

Seeking Balance in Oregon's Coastal River Aggregate Mining Policy:  
How Do Scientists Inform the Permit Streamlining Process?

by  
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## ABSTRACT

This essay presents a case study of the Regional Gravel Initiative (RGI) workshop, one instance of policy makers using science to inform decision making for sustainable and streamlined processes. The RGI consists of eight agencies, both federal and state, with responsibilities for informing and issuing permits for mining aggregate on Oregon's coastal rivers and streams. Aggregate is an essential component of infrastructure, but regulations protecting water quality and salmon habitat have contributed to decreased aggregate yields from in-stream sources. Recognizing the state's need to balance these competing resources, the RGI conducted a workshop featuring scientific panelists who were tasked with providing and interpreting information for policy makers.

This essay specifically addresses the question *how do scientists inform the permit streamlining process?* using Pielke's Honest Broker framework. Document review, participant observation, and interview methods are used to analyze the roles scientists filled in informing policy makers. Results show that scientists collectively acted as honest brokers of policy alternatives, expanding and clarifying options to decision makers. The workshop setting limited scientists' abilities to act in other ways, but scientists are presented with opportunities to inform through other roles in other settings throughout the policy process.

This essay will be useful to continuing and future efforts to streamline and inform policy processes. Policy makers should be aware of the roles scientists may fill in informing decision making and of their abilities to direct scientists' impact on policy processes.

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## LIST OF ABBREVIATIONS

The Corps	U.S. Army Corps of Engineers
CHERT	County of Humboldt Extraction Review Team
CWA	Federal Clean Water Act
DEQ	Oregon Department of Environmental Quality
DLCD	Oregon Department of Land Conservation and Development
DSL	Oregon Department of State Lands
EA	Environmental Assessment
EIS	Environmental Impact Statement
ESA	Federal Endangered Species Act
GP	General Permit
IMST	Oregon Independent Multidisciplinary Science Team
INR	Institute for Natural Resources
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
ODFW	Oregon Department of Fish and Wildlife
RGI	Regional Gravel Initiative
RGP	Regional General Permit
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WQC	Water Quality Certification

# Seeking Balance in Oregon's Coastal River Aggregate Mining Policy: How Do Scientists Inform the Permit Streamlining Process?

## INTRODUCTION

Balancing environmental health with economic vitality is a perennial concern for policy makers. To achieve that balance, policy makers face tough decisions and often look to science to provide a sound platform on which to make informed natural resource management decisions. Those seeking both scientifically-sound and innovative ways to achieve sustainability may consider permit streamlining. This collaborative process, in which agencies work together to simplify the granting of permits for a particular application, promises to increase project efficiency while maintaining environmental standards and promoting economic activity.

Much has been written about both the paradigm shift toward sustainability and the role of science in policy while less is known about the processes agencies use to make real steps toward sustainability, in particular permit streamlining. This study seeks to apply the current knowledge base to an application of this policy tool for promoting sustainable practices. It seeks to add to the understanding of the role of science in policy by addressing the question *how do scientists inform the permit streamlining process?*

This essay focuses on one instance of attempting to develop streamlined permits to mine aggregate on the coastal, salmon-supporting Chetco River near Brookings, Oregon, about five miles north of the California border (see Figure 1). Aggregate (sand, gravel and crushed rock) is needed not just to build infrastructure but also to keep local mining operations and the economy viable. One study estimates that if mining operations on the south coast of Oregon including Coos, Curry (where Brookings is located) and Douglas counties were to cease, “economic output would decline, by \$9.2 million a year taking with it 97 local jobs with wages and benefits

**Figure 1: Map of Study Site**

Source: Google Maps



totaling nearly \$3.4 million.” Aggregate consumers would have to seek aggregate from distant mines, further stressing the economy by raising the cost of projects by as much as 300% (Whelan 2007).

The possibility of aggregate mining ceasing has come closer to a reality recently, as the lead federal and state permitting agencies have denied applications to mine on the Chetco and several other south coast rivers due to environmental concerns, and this big-picture issue is accompanied by a smaller one. The process of acquiring the necessary permits to mine aggregate on the Chetco is problematic in itself. It is circuitous and cumbersome for gravel operators due to stacked layers of environmental regulations protecting water quality and salmon habitat. To reduce some of the regulatory burden, protect the environment and facilitate mining, eight agencies, both federal and state, are working toward the development of streamlined permits. The agencies agreed to proceed through a fact-finding phase bolstered by two agency-produced, scientific reports and to convene to discuss, understand and resolve scientific issues that pose barriers to approving permits.

This essay examines the roles scientists fill in informing agencies in problems of permit streamlining using the Honest Broker framework developed by Roger Pielke. Through document review, participant observation of an interagency workshop and interviews with two key informants, an understanding of scientists’ expected and observed roles is developed. This study will be useful for those who seek to inform the policy process through scientists and for those interested in streamlining and sustainability. It may be particularly useful for the continuing aggregate mining permit streamlining efforts on Oregon’s coastal rivers and streams.



## **BACKGROUND: Need for Streamlining and Science**

Oregon's use of aggregate represents the classic problem of sustainability, the need to provide for community, economic, and environmental benefit in the present while maintaining resources for the future. Aggregate is abundant in Oregon's natural environment and used ubiquitously in its built environment. So much aggregate is used in asphalt-paved roads, concrete foundations, and other infrastructure that each Oregonian's share is estimated to be between 10 and 17 tons of aggregate each year (Institute for Natural Resources 2005; Rohse 2001). Oregon's aggregate mining industry benefits from this usage. Because aggregate is heavy and expensive to transport, builders favor the use of local sources (Jaeger 2006). The rest of Oregon's industries benefit as well. Safe, reliable infrastructure is essential for Oregon's businesses, and harvesting more aggregate to build that infrastructure is essential to securing Oregon's future. Without accessible in-state sources, local aggregate industries would suffer and Oregonian's would lack vital roads and buildings. Yet these community and economic benefits are at odds with environmental quality, which can be harmed by mining activities.

The majority of aggregate used in Oregon is mined in-state. About 96% of all gravel used in Oregon comes directly from mines while the remainder comes from recycled sources. Aggregate can be mined using several methods, including digging from gravel pits and blasting from quarries, both private and public. In-stream aggregate mining, which largely consists of scooping loose gravel from riverbeds, is the method of interest in this study. Until the 1990s about 15% of sand and gravel mined in Oregon came from rivers and streams (Rohse 2001). More recently the share has fallen to about 8% (State of Oregon, "Aggregate Resources" 2007) as the result of layers of environmental regulations enacted since the 1970s.

### ***Increased Environmental Concern***

Three federal acts in particular have strained Oregon's in-stream aggregate mining process and contributed to decreased yields. The first, the National Environmental Policy Act (NEPA), became law on January 1, 1970, and indicated the beginning of an environmental era of new awareness and heightened regulation. The 1972 Clean Water Act (CWA) and the 1973 Endangered Species Act (ESA) soon followed in a broad array of legislation addressing environmental goals and protections.

As a symbol NEPA indicated the importance of the environment as a national issue by placing emphasis on humanity's connection to the environment. The act's practical effects included the establishment of the Council on Environmental Quality, an office that reports to the President and oversees the application of NEPA regulations in agencies (Kreske 1996). Most notably, NEPA requires an environmental impact statement (EIS) "be prepared for all major federal actions significantly affecting the human environment" (Luther 2007) and an environmental assessment (EA) be prepared if the impact of humans on the environment is unclear. Some actions are categorically excluded from the need to prepare an EIS if their impact is known to be insignificant. Federal actions refer to projects and programs requiring approval from federal agencies, which include in-stream aggregate mining in waters requiring permits from the U.S. Army Corps of Engineers (the Corps). The agency responsible for preparing the EIS or EA must gather comments from all other appropriate agencies as well as from the public. The NEPA process tends to be time- and money-intensive, but its true impact on resources is unclear because as an umbrella statute many NEPA procedures are also required by other regulations such as the CWA and the ESA (Luther 2007; Tripp and Alley 2004).

The goal of the 1972 CWA is to reduce or eliminate water pollution. Section 404 requires "regulat[ing] the discharge of dredged material into U.S. waters", which has been addressed through permitting managed by the Corps (Meador and Layher 1998). The ESA became law in 1973 but did not affect aggregate mining until the 1990s when the National Marine Fisheries Service (NMFS) listed many types of salmon as endangered or threatened species. In the NMFS Southern Oregon-Northern California Coast region, coho salmon were listed as threatened in 1997, and subsequent analyses have found little change to the population and habitat (Good et al 2005).

The culmination of changing awareness, values and regulations crippled the ability to mine aggregate in many of Oregon's coastal streams and rivers. Recognizing the need to maintain a certain level of mining activity for the health of the economy, Governor Kitzhaber issued an executive order directing the Department of State Lands (DSL) to examine the science and policy surrounding the issue to determine if administrative changes could ease pressure (Gregory and Percy 2002). This approach reflected the fact that despite broad agreement that agencies can craft more efficient methods for achieving environmental protection than the complex

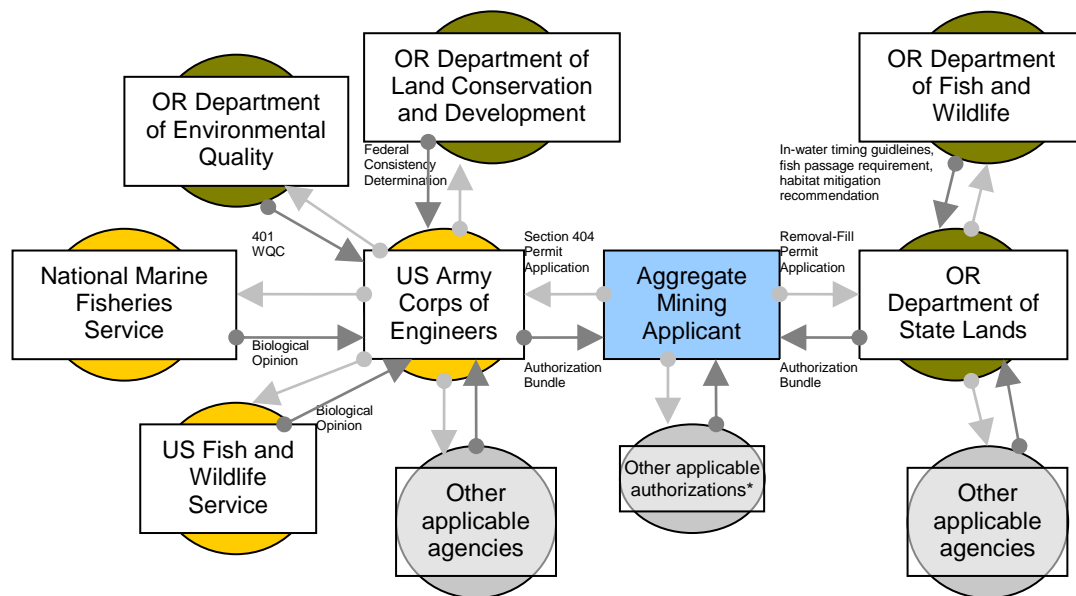
NEPA procedures currently used, there is insufficient knowledge and no consensus of how to do it (Luther 2007; Rabe 2002). DSL in turn enlisted Oregon's Independent Multidisciplinary Science Team (IMST) to work as an outside reviewer. The IMST recommended that DSL redevelop its policy to be more holistic and operate at a basin, rather than site-specific, level. The IMST also recommended incorporating more and better science into policies and increasing cooperation with interdependent agencies (Gregory and Percy 2002).

This 1999 executive order was among the earliest efforts to address the scientific and policy issues prohibiting aggregate mining. The following year Governor Kitzhaber issued an executive order addressing sustainability, calling for the state to "integrate efforts in ways that enhance the effectiveness of new and existing efforts; collaborate and cooperate to remove barriers and find solutions, ...[and] using good science, measure resource use, environmental health and costs to determine progress in achieving desired outcomes" (State of Oregon, "Development of a State Strategy" 2000). These early efforts would not nearly be the last ones in attempting to straighten the serpentine permitting process while promoting sustainability, collaboration and the use of science.

### ***Permitting for Aggregate Mining in Oregon***

The current process for obtaining a permit to mine aggregate from Oregon's waterways is resource-intensive, both for applicants and the reviewing agencies. The party intending to mine needs to secure both a *Removal-Fill Permit* from DSL and a *Section 404 Permit* from the Corps. These two agencies have similar goals – monitoring and maintaining certain standards of the environment while supporting the public interest – in authorizing or denying in-stream aggregate mining. However, each has its own specific goals and process, and to mine in Oregon waters protected under Section 404 an applicant must acquire the proper authorization from both agencies.

