

# **Appendix M**

## **Gas Bubble Trauma Monitoring And Data Reporting For 2008**

**Fish Passage Center  
Portland, Oregon**





## FISH PASSAGE CENTER

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November 18, 2008

Mr. Witt Anderson  
Director, Programs  
U.S. Army Corps of Engineers  
Northwestern Division  
PO Box 2870  
Portland, OR 97208-2870

Dear Mr. Anderson,

As per our agreement we are providing both you and Mr. Gary Fredricks of NOAA Fisheries with a copy of our "Gas Bubble Trauma Monitoring and Data Reporting for 2008". This report summarizes data collected during the 2008 juvenile salmonid migration.

Please feel free to contact us if you require any additional information.

Sincerely,

Michele DeHart  
Fish Passage Center Manager

CC: David Ponganis, COE  
James Adams, COE  
Gary Fredricks, NOAA Fisheries



## Gas Bubble Trauma Monitoring and Data Reporting for 2008

### Overview

The monitoring of juvenile salmonids in 2008 for gas bubble trauma (GBT) was conducted at Mid Columbia, Lower Columbia and Snake river sites. Fish were collected and examined for signs of GBT at Bonneville Dam and McNary Dam on the Lower-Columbia River, and at Rock Island Dam on the Mid-Columbia River. The Snake River monitoring sites were Lower Monumental Dam, Little Goose Dam, and Lower Granite Dam. Prior to 2005, monitoring was conducted at all sites during the spring spill season, and at Mid Columbia and lower Columbia River sites during the summer spill program. However, beginning in 2005 summer monitoring at the Snake River sites started as a result of the Court ordered summer spill program. This year summer spill in the Snake River occurred from June 20, 2008 until August 31, 2008.

Yearling Chinook and steelhead were sampled through the spring at all the sites. Once subyearling Chinook predominated smolt collections, the sampling of subyearling Chinook occurred until the end of August.

Sampling occurred two days per week at the Columbia River sites and one day a week at each of the Snake River sites during the time period that spill was implemented. The goal was to sample 100 salmonids of the most prevalent species (limited to chinook and steelhead) during each day of sampling at each site, the proportion of each species dependent upon their prevalence at the time of sampling. Examinations of fish were done using variable magnification (6x to 40x) dissecting scopes. The eyes and unpaired fins were examined for the presence of bubbles. The bubbles present in the fins were quantified using a ranking system based on the percent area of the fins covered with bubbles (Table M-1).

