Independent Multidisciplinary Science Team (IMST)

State of Oregon

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September 22, 2010

Ms. Suzanne Knapp
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Dear Sue,

In your February 25, 2010 letter you requested the Independent Multidisciplinary Science Team (IMST) to review and assess the scientific and technical underpinnings of the State of Oregon's document titled *Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead* (February 23, 2010 draft; hereafter the Plan). The IMST has completed its review. The attached review addresses whether the Plan's approach and analyses are credible and consistent with accepted scientific standards, whether the Plan's assumptions are supported by best available science, and whether uncertainties associated with the recovery of upper Willamette River Chinook salmon and steelhead are characterized adequately in the Plan. IMST approached these issues from the perspectives of both the federal Endangered Species Act (ESA) and ODFW's Native Fish Conservation Plan (NFCP) goals.

The IMST has now reviewed five salmonid recovery and conservation plans for the State of Oregon since 2007. With this latest review, the IMST chose not to include formal recommendations. Instead, it is the Team's intent to draft recommendations that address broad recovery and conservation planning issues that were repeatedly identified in our reviews. If possible, IMST plans to submit these recommendations to the Oregon Plan Salmon and Watershed Core Team and appropriate state agencies during the 2010/11 fiscal year.

As has been the case with past recovery plans reviewed by IMST, this Plan clearly reflects the high level of professional effort expended by ODFW employees to address the difficult and complex issues posed by declining salmonid populations in the upper Willamette River basin. The Plan contains several improvements over those past conservation and recovery plans.

In the review, the IMST offers several constructive comments on larger, overarching issues. Because of IMST's expanded work load and reduced budget, the Team was not able to provide more detailed comments as it has on past reviews. Many of our comments are similar to those made during IMST's reviews of recovery plans for the middle and lower Columbia River recovery domains.

We are reiterating these comments to help elevate their importance for resolution. By considering these questions and by adding or clarifying content where needed during revisions of this Plan, ODFW could strengthen the scientific basis of the Plan.

In closing, IMST realizes that this draft Plan represents a 'work in progress' intended to function as a living document that ODFW will revise on a regular basis as new information and tools become available. IMST offers these constructive comments with the intent of aiding ODFW efforts to strengthen the scientific basis of the Plan during future revisions.

Sincerely,

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IMST Co-Chair

Carl Schreck
IMST Co-Chair

cc:

Dave Jepsen, ODFW
Tom Byler, OWEB
IMST

IMST Review of State of Oregon's *Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead* (*February 23, 2009 draft*)

Released on September 22, 2010

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Review Preparation: This review was prepared by the IMST based on an initial draft by an IMST subcommittee (Carl Schreck and Vic Kaczynski with Susie Dunham providing technical support). The IMST discussed the draft review and unanimously (Bob Hughes and Vic Kaczynski absent from vote) adopted it at its September 20, 2010 meeting.

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ACRONYMS

CATAS	Conservation Assessment Tool for Anadromous Salmonids
DPS	distinct population segments
IMST	Independent Multidisciplinary Science Team
ESA	Endangered Species Act (federal)
ESU	evolutionary significant unit
GNRO	Governor's Natural Resources Office
NFCP	Native Fish Conservation Plan
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
SLAM	Species Life-cycle Analysis Modules

INTRODUCTION

The Independent Multidisciplinary Science Team (IMST) reviewed the State of Oregon's February 2010 draft document titled *Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead* (hereafter the Plan) at the request of the Governor's Natural Resource Office (GNRO; letter from Suzanne Knapp dated February 25, 2010). This review addresses whether the Plan's approach and analyses are credible and consistent with accepted scientific standards, whether the Plan's assumptions are supported by best available science, and whether uncertainties associated with the recovery of upper Willamette River Chinook salmon and steelhead are characterized adequately in the Plan. IMST approached these issues from the perspectives of both the federal Endangered Species Act (ESA) and Oregon Department of Fish and Wildlife's (ODFW's) Native Fish Conservation Plan (NFCP) goals.

