



# FISH PASSAGE CENTER

1827 NE 44<sup>th</sup> Ave., Suite 240, Portland, OR 97213

Phone: (503) 230-4099 Fax: (503) 230-7559

<http://www.fpc.org/>

e-mail us at [fpcestaff@fpc.org](mailto:fpcestaff@fpc.org)

## MEMORANDUM

TO: Agnes Lut, OR-DEQ  


FROM: Margaret Filardo

DATE: June 18, 2007

RE: Questions regarding Gas Bubble Trauma

On June 15, 2007 you sent an email asking the following questions and requested answers.

1. Does Gas Bubble Trauma kill fish? What level kills fish? Did the 1996 high flows and spills kill fish? How many?
2. 4% GBT = how many fish?
3. 1% GBT = how many fish?
4. In the Order it says that the Director will terminate the modification if there is 15% GBT. 15% GBT = how many fish?

Gas Bubble Trauma is used as a sign that a fish has been exposed to TDG. It does not equate to dead fish. The voluntary spill program is not “killing” fish. In fact, NMFS estimated in the 2000 Biological Opinion that the “voluntary” spill program to 120% increases overall juvenile system survival by 4 to 6% over a spill program to 110%. The 1996 flow year was 135% of average runoff and is not an example of a “voluntary” spill year. High levels of total dissolved gas like those observed in 1996 (135% or more), well in excess of that produced during “voluntary” spill (120%), may cause mortality. However, these high levels only occur in the system due to the presence of hydroelectric projects; that is, when flow exceeds hydraulic capacity of the project or when the flow exceeds generation needs.

The potential for mortality due to total dissolved gas is related both to the concentration of the TDG and to the length of exposure. The present monitoring program addresses both the

concentration and exposure by observing both the incidence and severity of signs of GBT. Both incidence and severity of signs of GBT increase with exposure and time. We assume that if our action criteria are not exceeded, then the likelihood of fish dying from total dissolved gas is negligible i.e. voluntary spill does not kill fish. Observing levels of TDG in the monitoring that exceeds the action criteria doesn't equate with mortality, it only means the probability of mortality increases.

Allow me to guide through the development of the present monitoring program to explain. When spill was incorporated into the 1995 Biological Opinion as a protective measure for juvenile migrants passing hydroelectric projects, NOAA-NMFS assembled a "Gas Bubble Expert Panel" to advise them relative to the protocol for the GBT monitoring program. They advised that a monitoring program would:

1. Use clinical signs that do not change upon collection;
2. Use representative sampling sites;
3. Use adequate sample sizes;
4. Know the relative significance of the signs of GBT.

The existing protocol addresses each of the elements suggested by the Panel. The State, Tribal and Federal fishery agencies also wished to develop a protocol that met these elements, but were concerned that the number of fish examined and extent of examination did not impose undue harm on the migrating fish. Knowing the relative significance of the signs of GBT was addressed using laboratory studies. In the mid-1990s, bioassays had determined lethal TDG levels primarily under shallow-water laboratory conditions, which are not representative of the conditions experienced by migrating juveniles. The Columbia River is sufficiently deep throughout the FCRPS that migrants could benefit from depth compensation for supersaturated conditions. Studies conducted by the U.S. Geological Survey, Biological Resources Division (Maule et al. 1997a, 1997b) found that significant mortality did not occur in their test fish until approximately 60% of the exposed population exhibited bubbles in the fins or 30% displayed bubbles covering 25% or more of any unpaired fin. The action levels for the monitoring program were developed based on this study. However, the action levels were reduced to 15% and 5% to provide a large margin of safety primarily because the research results indicated some uncertainty between fin bubble percentage and the onset of mortality. The present action levels require that action to reduce voluntary spill and TDG levels would be taken if more than 5% of the fish examined exhibited bubbles covering 25% or more (rank 3) of the surface of any unpaired fin, or if 15% of the fish showed any bubbles on unpaired fins. This wide margin of safety is why I believe the mortality is negligible due to the "voluntary" spill program.

What has been observed through the monitoring program is that when the system is operated to the "voluntary" spill program the percentage of fish affected with even minor signs of GBT is even much lower than the action criteria, consequently, mortality associated with the "voluntary spill" is considered minimal.

You asked me if I knew of any documented fish kills that occurred in the Columbia that were related to spill and TDG. I only know of one documented occurrence and I need to stress that this was in conditions far outside of what occurs under a "voluntary" spill program. The 1997 water year had the third highest runoff volume at The Dalles when compared to the 50 year

runoff records. Grand Coulee Dam spilled significant amounts of water and TDG levels exceeded 135% for significant amounts of time. The Columbia River Fish Farms, located 16 miles below Grand Coulee, and Global Aqua located 22 miles below Grand Coulee, both reported significant numbers of fish dying in their net pens.

In response to the fourth question above, when we talk about 15% of the fish, we are talking about 15% of the sample taken. The incidence in the sample is relative to the incidence in the population passing at that time.

I hope this helps address your questions. Please let me know if you need any additional information.