

COLUMBIA RIVER REGIONAL FORUM

TECHNICAL MANAGEMENT TEAM

Year End Review Session

December 8, 2010

FACILITATOR'S SUMMARY NOTES ON FUTURE ACTIONS

Facilitator: Robin Gumpert

The following notes are a summary of issues discussed at the year end review session. These notes are not intended to be the “record” of the call, only a reminder for TMT members. See the Meeting Minutes for more details of the discussion and considerations.

In Attendance for All or Part of the Meeting:

TMT members and alternates: Steve Barton (COE), Pete Hassemer (alternate, Idaho), Russ Kiefer (Idaho), Cindy LeFleur (Washington), Jim Litchfield (Montana), Tom Lorz (CRITFC-CTUIR), Tony Norris (BPA), John Roache (Bureau of Reclamation), Dave Statler (Nez Perce), Paul Wagner (NOAA), Dave Wills (USFWS)

Other participants: Mark Bagdovitz (USFWS), Doug Baus (COE – Division Office), Richelle Beck (D. Rohr and Associates), David Benner (Fish Passage Center), Brandon Chockley (Fish Passage Center), Ted Day (Bureau of Reclamation), Scott English (COE – Division Office), Barry Espenson (Columbia Basin Bulletin), Joel Fenolio (COE – Seattle District), Margaret Filardo (Fish Passage Center), Jason Flory (USFWS), Steve Hall (COE – Walla Walla District), Laura Hamilton (COE – Division Office), Kim Johnson (COE – Division Office), Russell Langshaw (Grant County PUD), Jerry McCann (Fish Passage Center), Chris McDowall (LDH Energy), Kristian Mickelson (COE – Seattle District), Bill Muir (NOAA Science Center), Jim Ruff (NPCC), Dan Spear (BPA), Glen Traeger (Ibevdrola), Pat Vivian (Official Note Taker), Nathan Zorich (COE – Portland District)

Facilitation team: Robin Gumpert and Donna Silverberg, DS Consulting

Purpose of Meeting

Robin welcomed everyone, led a round of introductions and went over the purpose and protocols for the day. The purpose of every TMT Year End Review is to take time outside of the usual TMT setting to review and reflect on the year's operations and how well the group (and the system) performed.

Conditions Review:

Weather and Water: Steve Barton, Division COE, reported on the 2010 hydrologic conditions. Precipitation was “average” overall, although the system experienced low snow pack during the early months and a dramatic increase in flows later in the year (June). Early water supply forecasts began predicting below normal precipitation and because of this, the COE ‘chased’ the actual water supply for the rest of the year. The late

season forecasts increased by four MAF from earlier in the year and the actual observed water supply came in higher than any of the forecasts.

With respect to runoff, compared to the previous five years, 2010 was one of the driest in the Columbia Basin as a whole. Low flows were seen until late April when runoff finally began—this created some difficulty for managers since reservoirs were kept low awaiting runoff.

Flow objectives and actual flows were generally close throughout the basin: some came up just below their objectives (Lower Granite), some met their targets (Priest Rapids with augmentation from Grand Coulee); and some were exceeded by their actual flows, depending on where in the basin the project was located.

Water quality: TDG standards were exceeded 234 times, which Steve said is consistent with prior years. Most exceedances were a result of too much water and exceeded powerhouse capacity. Temperatures were generally cool, with few days exceeding 68 degrees F.

Participant Questions/Comments:

- Were the TDG exceedances based on a 24-hour rolling period? A: Yes. They were 234 different calendar days.
- Regarding forecast vs. actual water supply: Is there a time when most of the water comes into the system? A: Historically peak runoff is in June. This year, the peak was slightly earlier. Q: What is the predictor? Are there patterns of under or over predicting runoff? A: Not sure, but we could look at statistics on this. For the Snake River, the April forecast is generally the best predictor.
- How does this year rank with the past 70 water years?
 - A: Not sure, but this is something we could revisit.
- Did Upper Snake flow augmentation have an influence on timing or decisions? How did it play out in the factoring? A: Upper Snake flows did factor in a bit—we knew we could depend on a certain amount, but also recognize we can't always rely on those flows. (See below for more discussion on Upper Snake River flow augmentation.)

Ocean Conditions and Salmon Marine Survival: Bill Muir, NMFS Science Center, reviewed the Pacific Decadal Oscillation (PDO) index and suggested that, generally, when it is warm, this creates unfavorable condition for fish, while cold means good conditions for fish. This past year, PDO shifts from warm to cold improved what had been predicted as a very bad ocean year for fish: by May, it looked to be a pretty good year. It took a while for the copepods to become productive sources of food. Bill said that likely this shift to later cool conditions will be good for fall Chinook, but it may not have been a great year for spring and summer fish.

2011 forecasting shows a continuing La Nina, with a negative PDO and cool conditions which should be good for survival of both spring and fall salmonids—and the food they eat.

Participant Questions/Comments:

- Your forecasts are looking at ocean survival not returns? A: Yes, and these match well.
- We saw a fish delay in June, but then they moved quickly—might the timing of the shift in PDO have helped summer as well as fall fish? A: Yes.
- Is there a relationship between deep sea and other sea species and salmon?

Fish Conditions: Juveniles—Paul Wagner, NOAA, showed that the late flows delayed juvenile migration. Compared to the 10 year average, steelhead saw a near reverse graph after late April—the passage numbers started well and then really dropped off until the late May Dworshak release, with a final bump in June with increased flows.

McNary steelhead saw a very large run, likely because few were transported this year so more were in the river than normal. Bonneville steelhead passage was close to the 10-year average in terms of timing.

Yearling chinook passage was early with larger passage numbers than the 10-year average. Sockeye passage was late with fewer counts than expected, except at McNary where it was a Mid-Columbia banner year for Okanogan fish. Bonneville numbers went up during the increasing flows in late May. Subyearling Chinook responded well to flows in typical fashion with good passage numbers. Passage numbers went up at Bonneville with the Spring Creek releases, but nothing atypical was seen for the rest of the season. Coho passage counts were mostly hatchery fish and timing was typical, with fewer counts than the 10-year average.

Participant Questions and Comments:

- Lower Granite steelhead indices are troubling. What is going on there? A: This might be explained by changes with the RSW and fluctuations of spill that occurred. It is best to look at the comparison of timing, not the proportion of fish.
- The abundance numbers shouldn't be included in these slides because really, the 10-year comparison reflects timing, not abundance. Also, it looks like the surface weir is not showing the fish moving—with high spill levels, the fish would have taken this route.
- Could we overlay onto the graphs the hatchery releases, to see the impact from those releases? Perhaps transparencies could be used to easily show the relationship of a number of factors.

Adults—Cindy LeFleur, Washington, shared information on adult passage numbers. Bonneville Spring Chinook have been averaging around 202,000 returns for the last ten years. Jack spring Chinook have experienced strong returns in the 2000s with an anomaly seen in 2009 with very high numbers. Cindy noted that predictive tools have been on track until recent years when much higher counts of fish have been observed than predicted.

Spring Chinook saw a similar upward trend from the 1980s (13,300), 90s (6,500), to now (17,100). Summer Chinook numbers increased from the 1980s (19,200), 90's (15,100) and 2000s (57,000). A record number of sockeye were seen at Bonneville this year, much higher than any recent history (counts go back to 1938). The Technical Advisory Committee (TAC) predicted 160,000 for 2011.

Fall Chinook numbers have been high in recent years, though they are not seeing the same pattern as spring Chinook. Fall Chinook counts are predicted to be around 300,000 this year. Bonneville pool hatchery stocks had a strong return this year; bright jack counts were very high in 2009 and not as high in 2010. Tule jack counts were a little less than half of last year's counts. Lower Granite Fall Chinook counts set a record this year of over 41,000. Cindy noted, however, that the number of wild fish is only 18% of the total run.

Finally, she reported that Summer Chinook have been doing well the last few years; a record was set in 2001, and since then they have been trending high.

Participant Questions and Comments:

- It is important to note that Pacific Lamprey are not trending as well. During the last 5-10 years, counts have ranged below 50 fish passing over Lower Granite Dam, and around 15 fish in the last couple of years.
- Clarify: Are all graphs depicting counts in the hundred thousand range? A: Yes.
- Note: Clipped/unclipped fish are determined based on tags and scales.

Adult Timing: Brandon Chockley, Fish Passage Center, explained how data was analyzed given some anomalies in the data base: for example, historic adult counting has been year round since 2001 and prior to that only 3/15-11/15 so extrapolations have to be made when making comparisons.

