State, Federal and Tribal Fishery Agencies Joint Technical Staff

Columbia River Inter-Tribal Fish Commission
Idaho Department of Fish and Game
Oregon Department of Fish and Wildlife
US Fish and Wildlife Service

May 22, 2006

Dr. Richard Zabel
NOAA Fisheries
2725 Montlake Blvd E.
Seattle, WA 98112

Dear Dr. Zabel:

We would like to take this opportunity to provide NOAA Fisheries with some of our general concerns regarding the development of NOAA Fisheries' COMPASS model. As the model is further developed and individual components of the model are better understood, additional concerns as well as our long-standing concerns are raised. We are providing the following comments for your consideration in NOAA Fisheries' continuing development of the model. We have attached our previous comments for reference, dated November 4, 2005, January 25, 2006, and February 16, 2006.

We have technical concerns regarding the structure of COMPASS, the data that are being used in COMPASS, and the proposed estimation procedures. Our concerns are that:

- **the COMPASS/SIMPAS/CRiSP dam survival approach does not reflect observed seasonal differences in dam survival,**
- **different scales of resolution for dam passage data, reach survival data, hydrological input data, and model time-steps preclude the integration attempted in COMPASS,**
- **several stages of independent estimation destroy the correlation structure between data sets and overestimate true sample sizes,**
- **the creation of artificial "data" is inappropriate,**
- **there is no weight-of-evidence framework for judging alternative survival hypotheses or alternative models of in-river passage survival, and**
- **the COMPASS approach demands high model complexity without sufficient data to support that complexity.**

The COMPASS/SIMPAS/CRiSP dam survival approach does not reflect observed seasonal differences in dam survival.

The COMPASS, SIMPAS, and CRiSP models all use the same approach for evaluating dam passage survival. They each use estimates of route-specific survival in combination with

estimates of fish guidance efficiency and spillway passage efficiency to calculate overall dam passage survival. The route-specific survival estimates and efficiency estimates are typically derived from telemetry studies and almost always represent season-wide estimates. Changes in survival or efficiency within-season are typically not evaluated. The effects of changes in flow on dam survival are also typically not accounted for, and as a result it is widely known that SIMPAS estimates of dam survival are insensitive to changes in flow (ISAB 2003). The COMPASS model is currently structured to calculate dam survival within-season on a weekly basis.

However, we know of two examples where telemetry studies have estimated dam survival within-season: at Ice Harbor Dam in 2004 with yearling Chinook and at The Dalles Dam in 2004 with yearling Chinook (Eppard et al. 2005, Counihan et al. 2005). Both of the studies demonstrate that dam survival varies within-season (Figures 1-2). For comparison purposes, we calculated SIMPAS estimates for the same time periods evaluated in the two studies using the most recent estimates for the route-specific survivals and efficiencies (Gary Fredricks, April 12, 2006 Data Group spreadsheet). We also plotted the weekly CRiSP estimates that have been used in the COMPASS modeling. It is apparent that both the CRiSP and SIMPAS estimates of dam survival are nearly constant across the season. Using these estimates of within-season dam survival to "back-out" what the corresponding reservoir survival rates were from the PIT-tag survival data will result in substantial bias across the season, especially in the early and late portions of the season (Figures 1 and 2). It is clear that the dam survival approach employed by COMPASS, SIMPAS and CRiSP does not reflect observed seasonal differences in dam survival.

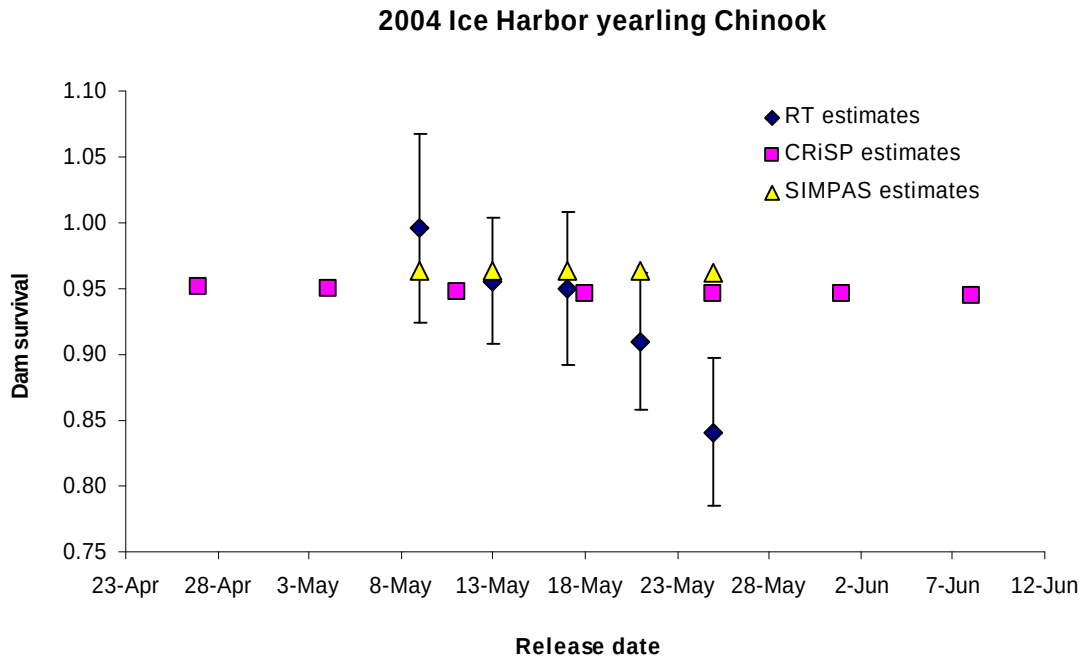


Figure 1. Yearling Chinook dam survival estimates from 2004 at Ice Harbor Dam from Eppard et al. (2005) (four-day blocks, shown with 95% confidence interval), CRiSP estimates (weekly blocks), and SIMPAS estimates for the same four-day blocks as Eppard et al. (2005).

