Mass. Chapter 372, Acts of 1984), the MDC is required to "utilize and conserve said water and other natural resources in order to protect, preserve, and enhance the environment of the Commonwealth and to assure the availability of pure water for future generations." Further, the MDC is required to periodically produce or revise watershed management plans that provide for "...forestry, water yield enhancement, and recreational activities" (Mass. Chapter 372, Acts of 1984). With regard to said forestry practices, the mandate is quite clear. "Lumbering or logging operations shall be permitted ...to the extent and for the purpose of maintaining and conserving its forests in a healthful state of natural ecological balance consistent with reservoir and watershed purposes..." (Mass. Chapter 737, Acts of 1972).

Thus, the MDC's objective for forest management on the Quabbin has been to maintain a healthy, resilient, and diversified forest cover. To accomplish this, silvicultural operations have been designed to improve tree vigor and quality while encouraging a diversity of age classes and species. During the early decades, this involved establishment of red pine plantations, creation of forest openings for wildlife habitat, and a variety of selective cuttings. By commercial standards, forest operations were low intensity, and cuttings were spread widely to avoid creating an anaesthetic appearance. Now, forest management focuses on: (1) improving stand composition (e.g., replacing upland species in moist sites, and shallowrootsd species in exposed stands); (2) strengthening red pine plantations and young hardwood stands susceptible to windthrow and fungus through thinnings; (3) improving stand health through salvage operations in areas of damage or decline from wind, insects, and possibly air pollution; and (4) diversifying composition of forest age classes through regeneration cuts (only in areas where deer browsing is low or hunting has been allowed) (Metropolitan Dist. Comm. 1991b, Appendix G).

THE PROBLEM

As early as 1947, reports of browse damage on the Quabbin arose, together with calls for a lottery hunt to reduce the size of the deer herd (McLaughlin 1947). It was unclear whether this damage existed or whether this was an attempt by local residents to regain access to former hunting grounds. However by 1950, deer were beginning to negatively affect natural regeneration, particularly onthePrescottPeninsula(Jones1950). Vegetation surveys revealed that 73% of the commercially important species, and 37% of all species, had suffered light-to-heavy



ıabbin Reservation and adjoining municipalities of central Massachusetts. Key: light dashed lines are town boundaries; d lines are
ɛservation boundaries; heavy solid lines are major improved roads.

