NOAA Fisheries Max Transport Proposal
ODFW Questions and Information for the ISAB
March 5, 2010

NOAA Fisheries has proposed that the Action Agencies forego the spread-the-risk spill transport operations when expected river flows are forecasted to be < 65 kcfs at Lower Granite Dam and instead maximize transport (provide no voluntary spill) at the Snake River collector projects (beginning no later than May 1 at LGR, May 5 at LGS, and May 8 at LMN and ending when fall Chinook salmon outnumber spring migrants for three consecutive days). It bases its proposal on the following rationale:

1. Adult returns from juveniles out-migrating in 2007 (which are incomplete as not all 2-salt steelhead and no 3-salt steelhead nor 3 or 4-salt spring/summer Chinook salmon have returned to Lower Granite Dam) indicate that while the transport to in-river migrant (T:M) ratios were less than in previous years with similar flows, they were, nonetheless, still positive and substantial (NWFSC 2010; FPC 2010b) – especially so in May for wild Chinook and steelhead (NWFSC 2010 - Appendix A, Figures A10 and A32; Appendix B, Figures B10 and B32).

2. Continuing the court ordered spill/transport operations in low-flow years like 2007 would result in substantial losses (in terms of adult returns) of wild SR steelhead and spring/summer Chinook salmon relative to maximum transport operations under these environmental conditions.

3. The likely impacts to wild Snake River steelhead and spring/summer Chinook populations from continuing court-ordered spill/transport operations in a low flow year exceed the likely or potential negative impacts of maximum transport operations to the other species; Mid-Columbia steelhead; Snake River sockeye; Pacific lamprey.

The ISAB recommended that "*whenever river conditions allow during the late April-May period, a strategy allowing for concurrent transportation and spill is prudent*" (ISAB 2008). NOAA Fisheries believes that the weight of evidence it has assembled indicates that under river conditions likely in 2010, it would not be prudent to concurrently spill and transport smolts and has asked the ISAB the following question:

> **"Has NOAA Fisheries correctly interpreted the ISAB's recommendation? If not, please further explain your reasoning in the 2008 recommendation."**

We ask that the ISAB consider the following clarification questions and supporting information when preparing its response to the question posed by NOAA Fisheries.

1. **Does the ISAB consider NOAA Fisheries' risk assessment adequate to conclude that "[r]epeating the 2007 spill/transport operation in future low flow years places too great a risk on the wild SR steelhead and spring/summer Chinook populations…" and thus warrants further degrading river conditions in May and elevating other risks (e.g., steelhead stray rates, in-river predation, lamprey mortality; sockeye mortality) in order to maximize transportation?**

<u>Information relevant to this question:</u>

The ISAB raised concerns in 2008 that "... *[decisions based on an] emphasis on simple ratios [SARs and T:M] rather than the NUMBERS of fish may be an oversimplification. For example, close evaluation of the number of fish moving in-river versus the number being barged is informative. If Type 1 mortality is acting on migrating fish running a gauntlet of predators, as the number and percentage of them decreases it would be natural that the in-river fish would perform progressively worse than the transported fish, especially in depleted stocks. Decisions based mainly on T:M ratios in this case would lead to a conclusion that barging is preferred, when the situation instead is that the more fish are barged the worse the in-river migrating fish do and the better barging looks*" (ISAB 2008). NOAA Fisheries, in its report entitled, *Analysis of juvenile Chinook salmon and steelhead transport from Lower Granite and Little Goose dams,1998-2008* (NWFSC 2009), cautioned that "*…the data presented [T:M ratios]...do not provide a complete basis for determining when to transport and when not.*"

