

SEI Science Panel on Columbia River

Minutes of First meeting, March 17-18 2001

Day 1

Courtney welcomed the panelists, presenters and audience members, and invited the group to introduce themselves. After introductions, *Brosnan* described the work of SEI, and the use of panels to examine technical issues. Panel members can help in evaluating scientific information, and may provide useful review of technical data. Action and regulatory agencies are charged with identifying the 'best available science', and using this to make their decisions. It is not the purpose of this panel to make any decisions, or to advise or otherwise influence the agencies making decisions. Panelists will comment on and review technical materials and discussions. The different agencies may find these reviews helpful in their ongoing discussions and consultation processes.

Courtney emphasized that the process would, as a scientific review procedure, attempt to understand the uncertainties associated with different information or issues. If it is possible to identify the predicted effects of an action, that will be useful. However, if it is not possible to unequivocally determine such effects, then it will be important to identify the probabilities of different outcomes and the risks associated with these outcomes. Panelists should strive for a full understanding of the science, and will be asked to provide their impartial individual opinions and reviews, and to indicate whether scientific results are well-founded, use appropriate methods, and reach reasonable conclusions.

The process will focus solely on salmonid-related issues. The proposed deepening of the Columbia River will affect many other species and raise other concerns. However, this panel is focused solely on the processes and functions that will have direct or indirect effects on salmonids, particularly those currently, or expected to be, listed under the Endangered Species Act (ESA).

The different agencies will be involved in consultation activities during the period of these panel meetings. It is not the purpose of these meetings to attempt to make decisions in the consultation process. These meetings will focus solely on impartial evaluation of scientific materials. These evaluations and reviews may be taken into consideration by the various agencies; however they will be making separate and independent decisions and evaluations.

Courtney: During the meetings, there will be formal presentations on different topics, followed by questions and discussion. Panel members are encouraged to question presenters, and to identify questions needing clarification. However, we ask that audience members hold their questions and comments to the Q&A periods. We also emphasize that this is a scientific process. We should avoid discussion of policy, politics, economics or other issues involved in decision-making. Those may or may not be valid concerns; however, they are not relevant to a scientific discussion of the technical issues. Panelists, presenters, audience members or others wanting to comment on non-scientific issues are encouraged to make their comments, but to do so in the appropriate forum. These meetings are purely scientific, and we will try to keep discussion focused on technical matters only. If audience members wish to discuss scientific issues they are encouraged to make their comments at the appropriate points in the discussion, or to see SEI staff to ensure that opportunities are provided for such presentations.

Courtney then went on to outline the issues that have been identified as important to the different agencies. These focus primarily on salmonid biology, including behavior and habitat modification; changes in estuary conditions, most notably of salinity intrusion and other physical processes; redistribution of sediments, especially those with toxic components; monitoring and mitigation strategies. Each major area of concern will be dealt with in a separate workshop. The purpose of this initial workshop is to provide an overall background and context for the more detailed discussions to be held in subsequent meetings.

Presentation by *Tortorici*
The Consultation Process

Presentation by *Tortorici and Young*
The Art and Science of the Endangered Species Act

Presentation by *Eriksen*
Proposed Activities

Cody questioned why the mitigation strategies had been proposed. Discussion focused on proposed activities that would create wetlands, and modify and improve existing conditions. “Mitigation measures proposed are primarily aimed at benefits to waterfowl. Although measures could be developed to benefit salmon, these have not yet been proposed. In fact the mitigation steps identified have been designed to intentionally exclude salmon. Mitigation could include salmon. For instance at Shilapoo, where wetland enhancement is proposed, and where a series of refuges on both sides of the river could be enhanced. Mitigation measures are scoped and agreed upon between action and resource agencies.”

Dunne asked about ESA concerns for salmon. *Eriksen* explained that previous consultation had included a workshop on salinity, which was, at the time, the biggest concern about the estuary. “These concerns were addressed during the first year and a half of the project. Some of the other issues involved salmon, including entrainment. Salmon was an issue, but the main focus was on the whole environment of the estuary.”

Boesch focused on issues raised in the Biological Opinion (BO). One was the new information that we will discuss and evaluate later. But other issues included a monitoring program, and participation in a comprehensive restoration plan. “What were the Corps’ positions on these, and where will the Corps go now?” *Eriksen* agreed that there were two requested items in the BO: a monitoring program and a restoration program. “The monitoring program, which would have monitored the impacts of the project, was discussed by NMFS and Corps, but no agreement was reached on the scope, so no action was taken. Restoration (4,500 acres) would have been carried out under another authority. CORPS has begun a reconnaissance study for ecosystem restoration in the estuary, which could lead to the 4,500 acres of restoration. But that study needed authorization [which happened October 1].”

Dunne raised the question of how ecological costs and benefits were quantified. *Eriksen* explained that project costs were calculated, but no monetary value was assigned to benefits. “Mitigation is an offset of impacts, so it is not shown as a monetary benefit. Project impacts were assessed in terms of their impact on habitat and species, particularly on ducks and other waterfowl. Mitigation is a one-to-one or better replacement of lost habitat. Mitigation should be focused on habitat for those species whose habitat is modified by the proposed action. Wetlands

that are important for salmon would be avoided in a mitigation plan, so as not to adversely affect them. It would not be possible to turn agricultural wetlands into juvenile salmon habitat.”

Curtis asked how salmon habitat was identified during site selection for dredge disposal. *Eriksen* explained that most disposal sites will not affect salmon in any way. “Upland sites will have no impact. In-water disposal is mostly at 50 feet or deeper, in areas where salmon do not occur. So on the disposal site issue, salmonid habitat was not a difficult problem. Previous studies have shown how salmonids use the navigation channel and the river-- so we picked sites that were deeper than where fish were, or in the middle of the channel, where they don’t migrate.”

Presentation by *Weitkamp*
State of the estuary

Cody asked for clarification on the Evolutionarily Significant Unit (ESU) as used in the ESA. *Weitkamp* explained that ESU is defined on a population/seasonal stock basis, and may or may not reflect actual observed genetic differences among stocks. Only ESUs that are listed under the ESA are considered under the consultation process.

Curtis asked for more information on transit times for ocean bound fish, and of the relative importance and behavior of wild and hatchery fish. *Weitkamp* explained that both hatchery and wild fish were important in ESUs, and that the relative importance varies tremendously with origin and stock. “The data for the Columbia River (CR) are not extensive, and the data on juvenile salmon are not great, compared to other estuaries. We have to take the data we have from the CR and other systems to try and interpret what is happening. Young fish are present in the estuary year round, and we have fairly good information on what stocks are present when, but we have very few data on how long individual fish are staying in the estuary. Growth has been studied a little, but data from other estuaries are better. A lot of data have been collected, but there are few publications.”

Quinn discussed the huge data sets generated by coded-wire, and more recently PIT-tagging of hatchery and wild fish, and queried whether there were efforts to sample these in the estuary, thus giving at least minimum period of time spent there. *Weitkamp* confirmed that there has been a trawl and beach seine effort in recent years, so that some data are available. *Weitkamp* and *Casillas* agreed that a rearing fish may be in the estuary from a few days to 2 to 6 weeks, depending on the stock.

There was discussion about the amount of habitat that has been lost historically, with figures of 30-50,000 acres being identified as the typical estimate, although some larger estimates of up to 400,000 acres have been suggested. This estimate needs to be clarified and the likely figure identified.

