Summary of Results of the Pool 5 and Pool 8 Drawdowns on the Upper Mississippi River

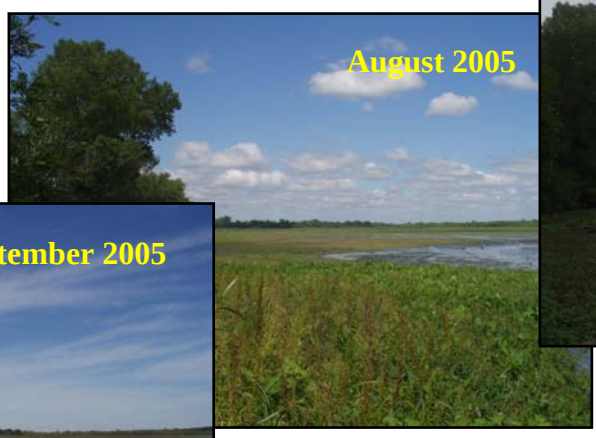
River Resources Forum
Water Level Management
Task Force

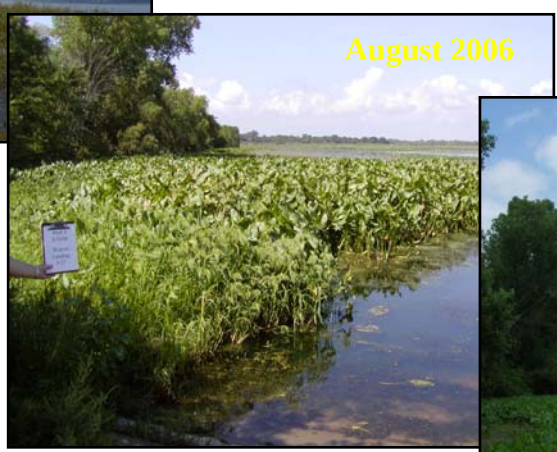
July 2007

Restoring Aquatic Vegetation Through Water Level Management

Pool 5, Weaver Bottoms

The drawdown begins ⟶

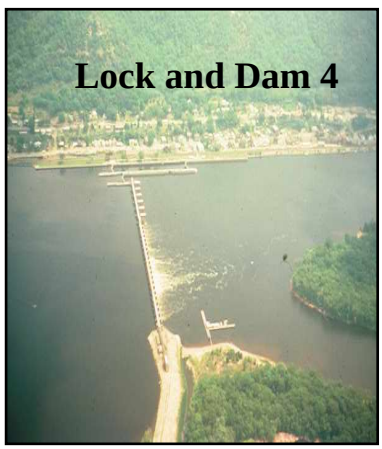




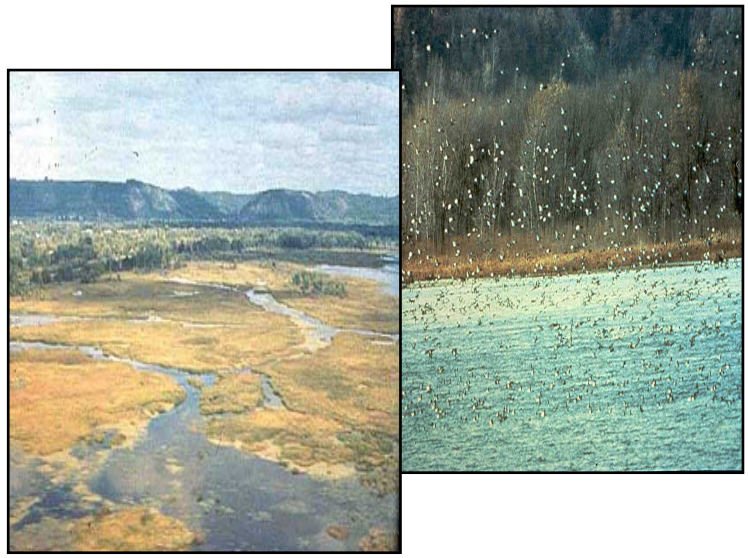
A Natural River

Prior to 1866, the Upper Mississippi River was a mosaic of channels, sand bars and wooded islands. In spring, the river flowed fast and furious, scouring new channels and forming sandbars in unexpected places. In summer, it was so shallow in places that a person could walk across it. But the natural river was too dangerous and unreliable for commercial boat traffic, so, in 1866, the 4-foot channel project was begun. It was the first of several channel improvement projects that would eventually result in the building of the locks and dams in the 1930s to maintain a 9-foot shipping channel.

When the system of locks and dams was completed, the free flowing river had been transformed into a series of navigation pools. The locks and dams maintained high and relatively stable water levels in the lower portion of the pools, which ensured the passage of tows and barges even in the middle of summer.



Spring Lake, backwater in Pool 5



Changes in River Habitat

For several decades, these pools supported a wealth of fish, wildlife and aquatic habitat, but it gradually diminished. The high water levels, caused by the locks and dams, made the islands in the lower portion of the pools more vulnerable to erosion from waves, and many of them disappeared. In addition, material carried by the river and soil washed from the nearby eroding islands gradually filled in channels and deep holes. Aquatic plants that grew in the shallow water bordering the islands were affected by these changes, and many formerly lush plant beds either decreased in size or disappeared completely. These plants are part of the foundation for the web of life in the river providing food and shelter for fish and wildlife.

Some pools were affected more than others by this chain of events, but many of the pools now have a wide open expanse of shallow water above the lock and dam. These areas are much less productive for fish and wildlife. To restore this habitat, river managers have been rebuilding islands, as well as restoring channels and deep-water habitat with funds from the Environmental Management Program. Even with these restorations, plant beds have only partially recovered.

Aquatic plants, particularly “emergents” such as arrowhead, cattail and bulrush, which grow along the water’s edge in moist soil and shallow water, often depend on a natural seasonal fluctuation in water levels for their long-term survival and the sprouting of new plants. With the relatively stable water levels created by the navigation pools, plant beds that were eliminated over time had little chance to become reestablished. Water level management offers a way to help restore the necessary seasonal fluctuation in water levels. It is an important step in renewing important fish and wildlife habitat on the river.

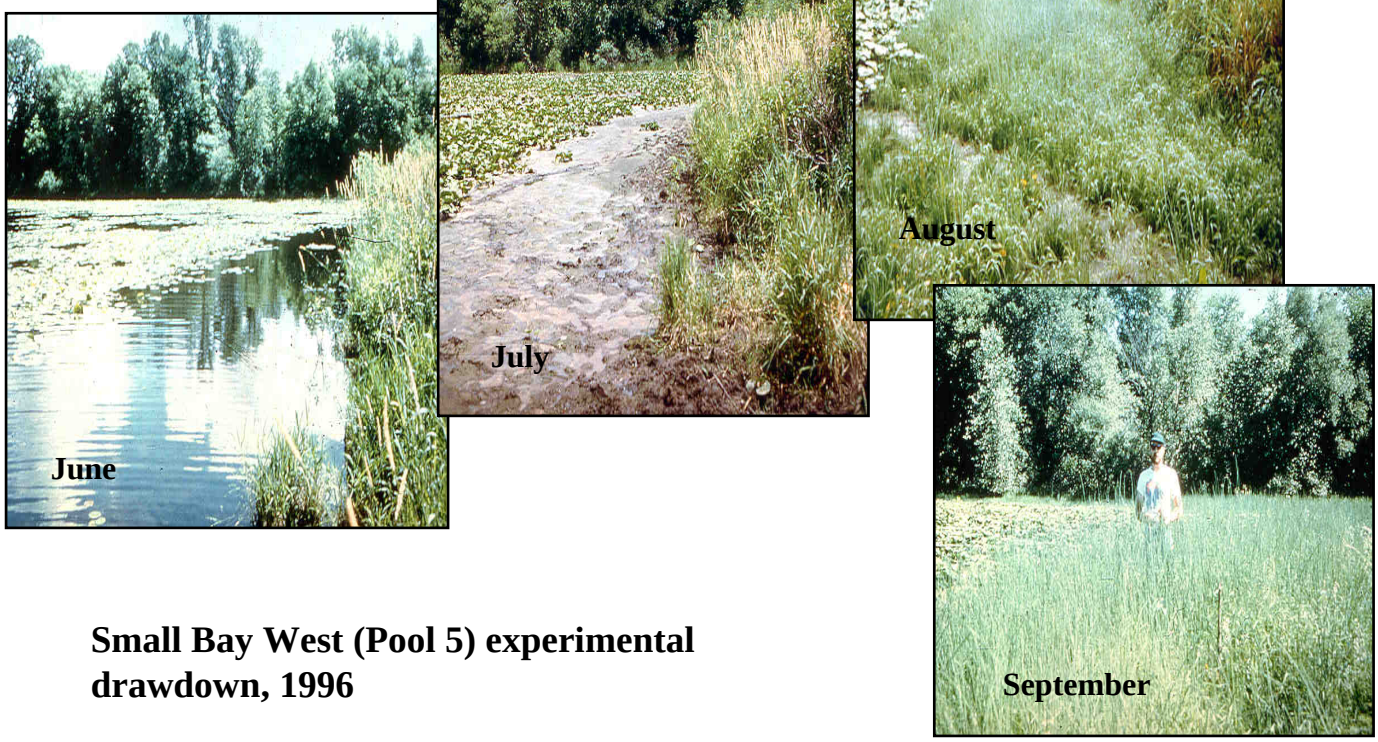
Water Level Management

Water level management on the Upper Mississippi River has evolved over time. It has been based on scientific analysis as well as "lessons learned." Pool elevations were first lowered in the St. Louis, Missouri, area by keeping water levels at the low end of the operating range in Pools 24 through 26 during summer. In the upper pools, a series of demonstration projects were completed under the guidance of the Water Level Management Task Force. The task force was established by the River Resources Forum, which is a partnership for coordination and study on the Upper Mississippi River.

