U.S. Department of Interior

Subcommittee 1 Final Report to

Federal Advisory Committee on Natural Resource Damage Assessment and Restoration

Final January 29, 2007

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EXECUTIVE SUMMARY

On December 1, 2005, our seven member subcommittee, with represents from academia, state and federal Trustee agencies, and potentially responsible party groups, was formed under the DOI FACA Committee and assigned to address Question 1:

What are the best available procedures for quantifying natural resource injury on a population, habitat or ecosystem level? What guidance is appropriate for the utilization of these procedures?

Following a full FACA Committee meeting in Denver, Colorado, in July 2006, another member of the full Committee was assigned to provide subcommittee 1 with a tribal trustee perspective on our question. That individual first participated on our subcommittee by joining a conference call on August 30, 2006.

This report was prepared by our eight member subcommittee to provide advice to the DOI FACA Committee regarding the above-referenced question. The subcommittee report was prepared with the intent of presenting all sides of the issues we considered while grappling with the various nuances of the question. We encourage the full Committee to consider all such relevant issues when seeking to reach consensus on the advice and recommendations made by our subcommittee.

<u>Present Process versus Regulations</u>

Information to support the subcommittee deliberations stemmed from subcommittee member experience, interviews with other NRDA practitioners, and a limited survey of settled NRDA cases. We identified three major issues:

We generally observe that there is a lack of strict adherence to the steps in 43 CFR Part 11 apparently because the regulations are deemed insufficiently flexible to allow practitioners to address the wide diversity of contaminants, potential injuries, habitats and resources present at CERCLA sites, or utilize newly emerging assessment and scaling methodologies. Subcommittee members were not in complete agreement as to which parts of 43 CFR Part 11 are considered inflexible, but one key issue was the regulations mandating that injury studies must be conducted at the population level and this term is not defined within the regulations.

For a number of years now, there has been an increasing desire among the trustee and responsible party (RP) practitioners for 'practicable' (see glossary for definition) or pragmatic approaches to assess natural resource injury and reach mutually satisfactory settlements. Practicable in assessment approaches has been balanced with the trustees' need to insure that the public is adequately compensated for the services lost spatially and temporally, and the responsible party's desire for a timely and cost-effective approach. Our subcommittee views the term 'practicable' in the NRDA context as using approaches and methods that preserve the spirit of 43 CFR Part 11, yet provide flexibility to the parties involved to obtain relevant information in a timely and cost-effective manner. Based on our interviews and personal experience, when 'practicable' was applied to the NRDA process in less complex cases, it allowed injuries to be assessed more quickly and usually resulted in an earlier discussion and implementation of potential restoration options. The ability to focus on key injuries more quickly and to discuss restoration options in parallel with the injury assessment process has been a powerful approach to reaching settlement more rapidly in the smaller, less complex cases.

Several key terms in the NRDA process, such as population, habitat and ecosystem are not defined within 43 CFR Part 11, and other terms, such as community, were not included. This has resulted in confusion and uncertainty over the meaning of these terms in the NRDA process and has unnecessarily inflamed the controversy over what is the appropriate level of biological scale (i.e., at the individual, population, community, or ecosystem level) for assessing injury and determining damages.

Recommendations of Subcommittee 1

1. DOI should provide clarity, either through a revision in 43 CFR Part 11 or through new guidance, that makes clear injury determination and quantification should be performed at the level of habitat and/or at the appropriate level of biological scale (i.e., at the individual, population, community, or ecosystem level) that is practicable, reliable, and reasonable for the site in question. Although the exact level or levels that should be considered will vary on a site-by-site basis, at a minimum, the following factors should be considered in selecting an appropriate level for documenting injuries and quantifying damages: cost, timeliness, uncertainty, and the valued added, or not, to reaching settlement or successful restoration by conducting the assessment at any particular level or levels. For example, injury determination and quantification at lower levels of biological complexity may be accomplished in less time and at lower cost than what would be necessary at more complex levels. However, if determinations at the lower levels result in data that are not scalable to damages or restoration, this may result in difficulty in obtaining agreement as to the magnitude of the injury and the appropriate amount of damages. Conversely, the cost and time involved in determining injury at higher levels of biological complexity may be extreme and the data, which are likely to be confounded by a multitude of factors that typically come into play at higher levels of complexity, also may result in difficulty in obtaining agreement as to the magnitude of injury and the appropriate amount of damages.

2. DOI should consider making revisions or modifications to the 43 CFR Part 11 regulations that are suggestive, but not prescriptive, in terms of mandating the level of biological scale appropriate for injury assessment. We also suggest that modifications or

future regulations not be overly prescriptive or mandate particular injury or damage assessment methodologies as these will inevitably change over time with improvements to scientific knowledge and NRDA practice. In our opinion, the present ambiguities in the regulations regarding biological scale(s) for injury determination may be most readily resolved through technical memoranda, updated guidance, or other official written documents.

3. In developing future injury determination and quantification technical guidance documents, DOI should prepare them in a form that is easily updated to account for the evolving nature of scientific methodology. To ensure accuracy and broad acceptance, the guidance should be subject to scientific peer review, and sufficiently flexible to recognize the diversity of contaminants, habitats and resources found at hazardous waste sites in the United States. Regarding the implementation of this recommendation, there may be merit in DOI assembling NRDA practitioners from the public and private sectors, academic experts and other scientists to work collectively on developing such technical guidance.

4. DOI should change their regulations to support habitat restoration or restoration-based options as an early consideration in the damage assessment process. With recent advances in restoration-based scaling methods (e.g., Habitat Equivalency Analysis), injuries can be scaled to the appropriate amount of restoration regardless of the magnitude of the injury. Thus, small injuries can be compensated with small amounts of restoration, and larger injuries will scale to larger restoration efforts. We believe that by considering restoration-based options early in the damage assessment process and by applying scalable damage assessment methodologies the conflict between trustees and responsible parties will be reduced. These actions should provide a better framework for resolving key differences and they will focus the parties on getting to the bottom line more expeditiously.

One member of Subcommittee 1 suggests additional guidance on Recommendation # 4 as further discussed in Section 4, ADDITIONAL PERSPECTIVES ON SUBCOMMITTEE 1 QUESTIONS.

5. DOI should ensure that all pertinent terms such as: individual, population, community, ecosystem, and habitat are defined in the regulations (see attached glossary of terms used in this document).

One member of Subcommittee 1 respectfully disagrees with several of the recommendations made in the Executive Summary by the majority of Subcommittee 1's members, as follows:

First, the Executive Summary indicates that the current Type B Rule set forth at 43 CFR Part 11 does not appear to be "sufficiently flexible" without acknowledging that the Rule is not mandatory and without providing any concrete examples of how it is not flexible. Instead, the Executive Summary seems to conclude that because some trustees have not followed the Rule in conducting some assessments that it must be because the Rule is not sufficiently flexible. The Executive Summary does not appear to consider, whether trustees in some cases do not follow the Rule for other reasons, whether it be for strategic purposes (e.g., litigation strategy) or because the amount of injury and damages in a particular case may not warrant a full-blown Type B NRDA.

Second, the recommendations made by the majority do not seem to recognize that both CERCLA and the questions posed to Subcommittee 1 require a focus on Best Available Procedures (BAPs), not flexibility and practicality.

Third, the Executive Summary also does not recognize that because populations are the fundamental units of biological organization, population level assessments should be the focus of NRDAs when quantifying injury to biological resources. There are reliable and scientifically–defensible procedures for quantifying injury at the population, community or habitat levels. Selection of the best assessment method depends on site-specific characteristics and the target species in the assessment. Although these methods are not referenced in the Type B Rule, they are described in the scientific literature and guidance is available from other statutory programs (e.g., CERCLA ecological risk assessment and various wildlife management programs).

Fourth, the recommendations also do not acknowledge that injury quantification at the individual organism level is not a BAP for formal NRDAs under the Type B Rule because of substantial uncertainties associated with extrapolation of organism-level effects to population or community-level effects and service losses.

Fifth, injury quantification at the ecosystem level is also not a BAP because of the complexity, lack of available assessment tools and uncertainty in interpretation of biological effects at the ecosystem level.

Finally, it is also important to note that the discussion of restoration-based scaling, including HEA, set forth in the Executive Summary and elsewhere in the Subcommittee #1 report goes beyond the questions posed to Subcommittee 1 about injury quantification and is not pertinent to these questions. HEA is a method for estimating damages, not quantifying injury. Subcommittee 1 has not engaged in a thorough discussion or evaluation of HEA or had any input from outside experts concerning HEA or other project-based damages estimation methods. For these reasons, Subcommittee 1 should defer to Subcommittee 3, which was expressly asked to consider the possible use of HEA to estimate interim compensable value damages.

SECTION 1: Background and Introduction

On December 1, 2005 this subcommittee was formed under the DOI FACA Committee and assigned to address Question 1:

What are the best available procedures for quantifying natural resource injury on a population, habitat or ecosystem level? What guidance is appropriate for the utilization of these procedures?

The subcommittee considered this question through a number of conference calls, email exchange, and face to face meetings over the course of approximately one year. To address the concern that our collective NRDA experience base (see Appendices for Subcommittee experience) may not be wholly representative of current NRDA practice, we undertook a number of phone interviews with, and posed questions to, individuals recognized for their NRDA experience (see Appendices for interview notes). We also conducted an informal, limited review of settled cases to determine if there were key points that were relevant to our assignment.

Early in our deliberations, we determined that the phrasing of this question was problematic. Since the question stemmed directly from the existing 43 CFR 11 regulations, the problem with the question and the existing regulations might be related to the training and experience among those individuals who drafted the regulations initially. For example, from a biological and ecological perspective, there is a lack of congruity among the terms population, habitat, and ecosystem. Typically, the complexity of biological scale increases from individual – population – community – ecosystem, and in this case, habitat is not a level of biological scale per se.