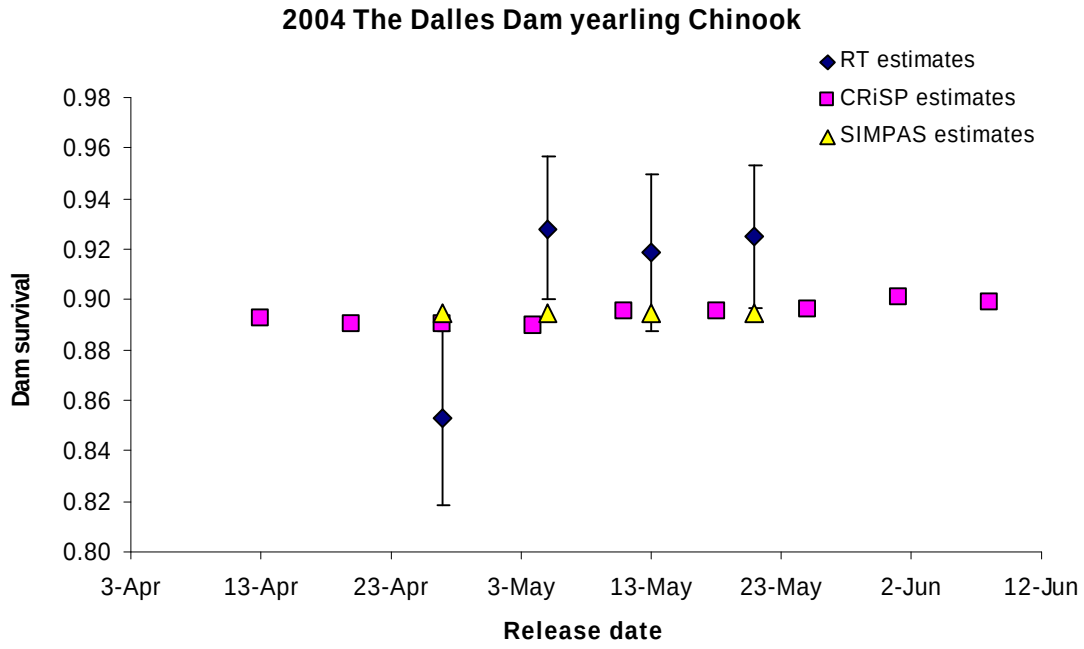


Figure 2. Yearling Chinook dam survival estimates in 2004 at The Dalles Dam from Counihan et al. (2005) (eight-day blocks, shown with 95% confidence intervals), SIMPAS estimates for the same eight-day blocks, and CRiSP estimates (seven-day blocks).

Different scales of resolution for dam passage data, reach survival data, hydrological input data, and model time-steps preclude the integration attempted in COMPASS.

We are concerned about the disparate range of data resolution scales that are being used in COMPASS and the problems that are emerging over their integration. The PIT-tag survival data are calculated using weekly release groups, the dam survival data are season-wide estimates, the HydroSIM flow inputs will be monthly averages, and COMPASS uses a daily time step. As demonstrated above, there are seasonal differences in dam survival that are not being accounted for, biasing the weekly "reservoir" survival estimates. There are also differences in flow within months that will be difficult to properly represent weekly, let alone daily. We believe that the finest scale that the COMPASS approach could be valid is defined by the coarsest scale of resolution for the data that are used in the model, which is the season-wide data on dam survival. Using a finer scale of resolution than the data were collected under overstates the certainty in those data, along with importing potential biases, and we believe that this practice is inappropriate and not scientifically defensible.

Several stages of independent estimation destroy the correlation structure between data sets and overestimate true sample sizes.

There appear to be four independent stages of estimation in COMPASS, each with very different assumptions, and levels of certainty and quality in the data. Because these stages are being treated independently, the covariance structure and errors between the data sets are being lost and/or misallocated.

The first stage of estimation is to use CRiSP or SIMPAS to calculate historical dam survivals. The second stage of estimation divides out the calculated dam survival values from the weekly PIT-tag survival estimates. Because there are relatively few studies on dam survival, most of these reservoir survival estimates utilize assumed dam survivals in years and projects where no studies were conducted. The third stage of estimation is to model the calculated reservoir survivals as function of various environmental variables. Because most of these reservoir survival estimates are rely on assumed dam survivals, the true sample size for investigating these relationships is greatly over-inflated and the data themselves are likely biased. The fourth sequential stage of estimation has been referred to as "calibration," whereby the parameters defining migration rates and variability of the arrival distributions are altered in attempt to match arrival timing distributions.

Although the COMPASS model approach treats these estimation stages independently, the data sets are highly correlated with each other. Errors in dam survival will translate into errors in reservoir survival. Errors in defining the relationship of environmental variables on reservoir survival can translate into errors in passage timing. Independent treatment of the four estimation stages ignores these connections between the data sets.

There are assessment methods available for simultaneously estimating model parameters using different data sources and accounting for the various levels of precision in each, but these have primarily been applied in marine stock assessments (Fournier and Archibald 1982, Methot 1989). To adopt such an approach for developing a passage model would represent a significant change in direction than is currently underway. If implemented this approach could deal with the correlations between data sets along with the processes which generated those data. While this kind of approach would be an improvement to the approach of independent estimation for each of the data sets, it would involve considerable effort to develop and would not ameliorate the need for a simpler passage model.

The creation of artificial "data" is inappropriate.

We object to the practice that has been implemented in COMPASS of generating artificial "data," both for dam survival and reservoir survival. The number of dams with season-wide (let alone within-season) survival studies is very limited. Those studies which have been conducted typically suffer from low precision. Currently the COMPASS model does not reflect these limited quantities of available data, as most reservoir survival "data" are based on SIMPAS-type calculations from year-reach combinations without dam survival studies, let alone weekly dam survival estimates. This practice greatly overstates the true sample sizes as well as overstates the certainty in those data. Furthermore, the precision in the reservoir survival "data" is being dictated solely by the CJS variance estimates, ignoring the imprecision in dam survival. This practice of creating artificial "data" does not seem scientifically defensible and lends itself to creating a false sense of certainty about the strength of the data and the resulting model predictions.

No weight-of-evidence framework for judging alternative survival hypotheses or alternative models of in-river passage survival.