As has been the case with recovery plans reviewed by IMST in the past, this Plan clearly reflects the high-level of professional effort expended by ODFW employees to address the difficult and complex issues posed by declining salmonid populations in the upper Willamette River basin. The Plan contains several improvements over past conservation and recovery plans that IMST has reviewed. The credibility of the Plan is greatly enhanced by the acknowledgement of scientific uncertainties and unknowns. It is also clear that the authors of the Plan put forth considerable effort to address comments made by IMST on recovery plans for salmon and steelhead in the lower and middle Columbia River recovery domains. These additions help the reader better understand how different model results and professional judgment were used in the recovery planning process.

IMST offers the following constructive comments on larger, overarching issues. Because of IMSTs expanded work load and reduced budget, the Team was not able to provide detailed, minor or editorial comments as it has on past reviews. The Team acknowledges that ODFW is aware of many of these issues but chose not to explicitly address them in the Plan. Many of our comments are similar to those made during IMST's reviews of recovery plans for the middle and lower Columbia River recovery domains. The Team reiterates these comments to establish the high priority that it gives to their resolution. By considering these questions and by adding or clarifying content where needed during revisions of this Plan, ODFW could strengthen the scientific basis of the Plan.

OVERARCHING ISSUES

Presentation of Uncertainty

It is clear that the science and monitoring resources available to determine current status, desired status, and conservation gaps are incomplete or entirely deficient for many populations included in the Plan. Several chapters in the Plan contain explicit descriptions of data limitations, uncertainty associated with model results, the limitations of analyses based on insufficient data, and how professional judgment is used to compensate for such deficiencies. In general, these upfront acknowledgements of where data are lacking, when professional judgment was used, and the amount of uncertainty associated with various analyses are well presented. However, such uncertainty is an inherent component of the risk that a population, stratum, evolutionary significant

unit (ESU) or distinct population segment (DPS) might decline to extinction despite management efforts. Areas where additional descriptions of uncertainty would strengthen the Plan include:

- Discussion of how the level of uncertainty in ranking limiting factors and threats compares to or is influenced by uncertainty in ranking threats imposed by ocean conditions, climate change and human population growth. It would be useful if the Plan included some discussion that addressed why the uncertainties associated with human population growth and climate change prohibit inclusion of such factors in quantitative models while the limiting factors and threats associated with freshwater habitat, hatchery production, harvest, and hydropower can be identified, ranked, and modeled for populations that are largely data deficient. Why do the uncertainties associated with these issues warrant such different treatments?
- There are inherent errors associated with being able to ascribe current status, determine conservation gaps, and understand how populations will respond to recovery actions. Such errors may interact in a multiplicative fashion. Has ODFW considered modeling how compounding uncertainty might affect viability assessments at the population or stratum-level? Such an exercise with one or two recovery scenarios could be insightful, particularly if the scenarios selected were those where ODFW had the least confidence *a priori*. The scientific rigor of the Plan would be strengthened if it included some discussion of compounding uncertainty resulting from multiple assumptions made at different stages during the determination of current status and during the development of desired status, conservation gaps, and recovery scenarios.
- Discussion of how the uncertainty associated with current model scenarios and expert opinion influences expectations for the performance of proposed recovery actions, implementation of the Plan, or the development of an adaptive management strategy.
- Projected estimates of the minimum amount and quality of quantitative data required to increase confidence in inferences made from model results. In other words, how much additional data must be produced by research, monitoring, and evaluation actions before model results can be interpreted with a high level of confidence?
- The candid discussion of model shortcomings is an excellent example of the caveats included throughout the Plan. Also, the effort ODFW made to cross check results of the CATAS model with the more heavily parameterized SLAM model are a quantitative strength of the Plan. However is not clear how well either of these models perform in predicting status of real populations. It appears that the comparison between the SLAM and CATAS models is being used to validate the CATAS model. Have results from CATAS or SLAM models ever been validated using historical to current conditions with a reasonable start year and similar assumptions? The use of these models as recovery planning tools would be better justified if the Plan included some description how these models were validated against data from actual populations.

