Androscoggin Lake and Dead River Wetland Resources and Fisheries Habitat Assessment Leeds and Wayne, Maine Draft Report

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1.0 INTRODUCTION

Androscoggin Lake (Lake) is located in the towns of Leeds and Wayne (Towns) in Androscoggin and Kennebec Counties, Maine (Figure 1). The Lake is connected to the Androscoggin River (River) via the Dead River. Because the Lake is only 5 feet higher in elevation than the River (269 versus 265 MSL), a reversal of flow from the River into the Lake can occur during flood events. By the 1930s, the River was polluted with untreated sewage, by-products from paper mills, and other waste products. In 1933, the State of Maine (State) constructed a dam on the Dead River to reduce the frequency of flooding and the amount of contaminants entering the Lake during reverse flow events. When originally constructed, the dam was thought to have a crest height of 274 feet (MSL). To increase the height of the dam and thereby increase its effectiveness at reducing flooding, 4-foot flashboards were installed on top of the dam. In 1936, a large flood event ripped out the 4-foot flashboards, which were subsequently replaced with 2-foot flashboards. The dam, with these 2-foot flashboards, was regularly overtopped during high flow events, and the flashboards were periodically ripped out by debris during flooding. In response to this continued flooding, the 2-foot flashboards were replaced by a combination of 3.0- and 3.5-foot flashboards in December of 2002. Continued concerns regarding the water quality of the Lake prompted the State and the Towns to evaluate the effectiveness of the current dam and dam management program at reducing the inflow of contaminants into the Lake.

Dead River Dam with 2-foot flashboards.

Several options are currently being studied, including dam removal, maintenance of the existing dam with flashboards, and construction of a new taller dam at a different location along the Dead River. Commensurate with the evaluation of these options, the State and Towns are reviewing the potential impacts on the ecosystem of the Lake and the portion of the Dead River upstream of the dam that might result from changing the flooding regime of this system. To assist the State and Towns with evaluating the likely effects of these potential changes, Woodlot Alternatives, Inc. (Woodlot) conducted a characterization of existing conditions within this ecosystem and developed a projection of possible changes to aquatic/wetland communities and fisheries habitat. Four scenarios were assessed as part of this investigation: No Dam, Existing Dam (without flashboards), Existing Dam With Flashboards (with a combination of 3.0- and 3.5-foot flashboards), and a New Dam (with a crest elevation of 282 feet).

2.0 METHODS

To assess how the proposed dam configurations might affect aquatic/wetland communities and fisheries habitat, Woodlot conducted a literature review and visited the Lake and Dead River to characterize existing conditions. We reviewed several documents related to previous studies of the Lake and numerous papers that discuss the effect of water level and flooding on aquatic/wetland communities. Studies of the Lake include two reports on water quality (MDEP 2001 and 2002), one report on the minimization of flood flows to the Lake from the River (E/PRO 2002), and one report on fishery management (McNeish and Woodard 1994). These reports formed the basis of our analysis of existing and projected conditions on the Lake with the various dam configurations. A review of research papers related to flooding and wetland communities provided a means to project how aquatic/wetland communities and fisheries habitat might change under different flooding regimes.

Scrub-shrub/emergent wetland on the Dead River Delta.

Woodlot conducted site visits to the Lake and Dead River on September 5 and 6, 2002. Prior to the first site visit, an ortho-corrected and georeferenced[1] aerial photograph of the Lake and surrounding area was obtained from the Maine Office of Geographic Information System web site (http://apollo.ogis.state.me.us). A digital image of wetlands as mapped by the US Fish and Wildlife Service (USFWS) as part of the National Wetland Inventory (NWI) was then overlaid on this aerial photograph. The NWI maps were generated by the USFWS using stereoscopic pairs of aerial photographs to determine the apparent location of wetland communities. Although a useful tool, the NWI maps typically were not verified by site visits to the mapped areas. As a result, during the creation of these maps, some wetland areas were missed and other areas misidentified. Nonetheless, these maps

[1] Ortho-corrected refers to photos that have been corrected for distortion in satellite images caused by uneven terrain. Georeferenced means that coordinates from a known reference system have been assigned to the photo.

provided Woodlot with an initial base map of wetland locations and community types that were then verified during our field observations

Fieldwork began with a flight over the Lake, which allowed an initial opportunity to check the accuracy of the NWI data and to photograph the study area from the air. A Cessna airplane from Twitchell's Airport in Turner was used for the flight. Throughout the course of the flight, the airplane flew at between 500 and 1200 (+/-) feet above the surface of the Lake and adjacent terrain. Changes to the base map were made by sketching unmapped communities on the aerial photograph or modifying mapped communities based on field observations. The remaining time in the field was spent boating around the Lake to further refine the map, to develop a list of plant species within the various wetland and aquatic communities, and to photograph these different communities. Information on the types of plant communities and the various species comprising these communities allowed an estimation to be made as to how communities might change in response to various flooding regimes. This information also indicated the areas of available fisheries and wildlife habitat.

Aquatic beds and wetland communities on Androscoggin Lake.

Woodlot collected elevation data from different locations around the Lake, which were then used to estimate when various plant communities might be inundated during different flood events. Elevation data were collected using traditional survey equipment (i.e., auto-level, rod, and tape). One transect was run across a part of the Lake known as the Delta. This transect extended from the Dead River across a variety of wetland communities to the Lake. Spot elevation data also were collected near the mouth of the Dead River and on the southwestern shore of the Lake. An estimation of the water level at the time of the fieldwork was determined by two means. First, the water level was measured at the upstream side of the Dead River Dam (Dam) and an elevation was calculated in relation to the assumed height of the Dam. Second, a water level gauge that is maintained by the US Geological Service (USGS) provided an approximate water elevation for this time period. This water level gauge is located near the Route 106 bridge over the Dead River in Leeds. According to the USGS, the water elevation at these two locations should be essentially the same (USGS 2002). Woodlot, however, found a 1.44-foot difference between water elevation measured at these two locations. After a series of inquires, Woodlot determined that the assumed elevation of the Dam might be in error, which would affect calculation of water level. At the direction of Mr. Mark Margerum of the Maine Department of Environmental Protection (MDEP), Woodlot conducted a spot elevation measurement of the Dam crest using a USGS benchmark on the Route 219 bridge over the Dead River as a reference point. This measurement indicated that the Dam crest was 275.23 feet rather than the assumed 274 feet. In order to confirm this elevation, members of the USGS measured the elevation of the Dam and determined that the crest is 275.3 feet (MSL). Because of the intricate nature that the height of the Dam plays in the hydrologic modeling study conducted by E/PRO Engineering and Environmental Consulting, LLC and Northstar Hydro (hereafter referred to as E/PRO), these models had to be revised before Woodlot's final analysis could be completed. Once these models were revised, Woodlot performed a limited stage-duration analysis based on the E/PRO model. This analysis provided a prediction of the number of days in a typical year that water levels would occur at specific elevations.

During our September field visits, Woodlot also conducted a cursory survey for rare plants reported to occur in and around the Lake. Because of the limited scope of this project, this survey primarily focused on three species: cat-tail sedge (*Carex typhina*) and two dwarf-bulrushes (*Fimbristylis autumnalis* and *Lipocarpha micrantha*). When individuals and/or clusters of these species were observed, a Trimble™ Pro-XR Global Positioning System[2] was used to record their locations.

Cat-tail sedge (*Carex typhina*).

