Wetland Habitats and Their Ecology: 
The Horicon Marsh Case History

Horicon Marsh is Wisconsin’s largest wetland and has a history of environmental change and human impact that has been played out on a vast scale. Some aspects of Horicon’s history are unique to this marsh, while others are representative of changes in many other wetlands in the state and beyond. Horicon Marsh is a restored wetland, and concerns today center on maintaining the ecological health and integrity of this altered ecosystem.

by William K. Volkert

Like most of Wisconsin’s 15,000 lakes and innumerable wetlands, Horicon Marsh owes its origins to the great glaciers of the last Ice Age. When they retreated nearly 12,000 years ago, these glaciers left behind an entirely altered landscape of gently rolling hills, depressions, and an irregular drainage system.

A Brief Geological History

Horicon Marsh was formed as the glaciers moved over and scoured the underlying bedrock. The advancing ice mass split around the Door County peninsula, creating Lake Michigan to the east and carving out three major basins—Green Bay, Lake Winnebago, and Horicon Marsh—to the west. As the ice moved forward, it heaped up the land into a series of elongated hills, known as drumlins, along its axis of movement. The greatest concentration of drumlins in the world is found south and west of Horicon Marsh. Even the islands in the marsh, presently surrounded by accumulating peat, are the remnants of drumlins.

The ice began to wane as the climate warmed, but did not simply melt away in a steady progression. Instead, the glacial front retreated in stages, sometimes coming to a rest on the land and occasionally even re-advancing. Each time it came to rest, the rocks, sand, gravel, and clay that had become incorporated into the ice mass were deposited at its front, leaving behind a moraine to mark its temporary halting point. Between Madison and Fond du Lac, there exist seven major reces-
sional moraines that mark the resting points of the retreating glacier.

Two such recessional moraines were laid down across the southern and northern ends of the Horicon basin, where the Cities of Horicon and Wau- pun are located today. The southern moraine served as an earthen dam to impound the meltwaters, creating a vast post-glacial lake. From this ancient lake, the waters flowed out at the southern end and cascaded over the glacial moraine to give rise to the Rock River. Because it was comprised of loosely consolidated glacial debris, the moraine was easily eroded and eventually led to the draining of the glacial lake. Thus was born the Horicon Marsh.

**Horicon's Archeological History**

From the end of the Ice Age until modern settlement, Horicon Marsh has been home to a profusion of wildlife, which has attracted a variety of human cultures that came to take advantage of these abundant natural resources. The archeological record clearly demonstrates that people have been a part of Horicon ever since the end of the Ice Age.

Artifacts such as stone tools and implements, campsites, village sites, effigy mounds, and a vast trail network provide the evidence to tell this ancient story. Scientists have found that nearly every major prehistoric Indian culture known to Wisconsin has been represented in the archeological record at Horicon Marsh, including the Early Paleo and Late Paleo Indians, the Copper Culture, the Red Ochre Mound Builders, the Effigy Mound Builders, the Hopewellian Indians, and others. This latter group of prehistoric cultures is commonly referred to as the Woodland Indians, yet most of these people associated more with wetlands and shallow lake and river systems than with woodlands. They are responsible for some of the largest archeological sites in Wisconsin, found around Green Bay, the Lake Winnebago area, Horicon Marsh, Sheboygan Marsh, and along the Wisconsin and Mississippi rivers (Figure 1).

Horicon's tremendous biological diversity and productive wetlands offered hunting and gathering opportunities that supported relatively large human populations. By the time of early European exploration and settlement, Horicon Marsh and the Rock River formed the dividing boundary between the Potowatomi and Winnebago (Ho-Chunk) people, and also separated the wide open prairies to the west from the hardwood forest on the marsh's east side. The site of the City of Horicon was at one time a large Winnebago village of more than 2,000 people. These people were displaced when the treaties of 1829 and 1832 opened the region for land claims and settlement.