Despite repeated requests for developing a weight-of-evidence framework for judging alternative survival hypotheses or alternative models of in-river passage survival (JTS letter to Chris Toole November 4, 2005, JTS letter to Richard Zabel January 25, 2006), none has been provided. We are reiterating our interest in the formulation of a cohesive framework for judging

the relative performance of alternative survival hypotheses or models of in-river passage survival in terms of explaining observed patterns in the data. We believe there is a need for a decision analytic framework that takes these uncertainties into account when projecting the range of outcomes for potential future management actions. Without such a framework that allows for differences in opinion when the data are questionable, the resulting projections will not account for the true range of potential outcomes.

The COMPASS approach demands high model complexity without sufficient data to support that complexity.

The current formulation of COMPASS is highly complex. It attempts to model within-day changes in dam operations, daily movements of fish, and weekly changes in survival. While it certainly would be desirable to have this capacity, we believe that the data are insufficient for supporting this level of complexity on this fine of scale. There is a fair amount of PIT-tag data that have been collected over the years, but the amount of data on dam survival is very limited. In addition, these dam survival estimates are season-wide and often suffer from low precision. We do not believe that the current formulation of COMPASS realistically reflects the quantity and precision of the data that are available. We are interested in developing a model that better represents the quantity and quality of data that are available, and does not rely so heavily on assumptions.

We hope that you will consider these comments as NOAA Fisheries continues to develop the COMPASS model. At this point, there are some serious technical issues that need to be resolved. We look forward to participating towards that resolution.

Sincerely,

Raymond R. Boyce

Ron Boyce, ODFW

Earl C Weber

Earl Weber, CRITFC

Charles Petrosky, IDFG

Steve Haeseker, PhD, USFWS

ATTACHMENT #1

State, Federal and Tribal Fishery Agencies Joint Technical Staff

Columbia River Inter-Tribal Fish Commission
Idaho Department of Fish and Game
Nez Perce Tribe
Oregon Department of Fish and Wildlife
Shoshone-Bannock Tribes
US Fish and Wildlife Service

November 4, 2005

Dr. Chris Toole
NOAA Fisheries Service
1201 NE Lloyd Blvd
Suite 1100
Portland, OR 97232

Dear Dr. Toole,

At the October 18, 2005 meeting of the Fish Passage Advisory Committee (FPAC), NOAA Fisheries Service provided an update on the effort to construct a revised passage model. We thank NOAA Fisheries for meeting with us and, after reflecting on the discussion that took place, we wanted to express some of our thoughts and concerns on the efforts that have occurred to-date on this topic.

As you recall, a meeting was held by NOAA Fisheries Service on August 10, 2005 to organize other fishery management agencies input into the NOAA Fisheries effort to develop a new passage model. There were several representatives from NOAA Fisheries, as well as agency technical representatives from USFWS, IDFG, ODFW, WDFW, and CRITFC present. At that meeting, NOAA Fisheries staff described their desire to develop a new model to replace the SIMPAS model. NOAA Fisheries staff explained that they were developing this new model in response to the regional criticism of the SIMPAS model. NOAA Fisheries staff requested technical input to their model development from the other fishery agencies' technical staffs.

The context in which this model would be used, and the fundamental question of whether such a model is the appropriate method for making decisions about future management actions, are of serious concern to us. The new model concept outlined to us on August 10 incorporates many of the elements of SIMPAS and CRISP, although both of those models have been extensively criticized and have serious shortcomings in their use in hydrosystem management

decisions. Because the revised version of SIMPAS is arguably more complex than CRISP, and CRISP has been denounced because of its over-complexity (Carpenter et al. 1998), this effort may be misguided. It does not appear to us that the development of revised versions of SIMPAS will overcome the significant issues of model complexity, system complexity, data gaps, and environmental variability, present in both the SIMPAS and CRISP models.

At the meeting on August 10, NOAA Fisheries staff also expressed the various applications they intended to use this model for. The fishery and tribal agencies technical staff voiced strong disagreement as to NOAA's intended uses for the model, as well as the context of their participation in the model development. Some of the technical concerns voiced include**:**

- How this model could integrate with the needs for overall life-cycle analyses;
- The model output is only focused on juvenile fish direct survival, with little analysis of effects of passage routes on adult return rates;
- The model cannot accurately measure incremental changes in system survival related to small operational changes at individual dams;
- Most of the data to be used in the model was collected from studies that were not designed from a life history perspective (i.e., short-term project-specific survival estimates designed to evaluate alternative management actions or passage routes for example often size distribution of fish was limited by tag size, making the marked fish not representative of run-at-large);
- Uncertainty as to how this modeling effort would be integrated with the technical needs and goals identified by the Technical Recovery Teams;
- Uncertainty on how technical disagreements and disputes surrounding the model are to be resolved.

It appears that NOAA Fisheries has already decided major aspects of the model development without the other fishery and tribal agencies' input. The invitation to work on the model did not include agency participation in developing the goals of the analysis, developing the uses for the model, determining whether such a model was the necessary or appropriate approach to take, or defining the management questions that the model could support for NOAA Fisheries. At the FPAC meeting you recognized that the failure to have these sorts of discussions was a shortcoming of the effort to-date. The present approach used to improve the NOAA Fisheries passage model is not our vision of collaboration on the research and management issues that need to be addressed for FCRPS operations relative to salmon recovery. We believe a collaborative approach for addressing the management and research needs for the FCRPS would be a more productive endeavor for the Region to recover salmon populations.

From our perspective, there are several examples of how collaboration can result in effective research and monitoring programs in the Region. The ongoing Comparative Survival Study (CSS) is an excellent example of effective collaboration among USFWS, CRITFC, IDFG, ODFW, and WDFW to study the effectiveness of transportation on spring Chinook and steelhead. The CSS group also organized a formally facilitated workshop to examine the issue of delayed mortality, which we believe resulted in improved understanding of this important factor. A proposal developed in 2005 for conducting a fall Chinook transportation evaluation was a collaborative effort among the USFWS, WDFW, ODFW, IDFG, and CRITFC. However, the

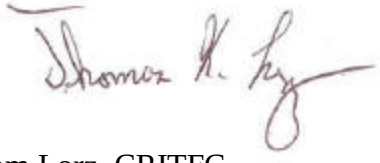
Corps rejected this proposal for funding in FY 2005. Subsequent collaboration between these agencies, the Corps, NOAA Fisheries and BPA is occurring to attempt to develop an experimental design for Snake River Fall Chinook with respect to FCRPS operations that will address many of the parties' management issues. Each of these efforts began with discussions to identify the important management and research questions, followed by discussions on what approach would be most appropriate for addressing these questions.