The data showed that adult passage timing across the years is highly variable. In 2010, the first 10% of adult passage was later than what was seen historically. This was also true of timing for 50% and 90% passage rates. Jacks saw the same basic trend except at the 90% level which was later than last year but similar to the historic trend. Later passage seems to be related to cooler temperatures.

Participant Questions and Comments:

- You said temperature and passage timing might be related. Can we see other trends with harvest timing? Might this be overlaid in future years?
- What levels of removals might influence the arrival dates from the early portion of the run?
- We are seeing pinniped build up below Bonneville at the same time—is there an impact to fish passage timing? (*Note:* The COE's Robert Stansell will provide an update on pinniped fishery interaction management at a future TMT meeting in early 2011.)

- Is there a relationship between large run size since 2000 and late arrival since 2000? Marine mammal numbers have gone up as well since 2000. All seem related to the fact that there are a lot more fish in the system.

Reservoir Operations

Joel Fenolio, Seattle District COE, shared operation highlights at Libby Dam. The project operated to meet deviation requests, sturgeon operations and bull trout minimums. All operations were coordinated with Grand Coulee operations so there were no impacts from local operations on the system. The forecasts for Libby were pretty accurate this year with actual runoff at 4,520 KAF. 260 KAF was stored for the deviation. A high rain event in late September caused Libby to be higher than the 2439' end of month target elevation.

Jason Flory, USFWS, shared that they were not able to get river stages at the right levels for the sturgeon test this year as had been desired. So, in planning for 2011, the USFWS hopes to find flexibility to do the test as called for in the settlement agreement of the USFWS Sturgeon BiOp.

Participant Question:

- Is the Corps planning for this year's possible test? It seems like making an effort to watch the rain and inflow levels all December, before drawing down, might be more prudent for meeting the obligations in the spill test.

John Roache, Reclamation, reported on Hungry Horse and Grand Coulee reservoir operations. Hungry Horse Water Supply Forecasts steadily declined throughout the year. At the end of the year, thanks to good rains in May and June, the actual water supply volume was higher than the forecasts were predicting.. For Grand Coulee, John noted that Lake Roosevelt will need to draw down to a maximum elevation of 1255 feet during the spring of 2011 for required drum gate maintenance in 2011. Drum gate maintenance work must be completed at least once during a three year period and has been deferred the last two years.

Participant Questions and Comments:

- Is 1208 feet considered empty at Grand Coulee? A: Yes, this elevation is the bottom of the active pool and most power generation is eliminated below this elevation. All pumps that pump water to Banks Lake are out of service below elevation 1208 feet and this is also the minimum drawdown elevation for flood control. The active capacity of Lake Roosevelt is roughly around 5 MAF and the total capacity is roughly around 9 MAF. 1,026 feet is the actual bottom.

Steve Hall, Walla Walla District Corps, reported on Dworshak operations, noting that spring rains helped in a very dry year. The project was substantially below flood control and impacted the COE and its regional partners' ability to provide certain desired operations. The project operated on minimums until June, which is very unusual. However, the COE was able to meet the request for augmentation made in May which seems to have correlated to fish movement—so they were happy to see a benefit after the

fact. Temperature augmentation was a big success this summer. Even with high temperatures all summer, the project was able to maintain at the 66-68 degree range with no exceedences above 68 degrees.

Upper Snake Flow Augmentation: Ted Day, Reclamation, reported on Upper Snake flow augmentation in 2010. This year saw many fluctuations with water supply, but ultimately the augmentation program ended on a positive note. Ted explained that each year is a unique challenge in determining where flows for augmentation will come from, with multiple sources that provide variable amounts (with variable timing) depending on runoff conditions, reservoir operations, reservoir carryover, and rental water availability. Two primary areas are tapped: 1) Upper Snake above Milner— this includes Palisades Reservoir, Jackson Lake (near Jackson Hole), and American Falls Reservoir 2) The Payette system—this is a very reliable source that includes Cascade and Deadwood Reservoirs. Also available to the flow augmentation program are lesser volumes from the Boise reservoir system (Lucky Peak, Arrowrock, and Anderson Ranch), with the remainder provided from natural flow water rights that the BOR owns or leases.

Ted explained that 2010's very low snow pack, with the 7th lowest runoff forecasted in 90 years of record for the Upper Snake at Heise, meant that no rental water would be available from the Upper Snake (above Milner) rental pool (under the terms of the Nez Perce agreement). This source of augmentation water typically provides 100-185 kaf during near average years, although the amount is prescribed on a sliding scale that goes from zero in a drought, to over 200 kaf in wet years. Without this rental source, it appeared as though the BOR would not be able to provide the full 487 kaf goal, and that providing the secondary goal of 427 kaf would require extraordinary actions. These actions included executing a one-time lease agreement with a landowner in Oregon for Snake River natural flow rights (at significantly higher cost than other rentals), and commitment of the entire amount of "powerhead" space reserved in Palisades Reservoir. Use of powerhead space is particularly significant since it can result in the eventual shutdown of the powerplant, and is the last to fill space in subsequent years which means the reliability of providing augmentation water may be severely impacted if drought conditions continue. Powerhead space is only used as an absolute last resort. Additionally, use of powerhead limits BOR to providing no more than 427 kaf (Nez Perce Agreement.) Despite the "cost", Reclamation was committed to providing an earlier timing of flow augmentation in May when it was most needed for fish due to low flows, and delivered the entire amount (157 kaf) that was expected from the upper Snake above Milner. Then, in June, over 200% of average precipitation fell in the basin, dramatically changing the water supply situation and even resulting in the highest releases ever from Cascade Reservoir. With cooperation from the state of Idaho and irrigators, BOR was able to rent additional water to effectively replace the powerhead that was used, thus lifting the 427 kaf cap and allowing BOR to rent additional water to the full 487 kaf in 2010. Ted noted that so far 2011 is off to a good start and looking promising for providing a full 487 kaf.

Participant Questions and Comments:

- From the various sources you mentioned, you have targeted timing for getting those sources. What is the possibility of seeing the stacked up look of these to help determine the hydrographic timing of those releases and the impacts on Brownlee?
A: It would be possible to plot the various flow rates (and timing) from the individual sources, which should show the combined effect at Lower Granite. Are the dates you listed opportunity dates or management dates? A: Both. The general goal is to release earlier and shift the water out of the later summer period, when it is warmer and has less benefit. Each year is unique, and our ability to manipulate the timing will differ year to year, depending on timing of runoff, volume of runoff, which sources are used, status of flow targets, etc., and some water will still be release in August from the Payette. It was easier to do when we only augmented in summer, after we knew exactly how much water was available from each source—but the benefit to the fish is in the spring so we are trying to manage to meet those benefits. Drought years, like we thought we were in, may prove fairly easy for earlier releases since we know there will not be flood control releases and we have a good idea how much water is available. But this has proven a challenge given the oddities of the past two years.
- Is there some lesson we are getting so far for next year?
 - A: We learned that we can provide the water during the most difficult of seasons and that the program has positive impacts by putting out the water when its needed. The last two years represent a fundamental shift in how we've done flow augmentation, starting in the early 90's, so there's a learning curve and attitudes to change. there is a good will component that comes into play when we can cooperate during contentious times.

General Observations/Lessons Learned:

- The Dworshak operation communication and implementation went well and had a positive impact on fish.
- Implementation of the Dworshak SOR was successful.
 - The strategy employed seemed to have a high benefit—especially when coupled with a rain event which added extra value to gain the cover of turbidity.
 - In the future, if a rain event is predicted, tie it together with water velocities to provide optimal conditions for the fish.
- Does anybody have or know of information about the impacts global warming may have on fish run timing?
 - A: Probably more speculation than research at this point. ISAB and WA put out reports that would be worth looking at. Likely climate change will have an impact on abundance.
- For next year, TMT will need to plan for the required spill test at Libby and drum gate maintenance at Grand Coulee.
- What would improve TMT's next steps?
 - This year we saw our creativity working well as a result of our good conversations. As we move forward, the key will be talking early and working through ideas so we can utilize the most flexibility in the system.

- It would be nice if we were able to better understand what might happen with releases at Hells Canyon and Brownlee—from flows to temperatures. Providing more certainty within the basin would help.

Specific Operations Review

Libby Water Supply Forecast: Joel Fenolio, Seattle District COE, shared information about the COE's new forecasting methodology in place to support December forecasting that has impacts on the rest of the year's operations. This work came about in response to regional discussions about the need to better manage Libby, the fact that it had not been updated since 2004, and the COE's desire to create a better forecasting tool. A specific change to the tool included use of Snotel sites and other data points, which are proving so far to be good predictors of the actual water supply in the area. The COE is now using the new methodology for 2011 management of Libby operations.

