Runaway Devils Lake

Devils Lake is where I began my career as a limnologist in 1964, studying the lake's neotenic salamanders and chironomids, or midge flies. Back then, the lake covered about 80 square kilometers, had a maximum depth of about 3 meters and held about 130,000 acre-feet of water. The lake has since risen 13 meters, from a surface elevation of 430 meters above mean sea level to 443 meters. Estimated lake volume is now 4.1 million acre-feet, or about 32 times greater than it was in 1964, and about 370 times greater than it was in 1940 when the lake stood at a record low elevation of 427 meters.

The Devils Lake Basin is an endorheic, or closed, basin covering about 9,800 square kilometers in northeastern North Dakota. The basin is at the epicenter of an unprecedented wet period in the lake's modern-day history going back to 1867, when the lake's surface elevation was first measured. Basin climate has become substantially wetter since 1990, with the years 1990 through 2009 ranking as the wettest 20-year period in more than a century. The National Weather Service has referred to this trend as "the new climate" for the Devils Lake region, cautiously predicting that the current weather pattern may continue for several decades and possibly intensify. Indeed, the agency has warned that the region faces the strong possibility of an "unprecedented fourth consecutive major spring flood threat in 2012."

Rising lake waters have flooded much of the region, engulfing hundreds of homes and farmsteads, more than 650 square kilometers of productive farmland, major highways and bridges, state parks, Native American tribal lands, historical landmarks and more than half a million trees. Submerged too is the North Dakota Biological Station, a two-story limnological facility established in 1909 to study the lake's unusual ecology and biogeochemistry. Portions of U.S. Highway 281 are now underwater, which has forced the relocation of this principal north-south highway several kilometers to the west. Other roads and highways are either extremely hazardous or simply impassable because of

encroaching floodwaters. Amtrak and the BNSF Railway may have to reroute their trains over more southern lines as rising waters threaten to wash out roadbeds and bridges. The small town of Minnewaukan, once located 13 kilometers west of the lake, is now partly underwater, and many of its 300-plus residents have been forced to abandon their homes. Only a handful of people remain in Churchs Ferry and nearby Penn, communities established more than a century ago. The city of Devils Lake, North Dakota's eleventh largest city with about 7,000 residents, sits behind a U.S. Army Corps of Engineers levee that protects the community from storm-generated waves that reportedly reach 2 meters or more in height. Without the levee, 3 to 4 meters of water would now cover parts of the city. To date, efforts by federal, state and local governments to control flooding and protect communities exceed $1 billion, a cost that is rising as fatefully as lake waters.

Ancient Lake Minnewaukan

Devils Lake owes its existence to a continental glacier that covered much of North America during the Pleistocene Epoch. Carving a basin as it advanced over the landscape, the glacier deposited excavated materials along its leading edges, leaving terminal moraines marking the farthest extent of glacial ice sheets. Near the end of the Pleistocene, roughly 11,000 years ago, the glacier began its retreat. As the glacier withdrew, glacial meltwaters poured into the basin, creating a vast proglacial lake dammed by morainal deposits. Native Americans called this lake Minnewaukan, meaning, among other possible interpretations, Bad Spirit Water. Recent flooding has perhaps given credence to a legend told by those Native Americans, claiming that the lake once overflowed and flooded the entire world.

Based on abandoned beaches, or strand lines, geologists estimate that the ancestral lake reached a maximum surface elevation of between 444 and 445 meters. At that elevation, the lake covered about 1,050 square kilometers, held about 5 million acre-feet of water and had a maximum depth of around 50 meters. A natural outlet called Tolna Coulee, which allowed water to flow out of the

basin and prevented the lake from rising and expanding further, controlled the maximum elevation. How often the lake has overflowed is uncertain, but geologists believe it has happened at least twice over the past 4,000 years, most recently around 2,000 years ago.

