

# Regional Gravel Initiative Workshop Summary Report

*prepared by*

Gail Achterman & Amy Ewing  
Institute for Natural Resources  
Oregon State University

Megan Kleibacker  
Oregon Sea Grant  
Oregon State University

*for*

Oregon Department of State Lands  
US Army Corps of Engineers Portland District  
Oregon Concrete and Aggregate Producers Association

December 2010



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**Gail Achterman & Amy Ewing**

**Institute for Natural Resources**

Oregon State University  
210 Strand Agricultural Hall  
Corvallis, OR 97331  
541.737.9918

**Megan Kleibacker**

**Oregon Sea Grant**

Oregon State University  
322 Kerr Administration Building  
Corvallis, OR 97331  
541.737.2714

*for*

**Oregon Department of State Lands**

**US Army Corps of Engineers Portland District**

**Oregon Concrete and Aggregate Producers Association**



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**Institute for Natural Resources**  
**Oregon State University**  
210 Strand Agricultural Hall  
Corvallis, Oregon 97331  
<http://inr.oregonstate.edu/>



# **Regional Gravel Initiative Workshop**

## **South Slough National Estuarine Reserve, Charleston, Oregon**

### **November 30-December 1, 2009**

## **Summary Report**

This report summarizes the presentations and discussions at the Regional Gravel Initiative Workshop. The Workshop was designed and conducted by the Institute for Natural Resources (INR) and Oregon Sea Grant (Sea Grant) on behalf of the U.S. Army Corps of Engineers (COE), the Oregon Department of State Lands (DSL) and the Oregon Concrete and Aggregate Producers Association to support and further the work of the Regional Gravel Initiative (RGI). The Workshop centered on a USGS report presented by Dr. Jim O'Connor and two scientific panels. The geomorphology panel was composed of Dr. Brian Cluer (NMFS), Dr. Pete Klingeman (OSU Department of Civil Engineering), Chris Lidstone (Lidstone and Associates) and Dr. Desiree Tullos (OSU Department of Biological and Environmental Engineering). The biological panel was composed of Todd Confer (Oregon Department of Fish and Wildlife), Dennis Halligan (Stillwater Sciences), Jim Waldvogel (Sea Grant), and Chuck Wheeler (NMFS).

The report was prepared by Gail L. Achterman of the Institute for Natural Resources based upon notes taken by Amy Ewing, INR, Megan Kleibacker, Sea Grant, and several agency staff members who shared their notes. In the portions presented in conversational format, the text represents summary - rather than exact - quotations. For convenience moving forward, the report incorporates the discussion questions developed for the workshop by the RGI Technical Team. The questions and other material from the discussion question paper are italicized in the report.

### **Welcome: History of the process and expectations for the future.**

**Erik Petersen, COE and Kevin Moynihan, DSL**

#### **Kevin Moynihan**

Kevin reviewed the highlights of the RGI charter and the reason for working on the Chetco River system first. He noted that gravel extraction activities from South Coast streams produce about 8% of Oregon's aggregate. Extraction is an historic use of the rivers and it is important to local economies in terms of both jobs and raw materials. Extraction raises concerns, however, related to water quality, habitat, land use and impacts on aquatic species, especially coastal Coho salmon, which are listed as threatened under the Endangered Species Act (ESA). Since Coho salmon were listed, permits issued by the COE have required consultation with the National Marine Fisheries Service (NMFS) and water quality certification by the Oregon Department of Environmental Quality (DEQ). Local land use approvals are also required.

The goal of the workshop was to provide information to all of the permitting and regulatory agencies in hopes of developing a process that can be replicated collaboratively to other South Coast river systems. After NMFS issued a "jeopardy" opinion under the ESA in July 2006, a meeting was held in Coquille between local, state and industry representatives to develop a collaborative process to address the issues and concerns about gravel mining, balancing economy and environment. The resulting RGI charter sets forth the responsibilities of the policy-oriented Executive Team and the science-oriented Technical Team. The teams have worked for three years in collaboration with the industry operators. The workshop is the culmination of work done to date.

## **Erik Petersen**

By bringing together additional technical resources from the university system and outside consulting firms for the workshop, the Executive Team's desired outcomes are to:

- foster understanding;
- where possible, build consensus by bridging geologic and fish interests;
- manage risks; and
- provide clarity on necessary conditions for permit development by understanding opportunities and constraints for permit conditions.

Through a collaborative process that combines the right people with the right resources, our hope is that the workshop will move the RGI process forward.

## **Goals: Overview of workshop expectations; introduction of technical questions; identification of workshop goals**

**Gail L. Achterman, INR**

*The purpose of this workshop is to gather input from experts to assist the agencies in making a sound decision on future gravel removal on the Chetco River. The intent of the process is to determine if gravel removal from the system is permissible based on recruitment of material into and through the system and any impacts to habitat, water quality, or other resources from material extraction. The workshop is an opportunity to discuss and investigate scientific, policy and other supported concepts to better inform permit decisions.*

The focus will be on developing a common information base and understanding among all participants. We want to have a full information exchange between the scientists, the regulators and the industry representatives. We will try to address all of the questions posed by the Technical Team so that we discuss:

- Fact finding - what do we know?
- Concerns - what don't we know?
- Strategies for addressing concerns
- Monitoring and adaptive management processes
- Schedules or milestones for moving forward

## **Background: The Chetco River**

**Frank Burris, Oregon Sea Grant**

Frank Burris provided an overview of the Chetco River System. Discussion with the participants occurred throughout the presentation, particularly on fish species and management.

There are two major tributaries to the Chetco River, the South and North Forks. The river discharge ranges from 85,000 cfs in the winter to nearly dry (82 cfs or less) in the summer. The basin is primarily owned by the federal government (70%) and managed by the Forest Service and the Bureau of Land Management. Private industrial forest land (South Coast Lumber) and private non-industrial forest land account for most of the rest of the land ownership, along with local and state governments. Land is managed primarily for forest use, with some agricultural land. Only about 1% of the basin is urban.

The river is very flashy with short duration high discharge periods during the winter. Summer flows go way down. Rain comes in events from 3-6 inches to 10-12 inches. In the summer, the South Fork provides cooling water to the main stem. The river opens up as it comes out of the canyon. Most gravel comes from headwater reaches. There is very little hard material suitable for gravel in the upland areas on the coast around Brookings. The basalt canyon walls in the upper basin are dark and absorb a lot of heat. The Upper Chetco, as it comes out of the wilderness area,

exceeds temperature water quality standards. The entire Chetco River is listed as water quality limited for temperature.

Much of the upper basin was burned by the Biscuit fire in 2002. Sediment loading has increased since the fire due to the lack of understory vegetation. Some areas, like Pearsoll Peak, were burned so intensely they still look like the surface of the Moon with no vegetation. Soils are serpentine in the headwaters and little grows on them.

Gravel forms in the river channels and side channels. Gravel mining has taken place along the lower river since the mid- to late 1800s using draglines and pits. Permits were required in 1967 and mining switched to bar scalping. The peak of gravel removal occurred in the 1970s and 80s when up to 170,000 cubic yards per year were extracted. In 1994 it was determined that the river is navigable, and companies entered into leases with DSL and paid royalties. On slide \_\_, "Chetco River Gravel Removal 1993- 2008" green bars show extraction from the river and blue bars show material dredged from mouth. Some of the dredged material may be material that moved back in from the ocean. Three companies, Tidewater, Freeman Rock, and South Coast Lumber, historically mined gravel.

The Steelhead population is strong with habitat fully seeded Chinook salmon are reduced from their historic number to about half of the all-time highs. There was a hatchery program for Chinook salmon between 1968 and 1996. Lack of estuary habitat limits Chinook salmon populations. There has been a downturn recently in Chinook salmon due to ocean conditions. Chinook salmon spawn between the North and South Forks. The estuary is the primary rearing area. The needs of Chinook salmon and Steelhead populations must be addressed when considering any management changes to address the needs of the Coho salmon population.

