

# **Appendix M**

## **Gas Bubble Trauma Monitoring And Data Reporting For 2009**

**Fish Passage Center  
Portland, Oregon**





## FISH PASSAGE CENTER

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November 20, 2009

Mr. David Ponganis  
U.S. Army Corps of Engineers  
Northwestern Division  
PO Box 2870  
Portland, OR 97208-2870

Dear Mr. Ponganis,

As per our agreement we are providing both you and Mr. Paul Wagner of NOAA Fisheries with a copy of our "Gas Bubble Trauma Monitoring and Data Reporting for 2009". This report summarizes data collected during the 2009 juvenile salmonid migration.

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

Sincerely,

Michele DeHart  
Fish Passage Center Manager

CC: Laura Hamilton, COE  
Paul Wagner, NOAA Fisheries

# Gas Bubble Trauma Monitoring and Data Reporting for 2009

## Overview

The monitoring of juvenile salmonids in 2009 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.

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 of the sampling program was to sample 100 salmonids of the most prevalent species (limited to chinook and steelhead) during each day of sampling at each site, with the proportion of each species sampled dependent upon their prevalence at the time of sampling. Yearling Chinook and steelhead were sampled through the spring at all the sampling sites. Once subyearling Chinook predominated in the smolt collections, the program shifted from sampling yearling Chinook and steelhead to sampling subyearling Chinook through the end of August. 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.**

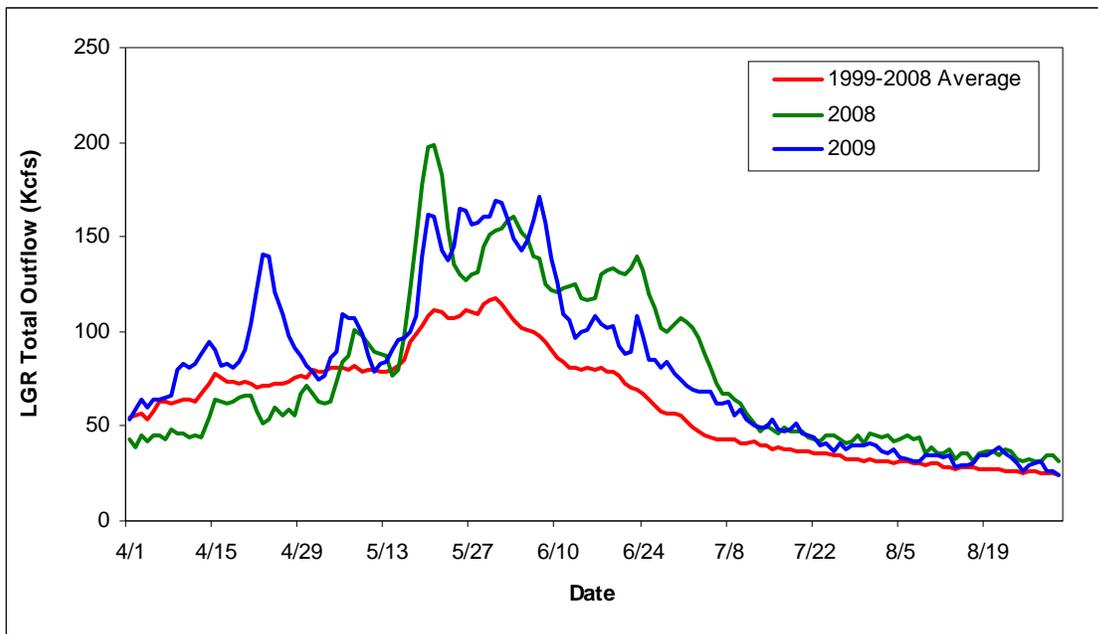
<b>Rank</b>	<b>Sign</b>
0	no bubbles present
1	up to 5% of a fin area covered with bubbles
2	6% to 25% of a fin area covered with bubbles
3	26% to 50% of a fin area covered with bubbles
4	> than 50% of a fin area covered with bubbles

The eyes of the fish were 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).

