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Karen L. Durham-Aguilera, P.E.
Director, Programs
U.S. Army Corps of Engineers
Northwestern Division
PO Box 2870
Portland, OR 97208-2870

Dear Ms. Durham-Aguilera,

As per your request we are providing both you and Dr. Mark Schneider of NOAA Fisheries with a copy of our "Gas Bubble Trauma Monitoring and Data Reporting for 2005". This report summarizes data collected during the 2005 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
Jim Adams, COE
Dr. Mark Schneider, NOAA-Fisheries

Gas Bubble Trauma Monitoring and Data Reporting for 2005

Overview

Monitoring of juvenile salmonids in 2005 for gas bubble trauma (GBT) was conducted at Mid Columbia, Lower Columbia and Snake River sites where fish were examined for signs of GBT. Fish were collected 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. The alteration of the spill program in the Snake River, because of low river flow, resulted in termination of the GBT sampling at the Snake River monitoring sites during the spring spill season. However, summer monitoring at the Snake River sites did occur this year as a result of the Court ordered summer spill program injunctive relief. Summer spill in the Snake River occurred from June 20, 2005 until August 31, 2005.

Sampling of yearling chinook and steelhead occurred through the spring at the Columbia River sites. Once subyearling chinook predominated smolt collections the sampling of subyearling chinook occurred at Columbia River sites to the end of August. Subyearling smolts were monitored in the Snake River during the summer spill period.

Sampling occurred two days per week at the Columbia River sites and at Lower Granite, Little Goose and Lower Monumental in the Snake River during the time period that spill was implemented. In previous years fish were sampled every other day (3 to 4 days per week) at most facilities. The number of sampling days was reduced in 1999, in order to decrease the number of fish handled. It was determined that the reduced sampling effort would not significantly diminish the capability to detect the presence of GBT in the migrating population.

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. A rank of 0 was recorded when no bubbles were present; rank 1 was recorded when up to 5% of a fin area was covered with bubbles; rank 2 was for 6% to 25%; rank 3 indicated 26% to 50% fin area was bubbled; and rank 4 indicated greater than 50% of a fin was covered with bubbles. The eyes of the fish were also

examined and the eye with the highest amount of bubbles in it 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).

Sampling techniques varied somewhat based on the location. This year 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.

Results

A total of 11,428 juvenile salmonids were examined for GBT between April and August (Table I). A total of 55 or 0.48 % showed some signs of GBT in fins or eyes, while

Table 1. 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 2005 as part of the GBT Monitoring Program.

Species	Site					Total
	BON	MCN	LMN ¹	LGS ¹	RIS	
Chinook Subyearlings	2,095	2,147	298	866	1,117	6,523
Chinook Yearlings	1,603	1,279			930	3,812
Steelhead	250	274	38	11	520	1,093
Total	3,948	3,700	336	877	2,567	11,428

fin signs were found in 52 or 0.46% of the fish sampled at all sites (Table 2). Only 1 fish was found with severe fin signs (rank 3 or higher) while, 1 fish had fin rank 2, with the remainder having rank 1 signs. The prevalence of GBT signs at Rock Island Dam was higher than any other Columbia River site during the 2005 monitoring season as is typically the case each season. Because the Rock Island data may obscure other inter-annual trends in the occurrence of GBT signs among sites, it will be treated separately in the remainder of this report.

¹ Modified sample dates.

Table 2. Number of juvenile salmonids found with fin GBT at dams on the Lower Snake River and on the Columbia River from April to August 2005 as part of the GBT Monitoring Program.

Species	Site					Total
	BON	MCN	LMN ¹	LGS ¹	RIS	
Chinook Subyearlings	0	0	0	8	16	24
Chinook Yearlings	0	1	0	0	19	20
Steelhead	0	1	0	0	7	8
Total	0	2	0	8	42	52