Although Horicon Marsh has a human history that spans nearly 12,000 years, the early people who harvested plant and animal life from the marsh and the surrounding prairies and woodlands did relatively little to alter the marsh itself. As is true of most of Wisconsin and North America, more changes have taken place here in the last 150 years than in the thousands of years prior. While aspects of the history of Horicon Marsh are unique, others are representative of the history of wetland changes and changing attitudes over the past century and a half.
Figure 1. Indian effigy mounds once lined the banks of the Rock River where the City of Horicon is located today, as seen in this 1856 map prepared by early Wisconsin naturalist Increase A. Lapham. WDNR file photo.

**Horicon’s Settlement History**

*Lake Horicon*—The City of Horicon was the first city on the marsh of the same name, founded in 1845 (Figure 2). This site was surveyed in 1838 by Solomon Juneau, the founder of Milwaukee, but the town was established by others seven years later. With the rapid influx of settlers into the area, changes came quickly. In 1846, only one year after the arrival of the settlers, a dam was built across the Rock River at the outlet of the marsh to power the first sawmill and, later, a gristmill. Composed of logs, rocks, mud, and hay, the dam measured 9 feet high and 150 feet across.
Figure 2. Map of Lake Horicon, showing surrounding communities and habitats as they were in the mid-1850s. WDNR file photo.
As a result of the dam, which essentially plugged up the outlet of the marsh, a vast lake was recreated that had not existed since the end of the Ice Age. Lake Horicon measured 51 square miles in area and was considered to be the largest manmade lake in the world at the time. But the high water flooded surrounding farmland, resulting in damage to private land and leading to demands for compensation. The case made its way to the Wisconsin State Supreme Court, which in 1869 ruled in favor of the landowners and required the dam operators to pay farmers for lost crop production. In the end, it was cheaper to simply remove the dam; 23 years after it was built, the dam was disassembled.

Private Hunting Clubs and Market Hunters—When the dam was removed, the land reverted to marsh and once again hosted an abundance of waterfowl and other wildlife. During the late 1800s, ducks—rather than the abundant Canada Geese we see today—were the primary waterfowl using the marsh.

During the period from 1870 to the early 1900s, two major forms of waterfowl hunting became established on Horicon Marsh to take advantage of this seemingly infinite resource. One of these was the development of private hunting clubs (Figure 3). These were comprised of wealthy businessmen from nearby towns—as well as from Madison, Milwaukee, Fond du Lac, and Chicago—but they also lured hunters from as far away as Ohio, Boston, and New York. The clubs included the Kaw-Kaw Club, the Greenhead Club, Strooks Club, the Fond du Lac and Horicon Shooting Clubs, and the Diana Club. The clubs leased huge tracts of land on the marsh, and in some cases hired their own wardens to keep out nonmembers.

The clubs’ attempts to privatize the marsh actually provided for the first form of conservation on Horicon. At this period in our history, wildlife resources were perceived to exist in unlimited supply and, as a result, there were no hunting laws or regulations. In spite of this perception, the private clubs did not allow hunting during spring migration and established the first bag limits on the marsh—at 25 ducks per day! While these conservation efforts may seem weak by today’s standards, they were at least an attempt to restrict the harvest.

Areas of the marsh not controlled by private hunting clubs were open to the exploits of market hunters, who commercially harvested wildlife for sale in the larger cities. Horicon Marsh was known as a major supplier of wild ducks for the markets of the upper Midwest. Market hunters sought to harvest the largest possible number of ducks in a short period of time. Waterfowl were baited by placing shelled corn or other grain in the shallow waters of the marsh to lure in and concentrate the flocks. These hunters commonly used four and two gauge shotguns—called “punt guns”—that were essentially small cannons with barrels 12 to 15 feet long (Figure 4). On average, a hunter could easily kill 30 to 50 ducks with a single shot. The ducks were taken to the towns of Horicon and Mayville and packed at a rate of 200 per barrel.

The market hunters harvested birds without regard for their limited populations (Figure 5), and also hunted prior to the nesting season (some hunters claimed that hunting in the spring was often more successful than
in the fall). This so seriously decimated waterfowl populations that, within 25 years, a seemingly inexhaustible population of ducks had been hunted to its limit and most market hunters had abandoned the marsh. As a result, market hunting became a nearly extinct industry even before laws were passed to ban the practice.