Coho salmon are present in the Chetco, but they are not seen very often. The historic high is estimated at 1,000 fish. The technical recovery team identified the Chetco as an independent recovery population, but no one knows if there is a viable population now. ODFW is not sure whether there ever was an independent population based upon the amount of habitat. ODFW sees strayed fish from other populations in the Chetco and is uncertain about whether there is a distinct genetic legacy. ODFW's data started about the same time as the hatchery data. No sampling has been done specifically for Coho salmon; Coho salmon are counted incidentally when sampling for Chinook salmon. There is no data on Coho salmon spawning. There is some data from the late 1940's, and sampling in the early 1970's picked up some Coho salmon. ODFW finds a high proportion of fish from other populations and does not know if the population sustains itself or is maintained by fish from other populations.

NMFS is developing a Coho salmon Recovery Plan. It is currently scheduled for release in February 2010. NMFS agrees that there is some evidence of Coho salmon now. Modeling analysis of habitat potential indicates that Coho salmon may have been there historically, but there is no data. The Smith River and Winchuck populations are viable, and Chetco Coho salmon could be a bridge between the southern Oregon and northern California populations.

What do we know about historical off-channel and side channel habitat? Suspect the availability of these habitats is not high because most land-use related changes in the watershed have occurred in its lower portion.

Jack Creek and the North Fork are likely to contain suitable Coho salmon habitat. Further up in the system the channel gradient is higher than what Coho salmon prefers. It is possible that the lowermost ten miles of the main stem were historically utilized by Coho salmon. Todd Confer indicated that the limiting factor for Coho salmon is lack of habitat due to the nature of the

Chetco River as a high energy, low gradient system. There is plenty of spawning and summer rearing habitat, but a shortage of winter-rearing low-gradient off channel habitat. This habitat may have been more common historically

Rich Angstrom commented that it is puzzling that we know so little about the limiting factors for the Coho salmon, yet we regulate around the population fairly aggressively. He wanted to try and get a handle on Coho salmon habitat issues related to the gravel industry. Knowing so little makes it difficult to understand the regulatory aspects. As we get into adaptive management discussions, he suggested that there is work that needs to be done on Coho salmon. An agency representative noted that while work does need to be done on Coho salmon, there are other species and other habitat issues that have to be addressed, too, such as Essential Fish Habitat under the Magnuson-Stevens Act.

Rich specifically asked whether there are opportunities for active management approaches to create new side channels. Frank responded that several areas could be used to create side channels, noting that there is an historic fill area in the estuary above the Highway 101 Bridge that could probably be removed and provide some habitat for Coho salmon smolts. There's virtually no aquatic vegetation in the boat basin because the sides are so steep. The estuary is missing low gradient, photic zone habitat for salmonids.

A question was asked about the role of urban development. Frank answered that the lower area is surrounded by houses. The boat basin occupies much of the estuary. Construction of the jetties in 1956 now keep the bar open, thus reducing estuary habitat.

Pacific Lamprey may be listed under the ESA and more information is needed about their presence in the Chetco system. They are present, but little is known about how many there are or where they are.

## **USGS Findings: USGS Open-File Report 2009-1163, Channel Change and Bed-Material Transport in the Lower Chetco River, Oregon**

**Jim O'Connor, USGS**

See Attachment E for presentation slides and <http://pubs.usgs.gov/of/2009/1163/> for report.

Dr. Jim O'Connor presented an overview of the USGS Report. Participants asked questions throughout the presentation. The Geomorphology Expert Panel then joined Jim and posed additional questions for him.

The Technical Team question addressed by the presentation and discussion was, *"What does the USGS report tell us about the current condition of the Chetco overall and of the 5 reaches specifically? The purpose of this question is to set the stage for the workshop and discuss the physical attributes of the Chetco overall and of the 5 reaches specifically."*

The Study Area included RM 12, near the Freeman Bar operation, and lower. It was divided into five reaches for analysis (Upper, Emily Creek, Mill Creek, North Fork, and Estuary). The Reaches are geomorphic, based on the location of major tributaries and other geomorphic aspects.

Geologic history is important to understanding fate and transport of gravel. The Chetco is still recovering from last ice age, with the river filling up the lower valley with sediment. The estuary, with time and under natural conditions, would be filling up and shrinking. The system is dynamic with uplift and sea level rise.

The goals of the study were to learn about how the river has changed and estimate bed-

material influx and transport. The bed-material, when transported, is bouncing along the bottom, not suspended. The bed-material generally makes up the gravel bars. The information came from seven sets of photos dating back to 1939, LIDAR, soil, bathymetric, channel, and navigational surveys and USGS cross sections. The thalweg profile was done with a canoe. Dr. O'Connor commented that LIDAR may be a key aspect of future monitoring.

A question was asked about the effect of the 1964 flood. Dr. O'Connor responded that between 1962 and 1965 the expanse of bare gravel increased due to flood. Since then bare gravel has been colonized by vegetation. The woody shrubs are willows. What was the difference between 62 and 65 in terms of plan view? It would be interesting to see what effect the 64 flood had on the plan view of the river.

There is less shallow habitat in the estuary now than there was in 1939. On average, the elevations in the estuary in 2008 are half a meter deeper than in 1939. There are more deep spots in now. No sampling has been done of the discharge to the ocean, but similar systems do not show discharges.

A question was asked about a large side channel evident on the lower river in earlier periods. The channel is known as Snug Harbor. It was natural but has filled in with sediment. Ted Freeman said that he swam in it as a child. Later the owner spent money to dredge it, but it filled back in with silt.

The channel bed is lower by 1-1.5 meters since 1977. Much of the lowering may have occurred shortly after the 1977 survey. Gauge analysis was also used to measure the vertical change. Sometimes records are biased because gauging stations are put at the most stable place in the river. The general trend with time has been slightly downward indicating that the elevation of the water surface for each discharge has declined with time, as a result of both lowering of the streambed and decreasing channel width. Both have happened. Aggradation during the 1970s could be due to the 1964 flood. In summary regarding channel change:

- bar area has been reduced;
- the channel is lowering;
- there is channel aggradation at the second bridge; and
- planform changes in the North Fork reach are consistent with channel incision.

The bed-material flux analysis was done with information from flow records at the Second Bridge and other sources. The sampling equipment misses some material so it underestimates transported material. Most of the gravel transport occurs over a very short period of the year. The reach-by-reach gravel transport analysis is consistent with channel change and filling of the estuary. There is a lot of gravel in the upper reaches and little coming out in the lower reaches. The river is focusing its deposition around RM 8, just north of the confluence of the North Fork. The Chetco River bars are relatively less armored than bars in other rivers because transport events are more frequent and transport rates are high. There is no chance for the material to sift out.

In summary, flux into the lower river is 40,000-100,000 m<sup>3</sup> per year which is about the rate gravel has been removed from the river. Flux varies from year to year. Under natural conditions gravel would accumulate between Mill Creek and North Fork reaches.

Two issues are raised regarding the sediment budget: (1) particle attrition (bed-material being broken off and becoming suspended load) and (2) amount of sediment coming in from the tributaries. The USGS tried to quantify the amount coming in. Tributaries also contribute to the sediment budget. Particle attrition also influences deposition

A question was asked about what caused the incision and straightening and bar armoring downstream. Dr. O'Connor said that a case could be made that because of the volume of gravel extraction in the 1970s there was channel incision and perhaps straightening. One could also build the case that the 1964 flood brought in a tremendous amount of gravel. The USGS Study has not tried to make this judgment or make predictions. In most rivers, the 1964 flood led to aggradation. In the late 70s, the river incised through that gravel. Attributing specific changes to the things that are going on there will never be clear. Channel lowering occurred since 1977.

