

University of Washington

School of Aquatic & Fishery Sciences

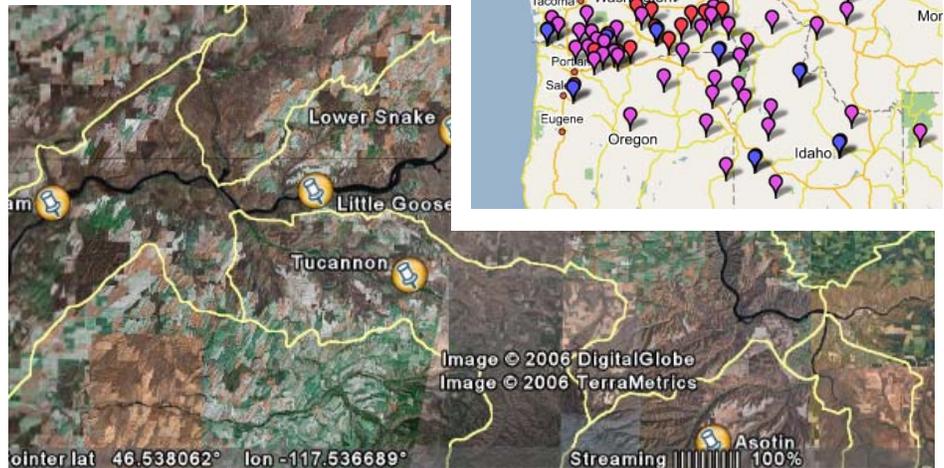
Columbia Basin Research

Salmon Insider
 Columbia Basin Research Newsletter
 Autumn 2006

Columbia Basin Research (CBR) is a scientific research group at the University of Washington, School of Aquatic & Fishery Sciences. We investigate salmon biology and survival in the Columbia and Snake river basins. We provide user-friendly data analysis and modeling tools, and maintain DART, an interactive secondary database, for the fisheries community and the general public. We will provide, upon request, support and training for the use of our analysis and modeling tools.

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Status & Trends Overview: Google Maps and Google Earth Interfaces

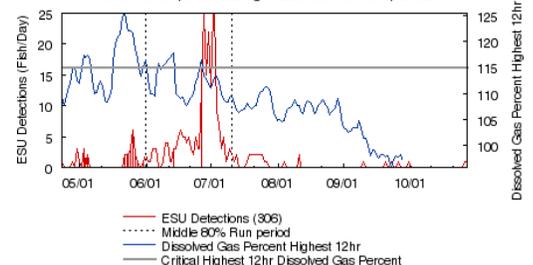


Water Quality Measures for Total Dissolved Gas

Total Dissolved Gas:

| Project ^ | Calculation Method | Threshold (%) | Status | |
|---------------------------------|-------------------------|---------------|-------------|----------|
| [No Filter] | [No Filter] | [No Filter] | [No Filter] | [Filter] |
| Bonneville Forebay | Average of 12 daily max | 115 | OK | graph |
| Ice Harbor Forebay | Average of 12 daily max | 115 | OK | graph |
| Ice Harbor Tailrace Mid-Channel | Average of 12 daily max | 120 | OK | graph |
| John Day Forebay | Average of 12 daily max | 115 | OK | graph |
| John Day Tailrace | Average of 12 daily max | 120 | OK | graph |
| Little Goose Forebay | Average of 12 daily max | 115 | OK | graph |
| Little Goose Tailrace | Average of 12 daily max | 120 | OK | graph |

2006 Little Goose
 Highest 12hr Dissolved Gas Percent
 Wild Snake R Fall Chinook ESU
 14.3% Fish exposed to Highest 12hr Dissolved Gas Percent above 115 %
 7.6% Fish exposed during Middle 80% of Run period



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CBR Status & Trends Overview: Google Maps Interface

The [Status & Trends Overview](#) website presents interactive displays of status and trends monitoring data with compliance targets for wild and hatchery adult and smolt salmon and related hydrosystem conditions. The database is searchable by performance measure (e.g., escapement, survival, travel time, temperature, etc.), species, hydroelectric site, province, subbasin, and now through a map interface.