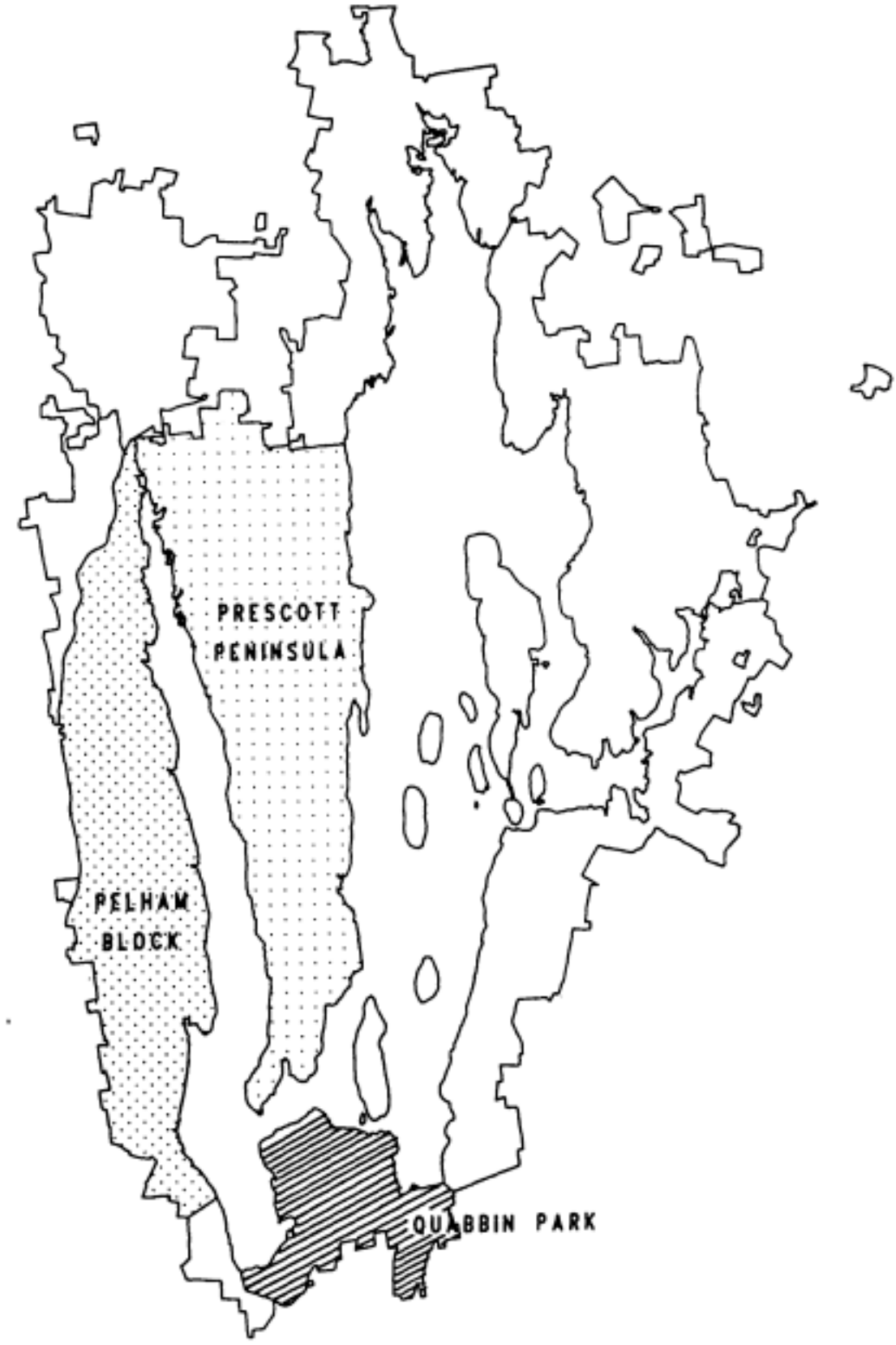


Fig. 2. Location of proposed deer browse management activities within the Quabbin Reservation, central Massachusetts. Key: Pelham Block -controlled public hunt; Prescott Peninsula - supervised small group hunt; Quabbin Park - electric fencing.

browsing damage from deer at an estimated density of 7-12 individuals/kmz (Jones 1950). Since then, deer density on the Quabbin has fluctuated, but remained high. Since 1983, it has ranged from 12-23 individualslkmz on Prescott Peninsula (W. M. Healy, U.S. For. Serv., pers. common.). During the early 1970s, MDC forest managers began to voice concern over the lack of regeneration and the unmistakable signs of browsing damage in certain areas of the reservation. By the late-1980s, MDC personnel estimated that 18,200 of the 22,660-ha land area within thereservation was moderately-to-severely browsed (Anon. 1989).

As the extent, severity, and potential consequences of browsing damage appeared to be increasing over significant areas of the reservation, a Natural Resource Management Review Panel, comprised primarily of wildlife and forestry professionals, was convened by the MDC in January 1988. Their task was to review, discuss, and evaluate, with regard to deer browse effects, the potential impacts of various management options upon the natural resources of the Quabbin. They also were asked to examine the practicality and benefit/cost ratio of each option. Options considered included vegetation management only, vegetation management with animal behavior modification (e.g., fencing, tree tubes), and vegetation management with animal population control. The panel's consensus was that a combination of forest management and deer herd control would produce the most resilient watershed forest and also increase both plant and wildlife diversity (Anon. 1989).

Concurrent with the Natural Resource Review Panel, the MDC had initiated an on-going, but separate, review and evaluation by 4 private consultants of MDC's Watershed Forest Management Plan for all MDC land holdings (including Quabbin). Although the intent of this review was to evaluate whether the plan would allow the MDC to satisfy stated goals consistent with existing legislative mandates (i.e., establish robust forest ecosystem, increase water yield, maintain and protect water quality, promote diverse wildlife habitat), the consultants clearly stated their concern that browse damage caused by excessive deer numbers was jeopardizing attainment of stated goals (Wallace, Floyd, Assoc., Inc. et al.1989). In fact, they recommended there was need of an immediate reduction and stabilization of the deer herd at Quabbin.

