**Columbia River Regional Forum**
**Technical Management Team**

**Summarized responses for chum salmon questions – September 28, 2005**

**Question 1**. What is the maximum fluctuation in daytime Bonneville tailwater elevations that can be tolerated without impacting chum spawning? (Chum Researchers)

Background: the current TW operation for chum is 11.3-11.7 ft or about 125 kcfs depending on backwater effect during daytime hrs; the Action Agencies would like to know if there is flexibility in exceeding this operational range for short times (2 hr) during the day for unexpected increases in flow.

Response (USFWS – Joe Skalicky): A definitive answer to this question is simply not known and has only recently been investigated and only at one of the three main spawning areas. A fluctuation or daily delta (maximum - minimum instantaneous flow) is one metric or method to characterize spawning conditions but other important factors including the duration of a fluctuation need to be considered. In late 2004 researchers from our chum project (USGS) evaluated increased Bonneville tailwater elevations up to a maximum elevation of 15.1 from 11.5 feet. Tailwater elevations were increased for only 2 hours and some negative effects were observed at 15.1. Operations between 11.5 and 15.1 did not appear to exclude or push chum off of redds for the 2 hr of increased flows. Other more subtle effects regarding spawning and spawning success were not examined and would require a very sensitive and detailed study operating at various temporal and spatial scales. I do not believe that 2 hr of an increased tailwater of 1.0 feet is long enough to negatively impact spawning. Likewise, nighttime stage should be decreased correspondingly from X to (X – 1.0) for 2 hr which would be the biological justification for increasing daytime flows. There is no concrete justification to support increases of more than 1.0 feet for any length of time.

Response (USGS – Ken Tiffan): There are two considerations for this question: duration and magnitude. It is my opinion that a duration of 2 h is not long enough for chum to respond by digging a redd at a higher elevation (one potential response) or by experiencing altered spawning behavior (e.g., reduced digging or courtship behavior; another potential response). The maximum acceptable fluctuation to chum is more difficult to determine. See response to question 2.

Response (WDFW – Todd Hillson): To be completely safe you wouldn't want to increase tailwater to such a degree that if a chum decided to use the newly inundated area for spawning it's redd would be un-watered at 11.5. This is not to say that the redd will be under a lot of water, but enough to maintain flow above egg pocket depth through emergence. Evidence from the Duncan Creek spawning channels (fall 2003) proved that just because a redd is dry at the surface does not mean it's lost.

You would need to look at Ken Tiffins (USGS) work for what increases in velocity due to higher discharge levels do to already spawning chum.

Personally, I don't think a two hour increase of tailwater is enough time for a female to establish and begin a redd in a newly watered up area. I would worry if the increase were big enough to water up new areas that might cause entrapment of adults if the level was brought down too quickly.

**Question 2**. What is the maximum nighttime flows that can be tolerated without impacting chum spawning? (Chum Researchers)

Background: during high flow events, high discharges (up to 250 kcfs) have been provided at night to maintain daytime flows within 11.3-11.7 ft. USGS conducted a study this year to evaluate effects of high day and night flows, and although no effect was found for flow blocks up to 175 kcfs this did not include higher flows observed in recent years. Study results also indicates that responses are dependent on whether chum have established a redd site.

Response (USFWS – Joe Skalicky): In 2003 and 2004 extreme reverse load following was implemented to manage to the daytime chum operation at 11.5 which is the minimum operation providing spawning habitat. While the daytime flow is appropriate, conditions at night have greatly exceeded the velocity threshold for spawning chum salmon in the Ives/Hamilton area. GIS analysis conducted by the USFWS have shown how operations in 2003 excluded chum from the Ives/Hamilton area and created downstream spawning habitat near I-205 at higher elevations. The artificial increase in elevation are a result of the 11.5 daytime tailwater and the much higher nighttime tailwater culminating 28 miles downstream into a sustained 24 hr stage that is higher than just a 11.5 flat tailwater at Bonneville. These elevations were not maintained through emergence and redds in I-205 spawning areas were likely dewatered 2003.