The map interface was programmed using the Google Maps API (application programming interface) and will be familiar to anyone who has used Google Maps before. Built-in capabilities allow a user to move the map from side to side, zoom in or out, and switch back and forth between the “map” view with roads, borders, city names, and, most importantly, rivers—or the satellite view.

In addition to these built-in features, we’ve added markers and regional boundaries for the provinces and subbasins, and markers for the hydroelectric sites. Figure 1 shows the map with all markers displayed.

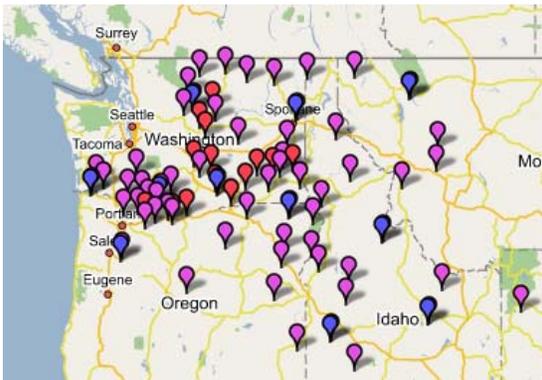


Figure 1. Map of the region with markers for provinces (blue), subbasins (purple), and dams (red).

The markers are color-coded to distinguish between the three location types as shown in Figure 2. Note also that the markers and boundaries can be turned off and on by checking the appropriate box (see Fig. 2). By default, the regions (not shown) are turned off to save on system resources and loading time.

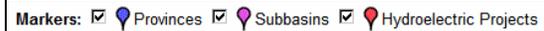


Figure 2. Legend for map markers with checkboxes that allow markers to be turned on or off.

Clicking on a visible marker causes a description balloon for the location to appear, overlaid on the map. This balloon contains location-specific information and will include links to the Status & Trends database. For instance, Figure 3 shows the description balloon for Lower Granite Dam.

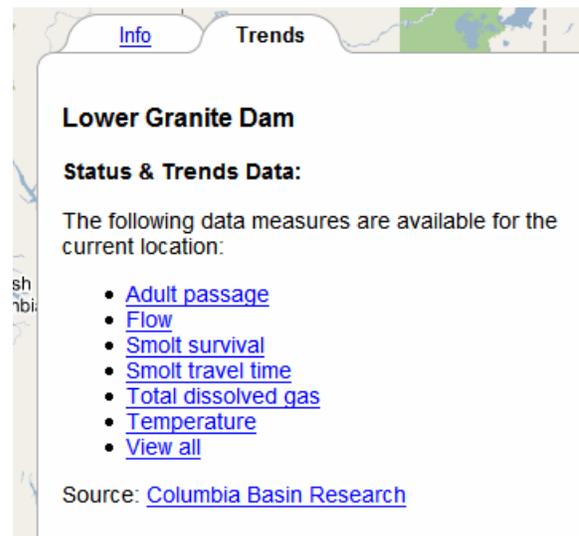


Figure 3. Pop-up balloon providing context-related links to Status & Trends data.

The "Trends" tab provides links to all available compliance data and performance measures pertaining to Lower Granite Dam. Clicking one of these links pops up a window with a table showing data available at Lower Granite for the given performance measure. For example, clicking on Adult Passage yields a table showing the status of adult passage for four species (Coho, Fall Chinook, Sockeye, and Steelhead) at Lower Granite (Figure 4).

Adult Passage:

| Project | Species | Run | Status | |
|-------------------|-----------|-----------|-----------|-----------------------|
| No Filter | No Filter | No Filter | No Filter | Filter |
| Lower Granite Dam | Coho | NA | VH | graph |
| Lower Granite Dam | Chinook | Fall | VH | graph |
| Lower Granite Dam | Sockeye | NA | VH | graph |
| Lower Granite Dam | Steelhead | NA | VH | graph |

Figure 4. Adult passage data table with status and links to graphics.

