# State of the Lake 2008
## Update on Water Quality in Flathead Lake for the 2007 Water Year

Synopsis for the Flathead Basin Commission biannual report based upon:
Ellis, B. K., J. A. Craft and J. A. Stanford. 2008. Monitoring water quality in Flathead Lake, Montana: 2008 Progress Report. FLBS Report #202-08. Flathead Lake Biological Station, The University of Montana, Polson, MT. 26 pp.

The Flathead Lake Biological Station has carefully documented the status of water quality in Flathead Lake and its tributaries since the Station was founded in 1899. In the early days, studies were periodic. Since 1977, measures have been obtained about monthly by the Biological Station using standardized protocols. These studies provided been the technical background for the development of a Total Maximum Daily Load (TMDL) allocation for the purpose of managing nutrient loads reaching in Flathead Lake.

Based on Station research, the Flathead Basin Commission (FBC) recommended the following interim targets to protect for the protection of water quality in Flathead Lake:

1) no increase in the biomass of lakeshore periphyton,
2) no measurable blooms of Anabaena flos-aquae (or other pollution algae),
3) no declining trend in oxygen concentrations in the hypolimnion, and
4) average annual concentrations of the following variables in the photic zone of the Midlake Deep site in Flathead Lake will not exceed the values indicated:
   - chlorophyll a - 1.0 ug/L (1 microgram per liter)
   - primary production - 80 g C m-2yr-1 (80 grams of carbon per square meter per year).

In 2007, periphyton biomass (algae growing on the rock surfaces at a depth of 5 m) was the highest ever measured and was significantly higher in 2007 than in 1987, the first time periphyton was measured on the lakeshore. However, continuous annual measures of periphyton biomass did not begin until 1999 and the recent record (1999- 2007) shows no statistically significant trend (Figure 1).

No visual evidence of an algal bloom was detected in the summer and fall of 2007, but qualitative assessment will have to be confirmed after enumeration of this conclusion needs to be confirmed by analysis of surface phytoplankton (algae) samples. Lack of sufficient Insufficient funding for the monitoring program since the TMDL targets were established has resulted in limited information concerning about this particular target. Additional funding is warranted to examine possible factors that cause the toxic blue-green Anabaena to flourish in certain years.

The dissolved oxygen target was not met, though values were not as low as in the past. In 2007, percent oxygen saturation dropped to 78% and 78.9% near the bottom of the Midlake Deep (the deepest area in the lake) and Ross Deep (in Big Arm Bay), respectively. However, recent studies at the Biological Station have shown a statistically significant trend of decreasing percent saturation of dissolved oxygen in bottom waters of the lake after the opossum shrimp, Mysis relicta became established in the lake in the 1980s. Funding is needed to obtain continuous measures of that variable oxygen concentration at both sites via sensors deployed on buoys.

Primary production, a measure of the lake's ability to grow algae, exceeded the target by 24%, but there is no statistically significant trend since Mysis became established (i.e., 1988-2007, see Figure 2). This target variable requires understanding of food web dynamics and cannot be interpreted independent of these dynamics. Funding is actively being sought for refinement of a working food web model for

Flathead Lake.

Mean chlorophyll a concentration (an indicator of algal biomass) was right below the target and there is a declining trend following the establishment of Mysis. Recent studies at the Biological Station indicate that the reduction in chlorophyll is a result of zooplankton recovery following the Mysis invasion. Most nutrient concentrations were about average and within the range of previously reported values, except soluble reactive phosphorus (the form of phosphorus most available for uptake by algae). The mean concentration was identical to that in 2005 and represents the highest annual average recorded for the lighted zone at Midlake Deep (1.1 ug/L).

Dramatic alteration of the composition of at least 3 trophic levels (e.g., Fish, Zooplankton and algae) of the lake food web occurred during the establishment of Mysis relicta in the mid to late 2980s. This essentially resulted in a lake with a different biological community which has likely altered nutrient cycling. There are also many indirect effects that are the consequence of the establishment of Mysis in Flathead Lake and those interactions are complex. Additional funding will be actively pursued to model the changes that have occurred in the food web and its effect on the TMDL target parameters.