Our concern is that the present process of system passage model development employed by NOAA Fisheries, combined with the intended application of the model, will only lead to continued disagreement and discord when the model is completed. We strongly recommend that NOAA Fisheries engage the other fishery agencies in a true collaborative effort for the system passage model development that will appropriately address, among other things, the concerns expressed above. We are encouraged with our recent discussions with you and staff and your willingness to work with us to address these issues and encourage further progress along those lines.

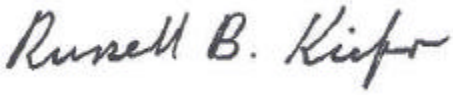
We believe the approach should first identify the critical management questions, and then develop a model to analyze alternative actions or hypothesis. We also believe the juvenile passage model must be linked to a life cycle model to provide a more complete perspective for alternative actions analysis. Specifically, we recommend a formally facilitated workshop process similar to the Comparative Survival Study workshop on delayed mortality be adopted, where a weight-of-evidence approach to developing hypotheses for further testing was employed. The weight-of-evidence approach has been extremely successful when varied views are represented among a group. There may be better approaches for addressing the important research questions than developing another passage model. We hope to provide some suggestions on alternative approaches in our future discussions. We suggest that NOAA Fisheries consider the workshop approach to engage the other co-managers in a more collaborative fashion. We look forward to working with NOAA Fisheries to develop a more meaningful process that will lead to agreed upon alternatives and actions to consider in the analytical process the will better meet our respective needs.

Sincerely,

Ron Boyce, ODFW



Tom Lorz, CRITFC



Russ Kiefer, IDFG

Dave Statler, Nez Perce Tribe

David Wills, USFWS

Keith Kutchins, Shoshone Bannock Tribe

ATTACHMENT #2

State, Federal and Tribal Fishery Agencies Joint Technical Staff

Columbia River Inter-Tribal Fish Commission
Idaho Department of Fish and Game
Oregon Department of Fish and Wildlife
US Fish and Wildlife Service

January 25, 2006

Dr. Richard Zabel
NOAA Fisheries
2725 Montlake Blvd E.
Seattle, WA 98112

Dear Dr. Zabel:

This is in response to your request on January 23, 2006 to review and provide comments to you on the NOAA COMPASS model, prior to 2:00 PM on Wednesday January 25, 2006. Along with the request you provided the COMPASS model manual, and several appendices. We appreciate the opportunity to review the NOAA documents; however the 48-hour review period is too short to allow us to provide a comprehensive set of comments, recommendations and concerns. We are requesting the opportunity to provide additional comments with additional time for review. The following represent our general concerns as a result of the short time frame provided for review. These comments do not represent the full scope and detail of our concerns.

ISAB review
We understand that NOAA has requested an ISAB review of the COMPASS documents. The questions proposed to the ISAB received limited review by the agencies and tribes and additional questions might be posed. The limited review of the questions and the fact that the COMPASS model is not complete and has not been calibrated, suggests that the ISAB review may be premature.

Development of the COMPASS model
Unlike the implication in the background discussion in the COMPASS manual, the model is primarily a product of NOAA. Due to pre-existing and ongoing workload constraints, technical staff of the USFWS, ODFW, CRITFC and IDFG have had limited participation in the development of the model. On November 4, 2005, the Columbia River Intertribal Fish Commission, the Nez Perce Tribe, the Shoshone Bannock Tribe, the Oregon Department of Fish

and Wildlife, the US Fish and Wildlife Service, the Idaho Department of Fish and Game provided some general concerns about the model being developed by NOAA, and that letter is attached for reference. To date we have not received a response to that letter and are unaware of how those concerns are addressed in the version of the COMPASS model provided for our review on January 23. We are again reiterating our concerns described in out November 4, correspondence to NOAA.

Although technical staff of the fish agencies have had limited participation in the model workgroups and have participated in discussions, it is not accurate to represent the agencies and tribes as co-developers of the model. In fact the 48-hour review period provided by this request is the first opportunity the agencies and tribes have had to review the model components, structure, foundation and purpose in a written version. The agencies and tribes intend to provide extensive review comments as the model is developed by NOAA, but at present it is premature to infer that the agencies and tribes are either in agreement or have adopted the NOAA approach and intended use of the model.

Reservoir mortality

We have serious concerns regarding the treatment of reservoir mortality in the COMPASS model. In the Comparative Survival Study workshop, in which NOAA participated with other fishery managers, tribes and researchers, several hypotheses regarding juvenile spring Chinook were considered. These included consideration of flow, spill, travel time, transportation and physiological condition and were based upon research results. These hypotheses do not appear to have been addressed in the reservoir mortality component of the COMPASS model. The data sets utilized to consider reservoir mortality are limited and preclude potential hypothesis testing. The data set utilized is limited to recent years, and do not reflect the time series utilized by the TRT and other analysis that feed into the overall framework analysis.

Latent Mortality

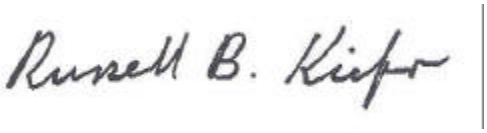
The manual states that latent or delayed mortality will be addressed in a separate module of COMPASS. It is our understanding that a scope of hypotheses has been developed by the delayed mortality work group and was submitted to NOAA. However, it is unclear how these hypotheses will be addressed and incorporated into the model. Therefore the adequacy of the treatment of delayed mortality in the COMPASS model is unknown at this time. The treatment of latent and delayed mortality in this model is of paramount importance, and how alternative hypotheses will carry through to the decision-making process is critical. We are unclear how competing hypotheses will be resolved, but it seems that these uncertainties would need to be resolved using well-designed monitoring programs.