The depletion of Horicon’s waterfowl affected what was the primary value of the marsh for most people. In the public’s mind, the value of a duck marsh that was nearly devoid of ducks was being called into question.

**Ditching and Draining**—In the early part of the twentieth century, efforts were undertaken to reap another kind of harvest from this land by ditching and draining it for agricultural use. At the time, Horicon Marsh was called “The Wasteland” and was considered useless swampland and an impediment to human progress. The hope was that if the land could be drained, it would become some of the most productive cropland in the state.

Beginning in 1910, ditches were excavated by a large piece of machinery known as “The Dredge,” which consisted of a barge with a steam shovel on it (Figure 6). The main ditch was dug 8 feet deep, 60 feet wide, and 14 miles long. It required four years to dig this ditch and an additional two years to complete the lateral ditches, which connected to the main ditch to drain the backwaters.

Farmers tried to raise onions, carrots, and potatoes on the dried peat soils (Figure 7), but drainage remained a problem, particularly in the southern portion of the marsh. Hori-
con has a large watershed and catchment basin, and a large amount of water flows into it following rains and the spring thaw. Drainage of these waters was impeded by the Hustisford dam and the slow flow of the Rock River, which drops only about 8 vertical inches between the cities of Horicon and Hustisford.

Failure to bring the land into agricultural production and to show significant profits eventually led to abandonment of the farming effort. By the 1920s, the peat soils lay exposed to the atmosphere and began to dry and rot under the summer sun. Decomposition of the peat led to spontaneous combustion, and fires burned throughout the 1920s and into the 1930s. One fire was reported to have burned continuously for three years.

Instead of improving a “wasteland,” humans had not only devastated the duck population through overhunting, but had ruined an entire wetland ecosystem through drainage and the resultant fires. By the 1920s, Horicon Marsh lay useless to both people and wildlife.

**THE RESTORATION OF HORICON MARSH**

What we see at Horicon Marsh today is the result of a vast restoration project—an attempt to rebuild the marsh for wildlife purposes. The campaign to restore the marsh was initiated locally (Figure 8). Under the leadership of Louis “Curly” Radke, then president of the state Isaac Walton League, a
Figure 5. One day's bag of ducks by market hunters on Horicon Marsh in the late 1800s. WDNR file photo.

Figure 6. The arrival of "The Dredge," a barge-mounted steam shovel for ditching and draining Horicon Marsh, was a cause for celebration, as shown in this 1910 photo. WDNR file photo.
Figure 7. Once the marsh was ditched and drained, Horicon’s peat soils were broken and plowed for agriculture. WDNR file photo.

campaign was organized in 1921. The purchase and restoration of the marsh was too costly and complex for local conservationists to undertake alone, so they took their efforts to Madison where they worked with the state legislators to enlist public assistance. Following a seven-year campaign, the state passed into law the Horicon Marsh Wildlife Refuge Bill in 1927.

This bill provided funds over a ten-year period to purchase land and to construct a dam at the outlet of the marsh to essentially plug up the ditches and restore the original water levels. When the dam gates were closed, the Horicon basin was again flooded, dousing the fires and encouraging the reestablishment of native wetland vegetation. This, in turn, created the habitat that began to lure wildlife back to the area. When the state funds were depleted by the late 1930s, however, only about one-third of the marsh had been acquired.

Horicon Marsh showed such a quick recovery and potential for restoration that it gained national attention as a conservation effort. In 1941, the federal government came in to complete the job begun by the state and established a national wildlife refuge. Today, the southern third of the marsh is a state wildlife area, under the control of the Wisconsin Department of Natural Resources (WDNR), and the northern two-thirds comprises the Horicon National Wildlife Refuge, under the jurisdiction of the U.S. Fish and Wildlife Service.