The panelists' questions and responses follow.

**What are data gaps and uncertainties? What are agency needs? What timeline is required for action?**

**Dennis Halligan:** I am curious about incision and loss of bar area, which may have been due to colonization of vegetative species. Does stabilization of vegetative flood plain surfaces constrict higher flows somewhat in a high flow spot perpetuate incision?

**Jim O'Connor:** Due to the channel being straighter now, bar growth often requires the channel to start to wiggle around. Irrespective of the causes of incision and straightening, part of the loss is because the channel is straighter now in that reach.

**Chris Lidstone:** Part of Dennis's question is what's a natural process? As bars stabilize, the channel is going to stay in place. A period of major channel forming events blows out the situation followed by a re-entrenchment phase.

**Brian Cluer:** What was the straightness of the river over the period of time 1965-1995?

**Jim O'Connor:** Bar growth is key for sinuosity development. As long as we haven't cut off sediment supply, sinuosity will come back. See figures 13 & 34.

**Desiree Tullos:** If we're interested in timelines, what is the appropriate timescale for asking these types of questions? You can't write a permit on a storm by storm basis.

**Jim O'Connor:** Influx varies tremendously from year to year. It depends on the physical issues one is interested in. Permitting must be concerned with the critical issues of concern (physical characteristics, fish habitat?) For example, incision could cause dewatering of side channels. What are the actual physical issues that interest you in the river? This study explains what will happen at the reach scale, but it's not going to address the resource of concern (fish habitat). It seems to me that the permitting has to think about what are the key resource issues of critical concern, and what are the timescales associated with those issues.

**Brian Cluer:** Related to time scale, do we think that 10 year events are most influential in changing the physical characteristics of the river? The big bed mobilizing events really need to be considered for management of the system. Any extraction of material will disturb a bar for a long time.

**Gail Achterman:** This suggests that the regulators need to think about time scale and spatial scale both. What is the appropriate timescale or spatial scale associated with management of the permit? Storm events? Annual?

**Brian Cluer:** It is important to not disturb geomorphic forms that you expect to return to their natural condition quickly.<sup>8</sup>

**Chris Lidstone:** When you get close to a 1.5 – 2 year event and above, those are more important. Gravel changes with time, but the bar form doesn't. 200 cfs mobilizes gravel transport. The 100 year events don't influence the development of the system that much.

**Jim O'Connor:** Big discharges can lead to avulsion, rearrangement of the channel bottom. There are very specific concerns about responses if you have a biological condition or place you are trying to protect. It comes back to the issue of identifying resources of concern and how you prioritize those.

**Kim Kratz:** If bed load flux is in dynamic equilibrium, and aggradation or incision represents departure, is there a way to evaluate that?

**Jim O'Connor:** The integrity of equilibrium as a concept is overrated.

**Kim Kratz:** Couldn't you decide on a system basis whether incision is significant enough to be a problem? What is the logic?

**Gail Achterman:** How would you define a trigger for allowing gravel extraction?

**Kim Kratz:** What's the metric, and the standard to measure it?

**Jim O'Connor:** Depends on how you define the problem. On the Chetco, if you have aggradation in certain places, that's going to change the flood hazard. That's something you can define quantitatively. With biological resources, I can't say "This incision is a trigger for a bad biological problem".

**Desiree Tullos:** Those are questions that geomorphologists/hydrologists can't answer.

**Jim O'Connor:** If we're concerned about a specific side channel, we can tell you how to keep it wet. We can make predictions about changes in flux rates. I don't think many biologists can point fingers at systematic changes. Relating the biology to the system habitat is something that is in its infancy.

**Rich Angstrom:** That's a theoretical discussion. Look at the vertical channel change.

**Jim O'Connor:** The key question is, is there a certain place we want to shoot for in the future, and on what basis? These profiles show where the river has been.

**Rich Angstrom:** To me, because there are natural and man made processes incising the river, regulators need to come to grips with some level of incision that is unacceptable. As a practical way of looking at this, the river seems to be in equilibrium.

**Pete Klingeman:** River systems can be in stable or dynamic equilibrium. You will find there are periods of time with high water events moving a lot of sediment. Some parts are left deeper than before. The data suggests we have some kind of aggradation. What is the time scale? That's a tough question. Sometimes the river rebuilds itself over decades. If we had good data... What are the consequences if it really is a degradation? What if some reaches are behaving better than others? You can't treat the whole thing the same way because it isn't acting the same way.

Is it possible that one reach can behave differently than other reaches? Shall we treat reaches differently?

**Questions were raised about whether incision occurred in the late 1970s and then stopped. Jim. O'Connor** responded that the only thing that can be said is that the incision occurred between the late 1970s and 2008. There is no evidence that supports a conclusion that incision is not continuing. It could be said that much of the incision occurred early during that period. Rather than focus on the cause of the incision, we should focus on a target. Do we want to shoot for that pre-late 70s elevation?

**Todd Confer** asked about the estuary reach and gravel recruitment, noting that the study seemed to show that there is little recruitment downstream of the North Fork reach, yet, in his experience, the Tidewater Bar recruits gravel rapidly every year. That seems inconsistent with a finding of little recruitment. Jim O'Connor responded that there is gravel recruitment to the lower reach. The capacity predictions suggest 10,000-20,000 m<sup>3</sup> per year getting into the Estuary reach. That's not trivial. He noted, however, that the study of the estuary is weaker than the rest of the study.

Concluding the session, Gail asked whether the panelists agreed with Jim O'Connor's summary conclusions.

- Multiple analyses indicated an average annual influx of 40,000-100,000 m<sup>3</sup> of bed-material into the lower Chetco River. The yearly amount varies tremendously, however, depending on discharge.
- Under natural conditions, much of this material is deposited near the North Fork confluence
- Since 1939 (and 1977) the estuary and channel have incised, in places up to 2 m; and there has been a large reduction in bar area—mainly between 1965 and 1995.
- These historic changes probably owe to a combination of bed-material removal (especially in the late 1970s) and transient river responses to large sediment volumes brought in by the 1964 flood.

All panelists agreed, noting however, the need to gather additional empirical data to refine the model.

### **Biological Panel: General Discussion of Technical Questions** **JimWaldvogel, Dennis Halligan, Todd Confer, Chuck Wheeler**

Note: Concerns were expressed that the Biological Panel originally was intended to be solely outside experts. Due to scheduling conflicts, Dr. Stan Gregory of OSU could not attend and Dr. Guillermo Giannico with Oregon Sea Grant at OSU did not hear the presentation and discussion of the USGS report. Dr. Giannico attended the workshop on the second day only, but did not participate as a panelist during this session. As a result, with the exception of Dennis Halligan, the biologists were all local agency staff.

**Fish Life History Summary.** The Chetco River system has four species of salmonids: anadromous cutthroat, winter steelhead, Coho salmon, and Chinook salmon. Pacific lamprey are also present. **Todd Confer** summarized the life histories.

**Coho salmon:** Adults return in late fall, early winter, moving rapidly to 1st, 2nd, and 3rd order tributaries to spawn. Eggs and fry are in the gravel until early spring, emerging in April–May. Fish reside in freshwater (mostly in the tributaries) for a year. At one year and with a length of 100-110 mm, they migrate to the estuary in April-June. Juveniles don't generally live in the main stem.

In response to a question from **Guillermo Giannico** regarding life history variability, **Todd Confer** mentioned that some Coho salmon do rear in the estuary, however, ODFW does not think that is a primary life history for Coho salmon in the Chetco River. The NMFS representative agreed, but mentioned that the population is so small that the significance of the estuary is difficult to determine. NMFS does not discount the potential of the estuary for the rearing of steelhead and Coho salmon. The Chetco has a relatively small area of tidal influence (2 miles). Coho salmon tend not to hang out in the tidal areas until they need to, then they make the adjustment to salt water and go out to the ocean.