Water level management on the UMR has been ongoing since the early 1990's. In the upper pools (1 through 13), after successfully conducting three small-scale drawdowns, a large-scale drawdown of a navigation pool was planned. After a lengthy selection process, Pool 8 was chosen for the first experimental drawdown, which was conducted in 2001 and repeated in 2002. Pool 5 was next, with drawdowns in 2005 and 2006.

Commercial Navigation Industry

•Citizen Groups



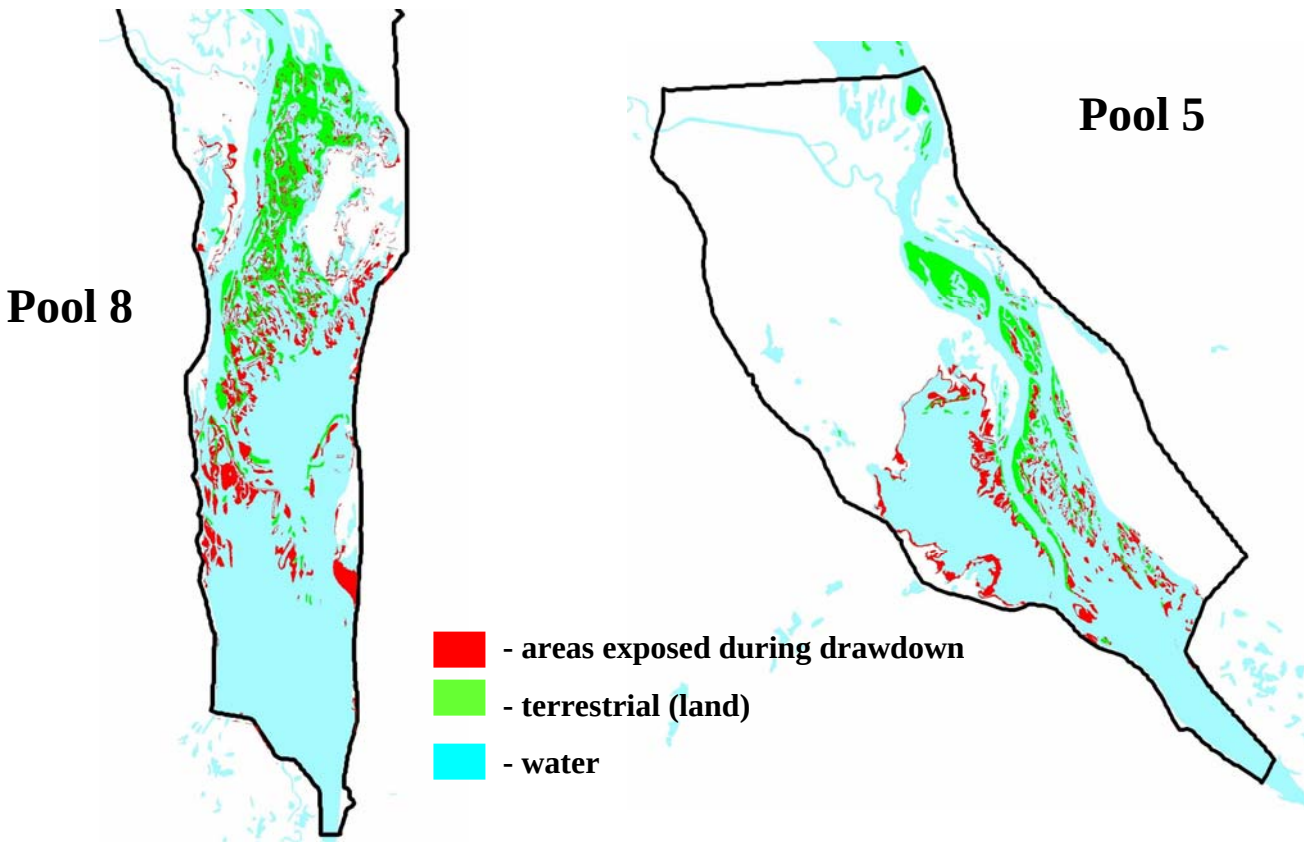
Small Bay West (Pool 5) experimental drawdown, 1996

Pool 8 and Pool 5 Drawdowns

Experimental drawdowns of 1.5 feet at the dam were conducted on Pool 8 in 2001 and 2002, and on Pool 5 in 2005 and 2006. Drawdowns were started in mid-June, and continued until the end of September if flows were suitable to maintain the drawdown. Water levels were lowered approximately 2 inches per day until the desired elevation was reached. During 2001 in Pool 8 and 2006 in Pool 5, drawdowns ended early because of low flows.

During the planning process, estimates of areas that would be exposed during a drawdown were computed for a range of flow conditions. Acres exposed were only computed for areas where bathymetric data (the topography of the river bottom) were available, mostly in the lower ends of the pools. The flow on the river changes every day, and, as a result, the number of acres and location of areas exposed also change during the course of the drawdown. In Pool 8, 1,954 acres were exposed on July 21, 2001, as shown below. In Pool 5, 1,032 acres were exposed on July 15, 2005. However, after August 1, 2005, low river flows caused a shift in pool operation, which exposed an additional 1,000 acres in the middle and upper end of Pool 5 for the remainder of the drawdown.

Monitoring was completed before, during, and after these drawdowns to determine the effect on vegetation, water quality, waterfowl, wildlife, fish, sediment, and commercial and recreational navigation. These data are described in this report. Where available, data from other non-drawdown pools are shown as a comparison. It is important to note that environmental conditions vary greatly within and between pools and over time, making comparisons difficult. In Pool 5, mussels were also sampled, and a pool-wide population estimate was determined in 2006, the first of its kind on the Mississippi River. This report describes the results of these monitoring activities and provides insight into the effect of drawdowns.



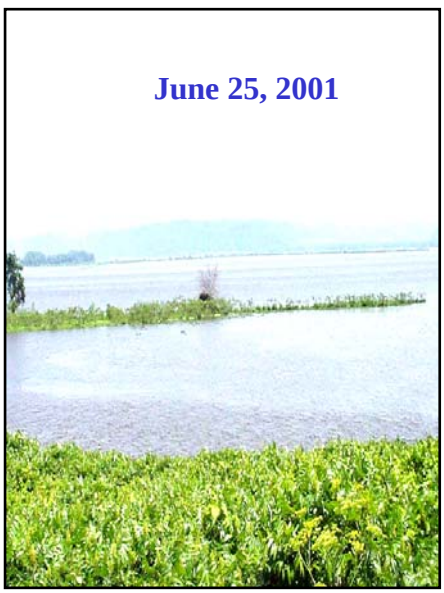
1,954 acres exposed on July 21, 2001

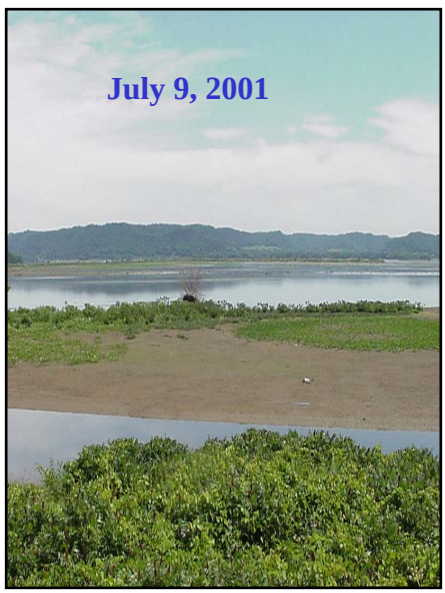
1,032 acres exposed on July 15, 2005

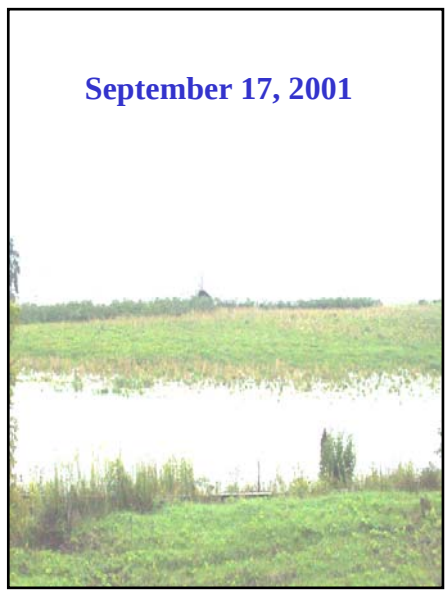
Aquatic Vegetation

Aquatic vegetation is an important indicator of the health of the Upper Mississippi River and provides critical habitat for fish and wildlife. Over time, the diversity and abundance of some types of vegetation has declined. Water level drawdowns have been used elsewhere to restore vegetation, especially for emergent perennial species such as arrowhead, bulrush, etc.

Seedbank Study: The drawdown was expected to improve natural seed germination of emergent vegetation. However, much of the river bottom that would be exposed during a drawdown had not been above water for over 60 years. A seedbank study was conducted in Pool 8 to determine if a viable seedbank existed. Fifty species of plants were identified in seedbank samples; the plant response to the drawdown was ultimately very similar to the results of the seedbank study.