To assess whether browsing by deer was preventing the MDC from achieving its established standard of maintaining a forest cover consisting of a minimum of 20-81 maturing dominant and codominant trees/ha, the MDC began examining existing natural regeneration throughout the watershed during late 1988 and early 1989. In addition, this study comparatively examined regeneration on "unmanaged" (i.e., nonhunted) sections of the watershed and on "managed" (i.e., hunted) MDC lands just outside the reservation. Researchers concluded that adequate regeneration of seedlings (< 0.3 m) was occurring on all sites, but growth of stems > 0.3 m in height but < 2.5 cm dbh was significantlyrepressedinplotswheredeerwerenotmanaged (Kyker-Snowman 1989). In fact, 57% of the plots where deer were not managed had no regeneration >_ 0.3 m in height and 89% had none > 1.4 m in height. Significant differences were noted between managed and unmanaged plots in all regeneration height classes except that < 0.3 m. Furthermore, investigators feared that continued browsing by deer would lead to the decline of some species in the understory and may cause them to be eliminated as a component of the stand for at least 80-100 years.

Finally, a private consultant, contracted by the MDC, conducted an analysis of the effects on water quality of a continued transition from forest cover to predominantly herbaceous cover on the watershed. Carlton (1990) found a potential for increased erosion, nutrient leaching, and an overall decline in water quality as forest cover gradually was replaced by herbs, forbs, and scattered shrubs and trees.

THE PUBLIC PROCESS

Given the results of both their own in-house investigations and those provided by outside experts and consultants, MDC managers believed there was sufficient cause for concern to necessitate remedial action. During summer 1989, MDC managers agreed that the large deer herd represented a problem with regard to MDC mandates, and that herd reduction represented the most workable solution to the problem. However, because Quabbin is a public resource and has such a large user base, any decision regarding potential changes to management policies was likely to generate considerable debate and emotion. Therefore, a decision was made that the development of any new management policies for the Quabbin would be an open and public process. The goals of this process were to: (1) provide factual data about the problem at Quabbin to help educate the public; (2) generate potential alternatives that satisfy key interest group needs, yet solve existing problems; and (3) obtain assistance or cooperation to smoothly implement the final plan.

The Quabbin Watershed Advisory Committee (QWAC), comprised of 11 members representing diverse interests, had been established during 1985 (by Mass. Chapter 372, Acts of 1984) to provide guidance to the MDC on many issues relevant to the Quabbin (e.g., forest and recreation management plans). In early summer 1989, QWAC reached a consensus that the deer problem was preventing the MDC from satisfying existing mandates, thus this problem needed resolution. However, it was clear to MDC personnel that input beyond QWAC would be needed. Personnel from the Division of Watershed Management within the MDC began making informational presentations to various interest groups to apprise them of the situation and the potential consequences of continued browsing damage. Although, these meetings were helpful in bringing attention to the problem (Goal # 1), they provided little guidance to the MDC on how best to proceed.

During fall 1989, the MDC conducted an extensive review of the scientific literature regarding effects of browsing by deer

on forest ecosystems, control options available, and examples of previous deer herd reduction programs. Information obtained from this search and comparative details specific to the Quabbin were condensed and summarized in an educational report (Metropolitan Dist. Comm. 1989), organized in a question/answer format, which then was distributed to the public.

On 4 November 1989 and 2 June 1990, all-day, public workshops were held involving 35-40 individuals from invited interestgroups (resource managementandregulatory agencies, sporting groups, animal protection organizations, forestry groups, and environmental organizations) to review and define the problem, establish issues of concern, identify existing expertise, and discuss and formulate a workable plan to solve the regeneration situation. Discussions ranged from whether a problem truly existed to a thorough evaluation of available options of controlling deer damage (e.g., herd reduction, trap and relocate, fencing, chemosterilization, forestry practices). Obviously, with such a diverse range of opinion and personal or professional beliefs, considerable debate and disagreement arose. However, many useful comments and viewpoints that previously had not been considered were raised (Goal #2). Information collected at the first workshop was used to develop a draft deer management plan that then was debated and evaluated at the second workshop.