During the centuries that followed the lake's origin, climate shifts caused water levels to fluctuate between 6 and 12 meters every few hundred years. Sediment analyses by geologist Edward Callender, published in his 1968 University of North Dakota doctoral thesis, indicated that the lake might have been completely dry 6,500 years ago. After the lake last rose to its maximum elevation and began overflowing, water levels continued to fluctuate in response to alternating dry and wet periods. A persistently dry climate 500 to 600 years ago held levels at relatively low elevations for perhaps as long as 200 years. Wetter conditions followed, raising the lake to levels that prevailed until the late 1800s. Levels then began dropping precipitously, falling to the lowest-recorded elevation by 1940 before rising again.

Whether Lake Minnewaukan was completely dry at times or not, periodic drawdowns during dry conditions reduced its immense volume to numerous remnant lakes scattered across the south-central region of the basin. Nonindigenous people who settled the region beginning in the mid-1800s named the largest and most prominent of these remnants "Devils Lake," perhaps because of the lake's highly saline, undrinkable water, or perhaps in tribute to Sioux warriors whose canoes were often capsized in the lake's treacherous, storm-tossed waters.

In 1964, Devils Lake consisted of three principal basins called West Bay, Main Bay and East Bay. West Bay then was essentially dry and Main Bay covered about 53 square kilometers. The Rock Island State Military Reservation separated East Bay—which covered about 27 square kilometers—from Main Bay. According to T. E. B. Pope of the U.S. Bureau of Fisheries, Main Bay and East Bay had become isolated during the 1890s after lake levels dropped about 6 meters during the previous 25 to 30 years. Besides Devils Lake, other major

lakes nearby included Pelican Lake to the west and, to the east, East Devils Lake, Swan Lake, West Stump Lake and East Stump Lake, in that order.

Water Supply and Overflows

Devils Lake receives nearly all of its water from surface runoff and direct precipitation. Most surface-water runoff originates from a chain of remnant lakes located a few kilometers north of Devils Lake, although many of these smaller lakes have now merged with Devils Lake as the water levels rise. (By September 2007, for example, Devils Lake and all of the lakes to the east—including the two Stump lakes—had completely merged.) Total annual inflows ranged from near zero during the drought-stricken 1930s to nearly 400,000 acre-feet in 1993. Inflows, averaging 65,500 acre-feet annually between 1950 and 1993, rose to 317,000 acre-feet annually between 1993 and 2000, a fivefold increase. The years 1993 to 1995 contributed 24 percent of all inflow to Devils Lake between 1950 and 1995.

If Devils Lake rises approximately two additional meters and begins overflowing, as scientists predict it will, lake waters will enter the Sheyenne River. The Sheyenne, which originates 50 kilometers west of the river's juncture with the Tolna Coulee outlet, meanders on an easterly course that lies about 15 kilometers south of the Devils Lake Basin. After turning south, the river is impounded by a Corps of Engineers dam (Bald Hill Dam) located 20 kilometers north of Valley City, a town of about 6,300 residents. The dam's narrow reservoir (Lake Ashtabula) extends 43 kilometers upstream and contains about 71,000 acre-feet of water at full capacity. After passing through Valley City, the river joins the Red River of the North near the city of Fargo. The Red River flows northward before emptying into Canada's Lake Winnipeg.

Like climate predictions in general, predictions about when the current lake will overflow are rife with uncertainty. For example, in a report published in 2008, the U.S. Geological Survey predicted that the probability of the lake exceeding 443 meters between years 2008 and 2015 was only 10 percent,

but the lake reached that elevation in 2011. Also predicted was a 50-percent probability that the lake would not exceed an elevation of 442 meters between 2008 and 2040. In fact, the lake had reached 442 meters by June 2009. Recent computer simulations predict that the probability of the lake overflowing by 2030 is only 15 to 20 percent, even with planned man-made outlets in operation. That scenario may prove to be far too optimistic, however, given that precipitation totals during water year 2011 (October 1 - September 30), which are forecast to continue, raised the lake 0.7 meters.