



FISH PASSAGE CENTER

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MEMORANDUM

TO: Ritchie Graves, NOAA

FROM: Michele DeHart, FPC

DATE: January 30, 2012

RE: Comparison of GBT incidence at Rock Island Dam versus Rocky Reach Dam in 2011

In response to the question you raised at an FPC Oversight Board meeting, the FPC staff reviewed the incidence of GBT at Rock Island and Rocky Reach dams in 2011. The question of whether GBT signs were missed at the Smolt Monitoring Program sampling site at Rock Island Dam was brought up at a FPC Oversight Board Meeting when you compared the incidence of signs at Rocky Reach Dam to those reported at Rock Island Dam as part of the Smolt monitoring Program.

Sampling at Rock Island Dam is conducted as part of the gas bubble trauma (GBT) monitoring program under the Smolt Monitoring Program (SMP). Under the GBT monitoring protocol, approved by regional water quality agencies and fisheries managers, SMP personnel target 100 yearling Chinook, subyearling Chinook or steelhead per day for the GBT sample, based on the prevalence of the fish collected that day. The sample size of 100 fish was determined to be adequate to detect within +6% the incidence of fish in a population showing signs of GBT based on a population where 10% of the fish had signs. Smaller sample sizes yield much greater variability and limited applicability to the population as a whole.

Sampling at Rocky Reach was conducted by Douglas County PUD to monitor the effects of TDG resulting from dams upstream of Rocky Reach. Both GBT crews were trained at USGS by SMP personnel prior to the season, so the methods for examining fish and the reported incidence of fin GBT should be comparable. However, the Rocky Reach monitoring is not part of the SMP and sample size guidelines were not the same for the two efforts. Nor were the species examined the same. At Rocky Reach fewer fish per day were examined and species examined included Chinook and steelhead similar to SMP, but also included sockeye and coho salmon smolts.

The difference in sample size per day of exams was important since small sample sizes can yield different results, and may be enough to explain the perceived differences in incidence of GBT signs between the two sites. In addition the use of sockeye and coho could also have affected the incidence of signs measured. We decided to look at the impacts of sample size and additional species on the incidence of signs as reported.

Our conclusions based on our comparison were as follows:

- The percent of fin GBT signs were very similar between Rock Island and Rocky Reach when all species were combined daily at each dam.
- It appears that the GBT monitoring at Rock Island Dam did not miss signs of GBT when compared to Rocky Reach Dam.
- There would have been no meaningful differences in management decisions related to exceedences of the 15% biological action criteria based on monitoring results at either dam.
- When lagged 3 days, the percent fin signs appeared to match up quite well at the two sites. The greatest difference occurred on May 30 when 92% fin signs were reported at Rocky Reach, and 60% signs were observed at Rock Island Dam during the sample on June 1. However, both samples greatly exceeded the action criteria and would have resulted in actions to reduce spill, had that been possible.
- Percent fin GBT in coho appeared to be higher at Rocky Reach during the last two weeks of May than fin GBT in Chinook, sockeye and steelhead also sampled at the same dam.

Comparisons of Data

Tables 1 and 2 display the fin GBT data collected at Rocky Reach and Rock Island dams in 2011 (respectively). For this comparison we included data from May 24 to July 21. This time period encompassed a period before, during, and after the highest TDGS event in 2011 that occurred the first week of June at Rocky Reach (Figure 1). During that event TDGS levels rose above 130% on May 28 and remained above or near that level until June 21. The percent fin signs varied considerably between dates at both sites (see Tables 1 and 2 and Figure 2). To investigate the effect of sample size on the daily estimation of percent GBT, the daily observations were fitted with binomial confidence intervals to show the relative precision of the daily GBT percentages derived from the samples. Due to small sample sizes there was greater variability in the percent signs at Rocky Reach when only two species were combined (yearling Chinook and steelhead) or (sockeye and coho) consistent with the GBT protocol used for SMP. Even when aggregated this way the high variability at Rocky Reach was due to sample sizes that were well below target levels recommended in the GBT monitoring protocol of 100 fish per date.