Horicon is finally receiving the appreciation it has long deserved. Due to its unique and outstanding glacial history, Horicon Marsh is now included as a unit of the Ice Age National Scientific Reserve, in cooperation with the National Park Service. In 1991, Horicon was recognized by the Ramsar Convention under the United Nations and received the prestigious title of Wetland of International Importance. And in 1997, the marsh was recognized by the
American Bird Conservancy as a Globally Important Bird Area.

Horicon is now recognized as one of the most important wetland ecosystems in the upper Midwest. The state portion of the marsh was originally established as a migratory stopover site and nesting grounds for waterfowl, and the national wildlife refuge was established as a nesting area for Redhead ducks (*Aythya americana*). Today, Horicon is one of the largest nesting sites for Redheads in the eastern U.S. Over the years, management efforts have also focused on restoring populations of Canada Geese (*Branta canadensis*) and, in recent decades, of a number of threatened and endangered species. Concerns during the 1970s and 1980s focused on nongame wildlife, and now increasingly emphasize the biodiversity of this entire wetland ecosystem.

**The Horicon Marsh Ecosystem**

Compared to what the early settlers found more than 100 years ago, Horicon Marsh today is a vastly altered wetland system. Descriptions from waterfowl hunters of the late 1800s tell us that the original marsh was shaped by a braided stream system formed as the two branches of the Rock River spread out over this vast basin. At that time, the marsh was comprised of a series of wetland communities, with river channels and open water areas interspersed with oxbow lakes, peat lands, and islands. Early naturalists described the area as supporting open water with lily pads, cranberry bogs, floating bogs, cattail marsh and sedge meadows, lowland brush, and forested areas. It was, in fact, a mosaic of various wetland types that changed and shifted over
time with drought and flood, and with
the occasional fires that swept in from
the prairies and oak savannas on the
west side of the marsh. It was essentially
diverse and ever-changing.

Today, Horicon Marsh is a very mono-
typic wetland composed primarily of
open water and cattails. Paradoxically,
this very simplified wetland still sup-
ports a diverse bird community; over
the years, a total of 268 species of birds
have been recorded here. The marsh’s
present bird diversity appears to be a
function of Horicon’s vast size and the
variety of structural habitats available
among the cattails and open water.
Species that are area-dependent (re-
stricted to large wetlands), such as
Great Blue Herons (Ardea herodias),
Great Egrets (Ardea alba), and Ameri-
can White Pelicans (Pelecanus erythro-
rynchos), find plenty of space in Hori-
con’s 32,000 acres. Other species ex-
plot the structurally diverse habitats
that range from shallow to deep ex-
panse of open water, sparse to dense
stands of cattails, and occasional ex-
posed mudflats.

The bird community has favorably
responded to the restoration of Hori-
con Marsh, but there still have been
dramatic changes in bird populations
over the past two to three decades.
Many waterfowl hunters can verify that
ducks and American Coots (Fulica
americana) were much more abundant
in the 1940s through 1960s than they
are today. In the past, coots were seen
in “rafts” of literally thousands of in-
dividuals.

Unfortunately, people often try to
reduce the complexity of nature to
simple cause and effect relationships. I
have often heard people say that in-
creasing Canada Goose populations
chased the ducks out of the marsh.

While it is evident that duck popula-
tions at Horicon are down and that
geese have dramatically increased, no
simple relationship exists between the
two. Horicon has also witnessed
changes in other wildlife populations,
such as the dramatic increase in carp
and the decline of muskrats. These
changes are the result of a complex se-
ries of interacting ecological events
and are more complicated than simply
one species supplanting another.

Changing Land Use Practices in the
Rock River Watershed—The east and
west branches of the Rock River are the
primary streams that feed into Horicon
Marsh. Horicon is considered to be the
headwaters of the Rock River, which
eventually delivers its water to the Mis-
sissippi River.

