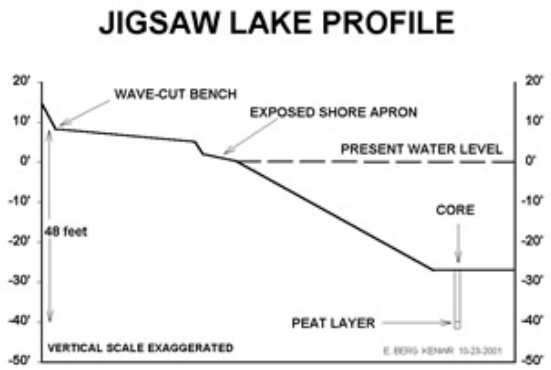
Jigsaw Lake shows Central Peninsula was very dry 8600 years ago

by Ed Berg



Profile of Jigsaw Lake

Few people believe me when I tell them that we live in a dry climate here on the central Peninsula. The Kenai airport reports 19 inches of total precipitation per year, which is the same as Fargo, North Dakota. We are in a strong rain shadow from the Kenai Mountains, and less rain falls as you move toward the mountains. For example, the Moose Research Center northeast of Sterling gets 17 inches of annual precipitation, whereas on the other side of the mountains Seward get 67 inches and Whittier gets a 197 inches.

On this side of the mountains, however, the climate is getting drier. The dryness is due to less rain and snow, as well as increased water loss caused by warmer summers.

Water is lost both by direct evaporation from soil and water surfaces, and by the vegetation breathing out water (transpiration), which together are called "evapotranspiration." I like to think of water in economic terms, viewing total precipitation as "income" and evapotranspiration as "expense" or loss. With money, the bottom line is the net difference between income and loss, i.e., the profit, which is available for spending. In hydrology the water remaining after evapotranspiration is what really counts. This is the "water surplus," which is available to fund rivers and lakes, groundwater recharge, and biomass growth.

I have estimated the trend of annual water surplus from Kenai airport data (back to 1944), and I can see that we shifted into a drier mode after the 1968-69 drought. Prior to this drought we had about 5.8 inches of available water surplus. After 1967, precipitation declined by 1.7 inches and warmer summers raised the evapotranspiration by 1.0 inches, which together reduced the water surplus to 3.1 inches. This is a 47% decrease in available water.

These calculations, I admit, are rough. A better approach is to look at water levels in lakes, as "meters" of water surplus. Only closed-basin or land-locked lakes (with no outflow) are suitable climate meters. Lakes with outlets are like over-flowing bathtubs; the level can stay the same, regardless of any variation in water flow through the lake (at least for small lakes). With closed-basin lakes, however, the water level reflects the local groundwater table, which depends on climate, i.e., on the annual water surplus.

On the Kenai National Wildlife Refuge we have for some time been watching declining water levels in various closed-basin lakes and kettle hole ponds, as readers of past columns may recall. We have seen water level drop several feet in closed-basin lakes, and many former ponds are now grassy pans with invading spruce.

It is interesting to ask if the present drying of the landscape is significant in the grand scheme of things. Is this drying large or small compared to past climate fluctuations on the Peninsula? Ordinarily, this would be a tough question to answer with any confidence, but a new study suggests that our climate could get a whole lot drier than it is now. In a word, we haven't seen anything yet!

Last summer a team of geologists examined the sediments in Jigsaw Lake, a 144-acre closed-basin lake near the end of Swan Lake Road. Like most land-locked lakes, Jigsaw Lake is extremely poor in nutrients (due to a small watershed); it has very little aquatic vegetation and only a few stickleback fish. The water level has declined about two feet in the last several years. The exposed shore apron is revegetating with sedges, but no woody plants have become estab-

lished.

Geologists Al Werner from Mt. Holyoke College and Darrell Kaufman from Northern Arizona University and three students were coring lakes in the Anchorage area for volcanic ash layers. (They were pictured taking samples on their raft in the *Anchorage Daily News* in July.) As a side project they spent three days taking cores in Jigsaw Lake to look for evidence of past water level changes. The cores were taken with a sixteen-foot length of four-inch PVC pipe driven into the sediments. With this method one looks at series of cores from shallow to deep water. By tracing the layers from one core to the next, it is possible to see where a shoreline has retreated or advanced with falling or rising water levels.

In Jigsaw Lake, however, the answer was more obvious. Grad student Christian de Fontaine has so far analyzed the first core, and found a layer of peat 13 feet down in the core. This peat is from a peat bog or muskeg, with Sphagnum peat moss and sedges. The geology team took this core in 27 feet of water. This means that the water level in the peat bog was at least 40 feet below the present lake level! A radiocarbon date showed the peat was 8600 years old.

If the lake nowadays is up 40' from its low point, how much higher has the lake gone in the past? Geologist Dick Reger and I spent a day with a laser level shooting old shoreline elevations around the lake. The highest level was a wave-cut bench at 8.4 feet above the present water level. This means that we have evidence of more than 48 feet of water level change in this lake. Jigsaw Lake is thus proving to be extremely climate sensitive!

It is well known that the climate in the Northern Hemisphere was distinctly warmer 6000 to 10,000 years ago, when Jigsaw Lake was at its low point. This is called the Hypsithermal Period. The extra warmth was due to a favorable alignment of the Earth's orbital parameters, which produced more solar radiation in the summer and less in the winter. The axis of rotation was near maximum tilt (24.2 degrees), which increased seasonality. Likewise, the Earth was closest to the Sun in July, rather than in January as at present. Finally, the ellipticity of the Earth's orbit was at a local maximum of flatness, which also increased seasonality. The combined effects added about 6 degrees-F to summer temperatures, and this no doubt greatly increased evapotranspiration and lake drying.

If climate was only determined by the orbital parameters, we ought to be headed for another ice age, which should reach its coldest point in about 15,000 years. It will be 40,000 years before there is another warm-summer alignment of the orbital parameters. The dramatic climate warming that we are now seeing in the northern latitudes is in direct opposition to the downward trend of the orbital parameters, which should be taking us toward another ice age. Most climatologists attribute the present warming trend to the "greenhouse effect" of added carbon dioxide from fossil fuels. If we are headed for another Hypsithermal Period any time soon, it will probably be one of our own creation.

There will be more to the Jigsaw Lake story as the geologists examine the other cores from last summer. They took one core at the deepest point (46 feet) and it should have the full record back to the end of the last major glacial period 14,000 years ago, when the lake was formed. I'll keep readers posted as the story unfolds.

Ed Berg is has been the ecologist at the Kenai National Wildlife Refuge since 1993. He will be discussing this research in more detail in his one-credit "Cycles of Nature" class at the Kenai Peninsula College, Tuesday evenings, March 26 – April 23. Call the College for information (262-0300). For more information about the Refuge, visit the headquarters on Ski Hill Road in Soldotna, call 262-7021 or see the website at http://www.fws.gov/refuge/kenai/.