**Steelhead:** Adults come in late fall-early winter, spawning from February to April. Juveniles stay in 1-3 years, primarily utilizing the tributaries. Steelhead are larger than other species when they migrate, 150-200 mm. Juveniles move between the tributaries via the main stem.

**Cutthroat:** The life history of Cutthroat trout is similar to Steelhead, but they tend to return to freshwater earlier, as early as August, moving up into spawning regions as early as November. Anadromous runs return to the river earlier in the season and move up when the water comes up in the fall and winter.

**Fall Chinook Salmon:** Adults return from October-December. Peak spawning is in mid December both in the main stem and larger tributaries. Juveniles emerge in spring and migrate down main stem quickly into estuary, spending little time in freshwater. This species spawn in areas where gravel removal occurs in the Chetco River. They depend on the estuary for summer rearing. They leave for the ocean from Aug-Sep at 90-100 mm. Chetco fish are more dependent on the estuary because the system is small and less productive than other coastal systems. They need to spend more time in the estuary to bulk up before they go to the ocean.

**Rich Angstrom** asked what it meant that the limiting factor was **estuary habitat**. The panelists responded that for a small river like the Chetco the limiting factor for all species is the estuary. There is a lot of spawning habitat and not much rearing habitat. All of the fish are funneled through the estuary at some point and need to spend time there, putting on some weight before they enter the open ocean. **Chuck** thinks that the upper estuary and lower river are significant for rearing. He reported that he snorkeled from RM2 in the estuary and saw Coho salmon. That small a population could be significant. They don't know. From RM5 to the estuary is probably completely stocked with Steelhead and also has Chinook salmon. Lots of steelhead rear in the main stem.

Before addressing the Technical Team questions, several questions were asked about habitat needs: ***What are the habitat needs for fish – what physical features must be present? What structure is missing from the river? Question: Historically, were a lot of side channel habitats available in the system? Can the habitats be developed? Is armor habitat for small fish, or is it non-embedded substrate (non-sorted mixture)?***

**Jim Waldvogel:** The Smith and Chetco systems are nearly identical. Coho salmon love lots of instream structure and are less amenable to open areas. They are smaller and need protection from heavy discharges. Coho salmon like to hide under root wads and logs laid in the stream. Chinook salmon will use root wads, but that use is more limited. Steelhead are much more abundant and when older can use reaches with heavy discharges and less structure. Cutthroat trout will wander everywhere. They'll feed on anything, often on the juveniles in the estuary. Steelhead like running water. Chinook salmon get in schools and move using grassy areas for

feeding.

**Dennis Halligan:** Winter habitat is a limiting factor for Coho salmon. They need woody structure and off channel habitat with overhanging vegetation which provides access to winter feeding, and nice, quiet water. They need access to low-gradient, off-channel habitats. Recreating those habitats is necessary for Coho salmon restoration. Any given year, 3-4 days of high discharges are when that habitat is needed. They need complex channel edges at these times. Channel edge structure (alcoves, oxbows) is the key. Old oxbows or abandoned channels with lots of cover would be beneficial to Coho salmon. The more simplified the channel edges are, the less likely they provide suitable overwintering habitat. Cobble edge waters are also important. If there is some overwintering habitat in the main stem between the Mill Creek reach and downstream, Coho salmon could survive.

*Was there habitat for Coho salmon historically? There were some back water areas in the past. This may be significant if there are only a couple of places. Those habitats are still there and are capable of being restored either naturally or mechanically.*

**Guillermo Giannico:** *What is the value of gravel as habitat for fish?*

**Dennis Halligan:** In winter, the value of gravel bars is that they provide a continuum of slower velocity of water. Fry like edge water habitat and cobble rich substrate where they can dive in or come out as needed.. Juvenile Steelhead also like un-embedded coarse substrate. Juvenile Steelhead will dive into cobble to escape high discharges. They like 6-15 cm of cobble to dive into to avoid high discharges.

**Chuck Wheeler:** Channel complexity is also needed at the reach level, a bigger spatial scale than the size of the rock, to maintain sinuosity for channel complexity. You can find juvenile Coho salmon in the main stem during the summer months.

**Guillermo Giannico:** How about the role of gravel in food production?

**Chuck Wheeler:** Yes – gravel is also important for fish food production, e.g. aquatic invertebrates.

**Todd Confer:** From the Mill Creek reach down there used to be more complex structure.

**Jim Waldvogel:** There used to be more Coho salmon habitat, more backwater areas, especially in the confluence areas like the mouth of Jack Creek. Everything has flattened out. The two to three miles from Jack Creek to Highway 101 are key.

**Dennis Halligan:** Figure 13 in the USGS Report showed channel migration, so you should expect that. Those habitats that were there are capable of being formed naturally or mechanically. Snug Harbor seems to be a restoration opportunity even though the silt in there is not good for commercial gravel purposes. Lamprey would like that habitat, too. There may be opportunities for public-private partnership with cost-sharing and perhaps operators donating equipment. Another opportunity would be to install structures in Jack Creek.

**Brian Cluer:** Space between gravel particles is used for hiding and cover. *Is an armored surface or an unembedded surface better habitat for fish?* Young fish need slow flow and low turbidity. Armored surfaces mean the fines are winnowed out and void spaces exist between cobbles. Un-embedded means that there is a mixture of particle sizes that are mobile.

**Dennis Halligan:** At the early life history stage, edge water habitat is needed where turbidities are less. Having armor on gravel bars, especially at the head of bars, helps to maintain channel steering for meandering and pool formation. It maintains high velocity zones against the higher bank. Armor is necessary for winter survival and habitat formation.

**Jim Waldvogel:** Creating currents is important, not necessarily substrate. As you get into spring and summer, it is important.

**Joy Smith:** Can you develop a scheme that creates a win-win for habitat and industry?

**Chuck Wheeler:** Biologists can tell us generally what fish need. They cannot tell us how to recreate it. In general, the higher the sinuosity the better. The more overhanging vegetation and the more large wood the better. But if that can be effectively created is not a question he is comfortable answering.

A question was asked about particle size. The panelists answered that large woody debris (LWD) is transitory in the Chetco main stem. It was also pointed out that LWD in the main stem gouges holes in the substrate which can trap fish. Other structure, like rooted vegetation, are more important and stable.

**2. What indicators are most important for assessing the health of the river and its habitat for fish? (Indicators to consider are things like the degree of incision, bar armoring, coarsening of bed-materials, channel sinuosity and rate of frequency of channel migration and size and location of the gravel bars.)**

**Dennis Halligan:** All of the suggested indicators are physical; none are biological. An approach being used in Northern California is to **map all fish habitat** with aerial photos. Polygons can be coded for spawning, holding, winter alcoves, etc. This is really forensic mapping. The office analysis can be ground truthed. Enough data sets over time will give you trend information and an indication of whether mining will have a positive or negative effect.

Desiree asked how many years of data are needed for the analysis. Dennis responded that as long as you have a historical photo sets and semi-regular photo sets leading up to present conditions you can make some basic determinations. Yearly photo sets after that are probably not necessary- maybe photo sets every 5-10 years.

**Chuck Wheeler:** Another indicator could be to develop a **measurement of channel complexity**, using the variance of bed elevations to get at channel complexity and adding in other measurements such as variance in velocity, overhanging vegetation, large wood and high flow refuge areas. The complexity indicator would somehow blend these data. Use the complexity "index" to create a base line for each reach. Then evaluate every 5 years or so and look at trends. Jay Charland asked about on how many different spatial scales those measures of variance would work? Chuck responded with a quick answer that they would work on the same scale as our study reaches, but noted he would have to think this through with more time.