It is presumed in the question posed to us that some or all of 43 CFR 11 has been a problem for NRDA practitioners. Our initial review of 43 CFR 11 indicates that the regulations are confusing with respect to the terms population, habitat, and ecosystem, as they are undefined and thus open to diverse interpretation. This may be one of the underlying stimuli for the question posed to the subcommittee. As a backdrop, moreover, confusion in the regulations, ambiguities, uncertainties, etc. may be one of the reasons why there is not strict adherence to 43 CFR 11 by practitioners, and why approaches at one site may be vastly different (perceived or otherwise) than for another site. One might also envision that there could be an additional constraint when some practitioners believe that under the existing language of 43 CFR 11 assessments can only be conducted at the population, ecosystem or habitat scales. Those individuals might then proceed with assessments at these scales under the assumption that they are mandated by the existing regulations. However, as noted above, the experience base among the Subcommittee's members suggests that a large number of assessments have been, and continue to be conducted at the individual and habitat levels. Further, we found no evidence thus far to indicate that there have been any assessments conducted at the ecosystem level.

The report that follows is structured into two major sections. Section 2, Analysis, reviews our assessment of the existing regulations and the problems (perceived or real) that result from their application (or lack thereof). Within this section, we also include specific responses to the question regarding methods that can be applied at various biological scales, and the strengths and weaknesses of those methods. We did not, however, attempt an exhaustive review of methods as this would be far beyond the scope of our assignment. Section 3, Conclusions and Recommendations, provides specific points for the full FACA to consider regarding Question 1. Following these two sections is a section that provides for “additional perspectives”, and a number of appendices that provide additional details on the Subcommittee’s deliberations. The appendices provide an overview of what in the existing regulations may be leading to their lack of application in most NRD cases, and what methods may be suitable for certain applications.

SECTION 2: ANALYSIS

2.1 Role of existing regulations – 43 CFR 11

As noted in Section 1, we found incongruities in the regulations regarding the biological scales at which injury determination and quantification should be conducted. The regulations appear to identify populations, habitats, and ecosystems [DOI 43 CFR 11.71 (l)] as the levels where injury quantification should occur, but the regulations do not provide working definitions of these terms. Under 43 CFR 11 accurate quantification of injury rests on developing "numerical data that will allow comparison between the assessment area data and the control area or baseline data (DOI 43 CFR 11.71(l)(I), and, depending on the resource being evaluated, that quantification can occur at various levels of biological organization, or can be based on habitat characteristics." Yet there are no definitions or examples given in the regulations that would help practitioners interpret the meaning of population, habitat or ecosystem or how one would go about conducting injury determination at these scales.

Although detailed publications on undertaking evaluations at these biological scales exist, an exhaustive review of them is beyond the scope of the Subcommittee's assignment. We do provide some general guidance on these methods later in this section, and some additional details in the Appendices.

Language in the existing regulations indicates that injury quantification should focus on evaluating impacts at the population (or community level although it is not noted specifically in the existing regulations), habitat or ecosystem levels, especially since extrapolation of individual species effects to higher levels of biological scale are highly uncertain and spatial and temporal factors must be carefully considered. Nevertheless, what appears to have predominated in practice, based on the experience of some subcommittee members, and from interviews with current practitioners, is that injury assessment at the population level or higher seems to be rare for NRDAs that do not involve litigation.

Relationship of Question 1 to the Regulations

For injury quantification, the regulations are explicit in stating: "The extent to which the injured biological resource differs from baseline should be determined by analysis of the population or the habitat or ecosystem levels" [43 CFR § 11.71 (l) (1)]. The regulations view injury quantification, as described above, as a distinct and separate step from injury determination. A wide variety of biological responses can be used to determine injury, including measurements at the organism or sub-organism levels, insofar as they meet four acceptance criteria identified in the regulations. Injury determination is effectively a screening step that identifies potentially injured resources. The analysis of populations, habitats, or ecosystems is then conducted for resources where injury has been determined. This is an important distinction because the objective of an NRDA is not just to determine that an injury has occurred, but it is necessary to quantify the magnitude and extent of that injury so that service loss, and thus damages or restoration, can also be quantified.

In 43 CFR § 11.71, the regulations specify that measurement methods at the population, habitat, or ecosystem levels must be selected to provide data in terms of services. Services are defined in the regulations as functions performed by the resource and are the result of the biological qualities of the resource. Examples of biological services include provisions for food, habitat, or other needs of the resource. Under certain circumstances, the regulations also indicate that services can be quantified directly rather than quantifying changes in the relevant resource at the population or other level. In such cases, it must be shown that any change in services resulted from the resource injury and that the measurement of services provides a better indication of damages than direct quantification of the injury itself.

The regulations provide general guidance on methods that are appropriate for injury quantification at the population and habitat levels. For example, for estimating population differences, the regulations specify that "…standard and widely-accepted techniques, such as census, mark-recapture, density, and index methods…" shall be used (43 CFR § 11.71 (l) (5). For quantifying wildlife populations, standard and widely-accepted techniques such as those identified in the Wildlife Management Techniques Manual (1980)[1] and references cited therein are recommended. Although the regulations state that a specific method used in an NRDA need not necessarily be cited in the manual, any methods used should conform to the recommendations for data quality contained therein. It is also stated that measurements of age structure and life table statistics will generally not provide acceptable data for injury quantification unless it can be demonstrated that the release has differentially affected age classes and appropriate baseline age structure data are available.

For plant populations, the regulations simply state that standard techniques may be used such as estimates of density, species composition, diversity, and cover. For habitat quality, techniques such as Habitat Evaluation Procedures (U.S. FWS, 1980) may be used.

In summary, the regulations are specific concerning the need for population-level or higher assessments as part of the injury quantification step in an NRDA. However, the

[1] Currently available as: Techniques for Wildlife Investigation and Management (6th ed.) 2005. The

regulations are not prescriptive concerning specific methods that must be used. It is acknowledged, however, that there are standard and widely-accepted methods available for many kinds of biological resources and that such methods can be used for injury quantification as long as they produce meaningful comparisons between resource services at assessment and baseline areas.

As a result of the above, one of the subcommittee's deliberations has been to explore possible reasons for the discrepancy (between the regulations and actual practice) and, where feasible, identify when assessments at each of the levels prescribed by the regulations may or may not be appropriate. Our current evaluation is that the desire to expedite the assessment process is often driven by goals shared among practitioners of 1. avoiding litigation, and 2. Ensuring that more effort and expense go toward the settlement goals rather than on the assessment process. We have attempted to capture some of the reasons for the current practice in the Appendices. In many cases, restoration-based, cooperative settlements have been reached in which there is an expedited assessment of injury that does not comply with the DOI regulations.

However, in some situations, strict adherence to the regulations may have been favored (e.g., in very complex sites involving very large alleged damages) because from a legal perspective it provided a more rigorous correlation between releases, injuries, and resultant damages. Ideally, there should be room in the overall injury determination and quantification process to accommodate both situations – one when there is general agreement and cooperation among Trustee and RP groups, and another when there are substantive differences in perspectives as to the alleged injuries, service losses, and subsequent damages.

Wildlife Society, Bethesda, MD.

Clarification of the regulations and/or substantially updated guidance documentation may be appropriate to preserve trustee and RP flexibility, rather than undertaking wholesale replacement of important concepts and safeguards in the existing 43 CFR 11 regulations. Based on our experience base, the rebuttable presumption that is afforded to Trustees under the current regulations is rarely pursued; however, it does not mean that this judicial review standard should be eliminated. Portions of the existing regulations are likely to be useful in protecting both the Trustees and the RPs, and neither group should have to forego any technical or legal defenses that may be useful under existing laws and regulations.

Under existing 43 CFR 11 language, there is a provision for the use of Best Available Procedures (BAPs), which may offer another explanation for some of the diversity that is found in the NRDA practice, and why there does not appear to be a universal adherence to the regulations. BAPs, will, as a matter of course, evolve as the scientific underpinnings of these procedures improve with increased knowledge. Thus, over time, new procedures may be applied at some sites and not at others, depending in part on the training and experience of the trustees and RPs involved. Similarly, one could also envision that BAPs for physical, chemical, biological, or toxicological investigations may apply at some sites and not at others, owing to differences in the types of habitats and receptors that might be present at one site and not at another. As much as any other possibility that could exist, variability among injury assessments at CERCLA sites may result from the use of BAPs where practitioner preference or regional needs (specific types of ecological receptors, habitats, etc.) underlay the approaches.

While we did not attempt to survey practitioners directly regarding what in 43 CFR 11 is deemed “inflexible” we observe that time, resources, the need to reduce uncertainty and costs may be the primary issues at work. In other words, while there may not be an explicit issue with the lack of flexibility in the existing regulations, Trustees and RPs may, over time, have focused on "practicable", e.g. getting the NRDA conducted at a biological scale that is most amenable to a timely and cost-effective determination of injury. Practicable, in our opinion, subsumes the issues of time, resources, costs and uncertainty. This observation comports with some of the subcommittee members' experience base, with some of the interviews we conducted with leading NRDA practitioners, and with the limited number of settled cases that we reviewed.

We are cognizant of the ambiguity in applying the term "practicable" to NRDA in that the term can be open to highly diverse, and potentially divergent interpretation. In this context we view "practicable" as using approaches / methods – the recent experience base among practitioners in the governmental, industrial and consulting communities – that preserves the spirit of 43 CFR 11 yet provide information in a timely and cost-effective manner. We observe that applying "practicable", as we have defined it, to the NRDA process seems to have allowed trustees and RPs, in some cases, to more quickly move through the injury determination and quantification, and reach timely, cost-effective settlements. We also recognize that the utilization of 43 CFR 11 regulations in an NRDA is not mandatory per se, but we cannot confirm that this is the main reason for the lack of adherence to the existing regulations.

2.2 Methodologies

Despite the need to fully address the question posed to us, it was beyond our scope to provide an exhaustive review of methods that might be used to conduct injury determination and quantification at the population, ecosystem or habitat scales, nor to do so for individual or community scales. We do provide some general commentary on methods at each of these scales, along with their strengths and weaknesses as applied to injury determination and quantification. As we indicated previously in this report, there are numerous published materials that address each of these biological scales and how the methods involved may or may not be applicable to certain situations. We caution that few, if any, of the published materials cited or reviewed in this report respond directly to the question of whether or not the methods are applicable for natural resource injury determination or quantification. It should be self-evident that the decision as to their applicability to NRDA is up to decision and policy makers in the relevant federal agency. What we have endeavored to provide is the scientific underpinning to inform that decision, as the selection of any one method or biological scale should have a strong scientific basis.