Graphs may be viewed by clicking on the "graph" link in the far right column of the table. On the graph page, you will

find a bar chart with total annual adult passage at Lower Granite for the selected fish type, a table with the same data, comments and equations further explaining the results, and tools for further data analysis including linear regressions, decadal means, etc.

A status column is also provided in the performance measure table. In this case, adult passage at Lower Granite for salmon and steelhead is identified with a status of VH, or very high. The status is based on performance during the 2000s relative to performance during the 1990s. The documentation for this computation is provided in the comments section of every graph page.

Access the Google Maps Interface through the [Status & Trends Overview](#) website by clicking "Map" in the "Begin search by" section. <http://www.cbr.washington.edu/gmaps/>.

Google Earth Interface

The same status data and location information may be viewed through the Google Earth program (Figure 5). A data file for Google Earth is available

for downloading on the CBR website, <http://www.cbr.washington.edu/gmaps/gearth.php>. A short tutorial on using Google Earth is provided along with the data file.



Figure 5. A screen shot from Google Earth with dams and subbasins displayed.

Water Quality Measures for Total Dissolved Gas

Two web-based tools for tracking total dissolved gas (TDG) compliance can be accessed at the CBR website. The [Status & Trends Overview](#) tool contains annual counts of days of non-compliance for all years, and the [Columbia Basin Performance Measures](#) tool allows users to analyze details for individual years. To illustrate the information these tools can provide, we will examine TDG at Little Goose Dam. TDG data used in analyses by both tools are from the [Columbia River Data Access in Real Time](#) (DART) database and based on hourly observations from U.S. Army Corps of Engineers Water Quality Monitoring (WQM) stations located in the forebay and tailrace of most Columbia Basin projects.

Status & Trends Overview

<http://www.cbr.washington.edu/trends>

The [Status & Trends Overview](#) site provides compliance analysis of TDG for all Snake and Lower Columbia dams, at both forebay and tailrace, where available, and across all years for which data are available. Days of non-compliance are based on the average of the 12 highest hourly percent TDG values on a given day and compared to a threshold of 115% for forebay sites and 120% for tailrace sites (*2000 FCRPS Biological Opinion, Appendix B.3.2*).

Compliance results for TDG have been updated through the end of the 2006 spill and migration seasons.

To view the gas compliance data, go to the [Status & Trends Overview](#) site, select Total Dissolved Gas from the menu labeled "Select a Measure," and click the "Submit Query" button. The TDG status for each analyzed location is displayed in color in the results table (see Figure 6).

Total Dissolved Gas:

| Project | Calculation Method | Threshold (%) | Status | |
|---------------------------------|-------------------------|---------------|-----------|--------|
| No Filter | No Filter | No Filter | No Filter | Filter |
| Bonneville Forebay | Average of 12 daily max | 115 | H | graph |
| Ice Harbor Forebay | Average of 12 daily max | 115 | H | graph |
| Ice Harbor Tailrace Mid-Channel | Average of 12 daily max | 120 | H | graph |
| John Day Forebay | Average of 12 daily max | 115 | H | graph |
| John Day Tailrace | Average of 12 daily max | 120 | H | graph |
| Little Goose Forebay | Average of 12 daily max | 115 | H | graph |
| Little Goose Tailrace | Average of 12 daily max | 120 | H | graph |
| Lower Granite Forebay | Average of 12 daily max | 115 | VL | graph |

Figure 6. Results table for TDG measure (table truncated).

The Status for the measure at each project is calculated by comparing the mean days of non-compliance in the 1990s to the mean in the 2000s as follows:

$$p = \left(\frac{\bar{x}_{2000s} - \bar{x}_{1990s}}{\bar{x}_{1990s}} \right) 100\% . \quad (1)$$

The color-coded grade ranging from very low to very high is based on Equation (1) and the criteria in Table 1.