In the interim between workshop sessions, the Massachusetts Legislature conducted hearings on a bill submitted to enable control of deer at Quabbin. Legislation ultimately passed in December 1990 (Mass. Chapter 436, Act of 1990, to amend Chapter 737, Acts of 1972). The impetus for passage of this authority was initiated by sporting interests, not the MDC. Although this would have been a necessary step in the process to undertake a herd reduction program, it had not been decided at the time legislation was filed that the hunting option would be followed. Passage of this legislation contributed to the skepticism of those workshop participants opposed to hunting of the value of their input and made subsequent discussions somewhat more difficult.

Soon after the second workshop, and with a new working draft of the management plan, the MDC scheduled a series of educational forums (panels comprised of 7-8 speakers representing various interest groups and agencies) at 3 locations across the Commonwealth. Forums were advertised through public service announcements to television and radio stations and press releases to local newspapers. The purpose of these forums was to inform the general public and watershed users of the MDC's new management intention (i.e., manage the deer herd, correct existing regeneration problems), to answer questions about the draft plan, and to allow presentation of differing viewpoints. These were not public hearings in the typicalsense. Duringthequestionandanswerpenod,comments, public statements, or debate were discouraged. More than 600 individuals attended the 3 forums (31 July, 7 and 8 August 1990). Subsequent to additional amendments to the plan, 2 public hearings were held (13 and 14 May 1991), at which time individuals were allowed the opportunity to voice their cerns about or support for the plan. More than 300 individ attended these hearings and approximately 100 written sl ments commenting on the draft were received by the MIX final management plan was prepared (incorporating man; the comments received during the public process) and dist uted by mail during July 1990 to interested parties or m available to the public at MDC facilities. The plan descril below reflects the outcome ofthisfinalreviewprocess. Althot public input activities clearly helped improve the management strategy developed in the final plan, we do not yet know wheel its implementation will be improved via this process (Goal #:

THE PLAN

The Quabbin Reservation White-tailed Deer Impa Management Plan (Metropolitan Dist. COMM. 1991a) incom porates distinct components: (1) a controlled public hunt; (: small group supervised hunts; (3) electric fencing; and (4 modifications in existing forest and field management activi ties. Taken collectively, these proposed activities or modified cations in policy will directly affect about 65% of the reservation land area. Each of the plan's components is described in detail below.

Controlled Public Hunt

The MDC determined that a controlled public hunt would be the best option to achieve their stated goal-to reduce the size of the deer herd sufficiently over a large acreage so that regeneration will be assured (not to provide public access or recreational opportunity). Therefore, during fall 1991, 3,642 ha along the western shore of the reservoir (the Pelham Block, Fig. 2) will be opened to hunting to 900 individuals selected via lottery. The Pelham Block was selected because: (1) it is an area subject to heavy browsing pressure and low regeneration (< 405 seedlings/ha); (2) it is susceptible to wind (hurricane) damage due to the predominance of east-facing slopes; and (3) it has a well-established infrastructure (i.e,roads, trails) providing access to and control over a large area of the reservation. Three, 3-day, shotgun-only huntperiods (300 individuals/period) have been scheduled to coincide with the state's existing deer season. Participants will be assigned to 1 of 12 management compartments administratively subdividing the western edge of the reservation and issued an antlerless permit (in addition to the regular buck tag obtained with their hunting license). Because of concern about the extent of vehicular activity within the watershed, MDC personnel will provide bus transportation within the reservation for approximately 1/3 of the participants. Others either will walk to their designated area or be allowed to drive to the assigned area. All participants will be required to enter and exit at 1 of 6 designated check points. Individuals found within the reservation without proper check station verification (i.e., button or badge) will be removed and prosecuted.