With the data we have so far it is very difficult to estimate or derive a maximum nighttime operation. Since we know they spawn 24 hr/day and because populations have decreased by 1/3 for last three years, I would be hesitant to guess. Since the research conducted by our project (USGS) measured negative effects of a 15.1 ft tailwater and that research only attempts to measure gross physical responses, I would say the maximum operation should be less than the 15 foot tailwater, perhaps near 13.5 feet.

Response (USGS – Ken Tiffan): The research we conducted in 2004 only examined tailwater increases up to 15.1 ft. (flows of ~175-185). Although we did not see any major effects on behavior at the 15.1 ft, the trend was toward reduced digging activity at higher flows. Velocities measured at 15.1 ft were up to 1.5 m/s, which is well above the preferred velocity (0.2-1.0 m/s) of chum. I believe we were starting to see some effects at 15.1 ft, which would probably be amplified at higher flows. Changes in behavior may also have been more evident if the maximum 15.1 TW was maintained longer than 2 h. A TW of 15.1 ft resulted in watering up the channel on the north side of Ives Island where chum spawned in 1998 and 1999 at higher flows. If a TW of 15.1 ft was

maintained for longer periods of time (days?), I don't think new chum would select the higher velocities that would present in the channel below the mouth of Hamilton Cr., but would move over to the north side of Ives Island, or elsewhere, to spawn. In 2005, examining higher flows would be beneficial in determining the flow and TW at which behavior is altered to determine the "maximum" nighttime flow.

Response (WDFW – Todd Hillson): Looks like all we have is data for up to 175kcfs. I would again worry about the possibility of stranding adults if flows were ramped down quickly. Ken did his work in 2004 when there were very few chum using the "pocket area" near Ives Island (past years have seen heavy use in this area). If a lot of chum were in this area and they brought flows up there is definitely the chance that adults could be stranded at the upper end of this area.

**Question 3**. What are the implications to other BiOp requirements (Apr 10 RCs, spring flows, etc) and the Vernita Bar Agreement of maintaining TWs above the current 11.5 ft throughout spawning, incubation, and emergence? (Action Agencies)

Background: Whether intentional or not, TWs have exceeded the 11.5 ft minimum requirement. Given the storage conditions likely to exist beginning November 1, TMT members would like to know what are the effects of meeting the BiOp requirements and VB by maintaining TWs at higher elevations (ex: 12.0, 12.5, 13.0 ft etc). At TMT, it was discussed the Corps or BPA HydroReg models could be used to assess risks to these requirements using a 50 year period of record in the analysis.

Action Agencies response.

**Question 4**. If TWs are increased to provide additional spawning habitat and reduce superimposition in the Hamilton Creek area, when would the best time to do this and to what TW to provide the greatest benefits to chum? (Chum Researchers)

Background: Chum researchers have noted high spawning densities and expressed concerns with potential superimposition of chum spawning in the Hamilton Slough area below Hamilton Creek. One strategy to reduce densities and superimposition is to start with a 11.5 ft TW operation early in the spawning cycle but then increase to a higher (ex: 12.5 ft) later in the run (ex: November 15) to allow access to other spawning habitat and "spread out the spawners".

Response (USFWS – Joe Skalicky): This also is a difficult question to answer because no research has been specifically conducted to profile redd superimposition. The protracted arrival of adult spawners and spawning complicates this task further. If we knew the explicit carrying capacity of the Ives Island area at the 11.5 operation, we could increment to the next operation once that number was counted. The current chum model we developed cannot calculate the carrying capacity at a level of accuracy sufficient for this exercise. As a surrogate, however, we could use the weekly counts coupled with a GIS analysis to determine at which week redds start to superimpose. At

that point, we could operate up to the next operation that would preclude fish from spawning at the 11.5 operation and provide a new spatial distribution habitat. Based on our past modeling efforts and on site knowledge of the area, a tailwater operation of 13.5 should work. Even if the some of the redds associated with the 13.5 operation are subsequently dewatered, the net effect should be increased overall production.