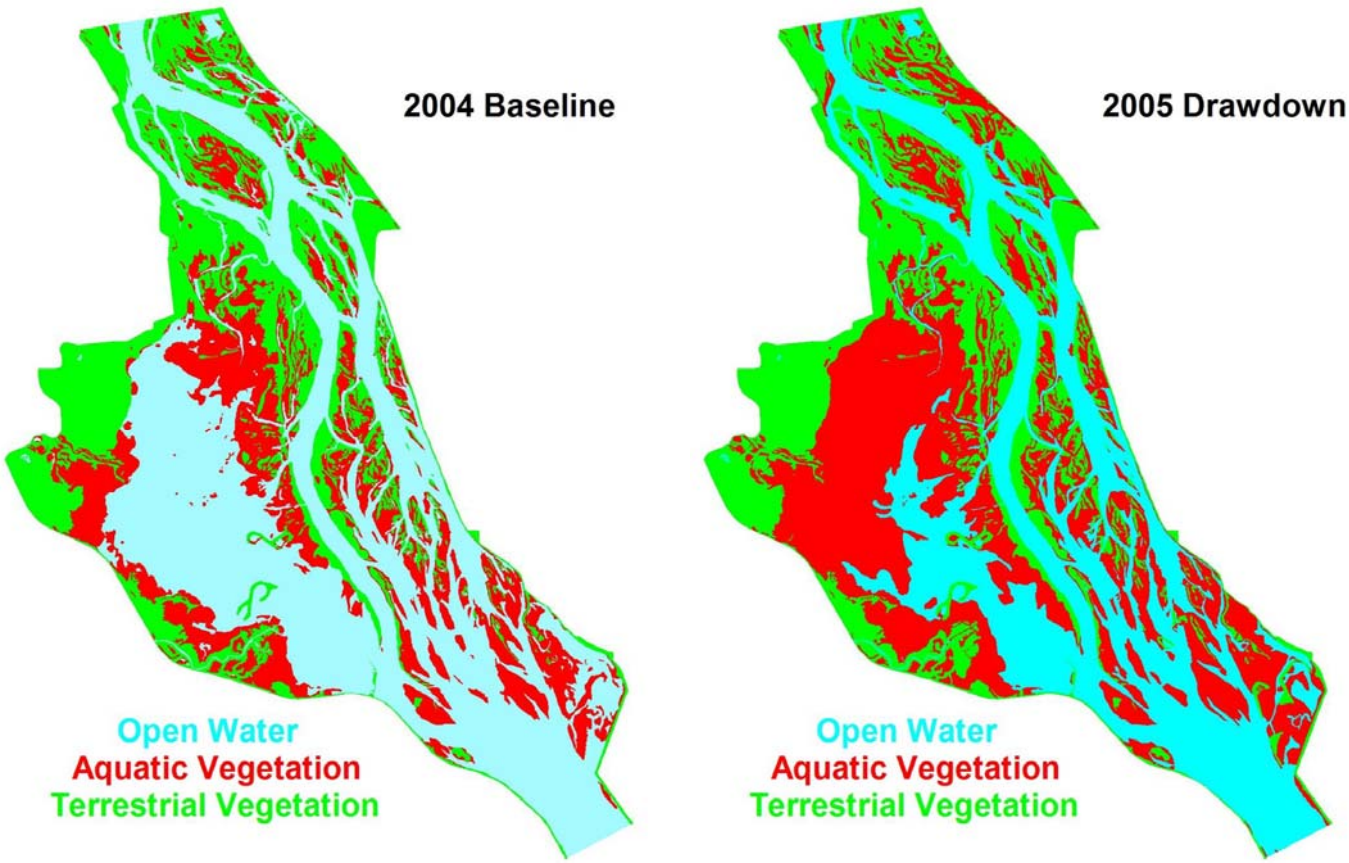




Plant Response: Researchers monitored the development of vegetation on exposed areas along transects at 13 locations in Pool 8. They found:

- More than 50 species of moist-soil, perennial emergent and aquatic species on the exposed sites. Rice cutgrass, broadleaf arrowhead, water stargrass, nodding smartweed, chufa flatsedge, false pimpernel, and teal lovegrass were the dominant species. Many of these species are a valuable source of food and cover for wildlife.
- Plant density was largely related to the duration of substrate exposure; likewise, arrowhead tuber production was better on sites exposed the longest.
- A shift was observed from a plant community containing a mix of annual and perennial plants the first year of drawdown to one dominated by perennials such as arrowhead the second year of drawdown.

In Pool 5, similar results were observed. Over 70 species of plants were recorded on the exposed areas the first year of the drawdown; composition shifted from predominantly annual plants to mostly perennial species the second year.

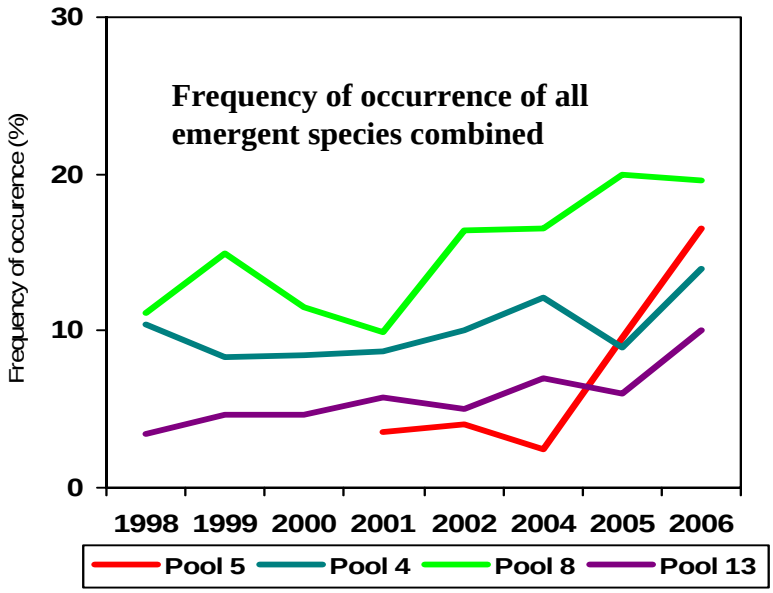


In Pool 5, vegetation cover changed on 2,314 of 13,626 acres (17%) from 2004 (pre-drawdown) to 2005 (drawdown). Open water habitat was reduced by 2,054 acres (15%) and the rooted-floating aquatic community decreased by 178 acres (1%). Increases were observed in the shallow marsh annual plants (370 acres – 2%), shallow marsh perennials (225 acres – 1%), and submersed aquatic vegetation (1,435 acres – 11%).

Drawdowns resulted in a reduction in open water and an increase in areas dominated by marsh plants and submersed vegetation. Plants shifted from mostly annual to mostly perennial species from the first to second year of drawdown.

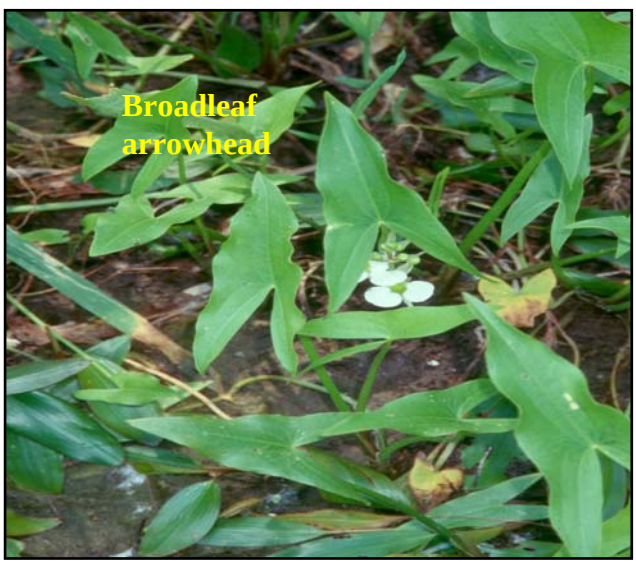
Emergent Vegetation

Emergent vegetation grows primarily in shallow water along the edges of marsh and wetland areas. Species like arrowhead and giant reed grass are well known to most "river rats" and once covered large areas of the Upper Mississippi River. Emergent species help stabilize bottom sediments and provide a critical source of food and cover for waterfowl and furbearers. Emergent vegetation has declined in abundance over the last two to three decades, especially in the middle and lower portions of pools. The primary objective of drawdowns is to restore emergent vegetation.



US Geological Survey – Long-Term Resource Monitoring Program data

Much of the plant response observed on exposed substrates was directly influenced by the drawdown. Many emergent, moist-soil, and terrestrial species that require exposed substrates or shallow water for germination and development would not have become established under normal water levels.



Pool 5 drawdown response, Weaver Bottoms

Emergent vegetation increased as a result of the drawdowns.