In consultation with personnel of the Massachusetts Division of Fisheries and Wildlife, the MDC has determined that about 5 or 6 years will be necessary to reduce the herd to levels

consistent with regeneration needs (i.e., from the 1990 estimate of 17 deer/km2 in this area to approximately 4 deer/kmz). To accomplish this, an average annual reduction of approximately 25 % of the prehunt fall population will have to be removed each year. Annual examinations of harvest and forest regeneration data will be made to determine if harvest allocations are being reached or need adjustment. To determine whether adequate regeneration has been attained, 120 40-m2 plots (60 fenced, 60 unfenced) will be established throughout the 12 compartments and monitored for seedling growth and density. Adequate regeneration will have been attained when > 800 stems (1.4 m tall to 2.5 cm dbh) per ha are achieved and maintained and species composition is suitable for site conditions (approxi mately 20% hemlock, 20% pine, 20% oak, and 40% other species). After the 6-year program concludes, a detailed evaluation will be made of the controlled hunt to determine whether the plan's objectives were achieved and whether future treatments are required.

Small Group Supervised Hunt

By legal mandate and agency policy, Prescott Peninsula remains closed to the general public, and only environmental research and watershed management activities presently are allowed within its boundaries. Because of concern for the unique qualities of the Prescott, a public hunt was deemed incompatible with existing policies. However, because the Prescott suffers the most severe browsing damage within the reservation, the need for an effective solution was critical.

Having ruled out such options as electric fencing, open hunts, or use of sharpshooters for a variety of economic or logistic reasons, the MDC decided to employ small, supervised groups of hunters to cull deer on the Prescott beginning in the fall of 1992 (Fig. 2). Twelve, 3-day hunts incorporating a maximum of 40 participants/hunt will occurr over a 45-day period during October, November, and December. Individuals who were successful in taking > 1 deer during the previous year's controlled hunt will be given preference for participation. Hunting will concentrate on an individual management block (approximately 600 ha) until reduction goals are satisfied, at which time participants will be moved to the next block until the entire peninsula has been treated. Only traditional hunting methods will be used (i.e., shotgun only, no baiting or spot lighting). The goal of the supervised hunt is to reduce deer density to about 4 deer/kmz (i.e., same as the controlled hunt), but with a greatly reduced human presence. The supervised hunt program will be reviewed and evaluated in a manner similar to the controlled hunt after a 6-year trial period to assess its effectiveness and determine whether the program goal has been fulfilled.

Electric Fencing

Although use of electric fencing to exclude deer from critical habitats has inherent appeal as a nonlethal means of animal damage management, economic and logistic factors preclude its use over large undeveloped areas. Preliminary estimates developed to evaluate the feasibility of erecting and maintaining fencing on 14,570 ha of the reservation exceeded $3 million. However, because strong public opposition to the use of only lethal techniques was voiced, the MDC incorporated a fencing option in its plan primarily to determine whether fencing can provide effective browsing deterrence on large plots. Placement of fences will be dictated by: (1) MDC's ability to protect fences from vandalism; (2) existence of a road or trail system to provide access for construction and maintenance; and (3) visibility to the public to enhance education opportunities and to gain acceptance for its use.

As proposed, installation of fencing by private contractors will begin during spring 1992 on approximately 360 ha in Quabbin Park, an area of substantial deer browse damage adjacent to MDC's maintenance and police headquarters (Fig. 2). Because of heavy public use in this area (> 500,000 visits/ year), fencing was deemed more suitable than lethal methods. Initial estimates indicate this option will cost $90,000 for installation and$5-10,000/yearformaintenance. Within fenced areas exhibiting severe browsing damage, MDC personnel will plant seedling stock >_ 3 years old to supplement natural regeneration. After a 6-year trial period, a detailed evaluation of costs (materials and labor), maintenance requirements, and forest regeneration success will be made to determine if fencing achieved intended goals and has a potential usefulness for other areas of the reservation.