Once fieldwork was completed, changes to the base map were sketched onto a single aerial photograph and then digitized. This modified image was imported into AutoCAD, where the acreage of each type of aquatic and wetland community was calculated. In addition, the location of the rare plants was plotted on this revised base map. A matrix was developed based on a review of the literature and on field observations of fish and wildlife species known or suspected to occur in and around the Lake. Because of the limited scope of this project, only a representative number of species were included in this matrix. The matrix includes information on habitat requirements of the species, which could be related back to

[2] This system is accurate to 3 – 5 feet.

available habitat depicted on the base map, and proposed changes in habitat from flooding due to differing dam heights.

3.0 RESULTS

3.1 Flood Data

The MDEP conducted an analysis of data available from 1950 to 1999 to predict the estimated water loading to the Lake from the River during individual reverse flow events (see MDEP 2003). These predictions were applied to each of the four proposed scenarios. As would be expected, the No Dam scenario predicted the highest number of individual flood events and the New Dam scenario the fewest events. Similarly, the stage-duration analysis conducted by Woodlot indicates that the most days of annual inundation will occur under the No Dam scenario and the fewest days under the New Dam option. For example, the stage-duration analysis predicts an average of four days during a typical year when the water level will reach an elevation of 272 feet with No Dam versus less then a day during which the water will reach this elevation with the New Dam (Table 1). Based on the estimated water loading predictions developed by MDEP, the highest percentage of these events regardless of the scenario occurs during the spring (i.e., March through May). For this part of Maine, this period represents the time prior to, or at the beginning of, the growing season, which generally extends from April 15 through October 15 (Tiner 1994). A second, smaller spike of flooding occurs during the fall and early winter (i.e., October though December). These later season flood events represent approximately 25 percent of the total flood events for an average year.

Dead River Delta.

Using the predictive model developed by E/PRO, the following is a summary of the effects expected with the four scenarios.

- No Dam and Existing Dam scenarios yield relatively similar results under the six different flooding frequencies analyzed.

- No Dam and Existing Dam scenarios both result in some level of flooding for each of the flooding frequencies.
- The magnitude of flooding is greater with the No Dam scenario than the Existing Dam option, resulting in higher water levels in the Lake.
- With No Dam it takes longer for the Lake to return to a pre-flood elevation during all but the 10-year and 25-year events. For example, during a 1-year flood event, with No Dam the Lake will reach an elevation of 247.5 feet and take five (5) days to return to pre-flood conditions, whereas with the Existing Dam the Lake will reach an elevation of 272.4 feet and will return to pre-flood conditions in two (2) days.
- The Existing Dam With Flashboards should prevent the <1-year events and the 1-year events and should allow only minor flooding during a 2-year event.
- The New Dam will prevent all but the 10- and 25-year events.
- The Existing Dam With Flashboards and the New Dam will both reduce the magnitude of flooding when compared to the first two scenarios and, in general, will allow the Lake to return to pre-flood elevations more quickly.
- Of the different magnitude flood events, it will be the more frequent events (i.e., <1-year, 1-year) that will influence the formation and changes in wetland and aquatic plant communities, because they influence the annual growing season hydrology of these plant communities. This will also be true for long-term stability of fisheries and wildlife populations.

3.2 Plant Community Data

Using an integration of NWI data and field observations, wetland communities in proximal association with the Lake or the Dead River were identified on a map depicting existing conditions (Figure 2). These wetland communities were typically located within 2,400 feet of the shoreline of the Lake or Dead River, and were either directly connected or connected via other wetlands to one of these waterbodies. Six wetland and aquatic community types were identified through this process and are described below. Areas with depths greater than 6.6 feet are classified as lacustrine open water and were not addressed during this study.

- The lacustrine aquatic bed includes those species that grow completely below the surface of the water (e.g., common waterweed [*Elodea canadensis*]), or originate below the surface of the water, but have leaves that float on the surface (e.g., yellow water-lily [*Nuphar variegata*]).

- The lacustrine emergent community is dominated by erect rooted plants such as pickerelweed (*Pontederia cordata*) that die back below the surface of the water in the fall, so that during the winter and early spring, there are no signs of vegetation.
- The palustrine open water community includes small, shallow, permanent or intermittent bodies of water often referred to as ponds.
- The palustrine emergent community is dominated by herbaceous vegetation such as grasses and sedges that remain visible following senescence.
- The scrub-shrub community is dominated by woody vegetation including young trees that are less than 20 feet tall.
- Forested communities are dominated by woody vegetation that is 20 feet tall or taller.

Table 4 shows the existing acreage of each wetland and aquatic community identified in association with the Lake.

The two lacustrine community types are most directly associated with the Lake. These communities were not identified in the NWI data because the NWI analysis is based upon spring photographs. During the spring, many of the plants within these lake communities are obscured by high water, or the plants have not emerged and are therefore not identified. The palustrine communities are those communities that are affected by flooding of the Lake and the Dead River, as well as by other sources of hydrology such as groundwater and precipitation. The degree of flooding and/or the duration of high groundwater level influence the location of these different palustrine communities. The typical pattern of shoreline vegetation that results from this influence is the development of emergent communities in the areas of longest inundation, followed by scrub-shrub communities, and ending with forested wetlands at the upper edge of flood limits. The open water wetlands within the area influenced by flooding tend to be a reflection of topography rather than the duration or frequency of inundation. Floodwater trapped in topographic depressions does not recede following a flood event, but remains until the water either evaporates or percolates into the soil.

Within each class of palustrine community (e.g., scrub-shrub), there are different subclasses based on the dominant vegetation. For example, a forested community can be dominated by hardwood species such as red maple (*Acer rubrum*) or by softwood species such as black spruce (*Picea mariana*). In addition, there are different hydrologic regimes that reflect how often or how long an area is flooded, or the duration of soil saturation. These hydrologic regimes influence the type of vegetation community that develops. For example, a red maple swamp is more likely to form in an area that is inundated for a few weeks out of the growing season, whereas a black spruce bog is more likely to form over soils that remain saturated throughout the entire year. Four different hydrologic regimes were identified for the vegetative palustrine communities within the study area. For the emergent and scrub-shrub communities, the hydrologic regimes included seasonally flooded, seasonally flooded/saturated, and semi-permanently flooded. For the forested communities, the hydrologic regimes included temporarily flooded, seasonally flooded, and seasonally flooded/saturated. To simplify this rather complex set of variables, this report has combined the different subclasses of the palustrine community types for some of the analyses. Where appropriate, this discussion addresses the different subclasses as they relate to the effects of flooding. For the scope of this project, vegetation observed in selected wetland communities is used to describe and gauge the effect of flooding on the "typical" vegetative community. A list of species observed within various community types is presented in Table 3. Based on the map of existing conditions around the Lake and Dead River, the approximate area of each community type was calculated (Table 4).

Data on the elevation of different plant communities was collected at three locations around the Lake (Figure 2). One complete transect was run from the Dead River across the Delta to the Lake. A cross-section depicting the communities identified along this transect, and their elevation with respect to the normal summer water level is shown in Figure 3. Abbreviated transects also were run at the northern tip of the Delta near the mouth of the Dead River, and along the southwestern shore of the Lake. These three areas were selected as representative of the wetland communities around the Lake. For the Delta transect, there was an approximately 6-foot difference between the river level and the top of bank, using the water elevation (268.16 feet) for the day of this survey. Because of low summer rainfall amounts, water levels in the Lake and River were about a foot below the normal elevation of 269 feet. Moving south across the Delta, the elevation drops gradually from the Hardwood River Terrace Forest[3] to the Silver Maple Floodplain Forest, which has an average elevation of approximately 270 feet. Topography continues to drop very gradually, reaching an elevation almost equal to the summer water level within the Mixed Graminoid Shrub Marsh before dropping to the Lake, which had a measured

Scrub-shrub community west of ice berm.