A typical applicant would initiate the permitting process by submitting concurrent applications (see Figure 2, in which state agencies are represented by green circles and federal agencies are represented by yellow circles). Then the two agencies, which use the same application form, would follow similar processes to consider allowing mining. The involvement of the Corps calls for the formal

**Figure 2: Permitting Process**

Green circles represent state agencies, and yellow circles represent federal agencies. Light arrows indicate request for consultation or authorization, and dark arrows represent opinions or authorizations returned.

\*Oregon agencies suggest that mining operations may further require a State Lands Proprietary Authorization (DSL), a Mineral Land Operating Permit (Department of Geology & Mineral Industries), and local authorizations (State of Oregon, "Before I Use This" 2007)

involvement of the state Department of Environmental Quality (DEQ), which is responsible for issuing a 401 Water Quality Certification (WQC) under the CWA based on the final proposal of the Corps permit. That final version must be reviewed for consistency with state coastal zone management by the Department of Land Conservation and Development (DLCD) under the Federal Coastal Zone Management Act. It must also be commented upon by NMFS and the U.S. Fish and Wildlife Service (USFWS) under the Fish and Wildlife Coordination Act and the ESA, potentially resulting in a different project proposal than the one originally submitted to both DSL and the Corps. In the meantime, the application to DSL would be reviewed and commented upon by applicable state agencies, including the Department of Fish and Wildlife (ODFW). Final approvals are then issued in the form of several permits and authorizations from multiple agencies rather than in one permit. Because not all concerns raised by state and federal agencies are resolved within the 90-day period allowed by state law for DSL to handle applications, applicants often receive a permit with conditions stipulating that further requirements must be met before a project can proceed. The Removal-Fill Permit application process alone can take 120 days (Carmichael Consulting 2005; State of Oregon, "Aggregate Resources"; Water Related Permit Process Improvement Team 2006). Despite having obtained these

state and federal authorizations, the permitting process is not complete. Mining operators must still obtain applicable local authorizations.

The entire process exists to help maintain environmental health, but its overlapping demands strain agencies, applicants and Oregon's economy. DSL and the Corps, in line with previous gubernatorial efforts, are attempting to simplify it through exploring the potential to develop and implement a tandem General Permit (GP) and a Regional General Permit (RGP), respectively. These two streamlined permits would pre-authorize in-stream aggregate mining in specified areas.

Although no identical permits have been issued previously, an understanding of how the anticipated RGP will function may be gleaned from a public notice issued by the Corps on March 5, 2010. The five-year permit would authorize extraction activities on a "three-year cycle [including] two mandatory rest periods," providing that a trigger volume of aggregate has entered into the system. An exception to the three-year extraction cycle occurs in the event of a "five-year influx" in which 90,000 cubic yards of material or more enters the system within one year. In that case extraction is allowed and the cycle is reset. With regards to the permitting process itself, the public notice indicates that the proposed permit would contain upfront certifications and opinions from applicable agencies (U.S. Army Corps of Engineers 2010).

### ***Adopting a Streamlined Approach***

Across all levels of government, agencies seek to increase project efficiencies through a variety of methods often termed *policy, regulatory, or environmental streamlining*. *Permit streamlining*, referring to a process in which agencies work together to simplify the granting of permits for a particular application, is a special case of increasing efficiency. It is a nascent policy tool that may be used to reduce lengthy project lead times, jurisdictional overlaps and administrative impasses both for the numerous agencies that must coordinate with each other to approve a project and for the industries and local contractors who seek approval. A successfully streamlined permit can further increase efficiency if it is replicable for future applications. These terms apply to general efforts, like those to simplify the NEPA process, and specific ones, like those to simplify the aggregate mining permitting process.

When it comes to projects subject to NEPA requirements, agencies seek to increase efficiency by adopting a coordinated environmental review process in which

NEPA requirements are conducted concurrent to other reviews (Hansen et al 2007). Environmental reviews are too often conducted as an afterthought to the planning and design process solely to comply with NEPA rather than to inform decisions, and not even the decision makers read and make use of environmental impact statements (Rosenbaum 1995). Weaving various reviews into one streamlined process promises to better inform agencies, to reduce time required to conduct reviews and to smooth interaction with other regulations such as the ESA and CWA (Tripp and Alley 2004; Transportation Research Board 2005) though possibly at the cost of public involvement (Luther 2007), a goal of the act.

When it comes to permitting, the objective of streamlining is often to spur economic development (Rabe 2002). Many streamlining programs are administrated by offices focused on business and economic development, and many streamlined permits are issued only for projects that meet the criterion of promoting development. In accordance with that objective, the outcome of a streamlined process is often not better environmental protection or decision making but rather reduced process time benefitting commerce. The benefits afforded to the environment and the public usually come in the form of access to better information about a project that can then be used to monitor outcomes (Rabe 2002).

Oregon policies have followed a commerce-oriented model. When Governor Kulongoski first addressed regulatory streamlining through an executive order in 2003, he established the Office of Regulatory Streamlining for the purposes of facilitating conducting business in the state and thereby stimulating the economy (State of Oregon, "Regulatory Streamlining" 2003). In a second executive order, issued six years later, the regulatory streamlining efforts of that office were reassigned to the state's Economic Revitalization Team. The second order at once lauded the efforts of the Office of Regulatory Streamlining, which "catalogued a list of over 300 separate regulatory improvements that have removed barriers to business", and decentralized its elements (State of Oregon, "Amending" 2009).

An achievement of Office of Regulatory Streamlining was the establishment of a Water Related Permit Process Improvement Team (the Team) composed of representatives from DSL, DEQ, ODFW, DLCD and the Oregon Water Resources Department. True to commerce-oriented streamlining principles, the Team's goal was to address concerns of applicants for DSL's Removal-Fill Permits (which authorize a variety of activities including but not limited to in-stream aggregate

mining). It settled on addressing two of applicants' main concerns: having to chase approvals through multiple state agencies only to receive multiple or vague approvals at the end of the process and not understanding at the outset of the application process what processes and requirements are necessary to acquire approvals.

The Team met over a one-month period to analyze the current permitting process and to make recommendations for improvement. It identified a variety of problems, broadly categorized, in the structure of the permitting process, the structure and culture of the agencies themselves and the availability of resources. It issued 32 recommendations for improving the current process to be completed within a set of staggered deadlines. The recommendations tend to be broad and vague. A good example is the first, to be completed within six months of the report's issuance, to "develop an SPGP [State Programmatic General Permit] applicant education program and DSL Implementation Plan." None suggest opportunities for clarifying or reducing environmental or scientific concerns that might result in a clearer, more efficient process. An additional set of recommendations for overhauling the existing system focuses on having state agencies provide *shepherd* or *project manager* service to applicants (Water Related Permit Process Improvement Team 2006).

Some recommendations, such as making a guidance document available to applicants, have been implemented to varying degrees of success. DSL did issue SPGPs, "a Corps permit administered by DSL," in lieu of Removal-Fill Permits for activities causing minimal environmental harm (not including in-stream aggregate mining), for the first nine months of 2006. It ended the program due to "customer feedback and implementation challenges" (State of Oregon, "Oregon's Removal-Fill Program Report 2004-2006" 2006.). The failure of this program helped lead to the 2007 passage of HB 2105, which makes possible joint applications and "authorization[s] from DSL and the Corps for activities that are substantially similar in nature, recurrent or ongoing, and have predictable effects and outcomes" (State of Oregon, "Removal-Fill Report Fiscal Years 2007 and 2008" 2008). This renewed effort allows for the inclusion of in-stream aggregate mining activities.

Some of the Team's findings are consistent with the larger body of knowledge suggesting that the nature of bureaucracy, with authority fragmented across agencies with different missions and modes of operation and political pressure affecting administration, acts as a barrier to progress (Rosenbaum 1995; Frederickson and Smith 2003). Agencies struggle to harmonize their mandates because they do not

have the knowledge or resources to do so and, without clear domain and direction, can incur costs in terms of time, money and institutional relationships (Kreske 1996). The Team did not, however, address issues of interagency collaboration, which is essential to progress beyond agency-level problems and to streamline permits (Rabe 2002). An agency's need to collaborate often arises out of having overlapping *turf*, or policy domain (Wilson 1989; Bardach 1996; Gaines and Lurie 2007). Working together, identifying similar goals, developing shared objectives and committing to engaging in a truly deliberative process can help to remove turf barriers (Daniels and Walker 2001; Kreske 1996; Thomas 2003). Despite this there remain limitations to the ability of collaborative process to assuage problems and achieve streamlining.

### ***The Regional Gravel Initiative Workshop and Science***

The factors described above - the state's need for aggregate mining, increased environmental regulation, the complexity of the current permitting process and the state's interest in streamlining regulations - contributed to the development of the Regional Gravel Initiative (RGI), an interagency collaborative workgroup committed to working towards streamlined permits on the Chetco River and subsequently other coastal rivers and streams. DSL's denials of two aggregate mining permit renewals on the Chetco, one each in 2006 and 2007, on the grounds of likely harm to listed salmon species and the Corps's ten additional denials on the nearby Umpqua River in 2006 (State of Oregon, "Aggregate Resources") provided a particular urgency to the issue.

The Corps and DSL led the effort. The RGI was established July 10, 2008 with the goal of "strategically evaluat[ing] on a watershed basis, whether the mining of gravel from Oregon rivers can be permitted" (U.S. Army Corps of Engineers Undated). Eight agencies, both federal and state (see Table 1), with a wide array of mandates collaborated. The effort was structured to include both a policy-oriented executive team and a science-oriented technical team, each comprised of representatives from various agencies. The Oregon aggregate industry, represented by the Oregon Concrete and Aggregate Producers Association, collaborated on the RGI as well.

The RGI found scientific questions to be at the heart of the issue. Before decision makers would proceed with developing programmatic permits, they enlisted the help of scientists through a workshop format to help determine whether mining



	<b>Agency</b>	<b>Responsibility</b>	<b>Authority</b>
<b>F E D E R A L</b>	U.S. Army Corps of Engineers, Portland District	Regulates removal of aggregate from sites under Corps jurisdiction*	Section 10 of Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act*
	National Marine Fisheries Service	May review, comment, and recommend to Corps approval or denial of permits based on effects to habitat or species; consult with federal agencies taking action that may affect a listed species*	Fish and Wildlife Coordination Act; Endangered Species Act*
	U.S. Fish and Wildlife Service	May review, comment, and recommend to Corps approval or denial of permits based on effects to habitat or species; consult with federal agencies taking action that may affect a listed species*	Fish and Wildlife Coordination Act; Endangered Species Act*
	U.S. Environmental Protection Agency	Approves state water quality standards**	Federal Clean Water Act Section 303
<b>S T A T E</b>	Oregon Department of State Lands	Regulates removal of aggregate from in-stream sources*	Oregon Removal-Fill Law of 1967 ORS 196.800-990*
	Oregon Department of Environmental Quality	Reviews permits for compliance with state water quality standards* and issues 401 Water Quality Certification**	Federal Clean Water Act Section 401, ORS 468 and OAR 340-041-0001
	Oregon Department of Fish and Wildlife	Reviews compliance with in-water work period, fish passage requirements, and mitigation plans**	Multiple Oregon Revised Statutes and Administrative Rules**
	Oregon Department of Land Conservation and Development	Ensures compliance with Oregon's Coastal Management Plan**	Federal Coastal Zone Management Act**
Sources: *State of Oregon, "Aggregate Resources" 2007; **Water Related Permit Process Improvement Team 2006			

operations may be tenable. Specifically, the RGI sought "to determine if gravel removal from the system is permissible (sic) based on recruitment of material into and through the system and any impacts to habitat, water quality, or other resources from material extraction" and if so what monitoring, river conditions and management strategies ought to be used ("Chetco Gravel Mining Workshop" 2009).

The workshop, held November 30 - December 1 2009, aimed to clarify and interpret a U.S. Geological Survey (USGS) report titled "Channel Change and Bed Material Transport in the Lower Chetco River, Oregon". Approximately 39 people including scientists were in attendance (see Table 2) to view presentations and participate in discussions facilitated by Gail Achterman of the Institute for Natural Resources at OSU. (For a summary of workshop findings, see Appendix A.)

The RGI technical team developed eight multi-part questions (see Appendix B) in response to the USGS report. The questions were tailored to be narrowly-focused and as (scientifically) positive as possible in order to ascertain responses

from a representative of USGS, which as an agency acts in a positive rather than normative fashion, in attendance. The questions were posed to the USGS scientist as well as to a mix of eight university, government and private scientists (see Table 3). After panel discussions were completed, the technical team regrouped to identify new concerns that had arisen.

Scientists were placed onto two panels to interpret the report and its implications for mining aggregate in the Chetco River. One panel featured biological experts, and the second featured geomorphological experts. Some experts sat on both panels, and in concluding the workshop all panelists formed one final panel. Under study here are the roles of these nine scientists.