Participant Questions and Comments:

- How does the new methodology take in to account aggressive December management – can it be corrected for deviations? A: Yes, the COE can file a deviation request based on best professional judgment.
- The previous method used snow course data, now just Snotel. How often will the measurement be used? Why is it better? A: We can now track accumulation on a daily basis instead of once a month and we can better respond to what we're actually seeing.
- It appears this will move us to a better spot without consternation. The outlook is good for 2011, but in the future, keep in mind we may ask you to use a deviation request as a management tool.

Avian Predation: Nathan Zorich, Inland Avian Predation Study Unit of the Corps, shared information on the avian predation management program. The program is in place to help meet BiOp goals of enhanced smolt survival through reduced predation. In 2009-10, the COE evaluated impacts of predators at John Day and The Dalles as well as the avian line array/boat hazing at John Day. The team estimated avian impacts by counting avian consumption (not predation since sometimes the birds were eating already dead fish). California gulls turn out to be the most numerous in the area with herons, pelicans, cormorants and mergansers among others seen. Changes in the line array and hazing did have positive impacts on reducing predation (the daily mean gull count dropped from 99 to 19). The team found that the birds are eating a lot of lamprey and salmon as well as other species, and that more consumption happens at The Dalles than at John Day. The bird populations in the area are increasing due to landfills, agriculture and dams that provide great food sources: insects, rodents and fish.

In summary, Nathan reported that gull numbers were highly variable. Avian array lines proved effective at decreasing consumption counts by 61,000. Future suggestions include installing more lines at The Dalles; implementing a sustained hazing program (boats and shore based); using mobile crews to respond to movement; and using a variety of habitat modification tools at Miller Island Rocks to prevent nesting. Also, the program will need

to prioritize where to use avian predation funds, and will look to create better monitoring devices.

Participant Question:

- What if any impacts has The Dalles spillwall had on avian predation in the area?

Juvenile Survival through the Hydro System: Bill Muir, NMFS Science Center, reported on Chinook and Steelhead survival numbers, as determined by pit tag arrays throughout the system. He said survival was very high in 2010 for fish migrating in-river. Transportation operations were started late and combined with surface passage structures at Snake River dams, resulted in fewer fish transported last year. Until late April, he said, in-river fish tend to do better than transported fish. Bill reported that sockeye survival for smolts released from Red Fish Lake were very low and it was unclear at this time why that was so. Idaho Fish and Game and NOAA will be doing a radio telemetry study next year to try to sort out why certain areas are problematic for juvenile survival.

Participant Question:

- Why has steelhead survival increased so much in the last two years?
 - A: Both years had increased surface collectors, higher spill and fast travel times. 2010 was a low flow year, but saw increased spill, with increased surface structures also leaving a higher number of non-pit tagged fish in river which seems to be having an impact on overall numbers.

BON Powerhouse 2 Spring Operations: Paul Wagner, NOAA, and on behalf of FPAC, reported on the success story that descaling decreased when the Corps responded to the SOR 2010-03 request (dated June 15) to decrease turbine unit loading. Now, FPAC is discussing the possibility of a structural fix to the cause, but any change will not occur until 2014 at the earliest, indicating the region might need a fixed procedure in the meantime. This is being worked out with ERDC and others. In the meantime, it was noted that the action agencies responded well and FPAC hopes for such quick responses in the future.

Fall Subyearling Chinook Survival: Jerry McCann, Fish Passage Center, reported on fall Chinook juvenile survival in 2010, noting that it was a pretty good year for these fish—with increased spill, decreased transit time and cool temperatures all playing a role. Jerry also said that flows through June and above average spill while temperatures were at or below average for the period analyzed may have had positive impacts.

Chum Operations: Paul Wagner, NOAA, reviewed Ives Island chum spawning operations. Looking at numbers, he suggested that 50% protection was provided in 2010. Paul noted that no one felt more could be done, but acknowledged that the managers had to make the call of terminating protection flows earlier than usual. Paul said it is uncertain what percentage was lost with each elevation change made, and expressed hope that there would be better information for decision-making in the future about where the redds are as compared to other years.

Hanford Reach Operations: Russell Langshaw, Grant County PUD, reviewed operations and spawning dates for Hanford Reach operations, which he said were consistent with past years. Russell shared that the protection criteria were met 82 of 86 times, even better than recent years. He reviewed studies planned as part of the 401 water quality process that have been initiated, and shared a video of sturgeon eating redds. Russell will be studying egg pockets for redds and will share analysis results relative to keeping redds watered in the future.

Year End Review Wrap Up

Participants spent the remainder of their time together reflecting in small groups about the information and discussions heard today, noting for each other those pieces that could help future successful collaborative work and good management operations.

Note: TMT acknowledged that Cathy Hlebechuk, past TMT chair, passed away on Friday, November 19. She was and will always be remembered as a dedicated and beloved member of the TMT community. Her presence will always be felt—and she will be missed by all.

These summary notes were prepared by Donna Silverberg. Comments or suggested revisions should be made to facilitator Robin Gumpert at rgumpert@cnw.net.

Columbia River Regional Forum
TECHNICAL MANAGEMENT TEAM OFFICIAL MINUTES

2010 Annual Review of Lessons Learned
December 8, 2010

Notes: Pat Vivian

1. Introduction

The 2010 TMT year-end review was chaired by Steve Barton (COE) and facilitated by Robin Gumpert (DS Consulting). Representatives of the COE, Idaho, BPA, BOR, Montana, NOAA, NPCC, FPC, Washington, USFWS and others participated. This summary is an official record of the proceedings, not a verbatim transcript. Anyone with questions or comments about this summary should give them to the TMT chair or bring them to the next meeting.

The purpose of today's meeting was to review specific conditions and operations in 2010, focusing on lessons learned that can be applied to in-season management going forward. The presentations were accompanied by slide shows which are posted on the TMT web page, linked to today's agenda.

2. Conditions Review

2a. Weather, runoff and water quality summary. Steve Barton (COE) covered hydrological conditions and issues in the 2010 water year, including precipitation, temperature and observed runoff in relation to BiOp flow targets and state water quality standards.

Precipitation in water year 2010 was near normal throughout the basin for the year as a whole, with the exception of southeast Idaho and the Bitterroot divide which were below normal. Conditions at first looked favorable in early fall 2009 but rapidly deteriorated to significantly below normal until April and May 2010. This was followed by record precipitation in June.

Winter brought an Arctic blast in December 2009 and temperatures that were significantly below normal through March 2010. Then conditions in the southern portion of the basin returned to near normal temperatures, with the Canadian basin above normal. Storms that brought precipitation in May and June also brought cooler weather. The rest of the year brought near normal temperatures except in the northern and southern edges of the basin.

Water supply and runoff forecasts started off predicting below normal volumes. As snow on the ground began to deteriorate and forecasts declined, the water supply looked increasingly dismal. However, things improved significantly in June and July following June's heavy precipitation. The late-season water supply forecast was raised by 4 maf at Lower Granite and 8.5 maf at The Dalles.

This was far from normal. Generally, observed precipitation levels came in higher than the latest season forecast throughout the year.

Seasonal runoff volumes were significantly below normal basin-wide, and rapid changes made forecasting especially difficult. The year was one of the driest of the last 5 years for the basin as a whole. Flows and runoff stayed low through April, which was a challenge for specific project operations. The season ended with a peak unregulated flow rate of 550 kcfs at The Dalles on June 7, 2010. The actual observed peak discharge was 393 kcfs on June 11. Spring 2010 flows were augmented by Grand Coulee releases to meet BiOp spring flow objectives. Barton compared BiOp flow targets with actual flows:

- Lower Granite – Spring seasonal flow objective of 85 kcfs in spring and 50 kcfs in summer. Fell short of objectives but came close to meeting them, with an average of 78 kcfs flows in spring and 47 kcfs in summer.
- Priest Rapids – The spring objective of 135 kcfs was exceeded at 138 kcfs average flows.
- McNary – The spring objective of 220 kcfs was exceeded at 226 kcfs average flows. The summer objective of 200 kcfs was not met, with only 130.55 kcfs average flows observed.

Water quality standards were exceeded on 234 days this year, as compared to an 11-year average of 257 days. These were calendar days, not 24-hour rolling averages. Camas Washougal and Ice Harbor forebay are among the gages that historically have had a higher number of TDG exceedances. When these exceedances are categorized by type, the majority in 2010 were associated with excess powerhouse capacity that was brought on by high flows and heavy spill in June. Causes of type 1 exceedances (which occurred despite best professional judgment) were intertie and powerhouse outages.

Overall, 2010 was a cool year. The basin had a total of 663 days on which the 24-hour average was above 68 degrees F (20 degrees C). Temperatures at Lower Granite Dam never went above 68 degrees F.