[3] Community classification from the Maine Natural Areas Program.

elevation of 268.13 feet on the day of the survey. With an assumed winter water level of 271 feet in the Lake, all of these communities, with the exception of the upper end of the Hardwood River Terrace Forest, should be inundated at least during the spring in a normal year. The palustrine emergent and scrub-shrub communities surveyed at the mouth of the Dead River also should be inundated by the typical winter water level. The elevation of these communities is between 268 and 270 feet. A shallow levee in this area with an elevation of 269.88 feet prevents continued inundation of these communities during a normal summer. Along the southwestern shore, a taller ice berm (272.93 feet) prevents the Lake from inundating the scrub-shrub community located west of the berm. Wetland hydrology for this wetland is provided by precipitation and groundwater in years when flooding does not occur. However, flood events that overtop this berm will result in inundation of this community.

3.3 Rare Plant Data

The Lake and its surrounding land area support a number of rare plants that occur in five or fewer locations in the State, or are otherwise vulnerable to extirpation because of a unique aspect of their biology. Of these species, the cat-tail sedge would probably be considered the rarest. The cat-tail sedge was first identified on the shores of the Lake in 1940. This was the only known location of this species in the State. Until July of 2002, the status of this species was uncertain because it had not been recorded since its initial discovery in 1940. In July, the cat-tail sedge was relocated along the Delta by members of the Jocelyn Botanical Society. The sedge occurs as scattered individuals and in small clusters along the length of the Delta, from the point known as the Carry almost to the eastern tip of this land area. Some of the locations of this species have been plotted on Figure 2. The sedge occurs in the community designated as the Hardwood River Terrace Forest in Figure 3. Vegetation in this community includes red oak (*Quercus rubra*), red maple, silver maple (*Acer saccharinum*), tupelo (*Nyssa sylvatica*), maleberry (*Lyonia ligustrina*), green ash (*Fraxinus pennsylvanica*), silky dogwood (*Cornus amomum*), sedges (*Carex lurida* and *C. intumescens*), ferns (*Onoclea sensibilis, Osmunda claytoniana,* and *O. regalis*), bluejoint (*Calamagrostis canadensis*), and eastern lined aster (*Symphyotrichum lanceolatum*). The bladder sedge (*Carex intumescens*) appears to be the species most closely associated with the cat-tail sedge in this community. This community ranges in elevation from 270 to 274 feet, and the cat-tail sedge occurs most commonly between the lower and middle elevations. In some locations, this species was seen growing directly in the drift line left by flood events. It was never observed growing within the adjacent Silver Maple Floodplain Forest, where inundation appears to last for several weeks during the growing season.

New Jersey-tea (*Ceanothus americanus*).

Other rare plants reported to occur in and around the Lake include New Jersey-tea (*Ceanothus americanus*), Indian grass (*Sorghastrum nutans*), dwarf-bulrushes, and small purple bladderwort (*Utricularia resupinata*). Of these species, Woodlot located a few individual dwarf-bulrushes, *Lipocarpha micrantha*, on the eastern shore of Lothrop Island (Figure 2), and a small population of New Jersey-tea on the southern tip of Androscoggin Island. The dwarf-bulrush occurs in the drawdown area of a sandy beach, and the New Jersey-tea grows in an area of rocky shore located several feet above the normal summer water level. The Maine Natural Areas Program also identified a second population of *Lipocarpha micrantha* on Lothrop Island, which also included *Fimbristylis autumnalis*. New Jersey-tea and Indian grass have both been reported from Lothrop Island. Although the endangered small purple bladderwort has been reported from the Lake, Woodlot was unable to locate any individuals of this species.

3.4 Wildlife Habitat Data

To assess how a change in the flooding regime could affect wildlife species, Woodlot selected 29 representative species of fish and wildlife known or expected to occur in or around the Lake and Dead River (Table 5). This assessment focused on species that are considered dependent upon or often associated with wetland and aquatic habitats such as common loon (*Gavia immer*) and beaver (*Castor canadensis*).

4.0 DISCUSSION

4.1 Plant Communities

Wetland and aquatic plant communities are influenced by fluctuating water levels (i.e., hydroperiod). According to Hudon (1997), there are four characteristics of water level fluctuations that can potentially affect wetlands. First, the maximum and minimum water levels define the location and extent of various wetland communities. Second, the average yearly water level influences the distribution of species within these communities. Third, the short-term and long-term variation in water level influences the species diversity of wetland communities. Fourth, the seasonal cycle of changing water levels and ambient temperatures affect the natural biological processes of plants within these communities.

The tolerance of different species to flooding and the resulting anoxic conditions (absence or lack of oxygen) are key factors in determining the distribution of plants along a water level gradient (Haraguchi 1991). Typically, a change in species composition and plant community occurs as the water depth changes. As water depth decreases, the plant community transitions from aquatic species, such as water-milfoil (*Myriophyllum* spp.), to emergent herbaceous species (i.e., grasses and sedges), and eventually to woody species, such as willow at the upper end of the gradient (Geis 1979). Changes in the location and composition of these communities seem to result from long-term alternations in the "normal" hydroperiod. Such changes would include prevention of the annual cycle of a rise and fall of water levels, or dramatically changing the magnitude of the high and low water levels. For example, following higher than normal water levels in Lake Ontario over the course of three consecutive years (1972 – 1974), extensive die off resulted in the adjacent wetland communities (Geis 1979). During this time, emergent communities, which displayed the highest level of dead vegetation, were inundated for up to three consecutive months.

In lakes where the water level is maintained at a relatively constant level, the diversity of the macrophyte (plant visible without a microscope) community has been shown to decrease (Wilcox and Meeker 1991). This change in community composition is attributed to a reduction in the level of disturbance that results from naturally fluctuating water levels (Wilcox and Meeker 1991). The diversity of the macrophyte plant community also decreases when water levels are annually allowed to drop well below and rise well above the natural water levels. For example, the water levels in Namakan Lake in northern Minnesota are allowed to fluctuate nearly three feet more than would normally occur. In this situation, only those plants able to adapt to long-term inundation or exposure, or that are early colonizers, are able to survive (Wilcox and Meeker 1991).

Changes in community location can also result from alternation in hydroperiod. Along the St. Lawrence River, Canada, research suggests that emergent vegetation would respond to persistent changes in water level by migrating downslope when water levels were kept low, and returning upslope following recurrent high summer water levels (Hudon 1997). For the Mink River in Wisconsin, water levels are sometimes maintained at elevated levels for periods lasting two to five years (Keough 1990). When this occurs, streamside emergent communities are drowned, eroded, or scoured away by ice, and trees and shrubs at lower elevation are killed by inundation. As a result of these impacts, each type of wetland community shifts upslope. In contrast, during periods of low water levels where mudflats become exposed, marsh vegetation spreads into these areas of drawdown (Keough 1990).

The affect of flood duration, timing, frequency, and magnitude has all been linked, to some extent, to changes in plant communities. Research conducted at hydroelectric lakes in Sweden has indicated that the duration of flooding is the most important factor in determining vegetation patterns (Nilsson and Keddy 1988). The timing of flooding and the number of floods had less of an impact on vegetation patterns. For aquatic plants in the St. Lawrence River, the maximum flood levels were found to have little influence on these communities unless they occurred during the growing season (Hudon 1997). For Androscoggin Lake, most flood events occur prior to or during the early weeks of the growing season. Timing of these events corresponds with melting of the snow pack and ice and with spring rains. Based on information available in existing literature, it is long-duration flood events lasting several weeks or longer that have significant affect on aquatic and wetland plant communities. Based on the stage-duration model for Androscoggin Lake, flooding to an elevation of 272 feet would likely occur for four (4) days during a typical year if the existing dam were removed. Inundation to this same elevation is predicted to occur for three (3) days, one (1) day, and half (0.5) a day for the other scenarios studied. Based on the limited elevation data collected by Woodlot, many of the wetland communities along the Lake occur between 269 and 270 feet. These communities should all experience some duration of flooding from the Lake without additional input of water from a reverse flow event, assuming a 271-foot winter water level. However, because the stage-duration model was limited to assessing water levels at or above 272 feet, it is unknown how many days of inundation are expected for these lower elevation wetland communities. It is at least equivalent to the period of inundation predicted for an elevation of 272 feet and is likely longer. Below an elevation of 272 feet the period of inundation is influenced by the watershed above the Lake rather than being almost solely dependent upon flooding from reverse flow events. If the minimum and maximum elevations of the Lake are not significantly altered for extended periods of time, as has occurred in some of the waterbodies mentioned in this section, and the "natural"

Emergent wetland community on Androscoggin Lake.

cycle of rising and falling water levels continue, then these scenario should not result in a measurable shift in aquatic or wetland plant communities.