Quinn, *Boesch*, *Eriksen*, and *Weitkamp* discussed sediment loads, with estimates of a million metric tons per year being reasonable. Much of this material is moving along the bottom, with waves in the bedform that are indicative of a dynamic system. There has been a large reduction in sediment load since dam building, due to changes in flow. *Cody* queried how annual variation in rainfall affected this; it was confirmed that annual rainfall does have dramatic effects (e.g., 1996 very high, 2001 very low).

Dunne queried the basis for concerns over salinity intrusion, and asked for information on how any change in salinity would affect organisms of importance. This discussion was deferred till later.

Presentation by *Young*
Coastal Cutthroat Trout

Cody asked for clarification on when this species might be listed. *Young* explained the moratorium currently in place. Since the species is not formally listed, a process parallel to consultation, ‘conferencing’ will be carried out. However all agencies have agreed that the species will be treated as if it were listed in terms of protection. Note that there have also been some (not recent) records of bull trout in the area.

McAdory asked for information on fish movement – do they move out in spring, and back in summer? Is this correlated with the hydrograph of the river? *Young* stated that the fish will be moving on the ascending limit, with out-migrations, and that they probably remain on the descending limit. The fish are not being flushed through the system. *Young* speculated that as fully functional, almost adults, the fish are able to work their own way through the system.

Goldman asked for clarification on whether hatchery fish might be working against the survival of the wild stocks. *Young* confirmed this was a possibility, and the cause of argument for this and other species in CR. “When you start looking at coastal cutthroat trout throughout its range, we’ve got an almost across the board – where we’ve got sea-run fish in the lower 48 at least – a very small sea-run component coming back that’s a native component. Some people speculate that you might have enough on an annual basis of the resident fish turning into a sea-run component. You don’t have truly a sea-run component reproducing. We’re getting some level of annual contribution, and this is speculation. There’s very little research going on with this species right now.”

Larson asked how USFWS is assessing the population level in the lower Columbia River. “How do you know whether this species is actually in trouble or not? On the upflow, for instance, it has the dam where we can count them. It appears that there’s no place that the fish are counted. So why are they proposed for listing?” *Young* stated that there have been major reductions in sport angling catch and return to hatchery. There have been specific areas where it’s being measured outside those hatchery systems through fish traps. There were two or three reasons that stand out with the proposed listing. Major changes in the resident spawning area habitat, changes in the estuarine area, strong changes in abundance that were being reported by the Oregon and Washington departments of Fish and Wildlife. There appears to be significant decline in abundance superimposed with significant changes in their habitat.

Curtis queried whether people have looked at ocean conditions and the success of that form of the cutthroat. *Young* emphasized the fragmentary nature of the data that have been collected opportunistically. *Bottom* indicated that much of the ocean information on salmonids is based on correlations and on major shifts in regime. “So it implies that you have a pretty long data set to draw those conclusions. And with the other salmonids we have ocean fisheries to provide some of those long-term data sets whereas with cutthroat we don’t have that kind of long-term data from commercial fisheries.” *Curtis* wondered whether, for a species that spends so little time in the ocean, river data alone could provide a correlation with previous ocean conditions. *Young* described the current data mining exercise with staff from Parametrix. Data were often collected at different sites in different years, and using different gear, so that it is difficult to identify any trends. *Quinn* emphasized that, as a fish biologist, he would be very uncomfortable if anyone tried to go far with these data. *Young* described the current phase of the cutthroat work, which includes completing as many phone interviews as possible with scientists who used to work on this species, or incidentally handled this species. “We’ll have the white paper together in no more

than a couple of months. We would certainly like to get out as much information as possible before our next issues meeting, so that we can try superimposing our limited knowledge of the baseline on potential effects from that issue.”

Casillas asked whether there was a determination yet on the various habitats that most cutthroat go through in terms of importance to their life history. *Young* indicated that, based on a cursory look at what little is available, there are records from January through December. The river seems to be much more periodic where there’s an early season downstream migration and a later summer upstream migration. And the ocean component is perhaps 3 or 4 months. “So it seems like the estuary is our big question mark. The data collection methods – you’ve got beach seines, purse seines, trolls – are the three main sampling techniques. A lot of them are in shallow-water areas where you can pull them, so they’re not in complex habitat where you might find more fish. It was not set up to answer the kind of questions we’re asking about it right now. So in the consultation process, considering the baseline for the proposed action, we are faced with a species with a lot of uncertainty. We know that mostly juveniles and some adults might be in the estuary year round. We know that juveniles have a high percentage of invertebrate as far as their food habit. How does salinity affect the availability of food? USFWS is going to be probably asking less specific questions than say maybe NMFS can, because we don’t have as much information on what the fish eat and when.” *Courtney* emphasized that part of what we’re doing here is laying out the uncertainties, and that *Young* was indicating that, in the BA process for cutthroat, USFWS would have to deal with uncertainties.

Presentation by *Bottom*
New information on CR estuary

Dunne and Quinn queried whether changes from historical flow to present (18,000 cubic meters per second) might be beneficial to fish, due to reduced flows in spring. *Bottom* indicated this was a possibility, but also that if flows were brought back to higher levels, with the loss of habitat, the system would not now accommodate fish so well. “One of the problems with the model is that we were unable to characterize the areas that are now diked. We didn’t have the historic data to be able to do that. So some of this might be explained if that diked area were incorporated historically -- there might have been more water spread out. It could be shallow-water habitat today since there’s been an increase in that. If you look at the change in habitat opportunity, what you’re immediately struck by, at least in terms of shallow-water habitat, is that we have not only a quantitative change, but a qualitative change as well, in how it’s distributed throughout the system.” *Larson* asked if there were any qualitative value on habitat other than velocity and depth criteria. *Bottom* replied that, “We don’t know how that’s changed since 1880. The only thing that we can look at in the change qualitatively is these physical measures, which are very gross measures. This is just based on something we think we can describe and the only way we can even describe this is through a modeling exercise because the data simply aren’t there.”

Cody and Quinn asked about the effect of topography. Simplistically, if the river were just a perfect V shape, and you have particular criterion per depth as it went up and down, would it make any difference, or would it just be sliding up and down the scale? *Boesch* argued that, “You’d have some sort of interaction between these two criteria, too, because in the more recent, contemporary situation you have more shallow water and that would affect the velocity.” *Bottom* agreed. “NMFS attempted to model this interaction, but it proved impossible because of the sensitivity to underlying assumptions. This just shows that for depth criteria in most areas we saw more habitat now than we’ve had historically. But there are still many uncertainties.”

Dunne asked what happens if you combine the discharges with the flood duration. You calculate not the opportunity to control for discharge, but the total opportunity through the year as the hydrograph rises and falls. *Bottom* stated that this would be nice to do, and that NMFS did this for May – July because of computation costs. Opportunity could be calculated in terms of area (grid cells) and hours per month of flow. *Cody* asked if we could then calculate carrying capacity of fish from the number of hours of opportunity and the number of cells. *Bottom* argued not for carrying capacity, but stated that, “The temporal movement of fish through that system at different times is probably much more important than a static measure of how many fish you can put in the estuary. All we’re doing is trying to provide relative indicators of how sensitive the system is, and how it might’ve changed. Rather than calculate the number of fish here, we’re trying to say that, based on these criteria, which are the most objective criteria we could come up with without having other data, how does the estuary behave differently now, in terms of potential habitat the fish might be able to access, how does it differ now compared to how it did historically? And how sensitive is the model to changes first in bathymetry and how sensitive is the model to behavior in terms of changes in flow? Since both of those things interact, we can’t totally separate them. We’ve tried to separate them somewhat in our modeling context by the types of runs we did. We did some runs where we used the old bathymetry and today’s flows, we used some where we used the old bathymetry and the old flows, and vice versa.”