Despite advisories by the ISAB and its own scientists, NOAA Fisheries relies primarily on T:M ratios (i.e. comparisons of SARs from fish transported in May compared to SARs from fish collected at the dams in the bypass system and detected or marked and returned to the river) in its assessment of benefits and risks in a low flow year associated with a spill/transport operation similar to that conducted in 2007. This within-season comparison does not compare transported fish to true in-river migrants that were afforded spill passage. In its transport analysis (NWFSC 2009), NOAA Fisheries concludes their analysis provides data to evaluate which strategy, transport versus bypass, worked best for fish that had already been collected, but the analysis does not address management strategies related to the provision of spill and non-collected fish afforded spillway passage. The analysis acknowledged the need for additional years of adult returns from ongoing and future operations and studies to better understand benefits and risks of transportation for all spring migrants. In its closing statement, NOAA Fisheries refers to the ISAB's 2008 report (ISAB 2008) to highlight the ISAB's recommendation that besides T:M ratios for spring-summer Chinook and steelhead, managers should consider other factors, including:

- maintaining the ability to learn how populations respond to current dam configurations under a range of operations and conditions,
- the effect of transport on stray rates, and
- the response to transport of ESUs other than spring/summer Chinook and steelhead.

The 2009 Comparative Survival Study (CSS) Annual Report (Tuomikoski et al. 2009), illustrated how spill and flow affected juvenile yearling Chinook and steelhead under the unique conditions present during the spring of 2007. The approach for examining the effects of spill in 2007 was to compare and contrast the fish travel times and survival rates observed in 2007 with the fish travel times and survival rates that were observed in 2005, a year with similar flow conditions, but without voluntary spill at the transportation projects.

For the combined wild and hatchery steelhead (hereafter designated simply as steelhead), water transit times were similar between 2005 and 2007, typically within three days of each other across the migration season. Likewise, average water temperatures were also similar during the spring migrations of 2005 and 2007, averaging only a difference of 0.2 degrees Celsius higher in 2007. However, the spill percentages were considerably higher in 2007. During the steelhead migration period, average spill percentages were 5 -18 percent higher in 2007 than in 2005. The average percent spill estimates in the Lower Granite Dam – McNary Dam reach during 2005 are greater than zero due to spill at Ice Harbor and McNary dams and involuntary spill at the transportation dams, which occurred despite the elimination of voluntary spill at the transportation dams in that year.

In terms of biological responses, steelhead showed marked improvements in fish travel time and survival in 2007 compared to 2005. Steelhead travel times were up to 6.5 days faster (first temporal group) and averaged a reduction of 1.3 days across the six temporal groups in 2007 compared to 2005. Estimated survival rates were up to 26 percent higher (last temporal group) and averaged an increase of 12 percent across groups in 2007 compared to 2005. These observations demonstrate that the provision of spill, even under low-flow conditions, can result in improved juvenile migration rates and survival rates in the Lower Granite Dam – McNary Dam reach.

There appear to be several environmental-biological mechanisms underlying these results. In terms of fish travel time, multiple regression analysis results showed that for a given water transit time and Julian day, spill reduces migratory delay. With reduced travel time and a fixed instantaneous mortality rate, survival is expected to increase. For steelhead, instantaneous mortality rates decrease with increasing spill levels, which would further enhance survival. In addition to altering migration rates, spill also functions to modify the proportion of fish passing the spillway, bypass and turbine routes. High spill percentages increase the proportion of fish that pass spillway routes, while low spill percentages increase the proportion of fish that pass turbine routes. Spillways have been found to be the migration route with the highest survival at Snake River dams, while turbine passage has been found to be the migration route with the lowest survival (Muir et al. 2001). Thus, the provision of spill increases the proportion of fish passing the highest survival route while also reducing the proportion of fish passing the lowest survival route.

The provision of spill also decreases the proportion of the population that is transported, increasing the number of in-river migrants. If predation mortality is depensatory, then the provision of spill, with the commensurate increase in the number of in-river migrants should result in higher survival than would be achieved with fewer in-river migrants. It appears that each of these environmental-biological mechanisms contributed to the results that were observed in 2007. With high spill levels and better water transit times than occurred in 2007, we would expect that future steelhead survival rates would be even higher than was observed in 2007.

Comparing 2007 and 2005 illustrates the benefit of the spread the risk management approach to transportation in low flow years. These years were similar in terms of flow but different in their in-river survivals and in-river SARs. However, the T:M ratios were lower in 2007 reflecting the benefits of spill and reduced proportion of transportation in 2007 as compared to 2005. However, while migration years 2005 and 2007 were similar in their in-river environmental conditions (i.e., flow, water transit time), they differed in their ocean conditions.