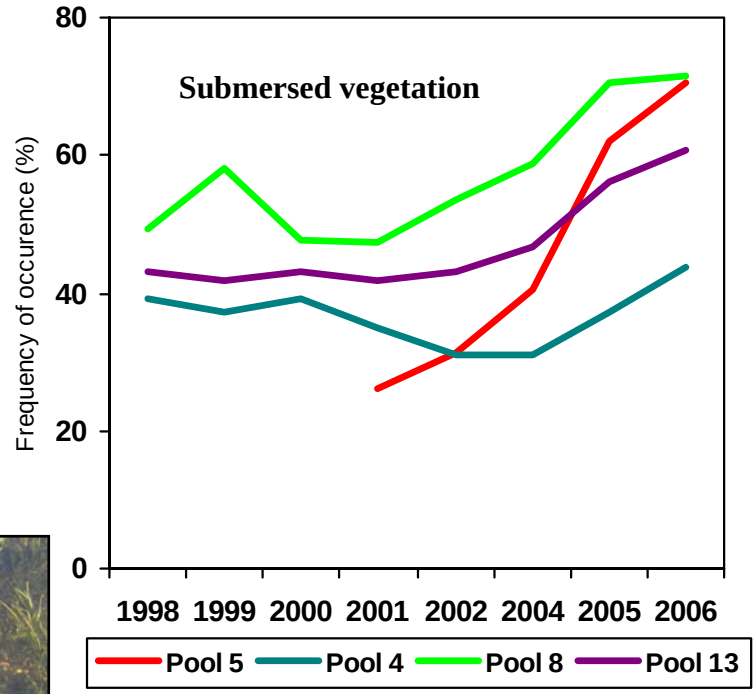
Submersed Vegetation

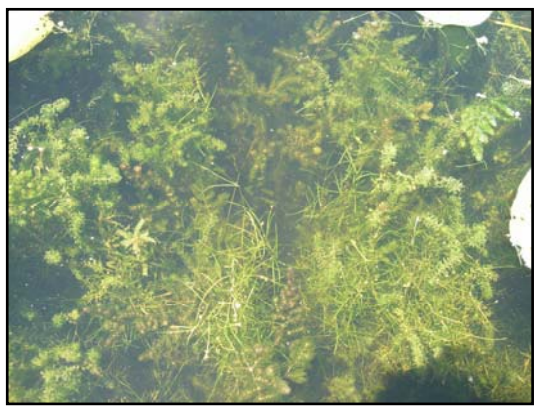
Submersed vegetation grows underwater and helps filter sediment, reduce wind waves, stabilize bottom substrates, and provide food and cover for fish, wildlife, and invertebrates. Over 20 species of submersed vegetation are found in the Upper Mississippi River.

While drawdowns were expected to improve emergent vegetation, one of the more common questions prior to the drawdowns was the effect on submersed vegetation. Negative impacts were expected in areas that would be dewatered from the drawdown, while increased light penetration in deeper areas and firmer substrates resulting from the drawdown could benefit submersed vegetation overall.

Monitoring of submersed vegetation has been conducted annually since 1998 in Pools 4, 8, and 13 by the Long Term Resource Monitoring Program. In addition, monitoring work was expanded to include Pool 5 in 2005 and 2006 to help evaluate the impact of the drawdowns.

Submersed aquatic vegetation was NOT negatively impacted by the drawdowns, instead the frequency of occurrence increased in the drawdown pools. However, a similar increase occurred in other pools monitored, making it difficult to determine how much of the response was the result of the drawdowns. Continued monitoring will help answer this question.

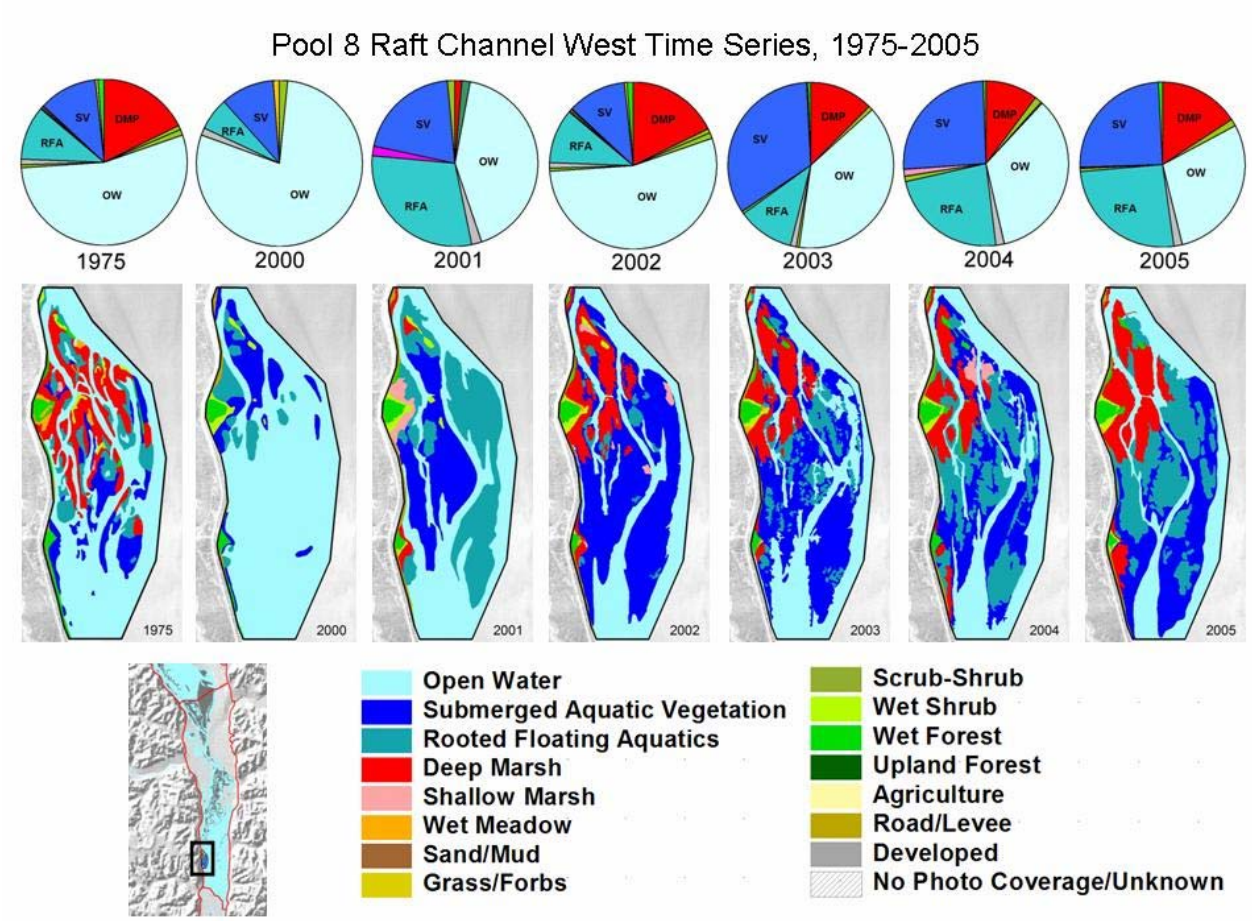


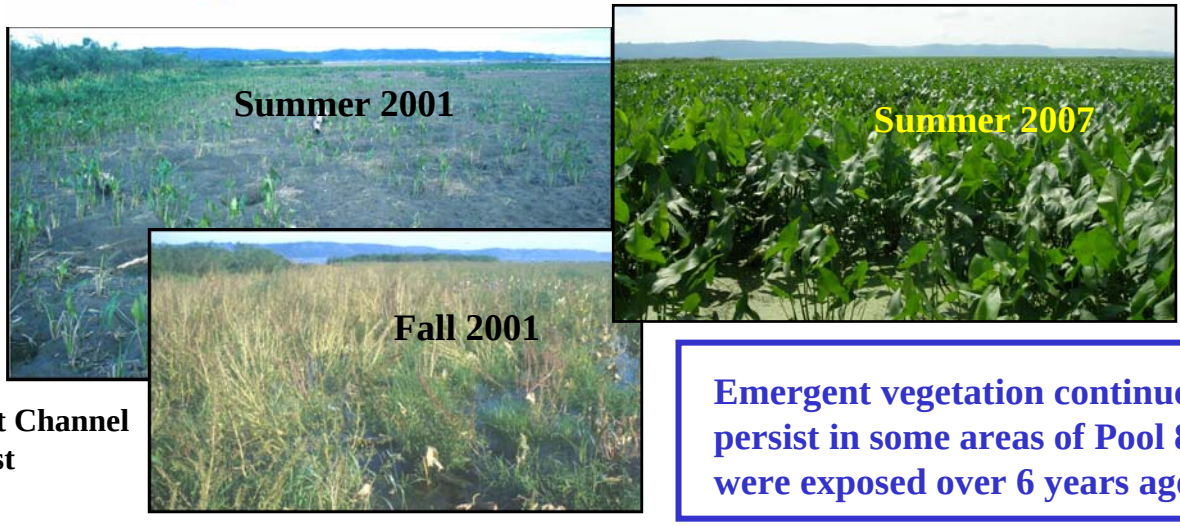


Submersed vegetation increased; however, similar increases were observed in other pools that were not drawn down. Additional monitoring is needed to determine the effects of drawdowns on submersed plants.

How Long Does the Vegetation Last?

One of the important questions surrounding drawdowns was how long vegetation grown during a drawdown would last. The time series below was taken from Raft Channel West, a 500-acre area below Brownsville, Minnesota, in Pool 8. Red indicates perennial emergent plants (like arrowhead and bulrush), dark blue indicates submersed vegetation (like coontail and wild celery), aqua blue indicates floating leaved plants (like water lily and lotus), and light blue signifies open water. The figure at left is from 1975, when aquatic vegetation was considered healthy and abundant. The remaining figures are from 2000 to 2005. By 2000, vegetation had nearly disappeared in this area. Following the drawdown, it became reestablished and has remained abundant through 2007, as observed from the photos below.





Raft Channel West

Emergent vegetation continues to persist in some areas of Pool 8 that were exposed over 6 years ago

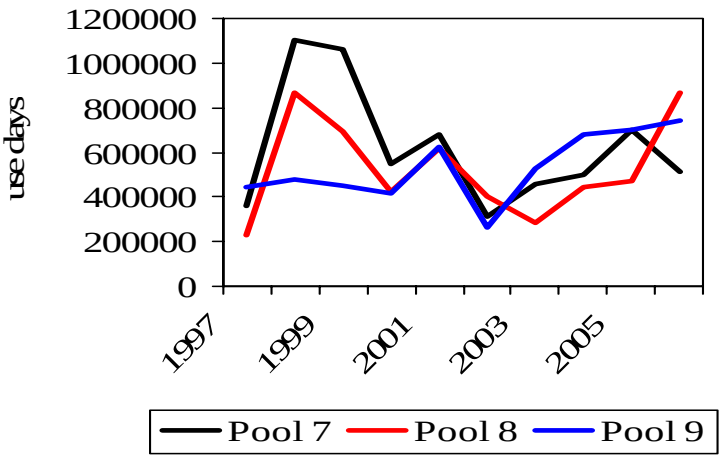
Waterfowl

The Mississippi River is world renowned as a migration corridor for waterfowl. Aquatic vegetation provides seeds and tubers, as well as habitat, for an abundance of invertebrates, all of which are a critical food source for migrating waterfowl. With improvements in aquatic vegetation a primary goal of drawdowns, increased use by waterfowl could be expected. Weekly aerial waterfowl surveys have been conducted during the fall by the U.S. Fish and Wildlife Service to estimate total use days (1 use day = 1 waterfowl for 1 day) for puddle ducks (such as mallards and wigeon), diving ducks (such as canvasbacks and scaup), geese, and swans in Upper Mississippi River Pools 4 through 13.