Scientific Unknowns

IMST appreciates the effort ODFW intends to put into addressing science unknowns and the time required to develop the necessary research plans. However, IMST's ability to assess not only the

scientific adequacy but also the biological feasibility of the Plan is hampered by the fact that the success of the Plan hinges heavily on future research that must be correctly targeted to fill critical information needs. The research activities proposed in the Plan are ambitious and may require decades to complete. The overall impression is that successful recovery will depend on information produced by many studies that are presently at the level of 'research goals' rather than detailed proposals. For example, in many sections the approaches to proposed research goals are described as 'to be determined'. This does not instill a tremendous amount of faith that the Plan will successfully lead to recovery. This aspect of the Plan could be strengthened if it included either explicit descriptions of how research questions will be approached, or a timeline for determining research approaches, developing proposals, and implementing research programs.

Future Threats

While the Plan is well written and comprehensive, it remains firmly in the four Hs (hydropower, harvest, hatchery, and habitat) approach to freshwater salmonid management without questioning whether or not this paradigm remains valid in the light of emerging information about the risks associated with future threats such as invasive species, ocean conditions, climate change and human population growth. It is obvious from reading the Plan that ODFW appreciates the importance of considering climate change and that the human and ecological state will change over the time course required for recovery. However, in order to strengthen scientific credibility, it is important for ODFW to demonstrate a solid grasp of emerging threats that will likely influence the outcomes of its recovery plans. ODFW builds several analytical conservation buffers into analyses presented in the Plan as a mechanism to compensate for uncertainties that might lead to incorrect conclusions about when recovery goals have been met. Given the high level of uncertainty inherent in this Plan, IMST agrees with approaches that will result in conservative decisions about salmon and steelhead recovery in the upper Willamette River. However, it is unclear how or how much the analytical conservation buffers outlined in the Plan change estimates of desired status and conservation gaps. It is unclear how the 20% adjustment to the conservation gap mean abundances will compensate for the future effects of both population growth and climate change. Why is this adjustment applied equally across all populations when some may be disproportionately affected by either or both of these threats? How were the potential effects of future climate change or human population growth factored into rankings of limiting factors and threats?

IMST believes that sufficient models now exist for both climate change and human demographic changes that could be incorporated in the Plan's analyses. Climate change and demographic models currently available are sufficiently fine-scaled to allow application in recovery planning. For example, the pixel size for the climate change models for the Willamette River are at about 800 square meters and those for futuring are 80 square meters. IMST suspect that the errors associated with the models concerning climate change and human demographics are similar to those of CATAS and SLAM. Therefore, it is difficult to understand why these models were not incorporated in the analyses conducted in the Plan when other, equally complex, models are used extensively. The scientific rigor of the Plan would be enhanced if ODFW were to incorporate results of several climate and futuring scenarios such as comparing status quo with the worst case scenario predicted by these models. It would be interesting to know if elevated water temperature and increased human infringement in watersheds would necessitate more extensive or restrictive recovery measures.

The level of guidance provided by the Plan could also be enhanced by an examination of the limiting factors identified and how each might change (and in general become more limiting) under the most commonly agreed scenarios both of climate change and of human population increase. For example, ODFW might extend the discussion of threats posed by climate change and human population growth by identifying salmonid populations that may be particularly vulnerable to either or both of these threats, hypothesizing how key or secondary threats identified for these salmonid populations might change in the future, and discussing how recovery actions might be prioritized or implemented differently (e.g., type, amount, location, timing, intensity) under a changing climate and growing human population. Some of the discussion points would be speculative, but IMST believes that there is sufficient information from which to construct narrative analyses for each population. This process and discussion would greatly aid collection and interpretation of appropriate monitoring data and also lead to the development of criteria for reconsidering key and secondary threats within the context of climate/ocean changes and population growth.

It would be advisable to run the CATAS models without the analytical conservation buffers to provide estimates of recovery that are based on what is currently known. These results will likely provide different estimates of extinction risk and conservation gaps and provide an informative baseline for comparison. It might also help to review recent approaches to incorporating uncertainty into forecasts of environmental change, such as those used in the Millennium Ecosystem Assessment (http://www.millenniumassessment.org).