4.2 Rare Plants

There appears to be little readily available information on the habitat of the cat-tail sedge, and the information that is available does not provide specific details on the flooding requirement of this species. In general, its habitat is described as moist to wet woods and meadows, marshes, and shores (Haines and Vining 1998; Seymore 1993). Other sources state that the species requires calcareous habitats, which are not common in the State (Maine Natural Areas Program 2002a). In Massachusetts, it is known to occur in Silver Maple-Green Ash Floodplain Forests (Sorrie 1987). Floodplain forests in Massachusetts experience at least annual, spring floods, but information on the duration and frequency of flooding in these areas was not provided (Massachusetts Natural Heritage and Endangered Species Program 2002). In these floodplains, the cat-tail sedge occurs with some of the same associates observed in the project area including silver maple, red maple, sensitive fern, and bladder sedge. In Wisconsin, this sedge occurs in the Southern Lowland Forests, which are located along large, periodically flooding rivers (University of Wisconsin 2002). Again, some of the associates of this species are similar to those seen on the Delta such as silver maple and green ash. The cat-tail sedge is listed as Threatened in Massachusetts, where it is considered rare because it occurs at the northeastern limits of its range, and much of its habitat has been cleared for agriculture (Massachusetts Natural Heritage and Endangered Species Program 2002).

Similarly, in Maine, the cat-tail sedge is rare because it is at the northern limits of its range (Maine Natural Area 2002a). Based on available information, the cat-tail sedge occurs in habitats that receive at least annual flooding. It also has been suggested that this species requires flooding for two specific reasons. First, regular flooding helps to reduce the establishment of woody plant species thereby reducing competition for the cat-tail sedge. Second, spring flood events may help to disperse the seeds of this species to new locations (Reznicek 2002). On the Delta, this species appears to occur at elevations between 270 and 274 feet. Based on the stage-duration model, a minimum of a half a day of inundation should occur to an elevation of 272 feet under the four scenarios investigated. This indicates that at least a portion of the cat-tail sedge population will receive annual flooding. Those plants that occur at elevations above 272 feet will receive less (if any) inundation during a typical year.

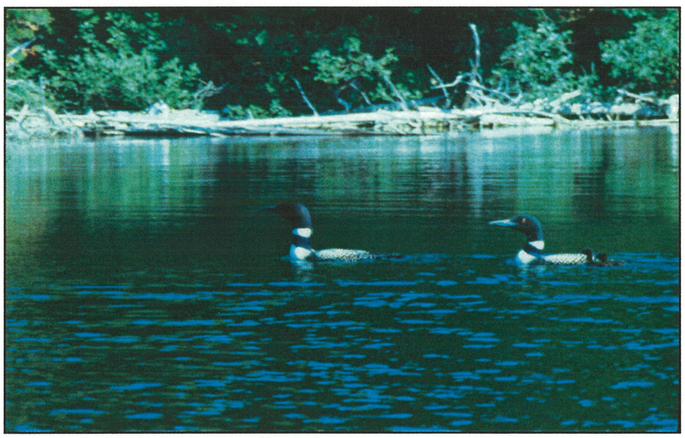
The influence of the four scenarios on the cat-tail sedge population may depend on how much disturbance is necessary to discourage an increase in woody vegetation. It is unlikely that a half a day of inundation alone would be sufficient to prevent encroachment of woody vegetation into the areas where the cat-tail sedge currently grows. Other factors such as water velocity also will play a part in preventing the establishment of woody vegetation. However, specific information on the type, duration, and intensity of disturbance necessary to discourage establishment of woody vegetation is not readily available.

Of the other rare plants that occur, or are reported to occur, in and around the Lake, New Jersey-tea is the least likely to be impacted by changes in the flooding regime. This plant grows in dry, rocky, or sandy woods (Maine Natural Areas Program 2002b), and should not be affected by changes in the frequency of flooding. The habitat of Indian Grass is described as open woods, the borders of woods, and fields (Haines and Vining 1998). In Maine, this species occurs along river and lake shores (Maine Natural Areas Program 2002c). Based on this general description of habitat, it appears that this species typically grows in upland communities and should not be impacted by an altered flooding regime. The two dwarf-bulrushes both grow in sandy wet soils of pond shores that are exposed by receding summer water levels. If water levels in the Lake are allowed to undergo "normal" annual fluctuations where these sandy shores are exposed during the summer months, the populations of these two species should not be impacted by changes to the Dam. Little information is available on the ecological requirements of the small purple bladderwort, other than that it grows in sandy substrates, and that flowering may be triggered by low water levels (Maine Natural Areas Program 2002d). According to the Maine Natural Areas Program (2002d), the "requirements for population persistence (of this species) are not known," which makes determining the effects of a change in the flooding regime difficult.

4.3 Fisheries and Wildlife

Fish and wildlife species that live in and around the Lake and Dead River have adapted to the normal seasonal changes in water levels. Significant changes in this hydrologic regime could negatively affect these populations. In Voyageurs National Park along the Minnesota-Canadian border, the water in several lakes is regulated by hydro-dams (Kallemeyn *et al.* 1988). Some of the lakes experience fluctuations in water levels that are greater (by approximately 3 feet) than would occur under normal circumstances. Fluctuations on one of the other lakes are less (by approximately 3 feet) than would naturally occur. These hydrologic regimes were found to negatively affect several fish and wildlife species. Early spring flooding is necessary for northern pike (*Esox lucius*), which breed in inundated emergent vegetation. However, in these lakes, the flooding necessary to inundate the pike's breeding habitat only occurred when water levels exceeded the maximum level established under the lake management plan. The large fluctuations in water levels were also found to have a negative impact on breeding populations of common loon (*Gavia immer*), and over-wintering populations of beaver and muskrat (*Ondatra zibethicus*). The nests of breeding loons were often flooded by high water levels, and successful nesting typically was the result of "responder" loons, which had adapted to breeding on floating bogs or breeding later in the season after water levels had peaked (Kallemeyn *et al.* 1988). Beaver and muskrat were affected by low lake water levels that left their lodges/houses exposed and negatively impacted their food resources. Researchers studying the management of these lakes recommended a more "natural" hydrologic regime where water levels would be high in the spring, relatively stable until early summer, and then slowly decrease over the course of the summer.