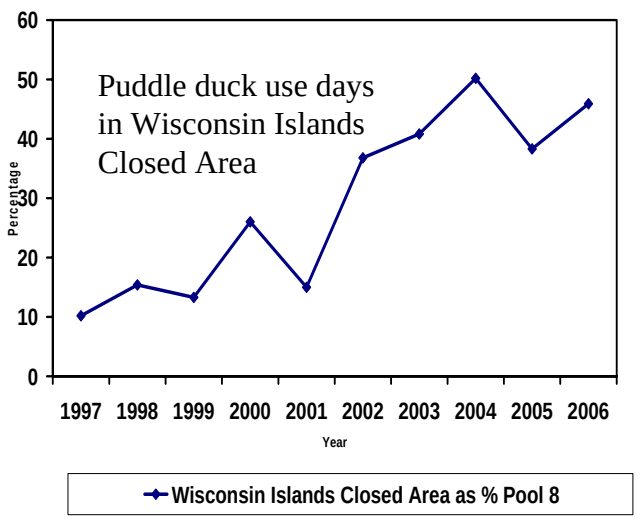
In addition, in 2001 and 2002, waterfowl hunters using Pool 8 were surveyed to determine whether they were aware of the drawdown and if they thought the habitat response was positive or negative. The surveys indicated that 80% or more of the hunters were aware of the drawdown, with over 60% considering it a success.

Dabblers or Puddle Ducks

Puddle ducks feed primarily in backwater areas on plant seeds, insects, and other items. Flooded annual plants like smartweed are especially attractive.




Wigeon - Photo by Tim McCabe



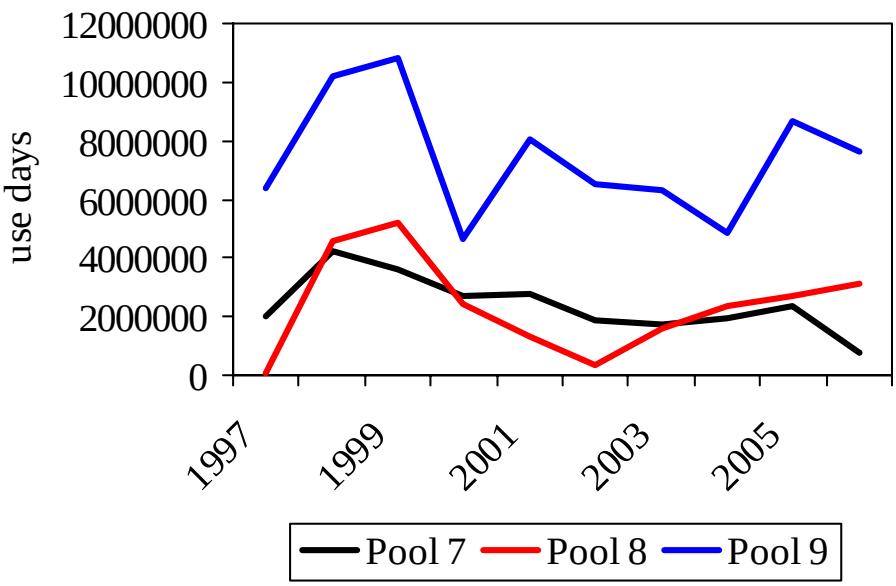
Use days for puddle ducks in Pool 8 fluctuated similarly to Pools 7 and 9, although the response to the drawdown was more evident on a localized basis.

Puddle duck use shifted within Pool 8 after the drawdowns. The Wisconsin Islands Closed Area, located in the drawdown zone, provided almost 40% to 50% of the use days in Pool 8 after the drawdowns.

Diving Ducks

Diving ducks feed in open water areas on submersed vegetation such as wild celery, as well as fingernail clams and other invertebrates found in these areas. However, canvasbacks consume more plant material such as wild celery and arrowhead tubers than scaup which favor snails, fingernail clams and other invertebrates. Therefore, canvasbacks are more likely to be affected by changes in submersed aquatic vegetation. Canvasbacks also comprise the large majority of diving duck use days on the Upper Mississippi River.

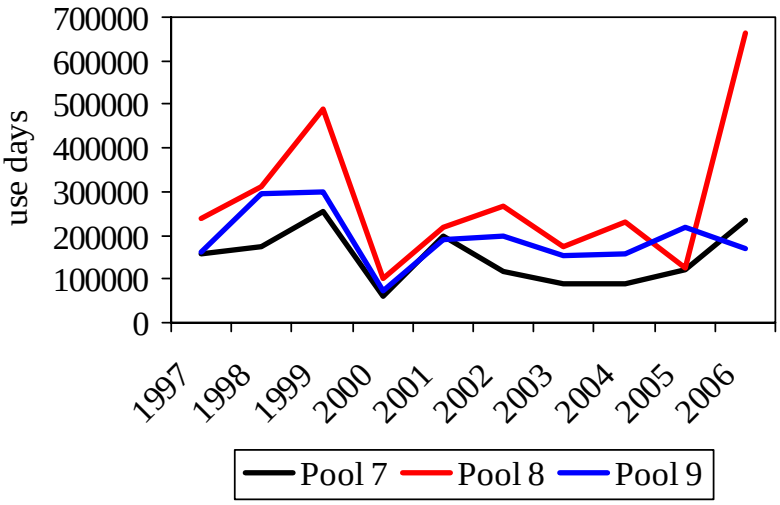

Canvasback - Photo by William Vinge



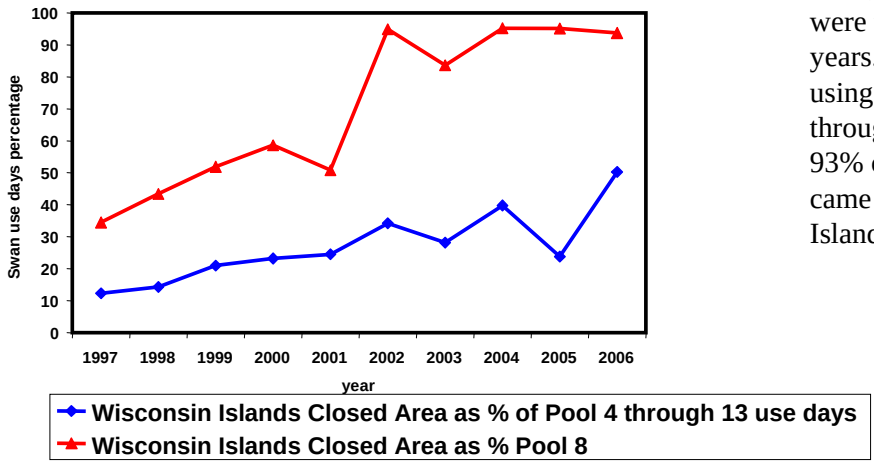
Although diving duck use days decreased during the drawdowns in Pool 8, the decrease was not related to the drawdown, because the submersed aquatic plants actually increased during those years. Diving duck numbers have continued to increase each year thereafter.