In general, 2005 is considered a “poor” ocean year and 2007 is considered a “moderate” ocean year. It is possible that the increased SARs for 2007 out-migrants may be solely due to the “better” ocean conditions. If this were the case, one would expect the relative increase in SARs to be similar for transported and in-river groups. However between 2005 and 2007, the transport SAR increased by 360% for wild steelhead, did not increase for hatchery steelhead and increased 724% and 400% for their in-river migrating counterparts. This reinforces the assertion that improved in-river conditions during 2007 enhanced the positive ocean influences on adult returns.

In addition to comparisons of selected years, the CSS study has documented a relationship between T:M ratios, in-river survival and migration conditions across all available years. This relationship extends to in-river conditions as well. Wild steelhead and wild Chinook TIRs were both less than 1.0 in 2006, a high-flow, high-spill year. In contrast, T:M ratios were high during the 2001 low-flow, no-spill migration year. Environmental conditions in 2007 were unique in that flows were similar to 2005, but relatively high levels of spill were provided. Despite 2007 flows being similar to the 2005 low-flow conditions, T:M ratios of wild Chinook and wild steelhead were much lower in 2007 than 2005 and not significantly different from 1.0 for wild Chinook. The results from 2007 suggest that the provision of spill may lower T:M ratios (i.e., increase the in-river SAR relative to the transport SAR), even under low-flow conditions. As discussed above, one mechanism for this result is that spill increases the survival of in-river migrants and reduces migration delay (see above), thus increasing the in-river SAR relative to the transport SAR, with the result being a T:M ratio less than or equal to one.

The exact flow level at which transportation would clearly benefit all species, regardless of the provided spill levels, is unknown. While the T:M ratios in 2001 were high, this occurred under a no-spill condition at all dams. The comparison of 2007 versus 2005 showed that SARs could be increased for in-river fish through the use of spill and, therefore, T:M ratios decreased. Given these results, it is quite possible that SARs could have increased in 2001 as well if spill had been provided, leading to lower overall T:M ratios than were observed.

A key measure of performance in a given year is adult returns. The Fish Passage Center found that the near-record steelhead return in 2009 was primarily comprised of juvenile out migrants from 2007 and 2008 (FPC 2009). In addition, the Fish Passage Center found that sockeye returns to the Snake River reached a record historical high in 2009 (FPC 2010c). Based upon PIT tagged sockeye, 87% of sockeye adults returning in 2009 out-migrated in 2007, a low flow year with higher spill and lower transport than prior low flow years. Previous low flow years, without spill and with maximum transportation of sockeye, resulted in dismal adult returns.

2. **Does the ISAB consider data from spread-the-risk spill and transport operations compelling enough to reverse their earlier recommendation for further evaluation of these operations at a range of flows?**

<u>Information relevant to this question:</u>

In 2008 the ISAB made the following recommendation: "*Spill-transport operations like those of 2006 and 2007 should be continued long enough to determine how much influence such operational changes have on downriver migration and total adult returns. Continuing recent spill-transport operations is advised to improve future evaluations of the trade-offs associated with spill and transport decisions.*" The ISAB also stated "*... terminating spill would eliminate the possibility of learning about the effect of partial spill during this critical period, thereby reducing opportunities for improved decision-making in the future*" (ISAB 2008).

NOAA's proposal to degrade river conditions in order to maximize transportation, based on only one incomplete adult return for Chinook and steelhead, is inconsistent with scientific protocols recognizing inherent environmental and experimental variability and the need for multi-year experiments over a range of environmental conditions. The comparison of 2007 versus 2005 showed that SARs could have been increased for in-river fish through the use of spill and, therefore, T:M ratios decreased. Given these results, it is quite possible that SARs could have increased in other "low flow" years as well if spill had been provided, leading to lower overall T:M ratios than were observed. River conditions in 2010 provide an experimental management opportunity to replicate those in 2007 and learn more about how spill affects in-river migrants under "low flow" conditions, as well as related stray rate, lamprey and predation effects.