The following peer-reviewed references provide examples that might be useful in considering alternate methods of integrating uncertainty associated with climate change into recovery plans for salmon and steelhead populations in the Upper Willamette River Recovery Domain.

- Fuller T, Morton DP, Sarkar S (2008) Incorporating uncertainty about species' potential distributions under climate change into the selection of conservation areas with a case study from the Arctic Coastal Plain of Alaska. *Biological Conservation* 141: 1547–1559.
- Heller NE, Zavaleta ES (2009) Biodiversity management in the face of climate change: A review of 22 years of recommendations. *Biological Conservation* 142: 14–32.
- Vos CC, Berry P, Opdam P, Baveco H, Nijhof B, O'Hanley J, Bell C, Kuipers H (2008) Adapting landscapes to climate change: examples of climate-proof ecosystem networks and priority adaptation zones. *Journal of Applied Ecology* 45: 1722–1731.

Present Land Use and Future Changes in Land Use

The description of limiting factors appears abbreviated or incomplete particularly with respect to water quality factors that occur along urbanized streams. Also the effects of land use change, particularly urbanization, on habitat are not sufficiently examined with respect to limiting factors. Human population growth is a well established and growing threat to salmon and steelhead populations. Why is the role of toxins not given more weight, particularly when combined with lower base flow conditions that might be made more extreme by the "urban stream syndrome" in cities? Such rankings may not be sufficient for salmon and steelhead populations that must traverse heavily affected streams and rivers associated with the Portland-Metro region and other urban areas.

Has there been any consideration given to the possibility that human population growth could affect water availability or the timing of when water might be in the rivers? Similarly, has there been any forecasting done to see if there are any trends associated with agricultural land use? Does ODFW have any understanding of how changes in land use might affect groundwater availability, the timing when water withdrawals are made, the nature of chemicals put onto the landscape, and the amount of impervious surface and its location within a basin?

Given that many of Oregon's upper Willamette River tributaries are listed on ODEQ's 303(d) list for exceeding temperature criteria for spawning, rearing, passage or all three, why is water quality typically a secondary concern – especially when linked with poor riparian and sediment conditions? It appears that ODEQ and the US Environmental Protection Agency view such water quality impairments as significant issues for salmonid recovery in Oregon. If this is true, why shouldn't these standards be given more weight (i.e., be ranked as key concerns) in recovery planning?

Extinction Risk Categories

Presenting the distribution of extinction risk scores for each population is an excellent approach to characterizing uncertainty in the Plan. However, it is not clear how the break points in the range of extinction probability values were determined and assigned to risk categories. The definitions of extinction categories presented in the Plan are non-linear, i.e., the low risk category ranges from a 1 in 100 to a 1 in 20 risk of extinction, the moderate risk category ranges from a 1 in 20 to a 1 in 4 risk of extinction, while the high risk category ranges from a 1 in 4 to a better than even risk of extinction. The sense of urgency that underlies recovery efforts is very different for a population with a 1:20 chance of extinction compared to a population with a 1:4 chance, yet both are considered to be at moderate risk under ODFW's current system of aggregating risk. This type of categorical approach could result in equivalent viability determinations for populations that may be recovering at very different rates. Is there robust scientific information that supports the numeric break points used in the extinction risk criteria? Why not use continuous scoring instead of class scoring with its inherent judgmental classes?

IMST suggests that aggregating extinction risk as a first step in the analysis of current status, desired status and conservation gap analyses greatly decreases transparency in these analyses. For example, the figures depicting current and desired status for populations give the appearance that the steps between risk categories are linear when they are not. These figures would more clearly portray the range of variability in extinction risk within and among populations if the y-axis represented the continuous probability of extinction rather than extinction risk categories.

The scientific rigor of the Plan would be strengthened if an explicit description of the empirical basis for assigning extinction probabilities to risk categories were included. Also, presenting the change in probability of extinction risk (as a range) required to meet desired status in summary table form would better reflect the magnitude of effort required to recover individual populations, as well as the uncertainty involved in doing so.