The primary land use in this region
of Wisconsin is agriculture. During the
1940s to 1960s, when the small-scale ag-
icultural practices of the day were
much more compatible with the needs
of wildlife than they are today, the re-
region from Madison to Horicon Marsh
to Green Bay was considered among the
most productive agricultural land in
the state and the most productive re-
region for nesting waterfowl and pheas-
ants. We can assume that other grass-
land and wetland birds were also rela-
tively abundant in this same area, but
we only have data on game species for
this period. During the 1970s, duck and
pheasant populations showed their
greatest decline in this part of the state.

The advent of modern agriculture
brought a tremendous increase in food
production, but also resulted in the
loss of hedgerows, numerous small wet-
lands, and the practices of rotating
crops and letting land lie fallow. Like
so many other areas, the Rock River wa-
tershed has seen a tremendous loss of topsoil, which continues today. These events set in motion a complex series of changes that have had profound impacts—both positive and negative—on bird and plant populations in the Horicon ecosystem.

Due to the loss of small wetlands surrounding Horicon Marsh, there is less land to absorb rain and melting snow and spring runoff has greatly increased. This surge of runoff carries a tremendous load of sediment and nutrients from the surrounding farmland and expanding urban centers. Water quality monitoring in the Rock River upstream from the marsh, conducted by the WDNR in cooperation with the U.S. Geological Survey, has shown that 17,600 pounds of phosphorous and 3.9 million pounds of sediment poured into the marsh during a single four-inch rain event in April 1998.

Sedimentation has changed the bottom of the marsh from peat layers to soft, semi-suspended muck and silt. Additionally, nutrients have increased to a point where existing aquatic plants cannot absorb the abundant phosphorous, leading to increasingly common algal blooms in recent years. Dense algal mats shade out the submergent plants, allowing fewer plants to grow in the water column and leaving even more nutrients to fuel algae growth. When the algae dies and decomposes, oxygen levels in the water fall, occasionally resulting in die-offs of northern pike and panfish, such as bluegills. The survivors of these low oxygen conditions are carp and bullheads, which are now without predators or competitors.

A healthy aquatic plant community is important because it provides a number of vital functions for the marsh. Aquatic plants take up nutrients, produce oxygen for aquatic life, and slow wave action that acts to re-suspend sediments. They also provide spawning sites for fish and frogs and shelter for fish and aquatic invertebrates. These plants and invertebrates are the primary food for most of our ducks and coots, as well as for other wetland birds. Their loss has led to the decline of food in the marsh, and, in turn, the decline of ducks and coots.

**Changes in Fish Populations**—In recent decades, the carp population has exploded in Horicon Marsh due to a loss of predators. In the 1940s, northern pike weighing over 20 pounds were caught in the marsh (Figure 9). These large predators kept check on the carp, while bluegills fed on carp eggs and fry.

Carp now dominate Horicon’s fish population, and have major impacts on the aquatic and wetland environment. Carp are bottom feeders that wallow in the mud to obtain food. This action re-suspends the sediments and further clouds the waters, in many cases reducing water clarity to as little as 4 to 6 inches. When this occurs, there is insufficient light reaching the bottom to allow submerged aquatic plants to grow. When carp wallow in the soft mud bottom, they disturb existing submergent plants by uprooting them. As a result, there exist today large open water areas of Horicon Marsh that are nearly devoid of aquatic vegetation due to abundant carp.

Over the years, there have been at least three attempts to chemically eradicate carp from the marsh through the application of rotenone as a fish toxicant. Literally millions of pounds of carp were killed, but their populations
rebouned to former levels within 10 years because the ecological condition of the marsh had not changed. Essentially, it still remained as ideal carp habitat and the few remaining carp soon repopulated the marsh.

**Changes in Bird Populations**—Horicon Marsh and similar wetlands have seen major changes in the composition of populations of waterfowl and other birds. The decline in ducks over the past several decades is not a result of competition with Canada Geese, but rather is due to a lack of food resulting from the many complex changes to Horicon’s aquatic environment. Canada Geese have increased due to controlled hunting and because, unlike ducks, they can find abundant food in the cornfields surrounding the marsh. Geese will eat aquatic vegetation, but they are primarily upland grazers. They use the marsh as a safe resting area and fly out each day during migration to feed in agricultural fields.