Table 1. Color-coded status grading system.

| Grade | Range (%) |
|-------|-------------------|
| VL | $p \leq 0$ |
| L | $0 < p \leq 2$ |
| M | $2 < p \leq 24$ |
| H | $24 < p \leq 100$ |
| VH | $100 < p$ |

Every graph page includes the measure-specific status value and can be accessed by clicking "graph" in the far right column for a specific project.

The days of non-compliance of the TDG measure for each year at a project are plotted on a bar chart and presented in a table on the graph pages. For example, clicking on the graph link for

“Little Goose Forebay,” opens the graph page that contains the bar chart of compliance for all years (Figure 7) and its associated annual table of days of non-compliance (Table 2).

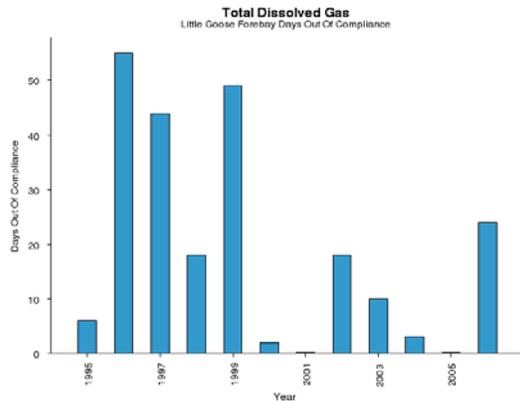


Figure 7. Little Goose forebay TDG compliance bar chart.

Table 2. Annual days of non-compliance for Little Goose Dam forebay as presented on the TDG graph page.

| Year | Value | Year | Value | Year | Value |
|------|-------|------|-------|------|-------|
| 1995 | 6 | 1999 | 49 | 2003 | 10 |
| 1996 | 55 | 2000 | 2 | 2004 | 3 |
| 1997 | 44 | 2001 | 0 | 2005 | 0 |
| 1998 | 18 | 2002 | 18 | 2006 | 24 |

To further investigate TDG levels at Little Goose Dam, the Columbia Basin Performance Measures tool can be used to examine the within-year observations and the extent to which fish runs were exposed to various TDG levels.

Columbia Basin Performance Measures

<http://www.cbr.washington.edu/perform/>

The [Columbia Basin Performance Measures](#) tool summarizes fish exposure to river conditions based on user-specified criteria. We have expanded this tool to provide summaries of river

conditions only, without requiring the presence of fish. In addition, we have added two new river condition parameters to further assist in the examination of current river conditions and compliance with water quality standards. The two new river parameters are:

- *Dissolved Gas Percent Highest 12 Hours:* Average of the 12 highest hours of dissolved gas percentages within the day. For each month and day with at least 12 hourly measurements reported, the data are averaged for the highest 12 hours (not necessarily consecutive).
- *Temperature 7DADM:* Average of the daily maximum hourly temperature for 7 days in degrees Celsius. Temperature 7DADM is calculated for a given date and the preceding 6 days.

Continuing the example of TDG compliance at Little Goose forebay (Figure 7) from the Status & Trends Overview section, the Columbia Basin Performance Measures tool can be used to query for the within-year details for the 24 days of non-compliance in 2006 for TDG above 115%.

Start on the [Columbia Basin Performance Measures](#) web page. Under the “Observed River Conditions at Hydroelectric Projects/Locations” category, click the “Go to Query Page” button. On the query page, make a selection from each drop-down menu:

- Year: 2006
- Project: Little Goose
- River Parameter: Dissolved Gas Percent Highest 12hr
- Critical Value: 115.

Then click the “Generate Graph” button. The results web page includes a graph of observed values with days exceeding the

specified critical value, 115%, highlighted in red (Figure 8) and a table of the exceeding dates and values (Table 3).