<i>Attendee Type</i>	<i>Number*</i>
Agency Representative	20
Scientific Panelist	9
Industry Representative	5
Staff	5
*Numbers are approximate due to flux of participants over two-day period	

<i>Scientist Type</i>	<i>Number</i>
University (OSU)	2
Government	5
Private	2

## LITERATURE REVIEW

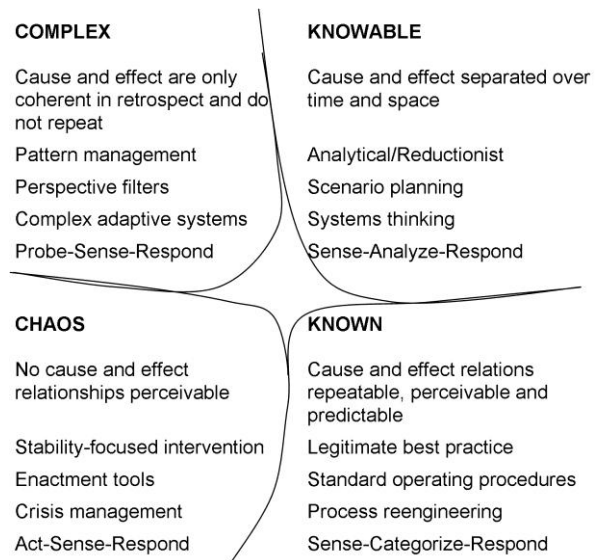
The following pages present a review of the role of science in policy and provide an explanation of a policy framework used to understand and typify science's role in decision making. These concepts may be better understood by first considering the relationship between science and policy in terms of the Cynefin framework, a sense-making framework that encourages new modes of thought to reconceptualize and clarify problems.

Kurtz and Snowden (2003) developed the Cynefin framework as a tool for conceptualizing issues in knowledge management. They and others have since applied it to a range of fields "primarily to consider the dynamics of situations, decisions, perspectives, conflicts, and changes in order to come to a consensus for decision-making under uncertainty." The framework features five domains – chaos, complex, knowable, known and the central, unnamed domain. Each describes a decision-making context and features a decision model (e.g. probe-sense-respond or sense-analyze-respond). These domains imply no values or hierarchy.

Decision-making occurs both within and across these boundaries. Movement between boundaries may be quite institutionalized. For instance, the scientific method may be conceptualized as scientists moving between the known and knowable domains. Hypotheses found to be true would move from the knowable domain into the known domain. New hypotheses would be developed from the known domain and moved into the knowable domain (Kurtz and Snowden 2003).

This model assists in understanding the interaction of science and policy by providing a framework to consider how scientists and policy makers make decisions. Scientists tend to operate within the knowable and known domains, drawing on the

**Figure 3: Cynefin Framework**



complex domain to infuse new ideas, while policy makers tend to operate within the complex and knowable domains. More importantly this model assists by providing a framework to consider how policy makers *hope* to make decisions. For policy makers, operating within the known domain may be a goal, but achieving certainty and predictability in public issues is difficult. A feasible alternative may be operating within the knowable domain, in which “stable cause and effect relationships... may be known only by a limited group of people” (Kurtz and Snowden 2003) and enlisting the help of experts to move decision making into the known domain. Informing policy with science may be seen as a way to achieve the goal of operating within the known domain.

### ***Role of Science in Policy***

Science is only one of many factors influencing policy, but in environmental policy its influence can be profound (Scott et al 2008). Scientific information can provide a knowledge foundation, expose risks and uncertainty, resolve conflict and garner public favor. Its objectivity is valued so highly that federal acts such as NEPA, ESA and CWA demand the use of the best available science in decision making (Sullivan et al 2006), and an intended effect of NEPA has been “to institutionalize scientific analysis [in favor of] ecological values within federal agencies” (Rosenbaum 1995). Many decision makers expect that decisions founded in science will provide better environmental outcomes and will be more readily embraced by a variety of interests (Pielke 2007; White and Hall 2006). The quest for objective, rational and sound environmental policies has given science a key role in policy making.

Scientists may advocate or simply provide information; citizens may accept or oppose information; and policy makers may interpret and apply information. But in any policy situation these actors and others are unlikely to share the same focus and interpretation of science. Smith et al (1998) examined three separate studies of salmon policy to find that despite the \$70 million spent on salmon studies produced annually during the 1990s, managers, users and citizens still differed in their perceptions of reasons for salmon decline. An overwhelming amount of scientific analysis was used to inform, but did not necessarily lead all the informed to the same conclusions. This is illustrative of the fact that while science in this case outlined some viable options and thwarted others, it did not prescribe one particular course of action.

Science is not the value-free truth for which policy makers and other stakeholders often hope. Even when armed with the best, sometimes conflicting, objective information, society must still make value-laden decisions about how to best manage natural resources (Sullivan et al 2006). This apparent disconnect between what society expects science to do and what science can do with respect to policy has led researchers to examine the issue.

Studies have illuminated some perceptions of the proper roles for science. Steel et al (2004) employed a series of interviews and surveys conducted among various stakeholder groups in the Pacific Northwest to study attitudes about the role of science and scientists in environmental and natural resource policy. They found that despite support for scientists among interest groups, scientists were not confident in their abilities to provide objective information, advocate and make decisions. Even if scientists are reluctant to participate in the policy process, others have argued that scientists have an obligation to do so because of their roles as citizens and their superior access to information (Roux et al 2006; Nelson and Vucetich 2009; Lackey 2007). Scientists are routinely involved in policy whether outright or through their findings.

There remains disagreement on how involved scientists should be. Of particular concern is whether scientists should advocate; some (e.g. Cortner 2000; DeStefano and Steidl 2001; Foote et al 2009) argue strongly in favor. Gray and Campbell (2008), however, expanding on the work of Steel et al, found among a group of scientists, decision makers and practitioners “little support for a limited role for scientists, strong support for an interpretive role, almost universal support for an integrated role, moderate support for an advocacy role and little support for a complete decision making role for scientists” and that the accepted role of scientists may change across place and issues. Scientists have an ability to understand and interpret esoteric information that may be vital to policy yet be misunderstood by policy makers. They can assuage the burdens of inherent uncertainty that accompany all decision making by exposing and explaining risks.

Steel et al (2004) also showed that the public generally accepts scientists' interactions. They found that members of interest groups and the attentive public (defined to be citizens active in the policy process) accepted science playing an important role informing decision makers in the policy process. Yet the effects of scientists' involvement in the policy process are not clear. Another study showed that

scientists' presence in meetings working towards resolution of an environmental conflict affected stakeholders' learning. It suggested the direct interaction between scientists and stakeholders was a notable factor in changing perspectives though the strength and duration of the effect is unclear (Chase et al 2008). Whether science leads participants to the "true" conclusion or to an otherwise elusive consensus is not known.

Reports have offered examples in which a knowledge base provides a platform for better decision making. Oregon Department of Transportation decision makers analyzed information to develop a baseline understanding of its environmental streamlining project, leading to future savings of money and time for the Oregon Bridge Delivery Program (Gaines and Lurie 2007). Through an integrated permit writing and environmental streamlining program, New Jersey permit agents have extensive knowledge of the facilities for which they grant permits. That knowledge allows for making better decisions regarding environmental risks (Rabe 2002). The adaptive management scheme implemented to guide placer mining (a type of mineral extraction often occurring in- and near-stream) in Canada's environmentally sensitive and salmon rich Yukon Territory is dependent on accurate scientific monitoring as well as grounded in the traditional knowledge of people of the First Nations. Yearly monitoring is required to continually inform decision makers as to whether the environment can sustain mining activities (Yukon 2005). In each case policy makers have crafted programs that integrate information into decision making mechanisms. These projects rely on scientific information to improve outcomes for the benefit of the economy and the environment.

Local knowledge, information based on the perceptions of experienced citizens (White and Hall 2006), can supplement scientific knowledge, "improving decisions, especially with respect to effective implementation and sustainability" (Ozawa 2005). This information may be anecdotal rather than regimented but nonetheless contributes to the pool of knowledge informing decision making. Policy may even require the inclusion of local knowledge, as in the case Yukon placer mining cited above in which decision makers rely on local knowledge to fill gaps in scientific knowledge and shape the adaptive management scheme used to keep placer mining and the environment viable.

Despite the favorable outlook and instances of successful integration of science and policy, drawbacks remain. Daniels and Walker (2001) note the

importance of scientific and technical experts in the policy process, but caution that the hoped-for resolution of conflict may not be realized. The objective resolution offered by experts often conflicts with the cultural values of agencies and the general population.

Those seeking to make a science-based decision often find that other factors can stifle the expected outcome. Scientists' and decision makers' traditional academic separation poses a challenge to making sound decisions collaboratively (Rosenbaum 1995; Scott et al 2008; Roux et al 2006). Decision makers often do not have the capacity to understand and interpret the best available science even when it is accurate. Scientists, on the other hand, often do not have the capacity to operate effectively within the world of policy. Some studies even suggest that scientists' ideological orientations may affect the assertions they make and the way they interpret data and findings (White and Hall 2006; Nielsen 2001). A complementary problem exists among citizens, who may have a preconceived framework of an issue and favor the use of scientific information to support a foregone conclusion (White and Hall 2006).

Some scientists may exhibit "dueling experts syndrome," the situation in which experts informing an issue adhere to strongly opposing viewpoints and argue with science apparently informing the debate. Wade (2004) argues that this type of representation of science or expert opinion can be strategic. In a process of negotiation, outlandish claims provide a better starting position for achieving a desired outcome than modest ones. However, decision makers often struggle to make sense of this conflicting information and apply it. Schneider (2000) argues that the solution for decision makers is to engage a community of scientists "represent[ing] the credibility of a spectrum of views that characterizes the state-of-the-art knowledge base."

Even when all human factors are operating well, scientific information that is unknown or inconclusive may stifle the process (Sullivan et al 2006), and adding more information may actually increase ambiguity. Ambiguity and uncertainty are the driving forces behind the desire for science to direct decision making. The two serve opposing roles, used as a tool at times to promote conflict and at others to achieve compromise (Pielke 2007). In the end science may actually confound policy issues.

A fuller integration of science and policy may lead to better outcomes. Renevier and Henderson (2002) argue for moving "the scientific process from the

periphery to the center” of politics to provide transparency. It may require fundamental organizational changes (Cortner 2000), but in the present structure and culture there are opportunities for stronger integration. Some suggest scientists can learn to work more effectively in a non-scientific setting and with different groups of people. In these settings scientists may expect to meet with controversy and scrutiny and to have difficulty communicating their ideas (Steel et al 2004; White and Hall 2006). Because insufficient information is a base cause of agencies’ inability to meet deadlines and set standards (Rosenbaum 1995), policy makers can make a greater effort to understand and incorporate science. Still, some caution that society expects too much of science (Smith et al 1998). While science may provide objective information, society must bear the responsibility of envisioning the management goals and implementable policies that accompany it (Sullivan et al 2006).

### ***The Honest Broker Framework***

Accepting that science does and will inform policy, scientists and policy makers can seek to arrive at sounder decisions by better understanding its role. To do so, Pielke (2007) detailed a framework in “The Honest Broker: Making Sense of Science in Policy and Politics”. He formed his typology (see Figure 4) around a matrix posing two conceptions of democracy against two conceptions of science. The conceptions represent extremes of involvement by experts and scientists. In democracy, the Madisonian model represents the case of experts becoming fiercely involved by aligning with interest groups while the Schattschneiderian model represents experts involving themselves by providing policy alternatives to the public. In science, the linear model represents scientists studying and experimenting strictly to reveal the truth while the stakeholder model represents scientists acting in accordance with the needs of users of the eventual end products of their work.

The posing of democracy against science is appropriate because the two represent the “democracy versus technocracy quandary” that has arisen in post-industrial nations. The expectation in these advanced societies is that objective science can neatly solve the most complex natural resource policy problems. In addition there is a competing expectation that decisions ought to be made democratically by citizens who are primarily laymen when it comes to science (Steel et al 2003). Pielke, by combining extreme forms of these possible outcomes, has



illustrated the range of roles that scientists may fill in terms of post-industrial societies' expectations.