**Table M-1**  
**Ranking criteria used in monitoring for signs of gas bubble trauma.**

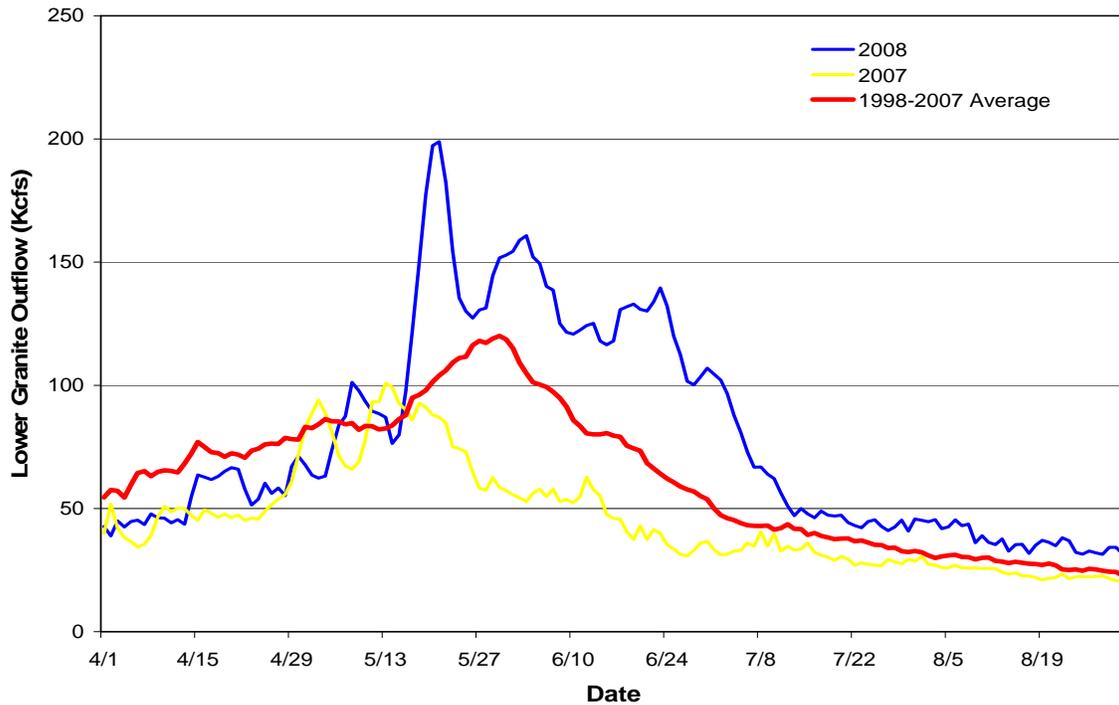
<b>Rank</b>	<b>Sign</b>
0	no bubbles present
1	up to 5% of a fin area covered with bubbles
2	6% to 25% of a fin area covered with bubbles
3	26% to 50% of a fin area covered with bubbles
4	> than 50% of a fin area covered with bubbles

The eyes of the fish were also examined and the eye with the highest amount of bubbles was ranked using the same criteria as was used for the fins. Additional information was recorded for each fish including, species, age, race, rearing disposition, fork length, fin clips, and tags. The examination procedures were similar to those used in past years of the program (see the GBT Monitoring Protocol for details of exam procedures).

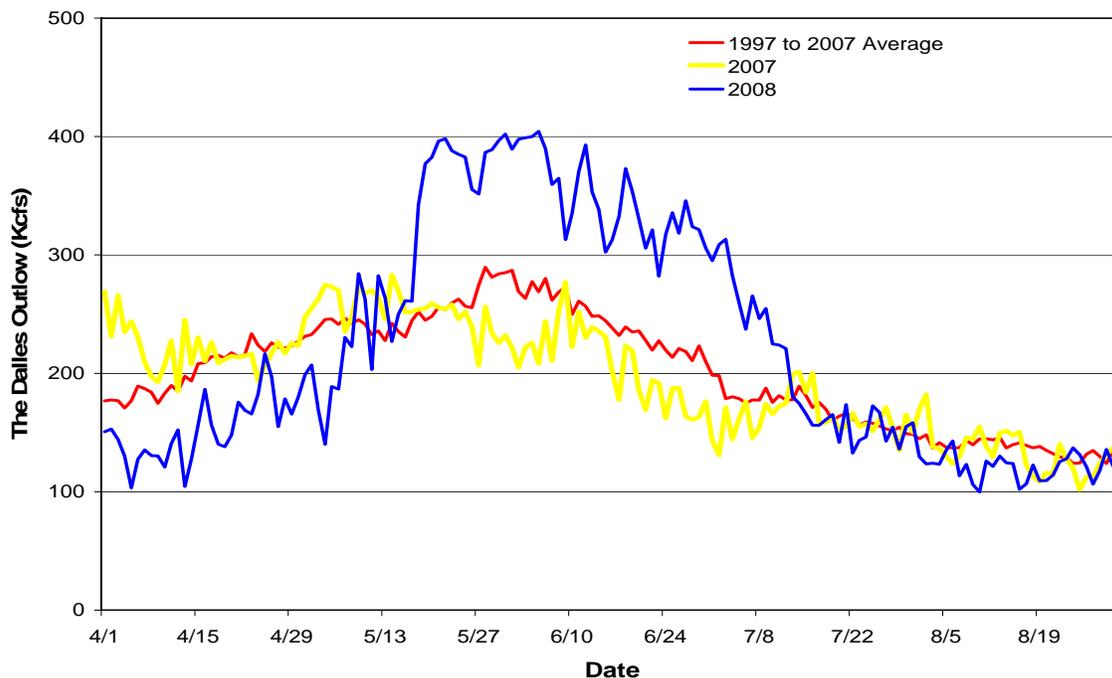
All sampling sites were at dams, where fish could be collected from the juvenile fish bypass system. At those dams where fish crossed separators the fish were collected as they entered the separator. Rock Island Dam is the only site where fish were held in a tank (up to 24 hours) prior to examination.