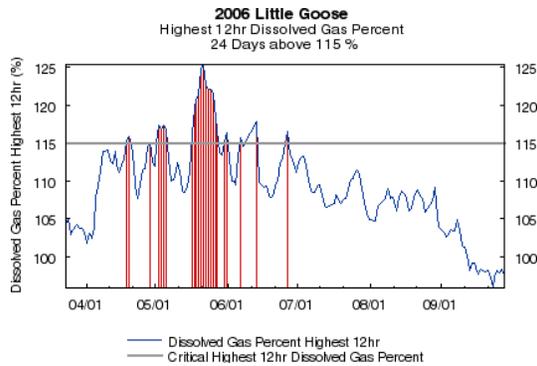


Figure 8. During the spring and summer spill seasons in 2006 at Little Goose Dam, there were 24 days where the forebay measurements of the highest 12 hours TDG exceeded 115%.

Table 3. Dates and values of the highest 12-hour dissolved gas percentages above 115%.

| | | |
|-----------------|-----------------|-----------------|
| Apr 19 [115.15] | May 18 [119.49] | May 26 [121.49] |
| Apr 20 [115.81] | May 19 [120.82] | May 27 [118.41] |
| Apr 29 [115.04] | May 20 [121.35] | May 28 [116.76] |
| May 3 [117.42] | May 21 [124.72] | May 31 [115.06] |
| May 4 [116.9] | May 22 [125.41] | Jun 1 [116.37] |
| May 5 [117.4] | May 23 [122.65] | Jun 7 [115.69] |
| May 6 [116.75] | May 24 [122.08] | Jun 14 [117.8] |
| May 17 [116.21] | May 25 [122.11] | Jun 27 [116.45] |

A user can also query for juvenile and adult salmonid populations that may have been exposed to the critical TDG levels and that population’s exposure index. For example, to examine the exposure of Snake River Fall Chinook ESU population to the days exceeding 115% TDG at Little Goose Dam, return to the [Columbia Basin Performance Measures](#) web page. Under the “Observed Fish Exposure at Hydroelectric Projects” category, select “Observed Juvenile Passage ESU Stocks” from the Fish Type menu and then click the “Go to Query Page” button. On the query page, make a selection from each drop-down menu:

- Year: 2006

- Project: Little Goose
- Species: Chinook, Wild Snake R Fall
- River Parameter: Dissolved Gas Percent Highest 12hr
- Critical Value: 115.

Then click the “Generate Graph” button. The results web page includes the graph of observed fish passage with passage days where TDG exceeds the specified critical value, 115, highlighted in red (Figure 9) and a summary table of population’s exposure index and run dates.

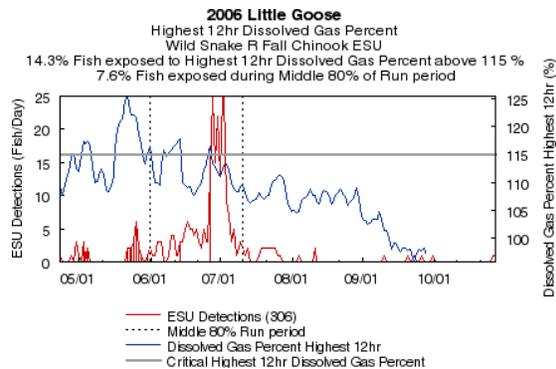


Figure 9. Snake River Wild Fall Chinook ESU salmon exposure to TDG levels above 115% at Little Goose Dam during the 2006 outmigration.

The results indicate 14.3% of the ESU population passes Little Goose when forebay TDG levels exceed 115% and 7.6% of the ESU population are exposed to these conditions during the middle 80% of the run period, June 1 – July 11.

Future Developments

We will add new measures for water quality standards, as they are defined, to both the Status & Trends Overview and Columbia Basin Performance Measures analysis tools. In the near future, we will be adding a new water quality measure for TDG based on the highest consecutive 12-hour average.