Questions and discussion: Q: When does most of the runoff come into the system? Are there patterns of under- or over-predicting? (Pete Hassemmer, IDFG) A: Historically, peak runoff is in June. The RFC forecast page has prediction error statistics. It's assumed that 80% of accumulated runoff will be in the Snake River by April 1, so the April 1 water supply forecast is critical.

Q: How does 2010 compare in relation to the past 70 years in terms of water supply? (Paul Wagner, NOAA) A: Flows at The Dalles were less than 80% of normal in 2010. Further comparisons would require investigation.

Q: How did weather predictions affect the timing of water releases to the Snake River in 2010? (Dave Statler, Nez Perce Tribe). A: The BOR made an effort to augment flows in the upper Snake earlier this year. More on this below; see section 3e, Upper Snake flow augmentation.

2b. Ocean conditions summary. Bill Muir, NOAA Science Center, summarized the effects of ocean conditions on salmon survival since 1940. Conditions were good (negative PDO with cooler ocean temperatures) in the 1970s, poor in the 1980s, and good again the 1990s, bringing high salmon returns. A negative PDO provides migrating salmon with cooler ocean temperatures and favorable conditions. In a good year, copepods and other foods for salmon are plentiful and salmon predators tend to swim far from shore. Conversely, warmer temperatures associated with a positive PDO bring food shortages and a higher incidence of predation on juvenile salmon.

Ocean conditions were good in 2009, but 2010 started out with a positive PDO due to the El Nino trend, thus poor conditions for salmon. In May 2010, the PDO shifted to negative and things began to improve. It took a few months for the shift to translate into higher copepod productivity. Recent data indicate that 2010, unlike 2009, provided poor ocean conditions overall, similar to 2004 but not as bad as 2005. (Those two years are among the worst in the past decade.) Forage fish appeared fairly late this year, which was not good for smolts entering the ocean. In terms of adult returns, the shift to a negative PDO might have happened too late in spring 2010 to do migrating salmon much good, although it might have benefited fall Chinook. Ocean conditions of 2010 could translate into lower survival rates for spring Chinook, chum, sockeye, coho and steelhead. The summer was anomalously cool, which aided late migrants like fall Chinook. Juvenile catches, typically a good indication of potential adult returns, were lower this year than in past years for all listed species except subyearling Chinook.

Forecasts for 2011 ocean conditions include a La Nina trend, a negative PDO and cool ocean temperatures, with relatively high spring flows. Food supplies for spring and fall salmon should be plentiful under this scenario.

Questions and discussion: Q: Conditions didn't look bad at first in 2010, so what happened? Are things still looking negative? A: More data are coming in to help clarify the 2010 water year. September 2009 catches were very low, and June 2010 catches are expected to be a bit higher.

Q: How did the low flows of 2009-10 followed by record precipitation in June 2010 affect survival numbers? A: June Chinook catches were low despite heavy rains. The timing of flows this year appeared to protect Chinook salmon. As for the 2011 water year, the current prediction is for la Nina conditions and heavy snowpack. However, conditions can change radically between now and next spring.

Q: Is there any relationship between the distribution of fish at the mouth of the Columbia and the distribution patterns of marine mammals? A: Last year, Humboldt squid were prominent along the Oregon coast. Further explanation of interactions with salmon would require extensive knowledge of deep sea creatures.

2c. Fish. Juveniles: Paul Wagner (NOAA) reported migration conditions, juvenile travel times, and juvenile survival rates through the hydrosystem over the past year, including transport percentages. Flows were late this year, so spring migration was delayed. The passage indices reflect that 80% of the fish in the river were hatchery fish. Migration proceeded surprisingly well for early April, with a delay at Lower Granite as expected because flows were so low. Numbers picked up with the June rains, but migration slowed again until the Dworshak release of 10 kcfs in mid June. As it turned out, delayed migration was for the best because ocean conditions at the time were not good for smolts. Steelhead passage tended to be later than Chinook this year because steelhead respond more directly to river flows.

At McNary, about 40% of steelhead were transported this year, as compared to 80% over a normal 10-year horizon. That means more steelhead traveled in-river than usual. Steelhead survival at McNary was way above the seasonal average. The story was the same at Bonneville for steelhead and yearling Chinook. There was a large increase in yearling Chinook passage at McNary toward the end of May. Lower Granite yearling Chinook passage indices followed their typical timing except the peak came earlier this year than usual.

Sockeye passage at Lower Granite was late, with lower numbers than expected. Sockeye survival was estimated to be 15-20%. The 2010 water year one of the lowest on record. This was a banner year for Okanogan sockeye but not Snake River sockeye. Sockeye arrived late at Bonneville.

Subyearling Chinook responded to the late May freshet and passed in large numbers at Lower Granite and McNary. The releases were all dominated by hatchery fish with the exception of steelhead. Coho runs, largely hatchery releases, had less than typical abundance but responded well to higher flows at Bonneville, Lower Granite and McNary.

Questions and discussion: Q: Have release sizes of hatchery fish been constant for 10 years? How has the timing of flows affected passage indices over the years? A: The passage index 10-year average is not a good measure of abundance, although it is fine to use the 10-year average to evaluate timing. The RSW at Lower Granite played a role in the survival rates for 2010. What differed this year was a 50% spill level in June, with higher percentages migrating in-river.

Steelhead passage was strong this year. Russ Kiefer (Idaho) noted that the surface weir at Lower Granite is more effective at lower flows, especially for

steelhead. There was discussion of ocean conditions and the timing of hatchery releases, as well as the passage indices in relation to flows.

Kiefer suggested that future graphs of juvenile migration correlate timing with flow volumes. Robin Gumpert and Jim Litchfield (Montana) suggested overlaying passage and conditions data to show how the different factors relate.

Adults: Cindy LeFleur (Washington) presented data for Columbia River salmon and steelhead returns. This year brought some of the largest runs seen since 2000, raising average returns for the past decade. Returns of adult spring Chinook by June 15 each year averaged 82,000 per year in the 1980s, 68,000 per year in the 1990s, and 202,000 per year since 2001.

There's still no explanation of the enormous return of spring Chinook jacks in fall 2009. The phenomenon didn't produce a correspondingly high number of adults in 2010, although the return of 16,000 adults in 2010 is considered good. WDFW is working on forecasting methods to account for it.

Lower Granite spring and summer Chinook adult returns have been low for the past decade and were even worse in the 1990s. This year's average is 13,008 fish at Lower Granite. Since 2001, however, there have been strong returns of upper Columbia summer Chinook beginning June 16, with average returns of 57,000 fish per year.

This year's return of 386,000 sockeye set a record going back to 1938 when Bonneville Dam was built. The previous record was 335,000 sockeye in 1947. Adult sockeye runs in the 1800s were over a million.

Fall Chinook returns in 2010 are estimated around 320,000 adults, with good returns on the Hanford reach as well. Bonneville hatchery fall Chinook returns were strong in 2010. This year brought another record return at Lower Granite of 41,000 fall Chinook – a good comeback from only 337 adults in 1981.

Summer steelhead have been doing well for years, with a record count of 600,000 adults returning in 2001. This year's return is estimated to be around 380,000 fish. Of these, about 38% had unclipped fins, indicating they were probably wild, although some hatchery fish are unclipped. Lower Granite summer steelhead had strong returns in 2009 at 588,000 fish.

Questions and discussion: Q: Are there any speculations regarding the spring Chinook jack returns for 2009? A: No. The prediction of 470,000 adults returning in 2010 was based on average predictions, not the high jack count of the previous year. The actual return this year was only 315,000 adults. There is still no explanation for the 80,000 jacks that returned in 2009.

Q: If fall Chinook passage at Lower Granite consisted of mostly wild fish during the 1980s, is the current estimate of 18% wild fish based on clipping information? A: No, it is based on run reconstruction efforts. Hatchery fall Chinook from above Lower Granite are not always clipped.

Dave Statler (Nez Perce) emphasized that, while some 200,000 endangered sockeye are forecasted to return to the Columbia River in 2011, this optimism does not extend to Pacific lamprey populations. Lamprey are in serious trouble, although they are not listed. Counts at Lower Granite have been less than 50 fish in recent years, their numbers steadily declining.

Adult run timing: Brandon Chockley (Fish Passage Center) presented 2010 data on the timing of adult returns. While the 2009 return of spring Chinook adults was late compared to recent years, the timing of the 2010 return was more typical. Spring Chinook adults at Bonneville Dam are now counted year-round, directly from April 1 to October 30 and by video from November 1 to March 31. In the years before 2001, fish were counted from March 15 to November 15 only, an important factor to consider when comparing run statistics for multiple years.