Although guidance is lacking in the NRDA area, there are a number of tools for higher-level assessments even though their application outside of a resource management paradigm (setting of hunting or fishing limits) appears to be limited.

It is important to recognize that there will be a balance between the need for expedited injury determination and quantification at some sites, compared to the need for more involved, higher-scale assessments at other sites. Responses at lower levels of biological organization are generally more specific and are better understood in terms of mechanisms. Consequently, cause and effect relationships are more obvious with sub-individual responses. Responses at higher levels of biological organization occur at broader spatiotemporal scales and have greater ecological relevance (Clements and Newman 2002). This point is illustrated in Figure 2-1.

Table 2-1 presents a discussion of various issues regarding methods of assessing injury in a simple matrix format. We include discussion of when and where these tools could be applied – and when and where they should not be applied – in response to the second part of Question 1. It is important to note that these tools are discussed in the context of their strengths and weaknesses so that any revisions to 43 CFR 11, or for the development of new guidelines, to include the full suite of tools that could be applied –

should they be necessary. Our purpose is not to indicate a preference for one tool over another, nor to exhaustively review all potential methods and tools, but to provide the general information necessary for practitioners to understand which tools may be more useful in a particular situation compared to another tool.

2.2.1 Individual-level assessments

The individual, by definition, is a single organism. It is the fundamental unit of various higher levels of biological organization. For example, a group of genetically similar and interbreeding individuals constitute a species, and individuals of a particular species within a defined geographic range can be described as a population. Collections of genetically similar or diverse individuals in a particular location or environment, representing one or more populations, can constitute a biological community.

In terms of biological value, the individual is a discrete unit that provides a species with genetic and reproductive diversity, which is essential for identity and persistence of the species. A key contribution of individuals to populations and ecosystems is to provide a reservoir of genetic diversity. This diversity is critical for maintaining stability of populations and providing resilience to “natural” and anthropogenic perturbations. Variation in life histories and the ages of individuals lead to age class diversity of species within a community, which is important for the long term survival and reproduction of many species. Age class diversity also is important to the productivity and stability of biological communities. Removal of select individuals of a specific age class can have significant impacts at the species or community levels. For example, a twenty year old willow tree differs from a one year old willow in a riparian corridor through its increased ability to withstand flood conditions, greater production of reproductive propagules, more foliage and resulting nesting habitat, and other properties affecting water and sediment dynamics in the riparian zone. Loss of the older willow may mean loss of critical nesting habitat since some birds nest only in trees matured to a certain age that produce or exceed a minimal foliage volume.

In special status species (such as locally rare, threatened, or endangered species), the biological value of the individual is considerably increased due to the relative contribution of the individual to the genetic diversity, reproductive capacity, age composition, or long term survivability of the species. In these instances, loss of a few individuals has an increased probability (vs. non T&E species) of resulting changes to species stability, community composition, and higher level energetics within ecosystems.

In societal terms, the individual can assume extreme importance not just for special status species but also for other species that may be deemed "charismatic macrofauna" – animals with fur or feathers, or plants such as redwoods. These are highly valued by humans for a variety of reasons such as wildlife viewing or simply through knowledge of their existence. Similarly, certain types of habitats have intrinsic values to humans based on societal as well as biological uses. Biological losses and gains are generally counted at the level of the individual, and similarly habitat losses and gains are often counted using a comparable single unit metric such as acre or hectare.

Additional examples of the importance of the individual can be found in the wildlife management practices for hunting and fishing, which control the takes of individuals to ensure continuation of populations of adequate size and composition so that a sufficient number of individuals are produced to preserve the wildlife resource. In many areas of the U.S., these resources are economically critical for both commercial take and recreation. Areas of specific watersheds, rangelands and coastal habitats are managed to ensure the productivity of valued populations so that individuals are available at specific locations with a great deal of predictability.

So what is the value of the individual in terms of damage assessments, and has compensable loss occurred if individuals are injured or lost to the population? Or, as some may assert, is there no loss if “no detectable change to the population” can be shown? To answer these questions, we need to address the nature and intent of the damage assessment process with an eye to the role of the individual organism. Additionally, we need to understand how changes to a population can be defined, and whether or not the changes can be quantitatively measured, related to the pollution incident, and compensated -- these are basic premises in the damage assessment process.

The NRDA process is intended to compensate the public for all losses to its resources and for lost uses of those resources. It is a legal process that encompasses both biological and societal (including economic) values for the resources. It is also a process that uses science and economics to measure and quantify the losses. The individual, as defined above, has both biological and societal value that can be characterized and quantified. Reduction in the number of individuals, or changes to the functionality of those individuals (i.e., sublethal effects), caused by a pollution incident are natural resource injuries. Loss of individuals represents the minimum level of injury for compensation, and additional compensation may be warranted if the loss of individuals leads to additional losses at higher biological levels such as at the population, community, and ecosystems levels. In some instances, loss of individuals may result in species shifts that alter community compositions and affect the overall quality of a habitat (e.g., decreases in native plant species leading to changes in biodiversity and resulting changes in saltmarsh structure and function; Zedler and Kercher, 2004). In such cases, compensation should address the loss of individuals, their offspring, and the associated changes at the level of the population, community, habitat, and ecosystem.

In practice, very few injury determinations in NRDA cases are focused at the population and ecosystem levels because of a variety of factors including high study costs to achieve adequate certainty for delineating populations in open systems, demonstrating causal relationships, and quantitatively addressing uncertainties associated with interpretations of impacts to higher levels of biological order. Most NRDA claims are based on direct measurements or modeled counts of individuals injured (e.g., number of birds killed or debilitated, counts in fish kills, number of sea otters impaired or killed, etc.), quantities of biomass or productivity lost, and specific numbers of acres of specific habitat types impacted. Losses of human use of the resources also are determined at the individual level (e.g., lost beach user days, diminished quality of individual fishing trips, lost access to wildlife viewing, etc. and more exacting losses including, for instance, Indian treaty rights and cultural uses of resources). Similarly on the credit side of the equation, compensation is scaled through restoration projects that are proposed to return similar numbers of individual “items”.

Experienced practitioners of NRDA know that proving injuries at the population or ecosystem level can be a very expensive and demanding proposition, especially if one is trying to circumscribe a population, delineate immigration and emigration rates, confer a level of biological significance at the population level caused by the loss of individuals, and tease out potential confounding factors that might also effect changes at the population level. Fortunately, this is not a requirement of the damage assessment process for asserting a claim of loss, which can be measured and scaled in terms of individuals lost. If the loss needs to be presented in terms of the population, then the population can be defined as the relevant group of individuals at the pollution-affected site, and the loss simplistically presented as the total population (N) minus the number of individuals lost or harmed (i) plus the offspring (o) that the individuals would have produced [population loss = N-(i + o)].

If the individual is the fundamental unit of value, then why consider population, community, habitat or other scales? The answer is that it puts the individual in its ecological context. Without a clear understanding of context, the extent of injury may be underestimated. The same numbers of individuals lost from a small, regional population may constitute a greater loss of a valued resource both at the time of the event and into the future, compared to a large, interconnected population of even the same species. In some species females are more valued because of their greater contribution of individuals as a resource in the next generation.

Claims of loss can be asserted for individuals harmed, and compensation scaled and pursued at the level of the individual, but this is likely to represent the lower bound for an injury claim. Additional losses at higher biological levels may not be adequately compensated by simply basing claims on losses of individuals. The decision to pursue claims for higher level losses generally reflects a number of factors, but the natural resource trustees are responsible for making this decision based on what is in the best interests of the resources and the public.

Various federal, state, and local laws define how we work in the NRDA process. The standard practice of trustee teams is to work through consensus to assert and settle claims that comply with all relevant laws. Many states have laws, guidance, and/or policies that explicitly state the need to compensate for any and all losses of natural resources, and agency guidance in some states specifies “no net loss”, whether measured in acres of wetland or numbers of individuals of a species. Regardless of how explicit or vague a federal law may be about the level of loss that should be compensated, trustee teams strive to comply with all participants’ legal requirements and practices – which has led to compensation at the level of individual.

2.2.2 Population-level assessments

Because populations are generally considered the fundamental units of ecological systems, it is appropriate that ecological risk assessments and, in some cases, natural resource damage assessments focus on this level of biological organization. Ecological assessment of the effects of stressors on populations includes quantitative measures of demographic characteristics such as density, age structure, reproductive rate, and recruitment (Newman 2001). Quantifying spatial or temporal changes in these demographic characteristics for natural populations generally requires the application of mark and recapture techniques integrated with population models. Some of the best examples of population level assessments of contaminant effects are from studies of birds, small mammals, and marine fish (Carlsen et al. 2004).

In population level assessments, the general assumption is that a causal relationship exists between stressors and demographic characteristics such that lower instantaneous rates of population increase (r, defined as the difference between birth rates and mortality rates) affect recruitment of new individuals in the population, thereby causing local extinction (Maurer et al. 1996). Two of the most significant challenges in population level assessments are establishing linkages between individual and population level responses to stressors and determining how much reduction in r a population can sustain and still persist in the environment. Raimondo and McKinney (2006) used demographic population models to establish a quantitative relationship between individual and population level responses for a series of toxicants. Spromberg and Meador (2005) have modeled the impacts of certain types of toxicants upon specific salmonid populations. These modes of actions produce identifiable patterns in the age distribution of the fish population. The application of population level assessments in NRDA_will require a better understanding of these relationships.

Uncertainty exists in the measurements and the models that assess population level effects. Measurement of population parameters that allow calculation of r or of the similar parameter λ for age-structured populations requires information on survivorship, fertility and mortality. Fortunately in many cases these data exists for commercially or socially important populations. A second major source of uncertainty is in the definition of the population being assessed and its spatial structure. Does the impacted site cover a significant portion of a critical population or only a small portion of the population? In the case of salmonids along the Pacific coast the unit of assessment is the evolutionary significant unit (NOAA 2005). How does the spatial structure affect the propagation of contaminant effects throughout a subpopulations of patchy or metapopulation (Spromberg et al 1998)? In many instances the spatial relationships may not be adequately understood.