The runoff (January – July) volume for the 2008 water year was 92% of average (1971-2000) at Lower Granite and 93% of average at The Dalles Dam. This near average water year resulted in higher than average flows during most of the 2008 spring spill season at Lower Granite and The Dalles dam and the high flows extended into early July (Figures 1 and 2).

**Figure M-1.**  
**Average daily flows at Lower Granite Dam**  
**2008, 2007, and the 10 year average**



**Figure M-2**  
**Average daily flows at The Dalles Dam**  
**2008, 2007 and the 10 year average**



A considerable amount of excess generation spill occurred at all the Snake River and Lower Columbia projects when the flow exceeded the hydraulic capacity of the projects, or when the generation needs were exceeded. This resulted in criteria for total dissolved gas levels being exceeded for most of the second half of May and the month of June at the Snake River monitors.

In the Snake River there were two turbine units that were out of service at Lower Granite Dam, limiting the hydraulic capacity at that project to about 70 Kcfs. Consequently, whenever flows exceeded 90 Kcfs, the project exceeded the court ordered spill of 20 Kcfs. This occurred through most of May and June, and into early July when flows were high.

## Results

In all, 12,884 juvenile salmonids were examined for GBT between April and August of 2008 (Table M-2). There was an incident at Little Goose Dam early in the season (April 15) when flows were low and TDG levels were well below criteria. The crew reported 25 fish out of 100 sampled with GBT. Upon review it was determined that the person examining the fish may have misidentified deformed fin rays as bubbles, particularly in steelhead dorsal fins. A total of 23 of 25 fish identified with GBT were steelhead. Only six steelhead had signs of GBT in other paired fins when the dorsal fin information was

excluded. A total of two yearling Chinook in the sample were identified with GBT. Together this would have translated to 8% signs on that date for non-dorsal fins. These data were eliminated from the database because of the extenuating circumstances.

**Table M- 2.**

**Number of juvenile salmonids examined for signs of GBT at dams on the Lower Snake River and on the Columbia River from April to August 2008 as part of the GBT Monitoring Program.**

<b>Sites</b>							
<b>Species</b>	<b>BON</b>	<b>MCN</b>	<b>LMN</b>	<b>LGS</b>	<b>LGR</b>	<b>RIS</b>	<b>Total</b>
Chinook Subyearlings	1,996	1,831	400	517		871	5,615
Chinook Yearlings	1,277	1,125	420	377	307	800	4,306
Steelhead	307	407	530	528	524	667	2,963
<b>Total</b>	3,580	3,363	1,350	1,422	831	2,338	12,884

Fin signs were found in 89 or 0.5% of the fish sampled at all sites (Table M-3). One fish was found with severe fin signs (rank 3 or higher) while, 5 and 83 fish had less severe fin signs of rank 2 and 1, respectively.