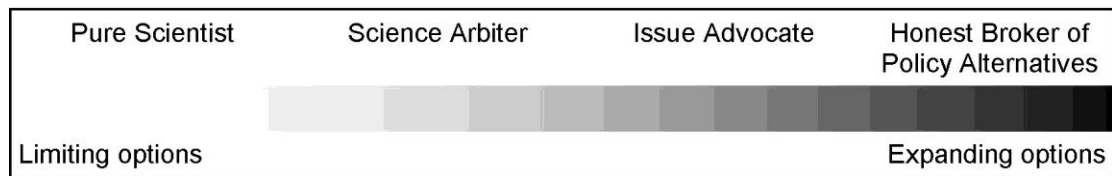
Pielke's choice of conceptions to illustrate extreme forms of democracy and science, however, have come under criticism. Jasanoff (2008) and Brown (2008) assert that the conceptions are too simple, limited and improperly-named. Jasanoff would describe the Madisonian model as interest-group pluralism and the Schattschneiderian model as guided democracy. In Brown's view, the attributes of the Schattschneiderian model belong not to E. E. Schattschneider but to "the elitism of Joseph Schumpeter". However the models should be named, Jasanoff and Brown agree that this spectrum of views is far too limited. The two take similarly dismissive positions on Pielke's treatment of the linear model of science. However, Pielke's framework retains merit despite these dismissals because "it is sufficiently comprehensive in scope and feasible and flexible enough to use in a variety of situations" (Currey and Clark 2009). Potential misnomers aside, the framework provides a clear typology of the roles scientists fill and allows the opportunity to analyze scientists at work.

The result is four typified roles – pure scientist, science arbiter, issue advocate

**Figure 4: Pielke's Honest Broker Framework**

		SCIENCE	
		Linear model	Stakeholder model
DEMOCRACY	Madison	<p><b>Pure scientist</b></p> <ul style="list-style-type: none"> <li>• provides fundamental information with no consideration for use or utility</li> <li>• allows research results to pool in society's reservoir of knowledge</li> <li>• has no interest in decision making and does not interact with decision makers</li> <li>• leaves use of information to decision makers</li> </ul>	<p><b>Issue advocate</b></p> <ul style="list-style-type: none"> <li>• focuses on the implications of research for a particular political agenda</li> <li>• aligns with a group seeking to advance interests through policy and politics</li> <li>• directs focus to a particular choice or set of choices</li> <li>• tells decision maker what to prefer</li> </ul>
	Schattschneider	<p><b>Science arbiter</b></p> <ul style="list-style-type: none"> <li>• acts as a resource answering factual questions relevant to decision maker</li> <li>• focuses on positive rather than normative questions that can be resolved by science</li> <li>• has interaction with, but does not attempt to sway, decision maker</li> <li>• may serve on a panel or advisory committee and return findings</li> </ul>	<p><b>Honest broker of policy alternatives</b></p> <ul style="list-style-type: none"> <li>• integrates knowledge with stakeholder concerns through possible alternative courses of action</li> <li>• expands or clarifies scope of choice and allows decision maker to reduce scope of choice based on own preferences</li> <li>• may be a collection of experts working together with a range of views, experiences and knowledge</li> <li>• seeks to enable decision maker's freedom of choice</li> </ul>

**Figure 5: Spectrum of Roles of Scientists in Policy**

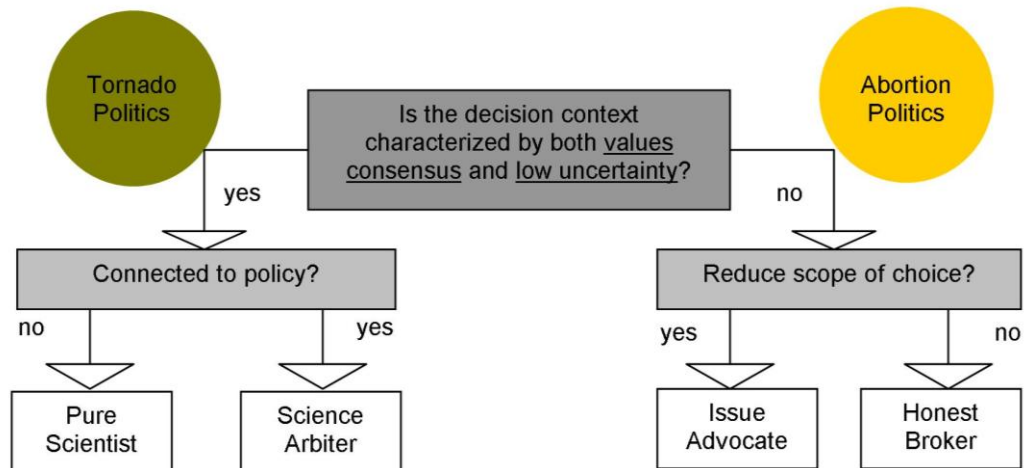


and honest broker of policy alternatives – that occupy a spectrum from limiting to expanding options to decision makers (see Figure 5). The pure scientist, at the meeting point of Madisonian democracy and the linear model of science, is a positivist whose findings are meant to belong to the cache of scientific knowledge and who participates in politics only to the extent that science is inherently political in nature. At the other extreme is the honest broker, situated at the meeting point of Schattschneiderian democracy and the stakeholder model of science. The honest broker understands and engages with the outcome of research and participates in politics in order to expand the scope of choice available to decision makers. Between these two extremes, the science arbiter provides more options to decision makers than the pure scientist by answering specific, positive questions, and the issue advocate provides even more options by directing decision makers to a specific choice or set of choices. Figure 4 explains each role in further detail.

Assuming these typified roles could fairly describe scientists in policy and politics, could one go back a step and understand which type of scientist would best inform a given situation? To some degree, scientists and decision makers may anticipate their interactions through the use of a flow chart illustrating “The Idealized Realms of Tornado and Abortion Politics” (see Figure 6). Pielke asserts that scientists face the set of choices illustrated in this chart in deciding how to interact with decision makers. The chart may help scientists and decision makers understand the choices scientists make when lending expertise to a given situation, but it is not meant to prescribe scientists’ behaviors.

Pielke’s initial motivation for introducing the chart shown in Figure 6 is to address the question, “What are the implications of different degrees of values consensus in decision contexts for the role of science in policy and politics?” He answers by explaining the difference between *tornado politics* and *abortion politics*. In the hypothetical situation of a group of people facing an impending tornado, one would expect the group to share a consensus of values, i.e. the group will seek shelter in order to live. One would also expect low uncertainty, i.e. the group will

**Figure 6: The Idealized Realms of Tornado and Abortion Politics**



Source: Pielke 2007

agree on a clear set of choices and associated outcomes. This hypothetical situation defines tornado politics. In another hypothetical situation of a group of people facing an impending decision on whether to allow abortion, one would not expect the group to share a consensus of values and to agree on a set of choices and associated outcomes. Though abortion in some ways represents a clear choice between life and death, many other factors are involved. Group members may choose to use scientific information to support predetermined values, to direct others towards certain values, or as a ploy to conflate the issue.

These hypothetical situations emphasize the importance of defining the policy issue. The way an issue is framed affects the way scientists and decision makers interact and ultimately the outcome of the issue. It also determines how science can inform the situation. If values are clear and scientific uncertainty is low, scientists may choose to limit options. If values are vague or scientific uncertainty is not low, scientists may choose to expand options.

Pielke's goal in developing this framework is to help scientists and decision makers understand how science and policy interact and what range of roles and behaviors scientists can occupy and display. Pielke does not advocate for scientists to choose one role over another. He does, however, explain that "for politics to do its job there must first be alternatives" to choose from and notes that there is a "notable shortage" of the honest brokers, the role that would expand alternatives. Despite any potential bias, his conception is not value-laden, suggesting that some roles are *bad*

or *good*. Rather, it is a way for scientists and decision makers to understand more clearly what they do.

More importantly, scientists and decision makers may understand the ramifications of their interactions and how to work together more efficaciously. The democracy versus technocracy quandary noted by many scholars shows this is an issue of concern to post-industrial societies that is likely to grow in importance as societies advance. Pielke's framework is used in this study to address the question *how do scientists inform the permit streamlining process?* Like Pielke's goal in developing the Honest Broker framework, the goal here is to understand – in a real world situation involving layers of regulations, entanglements of bureaucracy and collaboration and the competing demands of the environment and the economy – the interactions between scientists and decision makers.

## RESEARCH METHODS

This case study examines the roles of nine scientists in informing federal and state agencies facing a decision on permit streamlining. It makes use of documentation, participant observation and interviews to capture expectations, behaviors and perceptions. The data are analyzed in terms of Pielke's Honest Broker framework.

### ***Data Collection***

The initial phase of data collection consisted of review of publicly-available reports, such as those conducted and published by federal and state agencies. Other agency information, such as that available on websites, furthered an understanding of agencies' missions, goals and jurisdictions. I also conducted participant observation through attending workshop planning meetings as workshop facilitation staff. This phase provided a current and historical understanding of the issues surrounding the RGI. The data captured here aided in the development of the background and interview questions. It contributed to understanding the workshop and the RGI's expectations for scientists.

The second phase of data collection consisted of participant observation of the RGI workshop. I attended the workshop as an employee of the Institute for Natural Resources, which was charged with facilitating the workshop. My duty was to take thorough notes, which I typed into a word processing program. I recorded the workshop in a conversational format, capturing as much of the content as possible and attributing it to each speaker. The notes covered the entire course of the workshop, not only scientists' comments. The meeting was not audio recorded. Several sets of notes written by other attendees (one state agency member and one fellow workshop staff person) were used along with the workshop's final report (written by the workshop facilitator, Gail Achterman of the Institute for Natural Resources) to corroborate my own set of notes. Immediately following the workshop, I revisited the notes to fill out content. Several weeks later, I produced the workshop summary in Appendix A.

Finally, I interviewed representatives of both of the main organizing agencies. I purposively sampled to select those informants who directed the focus of the workshop. These two informants, as representatives of the lead permitting agencies, had the greatest stakes in the outcome of the workshop. Non-probability sampling is

appropriate for this research because the objectives are to learn from a distinct group of individuals who have a particular experience and expertise and to become more informed about agencies and actors in this particular process. Respondents answered five questions (see Appendix C) pertaining to the role of science in policy in general and in the case of the RGI. The interviews were semi-structured, and open-ended questions allowed for the revelation and exploration of issues that were not previously known. Participants were recruited by phone and email during the last week of January 2010. Participants were offered the opportunity to proceed with the interview immediately at the time of recruitment or at a later time of convenience. Interviews were conducted over the phone and lasted approximately 20 minutes.

### ***Data Analysis***

The data present the opportunity to analyze what scientists were asked to do, what they did and how their behavior was perceived in terms of Pielke's framework. I analyzed data by posing questions in a three-phased approach.

1. *What were the scientists asked to do?*

I reviewed documents and workshop planning notes to ascertain the organizers' expectations for scientists and what intentions were communicated to scientists.

2. *What roles did scientists fill?*

I analyzed scientists' verbal responses as individuals and as a group through the use of workshop notes in three levels. First, I maintained the conversational format of the notes to keep the dialogue within its original context. I looked for summary points within dialogue for each speaker and then categorized each summary point as an instance of one of the framework's roles. Then, I re-organized the notes to group each speaker's comments together, maintaining chronological order. Here I looked for trends, especially advocacy that may not have been apparent in the previous phase. The results from these first and second levels were compared and refined to form a more accurate analysis. The characterization of each scientist's verbal responses resulted in a dispersion across the matrix. Finally, I analyzed the notes thematically to capture the prevailing topics of discussion and place them within the framework.

3. *How did organizers perceive scientists' roles?*

I used interview data to corroborate or contradict the results of the first two phases. Respondents are asked to characterize the roles of scientists. Their perceptions of the kind of information received is compared to what scientists were asked to do and what they did.

### ***Data Considerations***

This research aims to characterize scientists' behaviors by analyzing verbal statements and responses as captured in notes. A major limitation of the data is the inability to capture what was said outside of public, panel discussion. The workshop was conducted over two days at an out-of-town location. Significant discussions may have occurred outside of public range during breaks, at dinner, or on the road. These discussions could fall into any typified role and affect the policy process. A second limitation is that this study did not attempt to make assertions about the roles individual scientists or types of scientists exhibited. Results do indicate the different roles displayed by types of scientists, but since there is a lack of sufficient data and a lack of precise methods of evaluation to make such an analysis meaningful, this is included for convenience and clarity in reporting only rather than for inferring individual-level conclusions.

The following results and discussion refer to collaborators, organizers, lead organizers and scientists. *Collaborators* should be understood to be all those participating in the RGI, including but not limited to agency representatives, industry representatives and mining operators, excepting scientists. *Organizers* refer to a subset of agency and industry representatives who had significant impact in developing the workshop by way of participating in planning meetings and drafting documents, etc. *Lead organizers* should be understood to be the representatives from each of the main organizing agencies. *Scientists* refer to the nine government, university and private scientists who informed the workshop.

## RESULTS AND DISCUSSION

### What were scientists asked to do?

Reviewing RGI workshop planning documents provides a view into what organizers expected from scientists. These documents do not expressly describe scientists' intended roles or duties, having at best indirect references to "scientists", "experts", "panelists" or their roles. Documents describe the intent of the workshop as to address scientific and policy issues but not to make final permitting decisions. Planning discussions supported this notion and provided more detail in two ways.