For the 29 species selected for this study (Table 5), the timing of flood events, water depth, and water quality can influence breeding and/or foraging efforts. For other species, the current flooding cycle of the Lake may not greatly influence their breeding season. For example, the brown trout (*Salmo trutta*) breeds from October to February so its breeding season does not coincide with the majority of flood events that occur in the Lake (Maine Department of Inland Fisheries and Wildlife 1976). Breeding success of species, such as the largemouth bass (*Micropterus salmoides*) and yellow perch (*Perca flavescens*), that breed during the spring or early summer are more likely to be influenced by these early season floods. Both of these species breed in shallow near-shore areas (Maine Department of Inland Fisheries and Wildlife 1976). If flood events inundate wetland areas adjacent to the Lake and these species move into the wetlands to breed, their eggs could be left exposed when the water recedes. It is unlikely, however, that all individuals of these species will breed at locations that will be exposed when floodwaters recede or that all will breed during any given flood event. Since both of these species have persisted despite normal springtime flood events, they have adapted to this normal hydrologic cycle. Long-term negative effects on populations such as these would likely result from more permanent changes in water elevation particularly those that regularly expose spawning areas.



Common loons (*Gavia immer*).

As was mentioned earlier, the common loon (*Gavia immer*) is another species that can be negatively influenced by flooding during the breeding season. In Maine and New Hampshire, egg dates for this species have been recorded from June 2 to August 10 (Viet and Peterson 1993). Historical data on flooding for the Lake indicates that relatively few flood events occur during the time when loons are laying or incubating eggs. However, there have been records of loon nests on the Lake being flooded by summer events. For example, a single loon egg was found floating in the Lake following a flood event in the summer of 2002. As with the fish species mentioned above, common loons have persisted in association with the "natural" hydrologic cycle of the Lake. Provided there are not large commonly occurring fluctuations in water levels that either regularly flood or strand nests this species should continue to be present on the Lake.

Aside from the timing of flood events, the general water depth of the Lake can influence foraging success of some species. For example both the bald eagle (*Haliaetus leucocephalus*) and the osprey (*Pandion haliaetus*) prefer to hunt in shallow water areas where fish are more likely to occur near the surface (DeGraff and Yamasaki 2001). If water levels were to permanently be raised so that shallow water habitats were significantly reduced then this could negatively affect the foraging success of species such as these. It would seem unlikely, however, that short-term fluctuations in water levels of one, two, or three days would have a significant negative effect on the survival of either of these species. One factor in addition to water level and the timing of flooding that may influence wildlife species on the Lake is water quality. Largemouth bass feed by sight and require water clarity of at least 15 and preferably 24 inches (Davis and Lock 1997). Heavily sediment-laden floodwater could at least temporarily hinder foraging efforts of this species by limiting visibility. Worse yet would be floodwaters that carried high amounts of phosphorous or other contaminants. Excess phosphorous can stimulate algal blooms that can set a series of negative events in motion. Algal blooms can reduce light penetration that in turn reduces photosynthesis in submerged aquatic plants. If the algal bloom persists, the submerged aquatic plants then die-off. This loss of aquatic beds reduces available habitat for wildlife species, which will result in a decline in populations. When then algae forming these blooms begin to die and decompose, the process of decomposition reduces oxygen levels in the water and can result in the die off of aquatic wildlife. The effects of other contaminants can be equally damaging to wildlife species. A discussion of the diverse effects of environmental contaminants on wildlife, however, is beyond the scope of this report.

Bald eagle (*Haliaetus leucocephalus*).

5.0 CONCLUSIONS AND RECOMMENDATIONS

It does not appear that the different flooding regimes associated with the four scenarios investigated will have a measurable impact on aquatic or wetland plant communities, or on existing fish and wildlife populations in Androscoggin Lake. The wetland communities immediately adjacent to the Lake appear to be at elevations between 269 and 271 feet. The projected duration of flooding at these elevations is unknown, but is influenced by the watershed above the Lake and not solely dependent upon reverse flooding from the Androscoggin River. At or above an elevation of 272 feet, the number of days of inundation varies for the four scenarios although these differences do not appear to be dramatic (i.e., 4 vs. 3 vs. 1 vs. 0.5 days). The length of inundation at or above 272, however, may influence the rare cat-tail sedge population. This species may be dependant upon regular flooding to reduce competition posed by woody vegetation. On the Delta, the cat-tail sedge appears to occur primarily between 270 and 274 feet in elevation. Under the New Dam scenario those plants located at or above 272 feet population will only receive a half a day or less of annual inundation. It is possible that this level of disturbance will not prove sufficient to prevent increased establishment of woody plants and could result in the gradual loss of the cat-tail sedge at these upper elevations.

Dead River Delta.

It may be the quality of water rather than the timing or duration of flooding that has a greater influence on the ecosystem of the Lake. Algal blooms resulting from an influx of excess phosphorous could cause declines in both aquatic beds and aquatic wildlife populations. Modeling suggests that the Existing Dam with flashboards or the New Dam would both reduce the number and volume of flood events, which would in turn reduce contaminants including phosphorous from reaching the Lake. The Existing Dam without flashboards would help reduce the volume of water reaching the Lake when compared to No Dam, but flooding would continue to happen during all six flood frequencies investigated.

The Existing Dam with the 3.0- and 3.5-foot flashboards that are currently in place will provide an opportunity for monitoring the affects of reduced flooding on the Lake ecosystem. According to models developed for the Lake, there should be fewer days of inundation at and above 272 feet, and a reduction of the number of flood events. Since the cat-tail sedge might be one of the first species to show signs of change related to a reduction in flooding, Woodlot has suggested that long term monitoring of this species be initiated during the 2003 growing season. Monitoring will consist of establishing several transects in areas where the cat-tail sedge currently grows and making annual visits to the Delta to collect data on this population. A group of volunteers will assess changes in the population by collecting information on percent cover and possibly stem counts of the cat-tail sedge within one-meter square plots along the established transects. Data also will be collected on other plant species encountered along these transects, which will provide information on the community as well as this individual species.