Cody queried whether the difference, mainly a factor between 2 and 5, better now than in 1880, is because of a combination of the differences in flows and the differences in bathymetry. *Bottom* agreed but cautioned against making too much of this because there are some other factors that may be equally or more important in terms of habitat opportunity than what the model shows. “Because this is representing primarily habitat within the model boundaries, which do not include any of the tideland areas that have been lost. We’ve lost a lot – almost a quarter of the area of the estuary and 12-15 percent of tidal lands.” *Simenstad* confirmed that all of the tidal swamp and a good portion of the highland marsh is not included in the historic model calculations. Also those are absolute numbers in terms of opportunity. “If you’re a fish moving through the system, if you have inappropriate depth or velocity, it doesn’t mean you can access all the appropriate depth and velocity. So that’s another thing that’s not in the model.” *Bottom* reiterated that the model is fairly simplistic. “If salmon are actually moving through the system and accessing a sequence of habitats as they move through it, then the sequence is going to be as important as just the total amount of habitat, and that’s not captured in the model.”

Dunne pointed out that fish in the system now appear to be bigger – is that good or bad? *Bottom* replied that we may have confined the number of different types of life histories moving through the system. “We’ve got relatively large fish coming through the estuary and we know that the larger fish generally don’t go into these shallow-water habitats, and they’re the ones that are least likely to want to stay in the estuary.” *Quinn* then questioned whether there was a substantive residence period. *Bottom* confirmed that, “We don’t see a lot of the ocean-type fish in the estuary. We don’t see that influx of those small fish coming down as fry, and fish that come in as fry might stay for a couple of months.” *Quinn*: “That could be because we’ve degraded the spawning habitat. We’re only getting hatchery fish coming out of those rivers. That’s why you don’t get any real small ones; any ones that were produced farther up have gotten a little bit bigger before they got down. And if the wild ones are produced now predominantly a little bit farther up, they’d be bigger by the time they got there.”

Bottom discussed residency times again. “Most of the data are based on tag groups. And most of those tag groups are either yearling fish or they’re larger fin sub-yearlings. And those fish do not want to stay in the estuary. And that’s mostly what we see when we sample and compare at that one site the distribution of those fish with what Willis Rich saw at that one site (in 1914). All I’m

saying is that at that one site where we have data, we had fish that were doing more things than they're doing now. The other part of this story is that there has been virtually no sampling in these peripheral marshes. First of all, we lost a lot of habitat and where we have it, people haven't sampled. So we don't have data from there and neither did Willis Rich when he described this. On the basis of that one area, there is evidence at least that we have perhaps lost a lot of diversity in the system and part of that could be a reflection of lost habitat up river where we've lost those sub-yearly types. We know, for example, there used to be summer and spring zero-aged migrants up in some of the upper tributaries. We think we've lost most of that because the rivers are too warm to support them, so they're not there anymore. We probably have some other zeros that have been lost further down river, so a lot of those have been lost, either through hatchery effects, or harvest effects, or through habitat loss. And then we know our rearing programs are based on feeding fish to larger sizes before we release them, so it forces them into this kind of mode. One interpretation would be that we now have a primarily hatchery run system. The portion of wild fish in the system is very much smaller than it was historically. Those hatchery fish are fed to larger sizes, and they don't want to go into these off-channel rearing areas, possibly. They may be in there; we haven't sampled there."

Dunne: "Earlier, your model said that the diking of the system has reduced the amount of habitat. What's the relevance of that if you still have plenty of habitat around?"

Bottom: "What we've described is a situation where we cannot discount the possibility that, as modified as this estuary is, as much habitat as we've lost -- and we've lost a lot -- we can't discount the possibility that the fish aren't even using what's there now because of the modifications elsewhere. So, we can say that it will be necessary to restore that habitat if we want those life histories to express themselves to some level comparable to what they did historically. But it may not be sufficient because of everything that is going on here. What that says is that when you're talking about estuary restoration, it's important and it may be real important to know which habitats are probably most important to concentrate on, but if you're going to get the full benefit out of that, you're also going to have to think about changing some other things in that system to make it worthwhile."

Curtis questioned whether historical stocks were still present to allow recovery. *Bottom* confirmed that many are not. "Oregon Trout did an analysis of that very thing, and they came up with something on the order of a couple hundred different individual populations that are gone. We don't know what kind of diversity in those life histories actually existed; we don't know whether they were very different from one another. We just know from those individual streams that they're not there anymore."

Cody clarified that the populations that are represented in Rich's data by "fry 1" and "fry 2" may no longer exist because the river is completely demolished. "And that's why you're not picking them up now in the contemporary data." *Bottom* confirmed this as a possibility - it could be what's been lost in the estuary, or it may simply be what's been lost up river, or a combination of the two.

Boesch: "But you also don't know if you took care of things up river whether the estuary conditions are sufficient."

Bottom: "That is correct."

Cody: "So that doesn't mean ... work on the other part of the river?"

Bottom: I hope it doesn't mean that because that's what we've spent our whole lives doing. Where is the bottleneck? What I'm saying is that is not the correct question. The real question is how do we create the sequences of habitat that will allow for a whole variety of different life histories to express themselves? You can't do one without the other."

Dunne: "But that's 'bottomless logic.' If you just keep fixing parts of the system in the hopes that eventually you've fixed it all..."

Bottom: "Obviously, you've got to set priorities and use best judgment where you do it. What we're saying is there are some things we can do that we think are important, and yes, those are the peripheral areas that have been so heavily lost. What we're cautioning is that we have a hatchery program pumping out millions of fish that may not want to use any of that habitat. And if you're interested in restoring the estuary, then you need to give some thought to that."

Tortorici: "The All-H plan addresses the entire basin and how we need to achieve recovery. How we're going to deal with harvest, hatcheries, hydro, and habitat with relation to recovery of salmon. It's not that we're tunneled in on the estuary, it's just that through the work we've done with modeling and from a scientific perspective, we recognize that the estuary is significant from the standpoint of survival of these species."

Goldman: "Earlier on you indicated that the shallow-water availability is greater now than it used to be. Could this be a negative since it exposes smolts to greater predation?"

Bottom: "It's possible. Without knowing how different types of shallow-water habitat operate... or one of the things I haven't talked about is, that as a result of losing that interaction with the floodplain, is probably the loss of input of large wood, which would provide some cover for fish. We know that a lot of our estuaries used to be choked with wood, and very few of them have a lot of wood today. We don't, however, have much information at all on the function of wood in an estuarine situation. We have it in freshwater in great amounts. I suspect that it may provide some of the same functions, but it would vary a lot because of the tidal effects. So its location is probably going to be critical to whether it is successful or not."

Boesch queried what in this study caused NMFS to withdraw its BO. *Tortorici* stated that it was the information that was provided in this report regarding flow and bathymetry and how that changes shallow-water peripheral habitats. "We're finding increasingly that this kind of habitat is more and more important to salmon. So NMFS felt that was a significant enough piece of information that was unavailable at the time of writing the BO, and NMFS needed to take a closer look at it." *Boesch* argued that this study suggests that with the change in bathymetry through a dredging activity it would affect the habitat quality in the shallow areas in which the small fish are resident. *Tortorici* stated it was quality and quantity of habitat. *Casillas* emphasized that there are other ways of looking at habitat opportunity within a system; not just looking solely at salinity intrusion. "The question becomes - is salinity intrusion a reasonable service for all the other features that we know salmon may key in on? NMFS staff don't think that's true."