First, organizers discussed which types of scientists, specific scientists and scientific panel structures would produce the best results. Organizers consulted with INR in choosing scientists. They chose to invite an assortment of scientists from Oregon State University, private consulting firms and government agencies to serve as panelists on either a geomorphological or biological panel. All scientists had a past association with the agencies and/or with INR. There was deliberation on which scientists could best contribute and inform, but there was no formal vetting of the scientists. Ultimately, some originally selected scientists agreed to attend while others did not due to availability. Organizers instead relied on the input of additional scientists from the same fields of expertise who had availability on the workshop date.

Second, organizers discussed which types of questions and which specific questions should be posed. Organizers were especially concerned with the appropriate phrasing of questions, whether positive or normative. It was understood that due to professional limitations, the duty of the USGS scientist would be to present information and to answer questions of a positive nature. Organizers expected something more of the scientific panelists. These scientists would interpret the information presented by USGS as it applies to permitting for aggregate mining on the Chetco River. The final set of questions was neither strictly positive nor strictly normative but aimed at eliciting professional opinions based on science.

The clearest indication of RGI's expectations for scientists came in the form of an emailed packet of workshop preparation materials. A letter informed panelists of the RGI's larger effort to "streamline the permitting process for mining aggregate on the Chetco River", the workshop's goal and their duties. Specifically the letter stated:



The main goal of this workshop is to gather expert input in order to understand whether any mining on the Chetco is sustainable and, if so, how much mining is appropriate. By providing your perspective and interpreting existing scientific literature, you will be assisting policy makers as they address regulatory issues ....

Reviewing these documents is all that is needed to prepare for the workshop.... As an expert panelist, we hope that you will help to clarify scientific issues and lend your expertise to this collaborative effort. Specifically, on the first day, the expert panelists will all be asked to comment on the USGS report on sediment transport. On the second day the expert panelists will be asked to address the technical questions.

(Institute for Natural Resources 2009)

Along with this letter, panelists received a copy of the agenda, the technical questions, several scientific background documents and a brief background document on the RGI.

Organizers' expectations clearly do not fit the Madisonian idea of democracy, in which experts align with interest groups. Instead, organizers expected panelists to operate in line with Schattschneider's model of democracy in which experts provide alternatives to the public. (Figure 4 is repeated here for convenience). Whether

**Figure 4: Pielke's Honest Broker Framework**

		SCIENCE	
		Linear model	Stakeholder model
DEMOCRACY	Madison	<p><b>Pure scientist</b></p> <ul style="list-style-type: none"> <li>• provides fundamental information with no consideration for use or utility</li> <li>• allows research results to pool in society's reservoir of knowledge</li> <li>• has no interest in decision making and does not interact with decision makers</li> <li>• leaves use of information to decision makers</li> </ul>	<p><b>Issue advocate</b></p> <ul style="list-style-type: none"> <li>• focuses on the implications of research for a particular political agenda</li> <li>• aligns with a group seeking to advance interests through policy and politics</li> <li>• directs focus to a particular choice or set of choices</li> <li>• tells decision maker what to prefer</li> </ul>
	Schattschneider	<p><b>Science arbiter</b></p> <ul style="list-style-type: none"> <li>• acts as a resource answering factual questions relevant to decision maker</li> <li>• focuses on positive rather than normative questions that can be resolved by science</li> <li>• has interaction with, but does not attempt to sway, decision maker</li> <li>• may serve on a panel or advisory committee and return findings</li> </ul>	<p><b>Honest broker of policy alternatives</b></p> <ul style="list-style-type: none"> <li>• integrates knowledge with stakeholder concerns through possible alternative courses of action</li> <li>• expands or clarifies scope of choice and allows decision maker to reduce scope of choice based on own preferences</li> <li>• may be a collection of experts working together with a range of views, experiences and knowledge</li> <li>• seeks to enable decision maker's freedom of choice</li> </ul>

organizers' expectations align with the linear or the stakeholder model of science is less clear. The statement of the main goal to be the determination of positive information (whether aggregate mining is sustainable) and the putting of effort into crafting positive questions corresponds to the linear model. However, all other indications suggest a stakeholder view. All scientists with the exception of the USGS scientist were expected to "interpret" research findings to apply to this case. Scientists were directed to provide "expert input" and "[their] perspective", to "clarify scientific issues" and "to comment on the USGS report", indicating a high level of interaction between the scientist and the issue.

Despite efforts to frame the workshop and technical questions in positivistic terms, the ultimate goal ("how much mining is appropriate") is a normative question. Organizers used language consistent with both the science arbiter and the honest broker of policy alternatives roles. Although they in some ways framed the workshop as a task for science arbiters, through their choice of language organizers ultimately indicated to scientists that they should act as honest brokers of policy alternatives.

### **What roles did scientists fill?**

Pielke's theoretical framework provides four clear ideas of scientists' roles, occupying a spectrum from limiting to expanding options, in policy. Typifying scientists' actions according to those categories in practice is not as clear cut. Neatly interpreting every action or statement to be a display of one role is imprecise, as arguments for one instance fulfilling various roles could be made. However, typifying each scientists' statements throughout the course of the workshop and then aggregating those results provides a fairer picture of which roles were filled by whom and what issues and inconsistencies arise. The considerations made in typifying statements are discussed in the following paragraphs before results are presented.

Necessarily, no scientists filled the role of pure scientist. Merely participating in the RGI workshop precludes scientists from taking on this role because scientists agreed to interact directly with decision makers. Most often recognized in the workshop transcripts were the roles of science arbiter and honest broker. These two roles are often exhibited by scientists participating as part of a panel or advisory group, and this was the case at the RGI workshop.

Distinguishing between the science arbiter and the honest broker could be difficult. The determining factor proved to be whether a statement directly referenced

the policy issue. For instance, a scientist describing the types of habitat required by a certain species would be acting as science arbiter, but the same scientist suggesting methods for creating or monitoring that habitat within the Chetco River would be acting as honest broker.

Those roles could further become conflated with the role of issue advocate. Though scientists sometimes acted clearly as an honest broker by stating several courses of action or even by asking questions meant to clarify and expand the range of options, in other instances scientists made statements directed toward a particular course of action which may have been viewed as issue advocacy. Within the context of the discussion, they may simply have been clarifying the range of options or may have been advocating. In these instances viewing the compiled record of each scientists' responses showed whether patterns of advocacy emerged.

Whether any of these instances should be considered issue advocacy is debatable. According to Pielke's (2007) framework under the Madisonian view of democracy, issue advocates support an issue and use politics to advance their agenda. One might argue that a scientist would have to align with an interest group to act as an issue advocate, but in Pielke's framework this is not a necessary condition. The determining criteria here is whether a scientist's input had the effect of limiting rather than expanding options regardless of any known or unknown connection to any interests. The instances noted here should be understood with that caveat.

I began by analyzing the data in its original format to determine the frequency of each role's exhibition by each scientist. I then refined those results by organizing the data by speaker while maintaining chronological order. This helped to clarify statements that may have been instances of more than one role and to affirm or to dispel instances of issue advocacy.

Results are illustrated in Figure 7, shown in the format of Figure 4, Pielke's Honest Broker Framework. Under each role is a subset of nine boxes. Each of the nine boxes represents an individual scientist's contribution. The dark gray cells represent government scientists, the medium gray cells represent university scientists, and the light gray cells represent private scientists. Observed instances are marked by a '●' rather than numbered to emphasize relative frequency rather than absolute number. The marks under each role's title indicate the number of instances totaled across all scientists. Honest broker was the most frequently



narrative that considered scientific elements of habitat and geomorphology, but the narrowing of options nonetheless surfaced in the second level of analysis. In contrast, another scientist who consistently acted as a science arbiter and honest broker argued one point in three instances. The second scientist's presentation of the argument differed from that of the first scientist in that it encouraged decision makers not to choose a specific policy option but rather to frame the policy questions in a particular way. In these instances of advocacy, the second scientist continued to act as an honest broker by attempting to clarify and expand options to decision makers rather than to limit them.

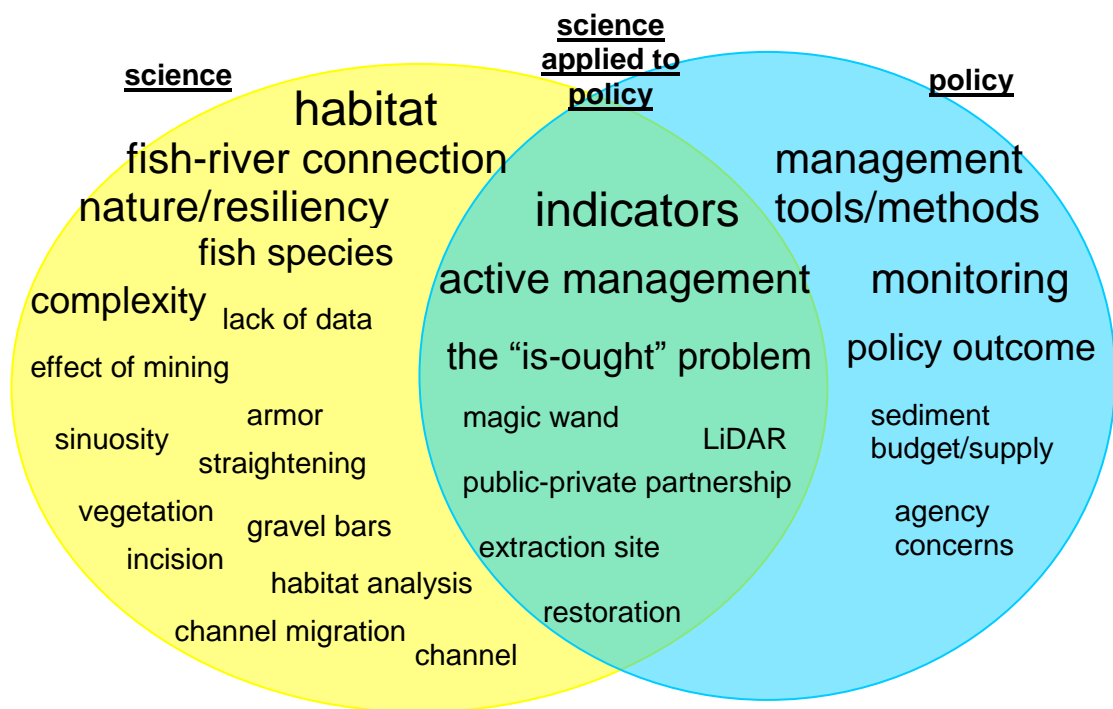
Analyzed this way, each scientist was found to have an issue of central concern. (See Table 4. Scientists 1-5 are government scientists, 6-7 are private scientists and 8-9 are university scientists.) Whether presenting that issue was taken to be an instance of issue advocacy depended on the way it was presented, by either limiting or expanding options. If the issue was presented in a way that directed decision makers to a preferred course of action, that instance was counted as issue advocacy.

Scientist	Issue of concern	Tell decision makers what to prefer?
1	frame decision making by defining a set of preferred conditions and then deciding how to achieve them	no
2	resiliency of nature	yes
3	fish species	no
4	river complexity	no
5	river complexity	no
6	active management through public-private partnership	yes
7	benefits of extraction	yes
8	pragmatic decision making	no
9	need for more information	no

Analysis revealed that scientists generally tended to act as science arbiter earlier in the course of the workshop and progressively capture the role of honest broker. This was not a one-way relationship. Scientists could go between the two, but on the whole appeared to become more willing to expand options rather than just answer questions as the workshop progressed. This may be due to the structure of the technical questions, the workshop as a whole, or some other factors such as the progression of conversation and interaction between scientific panelists and attendees. Whatever the case, the honest broker role was the most frequently observed through the first two levels of analysis.

The final level of analysis, in which I analyzed scientists' remarks across the entire workshop thematically, revealed overarching issues and helped to characterize the overall discussion. Scientists' behaviors were aggregated to characterize the outcome of the workshop's discussions as a whole. At this level issue advocacy proved to be non-existent. The grouping together of scientists' remarks negated any biases or limiting of options. What emerged instead were three sets of issues: scientific, policy and science applied to policy. Figure 8 displays major issues within each theme, with text size indicating comparative frequency of occurrence.

**Figure 8: Themes and Issues Presented in Workshop Discussion**



Analysis of workshop notes illuminated the presence of three themes of discussion and major issues within each theme. The following is a brief explanation of selected terminology under each theme.

**Science** - “complexity”, “sinuosity”, “straightening”, “incision”, and “channel migration” refer to dynamic physical qualities of the river; “armor” & “gravel bars” refer to specific formations within the river and in this case can represent fish habitat and mining sites; “vegetation” refers to the plant life supporting the river’s ecosystem.