Tundra Swans

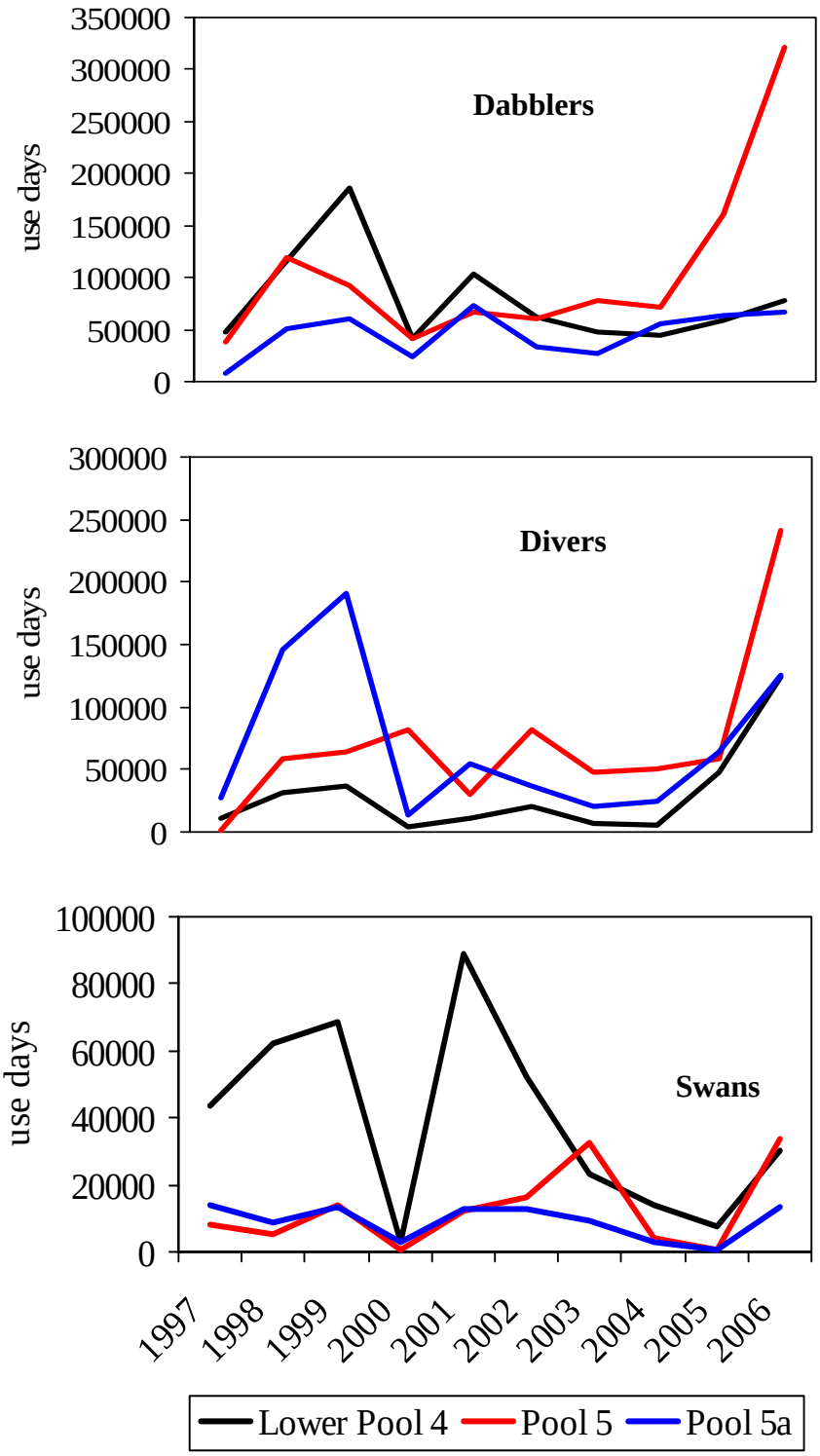
Swans are especially fond of arrowhead tubers and are often concentrated around large beds of this important emergent plant species.



Pool 8 has generally provided the most swan use days on the Upper Mississippi River (Pools 4 through 13) since 1997. However, after the drawdowns, swan use shifted within Pool 8 to being concentrated in the Wisconsin Islands Closed Area. This shift is due to a combination of improved habitat conditions as well as protection from disturbance. In 2006, swan numbers in Pool 8 were the highest in the last 10 years. There were more swans using Pool 8 than in Pools 4 through 13 combined, and over 93% of the use days in Pool 8 came from the Wisconsin Islands Closed Area.



Pool 5

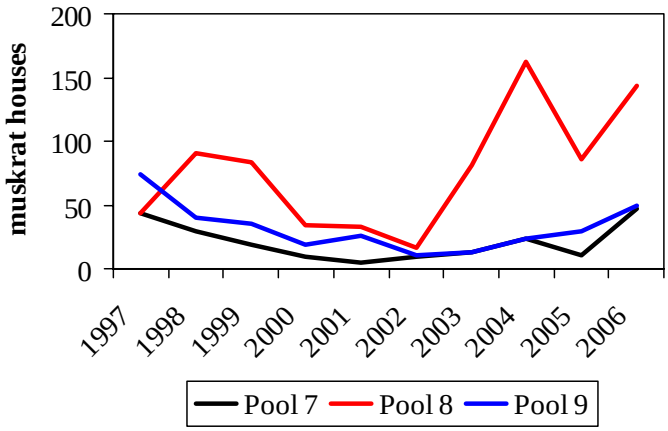


The response by waterfowl, including dabbling ducks, diving ducks and swans to the Pool 5 drawdowns, was evident. Use days for dabblers, divers, and tundra swans in 2006 were the highest recorded in 10 years. And, although adjacent pools also saw increases, the increases in Pool 5 were much more dramatic, particularly for dabblers and divers.

Waterfowl use increased in Pool 8 and Pool 5 as a result of the drawdowns.

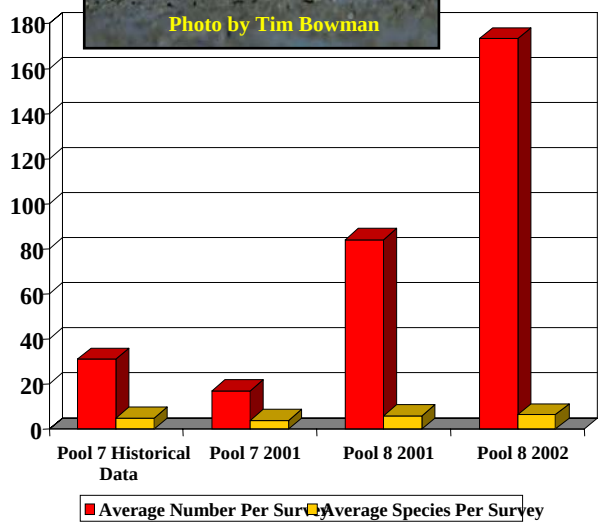
Muskrats and Shorebirds

The number of muskrat houses in Pool 8 increased following the drawdown. Muskrats feed on arrowhead tubers and other emergent plants and use them to build houses.



While the Mississippi River is not a major nesting area or migration corridor for shorebirds, drawdowns expose substrates and create shallow water areas that serve to attract hundreds of migrating shorebirds. Shorebirds using the interior migration corridor of North America, tend to be opportunistic when it comes to stopover sites rather than showing preference to a particular wetland. This increases the chances that habitats created during a drawdown will still be used even if the habitat is not available on a regular basis. Fall shorebird migration typically occurs between mid-July and late September in this area coinciding with the approximate times of the scheduled drawdowns.

Monitoring in Pool 8 in 2001 and 2002 suggested that the temporary feeding areas created by the drawdown attracted increased numbers of shorebirds and some uncommon species such as whimbrel and American avocet. No data exist for shorebird use of Pool 8 before the drawdown, but Pool 7 has historical data that indicate a much lower average number of shorebirds sighted. Surveys conducted in Pool 7 in 2001 continued with a lower average number per survey when compared to the figures for Pool 8 in both 2001 and 2002.



Comparison of average shorebird numbers and average species observed between Pool 7 and Pool 8.

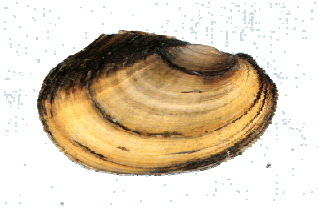
Other Wildlife

Many other species of wildlife and insects may benefit from drawdowns, such as frogs, sandhill cranes, egrets, dragonflies, etc. Additional monitoring is needed to evaluate the effects on these species.

Many species of wildlife benefit from drawdowns.

Native Freshwater Mussels

Nearly 50 species of mussels are in the Upper Mississippi River, more than half of which are listed as special concern, threatened or endangered. Biologists were concerned about stranding of mussels during drawdowns, however, pre-drawdown studies showed the population of mussels in shallow water (less than 1.5 feet) was small and the effect would be minimal. Three studies were done to assess the potential effects of drawdowns on mussel populations.



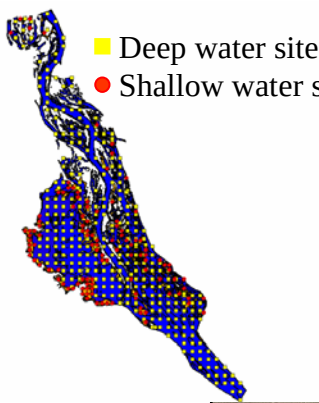
In 2001, a mussel rescue was conducted in Pool 8 which showed that some unknown number of mussels were stranded during the drawdown.

In 2005, to better assess these impacts, a study was done to obtain estimates of mussel mortality in the shallow water areas in Pool 5 during a drawdown.

While many mussels escaped to deeper water, at least 28% of mussels that were placed in shallow experimental plots in Pool 5 died, compared to no mortality in an adjacent pool (Pool 4, not drawn down). Additional observations suggest that a small number of state-listed endangered and threatened species perished as well. However, it is unknown what effects the drawdown had on the overall mussel population in Pool 5.

Given this, a comprehensive assessment of pool-wide mussel populations was completed in 2006.

In 2006, divers sampled 359 sites systematically over the entire pool using 0.25-square meter quadrats. At each site, all mussels were counted and measured. This information was used to determine species counts, size and age ranges, and an estimate of the total number of mussels in the pool—information that will be invaluable in assessing the impacts of future drawdowns on mussels. Note that any mussels that died in the 2005 drawdown were not included in the 2006 pool-wide population estimate.



Species Found Alive

- *Threeridge*
- *Threehorn wartyback*
- *Pink papershell*
- *Wabash pigtoe*
- *Lilliput*
- *Deertoe*
- *Paper pondshell*
- *White heelsplitter*
- *Pimpleback*
- *Pink heelsplitter*
- *Fragile papershell*
- *Round pigtoe*
- *Giant floater*
- *Hickorynut*
- *Mapleleaf*
- *Washboard*
- *Butterfly*
- *Fawnsfoot*
- *Monkeyface*
- *Fat mucket*
- *Black sandshell*
- *Plain pocketbook*
- *Sheepnose*
- *Creeper*
- *Elktoe*
- *Spike*

The mussel population in Pool 5 was estimated at 189 million. The majority of mussels were in depths greater than 1.5 feet.