Discussion then focused on whether changing bathymetry will reduce the opportunity to experience less than 0.3 meters/second flow velocity over the habitat. *Bottom* replied that it was clear to NMFS that bathymetry was an important factor, actually much more important in identifying availability of habitat relative to flow. "So of those two factors that looked at, bathymetry was actually the primary feature that dictated the availability of habitat. So NMFS needs to look at bathymetry more carefully and evaluate it in the context of this project."

Goldman asked whether terrestrial food was important in the system. *Simenstad* stated that food is coming from both endogenous and exogenous resources. *Bottom* stated that we're seeing a much greater use of insects than what historically had been thought of. These marsh habitats are a very rich food source particularly for the smaller fish before they moved on down into more brackish conditions and start eating arthropods.

Goldman asked whether, since the diversity of this population to some degree probably depends upon these different populations that are genetically separate, there has been much DNA work on separating them out and identifying them. *Quinn* replied that the main ESUs are distinguishable. "In part, the reason for lumping salmon populations that spawn in different rivers is that they share some general life-history traits and seem to have some common lineages as inferred from the genetics. It doesn't mean that they're not presently different and reproductively largely isolated, but they share enough of a lineage and enough of a suite of life-history traits that they're classified together. So that's why you have many more spawning populations than you have ESU's."

Goldman asked whether one of the problems that has been attributed to hatcheries is the destruction of this separation. *Quinn* replied that populations have been transferred back and forth for decades so to the extent that that's been associated with hatcheries, it will have altered population differences.

Cody: "Is the population that was represented by "fry" in Rich's data possibly still represented as an ESU by your sub-yearly or adfluvial populations in the contemporary study? Are those old fry populations of Rich's gone, or are they represented just by different sizes or ages in contemporary studies?"

Bottom: "There are some fry migrants, no doubt, from say the 0-aged chinook that might come down from the Hanford Reach. Some of the fry may have come from spring and summer populations upriver. Just because the populations are so low and the river conditions may have supported 0-aged migrants mostly we think of those as yearly migrants, but there's evidence that there used to be sub-yearly types -- a lot of those have probably been lost."

Boesch: "You were saying you don't have anything that replicates the Rich data in contemporary information. All the sampling that's been done down in the estuary over the years, there's lots of information."

Bottom: "There has been no consistent sampling to look at salmon life histories in the estuary, or even habitat requirements. In reference to Rich, what I was saying was that nobody has been trying to reconstruct life histories of the fish that they catch in the estuary on the basis of some scale analysis or other technique."

Goldman: "The paper by George McCabe says that more than 95 percent of sub-yearly chinook salmon were captured in inter-tidal and pelagic areas. Catches in shallow-waters, tributaries, sloughs, coves are small. Are you in effect saying that they made this statement but they didn't really sample enough, that they over-stretched?"

Bottom: "Yes."

Goldman: "Is one of the implications of what you've said so far that the larger fish released from hatcheries don't utilize the estuary so much because they go right on through? In a study we did, we found that by releasing smaller fish, they actually grow faster and do better than the larger fish

which have been sort of conditioned to eating every day when you throw them their pellets. So, I'm wondering if the estuary might be better utilized if they released a lot of these fish in stages or in smaller size?"

Bottom: "As you're probably aware, the tendency is for the system to release them at larger and larger sizes. This is all based on mass-production programs and so it's all relative because some of the wild survival rates are not always very good there either. There's been a lot of work done in the Columbia to suggest what is the best time to release fish. But again, the way it's been focused it's as if there's one appropriate time or one appropriate size. I think what you're saying is that in the context in the way these fish have evolved, that's not necessarily the strategy we're in now."

Cody: "So does that mean you would support a statement like, 'Releasing hatchery fish to the tune of four or five times the number of wild fish has resulted in a decline of the numbers of life history types in the wild'."

Bottom: "It certainly contributed to it. We can't say that hatcheries are the sole cause. But because it is now primarily a hatchery system, they may pull that system down further, too, from recovery."

Cody: "Hatchery fish are doing quite well according to your chart."

Bottom: "Well, that's relative abundance. If you compared it to relative to what the historic production was in the basin you wouldn't come to that conclusion because we're not producing a fraction of what the basin used to produce. The hatcheries were built basically to mitigate for the effects of the dam, and they haven't done that."

Presentation by *Casillas* Status of salmonids in the estuary

Cody asked for clarification on the paper by *Kareiva et al.*, and on the calculation of the sensitivity of λ to mortality (which may be most sensitive in the estuary/ocean phase in some species such as Chinook). *Quinn and Casillas* emphasized that there was no way to determine whether the key life-history phases (including second year of life) was most affected by ocean or estuary conditions, or some combination of both. It may become possible to separate the phases, but this is not possible at present.

Bartell asked for information on implementation of the ESA. "In order to determine whether there's jeopardy or adverse modification, ESA talks about reducing appreciably, or quantifiably, the likelihood of both survival and recovery or of the value of critical habitat. Is the default to claim a jeopardy and an adverse modification if there is no information on what will happen?" *Tortorici* replied that this is not the default position. "The fact is that there's a lack of information regarding the baseline. With the environmental baseline being so important to the analysis what it makes NMFS do is be more conservative in terms of the approach taken. This does not necessarily lead to a jeopardy decision, but it does give NMFS pause in terms of viewing the project." *Young* clarified that under congressional intent, regulatory agencies, when faced with uncertainty, err on the side of avoiding extinction. *Casillas* agreed, and said that when metrics can argue more than one way, the agencies use the weight of the evidence. "In the absence of a matrix under PFC [Properly Functioning Condition], the agencies will use the environmental baseline, which was concluded to be adequate prior to the issuance of the first BO. New information adds to this baseline. NMFS felt that bathymetry/flow characteristics meant that looking at habitat

issues could be a useful tool and probably was necessary. NMFS must look at all the relevant approaches to evaluate all the potential impacts.”

DAY 2

Courtney opened the day by discussing the use of science to reduce uncertainty. It may be that there is considerable uncertainty at the beginning of a decision process. As this process unfolds, there will be some new science (particularly in the modeling area) but mostly an evaluation of existing information. Perhaps this will reduce the uncertainty being faced by decision-makers. The role of science is in part to reduce that uncertainty. However it is probable that even at the end of the process there will be a lot of unknowns. At that point the scientists will have completed their task – it will be up to decision makers to weigh the different issues, and to evaluate the risks and uncertainties they face. Science can in fact sharpen the decision-making process by laying bare those uncertainties and risks – one of the tasks of the panel is to evaluate whether the different scientists have fully understood and laid out the uncertainties in the data and analyses. If, at the end of our meetings, there is still uncertainty, that is OK – this is information that is important to decision-makers.

Casillas presentation continued

Discussion focused on the Corps salinity model prepared by WES [Waterways Experiment Station]. NMFS requested more information on behavior of variables in the peripheral zones. There was some disagreement between NMFS and Corps over the past adequacy of the modeling. However, as pointed out by *Casillas*, NMFS’ present position is that salinity intrusion is a very small component of the habitat available – NMFS is really concerned with the entire system. The question is how we value all the habitats within the system and the impact of this project on all those habitat features. “Salinity is only one feature that drives where salmon go. Other factors are velocity, depth criteria, landscape connectivity, temperature, resources available for prey, refuges from predators --- a whole host of habitat attributes. The only characterization in the original Corps evaluation was salinity intrusion – NMFS wants more. What was Corps did originally was appropriate, but more information is needed.”

Dunne: “My perception of the problem is like this. Biologists have an infinite number of questions they can ask. And when they ask for physical predictions, they say we don’t have the models to talk about the biological significance of this. So it seems to me that what you need is to specify ahead of time exactly how you would use each element of the physical prediction you’re asking for. If instead of saying well if more calculations were made perhaps we will be able.... For me to get my head around the objections and what’s missing, I need to have a statement of what the biologists would do with each particular prediction that’s being called for. Otherwise the list is infinite. No matter what you answer, there’s always another question you can imagine about biology.”