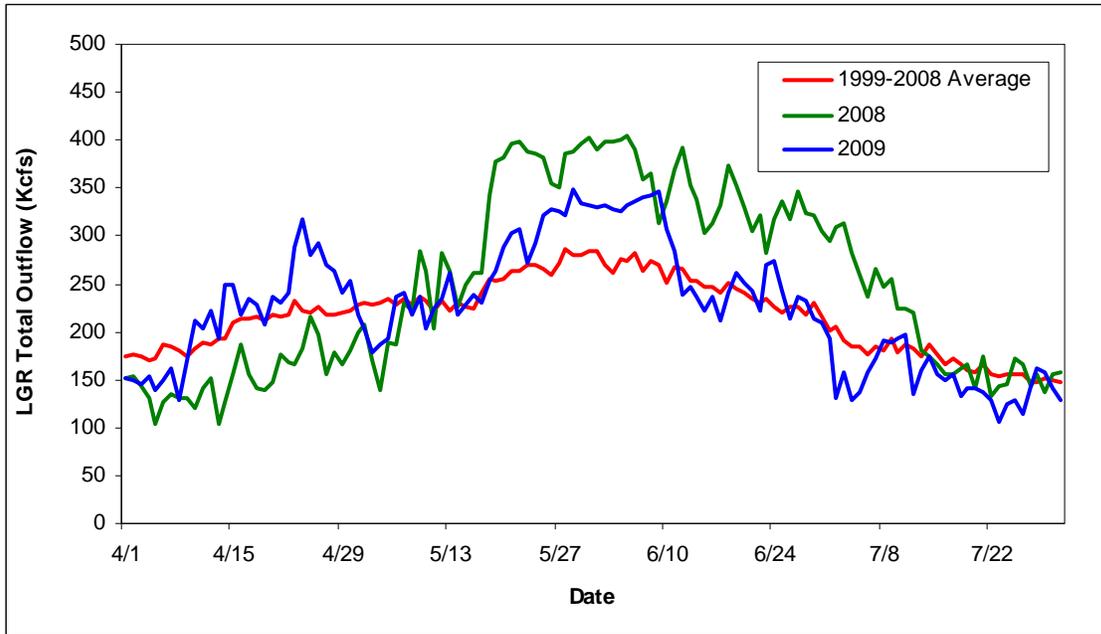
All sampling sites were at dams, where fish could be collected from the juvenile fish bypass system. At those dams where fish crossed separators the fish were collected as they entered the separator. Rock Island Dam is the only site where fish were held in a tank (up to 24 hours) prior to examination.

The runoff (January – July) volume for the 2009 water year was 96% of average (1971-2000) at Lower Granite, and 84% of average at The Dalles Dam. This water year resulted in higher than average flows in the Snake River during late April, and again during the latter part of May and the first two weeks of June (Figure M-1). During these periods the flows were in excess of the hydraulic capacity of the projects, and spill at some Snake River projects was at times a combination of fish spill and uncontrolled spill. In the lower Columbia the flows were closer to average as illustrated by the flow at The Dalles Dam (Figure M-2).

**Figure M-1.**  
**Average daily flows at Lower Granite Dam**  
**2009, 2008, and the 10 year average**



**Figure M-2**  
**Average daily flows at The Dalles Dam**  
**2009, 2008 and the 10 year average**



**Results**

In all, 12,935 juvenile salmonids were examined for GBT between April and August of 2009 (Table M-2).

**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 2009 as part of the GBT Monitoring Program.**

<u>Species</u>	<u>Sites</u>						<u>Total</u>
	<u>BON</u>	<u>MCN</u>	<u>LMN</u>	<u>LGS</u>	<u>LGR</u>	<u>RIS</u>	
Chinook Subyearlings	1891	2298	502	661	1	502	5,855
Chinook Yearlings	1276	1152	360	361	224	609	3,982
Steelhead	245	390	609	428	749	677	3,098
<b>Total</b>	3,412	3,840	1,471	1,450	974	1,788	12,935

