32125 Bio Station Lane . Polson, Montana, U.S.A. 59860-6815
Phone (406) 982-3301 . Fax (406) 982-3201
http://flbs.umt.edu/

Flathead Lake: Our Local Ocean in Motion

By Tom Bansak

Research Scientist, Flathead Lake Biological Station

Flathead Lake is the largest natural freshwater lake in the western US (excluding Alaska). Because of its size it is often more like an ocean than a lake. Those of you who have been out on its rough waters during a major wind storm can attest to this. In fact, Flathead Lake is so large that some of its water currents are influenced by the earth's rotation, termed the Coriolis effect, a phenomenon typically only seen in oceans.

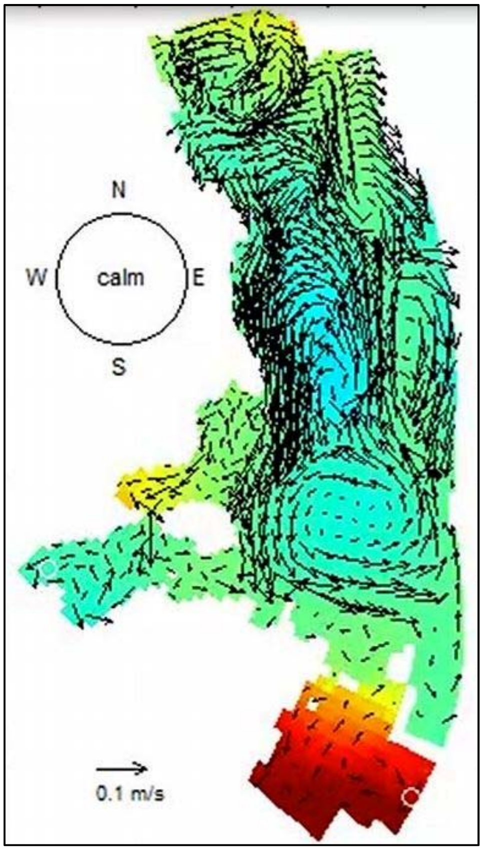
When researching Flathead Lake, the Bio Station regularly borrows oceanographic research instruments and techniques. For example our lake monitoring buoys and water quality profilers were originally designed for ocean use and were adapted for Flathead Lake by Woods Hole Oceanographic Institute. This cross-disciplinary benefit goes both ways, as oceanographers gain broader insights from the relatively contained nature of the "Flathead Ocean".

The Bio Station's physical lake ecologist, Dr. Mark Lorang, was actually trained as an oceanographer. Although a native Montanan who grew up tending a family cherry orchard on Flathead's east shore, Mark studied and taught oceanography for a decade on the coasts of the Pacific Northwest and Southern California before returning home in 2000. Mark's expertise includes water movement (currents and waves); sediment transport, erosion and deposition; and resultant features such as gravel bars and beaches. All of these are dictated by the rules of physics, and these rules are the same whether you are examining processes in an ocean or in a lake.

Studies conducted by Mark with other Bio Station researchers, students and visiting colleagues have shown that Flathead Lake is very dynamic. Using instruments such as velocity meters, directional wave gauges and pressure sensors, and techniques such as video analysis of particle movement, Mark has added greatly to our understanding of the processes and characteristics of Flathead Lake.

Water movement in Flathead Lake is complex, driven by a suite of factors including shape and orientation of the lake, timing and magnitude of stream inputs, wind speed and direction, water and air temperatures, and as mentioned earlier the earth's rotation. Surface currents have been measured up to 2.3 mph. And a few years ago Mark and colleagues put an instrument on the bottom of the lake's deepwater trench expecting to find very little water movement. Instead they recorded surprisingly fast currents of nearly 0.7 mph at 200 ft deep. This is about the same speed as the Flathead River where it enters the lake, but this deep current is roughly four times the width of the river and changes its north-south orientation as the wind changes direction. Just remarkable.

I can personally attest to the lake's rapid water currents. As one of the Bio Station's SCUBA divers I regularly dive to maintain our monitoring buoys. I specifically recall one winter day where the surface was dead calm, glassy even, yet when we dropped to 30 ft hand over hand along the north buoy's mooring there was a strong current causing our feet to "blow in the wind". I felt like a flag holding onto the mooring cable, and given the calm on the surface, this was entirely unexpected. Then, the same thing happened at the south buoy (off Yellow Bay) however the current was in the opposite direction!



Another personal experience was helping Mark with a "Drifter" experiment. Drifters are surface buoys that are attached to sea anchors (essentially underwater kites) at different depths. We were deploying drifters near the east side of Wild Horse Island, an area of the lake with particularly complex currents. We tossed the drifters over the side of the boat, and I was expecting to see them all head off in the same direction. However, we watched the surface drifter head to the north, the 1 meter drifter to the northeast, the 5 meter drifter to the east, and the 10 meter drifter to the south. None of them went in the same direction! There were dramatically different horizontal currents at different depths of the lake.

One general horizontal current is related to the input of the Flathead River at the lake's north end. River water travels southward along the lake's west shore and then when it gets to the Narrows near the tip of Finley Point much of it continues back up the east shore instead of going through the gap into Polson Bay. This water movement is visible from space – satellite imagery detects the sediment plume during runoff as it progresses along this pathway. This current is responsible for much of the driftwood that accumulates in Woods Bay.

There are also vertical currents in Flathead Lake. When wind (which I will discuss in detail in another article) blows from shore onto the lake, it can push surface water away from the shoreline. This allows water from the deep dark bottom to upwell to the surface. This phenomenon is particularly noticeable during the summer, when warm surface water is replaced by cold water from the deep. In Yellow Bay, I have seen (and felt!) 70 degree water replaced by 55 degree water in just a day of offshore wind. It certainly changes your swimming experience at the State Park.

But I am a biologist. Why should I care about all of this physical stuff? Well the physical conditions are the template on which the biology is overlain. Resources are not evenly distributed throughout the lake (or oceans). Currents deliver nutrients and other needed materials. For example, nutrient-rich upwelling currents along the Pacific coast of Alaska and Chile drive highly productive foodwebs that support some of the world's most diverse and lucrative fisheries.

Furthermore, currents can move the organisms themselves. Knowing how water and particles (including organisms) move around help biologists look for hotspots of ecological activity and production. Or in the case of a threat to our wonderful lake, Mark's studies of physical dynamics help us concentrate efforts looking for new aquatic invasive species. In short, understanding water movement in Flathead Lake can help us protect it.