Using daily fish counts, Chockley estimated the 10%, 50% and 90% passage dates for each annual run back to 1977. Then he compared passage dates for the 11 years since 2000 to the passage dates for the same runs from 1977 to 1999 to get a broad picture of passage trends.

This year's average passage dates came earlier than in 2009. The 10% passage date was April 16, 2010, compared to April 25, 2009. The 50% passage date was April 29, 2010, compared to May 8, 2009. The 10% jack passage date for 2010 was a few days later than in 2009. Chockley used regression analyses to investigate potential relationships between environmental variables such as temperature and flows from March 15 to April 1 and the 10% passage dates for adults and jacks. Later 10% passage dates at Bonneville were directly associated with cooler temperatures. Flows, however, had no measurable effect on 10% passage dates. The timing of spring Chinook and jack passage in recent years has typically been 4-6 days later for adults and 2-7 days later for jacks than it was in the years before 2000.

Questions and discussion: Q: Are the criteria for jack sizes the same for all dams? A: No, in the mid Columbia, jack size is up to 20 inches long. At Bonneville Dam, jacks can be up to 22 inches long.

Q: Is there a bigger gap between adult passage dates in recent years and years before 2000 than for jacks? A: Yes, the difference in timing between recent years and previous years is larger for adults. The one exception was the 90% passage date for jacks, which came a few days later in 2010 than in 2009.

Q: Did the high flows of late May and early June 2010 delay jack returns?
A: Yes, that is a likely explanation. See the regression analyses attached to this agenda item for potential links to environmental variables such as temperatures and flows.

Q: Do particular run sizes and proportion removals from the early part of the run significantly affect the 10% and 50% arrival dates? A: If Rapid River fish make up a large proportion of the early runs and are disproportionately harvested, it could affect their run timing. PIT tag data might allow that correlation to be made.

Jim Litchfield, Montana, and Cindy LeFleur, Washington, wondered if there has been a correlation between run size and timing in the years since 2000. Pinnipeds at Bonneville are disproportionately taking early stocks, Jim Ruff, NPCC, said. Chockley said he would welcome the opportunity to include pinniped abundance in his analysis of run timing.

3. Reservoir Operations Review

3a. Libby spring/summer operations. Joel Fenolio, COE, gave a retrospective of Libby operations for 2010. The May 2010 water supply forecast was for more than 4,800 kaf, which obligated the COE to provide 800 kaf of water for the sturgeon pulse. This year and for the next 2 years, the COE is also obligated to provide flows for a sturgeon spill test as part of the settlement agreement with the Kootenai Tribe. 2010 was a dry year, with water supplies in the Kootenai basin at only 4,520 kaf, 77% of average for 1975-2009. In response to the low flows, the COE made a flood control deviation request to store 260 kaf in Libby reservoir in an attempt to guarantee the minimum elevation of 2,415 feet required to provide 5 kcfs for the spill test. The September 30, 2010, elevation target for Libby was 2,439 feet, based on a forecasted April-August volume at The Dalles of less than 20% of normal. The 2 inches of precipitation in June 2010 instigated TMT coordination to keep outflows from rising dramatically. As a result, the reservoir was at elevation 2,441.4 feet on September 30, not 2,439 feet.

At the beginning of 2010, Libby reservoir was drafted down to 2,411 feet. The September forecast was for 6,500 kaf, and the reservoir provided minimum flows of 4 kcfs until bull trout minimum flows of 6 kcfs began on May 15, 2010. Once the 260 kaf for the deviation request was stored in the reservoir, Libby transitioned to VARQ flows of 14.5 kcfs. From June 1 to July 15, 2010, Libby released the 260 kaf plus the sturgeon volume. Once these volumes were out of the reservoir, outflows remained at 7 kcfs until September, when they ramped up to 8 kcfs in response to higher inflows.

Fenolio presented a graph of the theoretical VARQ operation for 2010 as opposed to the actual operation that included the deviation request to store 260 kaf. Starting June 1, the Libby operation ramped up to 4 units (17.7 kcfs) to get

the 260 kaf out for the sturgeon spill test. Libby reached its maximum refill elevation of 2,442.9 feet on August 15, 2010 – 16 feet from full, as in 2009. Libby reservoir finished the season at 2,441 feet on September 30. Heavy rains in September caused the reservoir elevation to rise above the September 30 target of 2,439 feet. Actual Libby inflows from April-August 2010 were 4500 kaf, so in retrospect the May water supply forecast for Libby was fairly accurate.

Jason Flory, USFWS Spokane, gave a retrospective of the 2010 sturgeon BiOp operation. The settlement agreement calls for 5-10 kcfs spill for a spill test to enhance sturgeon spawning. This year's spill of only 7 kcfs allowed the river to reach 1,761.5 feet, when the maximum at Bonners Ferry is 1,764 feet. Ultimately the spill was unsuccessful because it failed to move the spawning grounds to a better location. Going into 2011, it will be important to plan sufficient water supply for a successful sturgeon operation. TDG compliance is required during the spill test.

Questions and discussion: Q: Is the COE planning ways of predicting or managing spill volumes to meet the 2,415-foot reservoir elevation target in preparation for the sturgeon operation in 2011? Before drawing down to 2,411 feet, if 2011 looks like a dry season, wouldn't it be prudent to hold water back for the sturgeon spill test? A: The COE is indeed tracking this. In 2010 we learned an alternative approach is needed to address mathematical assumptions regarding Libby operations. There will be more discussion of this in 2011 when the COE implements its new methodology for calculating flow thresholds at Libby (see section 4a below).

3b. Hungry Horse operations. John Roache, BOR, described conditions and operations at Hungry Horse Dam in 2010. The basin ended up with 88% of the average runoff volume for May to September 2010; much of that was due to heavy precipitation in June. The May to September forecast serves as the BOR flood control period, while the April to August forecast drives the minimum flow criteria at Columbia Falls.

Actual inflow volume was 83% of normal, 1,838 kaf, from January 2010 through July 2010. Starting October 1, 2009, the project made minimum releases to meet the Columbia Falls minimum flow requirement. As a result, the reservoir was drafted to 20-30 feet below its flood control elevation by April 2010. Starting May 1, 2010, the project went to VARQ discharges of 4-5 kcfs. At the time, it appeared that flows of 4-5 kcfs could be maintained through the refill period. June rains led to inflows of 10-15 kcfs, and discharges were increased to control refill.

Peak reservoir elevation was 3,559.8 feet on July 2, 2010, at which time summer flow augmentation of 4.5 kcfs began and continued through September 30. The reservoir elevation was at 3,540.4 feet on September 30 and reached its 3,540-foot target two days later, on October 2, 2010. There were no questions.

3c. Grand Coulee operations. Roache gave a retrospective of 2010 at Grand Coulee Dam. The BOR became aware, as the water forecast continued to drop in early 2010, that it could be difficult to meet the April 10 target elevation in Grand Coulee reservoir and also meet chum incubation requirements below Bonneville. On April 20, the operation shifted to meeting a Priest Rapids flow objective which started at 90 kcfs. Grand Coulee continued to draft down to around 1,259 feet by mid May as a result of meeting weekly flow objectives at Priest Rapids. The reservoir hit full on Jun 21 and then drafted to elevation 1,277.1 feet on August 31, 2010

Among the critical elevations at Grand Coulee are the full pool BiOp objective of 1,290 feet on June 30; the August 31 BiOp objective of 1,278-1,280 feet on August 31; and a minimum elevation of 1,255 feet for required drum gate maintenance. The bottom of the pool at maximum flood control draft is 1,208 feet and all pumps and pump generators are out of service below this elevation.

Questions and discussion: Q: Is 1,208 feet elevation considered empty?
A: Yes, in terms of active storage, while 1026 feet is the absolute bottom in terms of inactive storage. There are 6 pump generators and 6 pumps out of service at elevation 1,208 feet. The total reservoir capacity is around 9 maf.

Q: How often have the pump generators been used to reduce the elevation at Banks Lake? A: They can only be used down to a certain elevation at Banks Lake. Below that elevation, flows must be released through irrigation canals. These canals may be used more in future for integrating the hydrosystem with wind.

3d. Dworshak spring/summer operations. Steve Hall, COE Walla Walla, gave a retrospective of Dworshak operations in 2010. Like other locations throughout the basin, Dworshak operations benefited from the heavy spring rains. Even with that boost, the Dworshak water supply was only 71% of average, and the reservoir elevation remained substantially below its flood control refill curve throughout the water year. The project released minimum flows until the SOR requesting 3 days of spring augmentation. The summer BiOp elevation target was 1,535 feet on August 31. Forebay elevations stayed below 1,520 feet through March 2010. As a result the normal minimum discharge of 1.5 kcfs was dropped to 1.2 kcfs with hatchery flows, causing cavitation problems in the turbines which are now being repaired.