In conclusion, serious concerns and reservations remain regarding the appropriate use of the COMPASS model, the data sets used in the model, the calibration of the model, the treatment of delayed mortality, and the treatment of reservoir mortality. Given these concerns and the fact that the model is not complete and that it has not been calibrated or tested against empirical data, we believe that an ISAB review is premature. We will provide detailed comments when we complete our review. Thank you for this opportunity to provide comments.

Sincerely,

Ron Boyce, ODFW

Bob Heinith, CRITFC



Russ Kiefer, IDFG

Steve Haeseker, PhD, USFWS

ATTACHMENT #3

FISH PASSAGE CENTER

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MEMORANDUM

TO: Ed Bowles, ODFW
Guy Norman, WDFW
Rob Lothrop, CRITFC

FROM: Michele DeHart

DATE: February 16, 2006

RE: COMPASS model discussion

On Monday February 13, 2006 state, federal and tribal staff that attended COMPASS meeting held on February 6, 2006 had a telephone conference call to discuss their impressions, comments concerns regarding the development of the COMPASS model to date. Two letters have been sent from the fish managers describing some concerns about the model and its intended use.

Those are attached for reference. Those participating in the call were:

Charlie Petrosky	IDFG
Kristen Ryding	WDFW
Margaret Filardo	FPC
Steve Haeseker	USFWS
Earl Weber	CRITFC
Rick Kruger	ODFW
Paul Wilson	USFWS

The discussion participants did not arrive at any conclusions, but the discussion was informative and thoughtful. Complete review will not be possible until the model is completed and validated against empirical information. In addition, the specific intended application of the model is not completely clear. The following points are provided for your consideration in future discussions

of the COMPASS model and the intended use of the model in the remand process to determine success in meeting the gap and for in-season passage management.

- The COMPASS model is complex, highly parametized, and requires many parameters and assumptions, much like the previous SIMPASS and CRISP models. The COMPASS model portends to include two additions that were not included in the previous models: delayed mortality and some treatment of variance around input parameters.
- The comments provided by CRITFC in the development of the COMPASS model distill a primary concern regarding the COMPASS model and it's use, expressing that "..caution should be exercised in the planning phase to prevent the development of a model that implies precision the underlying data can't support." This point is illustrated by recent model results for the McNary to Bonneville reach in which predicted model results differed from actual estimates.
- A model as a tool for developing hypotheses about potential fish responses to potential operational changes within a decision analytic framework is useful. However, the COMPASS model appears to be intended to stand alone as the definitive tool to determine in-season management of fish passage measures, specifically flow and spill levels, and to determine which suite of mitigation measures fill the BIOP "gap" determined by NOAA. Whether the available data is adequate to support the complexity of COMPASS for in season decisions for passage management is questionable.
- One fundamental issue is the context in which the COMPASS model output will be used. A decision analytic framework has not been identified. There are several categories of technical information that are generally considered in natural resource management decisions; analysis of risks, analysis of costs/benefits, natural resource modeling, existing monitoring data and stakeholder preferences. The COMPASS model or a simpler model could be used within a multiple criteria decision analysis framework in the modeling category. However, a decision analysis framework is necessary to fully integrate and evaluate these categories of technical information.

The conference call participants have participated in meetings of the model dam passage/data, reservoir mortality/calibration, and latent mortality sub-committees. There was a wide scope of concerns and impressions from the group regarding the development and potential application of the COMPASS model thus far. There was no overall conclusion from the group at this point. Brief descriptions of the points raised in the discussion follow.

Earl Weber described concerns regarding the reservoir mortality component of the model. He has provided Rich Zabel, NOAA with his concerns in writing. Earl provided his written concerns to the group and those are attached. Earl expressed concern that the lower Columbia reach in particular appeared problematic in the model since the predicted survival from the COMPASS model did not match the actual observed survival for the McNary to Bonneville reach. Earl is considering submitting an alternative approach for the reservoir component.

Paul Wilson explained that the latent/delayed mortality component of the COMPASS model is actually separate and has not been brought into the model at this point. The latent mortality group is developing hypothesis that they will submit to NOAA. Their understanding is that the COMPASS model will be able to incorporate various alternative hypotheses regarding delayed mortality.

The group discussed some of the general concerns regarding the model. Specifically that the COMPASS model is highly complex and "data hungry" with various stages of estimation implemented on little actual data. Some of the technical concerns that have been discussed include:

1. There appear to be four independent stages of estimation, each with very different assumptions, and levels of certainty and quality in the data. Additionally, because these stages are being treated independently, the covariance structure and errors between the data sets are being lost and/or misallocated. Presently, the CRiSP model is being used to estimate the historical dam survivals. This first stage of estimation is based on the current parameters utilized by CRiSP, and may not reflect the results of the few studies that have been conducted on dam survival. The second stage of estimation divides out these estimates of dam survival from the observed reach survival rates to arrive at estimates of reservoir survival. Because there are few studies on dam survival, most of these reservoir survival estimates utilize assumed dam survivals in years and projects where no studies were conducted. Because observed dam survivals, as well as survival rates for specific routes, can and have varied considerably across years and within seasons, the assumed dam survival rates at projects in years without studies do not appear to be tenable. The third stage of estimation is to model the estimated reservoir survivals as functions of various environmental variables. Again, because most of these reservoir survival estimates are largely "made up" based on non-tenable estimates of dam survival in non-studied years and within-season periods, the true sample size for investigating these relationships is greatly over inflated. The fourth stage of estimation has been referred to as "calibration," whereby the migration rates and variability of the arrival distributions are manipulated within COMPASS. It is unclear exactly how these manipulations are conducted or what objective functions or data are used to determine fit. Because the covariance structure and errors between the various data sets is broken by the independent treatment of the estimation stages used in COMPASS, it is likely that the relative strengths/weaknesses of the various data sets is not being accounted for properly and estimation errors are being misallocated.
2. As mentioned above, the COMPASS model appears to be creating data that do not exist and treating those data the same as data which have more of an empirical basis. The vast majority of the dam survival studies only report seasonal survival estimates. Therefore the only reservoir survival estimates that could have empirical support would be seasonal estimates of reservoir survival based on the empirical seasonal dam survival estimates and the empirical seasonal reach survival estimates. Empirical within-season dam survival estimates do not exist for the vast majority of the studies that have been conducted, and therefore the within-season reservoir survival estimates based on within-season dam survival estimates lack an empirical basis and are largely "made up." This is especially true for the cases where seasonal dam survival estimates do not even exist for project/year combinations. Subsequent to the creation of these artificial data, the data are all treated the same, regardless of whether there is an empirical basis or not.
3. There is no weight-of-evidence framework for judging the relative strength of evidence for alternative survival hypotheses or alternative models of in-river passage survival. While COMPASS developers have expressed a willingness to incorporate alternative

