**Bear Lake, Lake Health, and Human Perspective**

*Fred Van Dyke*

Sam asked me to talk with you about what makes lakes healthy, keeps them healthy, and the things a property owner can do. As to what keeps lakes healthy, that depends on the lake. Bear Lake is a natural kettle lake, formed from a block of ice detached from a glacier and buried in sediment. It melted slowly and the sediment above it collapsed, forming a pit. The pit reached the level of natural groundwater, which then added water to the melting ice, and the lake was formed, with input from rain and snow. This why Bear Lake has no natural inflow or outflow streams. And this brings us to one of the most important processes that affect the health of a lake. A process called flushing, and flushing rate.

 Flushing refers to how much time has to pass for the water in a lake to replace itself, to be “flushed”. Normally, or some would say, ideally, a lake would replace its water volume every year. Bear Lake replaces its water volume (over 13 billion gallons of water) every 3.4 years, or about every 41 months. That’s slow. So in one way Bear Lake is like Las Vegas. What happens (goes into) in Bear Lake stays in Bear Lake, at least for a while.

 The second process critical to lake health is mixing. Mixing occurs because water is a very common, but very unusual substance. Most substances increase in density (mass/unit volume) as they get colder. Water does this too, to a point. And as a liquid, it becomes denser (heavier) as its temperature decreases *down to 40 degrees F where it reaches its maximum density.* At 40 degrees, it’s still a liquid, but now, in the fall this “heavy water,” which has been cooled on the surface, sinks to the bottom of the lake, and displaces (that is, pushes up) the “lighter” water below it. What’s at the bottom (oxygen, nutrients, other gases) comes to the surface. Then that water cools to 40 degrees F, and it sinks, pushing up other water. And these mixing cycles continue until all the water in the lake is about 40 degrees. Now water at the surface no longer sinks as it gets colder (below 40 degrees) because it is getting *lighter* until it freezes and remains on the surface as ice. This seals the water below at 40 degrees, and creates an environment in which aquatic animals can survive the winter (otherwise, there would be no ice fishing). If there were no mixing, gases and nutrients would be permanently “stratified” (and isolated) in different “layers” of the lake, and the biotic part of the lake ecosystem would have to start over every year. Regular mixing keeps a lake healthy.

 These inputs are important because lakes and streams are what ecologists refer to as “derived” or “derivative” systems because they typically draw more energy and matter from *the land around them* than they do from *the things inside them*. What keeps a lake healthy, on its own (or we might say “naturally) also consists of two things. Energy that comes in is in the right amount, it’s the right kind, and it comes in at the right pace. Matter that comes in contributes to ecosystem function (things that make lake work and that the lake can “use”) and it comes in in the right amount and at the right pace, and, if the material is “bad” (harmful) the lake has sufficient speed and flushing rate to remove it before it can do irreparable harm.

 When a tree falls from the shore into the lake, its leaves decompose in the water, and provide food and structure for aquatic invertebrates. The logs and branches provide “structure” or places for other, larger aquatic animals, like fish, to rest and hide. And if these things come in the right way, at the right times, at the right pace and in the right amounts, the processes that transform this matter and energy work well, and aquatic creatures benefit. If nutrients come into the lake slowly and in small amounts, aquatic plants benefit and grow. And Bear Lake is an *oligotrophic* lake, a “low nutrient” lake, which means that, to stay oligotrophic, nutrient levels have to stay low. If nutrient levels rise too quickly and too much, that change favors plants and bacteria that can form dense populations and reproduce quickly all over the lake. As these organisms consume oxygen (both in life and in death, as they decompose), then oxygen is depleted for other aquatic life, like fish. As plants like algae flourish from these nutrients, they increase the amount of chlorophyll in the water, and water clarity goes down. Less light reaches deeper depths, and large rooted plants, the best agents the lake has at taking up and storing excess nutrients and holding bottom sediments in place, die. Now, with the additional chlorophyll, you have more sediment in the water, even less light penetration, and you change the composition of the plant and animal community.

