Department of Conservation and Recreation
Division of Water Supply Protection

Programs for Monitoring Natural Resources Management
July 2009

General Comments

There is a very wide variety of efforts underway on Division of Water Supply Protection (DWSP) lands to document the effectiveness of natural resources management in protecting the water supply, meeting management plan objectives for forest, wildlife, and biological diversity, and advancing the applied science of watershed forest management. The list below identifies some of these projects and gives a brief overview of methods and results and the application of these results in the implementation of watershed management.

Contact Information

While not all of these efforts include succinct reports, reports that do exist are available to the general public either on the Division's website (www.mass.gov/dcr/watersupply.htm) or by contacting the staff involved in their production. For Natural Resources Section reports, contact Dan Clark (Director, Natural Resources Section; 508-792-7806 x215), Ken MacKenzie (Wildlife Management; 508-792-7806 x313), or Thom Kyker-Snowman (Land Management; 413-323-6921 x551). For Forestry reports, contact Herm Eck (Chief Forester Quabbin and Ware River; 413-323-6921 x152) or Greg Buzzell (Chief Forester Wachusett and Sudbury; 508-792-7806 x317).

Programs

1. Annual Review of Proposed Silviculture

   For the past 15 years, DWSP has required the Forestry staff to prepare a detailed proposal for all silvicultural work to be conducted in the upcoming fiscal year. This includes describing the boundaries of the proposed lots, forest types within these lots, the condition of regeneration, wetland and other water resources, the presence of rare species, the proximity to the reservoir, details of known historic and prehistoric cultural resources, and a detailed description of the forest, the silvicultural objectives, and the harvesting proposed to meet these objectives. These proposals, with detailed GIS plots, are distributed to reviewers who assess the proposals against silvicultural and other constraints in the land management plan for the area, assess concerns regarding wildlife habitat or species, compare the area to locations of known populations of rare plant and animal species, check the road and staging areas for work needed prior to proceeding, and submit the area to the resident staff archaeologist for DCR to check for concerns about cultural resources. Proposals are either rejected, accepted as proposed, or accepted conditional on changes. These proposals are assembled in binders for each watershed and will be posted on the DWSP website for public review as they become available.

Department of Conservation and Recreation
251 Causeway Street, Suite 600
Boston MA 02114-2119
617-626-1250 617-626-1351 Fax
www.mass.gov/dcr

Deval L. Patrick
Governor

Timothy P. Murray
Lt. Governor

Ian A. Bowles, Secretary, Executive
Office of Energy & Environmental Affairs

Richard K. Sullivan, Jr., Commissioner
Department of Conservation & Recreation

2. Continuous Forest Inventory

In 1960, then Head Forester Fred Hunt established a system of more than 300 forest inventory plots on a ½ mile grid on the Quabbin watershed forest to track changes in species composition, growth, and mortality across that forest. These are 1/5 acre permanent plots, on which every tree is numbered, identified by species and vigor, and measured for diameter at breast height and total height. These and many other conditions at the plot have been remeasured every 5 or 10 years since they were established almost 50 years ago. The data are maintained in spreadsheet and database formats and are regularly consulted to determine relative abundance of major and minor tree species, the condition of regeneration and the sapling component of the forest, the availability of dead snags for wildlife support, and the growth in biomass or timber volumes, among other uses. A variety of internal and outside reports summarize these data, including an article in: Irland, L.C., A.E. Camp, J.C. Brissette, and Z.R. Donohew. 2006. Long-term Silvicultural and Ecological Studies; Results for Science and Management. Pg 74 "Quabbin Reservoir, MA: Monitoring watershed forests using CFI – 1960-2000", Yale University School of Forestry and Environmental Studies, Global Institute of Sustainable Forestry Research Paper 005. Summaries of the data from CFI are included in each Land Management Plan for the Quabbin and Ware River watersheds (see pages 57-63 of the 2007 Quabbin Land Management Plan: www.mass.gov/dcr/waterSupply/watershed/quablmp.htm).