Courtney: “Ed is saying it’s our regulatory authority. We think these data should be covered. You have to listen to what we say in order for us to try to make a better decision. Give us as much information as you can, but don’t give us big ranges as we started out with; try to narrow it down. Then I think you’re turning it around and saying, ‘Put this in some context so that I can be effective in my answers to you.’ And I think probably most of us here would regard that as a nice way to proceed.”

Dunne: “The point is that we need a more concrete list than what is in the Stein memo.”

Quinn queried dredging as a factor in spawning in the mainstem. *Casillas* stated that although this was possible for chum and chinook, the effect of dredging had not been identified as a concern, primarily because of the lack of information on mainstem spawning.

Curtis queried whether there was good enough information to support a statement that dredging was affecting sediment deposition patterns. *Casillas* replied that NMFS' position was not that dredging was having an adverse effect, but that it needed to be evaluated.

The panel discussed among themselves the relevance of using comparative information from other estuaries, dredged and undredged, and concluded that the strength of such inferences was limited.

Boesch: "This does not necessarily mean that dredging will increase the exposure since you also have a lot of suspended sediments moving through the system, which is the primary location of most of the contaminants and the source of transport. So you would have to then address or raise the question about whether dredging appreciably affects the exposure. Did you look at that?"

Casillas: "No; it raises the question for us. "

Presentation by *Eriksen*
Corps of Engineers analysis

The panel asked for information on juvenile salmonid distribution in the estuary. This is rather limited – some data will be collected by NMFS this year, using Corps funding. *Larson* pointed out that this work will study distribution of juvenile salmon in different habitats, how they use it, and what period of time they use it. There is already information on how salmon use the channel areas for migration and what their behavior is around dredge material disposal operations.

Dunne: "So that's the difference between you. You've [Corps] got the salmon around the channel and they're [NMFS] saying that's not enough. We want to know where the salmon are in the shallow water."

Larson: "There is some information on salmon use of the side channel areas, not quite as comprehensive though."

Dunne: "Sounds like those are the kind of things we need to lay out at some point."

Marsh: "I think the important point to take from this is that NMFS made a presentation and they think there isn't enough information. Karl [*Eriksen*] says that he thinks there's information available. What we need to do is look at, in future workshops, all the information that's available."

Courtney: "I think that's right and I'm also hearing that the panel wants that information right away."

Dunne asked for information on whether the material on the bar is of a grain size that just moves along the bedload, or does it get carried in suspension? *Eriksen* replied that it is basically along the bedload. "Most of the big shoals on the river are cutline shoals where the bedload transport back into the navigation channel along the cutline."

Boesch: “Regarding the forecast on volumes, how do you perceive the criticism that they are under-estimates because they were based upon a historically fairly low-flow period?”

Eriksen: “There is no correlation between dredging and suspended sediment discharge because it’s not a suspended sediment system. It’s a bedload system. It’s more a bed equilibrium profile cross section type issue than it is a total transport issue. There’s no correlation between the volume of suspended sediment load of the river and the need to dredge.”

Dunne: “It does seem to be that the analytical framework has shifted in this whole process. It doesn’t show any sign of condensing soon into anything that the various sides agree on. So, for example, in the early stages of the BA, there was some agreement among the Corps, ports, and at least part of NMFS. And then later when NMFS management consulted their science center, then the framework changed to the problems of the salmon runs in this entire basin.”

In response to questions, *Eriksen* reiterated that the Corps salinity model showed only small increases along the channel bottom, and very small increases in shallow-water habitat – this then lead to a consensus among the agencies that there was no significant biological impact. *McAdory* pointed out that flows are still high enough on occasion to make the entire estuary freshwater, with a freshwater plume at the mouth. *Dunne*, however, maintained a concern about a combination of deepened channel and low flows.

Eriksen reiterated that the river is a bedload dominated, sand-wave system, which is ‘very clean’. Only one of nine standard pesticides was detected in the channel. He concluded that there were no significant impacts to the physical environment (including sediment transport budget, bathymetry or sediment quality) and hence no significant impacts to salmonids (habitat, food or migratory behavior).

Dunne commented that the modeling was impressive, but that the Corps was not a good ‘teacher’ – they should not assume that everyone understands what is obvious to them. There is a need for the parties to condense the issues, and agree on a framework before they can move on. Science is not just about reducing uncertainty – we will always be uncertain. Science is fractal – finding out something leads to more questions, not less.

Panel Discussion:

Bartell commented on risk in decision-making. He believed that it’s possible to refine the decision-making process to in fact reach a decision. “If we don’t have a rational and coherent decision-making process, it’s not likely that we’re going to make a rational and coherent decision, regardless of anyone’s motives. By a rational and coherent decision, I simply mean if another group were given the same information and the same charge, would they essentially come to the same conclusion? If that’s not the case, then it has nothing to do with science.”

“What I’ve heard so far that in trying to establish a baseline to evaluate potential impacts that there are several conditions. One is that it’s a multi-dimensional problem. There’s also concern about how well we’re able to characterize, quantify, what we think we know about each of those conditions. For the Columbia River decision-making process, we’ve got to define how many dimensions we’re going to use to make a decision. If we keep adding dimensions, there’s no way to get through the process. Once we define what that finite set of dimensions is, that can determine how well we can quantify where the system is along each of those dimensions. That will provide a quantitative baseline of current conditions. Both parties will then examine the potential impacts of the project against this dynamic multi-dimensional problem. And in the

context of risk and decision-making, we arrive at how much of a change, and how certain we have to be about that change, in order to say yea or nay. So I think it's very possible to define, within the context of existing information, what that baseline is and then how big an impact we have to be able to establish in order to either object to or accept the proposal."

"The agencies should work in concert to establish this baseline. How does the scientific information relate to jeopardy and adverse modification? In a nutshell, I think it's imperative that the decision-making framework be set up as objectively and as openly as possible so that both parties will have an idea of what needs to be done in order to evaluate potential impacts and ultimately reach a decision."

Boesch: "We have an issue of whether the glass is half full or half empty. The emphasis so far has been on what we don't know about various conditions. On the other hand, there is an awful lot that we do know. We know more about the physical-chemical environment than we do about the biology. So the challenge is to find some resolution about potential impacts to jeopardy and adverse modification. Modeling workshops will provide a common language -- very important. So, we need to acknowledge the unknowns but recognize that we do know a lot that allows us to make some predictions."

"I was struck, along with my colleagues, that we were not presented with a very clear framework. On the issue of jeopardy, what are the risks with respect to habitat quality in the estuary as it might affect the completion of the life cycle of the species compared to the other risks that are also involved -- be they related upstream access and habitat condition of spawning areas or oceanic conditions, etc.? Do we have some inkling of that?"

"From my viewpoint, NMFS needs to state its case much more forcefully in terms of how this issue of potential risks to survivability in the estuary play in that broader framework. On the other hand, my unsolicited advice to the Corps is that we can no longer as a society address issues related to an environment as complex as the CR on an issue-by-issue basis. The fact of the matter is dredging activities do interact with changes that have also been made in terms of the flow regime. They do interact with upstream sources of contaminants. They do interact with transportation and movement of sediment. So we have to move toward managing these systems much more systematically. So the Corps of Engineers has to be the 'Corps of Ecosystem Engineers'."

"I echo the comments of my colleagues that you really need to get down to a more concrete, common framework to evaluate each of these issues as we move forward. And I would hope that when we go into future workshops we would organize them in a better framework in that sense. Also make sure that we bring to the table the experts and the knowledge and information that has been gained."