These and other uncertainties can be addressed by adequate sampling and a tagging program or through genetic analysis that defines the boundaries of the population. The use of biomarkers for exposure and effects can also lead to building a weight of evidence to establish a causal relationship between the stressor and the population level effect.

2.2.3 Community-level assessments

Within the context of the hierarchical arrangement of living systems, communities are intermediate between populations and ecosystems. Although a community may be defined as interacting populations that overlap in time and space, the study of communities is much broader than a simple description of individual populations. Instead of characterizing birth rates, death rates, and other demographic features of isolated populations, the focus of community level assessments is on structural characteristics such as community composition, species diversity, and abundance of sensitive and tolerant species. Although most general ecology textbooks devote significant coverage to the topic of communities, the focus in most ecotoxicological investigations_remains on individuals and populations. There is still the perception that communities are primarily human abstractions about groups of populations that lack defined spatial and temporal boundaries. Moriarty (1988) questioned the need to study effects of contaminants on communities and concluded that for ecotoxicology, the population is the most appropriate level of organization.

Because numerous factors in addition to contaminants affect community composition, demonstrating a causal relationship between anthropogenic stressors and community levels responses remains a serious challenge. The best examples of community level assessments in the ecotoxicological literature are generally from aquatic ecosystems, especially fish and benthic macroinvertebrates. Sophisticated multivariate statistical techniques (Clarke 1999; Sparks et al. 1999) and multimetric approaches (Karr 1981) have been employed to quantify effects of a variety of stressors on communities. Multimetric and multivariate approaches are particularly useful for community-level studies because they reduce the typically complex, multidimensional data to readily interpretable patterns. Indeed, our understanding of how fish and macroinvertebrates respond to various anthropogenic disturbances has advanced to the stage where researchers can now identify indicator communities that are indicative of specific types of disturbances. The development of these approaches for other groups of organisms (e.g., small mammals and birds) remains a significant challenge in NRDA.

Uncertainty exists in the measurement of community level impacts. There are a number of metrics that can be used, and each takes a different point of view on the best measure of the patterns in ecological communities. There is still no one best measurement technique for addressing questions about impacts or persistent changes. In some instances it may be that habitat for a specific critical species may be used as a surrogate when accurate measurements of population size are not possible. In this instance it is important to understand the habitat characteristics that are important, both the biotic and abiotic components.

There is also uncertainty in the lag times between the onset of a stressor and the appearance of a measurable response in the community metrics. Indirect effects may appear only after enough time has lapsed so that the community metrics being observed can respond. Effects may persist after the cessation of the stressor event as well. Phenomena such as Pollution Induced Community Tolerance (PICT) (Blank and Wangberg 1988) and Community Conditioning (Matthews et al 1996) demonstrate that effects can persist within the community even after the removal of the stressor. Uncertainty lies in the ability to differentiate effects from the stressor under consideration in the NRDA from other stressors to which the community is subjected.

These uncertainties can be addressed by ensuring that the sampling program includes a broad enough spatial extent such that effects of other stressors within the environment can be analyzed and separated from those of interest in the NRDA. Such an approach requires that a variety of environmental gradients be incorporated into the sample design. However, it is important to recognize that simple upstream-downstream, or reference-impact designs can be uninformative.

2.2.4 Ecosystem-level assessments

Likens (1992) defined an ecosystem as a "spatially explicit unit of the earth that includes all of the organisms along with all components of the abiotic environment within its boundaries." In contrast to the emphasis on structural characteristics, at the ecosystem level we are generally more concerned with effects of contaminants on processes, such as rates of energy flow, nutrient cycling, or primary production.

In general, effects of contaminants and other anthropogenic stressors on ecosystem processes have not received significant attention in the ecotoxicological literature and are rarely considered within a regulatory framework. In light of the complexity of ecosystems and the uncertainly in defining their spatiotemporal boundaries, the focus on populations and communities in most ecotoxicological research is understandable. One of the challenges associated with assessing injury to ecosystems will be to determine which particular processes are important. The most likely candidates (e.g., rates of primary production, energy flow, nutrient cycling, and decomposition) are notoriously variable (Schindler 1987), and, depending on the particular stressor, may either increase or decrease in response to disturbance. Furthermore, because of high variability and functional redundancy of many ecosystem processes, alterations in abundance of sensitive populations or changes in the structure of communities may occur long before we see shifts in processes.

From a practicable perspective, the fundamental question related to ecosystem level assessment is whether alterations in the rate of energy flow and material exchange can serve as sensitive indicators of anthropogenic perturbation. Rapport et al. (1985) have published one of the few attempts to compare ecosystem responses to a variety of stressors across different ecosystem types. One of the most striking features of this exercise was that, in contrast to population and community level responses, relatively few ecosystem processes consistently responded in a predicable way to anthropogenic disturbance.

There is uncertainty in several aspects of ecosystem level assessments in environmental toxicology. Defining the boundaries of an ecosystem has often been problematic and perhaps arbitrary. What should be the extent of the Clarke Fork River ecosystem or the Puget Sound ecosystem? Does the spatial boundary of these ecosystems also include the surrounding watersheds? In the case of Puget Sound where is the boundary between Puget Sound and the Georgia Straits ecosystem? The spatial extent of most ecosystems also makes adequate sampling at a sufficient time scale a challenge, which contributes to uncertainty. In order to conduct such a sampling program the questions must be specific and the timeframe adequately defined.

2.2.5 Habitat assessments

Habitat, defined as the natural abode, locality or region of an animal or plant, has been the subject of increasing interest as a tool for risk assessment, environmental management and decision making (Kapustka 2005). Habitat is not a level of organization in the classic hierarchical representation. Habitat is best thought of as those specific requirements that exist within a region that are necessary to support the organism and the continuation of the population at the levels required to provide the required ecosystem services or by regulation. These requirements can vary seasonally, both in location and in condition. Species with migratory patterns must have the specific habitat at the reproductive site, the migratory pathways, and the overwintering or other destination. Such considerations require examining the landscape requirements of the species over its entire range. Different life stages of a species often inhabit very different environments. For many invertebrates the larval life stage is pelagic, even if the adult is sessile. For example, Dungeness crab within the Georgia Straits use different parts of the marine environment depending upon the age of the individual.

The amount of habitat is also important. Habitat should be in sufficient quantity and quality so that a viable population can be produced that meets the socially defined needs. For species that are hunted, fished or harvested sufficient production should be available so that these takes are not large enough to depress the population below the required level.

2.2.5.1 Measurement of Habitat

There are a number of methods that have been developed to describe the relationships between the characteristics of an area and species distribution. These have been reviewed by Kapustka (2005) in regards to the suitability of the method towards ecological risk assessments. The requirements can be expressed qualitatively, semi quantitative and also in a quantitative fashion. The semi-quantitative habitat suitability index (HSI) has been derived for a number of species under the auspices of the U. S. Fish and Wildlife service. Currently 160 HSIs have been published, although only a few provide a quantitative estimate of species density. Maps of habitat within the region of interest can be generated using survey data and remote sensing combined in a GIS format

Remote sensing and ground techniques have been used as part of the US Geological Service (USGS) GAP program (see http://gapanalysis.nbii.gov/). Patterns of vegetation are plotted, land cover determined, and a variety of other data assembled during the process. Areas that provide suitable habitat for the species of interest can then be identified. Changes in habitat, either an increase or decrease, can be estimated by using either a GAP or HIS approach. Such a determination can be used as a surrogate for the increase or decrease of important populations or other assessment goals in the region. Such analyses can also provide guidance for restoration activities.

2.2.5.2 Uncertainties

There are several uncertainties associated with the application of habitat as a measurement. The most important uncertainty is defining of the appropriate habitat for the species of interest. Although over 160 HSIs are available, that still leaves a number of species undefined. Part of the assessment process may have to be the derivation of an appropriate index. Second is the mapping of the current habitat and documenting the change in habitat due to the damage. This is typically done by a combination of remote sensing and ground observations. Prior habitat distributions can be determined by past mapping efforts or routine surveys. Third is that is not always clear how the amount of habitat relates to the total population. Habitat is a necessary requirement for a species to exist in an area, but the spatial arrangement of habitat, the relationship to its prey species (Jager et al 2006), and the occurrence of other stressors (Munns jr. 2006) may also alter the number of individuals that can recolonize a restored area.

2.3 Use of Ecological Risk Assessment Methods / Approaches

With respect to other frameworks and approaches that might be useful in the context of NRDAs, one suggestion is to explore the tenets of ecological risk assessment (ERA) for application to NRDAs. In many respects, much of the data collected for the ERA is the same as that which will be used for the NRDA, however, it is recognized that the products of these differ {Barnthouse & Stahl 2002 239 /id}. The product of the ERA is an estimate of risk, coupled with a discussion of the uncertainties in the assessment and the data. The product of the NRDA is an estimate of injury and service loss which are translated into a claim that can be resolved through restoration or other means.

The approach to ERA has been subjected to significant peer review, national debate, and practice revisions over the past 10 years. Taking these lessons learned, and the improvements to the science, suggests that an ERA-like approach may be one way to improve NRDAs, provided some of the issues on dealing with uncertainty can be managed. _Ways to address uncertainty in the ERA context are to acquire additional data, be conservative in the risk management decision, or to monitor the results of the decision in an adaptive management approach (using monitoring data to trigger additional actions, if needed).

Similarly, this concept may be applied to the NRDA, where uncertainty can be addressed by determining the resource losses as a range rather than a single value. Following this approach, selecting and implementing a restoration project that would compensate for losses at the high end of the injury range could satisfy concerns about scaling and adequate compensation, thereby removing one obstacle that is often a major impediment to settling NRD claims. Addressing uncertainty in this fashion will likely be case by case and require substantial discourse between the Trustees, the responsible party, and the public before implementation.