Forest and Field Management

To identify any possible means of reducing the effects of deer on regeneration, especially during the period of herd reduction, the MDC reviewed its forest management policies to revise or eliminate activities dependent upon achieving re-

During thecourseofpublicdebate,considerablediscussion and difference of opinion arose over the potential effect existing forest management activities had on causing or exacerbating the deer browsing problem. Over the past 25 years, the MDC conducted thinnings and cuttings on approximately 400 of its 22,662-ha holding each year. In addition, crews cleared 162 ha of deteriorating redpine plantations during the 1980s to increase water yields and diversify wildlife habitat. Many individuals and organizations opposed to herd reduction contended that forest cutting and field creation activities by the MDC stimulated production of new browse material and led to the expansion of the deer herd, thereby creating the regeneration problem. Others countered that there was no relationship between silvicultural operations and the regeneration/browsing problem. In areas of the reservation where food was likely a limiting factor (as opposed to hunting, predation, weather), deer ate all the growth of preferred species whether or not cutting occurred. In fact, field observations and regeneration data indicated that the effects of deer browsing were quite extensive over large areas of the reservation that have not received forest management activity (Kyker-Snowman 1989). In addition, it is evident from early research (e.g., Jones 1950) that a browsing damage problem existed prior to the commencement of MDC's forest management activities.

generation after silvicultural cuts. For example, any proposed large cuttings intended to produce new regeneration were put on hold both because they would produce additional food for deer during the period of herd reduction, and because regeneration would be impeded by browsing. Additionally, a 5-year moratorium was placed on all field creation and maintenance activities on the reservation. The agency will also increase the amount of its holdings set aside from forest management activities from 3,035 ha to 4,047 ha (i.e., "Lands of Special Concern," such as wetlands, steep slopes, unique natural areas, reservoir island, historic/prehistoric sites, habitat of rare/endangered species). This increase includes the establishment of the Pottapaug Natural Area, a 565-ha forest habitat that will be designated a nature preserve (Fig. 2). Further, within heavily browsed areas, there will be a 38% reduction in the area subject to cutting over the next 5-year period. Silvicultural efforts will be restricted primarily to thinning pine plantations susceptible to wind, ice, or disease losses, selective thinnings on the watershed to promote tree vigor and maintain species diversity, and limited regeneration cuts to diversify age classes in areas with minimal deer browsing activity. Finally, the MDC will continue its planting program by placing 20-30,000 seedlings/ year(primarily whitepine) on the reservation, but theseplantings will be restricted mostly to those areas where deer impacts are light, or where numbers of deer have been reduced. Small plot L 2 ha) site-enhancement (e.g., scarification, stand thinnings, fern control) trials, in conjunction with electric fence exclosures, also will be conducted on the Prescott.

The MDC forest management program underwent substantial revision as a result of the public process. This program now accentuates management of forests to maintain or improve water quality whereas, in the past, multiple use management had been emphasized. The final plan incorporates a research project to examine and document differences between areas subject to forest management versus those left unmanaged.

CONCLUSION

Obviously, not everyone can be satisfied with the results of public debate and due process (e.g., court decisions, elections, legislative action). Such is the case with MDC's Quabbin Deer Management Plan. . One would expect that virtually every possible concern relating to this issue would have been raised and discussed thoroughly at this juncture. Yet, even though opportunity has been provided over the past 3 years to various interest groups to present and substantiate their positions, individuals dissatisfied with the outcome most likely will continue to exercise their right to challenge the decisions made (e.g., a court injunction was filed on 20 August 1991 in U.S. District Court, Boston, to stop the fall 1991 hunt). However, the MDC's goals for the public input process were not to gain a unanimous concensusamongopposinginterestgroups. Rather, the goals were to help educate concerned individuals, generate alternative solutions that potentially may have been overlooked, and improve implementation of the chosen methods. In this regard, public input has helped mold a solution that is unique to Quabbin's needs and one that hopefully can be implemented successfully. The use of public input in a focused and goaloriented manner also may have improved the efficiency of the management planning process.