When assessing the ecological health of Horicon Marsh, it is important not to focus our attention only on Canada Geese. After all, if these birds can thrive in downtown Milwaukee and Chicago, what can they tell us about the health of this marsh? Instead, attention should be focused on the marsh’s most sensitive species.

Among the 268 species of birds that use Horicon, we find a spectrum that runs from highly specialized birds like Forster’s Terns (*Sterna forsteri*), Great Egrets, Least Bitterns (*Ixobrychus exilis*), and King Rails (*Rallus elegans*) to generalists such as Canada Geese, Red-winged Blackbirds (*Agelaius phoeniceus*), and Ring-billed (*Larus delawar-
ensis) and Herring Gulls (Larus argentatus). Some of the most specialized species are already listed as threatened or endangered across their ranges. How do these birds respond to Horicon’s altered ecology? While the generalists tend to maintain themselves or even increase as habitats are altered, the specialists find it increasingly difficult to maintain their populations.

Due to the fact that they are so observable, birds are some of the best indicators of ecosystem stability or change. For example, the state threatened Great Egret (Figure 10) and the state endangered Forster’s Tern, both of which nest in the marsh, are good environmental indicators. So are Black-crowned Night-Herons (Nycticorax nycticorax), American Bitterns (Botaurus lentiginosus), Sora (Porzana carolina) and Virginia Rails (Rallus limicola), and Black Terns (Chlidonias niger), among others. As we watch for changes in populations of these species, they hint of subtle changes in the habitat or ecosystems on which they depend.

**CHALLENGES FOR THE FUTURE**

Restoring the ecological health of Horicon Marsh depends on developing sustainable uses of the land within the watershed. This will not be achieved through further regulations alone, but will require increased public understanding of our role in the scheme of things on an ecosystem-wide scale.

Certainly there is a great need for public education. Most of Horicon’s 400,000 annual visitors can identify

Figure 10. Great Egrets, a Wisconsin state threatened species, have nested at the Fourmile and Cotton Island rookery in Horicon Marsh since 1946. Photo by William K. Volkert.
only a very small fraction of all the birds present on the marsh. Many people come primarily to see the large flocks of Canada Geese during fall migration, and are unaware of the impacts ecological change has had on the marsh’s other bird species. Vast numbers of birders are drawn to and are concerned about the marsh, but many come from great distances and do not affect local land use policies and practices.

While we have tried to manage Horicon Marsh as an ecosystem, we are still only treating the symptoms of poor land use and poor water quality. Horicon has been recognized as a Wetland of International Importance, yet we continue to use it as a septic system for agricultural and other nonpoint sources of runoff. We need to address on a local level the sources of these problems, which include land uses that are incompatible with wildlife habitat and the resultant nonpoint source pollution.

The challenges at Horicon should not be construed as a problem of agriculture versus the environment, however. We need to remember that farmers were compelled to rely on modern agricultural practices through programs of the U.S. Department of Agriculture and university extension services. In the final analysis, this is not so much an agricultural problem as one for society as a whole. Unless we offer assistance to farmers and local towns to change to more sustainable agricultural and other land use practices, they will be forced to sell their land off to developers, leaving us with yet another set of ecological problems for wildlife and the health of the marsh.

Wildlife is simply a product of the land. In the natural scheme of things, wildlife populations are abundant in some areas and scarce in others because the resources they require—food, water, and shelter—are either available or not. As the land changes, certain species will find increased opportunities while others will decline. Sustainable use of the land will allow Horicon and similar wetlands to support a diversity of birds and other wildlife. Our actions and activities will be judged by nature, by whether or not we can define a sustainable lifestyle—a Land Ethic—that allows us to share this land with wildlife. This dynamic relationship is well revealed through the natural and cultural history of Horicon Marsh.

William K. Volkert
Wisconsin Department of Natural Resources
N7725 State Hwy. 28
Horicon, WI 53032
Forster's Tern at Horicon Marsh by Jack Bartholmai