**Table M-3**

**Number of juvenile salmonids found with fin GBT at dams on the Lower Snake River and on the Columbia River from April to August 2008 as part of the GBT Monitoring Program.**

<b>Sites</b>							
<b>Species</b>	<b>BON</b>	<b>MCN</b>	<b>LMN</b>	<b>LGS</b>	<b>LGR</b>	<b>RIS</b>	<b>Total</b>
Chinook Subyearlings	2	1	1	3		4	11
Chinook Yearlings	10	1	1	3	0	28	43
Steelhead	1	0	23	5	0	6	35
<b>Total</b>	13	2	25	11	0	38	89

The site where the most fish were observed with signs of GBT in the Federal Columbia River Power System was at Lower Monumental Dam (Figure 3). The incidence of GBT reflects the operations at the projects above where considerable uncontrolled spill took place and TDG often exceeded 120%, and at times was as high as 130%, in the forebay of Lower Monumental Dam. The percentage of fish showing signs of GBT peaked in early June, but did not exceed the action criteria of 15%.

**Figure M-3**  
**Percent GBT observed in the sample at Lower Monumental Dam.**

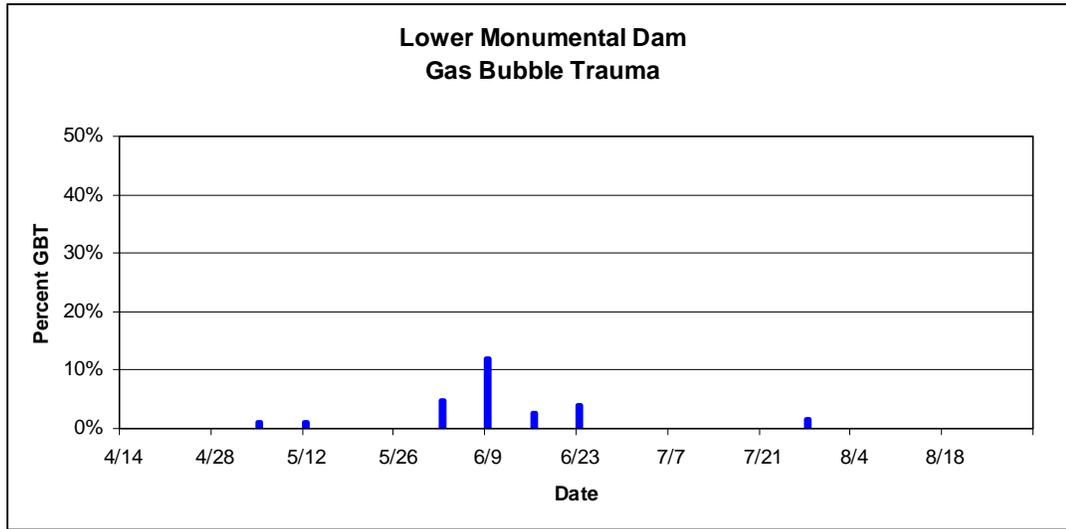


Table M-4 compares the 2008 estimates of the overall percentage of fish with signs of GBT to past years' estimates. As can be seen in the table the annual incidence of GBT in 2008 was within the range observed in past years.

**Table M-4**  
**Percent of sampled fish with signs of fin GBT estimated for the total fish observed.**

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total % Signs	3.3	3.2	1	0.3	0.2	0.001	0.7	1.5	0.18	0.46	1.6	2.4	0.5
% signs excluding RIS	4.2	4.3	1.6	1.4	0.2	0.1	0.7	0.5	0.18	0.11	1.4	2.9	0.7

The Biological Opinion Spill Program was managed using the data collected for total dissolved gas (TDG) levels. However, signs of GBT in fins of juvenile fish, examined as part of the biological monitoring, were used to complement the physical monitoring program. NOAA Fisheries originally established the action criteria for the biological monitoring program at 15% prevalence of total fish having fin signs **or** 5% with severe signs (rank 3 or greater) in fins. The criteria were never exceeded in the Snake or Columbia rivers in 2008.

## **Discussion**

GBT sampling was successfully accomplished for the 2008 migration season. In general, the incidence of GBT in migrating salmonids increased at the projects when TDG levels were high due to uncontrolled spill events. This year, as in previous years, the number of fish showing fin signs appears to be proportional to the levels of TDGS experienced by fish.