Cody: "I see panels like this as having the potential for useful input at three different levels: 1) To evaluate whether the best, or even, all the data are being used; 2) How project effects are being calculated, evaluated; and 3) What the projected consequences of the project effects are on the species of concern."

"The idea that the biology of the system is contained in these Evolutionary Significant Units is a sort of complicated one. We have several different species involved and each species has different runs, or different stocks, different phenologies, using the river in different ways. *Bottom's* talk yesterday suggested that when we compare contemporary data with historic data, we may have already lost some of this genetic variability from the system. And we also

understood from *Young's* and *Tortorici's* talk that the ESA addresses that point and we are supposed to be conserving different genetic stocks. And so, it's really not clear at this stage whether we had those genetic stocks before and we've lost them, or whether we simply had the behavioral plasticity, which perhaps we've lost due to a swamping effect of the hatcheries."

"We got the idea that potentially a significant effect of the project would be to influence the shallow-water habitats in the estuary. And we talked a great deal about the salinity intrusion model, but that model didn't really discuss changes in velocity at the edges of the estuary. Not much change in salinity (we were told), but salinity plus velocity plus temperature plus all the other things...we're not sure on that."

"We have several indications from different people that there are more data than have been aired, either in this meeting or in the original agency consultations. If it boils down to the critical issue of how to protect salmon, then we have seen a real dearth of salmon data. It's really refining our idea of salmon life histories, and whether there's genetic variability amongst them that needs to be preserved. And where there's some certain critical life history stage which is particularly at risk say from effects of the project, that's what it's going to boil down to and we really haven't got that."

Curtis: "I just wanted to give an example of how we might frame a future workshop. Technical people must be present at future workshops. To use toxics as an example. All parties must agree on approaches or we can't move forward. Here's what I'm thinking. NMFS talked about fish that were taken here and showed signs of toxics. From an analytical process, you need two kinds of data. We need all the data we can get about distributions of contaminants in sediments and in fish.. And it would be really nice if we could differentiate what's here at the periphery from what's in the channel. The next simple question is, if we disturb the channel, do we make more available to the fish? And at what concentrations? And we'll want to determine if these contaminants present hazards, or in your terminology, jeopardy, to the fish? If we do things in the channel, other than just locally, are we going to influence downward movement all the way through the system? Then we get into the sediment transport people because we will probably have to assume that contaminants are moving down associated with organic-rich particles rather than free solution. And I think the information is pretty good to validate those assumptions."

Last night, Steven [*Courtney*] talked about combining the sediment transport and toxics meetings into one, which makes sense to me. If we don't have some agreement up front about how we're going to assess it and what kind of data we need, we're going to be in a room like this two months from now unprepared to discuss things. I remember one of the guys that hired me saying, 'We can decide an experiment in a day; our job is to design the experiment that will make a difference.' And so, what I think our charge is to frame the discussion that will make a difference."

Goldman: "It seems to me that our job really is consensus building between the groups. We're not empowered to decide this for you. What we'd like to do is bring out the major issues and help you to resolve them; to come to some kind of a conclusion that you can all live with."

"When I look at the biological data on the estuary, I'd like to see a lot more of it. I'm wondering how much we can interpolate from our studies on the San Francisco Bay estuary, particularly with regard to salinity intrusion, and the food chain aspects -- two of the problems we face here. We're not dealing with a virgin ecosystem in any sense. Getting salmon runs back to historical proportions is probably an impossible dream without taking the dams out and recovering the vast areas upstream for spawning. What we're really talking about is preventing the demise of what

remains of a really badly impacted salmon stock. We really need to move as far as we can toward the best science-based decisions we can make on this issue. That's going to take a lot of good will and burying a lot of old hatchets, and getting together and facing what data are really available in terms of future projections of the impact of this really extensive dredging operation. It's a lot of material to move; maybe most of it will go right down the center as bedload. I'm wondering still about the fraction that's going to be in washload."

"The food chain aspects in that really vast area of estuary have got to be very important for that transition period when the smolts move from freshwater to sea. It seems to me that if we can keep an open mind and look for new sources of data -- I'm sure there are sources that exist. In a way, there's nothing quite as fragile as information. We're constantly sort of rediscovering the wheel in science simply because people have not been able to uncover existing and really relevant data. Estuaries have been studied for years. We know a lot about how they function and I would guess there can be some translocation of data from other studies that are highly relevant to making decisions on the current estuary. I'm just hoping that by keeping up the communication, and by our presence essentially forcing a new level of communication and understanding, we can in fact move beyond this conflict."

Quinn: "A couple of thoughts have occurred to me while listening here. First, I come to this with considerable sympathy for both sides. On one side, we have the Corps of Engineers -- and I don't entirely understand their mandate; obviously they have statutory requirements and the burdens that go along with that. The representatives of the ports have a significant socio-economic burden. That's a very, very big responsibility and one that we need to bear in mind here. On the other hand, as a fish biologist, I'm very sensitive to the responsibilities of the NMFS and the USFWS. They have both the statutory, and I think, the moral responsibility for the natural resources, the organisms, that have no vote. They are the representatives of those creatures, both for their own benefit and for the benefit of the citizens of the US."

"The data and the models based on the physical sciences, the engineering side, are more precise than the biological ones. There are more data, and the models seem to have less uncertainty as to the outcome. What I can sense here, and this is similar to other situations where biology and engineering meet, there's a certain frustration on the part of the engineers. They can calculate whether a house will collapse made out of 2x4's, so you build one out of 2x6's. You can calculate those things, you can figure it out, you can build around it and there's not a great deal of uncertainty. And they come back to biologists and feel frustrated they can't do the same. I've had to deal with engineers who are frustrated that, as an expert on salmon behavior, I can't tell them what the salmon are going to do because they can tell me what the river's going to do."

"Now why is this? Is it because Newton is simply smarter than Charles Darwin and Gregor Mendel? Or are there just some inherent complexities in biological systems that make them function in a less critical way? The data are, I think, for a number of reasons less satisfactory. It's no secret that huge amounts of money have been spent on the Columbia River system, on the order of hundreds of millions of dollars. A lot of that money was spent by BPA from the Bonneville Dam up. A decision was made that the estuary and the ocean were not part of the responsibility of BPA. So some surprisingly obvious things didn't get done. This is not a criticism of NMFS or the FWS; I know that their base budgets are not very large. I know that their scientists are good. It's awkward knowing we lack this information."

"A general problem is that we as a society, or as the agencies, don't ever seem to be able to anticipate the dramatic environmental issue or insult that crops up. Whether it's the trans-Alaska pipeline or the Prince William Sound oil spill, whatever it is we're always caught unaware. We

come along with a lot of after data and not enough before data, and we're caught. This is played out over and over again. Resource agencies are spending their money reacting to crises and rarely have the opportunity or the finances to look at the future and figure out where the crises are that are going to come down the line. So I'm extremely sympathetic."

"We also have to recognize this system is in trouble. Given all the insults, what is the incremental harm of this? That's one perspective. The other perspective is they can just die of a thousand tiny cuts. It would be difficult to say which was the cut that broke the camel's back. Which was the cut associated with mortality. The last things I'd like you think about are the issues of burden of proof and hypothesis testing. As scientists, we're taught to start out with the null hypothesis unless we're able to reject it based on the information that's collected. In the efficacy of a drug, we say we will not assume this drug is efficacious unless we have a level of certainty that this drug will in fact cure the disease or slow it's progression. That makes perfect sense from the point of view of giving out medicine. But in terms of issues like public health and natural resource management, what that means is the burden of proof is shifted to the other side. So we don't control cigarettes until there's an overwhelming burden of proof that they're harmful, after which time, there's already been a substantial amount of harm. What that means is the absence of data is interpreted as an absence of an effect. Similarly, the organism in the ecosystem bears the burden of proof."