Fish

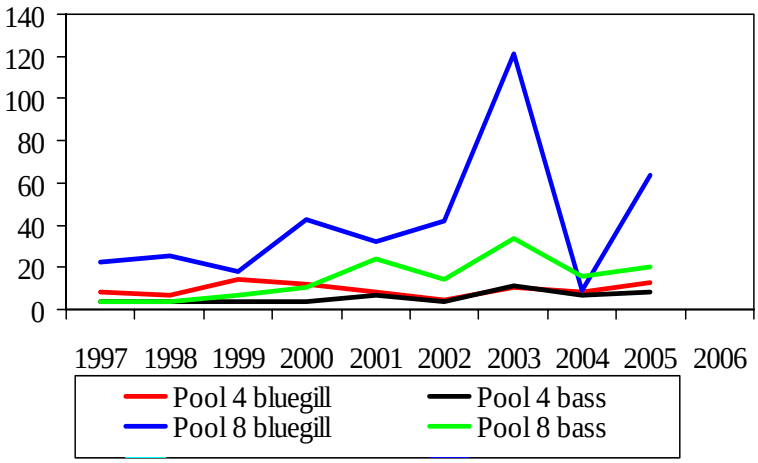
Drawdowns could affect fish in a variety of ways. Some fish may become stranded and die, spawning nests for some species could become exposed, or some species may experience higher predation as water levels are reduced and fish are more concentrated. Positive changes might also occur as improved vegetation and water clarity increase cover, food supply, and spawning habitat. Backwater species like bluegill and largemouth bass would be expected to benefit most from drawdowns.

Unfortunately, impacts to fish are very difficult to assess because fish are highly mobile and cannot be seen or "counted" in the water like ducks or other wildlife. For example, if reproduction is improved by a drawdown it may take several years of sampling before this change can be documented.

Fisheries data from the Long Term Resource Monitoring Program have been collected from Pools 4 and 8 annually since 1993, and annual fish sampling has been conducted by the Minnesota Department of Natural Resources on Pools 3, 5, 5a, 6, 7, and 9 since 1993. In addition, during the Pool 8 and Pool 5 drawdowns, backwater areas were periodically checked to document any fish kills.

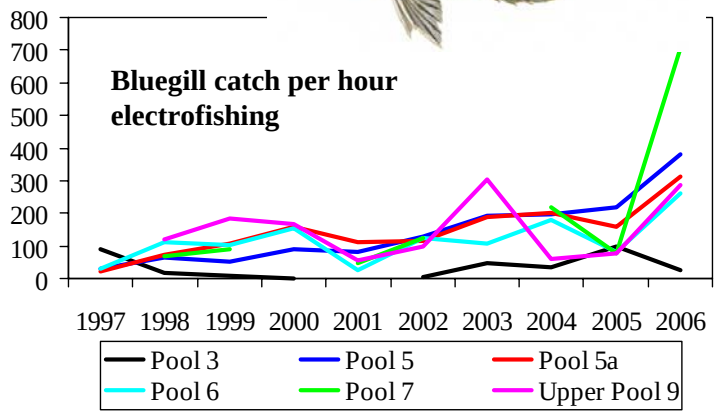
Dead fish were observed at a number of sites during the 2006 Pool 5 drawdown; however, a similar situation occurred in many other pools that were not being drawn down. Very low flows throughout the system combined with warm temperatures likely caused these kills.

It is too early to determine the effects of drawdowns on fish – several years of monitoring are needed.



Bluegill and largemouth bass catch per 15-minute sample from Long-Term Resource Monitoring electrofishing surveys in Pool 4 and Pool 8.

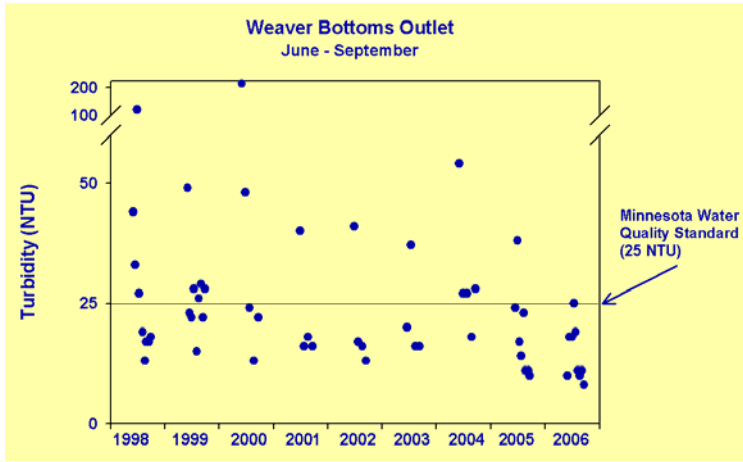
Bluegill catch per hour from Minnesota Department of Natural Resources surveys showed increasing trends in most pools, including Pool 5. Pool 3 was the only exception. Data from Pools 4 and 8 were collected as part of the Long Term Resource Monitoring Program and are not shown in this figure because different sampling methods were used.



Water Quality and Contaminants

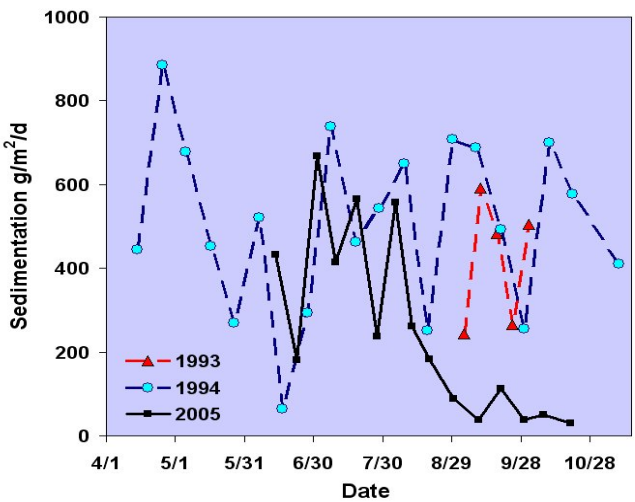
It was anticipated that water quality would improve with drawdowns. Increases in aquatic vegetation would reduce waves, stabilize bottom substrates, and capture more sediment, resulting in clearer water and reduced nutrient loading. Dissolved oxygen could also be affected by increased vegetation. Continuous monitoring equipment recorded measurements of dissolved oxygen, water temperature, light penetration, and wind speed in both Pool 8 and Pool 5. In Pool 8, the Long Term Resource Monitoring Program has been collecting annual data on suspended solids, dissolved oxygen, temperature, nutrients, and chlorophyll from randomly selected sites since 1993. In Pool 5, these same measurements were taken during the drawdown at Locks and Dams 4 and 5 and at the entrance to and outlet of Weaver Bottoms.

In Pool 5 the lowest summer turbidity values ever measured at the outlet of Weaver Bottoms occurred in late-summer 2005 and 2006. Although it is difficult to directly link the improved water quality in Pool 5 to the drawdown, the benefits to water quality resulting from increased aquatic vegetation, which accompany drawdowns, is well understood.

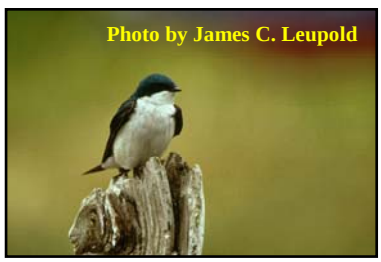


Weaver Bottoms turbidity readings 1998-2006 – readings during drawdown years were the lowest recorded – MnDNR

In Pool 8, no obvious changes in water quality parameters could be directly attributed to the drawdowns. Most parameters were within the normal range and followed the same trends as previous years and on other non-drawdown pools.



Low sedimentation rates were observed in Pool 5 late in the drawdown – WDNR



Tree swallows were monitored in Pool 8 to determine if contaminant levels might increase as a result of feeding in areas exposed by the drawdown. Contaminants did not appear to increase.

Water quality improvements were observed in localized areas where vegetation was established but were not apparent throughout the entire Pool.

Sediment Transport and Consolidation

The ability to implement drawdowns and much of the cost are related to main channel conditions. If channel depths for commercial navigation will be reduced by a drawdown, additional dredging is required. The cost of this dredging, however, can be partially offset if dredging in subsequent years is reduced. Increased flow velocity will increase sediment transport in the main channel, which could, based on modeling results, cause more rapid deposition in dredge cuts. Monitoring was completed in both Pool 8 and Pool 5 to determine the impact of drawdowns on sediment transport and subsequent dredging needs and costs. In addition, channel conditions were monitored at tributary mouths to determine if lower water elevations affected sediment transport and deposition.

It was also anticipated that sediments might consolidate and settle as they dry out, changing the chemical conditions in the soil and increasing depth after the areas are reflooded. Sediment cores were collected at more than 50 sites in Pool 8, primarily Lawrence Lake, Minnesota, to determine moisture content, soil density, and organic matter content.

Main channel flow and sediment transport increased during the Pool 8 drawdown. Some tributary mouths experienced erosion while others experienced deposition; no patterns were consistent with the effects of a drawdown. These conditions create greater bottom diversity, providing different habitats for fish and wildlife. Limited consolidation of sediments occurred in the drawdown zone in lower Pool 8, where much of the sediment consisted of silty sand with low organic content.

In Pool 8, average annual dredging increased to 83,500 cubic yards per year over the long-term projected value of 75,000 cubic yards per year, an 11% increase in dredging volumes over the 3-year period 2001 to 2003.

In Pool 5, results indicate more dredging was required. The long-term projected annual dredging volume is approximately 90,000 cubic yards per year. So far dredging volumes have been 362,000 cubic yards per year in 2005, and 48,000 cubic yards per year in 2006. Total volume of additional dredging will be determined after the 2007 navigation season.

The amount and cost of additional dredging to maintain adequate depth for commercial navigation during drawdowns varies by pool.