hypotheses, the process for evaluating the relative strengths of those hypotheses based on available empirical data has not been formally established. Additionally, a process for evaluating the historical predictive performance of COMPASS relative to other candidate models has not been established. Without a weight-of-evidence framework for evaluating alternative hypotheses or models, it will be difficult to assess the level of certainty that should be placed in prospective forecasts based on those alternative hypotheses and/or models.

4. The time steps used in COMPASS (daily time steps) are not supported by either the PIT-tag data or the dam survival data. The temporal resolution for the PIT-tag data used to date is a week. The temporal resolution of the dam survival data is a season. Breaking these data into a finer temporal resolution than that which exists for the available data does not appear to be scientifically valid or justified.
5. The assumption of population mixing at the dams violates the NMFS assertions of size-dependent collection efficiency, as expressed in the NMFS 2004 Effects Memo. In the Effects Memo, NMFS conducted analyses which concluded that small spring-summer Chinook smolts have a greater tendency to be collected than large spring-summer Chinook smolts. If this assertion is true, then the COMPASS and SIMPAS model assumptions of population mixing, whereby the probability of a fish (regardless of its size) experiencing spill, turbine, or collection is only determined by spill passage efficiency and fish guidance efficiency, is violated. That is, smaller fish would have a greater tendency to be collected and transported or bypassed than large fish, and therefore the smaller-sized members of the populations would be more likely to not experience spillway passage due to incomplete mixing at the dams.
6. Contrary to the assertions in the COMPASS manual, the COMPASS model is highly complex. Depending how one counts them, there are 60-80 parameters that require estimates for the COMPASS model to run. With this level of complexity in a highly data-hungry model, it will be difficult to assess which assumptions are being violated or reasons for lack-of-fit to empirical data. This COMPASS exercise does not advance the recommendations for a much simpler model, expressed by many reviewers of the complex models that have historically been used in the Region (Carpenter et al. 1998-PATH Scientific Review Panel Conclusions, and the ISAB review of the All-H Analyzer).
7. The rejection of data based on ad-hoc criteria does not seem to be appropriate. The COMPASS model documentation describes the developers' approach for rejecting data based on the estimated standard error of the estimates. Given that this model is so data-hungry, rejection of any available data does not seem justified. Instead, the estimation approaches utilized should account for the differences in estimate precision. By this, estimates with low precision would not influence the resulting relationships as much as estimates with high precision. Statistical methods for adopting this approach are readily available, and would be preferable to utilizing ad-hoc criteria or thresholds for precision (e.g., inverse-variance weighted regression).
8. The COMPASS model developers propose to adopt only one "best fit" reservoir survival relationship, ignoring model uncertainty. As stated in the COMPASS documentation, preliminary investigations several alternative forms of reservoir survival functions achieved nearly the same level of fit. However, only one representation of the reservoir survival model is proposed to be carried forward. This approach ignores model

uncertainty, whereby alternative models which achieve nearly the same level of fit are ignored. Reporting the results of only one model, when several others are nearly as likely, overstates the certainty in the predictions based on that model. Again, some sort of weight-of-evidence approach is warranted, where the level of evidence for the various alternative models is assessed, and this uncertainty is carried forward in the reporting of prospective forecasts.

9. There appears to be substantial bias in the lower river reservoir survival estimates generated by COMPASS for spring-summer Chinook. The COMPASS documentation has presented graphs depicting the COMPASS estimates of reservoir survival versus "observed" estimates of reservoir survival, and the COMPASS estimates are much greater than the "observed" estimates when the "observed" estimates are low. An important clarification of this information is that the "observed" values are not observed, but simply reservoir survival estimates generated by dividing PIT-tag reach survival estimates by CRiSP estimates of dam survival. Nevertheless, there is a substantial departure between the COMPASS model predictions and the reservoir survival values used in the fitting. Given the high complexity of COMPASS, it is unclear how one could ever resolve the reason for this disparity.
10. It is still unclear how or whether the COMPASS "gap" analyses will be consistent with or use the same assumptions and input data as the Framework analysis assigning proportion of total mortality to the hydrosystem and other Hs. It would seem that there needs to be some level of interaction between these two groups to ensure that the sets of input data that have been considered, the assumptions that have been used, and the approaches that have been taken are all mutually consistent.

Passage Model Design Considerations

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Background

NMFS has formed several collaborative working groups to assist in the development new Biological Opinion for listed Salmon stocks. One of working groups is developing a new passage model to replace a series of models used in the past. To date the effort has focused on the passage survival of Snake River spring/summer Chinook and, although other stocks could be assessed, it is doubtful that will happen in the near future because time constraints. This document examines some biological relationships and lists some precepts that may be useful in the development of the passage model.

Passage model applications

The most immediate use of the passage model under development will be to estimate the increase in survival thought to be possible through various management actions that presumably will be delineated in a forthcoming RPA (Reasonable and Prudent Alternative). Therefore, the group is being asked to develop an analytical tool before knowing what exactly will be analyzed. However, management actions will likely fall into several categories represented in former management proposals, namely flow augmentation, spill augmentation of some sort, and dam breaching. A forth category, temperature modification is usually associated with summer rather than spring migrants. Thus the first precept is that the eventual model should have the capability to address the survival increases associated with flow, spill, dam breaching and temperature management, if need be.