Typically a Dworshak-Grand Coulee flow augmentation shift requires filling Grand Coulee above its flood control requirement. Because the Grand Coulee forebay elevation remained some 30 feet below its flood control requirement throughout the entire spring operation, a Grand Coulee shift was not possible.

In its place was SOR-2010-02 in May, requesting 3 days of 10 kcfs flow augmentation from Dworshak to aid migration. This appears to have been a very successful operation that spurred the fish to move. Dworshak reservoir then refilled to within half a foot of full on June 15.

Temperature augmentation was successful in summer 2010. There were no exceedances of the 68 degrees F state standard in the Lower Granite tailwater despite high temperatures all summer. Temperatures in the Lower Granite tailwater remained within 66-68 degrees F through the summer.

Questions and discussion: Q: What is the meaning of the temperature spike at Anatone gage in early September, as shown on the temperature augmentation graph? A: The cause of this spike is unclear, although it most likely reflects bad data resulting from gage maintenance. The spike was inconsequential in terms of Lower Granite temperatures.

3e. Upper Snake flow augmentation. Ted Day, BOR, described the 2010 upper Snake River flow augmentation operation. Wide hydrologic fluctuations in 2010 made this a challenging year for flow augmentation. Every year, BOR seeks to release 487 kaf of augmentation with the primary sources being the upper Snake River above Milner Dam (Jackson Lake, Palisades, and American Falls reservoirs) and the Payette basin (Cascade and Deadwood reservoirs.) The reservoirs in the Boise basin (Lucky Peak, Arrowrock, and Anderson Ranch) are used to a lesser degree, and BOR also augments flows using natural flow rights it has acquired or leased on an annual basis.

The 487 kaf augmentation goal is not always achievable, and this year it looked like the goal would not be met. Snowpack was poor through the winter, and by April 1, 2010, the Boise basin snowpack was at 70% of normal, the Payette 60% of normal, and the upper Snake above Milner only 55% of normal. This resulted in runoff forecasts in the lowest 20 to 25% of years in the Boise and Payette, and in the lowest 7% of the past 90 years for the upper Snake above Milner. Under the terms of the Nez Perce Agreement, no rental water was available from above Milner, making the 487 kaf goal appear unattainable. The BOR set its sights on 427 kaf instead of 487 kaf and aggressively sought water resources. That included committing use of 157 kaf of powerhead space in Palisades Reservoir. The 157 kaf of powerhead space is meant to keep the plant operating and is used only as a last resort; its use also impacts reliability of augmentation water in following years if drought conditions persist. In addition, using it limits flow augmentation to 427 kaf for the year under terms of the Nez Perce Agreement.

One strategy under the 2008 BiOp was to find ways to shift flow augmentation to an earlier timeframe when fish need the water, while avoiding late-season releases of warm water. This year offered opportunities to use that strategy, so the BOR targeted the entire volume expected from the upper Snake

above Milner (157 kaf) for release from May 3-31, at a maximum rate of about 3,200 cfs.

When the rain came in June (200 to 300% of average), suddenly the entire Snake basin went from near-drought conditions to excessive flows. The rain helped convert snow into runoff as well. So this summer brought flood control situations and the highest releases in 60 years in the Payette basin. Flows at Lower Granite Dam went from 70 kcfs to 207 kcfs in just a few days.

At this point the system was flush with water, yet the BOR was unable to exceed 427 kaf of augmentation as a result of using powerhead space. Through cooperation from the State and irrigators, the BOR was able to rent additional water to effectively replace the powerhead that was used, thus lifting the 427 kaf cap and allowing BOR to rent additional water to provide the full 487 kaf in 2010. About 157 of the 487 kaf was released from the upper Snake above Milner in May when it was most needed, and another 40 kaf was released between June 30 and mid July. Storage releases from the Boise (~43 kaf) occurred June 16 to mid July, and from the Payette (~160 kaf) from June 18 to August 22. The remainder was supplied from natural flow rights, including 7 kaf the BOR rented at significantly higher rates than normal when it was aggressively seeking water early in the season. Water supplies for 2011 are currently looking good, and providing the full 487 kaf in 2011 is looking promising.

Questions and discussion: Q: Of the 157 kaf space the BOR used in Palisades Reservoir, how much of that was powerhead vs. other storage? A: That was 137 kaf of powerhead space plus 20 kaf of contracted storage space.

Q: In future presentations, would it be feasible to show a stacked hydrograph of flow augmentation water from various sources during the release year? It would be informative to see how flows stacked up in terms of Dworshak releases and to compare the timing of these releases with flows from Brownlee Dam. A: Yes, that could be easily done.

Q: Why was the 54 kaf of powerhead space not repaid? A: After the big June flush, all reservoirs were full with the exception of the 54 kaf, which handcuffed the operation, in that we were still limited to the 427 kaf cap. The 54 kaf of water was effectively replaced by renting from irrigators, which allowed BOR to release an additional 60 kaf and provide the full 487 kaf.

Q: Are the release dates in the graph the dates on which water became available, or are they managed dates? A: They're both – it changes from year to year depending on water supply to the various sources and timing of runoff. Once the reservoirs were out of flood stage and drafting, BOR defined that as the beginning of flow augmentation on the Payette and Boise. This year BOR sought opportunities to shift flow augmentation to earlier in the year, as done from above Milner, which is easier in dry years, like we thought 2010 would be, since you

pretty much know the volume you'll have available. In flood control years, it is moot because spring flows are more than ample, and water is more valuable in summer as flows decline. Releasing flows in summer is easier because it's less dependent on forecasting methods.

Q: What is the lesson of the past few years that can help us maximize the benefits of managing flow release dates? A: This year's experience offers hope that releasing flows earlier can be done successfully. Years like 2010 offer us a win-win situation when releases are shifted to earlier in the season.

The following questions/comments were from general discussion following BOR's augmentation presentation. The responses were not provided by BOR, but by others in the audience.

Q: Is there any research to indicate the effects of global warming on run timing? A: There is probably more speculation than research on this at present. ISAB recently released a report on climate change and run timing.

Q: What does TMT want most in terms of next steps for improving 2011 operations? Where are there opportunities for managerial flexibility? A: Last year, we got creative with a lot of operations and most of these turned out well. It's important for the Salmon Managers to communicate concerns early so there is sufficient time for the Action Agencies to investigate alternatives.

Q: Are there any discussions underway with Idaho Power regarding Brownlee Dam operations? A: The COE has had conversations with Idaho Power regarding temperature modeling, but not for the period of greatest concern. There has been concerted effort to use Dworshak releases to modify the temperature of Brownlee releases in late fall, but little action in summer when Hells Canyon releases have the greatest impact on the COE's ability to manage temperatures below Lower Granite Dam.

Paul Wagner, NOAA, commented that the 2010 operation at Dworshak was a product of better communication between the Salmon Managers and Action Agencies than we've had in previous years.

Dave Statler, Nez Perce Tribe, commented that the Dworshak SOR 2010-02, providing about 10 kcfs of flow augmentation in May 2010, turned out to be a good operation. When using releases for flow augmentation and temperature management during delayed runoff events like those of 2010, it is good strategy to match Dworshak augmentation releases with natural flows to make passage conditions even better. Higher water velocities associated with runoff create turbidity, which provides cover from predation.

Statler added that better knowledge is needed of Hells Canyon Dam operations, which are dependent on management of Brownlee Dam. This is the one thing needed most to coordinate the best possible Dworshak operation.

4. Review of Specific Operations

4a. Libby water supply forecast methodology and end of December operations. Joel Fenolio, COE Seattle, gave a presentation. The reason behind the COE's decision to revise the Libby water supply forecast procedure was updating the equations from 2004. The COE wanted to reevaluate variables used in the equations, including more climatic variables to hedge early season bets. Key changes are:

1. Instead of using snow courses to calculate runoff volumes, the COE will use SNOTEL sites. This means that monthly readings, which come in at any time from the 25th of the previous month to the 5th, can be replaced by readings taken instantaneous readings during the current month. This makes forecasting a more efficient process.
2. The new method includes potential variables based on data from 7-8 new SNOTEL sites along the continental divide in Alberta, Canada. Data from these sites have been correlated to the Libby water supply forecast. Adding these variables helps address a dearth of SNOTEL sites in the Kootenai River basin.

A graph of Libby performance during the last 2 years shows that all Canadian forecasts in 2009 had over-forecasted Libby runoff volumes. In 2010 the COE over-forecasted Libby volumes due to fall precipitation.