3. Review by DCR Service Foresters and Final Harvesting Evaluation by DWSP

Chapter 132, the Forest Cutting Practices Act in Massachusetts, requires inspection and monitoring of timber sales that exceed minimum thresholds. This includes review and sign-off on Cutting Plans by DCR Bureau of Forestry Service Foresters. These plans describe in detail the type of harvest, its location, and proposed protection for associated resources like wetlands, streams, and rare species. Service Foresters review all DWSP harvesting lots and may provide additional requirements for protection above and beyond what is described in the plan. When wetlands are involved, Service Foresters monitor lots during their operation to assure Best Management Practices are being followed. At the conclusion of these timber sales, the Service Forester visits again to sign-off on the operation and either verify that the required practices were implemented or require that additional measures be taken to stabilize the roads or staging areas.

In addition to the involvement of the Service Foresters, DWSP Foresters visit and monitor these lots frequently, sometimes daily, depending on the pace of activity and the conditions on the ground. At the end of the operation, the DWSP Forester in charge completes a final Harvesting Evaluation, which evaluates the operator's completion of DWSP requirements regarding water quality, harvesting, and general conditions of the permit. The operator must meet these requirements to the Forester's satisfaction in order to recover the Performance Bond posted at the beginning of the lot. Cutting Plans with Service Forester reviews as well as final Harvesting Evaluations are available to the public on request from the Forester in charge of each operation.

4. Regeneration Surveys
   Foresters in the DWSP have been collecting data on regeneration conditions since the 1960s, when Fred Hunt included basic regeneration information in his initial management plan for the Quabbin Reservoir watershed forests. More intensive surveys began in the late 1980s, when the agency began to prepare for initiating the first deliberate management of deer impacts at Quabbin in 50 years, in response primarily to decline of the forest's ability to regenerate. Surveys in the 1990s were two-stage cluster samples with uneven clusters; basically transects were randomly located and plots systematically placed along these transects in a manner that achieved acceptably small standard errors from 2-3,000 plots (each plot was 1/1,000 of an acre). During the same time period, regeneration was monitored in paired plots, one of which was fenced to keep out deer while the other was left unprotected. As regeneration began to recover quite aggressively, surveys for regeneration were reduced in frequency and intensity, and are currently conducted primarily in areas that were harvested within the past 3-7 years, in order to verify the regeneration response in deliberately created openings. Regeneration sampling is also a component of CFI remeasurement. In addition to annual reports on regeneration progress, the reports available that summarize these data include the "Quabbin Regeneration, Summary Report, 1988-1997" and the "2004 Quabbin Regeneration Report", which summarizes regeneration surveys from 1988 through 2004.

5. Browsing Surveys
   While regeneration reports provide information on the current conditions of the understory, they do not document sources of impact on these conditions. To provide this information, DWSP has conducted surveys using standard methods to assess browsing damage to hardwood sprout clumps, the most preferred browse. These surveys have produced a widely variable picture of conditions, recently made more variable by the influence of the growing moose population. Individual internal reports summarize results for the years in which these surveys were conducted, including 1998, 1999, 2000, 2004, and 2005.

6. Annual Quabbin Reservation White-tailed Deer Impact Management Program Report (1995 - 2008)
   These reports detail the condition of the white-tailed deer population at Quabbin, using a back-modeling technique that estimates the current size of the population based on the number of deer taken in the annual controlled public hunt and typical hunter success rates. These results are broken down by management block (Pelham, New Salem, Prescott, Petersham, and Hardwick). These reports also summarize the results of hunter surveys, program status, and proposals for the coming year. Copies are available on request by contacting the Director of Natural Resources.

7. Moose Sign Survey: Ware River; Annual reports: 2002-2008
   Moose began to appear on the DWSP watersheds in the late 1990s. Censusing these animals is difficult, but efforts are ongoing to track their sign, including scat, some components of their browsing habits, and bark stripping. In addition to these data on moose sign, hunters at Quabbin have been surveyed to identify and map sightings of moose during the annual Quabbin deer hunt. The results of these surveys provide one

method for estimating the population. Together, these reports provide evidence of the advancing size of the population, which is estimated to be as many as 100 animals at present and of increasing concern due to the impact of moose on the regeneration potential o f the watershed forests. Copies of the reports can be requested through the DWSP Natural Resources Section.

8. Reports on Moose and Deer Exclosure Experiments Conducted by MA Cooperative Fish and Wildlife Research Unit
   These experiments, established in 2007-2008, involve the placement of exclosures that a) prevent all browsers or b) prevent moose but allow deer, as well as unfenced controls that do not prevent browsing. Regeneration is closely monitored within and adjacent to these exclosures, which are established at Quabbin and Ware River. Details of these studies may be obtained by contacting the MA Cooperative Fish and Wildlife Research Unit at the University of Massachusetts.