In order to make a more meaningful comparison, we combined all species examined at Rocky Reach on a given date and again compared that to the combined GBT sample from Rock Island.

A graphic comparison of the fin GBT percentages by date at Rocky Reach and Rock Island dams shows a similar increase in the incidence of signs beginning in late May and peaking during the first week of June reflecting the time period when TDGS levels in the river rose (Figure 3). Again, daily observations were fitted with binomial confidence intervals to show the relative precision of the daily GBT percentages derived from the samples. Due to the increase in sample size from combining all fish sampled at Rocky Reach these samples show tighter confidence intervals for the Rocky Reach daily proportions compared to Figure 2.

These combined results showed a much more similar pattern in the incidence of fin GBT when comparing the two sites, with Rocky Reach showing a higher incidence of GBT on May 30, when 92% fin GBT was seen at the site. On that date the sample size was 61 fish. Excluding that one date at Rocky Reach, the Rock Island data showed a similar incidence in fin signs. The GBT incidence at Rock Island appeared to lag of 2 to 3 days behind Rocky Reach. This type of lag would be expected given the difference in frequency of sampling and time it might take for fish with high GBT signs to arrive at the downstream dam. Taking into account the lag, it appears the incidence of signs tracked very closely between the two sites, aside from the 92% incidence on May 30 (Figure 4).

Table 1. Daily fin GBT for each species examined and the number of fish found to have GBT at Rocky Reach Dam. Percent GBT in the sample at Rocky Reach Dam for combined Chinook and steelhead is shown for comparison to SMP at Rock Island and combined coho and sockeye percent GBT by date was also shown. Overall GBT percent by date for all species combined was also included for comparison to Rock Island.

| Date | All Chinook | | Steelhead | | ST & CH | Coho | | Sockeye | | CO & SO | All Species |
|------|-------------|---------|-----------|---------|---------|-------|---------|---------|---------|---------|-------------|
| | Exams | Fin GBT | Exams | Fin GBT | Pct GBT | Exams | Fin GBT | Exams | Fin GBT | Pct GBT | Pct GBT |
| 5/24 | 33 | 3 | 4 | 1 | 11% | 14 | 8 | 16 | 0 | 27% | 18% |
| 5/25 | 32 | 0 | 3 | 0 | 0% | 20 | 8 | 11 | 0 | 26% | 12% |
| 5/26 | 30 | 1 | 8 | 0 | 3% | 12 | 2 | 26 | 1 | 8% | 5% |
| 5/27 | 47 | 7 | 11 | 3 | 17% | 35 | 11 | 5 | 0 | 28% | 21% |
| 5/28 | 26 | 1 | 5 | 3 | 13% | 18 | 17 | 13 | 1 | 58% | 35% |
| 5/29 | 32 | 10 | 0 | 0 | 31% | 13 | 13 | 22 | 13 | 74% | 54% |
| 5/30 | 30 | 28 | 3 | 3 | 94% | 15 | 15 | 13 | 10 | 89% | 92% |
| 6/3 | 19 | 3 | 4 | 0 | 13% | 6 | 6 | 3 | 3 | 100% | 38% |
| 6/5 | 26 | 4 | 8 | 5 | 26% | 13 | 6 | 8 | 2 | 38% | 31% |
| 6/6 | 21 | 1 | 0 | 0 | 5% | 7 | 7 | 7 | 1 | 57% | 26% |
| 6/8 | 21 | 0 | 7 | 0 | 0% | 8 | 3 | 8 | 1 | 25% | 9% |
| 6/12 | 9 | 1 | 1 | 0 | 10% | 1 | 0 | 1 | 0 | 0% | 8% |
| 6/13 | 33 | 2 | 0 | 0 | 6% | 2 | 1 | 1 | 0 | 33% | 8% |
| 6/17 | 21 | 1 | 2 | 2 | 13% | 1 | 0 | 9 | 1 | 10% | 12% |
| 6/19 | 17 | 0 | 1 | 1 | 6% | 0 | 0 | 5 | 1 | 20% | 9% |
| 6/22 | 17 | 1 | 2 | 2 | 16% | 0 | 0 | 3 | 0 | 0% | 14% |
| 6/24 | 14 | 0 | 1 | 0 | 0% | 1 | 1 | 6 | 0 | 14% | 5% |
| 6/26 | 33 | 0 | 0 | 0 | 0% | 0 | 0 | 0 | 0 | | 0% |
| 6/29 | 22 | 0 | 0 | 0 | 0% | 0 | 0 | 3 | 0 | 0% | 0% |
| 7/5 | 60 | 6 | 0 | 0 | 10% | 0 | 0 | 0 | 0 | | 10% |
| 7/7 | 25 | 1 | 0 | 0 | 4% | 0 | 0 | 0 | 0 | | 4% |
| 7/10 | 41 | 0 | 0 | 0 | 0% | 0 | 0 | 1 | 0 | 0% | 0% |
| 7/11 | 24 | 0 | 0 | 0 | 0% | 0 | 0 | 0 | 0 | | 0% |
| 7/12 | 13 | 0 | 0 | 0 | 0% | 0 | 0 | 0 | 0 | | 0% |
| 7/21 | 2 | 0 | 0 | 0 | 0% | 0 | 0 | 0 | 0 | | 0% |