**Science applied to policy** - “indicators” refers to measurable qualities of the river’s ecosystem that can reflect its health to decision makers; “active management” describes setting a policy based on physical goals for the river system and actively trying to achieve them, possibly through the use of operators’ equipment and “public-private partnership”; “LiDAR” is a topographic mapping method used to monitor river health; “the ‘is-ought’ problem” describes science’s inability to inform how river qualities should be devoid of values, that is, science can inform how the river is but not how it ought to be.

**Policy** - “sediment budget/supply” refers to setting extraction guidelines based on the amount of available sediment or gravel

The results shown here are consistent with previous results. While issue advocacy was minimized and even negated at this level, science and policy options were central to the discussion. Each issue was presented by one or more scientists

with the opportunity for discussion, assessment and debate. The array of issues provide a field of options to decision makers, and the discussion of scientific issues serve to clarify some of those options. Many issues fell under the theme of science, emphasizing the role of the science arbiter in informing discussion, but the honest broker role best describes the statements and behavior of the entire group of scientists. The aggregated outcome of discussion, issues and themes had the effect of expanding and clarifying options.

### **How did organizers perceive scientists' roles?**

Due to the complexity of the issue, RGI lead organizers asked outside scientists to provide their input. One lead organizer identified “objectivity, good scientific credibility...and an outside, known, non-vested perspective” to clarify a value-laden problem as a main concern and hoped that science would help collaborators to understand the problem as well as the implications of decisions. He also hoped that the workshop would help science, rather than economic interests, to drive decisions (Interviewee 1 2010). The other lead organizer emphasized “informing” the decision making process through good research to make defensible decisions (Interviewee 2 2010).

Lead organizers considered this workshop a necessity rather than a luxury. The group had “hit a brick wall” (Interviewee 1 2010) in terms of making progress through political and scientific barriers to permitting. They saw the workshop as a venue through which agencies could represent their interests, become informed and have issues clarified.

In particular, the group needed to understand the science underlying the river system, especially as it relates to gravel transport and extraction and fish habitat. The RGI wanted to understand not only the present conditions but also the future implications of changes. Lead organizers had hoped that having this information would form a mutual understanding between economic and resource protection interests (Interviewee 1 2010; Interviewee 2 2010).

Organizers' thoughts prior to the workshop would have led a scientist using Pielke's flow chart to the role of honest broker for three reasons. First, despite having many values in common, a lack of some values and a lack of bridging between similar values resulted in sets of different values. Both lead organizers described the values in terms of agencies' mandates. Some RGI agencies act as regulators, “supporting

the public interest and balancing competing demands” (Interviewee 1 2010). Those agencies share a broad range of general and specific common interests. Other agencies are charged solely with protecting one resource. Those agencies share some values but see them from a different perspective. The two groups of agencies share some overlapping values, but as a group the RGI did not share a consensus of values.

Second, and unsurprisingly, RGI lead organizers also did not see low scientific uncertainty. This was the reason for organizing the workshop. Organizers’ main concerns were whether gravel operations caused impacts on fisheries resources, whether operations could continue, and if so under what conditions. The significant scientific uncertainty is what provided the opportunity to design an adaptive management process harnessing the uncertainty and managing it over time.

Finally, lead organizers hoped that scientists would expand or (in an unprompted, Honest Broker-termed response) “clarify” options. Lead organizers wanted to gather “new” or “additional” thoughts to inform decision making (Interviewee 1 2010). From there, collaborators narrowed that range of options into policy outcomes for political or administrative reasons rather than for scientific ones.

While the two lead organizers broadly shared views, one of them presented two distinguishing points. First, the lead organizer indicated an appreciation for scientists who had long-term, local experience, noting one scientist’s twenty years of working on the Chetco as an example of providing insightful information. The lead organizer did not, however, have the same appreciation for scientists whose experience working in agencies provided comparable policy insights because of the workshop’s scientific focus. Second, the lead organizer mentioned that this process was meant to be modeled after the County of Humboldt Extraction Review Team process (a similar process developed in California approximately 60 miles south of the Chetco River by the Corps’s San Francisco District that makes use of a Corps Letter of Permission rather than a Regional General Permit). For that reason involving science was necessary. This was mentioned as a side note rather than as a primary reason for involving science (Interviewee 2 2010). The other organizer may have shared these views but did not voice them.

The previous sections showed that organizers indicated scientists should fill the role of honest broker with some attributes of a science arbiter and that scientists did fill those roles. Lead organizers indicated that the information gathered at the



workshop was ultimately what they needed, even exceeding expectations. The information was found to combine elements of policy and science in an “encouraging” way that “enhanced understanding” (Interviewee 1 2010).

Organizers emphasized that at that point in the collaborative process, science was needed to help reconcile the “different value sets around the table. That’s part of the strength of collaboration – bridging gaps, respecting perspectives – and through understanding science, relieving fears and finding areas that can be conceded or compromised and build collaboration.” Yet science alone could not have decided the policy outcome. The effort “had to respect people and agency issues.” The workshop was effective in doing these things, as organizers were pleased with the progress made in issuing permits (Interviewee 1 2010).

### ***The Framework, the Workshop and the Role of Science***

The Honest Broker framework provides a structured way to capture and analyze the role of scientists at the RGI workshop. Analysis revealed that organizers may not have been entirely sure of their expectations for scientists. Regardless, they communicated to scientists that they should act in a manner characteristic of honest brokers of policy alternatives and, to a lesser degree, science arbiters. Scientists filled those roles, and organizers were pleased with the result. The following paragraphs summarize thoughts on scientists’ roles and limitations at the workshop. The discussion then turns to the larger role of science in informing permit streamlining.

#### **Shifting Roles**

Scientists could and did exhibit multiple roles at the workshop. They were precluded only from exhibiting the role of pure scientist by definition. They were free to move between other roles, but tended to act as science arbiters and honest brokers. They tended to answer factual questions in accordance with the role of science arbiter early in the workshop and progressively clarify and expand options to policy makers in accordance with the role of honest broker.

Environmental factors may explain the observed shift. Scientists may have become acclimated to the workshop, the issue or the other attendees and found themselves able to expand their purview as time progressed. In some instances a scientist would make a statement in factual, scientific terms but conclude in more general terms, often suggesting that decision makers take a normative approach to

the issue. Alternatively, the workshop facilitation may have changed. The facilitator or attendees may have altered their approach or directed questions in a different manner.

The Cynefin framework offers another possibility. Scientists in this study moved between the roles of science arbiter, honest broker and issue advocate just as Snowden and Kurtz (2003) identified people moving between the chaos, complex, knowable and known domains. Two examples illustrate how scientists' movement corresponds to identified dynamics. In the Cynefin framework, *incremental improvement* refers to information moving between the knowable-known boundary, as explained previously by the scientific method. At the workshop, scientists' explication and interpretation of information lead to decision makers' formation of questions and new possibilities. *Swarming* refers to moving first from the domain of chaos to the domain of complexity and then on to the knowable domain. This movement may be characterized by a particular instance in which scientists captured separately the geomorphological and biological indicators of river quality and fish habitat to identify patterns in the complex domain. Scientists then described methods for connecting and managing those patterns as a system. Scientists' behavioral dynamics as described within the Honest Broker framework are consistent with patterns identified in the Cynefin framework.

#### Organizers' Ability to Direct Workshop Outcomes and Bridge Gaps

The phrasing of technical questions left little room for any panelist to act strictly as a science arbiter. Organizers gave careful attention to the types and phrasing of questions to elicit the information they sought. This illustrated organizers' abilities to achieve a desired outcome through workshop design and to direct scientists to fill certain roles through preparation and facilitation.

Yet organizers may have missed another opportunity when they provided nothing more than a brief background document prior to the workshop and supplemented it with several presentations amounting to about one hour on the first day of the workshop. According to Pielke (2007), the lack of political background to the issue limited the ability of scientists to clarify options despite the fact that this workshop was science- rather than policy-oriented. Furthermore, individual scientists may have varied in their abilities due to having more background information than others. Some scientists likely had intimate background knowledge due to engagement with similar previous issues. Better informed scientists could have

provided more pertinent options, and evenly informed scientists could present a fairer spectrum of options.

Better informed scientists may also have helped to bridge separation of academic disciplines. The problem of traditional separation between scientists and decision makers is noted in the literature (Rosenbaum 1995; Scott et al 2008; Roux et al 2006), but here the separation between scientists – the geomorphologists and biologists – proved to be a problem. Although the two groups recognized the need to describe fish habitat in terms of physical river conditions in order to provide practical policy options, they struggled to do so.

#### Potential for Advocacy and Conflicts of Interest

The role of issue advocate proved to be minimal throughout several levels of analysis. Three instances were noted, one by a government scientist and one each by the two private scientists. These scientists may have been acting out of habit, representing their own or their agency's interest not for personal or professional gain but as is their custom. Alternatively, they may have been eager to represent what they view as the best option among the cacophony of others. Finally, they may have been acting out of dueling experts syndrome, staking out strong positions that could later be relaxed. Behavior over a longer time period than this two-day workshop is necessary to fully recognize what is advocacy, what is not and what motivates.

Questions remain as to the effect of any conflicts of interest. Four of the nine RGI scientists are employed by agencies that have a hand in providing opinions for permit applications though they may not personally have a hand in any decision making in this case. Scientists made references to their professional roles and their agencies, expressing their familiarity with the issue as agency professionals. While none have a known direct stake in the outcome here, some may still harbor biases or be limited by agency behaviors.

#### Structure and Composition of Scientific Panels

The panel-of-experts structure provides a neutralizing effect to any potential advocacy. Singular instances noted in the workshop were ultimately outweighed by the combined interests and efforts of all scientists. Even if some agency panelists represented agency concerns, if they ultimately clarified or expanded policy options as part of the group, they acted in the role of honest broker and not as issue advocate. This structure also suppressed opportunities for scientists to duel.

The composition of scientific panels should be of concern here as it was in the case of the RGI. Although organizers initially chose a group of scientists to lend their expertise to this process, they later settled on a selection of scientists based on their availability to attend the workshop. This suggests that while there was forethought into which scientists could best inform the process, ultimately the deciding factor in choosing scientists had little to do with what roles they could offer but rather simply who was available. A different set of scientists would have provided different individual outcomes but may not have seriously altered the outcome. With this type of panel the result will be the honest broker role unless the panel is aligned with an interest.

This is not, however, just cause for haphazardly choosing scientific panelists. Just because a panel or group of scientists represents a variety of backgrounds and expands options does not mean that they do so in a well-informed, pertinent way. That a group of scientists expands policy options does not mean they provide any good options. Research has shown that scientists are not universally confident in their abilities to provide objective information, advocate and make decisions (Steel et al 2004). Instead, this may be cause for choosing experienced, well-informed, well-rounded scientists with the broadest feasible set of backgrounds.

There is a trade-off to be made between scientists who are familiar with a given issue and those who are not. Those who are familiar can provide expert opinions on the science, policy, local and organizational issues. In this case, one organizer expressed great appreciation for the insights of a scientist with twenty-years' worth of experience working on the Chetco. However, those same, well rounded experts may also exhibit trained incapacity, the case when an agent's learned behaviors, which are necessary to work effectively under a certain set of conditions, act as impediments to expanding or clarifying options for working in new conditions. This may apply particularly to government scientists who work inside bureaucracies. Such scientists may be well-informed, but they may also be reluctant to change and therefore may not represent the entire field of options fairly.

#### Role of the Facilitator

Facilitators play a vital role in policy disputes. In this workshop the facilitator acted as a sentry managing passage of information between scientists and audience. One might even argue that she filled a role as or more important to the outcome of the workshop than that of the scientists. Yet despite all the attention given to

scientists, the facilitator received only casual consideration in this study. This has been intentional. The facilitator's role is separate from those of the scientists. Where scientists' duties involve the communication of science, the facilitator's duty involves communication and guidance. True, the facilitator may harbor biases and has considerable ability to effect them, but the aim of this study is to view role of scientists at the workshop in light of Pielke's framework rather than to reveal the degree to which the facilitator affected the outcome.

However, noting the Honest Broker framework's inability to address this issue is important. Pielke gives considerable attention to the fact that panels tend to display the roles of science arbiter and honest broker, but he does not attempt to explain how facilitators affect the outcome. This is largely by design. His framework poses conceptions of democracy against conceptions of science and can be justified by the democracy versus technocracy quandary. Assigning a facilitator to this framework could only be done forcefully, as while a facilitator may have very strong opinions on science and democracy, his goal has less to do with those two and more to do with conceptions of communication and collaboration. Pielke's framework simply does not allow for analysis of the facilitator's role in a meaningful way. In that way it falls short of fully describing scientists' roles, but Pielke never attempts to explain all external or limiting factors.