9. Rare Plant Surveys 1995, 1996, and Ongoing Monitoring
   DWSP contracted with the University of Massachusetts Herbarium in 1995 to develop a list of rare plants likely to be found at Quabbin and information to guide searches toward their most likely habitats, and to survey for rare plant populations in areas proposed for active silvicultural operations on the Quabbin watershed. As part of that survey, a complete master list of plant species present was developed for the areas surveyed. Four new populations of rare plants were located. This process was funded again in 1996 and expanded to cover sites within the Ware River and Wachusett Reservoir watersheds. Master plant lists were developed for each of these watersheds, and three additional rare plant populations were located and described. The master lists are included within the Land Management Plans for each watershed, available on line at: www.mass.gov/dcr/watersupply/watershed/dwmplans.htm. Copies of the full reports from 1995 and 1996 are available on request from the DWSP Natural Resources Section. In addition to these reports, Natural Resources staff monitor known populations of rare plants annually and provide reports on the conditions of these populations to the Natural Heritage and Endangered Species Program and the New England Plant Conservation Program of the New England Wild Flower Society.

10. Rare, Unique, and Exemplary Natural Communities at Quabbin, 2000
    In response to requirements of the Green Certification process, the DWSP hired University of Massachusetts faculty in the late 1990s to identify, classify, and describe the rare, unique, and exemplary natural communities in the Quabbin watershed area and to provide recommendations for their management. Associate Professor Kevin McGarigal oversaw the field research and produced the final report on findings in 2000. This report provides guidance on identification, delineation, and management of the rare natural communities present on the Quabbin watershed and describes in detail examples of each community type identified. Digital copies of this report are available on-line at www.mass.gov/dcr/watersupply/watershed/documents/quabbinnaturalcommunities.pdf

11. Reports on Terrestrial Invasive Plant Species on DWSP Properties
    The increasing problems associated with exotic species arriving on the watersheds, and in particular non-native invasive terrestrial plants, has been a topic of discussion for the past two decades. DWSP Natural Resources staff have served on the Massachusetts Invasive Plants Advisory Group (www.massnrc.org/MIPAG/) and received training in identification and control of these species. During the summers of 2007, 2008, and 2009, a seasonal crew was hired by the agency to work on mapping and control efforts for invasive plant populations throughout the Quabbin watershed. The findings of these crews, in the form of spatial and descriptive data, as well as estimates of cost for control techniques, are currently being incorporated in a draft Terrestrial Invasive Plants Management Strategy for DWSP Watersheds. Once this document is completed, it will be made available either online or by contacting the Natural Resources Section.

12. Hydrologic and Water Quality Responses to Natural and Deliberate Disturbances
    While routine water quality monitoring throughout the DWSP reservoir system has never detected degradation related to active forest management activities, the Natural Resources Section, in 1999, initiated a long-term research effort to more directly monitor water quality and water quantity effects of both natural and deliberate disturbances on Quabbin subwatersheds. V-notch weirs have been installed on four first-order tributaries to monitor background and storm event yield and both automated and grab sample water quality data. The initial calibration stage has produced a large volume of data that is currently being processed. As funding and staffing allows, the management test site will be treated and monitored for results relative to calibrated background levels of seasonal yield and standard water quality parameters (turbidity, conductivity, pH, nitrogen, phosphorus, and suspended solids). Results will be reported as they become available; Natural Resources staff can respond to general inquiries about this effort.

13. Long-Term Ecological Monitoring Program (with UMass)
    On September 21, 2006, EOEEA announced the creation of approximately 50,000 acres of "Reserve" lands amongst the public forests of Massachusetts, following a detailed process working with The Nature Conservancy to identify the best areas amongst 23 candidates, 5 public hearings, consultation with town boards, and briefings of state agency managers. These reserves were established in part to provide unmanaged control areas for comparison of ecological differences with areas that are under active forest management. To document these differences, the state land management agencies contracted with the University of Massachusetts Department of Natural Resources Conservation to design and conduct a long-term ecological monitoring program based on fixed survey plots within reserves and companion managed areas. This program proceeded through initial design and testing phases, and will continue indefinitely, pending funding. For a current update and summary of findings, contact DWSP Natural Resources staff.