Considering that the biological action criteria is 15% incidence of fin GBT, there would have been no difference in management implications of these differences in signs. Because spill was involuntary during this time period, no management action could have been taken to reduce the impact of total dissolved gases when the biological criteria were exceeded at either site. However, had managers been able to act, the implications would be similar for reporting 92% incidence of GBT as seen at Rocky Reach on May 30 or a 37% incidence at Rocky Island on the same date followed by a 60% on June 1. In either case the biological action criteria were exceeded by a large amount and actions would have been taken to reduce gas if it were possible.

Table 2. The daily number examined and the number of fish with GBT in fins, by species at Rock Island Dam. Also daily fin GBT percent in the sample for both Chinook and steelhead combined for comparison to Rocky Reach and for comparison to the biological criteria of 15 percent incidence.

| Date | All Chinook | | Steelhead | | ST & CH |
|------|-------------|---------|-----------|---------|-----------------|
| | Exams | Fin GBT | Exams | Fin GBT | Overall Pct GBT |
| 5/24 | 39 | | 61 | 1 | 1% |
| 5/26 | 30 | 1 | 70 | 1 | 2% |
| 5/31 | 23 | 6 | 77 | 31 | 37% |
| 6/2 | 13 | 8 | 87 | 52 | 60% |
| 6/7 | 11 | 2 | 89 | 38 | 40% |
| 6/9 | 27 | 6 | 73 | 25 | 31% |
| 6/14 | 4 | 1 | 96 | 20 | 21% |
| 6/16 | 18 | 0 | 82 | 10 | 10% |
| 6/22 | 11 | 1 | 62 | 7 | 11% |
| 6/23 | 13 | 1 | 90 | 26 | 26% |
| 6/28 | 46 | 2 | 18 | 4 | 9% |
| 6/30 | 87 | 5 | 13 | 1 | 6% |
| 7/6 | 94 | 1 | 6 | 0 | 1% |
| 7/7 | 88 | 5 | 12 | 1 | 6% |
| 7/12 | 96 | 2 | 4 | 1 | 3% |
| 7/14 | 99 | 1 | 1 | 0 | 1% |
| 7/21 | 100 | 1 | 0 | 0 | 1% |

Figure 1. Rolling average 12 highest hours TDGS at Rocky Reach Forebay in 2011 during high TDGS event.