2.4 Summary

Assessments of the effects of contaminants and other stressors have been conducted at all levels of biological organization. The tools and methodological approaches designed to assess ecological responses at higher levels of organization are well described in the literature. However, ecological assessments beyond the level of individuals in NRDAs have been quite limited, in part because of the inherent uncertainty associated with results at these higher levels of organization.

In general, our understanding of underlying mechanisms and our ability to determine causal relationships between stressors and responses diminishes at higher levels of biological organization (Clements and Newman 2002; Forbes et al. 2006). For example, many of the criteria used to demonstrate causation at the population level (e.g., strength and consistency of association, dose-response relationships, specificity, and experimental evidence) will be difficult to employ at the ecosystem level. Nonetheless, stressor effects beyond the level of individuals, particularly on populations and communities, are likely to occur and should be considered when quantifying injuries within the context of NRDA.

SECTION 3: CONCLUSIONS AND RECOMMENDATIONS

Over the course of the past 12 months members of the Subcommittee have engaged in numerous conference calls, interviews with leading practitioners, and face to face meetings. Through this interchange, and by applying personal NRDA experiences, we have attempted to provide a cogent response to the question posed to us. It is clear that there are numerous other questions that are subsumed questions posed to us, and we have endeavored to not become side-tracked in answering them, and thereby fail to complete our assigned task. Our goal was to not only be responsive to the questions presented, but also represent the diversity of views that are held on the questions.

Generally speaking we have observed there has been and continues to be a lack of strict adherence to the steps in 43 CFR 11 primarily because, apparently the current regulations do not appear to be sufficiently flexible to allow practitioners to address the wide diversity of contaminants, habitats and resources present at CERCLA sites. At this time it is not totally clear to us which parts of 43 CFR 11 are considered inflexible by the practitioner community, but some suspected underlying reasons for this observation have been discussed. Other reasons are likely to exist that we have not discussed in this report. We are also cognizant that the use of 43 CFR 11 regulations is not mandatory but cannot conclude that this is the main reason why there is not strict adherence to the regulations.

We have also noted that over the past 5 years, there has been an increasing desire for practicable approaches among the trustee and RP communities as it relates to natural resource injury assessment, and settlement. This practicable approach has been balanced with the trustee's need to insure that the public is compensated for the services lost spatially and temporally, and the responsible party's desire for a timely and cost-effective process.. In this context, and applying Subcommittee members' experience, we view "practicable" as using approaches / methods – the recent experience base among practitioners in the governmental, industrial and consultant communities - that preserve the spirit of 43 CFR 11 yet provide relevant, reliable information in a timely and cost-effective manner. Thus applying "practicable" to the NRDA process has allowed trustees and RPs to more quickly assess injuries in the less complex NRD cases, while at the same time, discussing potential restoration options at an early stage. The ability to assess injuries quickly and discuss restoration options in parallel appears to have been a powerful mechanism for quickly settling the smaller, less complex cases. We also remind ourselves and readers of this report that "practicable" is not an absolute term, and certainly is open to diverse and divergent interpretation as it relates to injury determination and quantification. Nevertheless, we think it is an underlying theme reflected in the current NRDA practice, and one that should be incorporated into any revisions to 43 CFR 11, or in the development of new guidance for injury determination and quantification.

A specific, tractable problem exists in 43 CFR 11 where the terms population, habitat and ecosystems are not defined. This has left NRDA practitioners, past and present, with uncertainties regarding their meaning, and, more importantly, with little or no guidance on what level of biological scale may be preferable for determining natural resource injury at specific sites. By providing definitions for these terms, and illustrating their application to injury determination and quantification, much of the real or perceived problem with 43 CFR 11 might be addressed.

3.1 Recommendations of Subcommittee 1

1. DOI should provide clarity, either through a revision in 43 CFR Part 11 or through new guidance, that makes clear injury determination and quantification should be performed at the level of habitat and/or at the appropriate level of biological scale (i.e., at the individual, population, community, or ecosystem level) that is practicable, reliable, and reasonable for the site in question. Although the exact level or levels that should be considered will vary on a site-by-site basis, at a minimum, the following factors should be considered in selecting an appropriate level for documenting injuries and quantifying damages: cost, timeliness, uncertainty, and the valued added, or not, to reaching settlement or successful restoration by conducting the assessment at any particular level or levels. For example, injury determination and quantification at lower levels of biological complexity may be accomplished in less time and at lower cost than what

would be necessary at more complex levels. However, if determinations at the lower levels result in data that are not scalable to damages or restoration, this may result in difficulty in obtaining agreement as to the magnitude of the injury and the appropriate amount of damages. Conversely, the cost and time involved in determining injury at higher levels of biological complexity may be extreme and the data, which are likely to be confounded by a multitude of factors that typically come into play at higher levels of complexity, also may result in difficulty in obtaining agreement as to the magnitude of injury and the appropriate amount damages.

2. DOI should consider making revisions or modifications to the 43 CFR Part 11 regulations that are suggestive, but not prescriptive, in terms of mandating the level of biological scale appropriate for injury assessment. We also suggest that modifications or future regulations not be overly prescriptive or mandate particular injury or damage assessment methodologies as these will inevitably change over time with improvements to scientific knowledge and NRDA practice. In our opinion, the present ambiguities in the regulations regarding biological scale(s) for injury determination may be most readily resolved through technical memoranda, updated guidance, or other official written documents.

3. In developing future injury determination and quantification technical guidance documents, DOI should prepare them in a form that is easily updated to account for the evolving nature of scientific methodology. To ensure accuracy and broad acceptance, the guidance should be subject to scientific peer review, and sufficiently flexible to recognize the diversity of contaminants, habitats and resources found at hazardous waste sites in the United States. Regarding the implementation of this recommendation, there may be merit in DOI assembling NRDA practitioners from the public and private sectors, academic experts and other scientists to work collectively on developing such technical guidance.

4. DOI should change their regulations to support habitat restoration or restoration-based options as an early consideration in the damage assessment process. With recent advances in restoration-based scaling methods (e.g., Habitat Equivalency Analysis), injuries can be scaled to the appropriate amount of restoration regardless of the magnitude of the injury. Thus, small injuries can be compensated with small amounts of restoration, and larger injuries will scale to larger restoration efforts. We believe that by considering restoration-based options early in the damage assessment process and by applying scalable damage assessment methodologies the conflict between trustees and responsible parties will be reduced. These actions should provide a better framework for resolving key differences and they will focus the parties on getting to the bottom line more expeditiously.

One member of Subcommittee 1 suggests additional guidance on Recommendation # 4 as further discussed in Section 4, ADDITIONAL PERSPECTIVES ON SUBCOMMITTEE 1 QUESTIONS

5. DOI should ensure that all pertinent terms such as: individual, population, community, ecosystem, and habitat are defined in the regulations (see attached glossary of terms used in this document).

SECTION 4. ADDITIONAL PERSPECTIVES ON SUBCOMMITTEE 1 QUESTIONS

One member of Subcommittee 1 provides additional comments on the above Recommendation # 4: One approach to support habitat restoration or restoration-based strategies could be the development of policies or guidance that would provide the flexibility for DOI and other federal trustees to consider proactive, voluntary restoration actions that could be applied to compensatory restoration requirements at CERCLA sites. Coupling such innovative strategies with "practicable" approaches to injury assessment could, possibly, help to expedite NRD settlements nationally.

One member of Subcommittee 1 disagrees with several of the recommendations and conclusions stated above in Section 3: CONCLUSIONS AND RECOMMENDATIONS as follows:

The report as currently drafted does not acknowledge that because populations are the fundamental units of biological organization; population level assessments should usually be the focus of NRDA's when quantifying injury to biological resources under the Type B rule. In fact, the draft report does not adequately acknowledge that "injuries to individual organisms may be relatively easy to document, but are generally not as relevant ecologically as injuries sustained at the population level and above and thus generally do not affect the services provided by the resource. In most cases services are provided by populations, communities or ecosystems, not by individual organisms." Barnthouse and Stahl, "Quantifying Natural Resource Injuries and Ecological Service Reductions: Challenges and Opportunities" at p.3.

The report as currently drafted fails to acknowledge these issues and the related issue that there are substantial uncertainties associated with extrapolation of individual organism level effects to population or community level effects or service losses. The report as drafted fails to adequately address the uncertainties inherent in such extrapolation despite the fact that one subcommittee member in support of the report's conclusions as currently drafted has published a peer-reviewed paper stating that "the transition of an effect from an organism to an ecological system is to transfer information between two structures with fundamentally different properties." W.G. Landis, "Uncertainties in the Extrapolation from Individual Effects to Impacts Upon Landscapes" Hum. Ecol. Risk Assess. Vol. 8, No. 1, 2002 at p. 195.

Instead of focusing upon these scientific shortcomings associated with an individual organism approach to injury quantification, the majority appears to justify its endorsement of injury quantification at the individual level by pointing out that some people have a strong attachment to individual organisms of some species, particularly "charismatic macrofauna." However, such economic issues of value are not relevant to the question of whether, as a matter of science, injury quantification at the individual level is a BAP for Type B NRDAs. The report as drafted takes these positions despite the fact that one of the subcommittee's scientist members has written that: "Without proper consideration of the population context, emphasis upon individuals leads to inaccurate assessments of risk." Landis WG. "Population is the Appropriate Biological Unit of Interest for a Species-Specific Risk Assessment" SETAC Ecological Risk Assessment Advisory Group Webpage, www.setac. org/eraag/era pop discourse 3.htm).

It is also important to note that the discussion of restoration-based scaling, including Habitat Equivalency Analysis ("HEA"), within recommendation #4 above goes far beyond the questions posed to Subcommittee #1, which address injury quantification. HEA is a method for estimating damages, not quantifying injury. NOAA Coastal Services Center webpage entitled "Habitat Equivalency Analysis" at page 2 (www.esw.noaa.gov/coastal/economics/habitategu.htm).