#### General Issues with the Honest Broker Framework

This case study points out additional issues that would benefit from further discussion or clarification within the Honest Broker framework. Analysis revealed confusion between the roles of science arbiter and honest broker. According to Pielke's flow chart (see Figure 6), this should not happen because whether there is a consensus of values and low uncertainty should place scientists in one role or the other. But as he also notes, the flow chart is defined by the difference between tornado and abortion politics, which are idealized concepts. In the real world, even if clear, shared values and low uncertainty exist, the two might not be communicated clearly between scientists and decision makers.

Two things are perhaps overlooked in the Honest Broker framework. The first is the role of local or traditional knowledge in informing policy. Pielke does not make space for this type of expert in his framework. This is understandable because local or traditional experts are not trained as scientists, yet they can play an invaluable role in informing. The local experts in this case were gravel mining operators seated in

the audience. Though not analyzed in this study, operators' contributions described in the workshop summary in Appendix A show that operators were able to fill gaps in knowledge. Whether this type of contribution is likely to expand the range of options presented to decision makers or limit the range of options in the manner of an issue advocate who intends to protect his economic best interest is unaddressed by the Honest Broker framework.

The second is the importance of questions from scientists. Scientists often asked questions of science, policy and the science-policy interface at the workshop. The questions were posed to other scientists, to decision makers and to the group at large. This actually served to expand and clarify options. It is part of scientists' exchanging ideas with each other in a public setting, agreeing or disagreeing and posing new questions to arrive at options and recommendations. This suggests that science is not a one-way conversation and stresses the normative component of policy. While science can inform decision makers as to how to achieve some set of conditions, that set of conditions must be decided upon outside the realm of science. Decision makers should be ready to answer questions about their goals for society and for natural resources in order for scientists to be able to provide pertinent information.

#### Moving from Empirical to Normative Modes of Operation

The need to consider policy issues in a normative way resonated throughout the literature and data analysis and appears to be the most important implication for informing permit streamlining with science. Academics, scientists and decision makers repeatedly stress that science can not prescribe an ideal set of conditions but rather that society must set out the ideal outcome and consult science on how to achieve it. There was no singular resolution to the technical questions in that sense. However, there seemed to be a sort of resolution as workshop attendees adapted to a new, normative mode of conceptualization. One attendee captured the shift by describing a switch from the "avoid, minimize, mitigate" conceptualization often used by agencies to one of creating a desired river system, functioning in dynamic equilibrium through adaptive management techniques.

#### Moving Closer to the Goals of NEPA, Streamlining and Collaboration

The workshop and its outcomes should be considered in light of several main issues in environmental policy processes. First, it quelled a main criticism of NEPA

processes, that even though environmental reviews are completed as required, the results become only a side note or afterthought to the policy process rather than providing a basis for decision making. Because science figured so prominently in this process, with organizers emphasizing that no permitting decisions would be made at the workshop, science took its role of informing policy as intended by NEPA. Scientists representing a fair range of expertise discussed merits and drawbacks of mining, and their input informed environmental review and policy. A remaining concern is that the structure of the workshop, in which only agents and a limited number of mining operators were in attendance, did not allow for public involvement which is a goal of NEPA. Public involvement may be allowed for in another setting.

Taking this first point further, it should be noted that the increased access to information provided by the workshop should have a positive effect in helping agencies meet deadlines and set standards. As Rosenbaum (1995) asserted, lack of information causes agencies to struggle to make decisions. Increased access to and integration of information, on the other hand, has been found to result in better decision making (Gaines and Lurie 2007; Rabe 2002; Yukon 2005).

However, this positive effect comes at a cost of time and money. NEPA processes are known to be time- and money-intensive, and though this format was not demanded by NEPA, it was no different. Agents had to commit at least two days to attend the workshop, and organizers paid for meeting facilities, facilitation staff and scientists' honorariums. These costs may be offset in the future by benefits in terms of time or money to RGI collaborators, gravel operators and citizens of Oregon alike, as is a goal of streamlining.

Second, in this case the primary goal of streamlining was not to promote development as set out by Governor Kulongoski's 2001 & 2007 executive orders. Instead, organizers sought to "determine if gravel removal is permissible (sic)" ("Chetco Gravel Mining Workshop"), a goal more closely aligned with streamlining NEPA processes to coordinate environmental reviews and Governor Kitzhaber's 1999 executive order on sustainability. RGI organizers' purpose was not to make permitting a swift and friendly process for operators, as the Water Related Permit Process Improvement Team (Team) aimed to do, but to determine whether mining is permissible in terms of having availability of resources.

Oregon does not have a system that aims to accommodate a process such as this one. The Office of Regulatory Streamlining made the Team's efforts to identify

permitting problems possible. The Team issued 32 recommendations to improve the current process and even more to overhaul the process with the intent of providing benefits to agencies and operators. Yet little change was effected as a result of its recommendations. Although permit applicants may have noticed incremental changes, the RGI's current process was still deemed necessary to allow for mining at all.

Processes like this one may only become more important as issues become more complex. For instance, at the workshop both operators and scientists indicated that external factors not subject to scrutinous review like that required by NEPA likely had significant effects on the environmental qualities under consideration. Runoff from upriver subdivisions likely affected water quality and may have affected fish habitat, but constructed as a project without federal oversight, the subdivision's developers did not have to account for the same kinds of environmental effects for which gravel mining operators are accountable. Further upriver a currently proposed gold mining camp must seek a series of federal and state approvals similar to those required for mining gravel (Zaitz 2010). Streamlining in the spirit of NEPA and sustainability goals could provide better outcomes for that project. It could also promote coordination with and fairer outcomes to downriver aggregate mining operations which are affected by upriver activities.

Finally, this case is a prime example of science being used not only to inform policy but also to encourage collaboration. Organizers felt the workshop was necessary to unite agencies with shared turf due to a political and scientific impasse. The shared turf amounted to what Pielke terms *values*. Collaborators shared overlapping turf and values, but their shared interests did not entirely correspond. To fill the gaps in turf or values, the workshop allowed collaborators to focus on the science at the heart of the issue rather than on political concerns. Collaborators seemed to have the ability and the need to come together around fundamental scientific issues rather than incongruous sets of values.

The caveat remains that despite all efforts this process may not lead to a singular set of shared conclusions in regards to scientific issues. As Smith et al (1998) explained, even an overwhelming amount of scientific evidence did not lead to agreement among managers, users and citizens on reasons for salmon decline in a separate issue. Chase et al (2008) further explained that though scientists certainly impact participants' learning in collaborative processes such as this one, the strength



and duration of the effect is not known. Collaborators' post-workshop ideas were not captured in this study, but a newspaper interview published after the Corps released its public notice indicates that operators take issue with agencies' conclusions about science. One operator is quoted as saying, "We just don't agree with what they're saying... It's not based on science. [The agencies] have paid for science but have not based anything on it" (Corley 2010).

The outlook seems relatively bright for this case. Lead organizers' responses in this study indicate that science was quite effective in informing policy, fostering agreement and impacting learning. Interviewed more than two months after the workshop, the two held a strongly-positive view on the outcome of the workshop and a positive to enthusiastically-positive outlook on the likelihood of issuing streamlined permits this season.

## CONCLUSION

The Regional Gravel Initiative organized as the result of competing environmental and economic concerns. Faced with an intractable and uncertain issue, organizers enlisted scientists to understand the technical, rather than administrative or political, barriers to permitting for aggregate mining. Informing policy with science not only helped to solve the issue at hand – whether environmental conditions allow for aggregate mining – but also worked to foster interagency collaboration and make NEPA procedures efficacious. Collaborators worked to harmonize their goals, to support Oregon’s goals of sustainability and streamlining and to address a main problem with NEPA. In this case, science was paramount to achieving local, state and national goals.

This study sought to characterize the roles of scientists in a real world situation using the Honest Broker framework. Scientists and the panels they formed were found to fill the role of honest broker of policy alternatives with some variation to the role of science arbiter, very little variation to the role of issue advocate and no variation to the role of pure scientist. Given background information on the policy issue and using Pielke’s flow chart, this outcome is to be expected.

The framework was applied to one defining occasion of debate - the RGI workshop - among several years of deliberations on this particular issue. The workshop’s design left little room for exhibition of roles other than science arbiter and honest broker, but nothing precludes informing through other roles at other points in time. Therefore, considering ways in which scientists could inform or have informed the larger issue through all roles may be instructive. Possibilities include the following:

- The **pure scientist** informs without direct interaction with the decision maker, uncovering findings for the sake of science without regard to politics. Many pure scientists have informed this situation through publishing reports on topics related to in-stream aggregate mining. These topics vary widely from minute details of salmon habitat to broad techniques for adaptive management. A drawback to informing this way is that scientific reports can be esoteric, and even experienced, science-oriented agents may have difficulty understanding and agreeing upon results. Agents may come to different conclusions about scientific findings or the resulting proper course of

action. This disagreement may lead to the need to reconcile differences, possibly resulting in a workshop like the one the RGI used.

- The **science arbiter** may inform outside of a panel setting but, not seeking direct interaction with decision makers, would have to be sought out. RGI collaborators could initiate contact with an individual scientist and present her with a specific set of questions. In other words, collaborators could seek the advice of a consultant. To truly act as a science arbiter, this consultant could only answer specific, positive questions and for decision makers further clarification may be needed. An example of this arrangement is RGI's consultation with USGS on bed material transport and channel change in the Chetco River. USGS was consulted to answer specific, positive questions. It returned results in the form of a report and presentations but left decision makers with questions about how to interpret the report to the policy setting. The RGI workshop was later developed to answer those questions.
- The **issue advocate** informs with the intent of directing the decision maker as to what to prefer. While three instances were noted here, there remains the question of whether these were true instances of advocacy. The role of issue advocate would be more clearly be represented by a scientist working for a group solely interested in protecting an element of the environment or the aggregate industry. This scientist would attempt to interact with decision makers in an argument that would encourage them to choose a certain option or set of options.
- **The honest broker**, like the science arbiter, may inform outside of a panel setting. Engaged with politics, nothing stops the honest broker from seeking interaction with policy makers, but in contrast to the issue advocate, the honest broker would only do so to expand or clarify options to decision makers. In practical terms, an honest broker to the RGI would be a consultant whose job is to expand options to decision makers, possibly by conducting a study synthesizing scientific information relevant to the issue or, of course, by acting as a scientific panelist as seen in this study. The honest broker would not be limited to answering positive questions.

The need to use and understand scientific information may often lead decision makers to seek honest brokers, but there is no value judgment associated with taking any of these roles. According to Pielke, all roles are needed to inform policy.

Decision makers and scientists should simply be aware of these roles and the expected outcomes of employing each one. In choosing which strategies to adopt, decision makers can consult the framework in an effort to evoke the type of information they seek. Scientists can use the framework to determine what type of information is best suited to assist decision makers.

## ***Recommendations***

### **1. Decision makers hoping to inform policy issues with science should:**

- a. have a clear understanding of the shared values or of the *confusion of values*** among agencies, agents, scientists and other stakeholders. This first step to decision making will begin to determine what type of information is apt to solve problems.
- b. choose scientists wisely.** Scientists have a wide range of abilities to inform policy. Some scientists have intimate knowledge of local issues (e.g. a scientist who worked for 20 years on the Chetco) while other have intimate knowledge of agency issues (e.g. a scientist who worked for 20 years in an agency). Even scientists who are armed with all relevant knowledge may still be reluctant to fill some roles and eager to fill others. Decision makers should be aware of the probable outcomes of choosing among these options.

These abilities change when scientists are grouped together or placed in different situations. Particular to the panel format, analysis shows that all panels, save those formed by biased groups, will exhibit qualities of honest brokers. That gives no guarantee, however, that those panels will provide well-rounded information. The best panels are likely to be those comprised of a variety of individuals, some representing agencies and all willing to consider an array of options.

- c. communicate expectations of scientists clearly.** Decision makers communicate certain needs and expectations to scientists. They should do so thoughtfully with clear ideas of what they expect to see as an outcome. Doing so may help to ease a problem noted by Steel et al (2004), that scientists are not confident in their abilities to inform. Clear communication should direct scientists to provide the type of support needed, whether strictly informative or

presenting an array of options, and make scientists feel secure in providing information.

- d. provide scientists with the relevant background information.** Scientists need not be issue experts to inform policy, but providing scientists with a solid base of pertinent information will help to bridge the gap between disciplines, just as decision makers develop some basic level of scientific knowledge to deal with science-oriented policy issues.
- 2. Scientists should be aware of the roles they fill.** Scientists do not simply inform policy in one way. They have the opportunity to fill a range of roles effecting different outcomes. To best inform policy, scientists should be aware of what they are doing and be honest about what they hope to achieve.
- 3. Facilitators should help decision makers choose scientists wisely, be aware of their ability to direct the behavior of scientists and use that ability.** This recommendation does not only apply to policy makers but to all those who have a hand in choosing scientists. Though the impact of the facilitator was not under study here, the facilitator has significant power to affect the outcome of workshops.
- 4. The State of Oregon should consider its motivations and expectations for streamlining.** The problems described in this study with permitting for aggregate mining are neither new nor unique. State agencies are encouraged to streamline and have devoted significant effort, time and money to making permitting more amenable to applicants. Despite all efforts, problems persist. This case showed that the efforts of the Office of Regulatory Streamlining, now the Economic Revitalization Team, to make permitting more applicant friendly addressed important issues but not essential ones. Addressing applicants' desire for convenience and customer service will benefit neither applicants nor the economy unless more basic issues are not addressed. The state should consider whether addressing the basest issues of permitting and other problematic policy areas will produce the desired effects of easing applicants' burdens better.