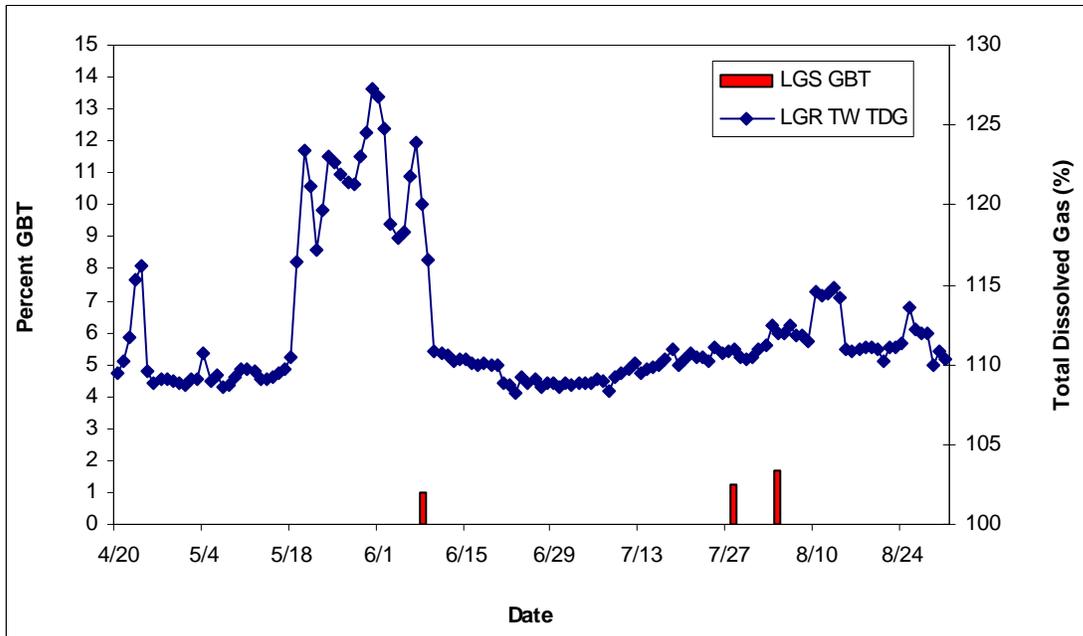
Fin signs were found in 37 or 0.29% of the fish sampled at all sites (Table M-3). All fish examined and determined to have signs of GBT exhibited the less severe fin signs of rank 1, where less than 5% of a fin area was covered with bubbles.

**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 2009 as part of the GBT Monitoring Program.**

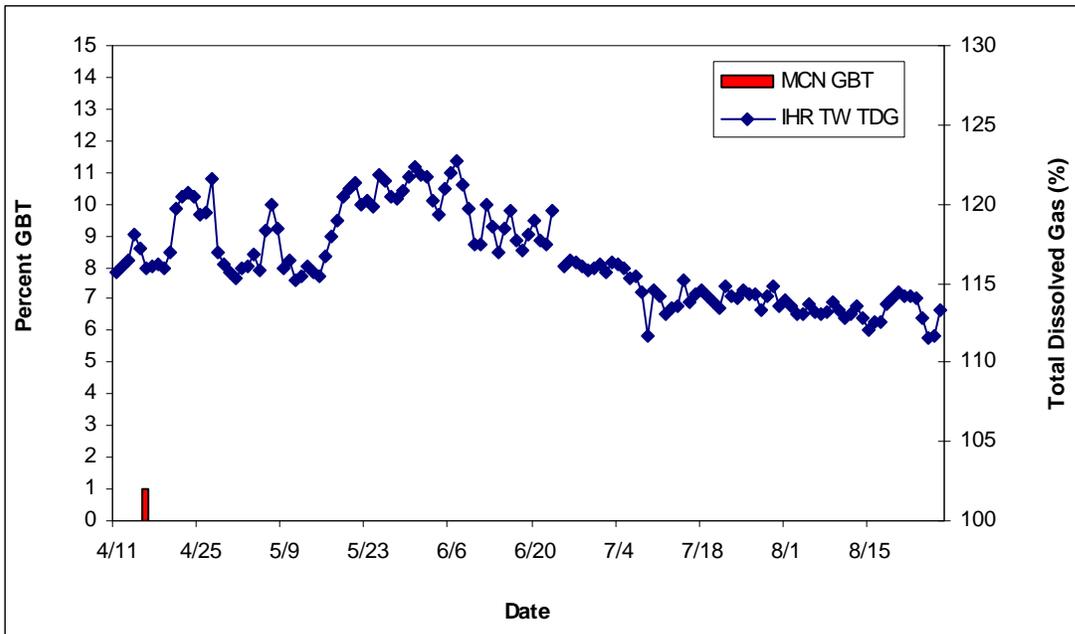
<u>Species</u>	<u>Sites</u>						<u>Total</u>
	<u>BON</u>	<u>MCN</u>	<u>LMN</u>	<u>LGS</u>	<u>LGR</u>	<u>RIS</u>	
Chinook Subyearlings	2	0	0	3	0	0	5
Chinook Yearlings	12	0	0	0	0	9	21
Steelhead	6	1	0	0	0	4	11
<b>Total</b>	20	1	0	3	0	13	37