SECTION 5: REFERENCES

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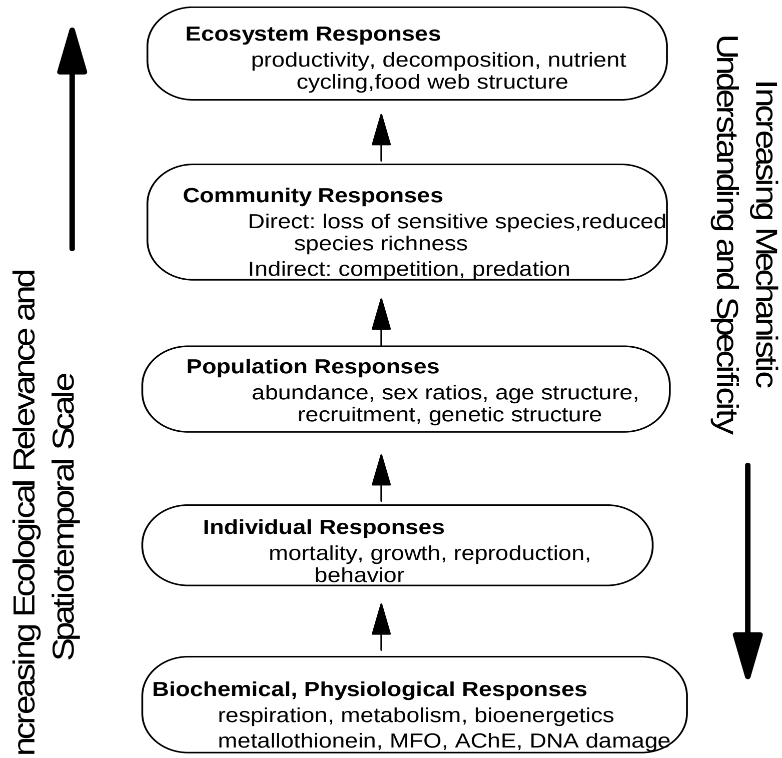
Figure 2-1. Biological scales and applicable types of measurements.



APPENDICES

A. BIOGRAPHICAL SUMMARIES OF SUBCOMMITTEE MEMBERS

William H. Clements

Affiliation

Department of Fish, Wildlife and Conservation Biology, Colorado State University.

Education

Bachelor’s Degree in Biology, Florida State University, Fresno; Master’s Degree in Biology, Florida State University; Doctorate Degree in Zoology, Virginia Tech.

NRDA Case Experience

CERCLA (specific cases- Blackbird Mine, Idaho; California Gulch, Leadville, Colorado)

Barbara J. Goldsmith

Affiliation

President, Barbara J. Goldsmith & Company, Environmental Management Consulting Services; Director, Ad-Hoc Industry Natural Resource Damage Group

Education

Bachelor’s Degree, George Washington University; Master of City Planning in Environmental Analysis, Harvard University (Joint degree program between Harvard School of Public Health; Kennedy School of Government; and Graduate School of Design)

Experience (CERCLA and OPA)

NRD-related briefings and policy formulation at the highest levels of the U.S. Government; coordinating the Ad-Hoc Industry Natural Resource Damage Group; preparing comments on emerging NRDA regulations and policies for individual companies and groups of companies, subsequently submitted to U.S. Government departments/agencies; establishing and managing PRP groups for sites involving NRD issues; assisting individual companies estimate their NRD liability, identify and retain experts, and providing litigation support to companies; managing the early NRDA activities for one of the largest Superfund sites in the country; providing briefings and serving as resource to over 15 national industrial trade associations on NRD related issues; and developing methodological approaches to natural resource damage assessment.

Lisa N. Gover

Affiliation

Lisa N. Gover, Consultant

Education

Bachelor of Political Science, University of New Mexico; Juris Doctorate, School of Law, University of New Mexico

Experience (CERCLA)

Coordination of policy recommendations and research of the National Tribal Environmental Council's, Superfund Working Group – a committee of tribal government officials and their supporting attorneys, scientists, and other technicians involved in CERCLA NPL and other Superfund caliber sites with NRD claims on and near Indian lands.

Roger C. Helm

Affiliation

U.S. Fish and Wildlife Service, Chief, Branch of NRDA and Spill Response Region 1.

Education

Bachelor's Degree in Biology, California State University, Fresno; Master's Degree in Biology, Moss Landing Marine Laboratories; Doctorate Degree in Biological Ecology, University of California, Davis.

CERCLA Case Experience

Montrose/CA, Iron Mountain Mine/CA, Coeur d'Alene/ID, Commencement Bay/WA, Elliott Bay/WA, Cantara Loop/CA, United Heckathorn/CA, Holden Mine/WA, Leviathan Mine/CA

OPA/CWA Case Experience

*Exxon Valdez/*Exxon, *Apex Houston/*Apex Oil Company, *American Trader*/BP, *New Carissa/*Green Atlas, Santa Clara River/ARCO; *Kure*/Humboldt Bay; *Jin Shiang Fa*/Rose Atoll; Santa Clara River/Mobil; Avila Beach/Unocal; Guadalupe Oil Field/Unocal, Pearl Harbor/Chevron, Barbers Point/Tesoro

Wayne G. Landis

Affiliation

Huxley College of the Environment, Western Washington University. Director Institute of Environmental Toxicology, Chair Department of Environmental Sciences.

Education

Ph. D. Zoology, Indiana University, Bloomington, IN 1979, M. A. Biology, Indiana University, Bloomington IN 1978. B. A., cum laude with Honors in Biology, Wake Forest University, Winston-Salem, NC 1974

CERCLA Case Experience

No CERCLA Experience

OPA/CWA Case Experience

Whatcom Creek, Bellingham WA

Relevant Study Experience

Regional scale risk assessments for Cherry Point WA, Willamette and McKenzie Rivers OR, Codorus Creek PA, Androscoggin River ME and NH, PETAR park in Brazil, Catchment in Tasmania, Australia, Lake Whatcom Bellingham WA, Trail smelter site British Columbia. Invasive species and GMO risk for the Chesapeake Bay, Mid Atlantic States, and central Oregon. Extensive research on the effects of toxicants at the population and community scales.

Robert W. Ricker

Affiliation

National Oceanic and Atmospheric Administration, Office of Response and Restoration, Acting Chief of Assessment and Restoration Division.

Education

Bachelor Degree in Botany, University of California, Berkeley; Ph.D. in Marine Botany, Melbourne University, Victoria, Australia.

CERCLA Case Experience

Castro Cove, CA; Commencement Bay, WA; Duwamish waterway, WA; Hudson River, NY; Iron Mountain Mine, CA; Montrose (Los Angeles), CA; Passaic River, NJ; Penobscot River, MA; Portland Harbor, OR

OPA/CWA Case Experience

ARCO/Santa Clara River; Bouchard/Buzzards Bay; Cape Mohican/San Francisco Bay; Evergreen/Charleston Harbor; Kure/Humboldt Bay; Jin Shiang Fa/Rose Atoll; Luckenbach; Mobil/Santa Clara River; PEPCO/Chalk Point; UNOCAL/Avila Beach 1 & 2; UNOCAL/Guadalupe Oil Field

Ralph G. Stahl, Jr.

Affiliation

E.I. du Pont de Nemours & Co., Principal Consultant.

Education

BS Marine Biology, Texas A&M University; MS Biology, Texas A&M University; Ph.D. University of Texas.

CERCLA Case Experience

Baileys Waste Site, TX; Palmer Barge Line, TX; DuPont Newport, DE; Tri-State Mining District, MO/KS/OK.

OPA/CWA/State-Lead Case Experience

Former Remington Gun Club, CT; Rio Tinto Mine Site, NV; Passaic River, NJ; NJ Groundwater, Statewide-8 Sites, NJ; East Branch, Grand Calumet River, IN.

Dale C. Young

Affiliation

Commonwealth of Massachusetts, Executive Office of Environmental Affairs, NRD Program Director.

Education

Bachelors of Science Degree, Environmental Science/Public Health, University of Massachusetts, Amherst. Graduate course work, Tufts University.

CERCLA Case Experience

Charles George Landfill NPL Site, MA; New Bedford Harbor NPL Site, MA; PSC Resources NPL Site, MA; Nyanza Chemical Waste Dump NPL Site, MA; General Electric/Housatonic River Site, MA; Colrain Sulfuric Acid Spill Site, MA; Holyoke Coal Tar Deposits Site, MA; Massachusetts Military Reservation NPL Site, MA.

OPA/CWA Case Experience

Bouchard 120/Buzzards Bay, MA; Hallmark/Mystic River, MA; Posavina Oil Spill, MA.

<u>B. BIOGRAPHICAL SUMMARIES AND NOTES FROM OTHER PARTIES CONSULTED</u>

The subcommittees of the DOI Federal Advisory Committee on Natural Resource Damage Assessment and Restoration have been charged with a number of key questions in DOI's implementation of CERCLA. Subcommittees have solicited input from experts outside the FACA Committee regarding relevant case experiences to help inform these evaluations. Specifically, Subcommittee #1 contacted the following NRDA practitioners to discuss case examples and advice in regards to their experiences in either the OPA or CERCLA context related to the Subcommittee's charge. The listing is provided in alphabetical order. In addition, The following text was provided to the parties consulted by Subcommittee #1 to guide the discussions:

"The Subcommittee 1 is charged w/ addressing: "What are the practicable steps to determine injury and damages to habitat and the various levels of biological scale (i.e., individual to ecosystem)?" We are therefore soliciting your input/response on the following questions to inform us on this issue:

In the past 10 years, how many NRDAs were focused on biological scale(s) at the individual level? How many at the population, community or ecosystem level? Please provide relevant NRDA case data in the attached "Q1 Case Matrix.

If you have been involved with NRDAs at the individual, population, community or ecosystem levels, what has been your experience- positive or negative with each?

For assessments at population or higher levels of biological organization, how were damages quantified and restoration actions scaled to the damages claimed?"

Michael C. Donlan

1. Biographical Summary

Affiliation

Principal, Industrial Economics, Incorporated.

Education

A.B., Geography modified by Economics, Dartmouth College

M.B.A., Stanford University.

CERCLA Case Experience

Several cases, including Montrose/CA, Duwamish/WA, St. Louis River/MN, Tri-State/KN, Tri-State/MO, Passaic River and Newark Bay/NJ, Hudson River/NY.