3. **Does the ISAB consider NOAA Fisheries' assessments of risks to other species sufficiently rigorous and robust to eliminate spill in May at collector dams?**

<u>Information relevant to this question:</u>

Previous ISAB recommendations are germane to this issue. *"Spreading the risk of negative outcomes among alternative routes of hydroelectric passage is advisable to prevent a recovery action that is designed to improve survival of one listed species from becoming a factor in the decline of another species."* (ISAB 1999) *"Spreading the risk of negative outcomes among alternative routes of hydroelectric passage is advisable in the face of uncertainties associated with potential negative effects of transportation on genetic and life history diversity."* (ISAB 1999) *"... all juvenile passage alternatives should be evaluated against the baseline of spill. As an avenue of hydroelectric project passage, spill more closely mimics natural situations and ecological processes than other available routes. Spill should be considered as an alternative when the improvements anticipated from other bypass technologies are not large enough to meet the passage goals."* (ISAB 1998) *"Straying by returning adults is a major biological threat to other wild populations. There is evidence that transportation increases the incidence of straying."* (ISAB 2008)

NOAA Fisheries admits that "*[t]ransported SR steelhead typically wander/stray 3-5% more than adults that migrated in-river as juveniles (NOAA Fisheries 2008a). These fish are often found in areas inhabited by Mid-Columbia River steelhead where they could interbreed and potentially affect the genetic integrity of some MCR steelhead populations.*" NOAA Fisheries also admits that "*...the data is presently insufficient to directly test T:M SAR relationships for SR sockeye* *salmon.*" Finally, NOAA Fisheries states that "*Pacific lamprey – which are unlisted, though an important species of concern – could be negatively affected by spill/transport operations either directly (mortalities of transported lamprey or increased mortalities passing dams without spill) or indirectly (removing migrating salmon and steelhead through transport could increase mortalities from avian or fish predators).*"

NOAA Fisheries' primary rational for eliminating voluntary spill and implementing maximum transport is to increase the proportion of the steelhead run that is transported. This is based in large part on studies that indicate higher SARs for transported steelhead versus those that migrated in-river or were bypassed. Although transported steelhead have higher SARs than those migrating in-river or bypassed, this is not the case for wild Snake River spring/summer Chinook. Furthermore, available data suggest there is no benefit to transportation for Snake River subyearling Chinook. It is unknown what kind of impact transportation has on Snake River coho but transportation may be detrimental to Snake River sockeye (Williams et. al., 2005).

Switching to maximum transportation with no spill in May and early June 2010 will inevitably increase the proportion of yearling Chinook, subyearling Chinook, sockeye, and coho that are transported. Furthermore, switching to a no spill operation during this time would mean that all juvenile lamprey will be bypassed or pass through turbines at collector dams instead of passing through spill. Analyses by the Fish Passage Center FPC 2010c) found that on average, 67-76% of Snake River yearling Chinook, 83-89% of juvenile sockeye, 87-89% of juvenile coho, and 23-24% of subyearling Chinook juveniles passed Snake River collector dams during the proposed period of the maximum transport/no spill operation. Furthermore, approximately 56-89% of lamprey juveniles passed the dams during this time.

<u>Yearling Chinook</u>: Results from the CSS Study (Schaller et al. 2007) found that the annual T:M ratio for wild Chinook was significantly >1.0 in only five out of eleven years, although the results were variable due to low adult returns.

<u>Subyearling Chinook</u>: Results from adult returns of PIT-tagged subyearling Chinook salmon suggests that transportation neither harms nor helps fall Chinook salmon (Williams et al. 2005). For juveniles detected prior to September 1, in four of six years the SARs of the bypassed group exceeded SARs of transported fish. In two of the four years where the T:M ratio was less than 1 the upper confidence was also below 1. In two other years the mean T:M ratios were also below 1, however, the confidence intervals were broad. Considering the "in-river" migrant groups in these studies were composed of fish collected, PIT-tagged at the collector dams and returned to the river, these fish do not represent true undetected in-river migrant fish that were afforded a chance for spillway passage.