The action criteria for GBT is established as 15% of fish showing any signs of GBT, or 5% of the fish sampled showing signs greater than rank 1. In 2009 there were no fish detected with signs of GBT at Lower Granite and Lower Monumental dams and very few fish with signs of GBT were observed at Little Goose and McNary Dam (Figure M-3 and Figure M-4). A few more fish were observed at Rock Island Dam (Figure M-5), however, this occurrence happens every year and is likely a function of holding fish in shallow water for a time period before sampling. The site where the most fish were observed with signs of GBT in the Federal Columbia River Power System was at Bonneville Dam (Figure M-6). The percentage of fish showing signs of GBT peaked in early June, but only a few percent of the sample were affected and the percentage did not approach the action criteria of 15%.

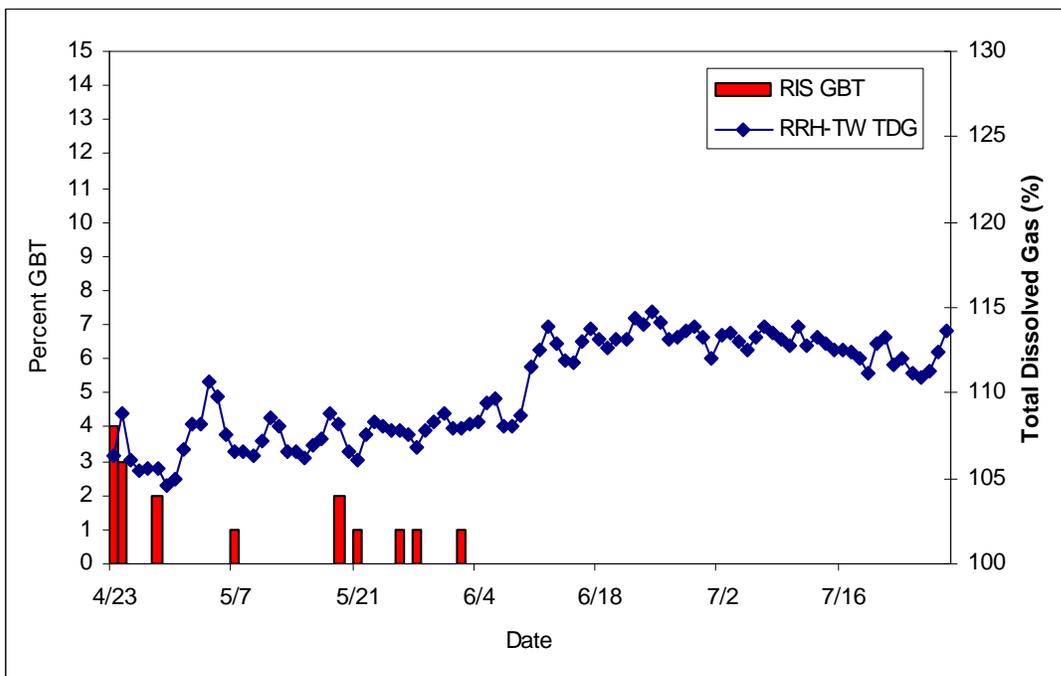
**Figure M-3**  
**Percent GBT observed in the sample at Little Goose Dam.**