If the new Libby forecasting methodology had been applied in 2010, there would have been a full relaxation of flows at Libby in December 2010, Libby Dam would have drafted to 2,426 feet elevation instead of 2,411 feet on December 31, 2009. Using a hypothetical example, 2010 would have been a Tier 1 year under the BiOp, meaning no sturgeon pulse. The VARQ flows would have begun on April 27, 2010 in place of the deviation request. Under Libby Dam's SRD, if the Libby forecast on December 1 is greater than 5,900 kaf, there will be a full 2 maf drawdown to 2,411 feet elevation in Libby reservoir. If the forecast is less than 5,500 kaf, there's a full relaxation, so the COE drafts to 1.4 maf of reservoir space to the in the reservoir

The forecast procedure change is expected to have a significant impact on the December drafts in the future. A review of how the new methodology would apply to Libby operations of the past 36 years there is overlap between the old and the new forecast equations shows that the December drafts would have been relaxed more often. The 2004 equations would have produced no relaxation at Libby in 80% of the past 36 years, a partial relaxation in 20% of

years, and a full relaxation in 15% of years. Using the 2010 equation would have produced no relaxation in 47% of years, partial relaxation in 53% of years, and full relaxation in 41% of years. This change has implications for BiOp requirements and the sturgeon pulse.

Questions and discussion: Q: Does the COE foresee a lot of forecast changes in December under the new methodology? A: No. The old forecast had a standard error of 1,100 kaf; the new one has a standard error of 900 kaf.

Q: If there's so much variability in December forecasts, is there any other mechanism being looked at to increase forecasting accuracy? In future years with a less rosy forecast, it could be imperative for the COE to coordinate a deviation request via TMT. A: Last December, if snowpack conditions had been 50-75% of average, the COE would have made a deviation request. However, snowpack is average to above average at present so no deviation request is needed.

Q: Did the previous methodology use snow courses or SNOTEL measurements? Why is using SNOTEL measurements an improvement? (Dave Wills, USFWS) A: The previous method used both. The new method using SNOTEL measurements makes it possible to track snowpack accumulation on the basis of daily reports, rather than once a month. This allows greater forecasting accuracy as conditions change.

Q: If weather service predictions were accurate in 2010, are the variables in the new equation closer to their variables? A: Yes, they will start correlating to winter precipitation and SNOTEL reports in February or March 2011. The previous equations didn't do that.

Q: If the new equation represents a potential improvement to the Libby operation, does that mean the new methodology would have been better for the system in 2010? This year's operation seems to have been a success despite the variable climate. A: The COE considers the 2010 operation a success. The impact of providing a sturgeon pulse under the old methodology was that the reservoir did not refill. The 2010 operation was definitely improved by the deviation request. While the COE isn't using the new methodology to judge the merits of past Libby operations, the new methodology will provide more accurate information on which to base future decisions.

Russ Kiefer, Idaho, and Tom Lorz, CRITFC, urged the COE to notify TMT in the coming years if a deviation request for Libby is needed. The COE will keep TMT informed of any deviation requests it intends to make.

4b. Inland avian predation. Nathan Zorich, COE Portland fish field unit, gave a presentation on research, evaluation and monitoring of inland avian predation. One way to reach BiOp targets for the recovery of listed stocks is to

limit predation, and this work focuses on bird predators of juvenile fish at inland dams.

In 2010 the focus was on the impact of predatory birds at John Day and The Dalles dams. Researchers tracked the consumption of live and dead juvenile fish by birds, the number of avian species present, estimated smolt consumption, and whether consumption levels differed between protected and unprotected zones at the dams. They identified California gulls, a species protected by the Migratory Bird Act, as the most numerous predator of fish in the Northwest. Researchers observed many gulls at John Day Dam in 2009, fewer in 2010. The heaviest predation occurring in the tailrace on the spillway side of the dam rather than on the powerhouse side.

Initial construction of bird wires at John Day Dam using stainless steel cables were unsuccessful; in 2010 the avian array was redesigned using synthetic materials and covered the entire boat restricted zone. In 2010 the avian array and hazing by boat reduced the predatory bird presence from an estimated 99 birds per day to 19 and reduced smolt losses.

In 1955, during a lamprey migration spike, researchers found avian predators with 90% juvenile lamprey in their stomachs, not salmonids. Avian predation on juvenile lamprey continues to be an issue.

Alongside work at John Day, researchers are studying The Dalles to determine if bird populations relocate there. To some extent that seems to have happened in 2010. An analysis of the contents of bird stomachs at The Dalles found that, of 155 stomachs, 32% contained fresh fish and/or lamprey parts.

The 2010 avian predation study found that 5,000-33,000 smolts were consumed at John Day, or 0.1-0.7% of the smolt index for 2010, which was 4 million fish. The smolt index was considerably lower than the PIT tag based estimate of fish passing John Day, around 40 million fish. The study found that boat hazing and the avian array reduced consumption by 63,000 smolts when compared to 2009 levels, a significant achievement.

The study also found significant fish consumption at The Dalles. While installing the extensive array at John Day, the COE actually estimated greater losses to predatory birds this year at The Dalles, where shallow areas make fish vulnerable to predators.

The years from 1930 to 1980 brought a threefold increase in the California gull population in the Northwest, mainly the result of agriculture, landfill and dam . Inundation of rivers by dams has created unnatural islands where birds find convenient nesting habitat and food sources.

The study team made a number of recommendations to reduce avian predation, among them bird wires at The Dalles, a sustained hazing program, and mobility of crews as birds relocate. Also, there are simple steps to keep gulls from nesting on Miller Island. Zorich presented plans for specific actions addressing RPAs in the BiOp regarding avian predation. Plans also include developing a standard avian survey protocol to avoid chasing birds from one project to the next. These plans envision bird counts made available online, with heat maps of significant areas to foster quick response to problems.

Questions and discussion: Q: Was gull predation on lamprey worse in the spillway or at the outfall for turbine passage? (Tom Lorz, CRITFC) A: There was more avian predation on the powerhouse side of the project. Note that hazing occurred from the dam only and was ineffective when birds shifted to the powerhouse side.

Q: Were any correlations made between bird populations and completion of the spill wall at The Dalles? (Scott English, COE) A: There were no specific observations of bird activity before the wall was built, making comparison difficult. Initiation of spill has shifted the tendency of birds to congregate at the spill bays.

Q: Were there more lamprey than salmonids found in bird stomachs at certain times of year? (Richelle Beck, DRA) A: In 2009 no, however during one week at The Dalles in 2010. However, lamprey are a higher-energy density food, which makes them more valuable to predators than salmonids.

4c. Juvenile survival for 2010. Bill Muir, NMFS Science Center, gave a presentation on migration conditions, travel time and survival rates of juvenile salmon migrating in-river through the hydrosystem in 2010. The study was based on fish that had been PIT tagged at Lower Granite Dam.

Weekly mean flows at Lower Granite in 2010 were similar to low flow years like 2001, 2004 and 2007. However, spill percentages in 2010 were the highest seen, making this year very different from 2001 and 2004. This year, 64.1% of smolts from Snake River hatcheries survived to Lower Granite Dam, compared to a long term average of only 61%. There is an inverse relationship of survival and distance, with survival rates declining the farther fish originate upstream of Lower Granite Dam.

Because 2010 was a low flow year, travel times started out slow and speeded up toward the end of passage season as flows increased. The travel pattern was similar for steelhead and yearling Chinook migrating from John Day tailrace to Bonneville tailrace and from Ice Harbor to McNary tailrace.

While Chinook survival was nothing extraordinary, juvenile steelhead survival surpassed the long term average in all reaches. Chinook survival through the Snake basin from Lower Granite to McNary tailrace was about 4%

higher last year than the long term average, or 77% compared to 73%. Steelhead survival was 61.7%, which is 17-18% higher than the long term average, second only to 2009.

Transport percentages in 2010 were considerably lower for wild and hatchery steelhead and Chinook. All were below 40%. and only 23% of steelhead were transported. The later start of transport at all Snake River projects has effectively reduced the number of fish transported per year. Based on detections at Lower Granite, wild Chinook and wild steelhead 3-year-olds are experiencing higher adult return rates than their barged counterparts. This pattern persists for smolts migrating through the third week of April, then reverses itself, with steelhead and Chinook smolts barged after the third week in April showing better adult returns.

Sockeye survival was only 15% in 2010, compared to a long term average of around 45%. There is no explanation yet for why it was so low this year. However, once sockeye entered the hydro system, their survival rate was 54.4% from Lower Granite to Bonneville tailrace, almost the same as yearling Chinook.