OPA/CWA Case Experience

Several cases, including *North Cape*/RI, Chalk Point/MD, *Athos*/MD/NJ/PA, Pago Pago/American Samoa.

Other Case Experience

United Nations Compensation Commission assessment of environmental damages arising from Iraq's 1991 invasion and occupation of Kuwait.

2. Discussion Summary

Background and Experience

- Works on mix of NRD cases, including oil spills and hazardous waste sites; of these, none have been based on population level impacts; 12-15 cases based on individual impacts. Also worked for United Nations on Gulf of War NRD issues.

Key Comments

- None of his cases involved estimating population reduction on statistical basis; Instead, generally look at # of individual losses; never taken additional step to determine if the loss affects the population. Case example: Montrose: DDT impacts on fish: Loss was quantified in terms of fish biomass; did not evaluate population impact.

- ERA: HQs are difficult to translate into service losses; inherently incorporate judgment calls. ERA focuses on high risk and not service loss. Try to rely on ERA but usually not enough information for NRD assessment.
- Usually select a couple representative species-indicators as proxy to understand injury

Recommendations based on earlier NRDA case work

- Need regulations to clarify NRDA process, with boundaries of some sort.
- Regulations should not require determining population level effects.
- Need to look @ service losses for NRDA.
- Recommend making NRD a Fact Finding or Arbitration Process vs. Litigation process.

Thomas C. Ginn

1. Biographical Summary

Affiliation

Exponent, Inc., Director and Principal Scientist, Ecosciences Practice.

Education

Bachelor of Science in Fisheries, Oregon State University, Corvallis, OR; Master of Science in Biological Sciences, Oregon State University, Corvallis, OR; Doctor of Philosophy in Biology, New York University, New York, NY

CERCLA Case Experience

Montana v. Arco (Clark Fork River/Anaconda)/MT; U.S. v Asarco et al. (Coeur d'Alene)/ID; Commencement Bay/WA; United Heckathorn/CA; Duwamish River/WA; Saginaw River/Bay/MI; St. Lawrence River (Massena)/NY; Ashtabula River/Harbor/OH; U.S. et al. v. Elkem Metals et al. (Ohio River)/OH and WV; FAG Bearing/MO; Shieldalloy Metallurgical Corporation/OH; Pools Prairie (Neosho)/MO; Koppers Texarkana/TX; SMC Newfield/NJ; Koppers Charleston/SC; Lake Hartwell, SC; Onondaga Lake/NY; Hudson River/NY; Alaska Pulp Corporation (Sitka)/AK.

OPA/CWA Case Experience

Pine Bend Refinery/MN; White River/IN

2. Discussion Summary

Background and Experience

- Ecotoxicology; Worked on NRDA since 1987 (devotes approximately 75% of time), including 22 CERCLA cases and a few OPA/CWA cases. Involved in several large scale cases in litigation (Clark Fork, Coeur d'Alene, Ohio River) and many Cooperative Assessments (St Lawrence, Koppers, Duwamish)

Key Comments

- Important to distinguish between small-scale sites with limited data and larger CERCLA sites with broad scale contamination and high potential for litigation (especially those involving large-scale sediment contamination)
- Effort devoted to predicting effects at the individual organism level has not "paid off" in terms of measuring loss of services
    - Example: should not predict population decline from water quality (e.g., comparison to ambient water quality criteria) or individual toxicity data. Individual level approach does not work well: high level of uncertainty and difficult to translate service loss based on predicted effects; also difficulty in extrapolating effects on individuals to Community/Population service flows. Critical of using biomarkers for individual exposure. e.g., immunosupression, as an indicator of population effects or service loss
    - We have the ability to quantify effects at higher levels of organization;
        - Examples:
        - Sediment quality triad
        - Benthic community assessments
        - Hatching success and demographic analyses of birds ("pseudo-population" involves only breeding population in assessment area)
        - Field assessments of fish populations (abundance, age structure)
- Noted importance of proper experimental design for field studies, especially

selecting reference sites to account for baseline conditions and consideration of statistical power; if not adequately designed; field studies cannot detect small effects

- Proponent of using gradient analyses (chemical concentrations or other stressor gradients) vs. reference sites (i.e., to establish baseline conditions). Frequently used in oil spills, more difficult in complex CERCLA cases.
- Notes trends toward 1) assessments at population and community (latter for benthic organisms) levels of organization within NRDA; and 2) linking restoration to quantification of service loss. These trends are likely a result of improvements in our ability to conduct and design assessments at higher levels
- In favor of using weight of evidence approaches, but questioned how we determine the specific weighting of each component
- Involved in population studies to assess service losses. For some species, may require 4-5 breeding seasons; caution in studying just 1 season due to potentially high variability.

Recommendations based on earlier NRDA case work

- Success of NRDA settlement is not necessarily related to amount of data collected or the level of biological organization examined
- Studies at population and community levels have been successful; however, knows of no attempts to assess ecosystem level effects ("considered not especially valuable")
- Allow some flexibility in regulations depending on what level of organization that we care about
- There is a critical need for Technical Guidance on conducting assessments at higher levels of biological organization.
- Does not recommend extrapolating results of individual level tests (toxicity tests, Micro-tox Tests, Sediment Quality values) to higher levels of organization

(Community, Population). The solution is to focus on resource of interest, e.g. If resource of concern is piscivirous birds, then focus on studying piscivirous birds and not on lower trophic levels..

- Conducting assessments at higher levels of organization does not speed up settlement, but may provide more appropriate data for making decisions and promotes greater cooperation.

Michael T. Huguenin

1. Biographical Summary

Affiliation

Harvard Center for Risk Analysis, Harvard School of Public Health, Executive Director
Formerly President, Industrial Economics, Incorporated.

Education

A.B. Physics, Washington University in St. Louis
M. Sc. Management, Massachusetts Institute of Technology

CERCLA Case Experience

Hudson River/NY, Montrose/CA, Iron Mountain Mine/CA, Commencement Bay/WA, Elliott Bay/WA, Massachusetts Military Reservation/MA, New Bedford Harbor/MA, Charles George Landfill/MA

OPA/CWA Case Experience

*Exxon Valdez/*Exxon, *Apex Houston/*Apex Oil Company, *North Cape*, Tampa Bay, Portland Harbor

Other NRD Experience

United Nations Compensation Commission, Geneva, evaluation of environmental damage in Kuwait, Iran, Jordan, & Syria caused by 1991 Gulf War

2. Discussion Summary

Background and Experience

- Formerly with Industrial Economics, presently with Harvard Center for Risk Analysis (April 10, 2006)
- Extensive experience on cases up until about 2000 including: Montrose, Exxon Valdez, North Cape, Hudson River, New Bedford Harbor. Since 2000 worked mostly on 1st Gulf War restoration/reparations

Key Comments

- Injury determination rarely focused on individual level except for rare/endangered and for macrofauna, e.g. birds and fish kills tend to evaluate at individual level. For small fauna would mostly look at community level impacts, ecosystem too big. NRDA can use/benefit from ERA.

Recommendations based on earlier NRDA case work

- Recommends against prescriptive regulations as science not advanced adequately, but recommend addressing 'uncertainty' somewhere in the regulations
- Recommends Fact Finding approach vs. Litigation context
- European Environmental Directive- the framework that Europe is using to base compensation claims from oil releases, is mostly based on OPA; Unaware of any process in Europe for compensation for hazardous waste releases.

Kenneth D. Jenkins

1. Biographical Summary (summary still pending interviewee approval)

Affiliation

BBL Sciences

Education: not provided

CERCLA Case Experience

Worked on 10 – 20 NRD cases, including Blackbird Mine, Clark Fork, and Montrose; currently involved in 7-8 ongoing NRD cases including Cooperative Assessments.

OPA/CWA Case Experience: not provided

Other NRD Experience: not provided

2. Discussion Summary

Key Comments

- Majority of experience in defining injuries for NRD cases has been at the level of individual organism. One exception is with fish injuries, which sometimes are measured by counts of impacted individuals, and losses are characterized at the population level (e.g., Clark Fork case). Recommends using several lines of evidence, e.g. fish kill, population survey, bioassay, pop studies; should not take individual line of evidence out of context.
- Documenting injuries at the population level is often complicated by difficulties in determining baseline (pre-incident) conditions. Important to account for patchiness in baseline environmental conditions.
- Analysis of spatial and temporal gradients can be useful for teasing out variables associated with contaminant releases; this approach has helped in past case discussions about site variables, baseline conditions, and uncertainties of exposure and contaminant related injuries.
- Limited experience documenting injuries at the community and ecosystem levels, with some work documenting injuries to benthics and plants at community level.
- Practicability in conducting and completing damage assessments moves us to use quicker and more definitive measures, which are generally at the level of the individual.
- Provided example from Housatonic PCB case of some ERA food web studies for birds. Data analysis in one instance demonstrated subtle reproductive impacts depending upon the statistical analyses performed. Study was limited to one point in time, which precluded answering questions about injury changes over time.

Recommendations based on earlier NRDA case work

- NRDA practitioners should work at the highest level of [biological] organization allowed by practicable constraints for documenting injuries and quantifying service losses.

- Injuries in the benthos should be documented at the community level rather than to specific benthic individuals.
- Use multiple lines of evidence to support injury claims, although these may conflict with one another (e.g., physiological changes, biomarkers, bioassays).
- When possible, use injury studies that account for spatial and temporal gradients of contaminant exposure; tease out variables of contaminant release(s) in light of existing environmental conditions.