**Jim Waldvogel:** Look at **densities of fish and species before and after extraction** each year for 5 years+ and use this information to help determine extraction effects on fish populations. **Measuring invertebrates** may be another option. Their population levels (density and species) would be another indicator on how extraction is affecting the biota in the system.

**Todd Confer:** He agrees with Chuck and would like to see a meandering channel in the North Fork where there is some opportunity for this. Measurement of habitat complexity would be ideal. Measurements of biota (as suggested by Jim Waldvogel) would be challenging to pinpoint changes in population due to extraction because of so many contributing factors.

Two other potential indicators might be **backwater areas in the main stem and structure in the tributaries.**

**a) Are there specific indicators that would be more relevant to the Estuarine reach?**

**Dennis Halligan:** Length of the salt wedge. Cover for hiding.

**Chuck Wheeler:** Indicators for the Estuarine reach are the same as those for the river, specifically a measurement of complexity (i.e. logs, algae, overhanging woody vegetation, alcoves).<sup>14</sup>

**Jim Waldvogel:** Level of predation increases in the estuary, so the structure to hide under becomes more important. This estuary is also dredged on an annual basis

**What is the effect on the system if gravel and other removal activities are not permitted? The USGS report indicates the potential for aggradation at points in the system, especially at the wide, flat reaches near Mill Creek/North Fork. How would this benefit or impact habitat, water quality, flooding, recreation fishing and navigability?**

*What would happen if gravel extraction stops?*

With gravel operations, there is an opportunity to create more structure. However, anytime the channel is manipulated it affects the river form. Below the North Fork and Jack Creek happens to be the lower gradient areas of high habitat value and also the area of high gravel recruitment. Without gravel operations, these features will naturally be formed and recover.

**Dennis Halligan:** Oxbows and alcoves are transient features, just like riparian vegetation. If we mechanically create these things that would be naturally occurring we will have to maintain them every so often. If the river was left alone, these features would eventually naturally form and change in location occasionally. It's not just the number of gravel bars that are mined, but the location of the bars that is important. Lower gradient areas have more habitat use throughout the year.

*Someone in the audience interpreted what was being said as meaning that rivers in their natural state are bad for fish and asked if that was the case.*

The answer from Dennis and Jim was, "No."

**Jim** added that a pulse of gravel from 1950s and 1960s floods is still in the lower system. That may be one reason why the complexity has reduced in the lower reaches.

**Chuck** said that he does not agree.

*Are there any active management techniques (e.g. mechanical movement of existing sediment at specific locations) that could be employed to enhance, maintain, or restore system health?*

**Chuck Wheeler:** Yes. A BiOp addresses the proposed action relative to the baseline. The poor state of the habitat and of the population makes the question difficult. An action which leads to recovery of habitat and species is good. What those actions might be is a separate question.

**Dennis Halligan:** There could be active management. Creation of habitat connectivity and cover, etc. Any extraction plan should mix getting the gravel out with habitat restoration. Extraction techniques that could be used include avoiding the top 1/3 of the bar, creating low flow channels, elevational flow offsets, and grooming to avoid stranding fish. Low flow channels and secondary channels can also be created. All brush can be kept on site for brush piles. Large wood can be salvaged and used in restoration. Alcoves and backwater areas can be created.

*Should Water Quality be used as an indicator?*

Note: The discussion of water quality focused on high-flow conditions. Water quality measures in those periods are not valuable. Water quality standards will be applied, however, during the summer months when gravel extraction activities have the potential to significantly alter water quality parameters.

**Dennis Halligan:** Turbidity, DO, pH are not good to look at. Temperature is also not valuable. The essentials would be pool/riffle ratios, overhanging vegetation, bar armoring, coarsening of bed-material, rather than degree of incision, pool elevation vs. riffle crest elevation.

**Chuck Wheeler:** Complexity, complexity, complexity. Biology doesn't happen in a year. Year to year extraction decisions may not work. You are left with a couple of things: recurrence of transporting discharges, something tied to flows and recruitment. Maybe armoring. An annual decision will have to be done based on physical parameters.

**Jim Waldvogel:** Not water quality.

**Todd Confer:** Not water quality. On the same page as Chuck, a measure of complexity is needed. Sinuosity is useful.

**Guillermo was asked for his summary comments on what we know/don't know, what indicators you'd be looking for, etc.**

**Guillermo Giannico:** In addition to what was highlighted by Dennis and Jim, we need to understand the use of gravel by juveniles, in the lower reaches where gravel extraction would be occurring. Additional indicators to consider could include: overhanging vegetation in side-channels, invertebrate assemblages in the estuary, mean bed elevation as it relates to riffle crest elevation, seasonal inundation levels, instream LWD, movement and distribution of salt water wedge, and marsh habitat conditions. In the lower reaches of the system is important to monitor and try to improve degree of connectivity between active channel and adjacent floodplain areas. Shorter term monitoring should focus on species that are less mobile (such as invertebrates), overall output of fish can only provide a measurable signal over much longer periods of time.

*If you had a magic wand, what would you change?*

**Jim Waldvogel:** Land development has probably been the biggest factor degrading water quality in the estuary. Eliminate houses in the estuarine watershed, change land development, building, and storm water codes.

**Dennis Halligan:** Boat buy-out. Get rid of the harbor, get the jetties out.

**Chuck Wheeler:** Get rid of the jetties, return the system to a bar-bound state. Monitoring Coho

salmon when they were originally listed 10 years ago would have provided data to discuss today. The only thing we agree on is that the population is low. Differences of opinion stem from the differences in how agencies look at the issues based on their responsibilities.

## **Geomorphology Panel: General Discussion of Technical Questions**

**Peter Klingeman, Desiree Tullos, Chris Lidstone, Brian Cluer, Jim O'Connor**

**1. What does the USGS report tell us about the current condition of the Chetco overall and of the 5 reaches specifically? The purpose of this question is to set the stage for the workshop and discuss the physical attributes of the Chetco overall and of the 5 reaches specifically.**

***Is the current level of incision part of an incising trend, or is it part of the natural variation?***

*Do we want to arrest this process or encourage this process of incision and channel widening?*

**Brian Cluer:** Using the words incision implies the river is in the first stage of transformation. Are there indicators of the next stages?

**Joy Smith:** Has the system degraded (become worse)?

**Jim O'Connor:** There has been incision, but whether there is degradation of habitat is less clear. What we are seeing in the Chetco is areas of local incisions that extend across a couple of meanders. What we look for in a degrading system is a trend away from this state of going up and down and back and forth. One way to see if there is a degrading situation is to look at the particle size distribution. The coarser material is left behind.

**Janine Castro:** Is the incision within the range of natural variability? We don't know enough about the channel.

**Pete Klingeman:** Figure 18 in the USGS Report raises the questions: Did some things happening in the 1970s that caused the system to become full of gravel? How much removal took place thereafter? Could we look at rates of extraction compared to other factors? There are missing pieces to deciding about incision.

**Desiree Tullos:** Is it possible to think about resupply rates in terms of storm events? Is there a one year or two year event that would resupply a gravel bar? What kind of event would resupply the system? An equation which related supply to storm event would be helpful to the regulators.

**Erik Petersen:** Yes, from a quantity standpoint that's a piece of the puzzle.

**Jim O'Connor:** There are timescale issues. All transport occurs between October and April/May. Extraction occurs in August/September. In May we have flow records already and can determine how much gravel has come in during the preceding winter, which could help determine extraction volume.