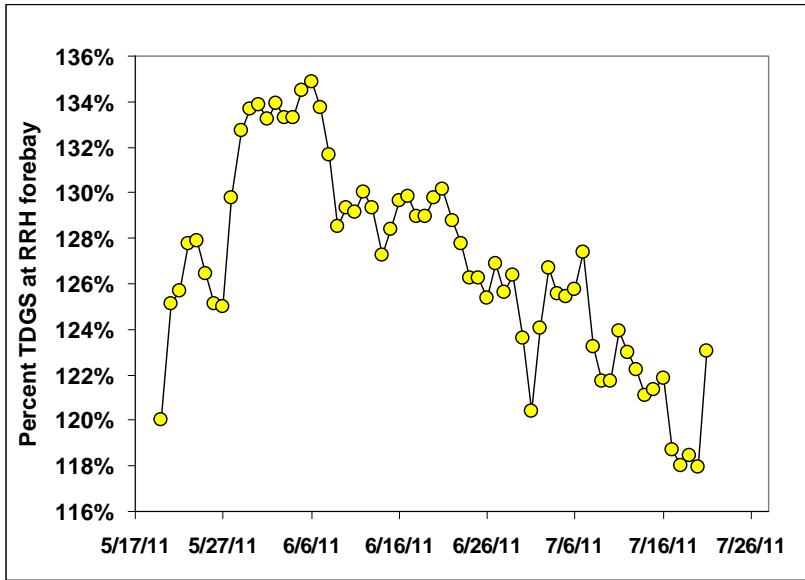


Figure 2. A comparison of percent fin GBT levels at Rocky Reach and Rock Island dams in 2011, with data grouped by date and two-species-groups as is done according to the GBT monitoring protocol. In addition to steelhead and Chinook, coho and sockeye were also examined at Rocky Reach in contrast to the GBT protocol used at Rock Island.

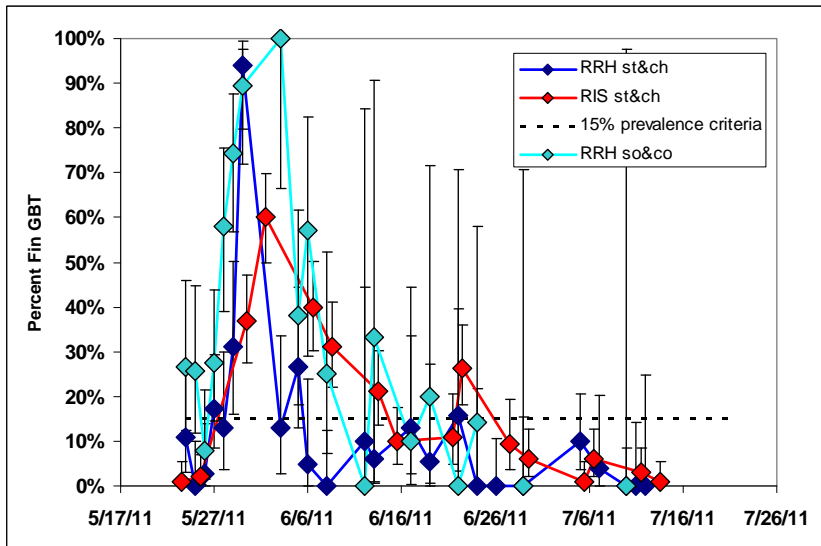


Figure 3. A comparison of percent fin GBT levels at Rocky Reach and Rock Island dams in 2011, with data grouped by date and all species were combined.