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FIGURES

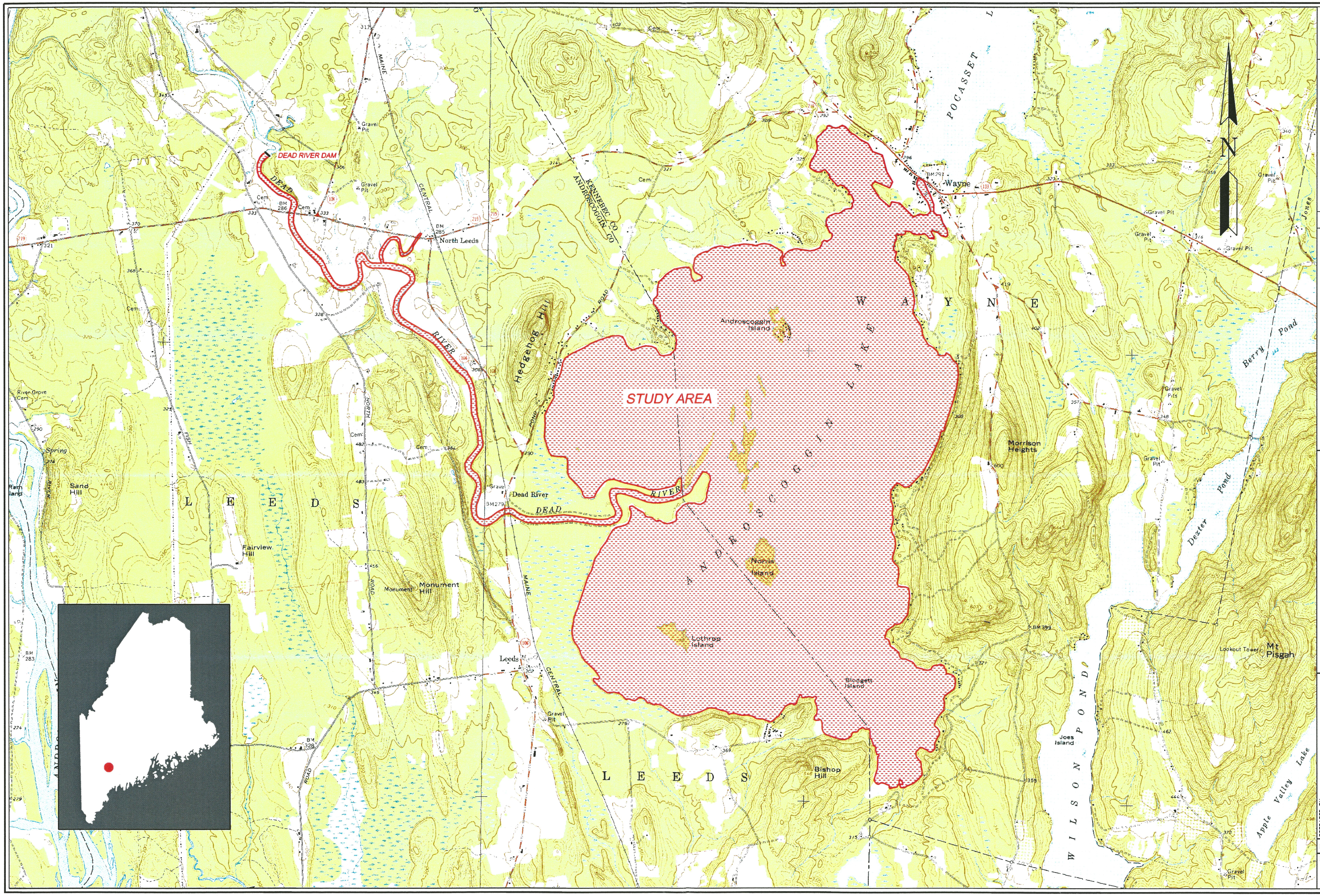

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FIGURE NO.	1

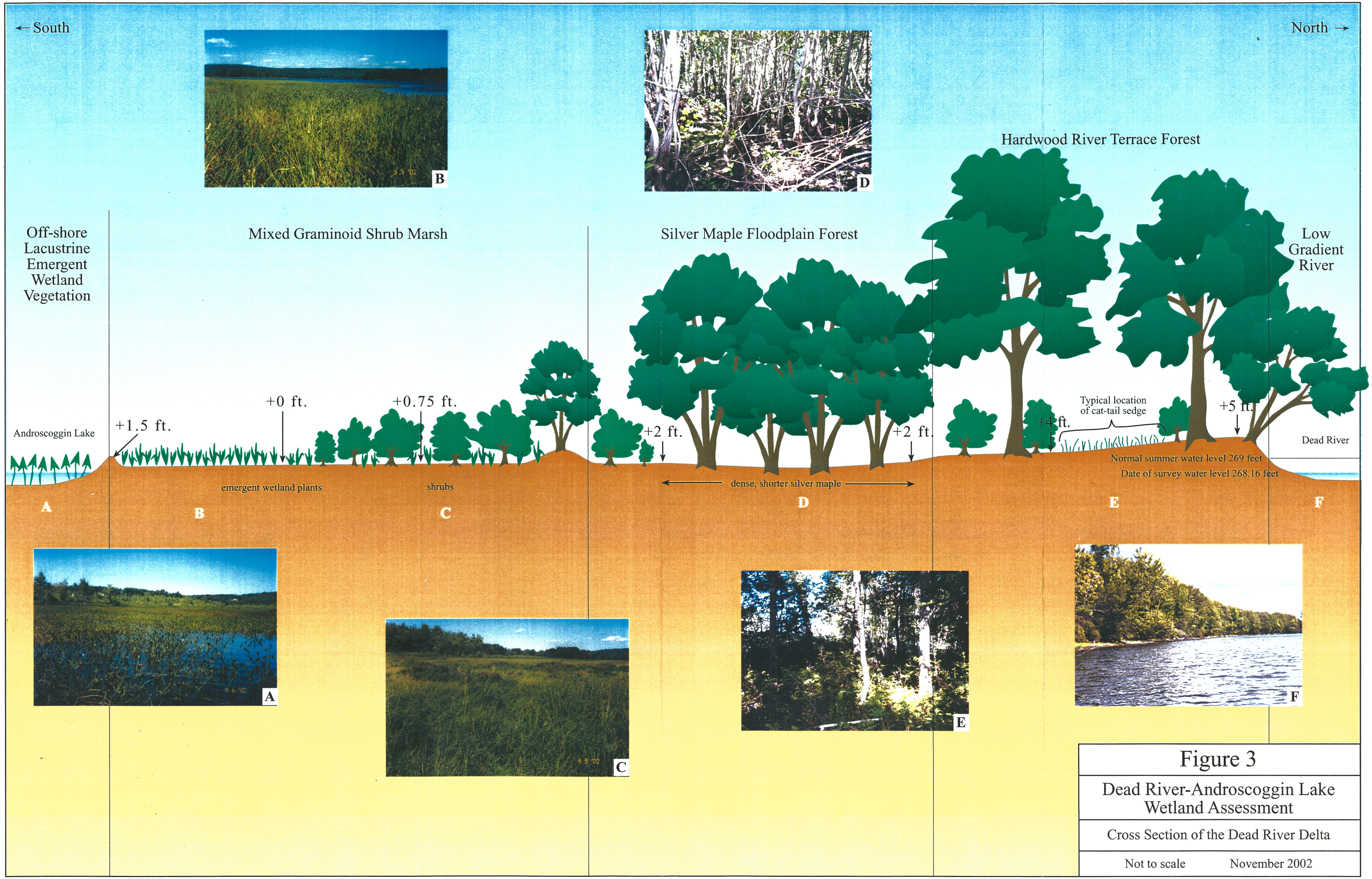

Figure 3

Dead River-Androscoggin Lake Wetland Assessment

Cross Section of the Dead River Delta

Not to scale November 2002

TABLES

TABLE 1: Stage -duration Data for Androscoggin Lake.

	Stage-Duration Data (i.e., Days of Inundation Per Year)			
Data Bin (ft)	**“No Dam”**	**“Existing Dam”**	**3’/3.5’ Boards**	**Elev. 282’ Crest**
272	3.95	2.58	1.09	0.48
273	2.23	0.48	0.26	0.04
274	0.81	0.25	0.12	0.01
275	0.26	0.13	0.06	0.00
276	0.12	0.07	0.03	0.00
277	0.06	0.02	0.01	0.00
278	0.03	0.02	0.00	0.00
279	0.02	0.01	0.00	0.00
280	0.01	0.00	0.00	0.00
281	0.00	0.00	0.00	0.00
> 282	0.00	0.00	0.00	0.00

TABLE 2: Summary of Dam Options as Developed by E/PRO (Revised 2003 Model).

Scenario	Frequency	Maximum Inflow		Lake Level	Time to drain
		Cubic feet per second	Acre-feet	Feet	Days
No Dam	<1-year	2000	8926	273.9	4
	1-year	3200	11702	274.5	5
	2-year	4200	15074	275.2	7.5
	5-year	5800	21719	276.6	8.5
	10-year	8000	30942	278.5	9
	25-year	9700	43835	281.2	11
Existing Dam	<1-year	500	1091	272.2	1.5
	1-year	1000	1983	272.4	2
	2-year	2000	5554	273.6	4
	5-year	5000	14380	275.2	7
	10-year	7500	23107	276.9	9
	25-year	9200	35455	279.4	12
3/3.5' boards	<1-year	0	0	272	0
	1-year	0	0	272	0
	2-year	400	992	272.2	0.1
	5-year	3200	6697	273.5	4
	10-year	6800	15669	275.3	8
	25-year	9000	28364	278	11.5
Crest elev. 282	<1-year	0	0	272	0
	1-year	0	0	272	0
	2-year	0	0	272	0
	5-year	0	0	272	0
	10-year	2500	2479	272.5	2
	25-year	6500	12198	274.6	7.5

TABLE 3: Plant species present in various wetland and aquatic communities in and around Androscoggin Lake and Dead River.