If high levels of bacteria enter the lake from septic fields, the bacteria consume oxygen, and oxygen is depleted by them. If toxic compounds or metals enter the lake, from what people do or from their septic fields, these accumulate in the sediments of the lake, and they are taken up and stored in the tissues of plants and animals, and then concentrated further in the animals that eat those plants and animals. Then those animals can become dangerous for humans to eat.

***Can Humans Keep Lakes Healthy?***

 Sam asked me to talk about what individual landowners can do. Before I say anything about *practices,* I need to lay a foundation for your *perspectives* and your *principles*. And I need you to first think of yourself as a community, not as individual property owners. Traditionally geologists have called the age (the “epoch”) we are now in the *Holocene*, which is considered to have started with the end of the most recent glaciations. All over the world today, geologists are looking at and seriously considering *giving our current period a new name, the Anthropocene,* an age dominated by people and what they do, an age in which Earth’s sediments now reflect our signature effects. When Ralph Gorsch and his sons built the first permanent home on Bear Lake in 1925, what they did was important. They chopped down trees and cleared lands. They increased the amount of sediment that went into the lake, and they probably contributed some human waste into its waters. We could call these things “human disturbances,” but the other residents of the lake outnumbered the Gorsch family, (the plants and animals) and could manage what they did without loss of function. But it’s not 1925 anymore. Humans are no longer a “disturbance,” they are a driving, planet-shaping force. Today human activity is the most powerful ecological force on Earth, with less than a quarter of ice free lands around the world still being truly “wild.” Human beings are now the Earth’s most powerful geologic force, because of how they move and transport sediment and change surfaces, and they are Earth’s most powerful climatological force. Today, you’re not just a disturbance.

 To have a healthy lake, you have to take a healthy perspective on who you are. You are the force that will shape Bear Lake into what it will be in years to come. If you think that your role is just to give nature a “tip,”, like the waiter at the restaurant, you won’t get very good service. You have to take a larger role because you are the fate of Bear Lake.

 And that’s why I want to ask you first to think of yourselves as The Bear Lake Association. Your mission is *to improve and protect Bear Lake*. That was a smart mission choice, because only by making the lake the mission can you have a lake that provides the benefits that you come back for and live here for. Join the BLA. Affirm its mission.

 Second, support the *policies* that you agree on together that make everybody a conservationists. Support the policy that provides Point of Sale Septic Inspection. Don’t hand off a bad septic system to a new owner, and don’t lay the burden on the ecosystem of the lake, in which you are the dominant species. Support the policy and, given Bear Lake’s flushing time, pump your septic field every three years. Together, as an organization, take the Score the Shore survey. Learn how your overall vegetation management and lawn practices affect the quality of the lake. Support and enforce the Bear Lake Township Noise Ordinance that you were instrumental in passing. Noise is a form of energy that affects your neighbors, and I’m not just talking about the human ones. It doesn’t take much loud noise for very long to get loons to stop nesting, or abandon the chicks they have started to raise. It doesn’t take many extended noise disturbances to move a Bald Eagle from Bear Lake to a quieter spot on another lake. It doesn’t take much loud noise to silence songs that birds and frogs sing and that you should learn and listen to. Support the creation of specified no wake zones in some parts of the lake. You’ll reduce inputs from wave erosion that increase sediment input that you don’t want, and you’ll be creating a place to welcome other creatures where they can build a home. Support a BLA lake cleanup day. You’ll be taking matter away from the lake (like plastic, paper, and metal) that its own systems can’t process, and you’ll be seeing the lake the way you want to see it. No one pays premium dollars to live next to the township landfill or the county cesspool. Make the lake the way you want it to be. Make it a lake that reflects the value you have invested in it.

 You can do these things as individuals. You can choose not to add fertilizer to your lawn, plant natural vegetation (raise that score on Score the Shore), learn the names and songs of the (wild) neighbors around your property. You can’t care for them if you don’t know who they are. You are the fate of Bear Lake. If the bus goes over the cliff, don’t blame the bus. IT’S THE DRIVER! Embrace that role. Drive the Bus. Wendell Berry said

*If we are to have an accurate picture of the world, even in its present diseased condition, we must interpose between the unused landscape and the misused landscape a landscape that humans have used well.* Bear Lake can be that landscape. But you have to make it so.