"So when we go back and think about these issues -- do we have data, how will we act in the absence of data? In a scientifically rigorous sense, we should say that we have no reason to reject the null hypothesis. What we need to bear in mind are what the consequences are for the organism. So I come in here with no strong opinion and no detailed knowledge about this issue of estuarine salmon biology. I appreciate the efforts that all of you have made to inform us because clearly you've spent a lot of time pulling all this information together. I look forward to future workshops."

Boesch: "Tom's [Quinn] very eloquently described a number of problems in terms of burden of proof. It might be a useful construct to look at not only the null hypothesis, but also examining the risk of rejecting the null hypothesis. I think if we can structure some conversations about that. It seems to me, just from the first round of discussions of all these issues, some will fall more easily by the wayside than others. It helps us narrow the issues."

Question and Answer Sessions

Marsh: "You talked about the roles of the federal agencies and your role. I want to add something about the role of the ports. The ports are essentially writing the biological assessment with the help of the consultant team they have hired. So selfishly, I'm thinking what do we need out of this? Our team needs to have the information that addresses all the issues. I think it's clear that we're not going to go out and do new research on the river that's going to add to this BA, but we need that information so we can put it together in a package that allows for deepening the channel while improving the environment. I'm excited about the future workshops. What role do the ports and the consultant team play in those workshops? We're going to have to gather the information anyway, so we can help you get what you need to be able to have productive discussions so that we can ultimately do a good job with the BA. Most importantly, we need to know how confident you are in the information, in actually telling us anything. I think the issues are pretty much laid out. We just need to bundle them into packages and have workshops to address them. Our team has some ideas on what those workshops should be."

Weitkamp: “I’d like to officially ask the panel to let us know what information you want, in what form you want it, and when you want it. We have a pretty good idea of what you want, but it’s important for us to hear directly from you. Let us know, and we’ll get it to you in a timely manner. We want to be sure we’re doing the best job we can.”

Courtney: “One strong suggestion is clear: We need to have original researchers at future workshops to answer questions.”

Perry: “Listening to the panel, it seems there is an array of perceptions about the scale of analysis. We would like to come to some agreement on this scope so that we can know how to structure the workshops. I’m somewhat mystified about how we narrow the scope.”

Quinn: “By way of example, if the purpose is to assess listed stocks of species of salmon, then all other organisms are important only to the extent they affect salmon. Are they prey, predator, or competitors? That certainly simplifies things. I can certainly see why you would clearly resist this sort of thing spinning off into other species. On the other hand, that’s exactly how we got into this problem in the first place. We only study the “crisis of the moment,” the “species du jour,” and then we get caught with our pants down about some other species. And then we say, “Wouldn’t it have been nice if we had thought that one through?” So I know it’s simpler and clearly streamlines the process if all we talk about is salmon. It’s your decision, not mine. All I ask you to think about is that there are all those other critters out there, and how are they affected?”

Courtney: “Our charge is to address listed salmon.”

Beasley: “An area at the mouth is closed to all salmon fishing because it’s a known juvenile rearing area. There’s a direct connection between the salmon and the crab because coho in this area rely on the crab for forage food. No one has spoken to this issue. We tried unsuccessfully to bring this up for a number of years. We have a particular interest in preserving all the crab we can. When you start to divorce everything else and just look at salmon you run into problems. Again, I realize you’re trying to narrow the scope to things that are critical to the life cycle of salmon, but you may be missing the big picture.”

Young: “The purpose of these workshops is to comment on the science, within the framework of the ESA, used in a reinitiation and a conferencing process when 14 ESUs have been identified. Within that context, we haven’t heard a great deal of discussion about the river, about the ocean, about other species that might be interdependent. We talked about ESA and the framework for ESA, which is a way to conserve ecosystems upon which these species depend, so therefore, we are in an ecosystem framework. We talked about baseline, in a historical context and in a snapshot-in-time context, and how we use historic information to build upon that current baseline. If we’ve got surrogate species, or guilds of species, that are useful for us to evaluate under ESA the effects of this project on survival and recovery. There’s my bureaucratic response to Dr. Quinn’s original question do we look at other species. In this context, *perhaps*. But the focus would be to keep down to the species and ecosystems upon which salmonids depend.”

Harding: “The reason I’m here is because we issued a water quality certification, which was denied. That, however, was not the decision that we wanted to make. Governor Kitzhaber’s already been very clear on this project. He wants this project to go through, but in an environmentally sound way. The reason I’m here is that I can’t get to that point from where we are now. My question is does it make sense to reach the conclusion that was reached on the sandy composition from the sampling and analysis that we’ve taken? What additional samples might be

required in order to determine that answer? So the questions I have are really very narrow. We have some very narrow questions to ask to get us to the point where we think we need to be.”

Courtney: “It is essential to point out that our charge in this process is emphatically *not* to get us to ‘yes’, but simply to evaluate the science being discussed. We’re trying to solve technical issues. I really don’t want to encourage anyone to make any statements about the importance of the project, the advisability -- or inadvisability -- of the project. That’s not our charge.”

Mishaga: “The whole process of NEPA is to resolve Section 7 of the ESA, which is consultation to federal agencies on the Endangered Species Act. We will need to re-scope this issue and deal with the questions and get your sense on how we can take a large framework focused on the issues that need to be addressed. The other issues are certainly very important, but right now, we need to focus on ESA issues. The first thing we need to do is to get a framework to deal with this issue.”

Dunne: “I’m still trying to figure out if this is the dredging project or is this all the questions related to salmon restoration in the Pacific Northwest? Those two issues open up a whole different range of technical issues that have to be sorted out.”

Courtney: “That’s a good question and speaks to our need for a framework.”

Cody: “We seem to be constrained here in a number of directions. The agencies really want to make sure that we have this broad, more-or-less ecosystem approach. So, within the study area, there are some questions that could be put forward which haven’t been. For example, shifting food webs away from emergent plants. Apparently, though, they weren’t that critical to the salmon because the salmon are still there. The Corps talked about the difference in the water table of the profile of just an inch or two from the dredging project. Well, an inch or two might be fairly critical to emergent plants on the outer edge of the estuary where the salmon tend to be. So there are all sorts of data that haven’t been brought up that are still squarely within the project.”

Thom: “It’s often useful to put understanding down on a piece of paper in terms of a conceptual model. In other words, what are the controlling factors, what’s the habitat structure, what’s the function that’s supported by that habitat structure? For example, if you’re trying to develop opportunities for salmon prey. What makes salmon prey? Well it has to do with elevation and salinity and these different factors. What controls those habitat characteristics? Well, it’s bathymetry, it’s current speed, etc. So you can use that framework for getting out your understanding of the connections among these important factors. And then, within those different boxes, you write down your understanding in terms of your certainty about those connections. Quantitatively, put down numbers. At least you then get something on paper that anyone can look at and argue about. What I’ve heard is there’s a lot of lists of things, but it might be useful to put down on paper what we really understand so that we can identify the uncertainties. The reason I say that is, because down the road, if this project goes ahead, and it will probably go ahead with some uncertainty, you’re going to have to do some monitoring and adaptive management. This conceptual model will form the framework for that adaptive program. Through that adaptive monitoring, you refine that conceptual model and you make decisions. So I’m thinking it might be a good idea to make a stab at a conceptual model, and that way, you can categorize the types of data you want to see with each one of these workshops.”