14. Land Management Plans
    Detailed 10-year land management plans are available online for each of the DWSP watersheds. These plans include background on the current status of the natural and cultural resources within these properties, as well as principles, objectives and programs

for management, including a wide range of existing and proposed general monitoring of these programs. Plans currently available online include:

a. Quabbin Land Management Plan 2007-2017
   www.mass.gov/dcr/watersupply/watershed/quablmp.htm
b. Ware River Land Management Plan 2003-2012
   www.mass.gov/dcr/watersupply/watershed/warelmp.htm
c. Wachusett Land Management Plan 2001-2010
   www.mass.gov/dcr/watersupply/watershed/wachlmp.htm
d. Sudbury Land Management Plan 2004-2013
   www.mass.gov/dcr/watersupply/watershed/sudburylmp.htm

15. Aquatic Wildlife Pathogen Control Zone

This 1999 document provides background information on the impact of aquatic wildlife (specifically muskrat and beaver) on water quality in Quabbin and Wachusett Reservoirs. The document outlines methods for surveying and controlling these species in defined control zones centered on the intake structures at each reservoir. A special year-round permit was granted by MassWildlife for the removal of these species within the control zone. The document is available on request from Natural Resources.

16. Annual Canada Goose Population Control Program Report

Resident Canada goose populations at all three water supply reservoirs can have an impact on water quality. In response to these populations, the Division annually locates all nesting geese on each reservoir. Eggs in each located nest are then treated to prevent hatching. The annual reports summarize treatment efforts each year. Reports available from Natural Resources wildlife staff include:

a. Sudbury Reservoir: 2006-2009
b. Wachusett Reservoir: 1996-2009
c. Quabbin Reservoir: 1998-2009

17. Long-term Wildlife Resource Monitoring Program

The Natural Resources Section established a long-term wildlife monitoring program at Wachusett Reservoir in 2001 on 30 permanent plots. At each plot, small mammal populations, reptiles and amphibians, and birds are surveyed. These data provide long-term data on changes in population and also provide insight into how animals respond to forest management. Information on this program is available by contacting the Director of Natural Resources.

18. Research on Regional Movements, Feeding Behavior, and Roosting Patterns of Ring-billed, Herring, and Great Black-back Gulls Utilizing Wachusett and Quabbin Reservoirs, Massachusetts

Gull populations in central Massachusetts have a documented effect on water quality at each reservoir. Research on these species began in 2008 through capture and marking of individual gulls to track movements and behavior. In addition, satellite transmitters were deployed on a small number of gulls. Progress reports are available for 2008 & 2009 by contacting Natural Resources.

19. Vernal Pool Monitoring

    There are several hundred "potential" vernal pools throughout the watersheds that were identified through aerial infra-red photography. Each spring, a sample of these pools are visited to verify their existence, and whether they are functioning as vernal pools that support breeding amphibians. A detailed database is kept for each pool. Reports available through Natural Resources include Access database files and a GIS layer/shapefile for each watershed.

20. Quabbin Roadside Breeding Bird Surveys

    Two permanent roadside breeding bird transects were established in the 1980s to track changes in migratory song bird populations on the Quabbin watershed. Annual surveys are conducted at permanent points spaced ½ mile apart on the road transect. Reports available from Natural Resources wildlife staff include Excel spreadsheets for 1988-2008.

21. Quabbin Deer Hunters Moose Survey

    An increasing moose population on the Quabbin watershed prompted the Natural Resources Section to develop ways to monitor their presence. In 2006, Quabbin deer hunters were asked to watch for moose during the deer hunt and report sightings to biologists as they left. Locations are carefully mapped and then analyzed to determine a minimum population estimate each year. GIS layers and summaries are available from Natural Resources wildlife staff for 2006-2008.

22. Prescott Peninsula Quabbin Reservoir Beaver Survey

    Prescott Peninsula has been closed to public trapping since the 1940s. In the late 1970s, graduate work on beaver led to an annual survey of the status of the Prescott beaver populations. These surveys have been done yearly, with few exceptions, since 1970. Each year, the whole peninsula (shoreline and interior) is walked to document active beaver colonies. Detailed locations are collected and information on the food cache and active maintenance of dams and/or lodges is noted. Annual reports for 1999 through 2008, as well as raw data for 1970 through 2008 are available by contacting the Director of Natural Resources.