Aquatic Bed (L2AB3Hh)

Bur-reed (*Sparganium angustifolium*)
Fern pondweed (*Potamogeton robbinsii*)
Floating pondweed (*Potamogeton natans*)
Hornwort (*Ceratophyllum demersum*)
Little floating heart (*Nymphoides cordata*)
Mixed bladderwort (*Utricularia geminiscapa*)
Northern snail-seed pondweed (*Potamogeton spirillus*)
Pond-lily (*Nymphaea odorata*)
Water-shield (*Brasenia schreberi*)
Water smartweed (*Persicaria amphibia*)
Waterweed (*Elodea cf. canadensis*)
Wildrice (*Zizania aquatica*)
Yellow water-lily (*Nuphar variegata*)

Lacustrine Emergent (L2EM2Hh)

Bayonet rush (*Juncus militaris*)
Bladderwort (*Utricularia cf. minor*)
Bur-reed (*Sparganium androcladum*)
Clayton's bedstraw (*Galium tinctorium*)
Common arrowhead (*Sagittaria latifolia*)
Creeping buttercup (*Ranunculus repens*)
Creeping spearwort (*Ranunculus flammula*)
Creeping spike-rush (*Eleocharis palustris*)
Grass-leaved sagittaria (*Sagittaria graminea*)
Needle spike-rush (*Eleocharis acicularis*)
Pickerelweed (*Pontedaria cordata*)
Pipewort (*Eriocaulon aquaticum*)
St. Johnswort (*Hypericum mutilum*)
Sweet flag (*Acorus americanus*)
Torrey's bulrush (*Schoenoplectus torreyi*)
Water lobelia (*Lobelia dortmanna*)
Water-parsnip (*Sium suave*)
Water smartweed (*Persicaria amphibia*)

Palustrine Emergent (PEM1Eh)

Autumn bentgrass (*Agrostis perennans*)
Barnyard grass (*Echinochloa crus-galli*)
Bayonet rush (*Juncus militaris*)
Blue flag (*Iris versicolor*)
Bluejoint (*Calamagrostis canadensis*)
Boneset (*Eupatorium perfoliatum*)
Bur-reed (*Sparganium androcladum*)
Buttonbush (*Cephalanthus occidentalis*)
Canada lovegrass (*Eragrostis pectinacea*)
Canada rush (*Juncus canadensis*)
Clayton's bedstraw (*Galium tinctorium*)
Common arrowhead (*Sagittaria latifolia*)
Common cocklebur (*Xanthium strumarium*)
Common skullcap (*Scutellaria galericulata*)
Creeping spike-rush (*Eleocharis palustris*)
Devil's beggar ticks (*Bidens frondosa*)
Eastern lined aster (*Symphyotrichum lanceolatum*)
Fresh water cordgrass (*Spartina pectinata*)
Golden pert (*Gratiola aurea*)
Hog-peanut (*Amphicarpaea bracteata*)
Marsh bellflower (*Campanula aparinoides*)
Marsh fern (*Thelypteris palustris*)
Marsh-potentilla (*Comarum palustre*)
Marsh St. Johnswort (*Triadenum virginicum*)
Meadowsweet (*Spiraea alba*)
Needle spike-rush (*Eleocharis acicularis*)
Nodding beggar ticks (*Bidens cernua*)
Nutsedge (*Cyperus diandrus*)
Pickerelweed (*Pontederia cordata*)
Pipewort (*Eriocaulon aquaticum*)
Redtop (*Agrostis gigantea*)
Redtop panicum (*Panicum rigidulum*)
Rice cut-grass (*Leersia oryzoides*)
Royal fern (*Osmunda regalis*)
St. Johnswort (*Hypericum mutilum*)
Slender spike-rush (*Eleocharis tenuis*)
Sedge (*Carex lupulina*)
Silky willow (*Salix sericea*)
Swamp candles (*Lysimachia terrestris*)
Sweet flag (*Acorus americanus*)
Three-way sedge (*Dulichium arundinaceum*)
Torrey's bulrush (*Schoenoplectus torreyi*)
Tussock sedge (*Carex stricta*)
Virginia water-horehound (*Lycopus virginicus*)
Water-parsnip (*Sium suave*)
Water smartweed (*Persicaria amphibia*)
Wildrice (*Zizania aquatica*)
Wool-grass (*Scirpus cyperinus*)
Wool-grass (*Scirpus pedicellatus*)
Yellow-eyed-grass (*Xyris difformis*)

Riverine – Exposed Shoreline

Devil's beggar ticks (*Bidens frondosa*)
Eastern lined aster (*Symphyotrichum lanceolatum*)
False nettle (*Boehmeria cylindrica*)
Maleberry (*Lyonia ligustrina*)
Marsh-potentilla (*Comarum palustre*)
Marsh St. Johnswort (*Triadenum virginicum*)
Nodding beggar ticks (*Bidens cernua*)
Rice cut-grass (*Leersia oryzoides*)
Sensitive fern (*Onoclea sensibilis*)
Silver maple (*Acer saccharinum*) – seedlings
Water-parsnip (*Sium suave*)
Water smartweed (*Persicaria amphibia*)

Forested Floodplain (PFO1Ah)

Arrowwood (*Viburnum dentatum*)
Bladder sedge (*Carex intumescens*)
Blue flag (*Iris versicolor*)
Bluejoint (*Calamagrostis canadensis*)
Canada mayflower (*Maianthemum canadense*)
Carrion flower (*Smilax herbacea*)
Cat-tail sedge (*Carex typhina*)
Cinnamon fern (*Osmunda cinnamomea*)
Common groundnut (*Apios americana*)
Common woodreed (*Cinna arundinacea*)
Drooping sedge (*Carex crinita*)
Eastern lined aster (*Symphyotrichum lanceolatum*)
Gray birch (*Betula populifolia*)
Green ash (*Fraxinus pennsylvanica*)
Interrupted fern (*Osmunda claytoniana*)
Long sedge (*Carex folliculata*)
Maleberry (*Lyonia ligustrina*)
Meadowsweet (*Spiraea alba* var. *latifolia*)
Patridgeberry (*Mitchella repens*)
Poison-ivy (*Toxicodendron radicans*)
Red maple (*Acer rubrum*)
Red oak (*Quercus rubra*)
Royal fern (*Osmunda regalis*)
Sedge (*Carex lupulina*)
Sensitive fern (*Onoclea sensibilis*)
Silky dogwood (*Cornus amomum*)
Speckled alder (*Alnus incana*)
Silver maple (*Acer saccharinum*)
Tupelo (*Nyssa sylvatica*)
Wild-oats (*Uvularia sessilifolia*)

Forested Floodplain (PFO1E) – Silver Maple

American elm (*Ulmus americana*)
Green ash (*Fraxinus pennsylvanica*)
Marsh fern (*Thelypteris palustris*)
Meadowsweet (*Spiraea alba* var. *latifolia*)
Royal fern (*Osmunda regalis*)
Sensitive fern (*Onoclea sensibilis*)
Silver maple (*Acer saccharinum*)
Winterberry (*Ilex verticillata*)