*Is two meters of degradation within the acceptable range of degradation for that stretch of stream? With only two data points it is hard to determine an answer to this question.*

*Can we calculate a resupply event, such as a storm event, and can that be useful towards permit generation?*

**Erik Petersen:** Yes, but the question remains open because we have only limited data.

**2. What indicators are most important for assessing the health of the river and its habitat for fish? (Indicators to consider are things like the degree of incision, bar armoring, coarsening of bed-material, channel sinuosity and rate or frequency of channel migration and size and location of the gravel bars)**

**Pete Klingeman:** Look at the plan form of the river to indicate the river condition: Transect the bar to get a good sense of shape/size. A pool/riffle analysis; how the flow has maintained depth, does the system carve deep pools as it turns sharp corners. Looking for a high variety of water depth, and sinuosity and the ability to develop a secondary current or spiraling action. This builds the bar in the downstream direction. He would want to see that we don't have too much homogeneity. Shape of gravel bars (longitude, transect) and channel adjacent to bars to understand how flow has maintained depth. Variety of water depth. Bank Vegetation. Large wood in the system

*Question from Kim. Would you expect the planform of the river to be different given the assumed effects of recent floods? Not necessarily. As the river winnows through a deposit, the deposit can be there for a long time. The same hydrologic processes will be at work. So there should be the same types of sinuous morph features (but not the same as without the pulse).*

**Chris Lidstone:** Geomorphic indicators can be used to address habitat issues. Confluence of tributaries provide important spawning areas, estuary refuge plan form review for backwater areas. Armoring and coarseness of gravel are not as important as biological indicators such as woody debris and overhanging vegetation. Is there some other way to provide quiet water?

**Jim O'Connor:** There are two ways of looking at this 1) what are needs the river has to improve fish habitat conditions (back water requirements, etc.) or 2) system wide look – things that may be attributable to what we are permitting that may indicate the overall state. Both are measurable. Channel bed elevation and variability and bar textures (coarsening, becoming more armored). Those things go hand in hand with other changes that are ecologically important and are measurable. We have to be able to measure our indicators in a meaningful way.

**Desiree Tullos:** Measurability. Degree of incision is a red flag (from what baseline, from what point? and what is the context?) We need indicators that are measurable, and translatable to our context. Frequency and duration of.....instead of trying to look at connectivity or complexity, which aren't specific enough. Connectivity: describe in terms of frequency and duration; complexity: variability of depth, velocity. There's lack of linkage between geomorphic changes and biological significance. There needs to be a conceptual map linking geomorphologic processes and biological significance. It might start with lists and linkages as shown below:

**Geomorphic Processes      Biological Processes      Indicators**

**Brian Cluer:** Use of Plan form analysis through aerial photographs and annual windshield tours. Tributary connectivity is biologically relevant. Tributary mouths are now a long way from the river. Previously the tributaries were right next to the main stem. This is significant from a systems perspective. From a systems perspective, resiliency to natural disturbance is key. We compromise a system's resiliency when we continually interfere with natural processes by skimming, removing layers, not allowing a channel to evolve into a sinuous system.

**3. Considering what the USGS study indicates about gravel recruitment on the Chetco and the proposal to extract gravel,**

- a) **Does the system require a "recovery period" to restore a balance to the system?**
- b) **Are there any specific reaches that might require a "recovery period" to restore a balance to the system?**
- c) **If so, should gravel extraction activities be authorized and, if so, under what conditions.**

**The purpose of this question is to obtain opinions about whether gravel removal should occur given the current condition of the river.**

**Chris Lidstone:** Reading question 3a you have to assume there is no balance to the system. The USGS report does not say the system is out of balance. I don't think the system is out of balance. The system is adjusting, as most systems do. It is a sediment rich system with high production in the upper system. Transport occurs through the upper study reaches, deposition below. My opinion is you have opportunities and constraints. Looking at the system historically, it has not had great habitat and it was made worse by the jetties and boat basin. The opportunities to improve are the ones that won't get ruined by a 2 year event. The greatest opportunity for the system recovery is probably through operators, identifying restoration opportunities that private-public partnerships can address.

**Jim O'Connor:** I'm not sure there ever was a balance. Cannot say if a recovery period is required. But, if you take more out than is coming in, then meandering will not proceed. Need to have more coming in than going out. It would be good for meandering to occur on the North Fork and Mill Creek reaches with improved connectivity to the floodplain.. Whether that requires a recovery period, or not, I don't know. With more gravel coming in, aggradation and connectivity to the floodplain will occur faster.

**Brian Cluer:** We can let the system evolve on its own or encourage it. That could be done through active management measures.

**Pete Klingeman:** There are things that are part of a long term cycle of events. Dealing with issues, we can't deal with a question like recovery period. They're beyond the relevant reality to address.

**Dennis Halligan:** Recovery applies some desired future or past condition that we want to achieve. There are no data out there telling us where we want to go. The desired condition needs to be explicitly spelled out for a responsible management plan to be developed for the system.

**4. The USGS study indicates the Chetco is flow limited (as opposed to supply limited) with respect to gravel recruitment, which ranges from 3,000 cubic yards at very low flow years to over 150,000 cubic yards in high flow years. The Tech Team is considering using flow data and the**

**model to estimate annual recruitment. If flows are of a certain minimum velocity (tbd), a percentage (also tbd) of the recruited material may be removed from the system.**

- a) **Does this seem like a reasonable approach to address extraction volumes for the entire system?**
- b) **If so, how might we derive the percentage that is available for extraction?**
- c) **LIDAR would be used to assess where the material is deposited and each operator will be allowed a certain volume based on this distribution. Does this seem like a reasonable approach to address the allocation of extraction volumes for each location on the river?**
- d) **Is there another method that can be used to reliably estimate annual recruitment and develop a process allowing extraction of some percentage of that volume?**
- e) **The purpose of this question is to get feedback from the experts about our approach to determining how much and where material may be extracted on an annual basis.**

**Pete Klingeman:** Regulation should be based on discharge, not velocity.

**Jim O'Connor:** The statement is twisted, but the concept should be apparent.

**Desiree Tullos:** The general concept works, but you would need to be conservative given the prediction error. Need more bed-material data collection. LIDAR would be interesting, but not cost effective. A key question is, how do you remove gravel in a way that increases complexity?

**Brian Cluer:** Sediment budgets are a pretty good general planning tool, but they shouldn't be the only tool. Sediment budgets have to be used in the context of the system and the cycle. The focus should be on on-site habitat and action. High resolution topographic mapping, digital terrain map once a year would be useful.

**Chris Lidstone:** You've got a management tool, which is the equation that has been developed by the USGS. Additional bed-material samples will improve the model and expand understanding. The attrition part of the analysis needs more work. The model produces good conservative numbers but there needs to be more bed material data collection. A collaborative year to year process to address the issues could be developed. A base level is needed to work with year to year for operations.

**Jim O'Connor:** A sediment budget is a point of departure. If we take more gravel out of the river than comes in, then bad things happen. The best way to know what's coming in is the model at the gauging station.

**Pete Klingeman:** Figure 37 of the USGS Report. There needs to be a tighter definition of the bed load transport curve. More attention to particle attrition is also needed. Water discharge v. Sediment transport. Figure 30. More measurements would make people feel more comfortable in extrapolating that information. Also needs all inputs, outputs, and changes of storage for a total mass balance. A mass balance should be one of the pieces of the overall plan.

**Jim O'Connor:** LIDAR could be used to estimate how much material is deposited on the beds each year. LIDAR is such a valuable monitoring tool in so many ways; it will tell us where the gravel is ending up. It is probably the most thorough way of attaining this information. LIDAR now can also see through water and tell us what is happening in the channel.

**Desiree Tullos:** The turn around time for LIDAR data analysis is too long to be applicable within the year. LIDAR would be an effective tool for monitoring long-term changes in the river, but impractical for annual permit decisions.