[*Thom* ‘volunteered’ to draft the conceptual model.]

Tortorici: “What we’re talking about is how to value this project in terms of what we see in the estuary. That’s the discussion Doug [Young] and I tried to lay out yesterday in terms of an environmental baseline. We’re not talking about valuing this project as what the estuary looked like 100 years ago. We’re talking about assembling information to understand how we got to where we are now, and then overlaying that project on top of it. Another way to think about it is we know there’s a certain amount of degradation that’s going on in the system; that species are on the decline. How is this project going to affect the trajectory of that decline? So I’m not sure if that helps in terms of understanding what we’re asking for, but we’re not asking for this multi-million dollar, 50-year study. All we’re saying is that from a regulatory and biological standpoint, doing this project in isolation does not make sense. We need to view it in the context of salmon ecology and what’s going on with the estuary.”

“We just issued a BO for the hydropower system. In that BO we made a connection between upstream actions in terms of flow releases down into the estuary, and asked the federal action agencies to look at things like monitoring and modeling and restoration. So as an organization, we look at this system as an ecosystem, a series of connected pieces. So all I’m trying to tell you is that we’re trying to value this project in the context of this system.”

Quinn: “That helps, makes me more optimistic. I think about this in terms of three levels.. The first is the activity, the second is the effect, and the third is the consequence. The activity is what you’re actually going to do. The second is the physical effect of that -- changes in velocity, salinity, all those kind of physical things. The big question is what is the consequence? How will each of those definable physical effects -- area, bathymetry, salinity -- have an effect directly on salmon, which is presumably on survival, growth, behavior? I think that clarifies it a lot.”

Courtney: “There is some dispute about the effects.”

Quinn: “Then we need to pin that down if we’re going to talk about consequences.”

Courtney: “That’s why we’re talking about salinity intrusion at the next workshop. But the third piece I’ve heard some of you talk about is the lack of connection between a physical effect and proposed biological consequence. That’s the bit that’s never gotten put together.”

Goldman: “Is there a definitive study on the actual impact of dredging -- you people have been dredging for years -- on the benthos?”

Eriksen: “I don’t think there is a study. I think there’ve been studies on a variety of potential impacts of dredging in the Columbia River. We’ve tried at different times to measure the redistribution of sediments or the turbidity plume. We’ve looked at various fisheries impacts. We’ve got a long history of bathymetric changes on the river, mainly mainstem and main channel. So there’s an abundance of information available on the river and dredging, but there’s not a definitive study.”

Larson: “We’ve done some studies on recolonization, disposal impacts. What Dr. Quinn was saying is exactly what we did. We started off at the beginning of this process by laying out what the action was going to be, deciding on what consequences that action would have with the physical modeling. I’m not going to beat a dead horse, but we did get concurrence from the agencies. We used that information, once there was agreement on what the physical impacts would be and the changes, to do what you are talking about. What does that mean for all organisms for the EIS process, and then only for salmon for the ESA process? And that’s where we got to, and where I think we’re in disagreement is did we adequately predict the physical

impacts? And the agencies now have different opinions on what that action means to the animals because of new information, or new theories. So we do have a volume of information that we used in putting the EIS together. I don't think we've ever been in disagreement with NMFS on the value of the estuary to juvenile salmon, it's interpreting what the physical impact is going to be and what that means for the fish. There's been lots of studies done since the seventies on how animals respond to dredging and disposal, disposal being the bigger issue in most cases than dredging."

Dunne: "This is a suggestion for future workshops. What we keep seeing, or hearing, is the crying need for interaction between two groups that are both doing the same thing -- predicting the effects of changes in flow and morphological change together on shallow-water habitat. We find out what each other's concerns are by talking, not by showing up every few months and slap transparencies on the screen.... The other interaction we need to see evidence of is interaction between the models and the data. We keep hearing the data are there, but we haven't seen it. So you can never tell what the whole picture is, or how much is known, or how much is available because there's never any interaction."

Fairbrother: "I'd just like to say that I agree with Dr. Quinn that you can't move forward unless you know what question you're asking. And there is one more interaction here, Tom [*Quinn*], that we desperately need, and that's a better interaction between biologists and the physical-chemical modelers. And I think the way to get at that is what Ron (Thom) was suggesting, which is to go back to square one and develop your conceptual model, which frames the questions that everyone is trying to get at. And it frames it from, "what is it that we're really concerned about?" That's sort of the mandate within which we're working, and you have to define what the fish need to exist or not to decline further. And what are all the different parameters that the fish depend on, either directly or indirectly, and which ones of those potentially could be affected by the channel deepening project? There's probably a whole bunch of parameters out there that affect the fish, which channel deepening has no interaction with, and so immediately you've already sort of collapsed and focused what it is we need to look at with this particular process. And then that helps us get around these issues that Tom was just alluding to of, 'Am I modeling the right thing?' Because all that has to be directed to answer back the questions of the fish. So I really hope that we can spend a little more time today defining the question that we're asking. I'd like to hear a little more discussion, if we could, about the cumulative impact assessment and how much of that needs to go into this. If you define, for example, that there's a 2 or 5 or 10 percent loss in some of the habitat attributes because of this project, is that going to push the animals over the edge, or are we just looking at the percent loss from this project? So kind of that cumulative impact context -- I'm not real clear yet on how that's working in. I'm still feeling like we can talk about specific topics for future workshops, but why are we picking those topics? We have to make sure that we put that within the framework of the endpoint questions we're trying to get to so that we know the roadmap that we need to follow."

Bartell: "A risk-analysis framework can provide a useful conceptual model. Are there recovery plans that have been approved for any of these species?"

Tortorici: "We're in the process right now of working on recovery plans for the Willamette and lower Columbia. We've got technical review teams working on this."

Bartell: "It seems to me those recovery plans would be very useful for formulating the model."

Tortorici: “Yes. We didn’t want to overwhelm the panel with too much information. We have status reviews on all the species. All of that information is on our web site. What we need to hear from you is what exactly you need.”

Courtney: “At the risk of moving us too fast, I’d like to suggest that we now discuss what we’d like to see happen at the next workshop. Reiterate need for technical experts to be present.”

Bierman: “What are we going to generate with these models? And how are we going to use the results to link to the biology? One could come at it from two directions. One could try to develop the linkage between the action and the forecasted changes in the physics in terms of salinity, flows, and so on. But the other way to do it is to say it’s the salmon we’re trying to protect. Doing physics is just part of the process for protecting salmon. One way to go about it is to ask what do the salmon need in terms of habitat? And then to ask how much of it do they need, and put ranges to all those variables -- salinity, temperature, flow, reproduction, etc. Then you ask at what scale do they need it? The whole river, the six segments that Dan [*Bottom*] showed us in the modeling, or do we need it at even finer scales? If I were doing the modeling for a BA, I’d want to know what those things are first so that I could know how to defend the model analysis.”

“I’m trying to imagine what this next workshop will look like if we don’t have those questions answered. Clearly what it can look like, is a fair exposition of what’s been done. What were the data, what were the modeling tools, how were those tools used to synthesize the data, and what were the results?”

Courtney: “I suspect that because salinity intrusion is relatively simple compared to some of the things we’ve talked about, that we may be able to make some technical resolution possible. We need to keep the momentum going.”

Bartell: “We need to use models to help us allocate resources to improve the knowledge base so that you can get to a point where we have an acceptable, in the context of ESA language, cause and effect mechanism and relationship between the potential stresses imposed by the actions. And use that model to help ground the uncertainties.”

The meeting was convened shortly after 5:00 p.m.