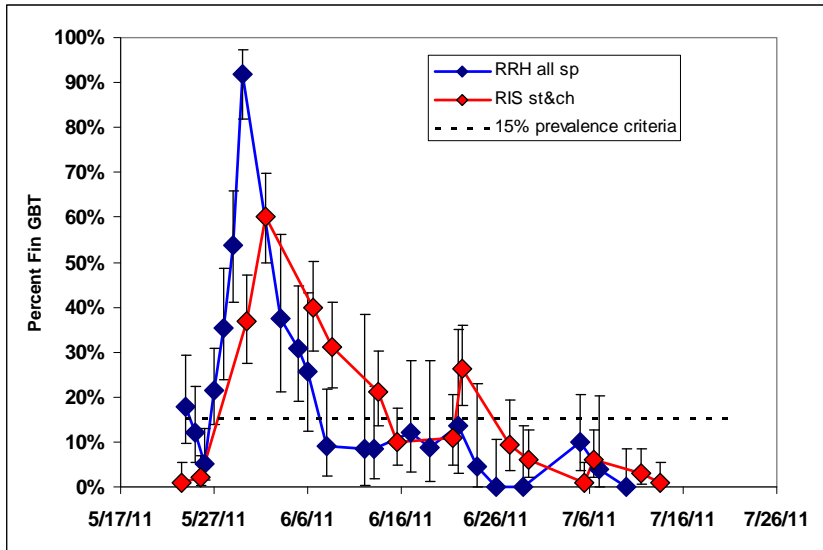
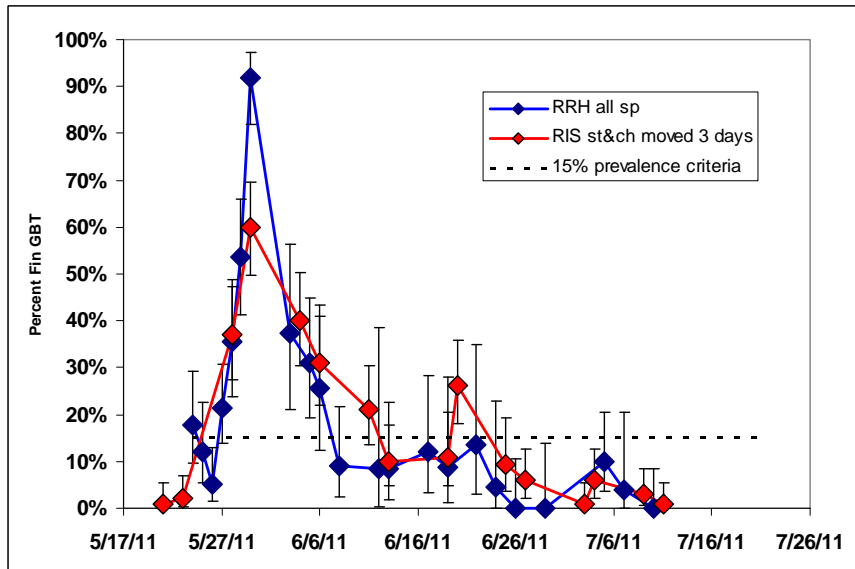


Figure 4. A comparison of percent fin GBT levels at Rocky Reach and Rock Island dams in 2011, with data grouped by date and all species were combined with Rock Island data shifted 3 days earlier to show the similarity in signs when data are lagged.



Summary and Conclusions

In summary, the purported differences between the observations at Rocky Reach and Rock Island Dam were likely due to very small sample sizes at Rocky Reach Dam and to species differences. From our analysis it appeared that the percentage of fin signs of GBT at Rock Island Dam when all species were combined was similar to that observed at Rocky Reach in 2011. For individual species of fish, especially coho at Rocky Reach, the incidence of fin GBT at Rocky Reach was higher, but sample sizes were quite low; often fewer than 20 fish per day for steelhead, coho and sockeye. These low sample sizes made it necessary to aggregate the Rocky Reach sample in order to compare the results to those observed at Rock Island. Once all species data were aggregated by date, the data showed similar patterns in the incidence of GBT, suggesting that small sample sizes had much to do with the perceived difference in fin GBT incidence at the two sites.

Also, implications to management actions resulting from exceedences of biological action criteria were not different between the two sites. The 15% prevalence criteria were exceeded at both sites for similar periods of time. In fact, viewed in this way Rock Island showed a longer period of exceedence of the action criteria (14 days) than was observed at Rocky Reach (11 days) based on the date when fin signs first went above the 15% criteria and the date when signs fell below that level.