**5. The agencies are considering employing adaptive management to determine whether gravel can be extracted and how much extraction should be allowed in any given year. In addition to employing the flow data and LIDAR above, this would involve evaluating physical and or biological indicators to assess the condition of the river and the potential for extraction activities. Some of the indicators to consider are listed below.**

- a) Which ones may be appropriate to consider for the annual extraction decision?
- b) Which ones may be more appropriate for a periodic (5 year) review?
- c) Are there other physical or biological indicators that would assist the agencies in determining whether, how much and from what location gravel may be extracted from the system?

**Potential indicators include:**

- **Recurrence of transporting flows (via stream gauges and rainfall)**
- **The degree of incision**
- **The degree of bar armoring**
- **The degree of coarsening of bed-material**
- **The degree of sinuosity of the channel (especially at the Mill Creek/North Fork reach)**
- **The rate or frequency of channel migration**
- **Size and location of the gravel bars**
- **Loss or gain of pool/riffle complexes**
- **Loss or gain of overhanging vegetation**
- **Presence/absence of target species**
- **Improvement or degradation of local water quality (e.g., temp, sedimentation, turbidity, DO, pH)**

**Brian:** High resolution topographic mapping is needed. LIDAR is one method of doing it. DTM (digital terrain map) could be considered versus cross-sections.

**Chris:** A complexity measure is needed. Loss or gain of pool/riffle complexes, the degree of bar armoring, degree of incision, mean bed elevation as it relates to riffle crest elevation. Annual surveys and developing trends must be analyzed relative to events that have occurred so that you can interpret trends relative to flow events. A panel of experts reviewing things annually would help to make intelligent decisions. This has worked in the CHERT process.

**Desiree Tullos:** Think about what you're evaluating for: year by year you're evaluating how much gravel can come out. Every 3-5 years you're evaluating programmatic and process questions such as: is the channel incising, is this permitting system program working?

For example the amount of extraction needs to be monitored annually for permit compliance. Longer term analysis, for example 5-years, is needed for programmatic questions.

**Jim O'Connor:** Monitoring should focus on critical issues. We're focusing on the Chetco but the answer to this question will vary from river to river and potentially tributary to tributary.

The degree of bar armoring and the degree of coarsening of bed-materials should be monitored every 5 years or less. On system health attributes, for many rivers, it could be done on a less frequent basis. The concept of resiliency has to come into this. The

Chetco has a high sediment yield, so it has a higher level of resiliency. If it gets messed up over a few years, it can be left alone for a few years.

**Pete Klingeman:** Take top diagram in Fig. 13 (USGS Report), and use this to help determine if the system has enough resiliency in any given year. A 5-year moving mean of sediment transport could be developed. Transects could be selected for each reach based on an overlay of plan views at fairly stable locations. At a given discharge, measure in detail to get the transect shape. Do a width averaged depth of the water. Each year you would have a tracking of the elevation at a given discharge (hydrologic condition). Then you would have a good idea of the longer term state of the system.

**Brian Cluer:** A set of indicators is needed. A flag raised by one indicator could lead to increased scrutiny. Several flags could lead to a yet higher level of analysis. It could go all the way to stopping mining. In California, these indicators are used as triggers for various actions, including more information and ceasing operations. The indicators could be a set of riffle crest elevations, residual pool depth, pool volume, and bar to pool relief as an indicator of habitat quality. Edge complexity measure- taking sinuosity to a finer scale.

**Desiree Tullos:** Doubts that edge complexity can be determined with conventional air photos.

**6. Are there any active management techniques (e.g., mechanical movement of existing sediment at specific locations) that could be employed to enhance, maintain, or restore system health?**

**Dennis Halligan:** There could be extraction techniques that have a restorative component. The way the extraction is set up in Humboldt, there are standard practices and those with a restorative component. Enhance meandering. Recreate side channels in bars and in other areas.

**Chris Lidstone:** Concentrate in the Mill Creek reach. The estuary could be holding ground for fish. The goal is to improve habitat, since we don't know the historical conditions. Good opportunity to use extraction and habitat improvement techniques. Taking out more of the lower bar might enhance meandering.

**7. What extraction techniques and conditions could be employed that would conserve habitat/water quality and support the health of the system?**

**Brian Cluer:** Lots of opportunity to use strategic extraction techniques.

**8. What is the effect on the system if gravel and other removal activities are not permitted? The USGS report indicates the potential for aggradation at points in the system, especially at the wide, flat reaches near Millcreek/No. Fork. How would this benefit or impact habitat, water quality, flooding, recreational fishing and navigability? Can adaptive management address both benefits and impacts?**

**Jim O'Connor:** The long term history of the Chetco is aggradation in the lower 12 miles of the river. The locus is in the Mill Creek/North Fork reaches. Without extraction, expect aggradation. Even with extraction, that area would continue to aggrade. Aggradation may be associated with good habitat effects, but also associated with negative social effects (flooding, navigability, etc).

### **Technical Team Questions to Science Panelists**

After a break the Science Panelists assembled at the front of the room to address questions and/or unresolved issues raised by the Technical Team. The panelists included: Todd Confer, Chuck Wheeler, Brian Cluer, Pete Klingeman, Dennis Halligan, Chris Lidstone, Guillermo Giannico, Desiree Tullos and Jim O'Connor.

**Alex Liverman** provided an overview of the remaining questions. She noted that the Team's proposal is to annually determine whether removal can occur based on a volume threshold for any given year. (The system threshold). The volume threshold would be based on the flows for that year being plugged into the model. If the threshold was met, and gravel removal is appropriate, we would then need to consider how much gravel (what percentage) could be removed and from where. Some reaches appear to be the target places for extraction. If we could map habitat potential, could we prioritize the places where adaptive management strategies would work?

A **general discussion** addressed these issues.

**Jim O'Connor:** A certain volume of gravel should enter into a reach before extraction is considered. A volume threshold could be set in terms of a gravel recruitment amount. It would have to be determined on a reach scale with given methods and locations. Calculating volumes extracted from bars relies on pre- and post- surveys. Before and after information on the sites is needed.

**Jay Charland:** Volume is a function of overall flow, plus the periods of maximum flow. The volume of gravel is what we will make our determination on.

**Jim O'Connor:** Is there a volume of gravel we want to ensure gets into the region?

**Lori Warner-Dickason:** Volume or discharge threshold?

**Jim O'Connor:** Volume of gravel threshold.

**Pete Klingeman:** Having a velocity discharge is discouraged. If you have a threshold discharge, you also need to know for how long. The floor isn't just going to go up and then stop.

**Gail Achterman:** Doesn't this mean that in any given year it could be simple luck that determines which operator gets to extract how much, depending upon the deposition pattern?

**Dennis Halligan:** Yes, the amount allowed to be minded would be set up to a particular volume at specific sites. Some years someone may get something and someone else could get nothing. Do field work. Determine the volume that has settled out on the extraction surface. Not all recruitment settles on the extraction areas, and not all that does settle will be taken. Instead, could remove material down to a specific final bar configuration, down to a baseline elevation.

**Rich Angstrom:** The current system's risks and rewards have been worked out by the three operators.

**Brian Cluer:** Moving to a system of using the model and setting a percentage of extraction allowed, doesn't change the risk to the operators.

**Gail Achterman:** So, the panelists suggest using the model USGS developed, then taking the next step to fine tune the threshold determination in order to determine what came in and where.

**Erik Petersen:** Are all bars created equal? Should enhancement opportunities or impact avoidance considerations drive allocation? Do we know enough to engage a process that tries to optimize the system for the operators and the resource?