Recreational Boating

Although the long-term environmental and ecological improvements expected from summer drawdowns would benefit boating and fishing enthusiasts, the potential short-term negative effects on these activities were recognized by the Water Level Management Task Force. These effects were primarily associated with reduced access to launch ramps, docks, harbors, marinas, boat houses, and some backwater access and potential safety concerns due to submerged hazards such as wing dams. As a result, an effort was made to minimize those effects prior to the drawdown and monitor the impacts on recreation during the drawdown.

Citizens were actively involved in the planning of the Pool 8 and Pool 5 drawdowns, especially regarding recreational access sites and needs. In Pool 8, provisions were made for dredging to provide adequate access at some recreational boat landings and access channels through a 75% federal cost share program to local governments or residents. In Pool 5, a Citizens Advisory Committee provided a map to the Water Level Management Task Force highlighting priority access sites. Several of these sites were dredged using state and federal funding. After the dredging was completed, the access routes were buoyed to help identify their locations.

Signs and water level gauges were placed at a variety of locations throughout the pools, informing boaters of the drawdowns and current water elevations. Frequent news releases helped get the word out and a web-site www.drawdowns.com provides current information to web users.

During the 2006 boating season, 998 surveys were randomly distributed on windshields at designated public boat landings in Pool 5, with 431 returned. The survey showed:

- 94% of boaters in Pool 5 were satisfied or very satisfied with their boating experience.
- 91% of boaters in Pool 5 had some knowledge about the drawdown.
- 76% of the boaters in Pool 5 observed an increase in aquatic vegetation.
- 51% of the boaters in Pool 5 rated the drawdown as very effective or mildly effective for improving fish and wildlife habitat.

Recreational boating activity was evaluated in Pools 8 and 5 using the biennial Recreational Boating Study of the Upper Mississippi River, which began in 1989 and is repeated in odd numbered years. This survey involves aerial counts of boats throughout the summer season.

Results from the Recreational Boating Study indicate no major fluctuation in boating activity in the immediate or adjacent pools as a result of the drawdowns.

Impacts on recreational boaters were minimal.

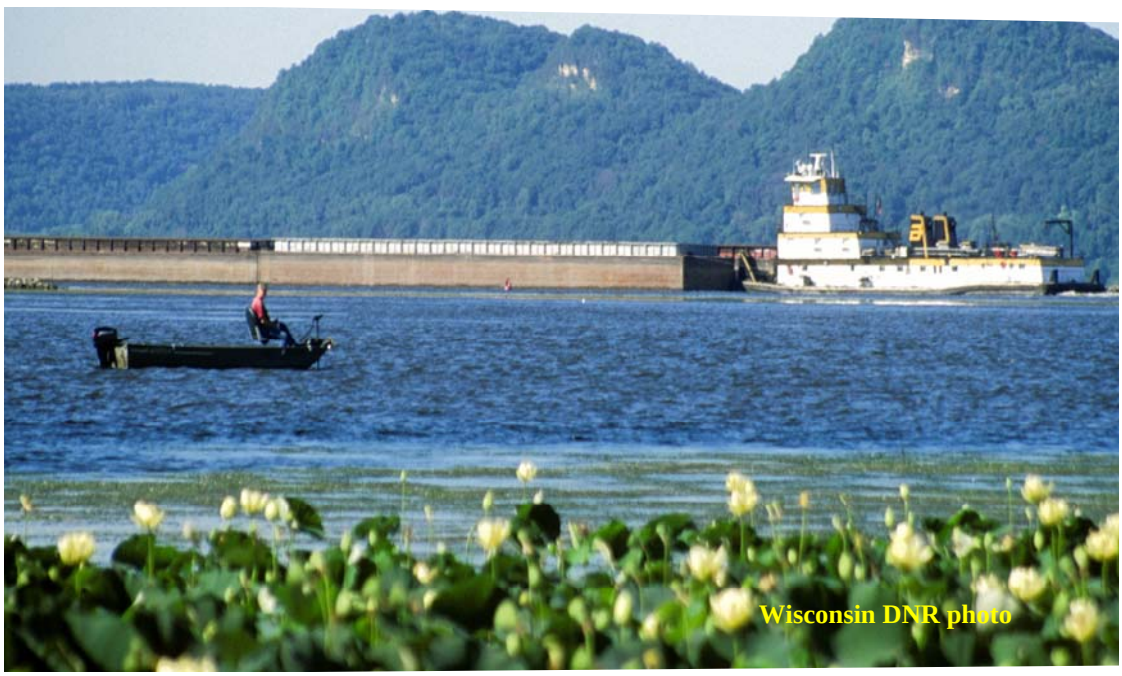
Temporary boat ramp constructed at West Newton, Minnesota, in Pool 5 to provide access during the drawdown. This was a popular access that is being made permanent.

Commercial Navigation

One of the criteria for successfully implementing Upper Mississippi River pool-scale drawdowns is to minimize adverse impacts on commercial navigation. Prior to and during the Pool 8 and Pool 5 drawdowns, main channel depths were extensively monitored. Dredging was completed as necessary prior to starting the first year of the drawdowns.

The potential navigation impacts of the drawdown were coordinated extensively with the navigation industry through the River Resources Forum, the Water Level Management Task Force, the River Industry Action Committee, and the U.S. Coast Guard. This collaboration with industry is essential in maintaining adequate channel conditions during a drawdown. Surveys of tow-boat pilots were conducted to get their input on the condition of the main channel. The surveys indicated that certain reaches of the pools were more difficult to navigate during drawdown conditions. However, pilots' comments indicated no serious threats to the safety and security of crews, infrastructure and vessels, and that the main channel was navigable during the drawdowns.

During the 2005 Pool 5 drawdown, six groundings were reported in Pool 5. None of the groundings were directly caused by the drawdown, and the reasons for the groundings were similar to reasons for groundings during normal, non-drawdown operations. During the 2006 drawdown of Pool 5, a grounding occurred in early July. Again, this grounding was not attributable to the drawdown, which had an effect of less than 0.2-foot at that time due to extremely low river flows. The 2006 drawdown was terminated shortly thereafter to ensure that commercial navigation could continue unimpeded.



Cultural Resources

Cultural resources are a major component of the Upper Mississippi River and are integral, nonrenewable elements of the physical landscape. As expressions of human culture, they convey an appreciation for the past, our cultural heritage and diversity, enriching and shaping our identities and those of future generations. Cultural resources include precontact and historic archaeological sites and artifacts, historic standing structures, historic and archaeological districts, cultural landscapes and ethnographic resources. The archaeological record, represented by thousands of sites, indicates continual human occupation along the Upper Mississipi River for approximately 12,000 years.

Unfortunately, many Upper Mississippi River cultural resource sites have been destroyed or are threatened by development, cultivation, erosion and looting. Preserving or minimizing the degradation of significant cultural resources is mandated by various federal and state laws, contributes to our knowledge of the past and is one of the responsibilities of the Corps of Engineers, the U.S. Fish and Wildlife Service, and other agencies. Pool drawdowns provide an opportunity to study impacts of changing water levels on archaeological sites and to identify sites exposed by lower water levels.

Burial mounds in Iowa - Photo by R. Clark Mallam.

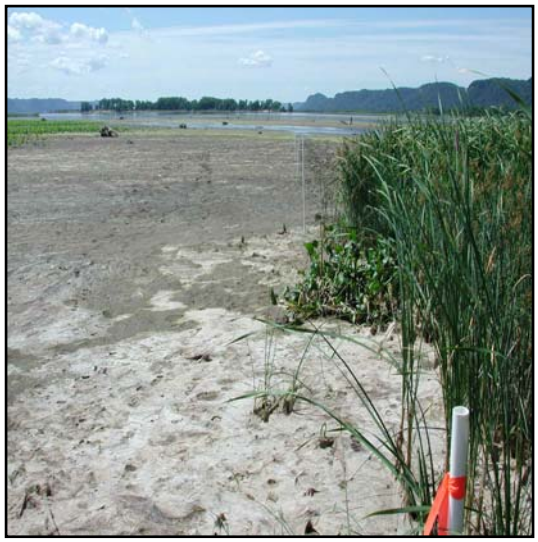
150 years ago, 250 burial mounds were in the Pool 8 area. Due to historic and modern land uses, less than two dozen are present today.

For the Pool 8 and Pool 5 drawdowns, a total of 38 sites were monitored. Almost half of these sites had a high probability of potential negative impacts from erosion or looting. While the impact on sites from the drawdowns are still being assessed, in some cases the drawdowns have helped to preserve sites by allowing vegetation to reestablish and reduce or eliminate erosion.

Precontact and historic artifacts

Cultural resources have not been adversely affected by the drawdowns.

Linking it all together



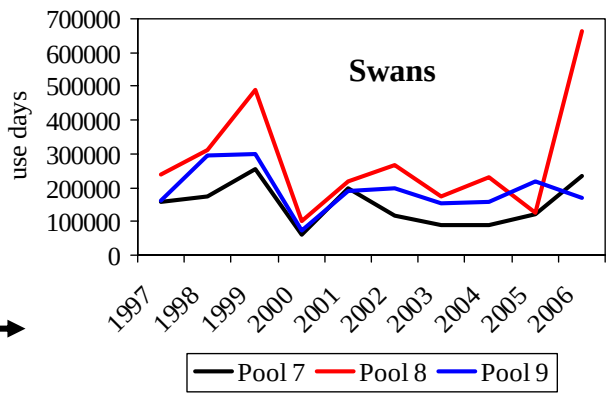
Drawdowns expose sediments that sprout vegetation

Vegetation is reflooded and collects sediment, improving water clarity

Clear water helps vegetation persist

Vegetation provides food and cover for wildlife

Wildlife numbers increase



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Or visit the following website:

www.drawdowns.com