<u>Sockeye</u>: Although transportation studies have not directly evaluated effects on listed sockeye, evidence exists that indicates sockeye smolts are vulnerable to descaling during collection at Snake River dams (Marmorek et al. 1998) and may not respond well to transportation (Williams et al. 2005). In addition, analyses by the Shoshone-Bannock Tribe (Taki 2010) indicate that SARs for sockeye were substantially higher in years when less than a majority of juveniles were transported. In 2005, a low flow year similar to 2007 and to that forecasted for 2010, no spill was provided and

86% of sockeye smolts from Sawtooth Valley were transported. The observed overall SAR that year was 0.03%. In 2007, spill was provided and 53% of Sawtooth Valley sockeye smolts were transported. In turn, the observed SAR was nearly 30 fold higher (0.85%).

These observations are consistent with recent analyses (FPC 2008) of adult returns of sockeye to the mid-Columbia and Snake rivers. In 2008, adult returns of sockeye were four times the 10-year average for mid-Columbia stocks and twenty times greater for Snake River stocks. These returns are associated with spill operations in 2006 and 2007, when the proportion of Snake River sockeye transported was lower (0.592 and 0.532, respectively) than the average for the previous eight years (0.772).

<u>Lamprey</u>: Under a no-spill operation juvenile lamprey passage will be restricted to turbines and screened power house bypass systems. Impingement of juvenile lamprey on turbine intake screens is a serious regional problem (Starke and Dalen 1995,1998; Moursand et al., 2000, 2001, 2002, 2003; Bleich and Moursand, 2006). Lamprey timing data indicate that a large portion of the lamprey passage distribution will be negatively impacted by the reduction in spill.

<u>Straying of adult steelhead</u>: NOAA Fisheries (2008) estimated that transportation of steelhead increased straying rates above that of in-river migrants 3% to 5% in their Supplemental Comprehensive Analysis. The 2009 CSS Annual Report (Tuomikoski et al. 2009) estimated that less than 0.2% of steelhead straying was by in-river migrants. Other studies also found stray rates to be significantly higher for steelhead transported as juveniles (Peery 2008; Ruzycki and Carmichael 2008; (Ruyzcki and Carmichael- in preparation; FPC 2010b, 2010c). Subsequent analyses by the Fish Passage Center estimated that over 60% of all steelhead strays were to the Mid-Columbia ESU tributaries and that at certain run sizes and transportation ratios, their numbers could be as high as 94% of the total return of local stocks of steelhead to those tributaries (Table 1). Other studies of stray rates of Snake River steelhead into mid-Columbia ESU tributaries found that 39% were found in the Deschutes River, 31% were found in the John Day River and 4% were found in the Klickitat River (Keefer et al. 2005).

Table 1. Estimated increase in strays of Snake River Steelhead to Mid-Columbia ESU tributary populations based on proportion transported and total Snake River Steelhead adults to Bonneville Dam compared to in-river only adult returns as baseline**.**

Adult Steelhead to BON	Estimated increase in number of Snake River strays to Mid-Columbia ESU (as a function of proportion of Bonneville Dam adults that were transported as				
	100%	80%	50%	10%	0%
350,000	10,500	8,400	5,250	1,050	0
237,500	7,125	5,700	3,563	713	0
125,000	3,750	3,000	1,875	375	0

Note: Mid-C steelhead geomean population was estimated at 11,214 for the NOAA Supplemental Comprehensive Analysis (NOAA 2008). Assumed 5% increased stray rate applied to Snake River steelhead population at Bonneville Dam and that 60% of strays entered Mid-Columbia ESU tributaries.