Response (USGS – Ken Tiffan): One of the assumptions here is that spreading the fish out will decrease redd superimposition and therefore increase production. We currently do not have any estimates of how many redds can be supported in the Ives area and if the different spawning sites have equal productive capacity. This is an important area of future research for a number of reasons. First, if we knew for example that the main spawning channel could only support 100 redds and that the area was seeded by Dec. 1, then continued restriction of the tailwater after that date would only result in redd superimposition and you may still only have 100 redds at the end of the season. If, however, you increased the tailwater, you might increase the number of redds in the area by the number that are constructed at higher elevations. The risk of course is subsequent dewatering if flows cannot be maintained. However, we really wouldn't know if the loss of any production at higher elevations would be any different than loss through redd superimposition. In other words, if we knew the redd capacity and the date at which it was reached each year, then it may be easier to take the risk of increasing tailwater and allowing fish to spawn at higher elevations. Assuming that fish will spread out if given the habitat, I estimated that increasing flow to 13.5 ft would provide water to the channel on the north side of Ives Island. I arrived at this by regressing tailwater on flow for Nov-Dec, 2004 to develop a regression equation (Tailwater=5.45+0.0541*flow; $r^2$=0.49). I then plugged in 150 kcfs (the flow we predicted to provide water to this area from our past modeling efforts) to get 13.5 ft. When to provide the flow would depend on when the State's surveys suggested that a maximum redd density had been achieved in the main spawning channel.

Response (WDFW – Todd Hillson): I don't believe that we have to data to say anything about what tailwater level above 11.5 is best. We have no physical sampling of gravel composition and percent fines for this area, or how the vertical hydraulic gradients that these chum key in on change as tailwater elevation moves. It's very possible that a one foot increase could water up several hundred square meters of spawning area that is substandard and we get less production than if we left them in a small area.

This is definitely something that needs to be looked at and modeled for future years use in water level management.

Using live and dead counts in combination with the carcass tagging results from work that Below The Dams (BTD) has done in the Ives area, mean arrival dates for spawners in this area using maximum likelihood equations for 2003 and 04 were 11/28 and 11/21. Given that chum arrive and spawn in a relative short and compact time span (7-10 days), you would want to have tailwater up before they arrive, November 15 sounds good to me. If you try and use in-season counts to pick the day it would likely be to late, we don't see the fish to count in the Ives area until most are already spawning.

**Question 5**. What is our best estimate for the number of chum expected to spawn in each of the mainstem areas (Ives Island, Multnomah, I-205) this year as well as tributaries (Hardy, Hamilton, Grays Harbor, etc)? (Chum Researchers)

Background: Chum escapements in each of the spawning areas have declined in recent years; if possible, TMT members would like to know for planning purposes how many chum are forecasted for this year recognizing that forecast tools for chum have not been developed.

Response (WDFW – Todd Hillson): Not much information on this one. The trend has been declining populations since 2001. Here's what I have from mark/recapture efforts under the Duncan Creek project.

| | 2004 | | 2003 | | 2002 | |
|---|---|---|---|---|---|---|
| | Estimate | 95% CI | Estimate | 95% CI | Estimate | 95% CI |
| Ives Area* | 1,041 | 870 - 1,212 | 1,899 | 946 - 2,851 | 3,179 | 2,886 - 3,472 |
| Horsetail | 102 | 73 - 131 | no data | | no data | |
| Multnomah | 652 | 584 - 720 | 1,024 | 947 - 1,101 | 1,267 | 846 - 1,642 |
| St Cloud | 107 | 89 - 125 | 167 | 149 - 186 | no data | |
| I-205 | 1,836 | 1,573 - 2,098 | 2,864 | 2,724 - 3,003 | 3,928 | 2,274 - 5,581 |
| Hamilton Cr. | 346 | 417 - 275 | 500 | 440 - 560 | no data | |

* The estimate for Ives area includes tributary spawners since those fish pass through this area and the estimate is numbers at time of tagging. To get an estimate for only Ives, use BTD carcass tagging estimate.

**Question 6**. What are the effects on Bonneville TWs and biological benefits to chum by drafting 4 ft (2055 to 2051 ft) from Lake Pend Oreille? (Action Agencies and Chum Researchers)

Background: Under the BiOp, a four ft draft from Lake Pend Oreille is identified to provide chum spawning flows. Ongoing Lake Pend Oreille research is evaluating the effects of maintaining higher elevations for kokanee spawning (an important food source for listed bull trout) and a request has been made to maintain elevation 2055 ft this year to gain additional data at this higher elevation if the water is not needed for chum flows.

Action Agencies response.