Note that the estimated survival increases will be used to determine the degree to which the management actions associate with the RPA will fill the "gap" identified within the "framework" working group. Note also that the passage model will address only direct survival increases and delayed mortality associated with transportation and expressed as the "D" statistic. The model will not estimate any potential reductions in "latent mortality" experienced by fish migrating inriver as identified by the post Bonneville mortality working group. Substantial levels of mortality attributable to the hydro system have been identified by several authors (Deriso et al 2001; Schaller et al. 1999; FPC/CSS 2004). Although passage models traditionally have not addressed reductions in latent mortality, previous modeling efforts assumed reductions in latent mortality proportionate to the estimated reductions in direct mainstem mortality estimates.

Data sources and limitations

The development of the passage model is employing mainstem survival data estimated on a weekly basis from PIT tags, for years 1998 through 2005. The data set that has been developed separates the mainstem into two reaches, Lower Granite Dam to McNary Dam, and McNary Dam to Bonneville Dam. However, because there are too few fish surviving through the entire

reach, estimates in the lower reach include fish from the Upper Columbia River that have joined their Snake River counterparts in McNary Pool.

Flow data originate with the U. S. Army Corps of Engineers. Rather than use flow directly, however, this approach uses estimated water travel time for several reasons:

1. Using flow to explain variability in system survival is complicated because there are two flows, one in the Snake and one in the Columbia River, and they are not highly correlated. Using water travel time eliminates this problem.
2. The underlying assumption behind this approach is that fish survival depends on travel time (duration) rather than flow per se.
3. Water travel time (and velocity) depend on the reservoir volume, not just the flow, because of differences in cross sectional area.
4. Alternative variables, such as flow or mortality per mile, do not comport with changes in survival following impoundment or, what changes in survival would be expected following breaching.

Water travel times are estimated using the replacement method (the time require for a given inflow to fill a given reservoir) and thus should be viewed as an indices rather that empirical estimates.

Also, fish travel time could be used instead of water travel time but that would add another layer of complexity against the wishes of previous reviewers who have argued for less complexity. Also, because water travel time is readily converted from flow data, the 60 year flow record can be used to provide a probability distribution of water travel times that can be used to represent long term annual environment variability, as proposed herein, for stochastic simulations. The relationship between weekly estimates of water travel time and fish travel time are shown in Figure I.

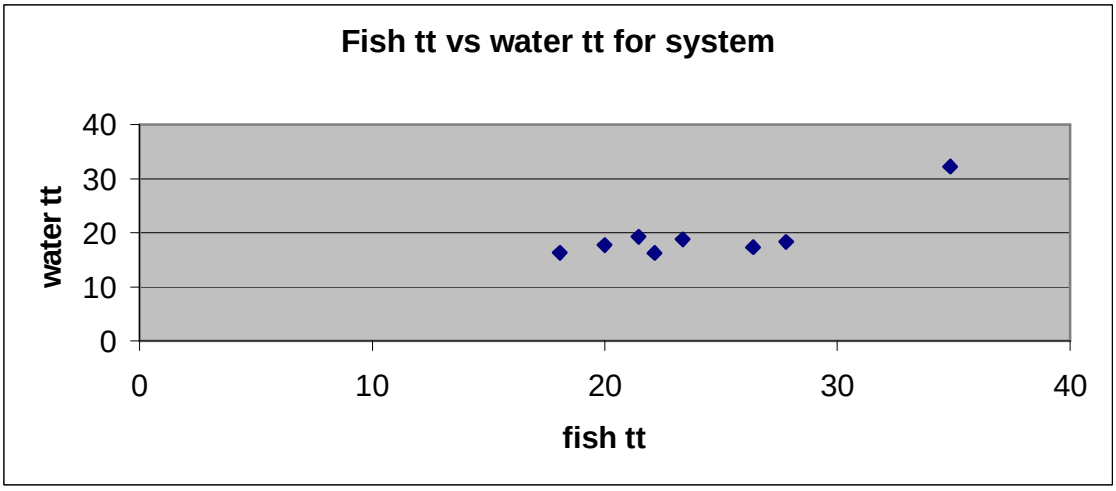

Figure 1. Relation of fish travel time and water travel time for the hydrosystem.
Annual estimates of both water travel time and fish travel time were estimated by weighting weekly estimates by the number of fish tagged during that week.

[Reservoir volumes are provided by the U. S. Army Corps of Engineers. The 60-year record of flows at all projects is available through Bonneville Power Administration and the Northwest Power and Conservation Council.]

Reservoir survival

Passage models, now and in the past, typically estimate the mortality associated with each dam as a preliminary step. Then, given an estimate of system survival, the dam survival is backed out leaving an estimate of system (total) reservoir survival. Water travel time may also be used to allocate reservoir survival among the reservoirs. [This allocation is necessary to simulate transport operations in which inter-dam mortality affects the number of fish collected.]

Weekly estimates of survival, water travel time and temperature were each weighted by the number of fish tagged during the week to provide annual estimates. The relationship between survival and water travel time is shown in Figure 2.