### ***Future Studies***

This study captured the roles of scientists within a workshop setting. Interviews with lead organizers conveyed their perceptions of scientists' behaviors but

gave no indication of how others perceived scientists' behaviors. Future research could address this gap, seeking to understand how collaborators, operators and the public perceived scientists.

This study was limited by the inability to capture information exchanged outside of workshop discussion and to analyze results on the level of individual scientist or types of scientists. Future research could seek to address these limitations through an alternate research format. More research is also needed to understand other factors that encourage or allow scientists to fill one role or another. These factors may include the influence of the facilitator and the structure and culture of organizations such as universities and private research institutes.

Finally, it is important to note that the Regional Gravel Initiative has not ended its efforts. The agencies are optimistic about issuing permits this season. If they do, they will implement an adaptive management process requiring further expertise. Future efforts are intended to impact other Oregon rivers, the Umpqua, Tillamook, Rogue and Coquille Rivers (U.S. Army Corps of Engineers Undated). If permitting is delayed, the RGI may again consult scientists to inform the policy. Therefore, the need for informing through science remains. Research that captures further detail on how science informs policy can only improve outcomes and increase the applicability of streamlined processes.

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## **APPENDICES**

## APPENDIX A: Summary of Workshop Findings

### The Regional Gravel Initiative Workshop

Charleston, OR - November 30-December 1, 2009

### Summary Report

The Regional Gravel Initiative is a collaborative effort comprised of representatives of four federal and four state agencies. Participants organized in 2006 to address the issue of permitting for aggregate mining on the Chetco River near Brookings, OR. The effort was divided into an executive team and a technical team. It exposed the problems of balancing the economy with the environment as well as gaps in technical knowledge that hinder agencies' abilities to develop sound policies. To address those gaps, RGI commissioned a technical report, provided by the US Geological Survey in 2009, on the channel change and bed material transport of the river. The report was rich in technical information, but left RGI collaborators, who needed to interpret the information into an actionable policy framework, with a more detailed level of questions.

RGI held a workshop to better understand and interpret the report. Organizers enlisted the help of scientists and seated them on a biological and/or a geomorphological panel. Over November 30 - December 1, 2009, federal and state agency representatives along with aggregate industry representatives questioned federal, state, university and private scientists. The major issues of concern included fish habitat and river health, whether mining could be consistent with or even conducive to river health, and especially what information remains unknown and how to gather it. This report describes the workshop through three sections: What We Know, What We Don't Know, and What Needs To Be Done.

**What We Know:** *A significant amount of technical and local knowledge supports our understanding of the river. Integrating and interpreting information is difficult. Using a variety of sources of knowledge, including local operators, agency scientists, and academics, paints a more comprehensive picture than any one source.*

Frank Burris, an OSU Extension Watershed Educator, provided a historical overview of the Chetco River in terms of land use and development, mining activities, flow levels, and fish habitat. A variety of factors, rather than only aggregate mining, affect the river's condition. Natural factors include rain events that cause the dynamic river levels to be described as "very flashy", dark, basalt canyon walls that cause the radiated river water to be DEQ listed for temperature, and a burned forest area that allows sediment to be lost into the river. Man-made factors include housing developments, the boat basin, and aggregate mining that affect water quality and disturb habitat, though the extent of effects is unclear.

Gravel mining has persisted since the mid-late 1800s and first required a permit in 1967. Operators switched from a pit mining technique to a bar scalping technique. Removal peaked in the 1970s and 1980s around 170,000 cubic yards per year. The true amount of extraction is not known because the harbor is dredged and some amount of gravel flows back from the ocean.

Local operators supplemented information provided through presentations and helped to answer questions throughout the workshop. For instance, operators were able to detail the history of a particular alcove, whereas in a technical report derived from aerial photography it was only identified as a natural harbor that became a sludge pit after it filled with sediment.

Jim O'Connor, a USGS hydrologist, presented the information at the heart of this workshop, a report titled "Channel Change and Bed-Material Transport in the Lower Chetco River, Oregon". USGS analyzed the area below river mile 12 and divided it into five reaches for the

sake of analysis. The information in the report came from seven sets of photos dating to 1939, LiDAR, soil, bathymetric, channel, and navigational surveys, and a USGS cross-section.

Most important to note is that the river is not a static system. The Chetco is in dynamic equilibrium. Geologic history is important to understanding the fate of gravel, and in geologic terms, this river is still recovering from the last Ice Age. Over the period of study here, in terms of channel change there has been a reduction in gravel bar areas, a lowering of the channel, aggradation of the channel at the second bridge, and channel incision. In terms of bed material transport there is an influx of 40,000 - 100,000 cubic meters of aggregate per year, which corresponds to the amount mined. The influx varies year-to-year.

Irrespective of what caused initial or major changes in the river, the present state of the river will tend to perpetuate itself or lead to future changes. For instance, regardless of how the straighter channels came to be, those straighter channels inhibit bar growth, thus leading to further straightening. Yet bars will return as long as sediment supplies remain, and the river will regain sinuosity. Changes occurring in any one part will not necessarily occur in another part. The river may simultaneously straighten in one section and become more sinuous in another. Any changes may have conflicting outcomes for species habitat.

Four salmonid fish species inhabit the Chetco: Cutthroat, Steelhead, Coho, and Chinook. Pacific lamprey are an additional species of interest due to possible listing under the Endangered Species Act. Scientists are able to describe the life histories and habits of these species in some detail. Each is known to emerge, grow, migrate, return, and spawn in its own time frame. Habitat needs for each activity vary. Spawning habitat is different than rearing habitat. Specific structures, such as fine or coarse aggregate and vegetation, define those habitats. As the river changes, habitats are altered, and different habitats are needed. For instance, in 3-4 days of high winter flows Coho need access to low-gradient, off-channel habitats.

A variety of factors may be used to make permitting decisions. To determine allowable extraction volume, regulators may use May flow records, since bed material transport occurs between October and April/May while extraction occurs in August/September. To assess fish health, regulators could develop a measure of channel complexity or fish densities. Which factors are most efficacious and cost-effective is not known. Experts did not provide consensus on how to make permitting decisions.

Regulators are concerned with protecting the river and the habitat it provides from adverse conditions. Experts showed that the river is not in a pristine, stable condition to be protected at all costs. Furthermore, experts suggested that regulators may view aggregate mining as a management or restoration opportunity. Permitting and mining may be used to achieve a desired outcome in the system.

**What We Don't Know:** *The USGS report and other sources of information provided a strong foundation, but much goes unknown. Some things may be predicted or speculated but can not be known for sure.*

In short, while we know things that cause changes in rivers, we do not know *what has caused geomorphological and biological changes and to what degree* in the Chetco River. Theoretical knowledge does not necessarily lead to empirical knowledge. Part of this uncertainty is due to the complexity of contributing factors. For example, in response to the question of what caused the channel changes, O'Connor stated that one could build a case for volume extraction causing channel incision and straightening *or* a case for the 1964 flood causing aggradation and later incision. The exact effects of the man-made and natural factors are not known.

This gap in empirical, systemic knowledge leads to a normative gap, as well. Science can indicate how to make certain changes happen in certain places. A scientist can advise how to achieve a certain effect, say maintaining viability of a certain side channel for mining or for habitat. However, that action will have unclear systemic ramifications. Maintaining side channel viability may only come at the cost of another river feature. Science falls short on describing how changes will interact with one another on a system scale, or in other words, how to manage an entire system.

In practical terms in this matter, science has fallen short on describing specifically what fish habitat is needed and how to attain that habitat in geomorphological terms. Biologists have some certain ability to describe the needs of fish habitat. Geomorphologists have some certain ability to describe the river. The two, perhaps as a result of traditional separation of academic disciplines, do not have the ability to describe needs of fish habitat in terms of things that can be accomplished geomorphologically.

Data gaps allow scientists to draw only a murky picture of the river and its changes. For instance, in analyzing the river knowing that there is incision over some finite time scale is not enough to conclude whether it is healthy or normal. Comparing that incision to historical data would provide a more useful indication, but that data is not available. Given the absent data scientists can only speculate what events and factors may have contributed. The same problem exists with Coho salmon, a species listed since 1997 for which no data has been collected. Finally, some matters completely outside the realm of this issue and the jurisdiction of agencies contribute to the river's condition. Urban development, for example, has had some undetermined effect which prohibits scientists from accurately describing the effects of mining on the river.

#### **What Needs To Be Done:**

Workshop discussions exposed a significant amount of known information, but an overwhelming amount of uncertainty remains regarding how to best use data and what data is needed. The expert panelists offered a variety of viable options but little consensus on how to manage and permit aggregate mining. Panelists did agree on the need for increased monitoring, but did not all agree on what should be monitored. Ultimately, collaborators will have to choose an approach to maintaining river health and choose to undertake the monitoring necessary to have full information for that approach or to work with the available information. Which of these comes first is not prescribed by science.

Scientists can tell collaborators about present and historical conditions in the river to a certain degree. Scientists can describe what conditions are necessary to meet certain goals and even how to achieve those conditions. Scientists can not, however, tell collaborators what river conditions should be, nor the appropriate time or spatial scales for granting permits. The river is not in an unadulterated condition and is subject to natural and man-made factors that force changes. Collaborators must determine the condition to be achieved, whether status quo or some greater or lesser condition, and then make decisions aimed toward achieving that condition.

## APPENDIX B: RGI Technical Team Questions

Chetco Gravel Mining Workshop  
November 30, December 1 2009  
Discussion Questions for the Group

Introduction and purpose: 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 agencies have before them applications for a GP (DSL) and RGP (Corps) and are considering whether commercial gravel removal may continue in the Chetco system and, if so, at what levels and under what conditions.

DSL, the Corps and other agencies are reviewing and assessing information to make informed decisions on the GP/RGP applications. The agencies have been working collaboratively with the gravel industry (OCAPA and individual operators) in this effort. 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. If gravel extraction is permissible, the agencies will be determining appropriate permit conditions, monitoring requirements, and adaptive management approaches to govern removal activities.

The regulatory agencies will not be making final permit decisions at this workshop. The workshop is an opportunity to discuss and investigate scientific, policy and other supported concepts to better inform permit decisions.

The agencies are using a number of sources for permit review and determinations. The US Geological Survey Open File Report 2009-1163 will be used as the best available science to evaluate current conditions on the Chetco. Other sources of information will be used as relevant to this process. Although the USGS report focuses on the physical conditions of the river, the agencies will be using this information as indirect indicators of the biological characteristics.

The Tech Team developed the following questions:

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.*

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)

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

*The purpose of this question is to hone in on the 3-5 indicators that could be evaluated to assess the health of the river with respect to habitat condition.*

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 to obtain opinions about whether gravel removal should occur given the current condition of the river.*



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?

*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.*

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)

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?

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

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?

## APPENDIX C: Questions for Organizers

I would like to ask you a few questions about the role of science in policy, specifically in the case of the Regional Gravel Initiative. I'm trying to understand more about how science is used to resolve complex problems spread across bureaucracy requiring interagency collaboration. To understand this issue, I'm thinking of scientists occupying "a continuum from strictly reducing choice to expansively presenting options" and examining the roles scientists filled in this case.

Thinking of yourself as a representative of the Regional Gravel Initiative...

Q1. RGI has been working to streamline aggregate mining permits on the Chetco for several years. What led you to consult with outside scientists?

Q2. Please briefly describe the issues you wanted to address through the use of science.

Prior to the workshop...

Q2.1 would you say RGI collaborators shared a consensus of values, and what values were there?

Q2.2 would you say the issue had low scientific uncertainty, and what uncertainties were there?

Q2.3 in seeking the help of scientists, did you seek to expand (or clarify) your scope of choice?

Q3. Please think about the outcome of the workshop and the kind of information the scientists actually provided. How would you describe the type of information you received?

{probes: *factual, advocating, limiting, range of options, policy-oriented, science-oriented*}

Q4. Ultimately, did you get the kind of information you needed? Why or why not?

Q5. From your perspective, was involving scientists in this policy process necessary? Could the Regional Gravel Initiative, with the goal of issuing general permits, come to a satisfactory conclusion without the involvement of outside scientists?

Q5.1 Could science alone bring the RGI to a satisfactory outcome?