**Figure M-4**  
**Percent GBT observed in the sample at McNary Dam.**



**Figure M-5**  
**Percent GBT observed in the sample at Rock Island Dam.**



**Figure M-6**  
**Percent GBT observed in the sample at Bonneville Dam.**

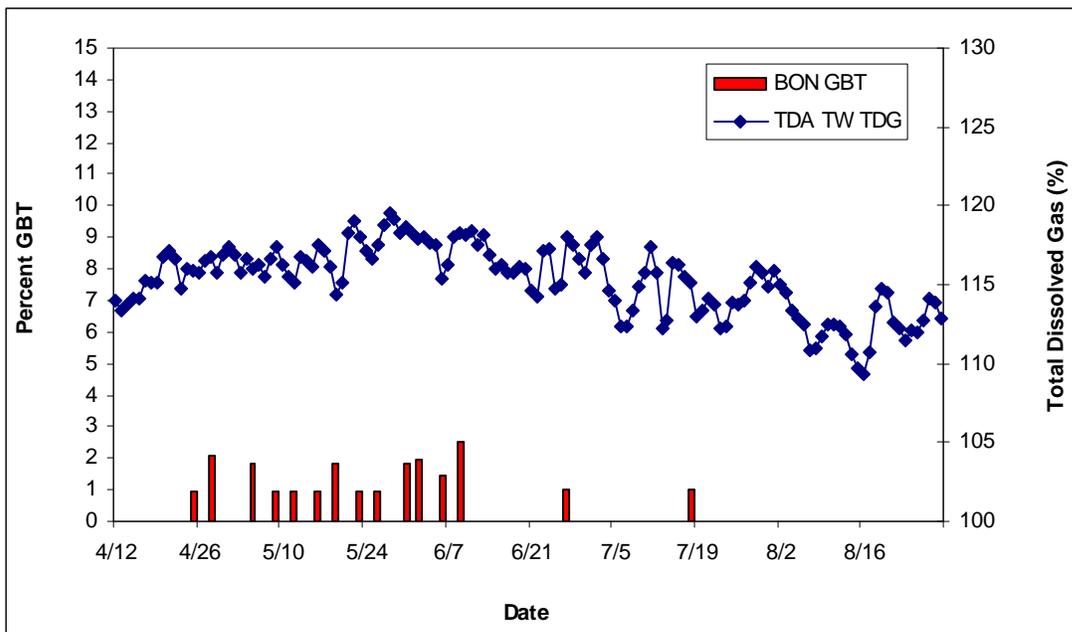


Table M-4 compares the 2009 estimates of the overall percentage of fish with signs of GBT to past years' estimates. As can be seen in the table the annual incidence of GBT in 2009 was on the lower end of the range observed in past years.

**Table M-4**  
**Percent of sampled fish with signs of fin GBT estimated for the total fish observed in each year 1996 to 2009.**

Year	Total % Signs	% Signs excluding RIS
1996	3.3	4.2
1997	3.2	4.3
1998	1	1.6
1999	0.3	1.4
2000	0.2	0.2
2001	0.001	0.1
2002	0.7	0.7
2003	1.5	0.5
2004	0.18	0.18
2005	0.46	0.11
2006	1.6	1.4
2007	2.4	2.9
2008	0.5	0.7
2009	0.29	0.23

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. The GBT criteria were never exceeded in the Snake or Columbia rivers in 2009, with the highest daily observation in 2009 being 4%. This was observed at Rock Island Dam on April 23, 2009, the first day of sampling.

## **Discussion**

GBT sampling was successfully accomplished for the 2009 migration season. In summary very few fish were detected with signs of GBT in 2009. Limited incidence was observed in the Snake River with most signs of GBT observed in the lower Columbia River. However, the signs observed were of the lowest designation and were only present in a small portion of the population. The observations from the GBT program reflect the generally lower TDG measured in the system this year.