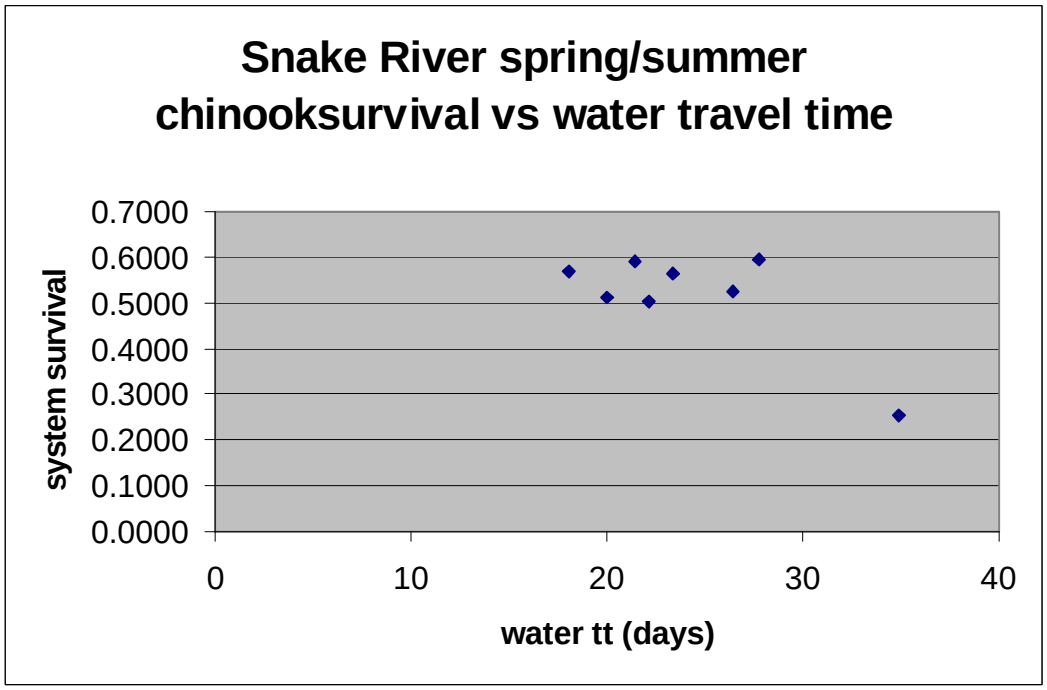

Figure 2. Relationship between mainstem survival and water travel time for Snake River spring/summer Chinook for years 1998 through 2005.

The eventual relationship will be influenced by the 2001 migration year (lower right). This relationship indicates that in years of poor flow (high water travel times) fish survive at relatively low levels.

The relationship between survival and temperature is shown in Figure 3.

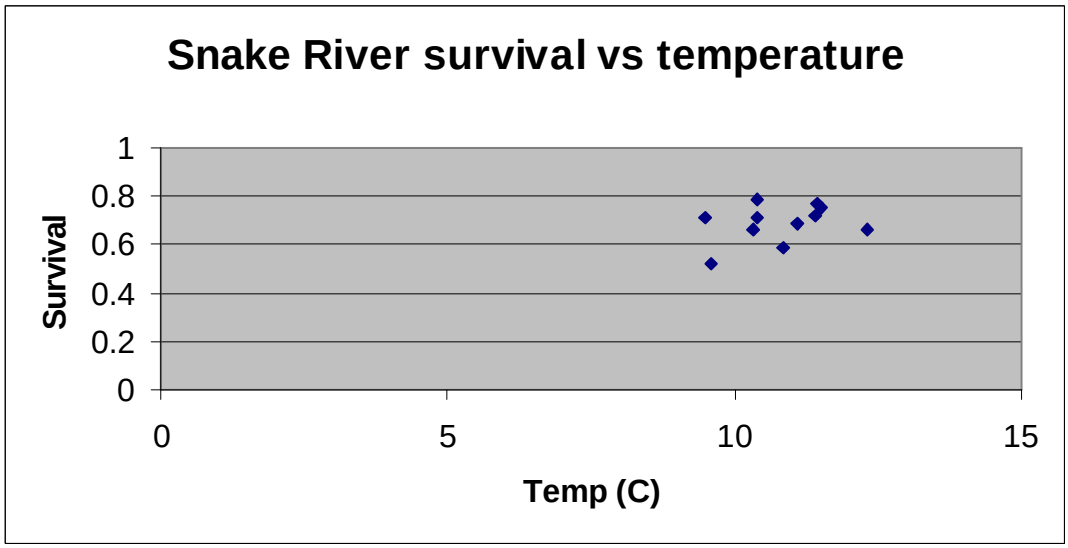

Figure 3. Relationship between survival and temperature for Snake River spring/summer Chinook, for years 1998 through 2005.

Unlike the relationship with flow, temperature effects appear to be more random in nature. This result was not unexpected because temperature appears to be an environmental cue for the fish that vary their migration timing to fit the temperature window. Because of the apparent lack of predictive value, and because temperature modification is unlikely to be proposed as a management action for spring migrants, it is tentatively proposed that temperature not be used as a model variable.

Note that spill is assumed to affect dam survival rather than reservoir survival. Thus in prospective simulations, spill actions, including the effects of Removable Spillway Weirs if they are part of the RPA, would result in an increase in dam, not reservoir survival. If spill actions, or any other actions such as dam breaching, seem likely to reduce latent mortality, such reductions can be simulated as described previously.

Discussion

The considerations discussed herein are intended to guide passage model development and are not intended as a proposed model at this point. This approach, or any other, should be considered tentative until its specific uses are identified. This approach is aimed at guiding the development of a fairly uncomplicated simulation tool for assessing the potential survival increases associated with management actions that are likely to be proposed. While more complex models can certainly be developed, their use may not be justified, particularly in light of past review comments urging simplicity. For example, temperature may affect fish behavior and survival in a manner that is too complex for a model in which temperature management actions, such as cold-

water releases, are not anticipated. See attached McCann document for a discussion on temperature and fish survival.

Model complexity, in a broader sense, may be severely constrained simply due to data limitations. The data set for dam passage is incomplete and what data are available have been collected under a narrow range of conditions. This affects model accuracy because reservoir survival is the residual after the assumed dam effects have been backed out. In short, because data are not available for all dams, during all years, under all conditions, even partitioning dam survival from reservoir survival should not be assumed to be highly accurate.

Inriver survival estimates are problematic also. As noted previously, inriver survival estimates for Snake River spring/summer Chinook include Chinook from Columbia River stocks in the lower reach because of low sample sizes and poor survival. For three years, 1995 through 1998, no estimates at all are available for the lower reach even though estimates in the upper reach are. In all years data in the lower reach require more aggregation so that fewer blocks exist relative to the upper (Snake River) reach.

For these reasons, caution should be exercised during the planning phase to prevent the development of a model that implies precision the underlying data can't support. Some members of the working group have suggested a time step of one day or less. This would seem to be unrealistic given that the data set in use is arranged in weekly tag release groups and those are frequently aggregated into larger time steps to provide adequate sample sizes. For example, there is currently interest in limiting transportation to only that part of the migration season where a benefit is likely. However, the only preliminary assessment to determine when transport should begin uses data from quartiles not weeks or days.

Thus the argument can be made that assessments of this sort should be conducted with conventional spreadsheets and statistical programs and reserving passage models as fairly straightforward simulation tools. If a large, complex model that few can use or even understand is developed, there is a very real risk of repeating past mistakes and developing a black box that divides the region on important passage issues instead of uniting it.