Mortality Rate Estimates

The capacity for reductions in limiting factors and threats appear disproportionately attributed to tributary habitat. Improving freshwater capacity will have a positive effect only to the degree that

the ocean is not limiting and the hatchery/harvest mortality does not preclude full seeding of tributaries. If the scientific basis of this approach were better explained in the Plan, it would be easier to understand why the Plan is heavily focused on tributary habitat actions.

Key and Secondary Limiting Factors and Threats

What explicit criteria define key and secondary factors and are they applied consistently across populations? How exactly was 'consensus opinion' used to differentiate between threat categories? When do cumulative effects of secondary concerns equal primary concerns and what is ODFW's plan for addressing cumulative effects of secondary concerns? How were uncertainties associated with the significance of limiting factors and threats considered during the ranking process and were such considerations applied equally across all factors? For example there is great environmental uncertainty associated with human population growth and climate change; how was this considered in comparison to uncertainties associated with harvest or hatchery impacts? IMST urges that recovery planners consider estimating the risk reduction potential and costs of classes of actions for individual populations/species.

Connecting Limiting Factors and Threats to Recovery

IMST had difficulty understanding how well important biological and physical processes related to recovery planning are understood. Assuming that the limiting factors and threats have been correctly identified and ranked, it is not clear whether the models used to explore threat reduction scenarios correctly reflect the relationships between limiting factors, threats and fish performance. IMST did not have the time or expertise to conduct a detailed review of the CATAS and SLAM models used in this Plan. Including interactive effects of limiting factors can result in highly variable model outcomes and considering such variability could change how limiting factors and threats may be ranked. It would be useful to the reader if the Plan contained some discussion on whether models analyzed the variables contributing to fish mortality as additive or compensatory, or a mix of both as appropriate.

Do the variables used to parameterize CATAS or SLAM include the extremely high pre-spawning mortality for adults in the upper Willamette River tributaries? Mortality of spawners collected at upper Willamette River system dams and liberated above barriers to reseed historic spawning habitat is exceptionally high, up to 80% in certain cases (ODFW spawner survey data). Do the models somehow reflect the importance of reproductive value of the mature adult life history stage? Elsewhere in the Columbia River system there also appears to be pre-spawning mortality, albeit it is apparently lower than in fish stocked above dams in the upper Willamette River system. Will freshwater rearing conditions in the upper Willamette River basin be capable of compensating for pre-spawning mortality by contributing significantly more juveniles than is normal for other systems with Chinook? The scientific rigor of the Plan would be strengthened if it provided information on pre-spawning mortality in the Willamette River below impassible impoundments and in other systems outside of the Columbia River region where populations are sustainable. The scientific rigor of the Plan could also be strengthened by presenting the number of juveniles entering the ocean per stratum and the projected numbers of juveniles necessary to achieve stratum viability. These numbers could be discussed in terms of the successful spawners produced and the feasibility of accomplishing this with the proposed recovery actions. The following references may

help focus the importance of mature adults in the context of recovery planning, although that is not their main intent. ODFW may have already taken such concepts into consideration in its decision not to place strong, emphasis on pre-spawning mortality as an important population viability factor, but the rationale for doing so is not documented.

The following peer-reviewed references provide examples that might be useful in considering reproductive value.

- Gallucci VF, Taylor IG, Erzini K (2006) Conservation and management of exploited shark populations. Canadian Journal of Fisheries and Aquatic Sciences 63: 931–942.
- MacArthur RH (1960) On the relation between reproductive value and predation. Proceedings of the National Academy of Science 46: 143–145.
- Wallace BP, Heppell SS, Lewison RL, Kelez S, Crowder LB (2008) Impacts of fisheries bycatch on loggerhead turtles worldwide inferred from reproductive value analysis. Journal of Applied Ecology. 45: 1076–1085.

The importance of the above comments and suggestions become apparent when one considers the complexity of biotic systems. The non-linearity of the relationships between recovery actions and population responses appears particularly likely given that both environmental landscapes and anthropogenic influences are dynamic, often synergistic, and will certainly change during the time course suggested for recovery.