**Response:** All bars are not equal.

#### **Discussion on systems approach.**

**Janine Castro:** When several bars are mined, we want to take a system approach.

**Alex Liverman:** We're moving to the regional approach

**Gail Achterman:** Has the group considered unitizing the sand and gravel industry like the oil and gas industry. Both systems are very fluid, unlike a commodity like coal. Oregon doesn't currently have the legal framework for this.

**Brian Cluer:** There is an example of this on the Russian River in Northern CA. That new plan is adaptive to make the best habitat through the tool of gravel management

#### **Discussion on LIDAR and survey methods:**

**Jim O'Connor:** Requiring LIDAR for the entire system can be resource intensive. Doing it on a 3-5 year basis but having permits with restrictions regulating take to some site-measured specifications that are a function of local recruitment might be a compromise: scaled down annual surveys and LIDAR done 3-5 years. LIDAR is expensive, but the cost for existing survey crews is also expensive (Freeman Bar \$7-14K a year).

**Chuck Wheeler:** We go back to LIDAR because the annual monitoring has to occur anyway.

**Desiree Tullos:** LIDAR has issues – it won't get anything underwater, and seasonally can be difficult.

**Brian Cluer:** System wide LIDAR is overkill because you can get the information you need with other topographic mapping.

**Chris Lidstone:** Use DTM on the bars in place of cross sections.

#### **4b: If so, how might we derive the percentage that is available for extraction? Do you want to frame how much in terms of specific sites or in terms of the system?**

**Janine Castro:** What percent change do you need to see before you can say something about it?

What is the volume threshold for detection? How much change do you need to see in storage?

**Jim O'Connor:** Vertical accuracy is within ten centimeters. Gravel deposits don't occur on top of the bar, instead they occur laterally, making them easier to detect. LIDAR timing could be determined by hydrologic events. For example, LIDAR could be done after every 10 year storm event, etc. Pre- and post- surveys would continue to be required on all bars to maintain the data sets.

Volume determinations can be modeled after water rights, user A gets X amount, user B gets X amount and X amount remains for in-stream use.

**Jim O'Connor** suggests treating the Chetco as an experiment, try say 50% for a five year span. Measure the affects of taking 50% a year and then evaluate this level compared to other possible percentages.

**Ted Freeman** (Freeman Rock): What if the operators don't want to take that much? What if we only want to take 20% for one of those years?

**Janine Castro:** There may be benefit in taking more material one year, then allowing a recovery period for 3-5 years. She asked the panel for their ideas on benefits/costs of taking 10 cubic yards a year for four years versus taking 40 cubic yards one year and none for the next four?

**Dennis Halligan:** I think it would cause problems.

**Guillermo Giannico:** Too hard to tell. Things in the river shift year to year- it may matter one year to have things left in the river and not matter the next year. Hence, long term monitoring as part of a controlled management approach would be one way to answer that question. The objective over the long term should be to maintain or improve current conditions.

#### **Removal Methods:**

**Pete Klingeman-** How are we going to integrate new habitat notions into the removal methods of the past?

**Brian Cluer:** Removal guidelines he wrote in 2004 laid out an ideal strategy to retain the form and function of a gravel bar while still extracting volume.

**Janine Castro:** If we know exactly what the habitat needs are we can design/recommend removal methods to give us our desired outcome.

**Rich Angstrom** recommended that agency folks talk to operators and hear their on-the-ground experience while determining the removal methods covered by the permits. "Don't do this from your desk." The operators have a good handle on what works and doesn't work on the ground.

**Alex Liverman:** Assuming some threshold and some quantity, we heard discussed accounting for throughput, what was deposited on various areas of the bar, to account for the error in the predicted model, to account for extraction area that's acting as a trap, to account for attrition, to account for some amount of instream or bar building process. Were there other factors?

**Chris Lidstone:** Tributary input.

**Factors to consider in setting an extraction percentage:** Throughput Amount deposited on the bars, Errors in the model, Extraction area acting as traps, Attrition (loss to small size particles and suspended load), Bar building process material.

#### **Can we develop a shared vision of what we want the river to look like?**

**Monty Knudsen:** Is that something the tech team and the operators can decide?

**Chris Lidstone:** Look for off-channel habitat opportunities and restoration in the tributaries, like enhancement of Jack Creek

**Bob Lobdell:** You cannot design habitat improvement on the bars themselves since they will be under several feet of water during high flow events.

**Rich Angstrom:** Supports a joint operator/agency meeting on developing a vision for the river. He says the agencies know what it needs to look like.

**Alex Liverman:** We shouldn't discount the possibility that allowing sinuosity will enhance connectivity, provide habitat, etc.

**Chris Lidstone:** The system will adjust. Try to force it... We may lose meanders. Nature will have to take care of it.

**Agency folks** all brought up flexibility, and the need for the permit(s) to be written to allow for flexibility in removal methods.

**Chuck Wheeler:** All discussions have focused on riverine portion and all issues there. What about section below river mile two, in the tidal area. One of the USGS diagrams shows great loss in the photic zone there. Given that:

1. Is it viable to even expect extraction at that site in the near future?
2. While it has similar form as the riverine bars, what are the appropriate removal methods and volumes for that location, accounting for tidal influences?

**Dennis Halligan:** 1. Yes, you should contemplate it. 2. How? Not sure.

**Brian Cluer:** It needs more estuary bed elevation to support vegetation and restore shallow water habitat.

### **What are the impacts of the annual dredging on the estuary/system?**

**Chuck Wheeler:** Not many impacts. According to the equipment operator, the material is mostly marine origin.

### **Key Discussion Issues (in lieu of breakout groups)**

#### **1. Extraction for Enhancement**

#### **2. Indicators/Monitoring**

- With what we know of the Chetco, is a year to year indicator appropriate?
- We need to differentiate between monitoring and indicators for *permit compliance* and indicators/monitoring for *program management*.

#### **3. Adaptive Management**

### **Are there any remaining (show-stopper) issues we have yet to address?**

**Judy Linton:** Timeline and process questions

**Alex Liverman:** Funding and staffing levels

**Frank Burris:** Biophysical processes, significant water temperature issues during low flow times of year, and exposed banks contribute to that greatly. Food webs are really important in estuaries and riparian vegetation contributes to food webs greatly.

**Jim Thraikill:** Lack of information on Coho salmon

**Gravel Representative from Umpqua River:** Until we get the Chetco going, we're not going to get anything done on the Umpqua. Who's in charge? How can we get our questions answered so we can really move forward? Who is ultimately in the lead to help push to the next stage?

**Joy Smith:** Concern about the group taking the next steps. Jim Waldvogel had a lot of good ideas and good vision on local restoration opportunities and solutions.

**Sally Puent:** Make sure the agencies have their questions answered so we can move to the next step.

**Ted Freeman:** Encourage the agencies to really consider adaptive management approach, learn from the CHERT process.

**Bill Yocum:** Would like to finalize the side boards and get the ecological concerns addressed. Concerned process will stall until next year.

**Tom Gruszczenski(?):** Need more information on Lamprey, in addition to Coho salmon

**Monty Knudsen:** What is the common vision of the river?

**Robert Elayer:** Hope technical team continues to communicate with operators about this process. Allocation (across operators).

**Rich Angstrom:** Need to be active in how we look at the river and manage it. The industry has heavy equipment and is in a position to be able do work that can help the river in the long run. He also encouraged the panelists and others (tech team) to come up with a percentage- to him this is the one big outstanding issue. Need to work on the process so that it can be replicated. This will require information and research.

**Janine Castro:** Reminder that we have more information through this process than any other stream system she's worked on. So, we may have holes, but in general we're in a better place to make decisions on this project compared to others. Important new thought has been "How can we use mining to accomplish goals, as opposed to a more traditional, confrontational avoid-minimize-mitigate."

## **Next Steps**

**Rich Angstrom:** An action item should be discussion between operators and agents to determine what opportunities for enhancement there are.