Because much of the process is still on-going, the success of many of its components cannot yet be gauged. At this time, only the benefits of public involvement in plan formulation can be assessed (i.e., by the number of issues that were raised or alternatives offered by the public that MDC personnel had not yet considered or deemed not to be a priority before public involvement). Whether implementation of the plan will be improved via the public process (Goal #3) or whether the selected options will fulfill expectations (Goal #2) have yet to be determined. However, because a preassessment of public knowledge and understanding about the Quabbin, deer control alternatives, and forestry practices was not made, it is unlikely the MDC will ever be able to ascertain the success of the education effort (Goal #1). Plans are being formulated to survey hunters following initiation of the control program, yet that target group may be the one least likely in need of education regarding the problem at Quabbin. MDC personnel have no way to assess, other than by subjective comment or impressions received, whether their educational programming influenced the decisions made, contributed to acceptance of the plan, or led to changesinthebeliefsoftheirconstituency. Additionally,the education process should not stop with plan implementation, but should be an on-going effort throughout the program. Even if the plan achieves biological success, there is no guarantee that the public will accept this plan as being a success. Should another important and potentially controversial issue arise at Quabbin, MDC personnel will not be able to establish which, if any, of the educational programs (e.g., slide shows, workshops) used during this deer issue process were successful and accomplished the desired intent. Thus, they may have missed a fruitful opportunity to conduct useful self-evaluation that could potentially improve the quality of future MDC programs.

LITERATURE CITED

Anonymous. 1989. Natural resource management review panel. Metropolitan Dist. Comm., Div. Watershed Manage., Boston, Mass. 44pp. + append.

. 1990. Quabbin facts and figures. Friends of Quabbin, Inc. and Metropolitan Dist. Comm., Div. Watershed Manage., Boston, Mass. 24pp.

Carlton, M. M. 1990. Literature review: water quality implications of converting forested watersheds to principally herbaceous cover-implicationstotheQuabbin Watershed. Metropolitan Dist. Comm., Boston, Mass. 44pp.

Conuel, T. 1990. Quabbin: The accidental wilderness. The Univ. Massachusetts Press, Inc., Amherst. 66pp.

Ellingwood, M. R., and S. L. Caturano. 1988. An evaluation of deer management options. Connecticut Dep. Environ. Prot., Wild]. Bur. Pub. DR-11. 12pp.

Flyger, V., D. L. Leedy, and T. M. Franklin. 1983. Wildlife damage control in eastern cities and suburbs. Proc. East. Wildl. Damage Control Conf. 1:27-32.

Healy, W. M., R. T. Brooks, and P. J. Lyons. 1987. Deer and forests on Boston's municipal watershed after 50 years as a wildlife sanctuary. Proc. Symp. on Deer, Forestry, and Agriculture: Interactions and strategies for management. Allegheny Soc. Am. Foresters. 21pp.

Hesselton, W. T., C. W. Severinghaus, and J. E. Tanck. 1965. Population dynamics of deer at the Seneca Army Depot. N. Y. Fish Game J. 12:17-30.

Jones, W. R. 1950. The deer herd of Prescott Peninsula, Quabbin Reservation, and its ecology. M.S. Thesis, Univ. Massachusetts, Amherst. 126pp.

Kyker-Snowman, T. 1989. 1989 Quabbin Forest regeneration study. Metropolitan Dist.Comm., Div. Watershed Manage., Boston, Mass. 35pp.

Lyons, P. J., and P. Rezendes. 1988. The ecology of eastern coyotes on Quabbin Reservation. Unpubl. rep., Metropolitan Dist. Comm., Div. Watershed Manage., Belchertown, Mass.

McLaughlin, C. L. 1947. Deer populations and damage to browse on the Quabbin Peninsula. Unpubl. manuscript, Wildl. Dep., Univ. Massachusetts, Amherst.

Metropolitan District Commission. 1989. Deer browse impacts on MDC Quabbin watershed lands: answers to commonly asked questions. Metropolitan Dist. Comm., Div. Watershed Manage., Boston, Mass. 108pp.

. 1991a. Quabbin Reservation white-tailed deer impact management plan. Metropolitan Dist. Comm., Div. Watertershed Manage., Boston, Mass. 44pp.

. 1991b. Quabbin Reservation white-tailed deer impact management plan: technical appendix. Metropolitan Dist. Comm., Div. Watershed Manage., Boston, Mass. 81pp.

Wallace, Floyd, Associates, Inc., Stone & Webster Engineering Corp., New England Research, Inc., and Normandeau Associates, Inc. 1989. Watershed forest management plan: a technical review. Unpubl. rep. submitted to Metropolitan Dist. Comm. 62pp. + append. (Available from: Metropolitan Dist. Comm., 20 Somerset St., Boston, MA 02108).