The mechanism for higher straying of steelhead adults that were transported as juveniles appears to be removal of the juveniles from their natural environment and disruption of sensory cues that are vital to homing behavior (Keefer et al. 2005; 2006). Numerous studies have documented straying (Keefer et al. 2005; 2006; Peery 2008, Ruzycki and Carmichael 2008; Ruyzcki and Carmichael-in preparation) and associated risks, particularly to the diversity viability criterion (McElhany et al. 2000). As part of its listing decision for mid-Columbia steelhead, NOAA Fisheries echoed concerns in Good et al. (2005) that "*(I)n recent years escapement to spawning grounds in the Deschutes River has been dominated by stray, out-of-basin (and largely out-of ESU) fish-which raises substantial questions about genetic integrity and productivity of the Deschutes population.*" In 2009, the conservation and recovery plan for Oregon populations of the mid-Columbia River identified steelhead straying from other areas as a limiting factor for recovery of distinct population in the John Day and Deschutes rivers (Carmichael et al. 2009).

Studies have also documented unaccounted-for losses and delay and fallback at dams by steelhead transported as juveniles (Keefer et al. 2006; DeHart 2006; 2007; 2007, Peery 2008).

4. **Given that maximizing transportation further degrades river conditions by slowing migration, increasing turbine passage and increasing predation rates for inriver migrants, does the ISAB consider migrants not collected and left to migrate in river to be at significant risk? Does the ISAB consider those fish left in the river to be ecologically and evolutionarily expendable? If low flows trigger transport operations that further degrade river conditions, would it be prudent to prioritize available resources in an attempt to help avoid low flows?**

<u>Information relevant to this question:</u>

NOAA Fisheries estimates that over 90% of Snake River steelhead and spring/summer Chinook would be collected and transported if no spill is provided in May 2010. Historical data from years when transportation was maximized indicate that similar proportions of sub-yearling Chinook and sockeye would be transported. Also, indicated in question 3, recent analyses by the Fish Passage Center estimate that 55%-89% of lamprey juveniles pass Snake River projects during the proposed no-spill period, and as such would either enter the bypass system or turbine intakes.

As pointed out by the ISAB in its 2008 report, in addition to the potential negative effects transportation or bypass may have on species other than steelhead, individuals left to migrate in river under no-spill operations face degraded river conditions and a gauntlet of predators. In a 2008 report, NOAA Fisheries concluded that if “more fish are left in-river to migrate as a result of spill, ...bird predators can only remove a set amount leading to the lower overall proportion mortality and, consequently, higher in-river survival.” From the data collected during the 2006 and 2007 juvenile migrations, NOAA concluded that in-river survival increases with increasing spill through the indirect effect of reducing individual vulnerability to predation.

Over the past ten years, estimates of juvenile steelhead mortality due to bird predation in McNary Reservoir have been about 4 to 5%, although the estimate approached 21% in 2001 (Faulkner et al. 2007, Faulkner et al. 2008). Roby et al. (2008) suggest that predation of juvenile steelhead may be significantly influenced by the abundance and density of in-river migrants, their travel time, and river conditions. They found that the avian predation rate on Snake River steelhead, based on PIT-tagged smolts last detected at Lower Monumental Dam and subsequently recovered on the Crescent Island tern colony, was only 4.9% in 2007 compared to 35.5% in 2004. The difference was attributed to a corresponding reduction in the size of the tern colony, a reduction in steelhead travel time (a few weeks in 2007 versus longer in 2004), and an increase in steelhead abundance and density of in-river migrants (55% of run remained in-river in 2007 versus 3.6% in 2004).

NOAA Fisheries acknowledges that data from 2006 and 2007 indicates that leaving more fish in-river to migrate results in lower proportional mortality caused by bird predation and higher in-river survival (Muir et al 2008). In an August 31, 2007 memo from John Ferguson, NOAA Fisheries noted that mortality rates of PIT-tagged fish used to estimate in-river survival may be influenced by high predation rates on the small numbers of total fish allowed to migrate in-river under a no-spill operation, and that higher survival for in-river migrants in 2007 may have resulted from greater volumes of water spilled and the operation of removable spillway weirs at Lower Granite and Ice Harbor dams. In addition, Ferguson noted that "*If one assumes a colony of avian predators requires a relatively fixed number of smolts, then when there are few non-tagged smolts in the population, most of this number is taken from the PIT-tagged population. Thus, the mortality rate is relatively high for the fish from which we estimate survival*". He concluded that "*Using those survival estimates to predict future conditions would require understanding avian/smolt predator dynamics.*"

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