Palustrine Forested (PFO1E) – End of Delta

Blue flag (*Iris versicolor*)
Bluejoint (*Calamagrostis canadensis*)
Blunt broom sedge (*Carex tribuloides*)
Buttonbush (*Cephalanthus occidentalis*)
Cat-tail sedge (*Carex typhina*)
Cinnamon fern (*Osmunda cinnamomea*)
Common flat-topped goldenrod (*Euthamia graminifolia*)
Common groundnut (*Apios americana*)
Deer tongue grass (*Panicum clandestinum*)
Devil's beggar ticks (*Bidens frondosa*)
Eastern lined aster (*Symphyotrichum lanceolatum*)
False nettle (*Boehmeria cylindrica*)
Green ash (*Fraxinus pennsylvanica*)
Inflated sedge (*Carex vesicaria*)
Long sedge (*Carex folliculata*)
Marsh fern (*Thelypteris palustris*)
Marsh St. Johnswort (*Triadenum virginicum*)
Meadowsweet (*Spiraea alba* var. *latifolia*)
Northern three-lobed bedstraw (*Galium trifidum*)
Red osier dogwood (*Cornus sericea*)
Redtop (*Agrostis gigantea*)
Royal fern (*Osmunda regalis*)
St. Johnswort (*Hypericum mutilum*)
Sedge (*Carex intumescens*)
Sedge (*Carex lupulina*)
Sensitive fern (*Onoclea sensibilis*)
Silver maple (*Acer saccharinum*)
Swamp candles (*Lysimachia terrestris*)
Sweet gale (*Myrica gale*)
Virginia water-horehound (*Lycopus virginicus*)
Water-parsnip (*Sium suave*)
Western poison-ivy (*Toxicodendron rydbergii*)

Palustrine Scrub-Shrub (PSS1E)

Black willow (*Salix nigra*)
Blue flag (*Iris versicolor*)
Bluejoint (*Calamagrostis canadensis*)
Bog willow (*Salix pedicellaris*)
*Bur-reed (*Sparganium androcladum*)
Buttonbush (*Cephalanthus occidentalis*)
Canada rush (*Juncus canadensis*)
Common water-purslane (*Ludwigia palustris*)
Creeping buttercup (*Ranunculus repens*)
Creeping spike-rush (*Eleocharis palustris*)
Fresh water cordgrass (*Spartina pectinata*)
*Green ash (*Fraxinus pennsylvanica*) – line of transition
Leatherleaf (*Chamaedaphne calyculata*)
Marsh fern (*Thelypteris palustris*)
Marsh-potentilla (*Comarum palustre*)
Marsh St. Johnswort (*Triadenum virginicum*)
Meadowsweet (*Spiraea alba* var. *latifolia*)
Needle spike-rush (*Eleocharis acicularis*)
Sedge (*Carex lupulina*)
Sensitive fern (*Onoclea sensibilis*)
Shining willow (*Salix lucida*)
Silky dogwood (*Cornus amomum*)
Silky willow (*Salix sericea*)
*Silver maple (*Acer saccharinum*) – line of transition
Speckled alder (*Alnus incana*)
Swamp candles (*Lysimachia terrestris*)
Sweet gale (*Myrica gale*)
River horsetail (*Equisetum fluviatile*)
Royal fern (*Osmunda regalis*)
Three-way sedge (*Dulichium arundinaceum*)
Tussock sedge (*Carex stricta*)
Water-parsnip (*Sium suave*)
Water smartweed (*Persicaria amphibia*)
Winterberry (*Ilex verticillata*)
Wool-grass (*Scirpus cyperinus*)

Palustrine Scrub-Shrub (PSS1Fh)

Buttonbush (*Cephalanthus occidentalis*)
Clayton's bedstraw (*Galium tinctorium*)
Creeping spike-rush (*Eleocharis palustris*)
Marsh fern (*Thelypteris palustris*)
Meadowsweet (*Spiraea alba* var. *latifolia*)
Silver maple (*Acer saccharinum*)
Swamp candles (*Lysimachia terrestris*)
Three-way sedge (*Dulichium arundinaceum*)
Water-parsnip (*Sium suave*)
Wool-grass (*Scirpus cyperinus*)

TABLE 4: Estimated current acreages of wetland and aquatic communities association with Androscoggin Lake.

Wetland Community Types	Acres
Lacustrine Aquatic Bed	58.85
Lacustrine Emergent	73.87
Palustrine Emergent	61.54
Palustrine Scrub-Shrub	203.21
Palustrine Forested	618.22
Palustrine Unconsolidated Bottom/Open Water	2.75

TABLE 5: Selected animal species known or expected to occur in Androscoggin Lake and Dead River.

	Scientific Name	Common Name	Special Habitat Requirements	Feeding Strategy
Fish	*Esox niger*	Chain pickerel	Quiet, shallow, weedy water, with mud substrate	Primarily piscivore
Fish	*Salmo trutta*	Brown trout	Lakes and medium- to high-gradient streams	Primarily insectivore
Fish	*Morone americana*	White perch	Lakes and streams	Omnivore
Fish	*Morone dolomieui*	Smallmouth bass	Cool, clear water, rocky substrate, scant vegetation	Primarily insectivore
Fish	*Micropterus salmoides*	Largemouth bass	Warm, shallow, weedy water with mud substrate	Carnivore
Fish	*Perca flavescens*	Yellow perch	Weedy areas of lakes and slow-moving streams	Primarily insectivore
Reptile	*Chelydra s. serpentina*	Common snapping turtle	Aquatic habitat; sandy, gravely soil	Omnivore
Reptile	*Chrysemys picta*	Painted turtle	Ponds, streams with projecting or floating logs	Omnivore
Reptile	*Thamnophis s. sirtalis*	Eastern garter snake	Moist areas, forest edges, stream edges, swamps	Carnivore
Amphibian	*Pseudacris (Hyla) crucifer*	Northern spring peeper	Pools for breeding	Primarily insectivore
Amphibian	*Hyla versicolor*	Gray treefrog	Seeps, aquatic sites for breeding	Primarily insectivore
Amphibian	*Rana clamitans*	Green frog	Riparian habitat	Primarily insectivore
Amphibian	*Rana palustris*	Pickerel frog	Shallow, clear water of bogs or woodland streams	Primarily insectivore
Bird	*Actitis macularia*	Spotted sandpiper	Shorelines	Primarily insectivore
Bird	*Aix sponsa*	Wood duck	Trees >16" dbh with large cavities	Omnivore
Bird	*Anas platyrhynchos*	Mallard	Variety of rural to urban aquatic habitats	Omnivore
Bird	*Anas rubripes*	American black duck	Variety of aquatic habitats, prefers forested, rural areas	Omnivore
Bird	*Ardea herodias*	Great blue heron	Tall trees for nesting	Primarily piscivore
Bird	*Ceryle alcyon*	Belted kingfisher	Perches over streams, lack of disturbance	Primarily piscivore
Bird	*Circus cyaneus*	Northern harrier	Marshes or open country with low vegetation	Carnivore
Bird	*Gallinago gallinago*	Common snipe	Moist, organic soils, large open spaces	Primarily insectivore
Bird	*Gavia immer*	Common loon	Water bodies with stable water levels and shallow coves	Primarily piscivore
Bird	*Haliaeetus leucocephalus*	Bald eagle[1]	Large bodies of water with fish	Carnivore
Bird	*Pandion haliaetus*	Osprey	Clear lakes and rivers with fish	Primarily piscivore
Bird	*Scolopax minor*	American woodcock	Moist, organic soils, small clearings and dense swales	Primarily insectivore
Mammal	*Castor canadensis*	Beaver	Woodland streams, lack of disturbance	Herbivore
Mammal	*Lontra canadensis*	River otter	Bodies of water, such as streams, ponds, lakes, rivers	Primarily piscivore
Mammal	*Mustela vison*	Mink	Hollow logs, natural crevices, riparian habitat	Carnivore
Mammal	*Ondatra zibethicus*	Muskrat	Wetlands with dense emergent vegetation	Herbivore