Steelhead survival has increased notably in recent years. It appears that steelhead benefited in 2010 from several factors – increased levels of spill, up to 7 surface collectors with associated faster travel times, and higher percentages of fish remaining in-river. These combined benefits have reduced steelhead travel times from an average of 30 days in 2001 to just 12 days in 2010. Juvenile steelhead survival this year was the highest since PIT tag studies began in 1993.

Recent management actions have increased the numbers of fish left in-river and improved their survival odds. These improvements have not necessarily increased the SARs of listed populations. In-river fish in 2010 took 12 days to migrate through the hydro system in 2010, compared to 1.5 days if barged. Barged smolts tend to have higher survival rates but lower adult return rates than in-river migrants. Stray rates are also very low for in-river migrants.

4d. Bonneville powerhouse 2 spring operations. Paul Wagner, NOAA, gave a presentation. In recent years, descaling of subyearling Chinook at the Bonneville 2nd powerhouse has typically occurred at a rate of 1-2% of the run. Later in the 2010 migration season, it jumped to 6%, and other species such as sockeye also showed descaling signs. SOR 2010-03 was drafted in mid June requesting that turbines be turned down to the mid or low range of 1% efficiency. The Action Agencies responded quickly, and the descaling rate dropped.

Because a structural fix for this problem is years away, the potential for adopting this operation long-term is currently being discussed in other forums, e.g. FPOM and in discussions between NOAA and BPA. There are turbine evaluations underway at ERDC to address the descaling problem. Little is known about how different speeds and loadings affect the turbine environment.

Comments and discussion: Ramping down to the lower end of 1% efficiency is equivalent to cutting about 200 MW in generation from the powerhouse for every hour all the B2 units are running, Tony Norris, BPA, commented. The turbine mock-up at ERDC is set up to seek ways of reducing turbine loading in the gatewell without impacting turbine operation, Kiefer said. The tradeoff, Wagner observed, is increased megawatt production at powerhouse 1 to offset the loss of megawatts at powerhouse 2 in order to prevent descaling. Wagner and Kiefer thanked the Action Agencies for their quick response on this issue in 2010.

4e. Fall Chinook survival in 2010. Jerry McCann, FPC, gave a presentation on subyearling fall Chinook survival on the Snake River. Survival estimates for 2010 were high at 73-78% compared to previous years. Survival from Lower Granite to McNary tailwater was in the 70-73% range.

In general, 2010 was a good year for subyearling Chinook, with increased summer spill, cool temperatures and relatively good transit times. Peak flows occurred at a time that benefited outmigrating subyearlings, which had some of the shortest travel times and highest survivals on record at Little Goose Dam from May 20-July 29, 2010. Flows on the Snake River converted into travel times of 8 days per 80 kcfs. Spill remained around 30% at Little Goose through the season. Shorter transit times directly correlated to higher flows. Fall chinook in 2010 experienced one of the most rapid travel times of any group, which is reflected in their survival rates. In 2010, hatchery subyearling Chinook had a 0.56% chance of being transported, which was higher than in 2009 but in the range of recent years.

4f. Chum operations. Paul Wagner, NOAA, and Cindy LeFleur, Washington, gave a presentation. This year's chum operation started on November 1, 2009, with a tailwater range of 11.3-11.7 feet elevation below Bonneville Dam. Spawning was declared complete on December 30, 2009, and the operation went to a daytime minimum elevation of 11.5 feet. On February 23 that was lowered to 11.3 feet. The goal was to provide protection until all 3 gages reached 825 temperature units. At that point flows were ramped down and on March 15 the elevation dropped to 11 feet. By March 17 it was 10.8 feet, by March 19 it was 10.5 feet, and by March 22 at minimum flows. This basically decimated the spawning area; protection of redds effectively ended at 10.5 feet on March 19, 2010. The threshold of 825 TUs is now being investigated, and in future years there will be better tools to guide the decision process.

Questions and discussion: Q: Is there any determination of the number of redds that were lost with each reduction in tailwater elevation? A: To determine that, it would be necessary to establish how many redds were located near each temperature gauge.

Q: Would it have been possible to protect chum redds longer by keeping the minimum tailwater elevation at 11.3 feet through the winter? A: That would probably not have made a big difference. The temperature threshold was most likely set too low; it probably takes at least 935 TU's for eggs to emerge.

4g. Hanford Reach operations. Russel Langshaw, Grant PUD, gave a presentation on the Hanford Reach fall protection program. For the spawning period, initiation of spawning for zones below 36 kcfs was October 20-November 3, 2009. Spawning ended on November 21, 2009, with an aerial count of 8,817 redds in Hanford Reach. Hatching began November 30, 2009, and ended February 12, 2010. Emergence took place March 2-May 2. Weekend protection minimum flows for incubation began April 10, and the rearing period continued through June 9, 2010.

The mean discharge from Priest Rapids Dam though the rearing period was 93.6 kcfs, which is less than normal. The mean daily delta (the difference between maximum and minimum discharges in a day) was 22.1 kcfs, also less than normal. Flow constraints, based on inflows, were less than 40 kcfs, indicating low flows. There were 4 exceedances for the year, all occurring on the first 4 days of the season. These were the result of spreadsheet error.

The 2010 protection program had a success rate of 94% compared to a long term average of 84%. Spawning dates were one calendar day prior to 2009 dates. The critical elevation was 65 kcfs, lower than expected. An estimated 90,000 fish escaped Hanford Reach in the past year.

Upcoming studies under the Hanford Reach agreement include a fallback assessment at Priest Rapids Dam; an egg-to-fry survival study indicating how many fish become stranded or entrapped; development of a hydro model; and development of a production simulation model that would follow individual fish through the life cycle. These tools could be used to predict the effects of Priest Rapids operations on Hanford Reach survival. All studies are expected to be completed in late 2011 except for the egg-to-fry survival study. As part of this study, researchers were surprised by the extent of sturgeon predation on redds. Langshaw showed a video of this occurring. He is also investigating the potential for operating at a critical elevation 6 inches lower than the current minimum, while still keeping redds watered. Because salmon egg pockets generally are 19-33 centimeters deep, the hypothesis is that a critical elevation of 15 centimeters, or 6 inches, would still keep the eggs sufficiently watered.

5. Lessons Learned in 2011

TMT ended the day in small groups to discuss 2010 operations and lessons gleaned from the question and answer periods following each presentation today. The day's exchange of information produced the following "white board" notations by facilitator Robin Gumpert:

Conditions Review:

- How did this year rank compared to others?
- Suggest providing graphs that overlay flows to passage abundance estimates and key hatchery releases.
- What are the trends in temperature relative to adult run timing? What is the influence of marine mammals on timing?

Operations Review:

- How will December elevations be managed at Libby to assure sufficient volume for the sturgeon spill test?
- Note that Grand Coulee will have a 2,055-foot elevation requirement for drum gate maintenance.
- Suggest showing a retrospective of stacked flows in the upper Snake.
- What is the lesson about when flow augmentation can and cannot be managed, based on complexities seen in the past 2 years?

Review of Specific Operations:

- The Dworshak SOR for flow augmentation had a positive effect on fish.
- With delayed runoff, how can we maximize flow augmentation to support fish?
- What are the impacts of global warming on fish run timing?
- Early communication on pending issues and opportunities is vital.
- More certainty about Hells Canyon and Brownlee releases would help with flow management.
- What flexibility will Libby have for adaptive management in December using the new methodology, particularly with regard to deviation requests?
- What is the impact of The Dalles spill wall on predation?
- The SOR to address descaling at Bonneville was successful, and long-term solutions are sought. There was good cooperation regarding chum operations this year despite limited information. Next year, better data regarding temperature units will aid decision making.
- Could setting winter elevations lower during dry conditions have provided better protection for chum redds?

6. Next Meeting

TMT will meet next on January 12 and again on January 26.

Name	Affiliation
Chris XX	Battelle
Doug Baus	COE
Barry Espenson	CBB
Russ Kiefer	Idaho
Tony Norris	BPA
Dave Benner	FPC

Margaret Filardo	FPC
Jerry McCann	FPC
Brandon Chockley	FPC
Richelle Beck	DRA
Russel Langshaw	Grant PUD
John Roache	BOR
Ted Day	BOR
Steve Hall	COE Walla Walla
Laura Hamilton	COE
Scott English	COE
Steve Barton	COE
Jim Litchfield	Montana
Bill Muir	NMFS
Pete Hassemer	IDFG
Jim Ruff	NPCC
Paul Wagner	NOAA
Cindy LeFleur	Washington
Dave Wills	USFWS
Joel Fenolio	COE
Kristian Mickelson	COE Seattle
Jason Flory	USFWS Spokane
Dave Statler	Nez Perce
Mark Bagdovitz	USFWS
Nathan Zorich	COE Portland