At the Lower Columbia River and Snake River sites (i.e. excluding Rock Island) a total of 8,861 fish were examined with (0.11%) exhibiting signs of GBT, compared to 0.18% in 2004, 0.5% in 2003, 0.7% in 2002, 0.1% in 2001, 0.2% in 2000, 1.4% in 1999, 1.6% in 1998, 4.3% in 1997, 4.2% in 1996 and 1.3% in 1995. Ten fish were found with fin signs in 2005 (0.11%), comparable to the last three of the past four years when less than 1% of fish have shown signs of fin GBT. The percent signs over the past several years have been 0.18% in 2004, 1.5% in 2003, 0.7% in 2002, 0.001% in 2001, 0.2% in 2000, 0.3% in 1999, 1.0% in 1998, 3.2% in 1997 and 3.3% in 1996. One fish was found with severe fin GBT in Lower Snake and Lower Columbia sampling. This low level of occurrence is similar to 2004, 2003, 2002, 2001, 2000, 1999, and 1995 when no severe fin GBT was found. Other years showed higher incidence of severe fin GBT; in 1998 four (0.01%) fish displayed severe fin signs, 1997 when 117 fish (0.27%) had severe fin signs (again excluding Rock Island) and 47 fish (0.12%) in 1996.

The Biological Opinion Spill Program was managed using the data collected for total dissolved gas levels. However, signs of GBT in fins of juvenile fish, examined as part of the biological monitoring, are used to complement the physical monitoring program. NOAA Fisheries originally established the action criteria for the biological monitoring program at 15% prevalence of fish having fin signs **or** 5% with severe signs (rank 3 or greater) in fins. The action criteria were not exceeded in 2005. This is similar to all past years since 1995, with the

¹Modified sample dates

exception of the high flow years (1996 and 1997) when uncontrolled spill occurred. In contrast there were 23 dates when GBT levels surpassed the action criteria in 1997 and 20 in 1996.

The prevalence and severity of fin signs in juvenile salmonids sampled in the Lower Snake and Lower Columbia rivers reflects changes in TDGS conditions in the river from year to year. The occurrence of severe signs in 1996 and 1997, and the increase in exceedences of the NMFS action criteria, reflected a significant increase in the number of days when TDGS rose above 125% in the forebays of these dams (see Tables 3 and 4). In other years few fish were observed with severe signs of GBT, reflecting the more moderate conditions found in the river.

Table 3. The number of days when TDGS levels were above 120% and 125% at representative forebay monitors in the Lower Snake and Lower Columbia Rivers from April 1 to August 31.

TDGS Monitor	2005		2004		2003		2002		2001		2000		1999	
	days >120	days >125	days >120	days >125	days >120	days >125	days >120	days >125	days >120	days >125	days >120	days >125	days >120	days >125
Lower Granite	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Goose	0	0	0	0	7	2	1	0	0	0	0	0	5	0
Lower Monumental	0	0	0	0	7	2	5	0	0	0	0	0	7	2
Ice Harbor	0	0	0	0	4	0	0	0	0	0	1	0	5	1
McNary (Oregon) ^a	0	0	1	0	1	1	0	0	0	0	0	0	3	0
Bonneville	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	1	0	20	6	6	0	0	0	1	0	20	3

^a 2002 data used Washington monitor at McNary due to missing data from Oregon monitor during July and August.

Table 4. The number of days when NMFS GBT criteria of 15% prevalence or 5% severe signs were exceeded at sites in the Lower Snake and Lower Columbia rivers from April 1 to August 31.^{ab}

Site	2005	2004	2003	2002	2001	2000	1999
Lower Granite	0	0	0	0	0	0	0
Little Goose	0	0	0	0	0	0	0
Lower Monumental	0	0	0	2	0	0	0
Ice Harbor	0	0	0	0	0	0	0
McNary	0	0	0	0	0	0	0
Bonneville	0	0	0	0	0	0	0
Total	0	0	0	2	0	0	0

^a Based on dates when at least 30 fish of the species exhibiting signs were captured.

^b More than 5% of fish showed severe signs on only 1 date in each year 1996 & 1997 and on those same dates the prevalence of fin signs was greater than 15%.

Discussion

GBT sampling was successfully accomplished for the 2005 migration season. In general, the low river flows this year resulted in a very controlled spill program. Consequently, few fish were observed with any signs of GBT. 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.

The 2005 sample year was uniquely different than other years because of the sampling that was conducted for the implementation of the court ordered injunctive relief spill program. The only signs of GBT detected during the implementation of the summer spill were at Little Goose Dam. A total of eight juvenile migrants (out of 877 sampled) were detected spread over several days during the summer time period (June 20 to August 31). The signs detected were of Rank 1, meaning that less than 5% of an unpaired fin was affected with bubbles. It can be concluded that the spill experienced by the subyearling migrants in the Snake River during the summer of 2005 did not result in concern for GBT in subyearling migrants.