Population, Strata, ESU, and Recovery Domain Designations

A fundamental assumption underlying the Plan is that independent populations ascribed to both the upper Willamette and lower Columbia River recovery domains are correctly identified. Population-level viability assessments form the basis for evaluating the viability of every higher level (strata, ESU/DPS, species, domain). Therefore, any error in delineating population boundaries could affect higher-level viability assessments as well as listing and delisting decisions. Given the small number of populations in some strata, one misclassification could change viability determinations at higher levels. How would a different population structure affect the nature and outcome of current status assessments and recovery planning for both the lower Columbia and upper Willamette River recovery domains? It would be useful to explicitly indicate in the Plan the existing life history and genetic data that support the boundary designations of populations, strata, DPSs and ESUs, and recovery domains within both the upper Willamette and lower Columbia River recovery domains. Also, it is not clear exactly how the ‘roll up’ process described in the Plan will integrate the recovery efforts in the lower Columbia and upper Willamette River management units. How confident is ODFW that these recovery plans can be sufficiently integrated to lead to recovery throughout the entire Willamette and lower Columbia River region?

The Plan would also be strengthened if some of the following questions were considered during the roll up process and during future revisions.

- What confidence does ODFW have that the population structure defined in the Plans will facilitate recovery?
- How might low confidence in some of the population boundary determinations affect current status and viability assessments at levels of strata and ESU/DPS?

- Are there alternative population structures with strong biological support? If so, how would the ability to meet viability goals change under these alternate structures?
- Is there any way to incorporate measures of confidence in independent population boundaries, current status, and viability assessments at the strata level?

Timeline for Recovery

It is difficult for IMST to assess the potential effectiveness of the Plan without additional detail on the timeline for both implementation and for expected responses. The Plan is based on a 25 year period, yet does not specify when the 25 year 'count down' will begin. Does it begin when the Plan is adopted, when the first recovery measures are initiated, when the last recovery measure that is to be implemented is initiated? Or, does the 25 year period reflect how long it will take for the necessary recovery measures to be implemented, how long it might take to start seeing if a population level response is as desired, or for full recovery to be achieved? It would be much easier to evaluate the likelihood that the Plan will lead to recovery if the Plan included target initiation and completion dates for various recovery measures and a timeline for the population level responses to recovery measures. For example, including a graph for each ESU that plots hypothesized status against time and also summarizes an implementation timeline for recovery actions would allow readers to visualize the type, timing, and sequence of actions ODFW believes could lead to recovery. The implementation timeline could be represented as the percentage of recovery actions to be implemented over time, possibly weighted by the importance of specific actions to recovery.

Success of the Plan appears contingent upon achievement of the most important recovery measures within some close temporal proximity to one another. If various recovery actions are not implemented as desired or if recovery actions are delayed, then priority recovery actions or information required to prioritize actions may change. Have the models used to explore threat reduction scenarios been run with different temporal scenarios. Given that resources to implement the Plan will likely be limited, determining the most cost-effective measures seems prudent. That is, what would be the population consequences if certain actions took much longer to achieve than others, and which are the most important to implement earlier in the process than others? Without information on such priorities and how ODFW would address such situations (i.e., actual implementation and adaptive management), it is difficult for IMST to judge the biological feasibility of the Plan.

It would also be helpful for assessment of the scientific credibility of the Plan if a discussion were offered that explained the rational for selecting a 25 year period for the Plan. That appears rather short, spanning only five to six life cycles for Chinook. Other recovery and conservation plans that we have reviewed have used much longer time spans. Is there something different about the situation in the upper Willamette River basin compared to the other recovery domains that suggest that a shorter timeframe would be successful or warranted?

Research, Monitoring, and Evaluation and Adaptive Management

With regard to sections on research, monitoring, and evaluation, and adaptive management the comments and recommendations made by IMST during its review of the recovery plans for middle

and lower Columbia River recovery domains still apply. A more thorough description of the adaptive management process and a timeline for the development of an adaptive management plan would strengthen the current document. How will on-the-ground actions be adjusted as new information becomes available? It would be useful if some sense of the process by which adaptive management will occur were included in the Plan.