Dr. F.E. Kirschner, LG, LHG

1. Biographical Summary

Affiliation

AESE, Inc. Technical representatives for various Native American governments

Education

BSc, Geology, University of Nevada Las Vegas

MS Hydrology, University of Idaho

Ph.D. Geology, University of Idaho

CERCLA Case Experience

Bunkerhill/Coeur d'Alene, ID; Midnite Uranium Mine, WA; Upper Columbia River, WA; Hanford, WA; Leviathan Mine, NV/CA; Sulphur Bank Mercury Mine, CA; Yerington Mine and Metallurgical Complex, NV; Tar Creek, OK; St. Regis, MN; Loring AFB, MA. Numerous other non-NRDA CERCLA cases

OPA/CWA Case Experience: *None*

2. Discussion Summary

Background and Experience

- *Has not personally been involved in cases that have been concluded. Therefore, a discussion on positive/negative aspects of the outcome would be premature. In most cases he has worked on, Tribes use a REA approach and scale the damages based on loss of resource days and loss of convenience. If replacement of equivalent off-reservation resources is contemplated as a compensatory mechanism (generally the reference areas), then damages from loss-of-rights tied to the land that are associated with the exercise of federally-reserved and protected rights must also be calculated.*

Key Comments

- *Tribes who rely heavily on natural resources for sustenance are inextricably linked with the immediate environment. Lands reserved for Tribes are the only lands in which these groups can exercise their federally-reserved and protected rights. These lands are the only places in which these groups can still legally harvest necessary resources. Such harvests are generally in excess of harvests on lands held by the general public rather than only during state-established seasons. For example, depending on the governing body, there are usually no bag limits on deer for western reservations. This means that a Tribal member must hunt on the reservation to provide necessary sustenance for the family.*
- *The difference in reservation and state laws associated with the take of fish and game, essentially constrains the Tribal member to extract all of his resources from reservation lands—the land (abiotic resources) and the biologic resources located on the reservation is his life. In order to make the Tribal government whole, this means that compensation must ultimately restore the uses of resources on the reservation.*
- *Tribes generally manage resources on the reservation on both an individual and population-level bases. This is due, in part, because the resource-base is highly monitored and managed because of its great value (resources are almost always at risk due to over harvest).*

- *Concerns with on-reservation resources generally are first noted at the on-reservation population level by managers and users. For example, reduction in a given plant areal density may be noted. The manager then investigates the concerns on an individual basis.*
- *On reservations, Tribes are only concerned with the populations that are on the reservation or appertain to the reservation resources—our scope of concern is different than the federal partners.*

Recommendations based on earlier NRDA case work

- In order to make the Tribal government whole, compensation must ultimately restore the uses of resources on the reservation. If replacement of equivalent off-reservation resources is contemplated as a compensatory mechanism (generally the reference areas), then damages from loss of rights tied to the land that are associated with the exercise of federally-reserved and protected rights must also be calculated. This should include, but should not be limited to: (1) the cost of replacement of past and future services; (2) the cost associated with inconvenience of use; (3) the cost of putting the newly acquired lands into federal trust, and (4) the cost of expanding the reservation boundaries to include these new lands.

Joshua Lipton

1. Biographical Summary

- BA Ecology, Middlebury College
- MS Natural Resources, Cornell University
- PhD Natural Resources/Environmental Toxicology, Cornell University

For more than 16 years, Dr. Lipton has been a central figure in the development and application of procedures for assessing natural resource damages, having served as lead scientist at many of the prominent NRDA investigations performed in the U.S. Dr. Lipton's expertise includes environmental toxicology and chemistry, ecology, and natural resources investigations. He has designed and directed laboratory and field toxicity tests, environmental sampling/monitoring studies, ecological field investigations, fisheries and wildlife population monitoring studies, and environmental modeling projects. Dr. Lipton is the author or co-author of numerous peer-reviewed articles in scientific journals as well as presentations at scientific meetings.

Affiliation

President and CEO of Stratus Consulting

Education

CERCLA Case Experience: extensive

OPA/CWA Case Experience: not provided

2. Discussion Summary

Background and Experience

- Has been involved in many dozens of NRD cases throughout the U.S., including large, litigated cases, small, expedited assessments, and cooperative assessments.
- Has been involved in many cases involving population and community-level injuries, as well as sites where assessment focus was on sub-population scales of organization.
- Has been involved in development of technical guidance and regulations at both federal and state levels.

Key Comments

- Different scales of injury quantification can be appropriate in different site-specific contexts.
- The trustee should consider various factors in selecting the proper scale of injury quantification, including study complexity, power to observe responses, biological/ecological factors, natural variability, reasonable cost, etc. Including the broad factors that should be considered by Trustees in the regulations could be useful.

- Other factors that may be considered by Trustees include practicable constraints such as schedule, cost, type/complexity of information needed to inform restoration decisions, relationship between Trustees and responsible parties, etc.
- As biological scale of organization increases, study complexity and uncertainty can increase.
- Rather than being prescriptive in the regulations, Dr. Lipton favors site-specific flexibility. Development of technical guidance can assist parties in selecting appropriate approaches.
- Ecological Risk Assessment (ERA): Use of Hazard Quotients from ERAs may be sufficient to determine Response Actions, but may not be sufficient to determine injury in fact. Trustees and EPA need to cooperate, but does not recommend prescriptive integration of ERA and NRDA.

Recommendations based on earlier NRDA case work

- Technical Guidance documents, rather than regulations, should be provided that address how to define injury, how to determine injury at various levels of biological organization, etc

Eugene R. Mancini

1. Biographical Summary

Affiliation:

E.R. Mancini & Associates, Principal and Sr. Scientist, Environmental Science Consulting, Camarillo, CA

Education:

B.A. Biology, Kenyon College (OH); M.A. Zoology, DePauw University (IN); Ph.D. Biology, University of Louisville (KY)

CERCLA and CERCLA-like site NRDA experience:

Clark Fork River (MT); Commencement Bay (WA; 3 site projects [Duwamish, Hylebos and “Confidential”); Indiana Harbor Ship Canal/Grand Cal River; Leviathan Mine

(CA/NV); Rio Tinto Mine (NV); Passaic River (NJ); Lower Roanoke River (Plymouth Mill, NC); Willamette River (OR); multiple metals refining and manufacturing sites (East and Midwest)

Various OPA/CWA sites: Not considered for this project

2. Discussion Summary

Background and Experience

Retired from Arco some years ago and started his own company.

Key Comments

"These responses to the Subcommittee questions represent my professional experiences and views regarding injury/damage assessments for CERCLA legacy contamination sites. They do not necessarily represent my opinions regarding oil spill or hazmat response incidents nor should they be construed to represent the views of any industrial entity. I hope that this information is useful to the Subcommittee in its deliberations."

In the past 10 years, most of the NRDAs I've worked on concerned population, community and especially habitat-quality focused objectives (NOT really ecosystem-focused). This has been the case for inland aquatic and terrestrial systems as well as coastal riverine/estuarine systems. In my view, the lower the biological level of analysis, especially at or below the individual level, the less relevant, credible and scalable the assessment becomes. I especially value biological community metrics (e.g., benthic macroinvertebrate and fish community indices; plant community metrics). I find biomarker data unreliably interpretable for these purposes. My mind boggles at the prospect of interpreting ecotoxicogenomic data in the future.

Analyses at the individual organism level (other than single species lab tox tests, of course) only tend to be relevant where specific injuries have occurred to special classification species (e.g., T&E species, commercial/recreational species). Even under *these circumstances, I've found that such analyses may constrain or distract other more comprehensive and useful assessments.*

Table 1, below presents a summary of my experiences and views with injury/damage assessments at various levels of biological organization for legacy contamination sites.

Biological Scales	**Relative values and notes**
Sub-organism (e.g. biomarker)	Difficult to interpret reliably for field effects application; difficult or impossible to credibly scale to quantitative injury
Individual	Some potential value under special circumstances (T&E species, commercial/recreational species applications); may confound or distract more substantive, higher-level assessments
Population	Quantifiable metrics available for aquatic and terrestrial systems; injury-relevant and scalable
Community	Many metrics available for quantitative injury determinations; scalable
Habitat-focused	Physicochemical and biological metrics can be integrated and scaled to quantify habitat quality; scalable
Ecosystem	Only occasionally useful for legacy sites where there is already overwhelming evidence of injury at nearly every level anyway

Finally, for assessments at higher levels of biological organization, injury is often effectively quantified as "% effect" indicating the magnitude and extent of adverse effect. This effect metric can be applied to a population, community or area as % of compromised habitat, for instance. It can also be used to quantify reduction in quantifiable resource services if used thoughtfully. This metric is subject to abuse but when negotiated to settlement may represent credible resource analyses.

Recommendations based on earlier NRDA case work

- *Damages can be calculated in a variety of ways but is most effectively calculated on a resource-to-resource basis….much easier to come to settlement. DSAYs, river miles, acres can all be used to identify the "quantity or value" of restoration* *options. HEA seems to be particularly useful because it provides substantial flexibility in settlement negotiations.*

Robert E. Unsworth

1. Biographical Summary

Affiliation

President, Industrial Economics, Incorporated.

Education

B.S., Forestry, State University of New York, M.F.S. Forest Science (focus on resource economics), Yale University.

CERCLA Case Experience

Dozens of sites throughout the U.S. (e.g., New Bedford Harbor, Housatonic River, Lake Hartwell, Lake Apopka, Lake Ontario, Onondaga Lake (NY), Grand Calumet River, Whitewood Creek/Homestake Mine (SD), Clark Fork River, South Valley (NM), Rocky Mountain Arsenal, Fernald (OH), Tutu well field (USVI), Blackbird Mine (ID), Great Swamp National Wildlife Refuge (NJ)).

OPA/CWA Case Experience

Numerous cases (e.g., *Exxon Valdez*, *Apex Houston*, *Bouchard*, Point Wells, Fish Creek (OH), Heinz Refuge (PA), Arthur Kill (NY/NJ)).

2. Discussion Summary

Background and Experience

- Works on both OPA and CERCLA cases, as well as cases filed under state law; typically cases are Cooperative Assessments or Negotiated Settlements

Key Comments

- Injury is defined in regulations at individual level, e.g. Reproductive effects, Death. Look at adverse effects for 1) Biota: compare effects w/ literature values; 2) Soil/Sediments: compare concentrations w/ literature values & sediment benchmarks. Case example: Lake Apopka, FL: Mortality of several hundred birds; counts of individual dead birds used, but ran model to determine population recovery thru 3 generations.

- Although population may have ability to adapt, there still could be an injury, e.g. food web effects and impact on foragers.
- ERA is useful for NRDA process in identifying a problem. ERA is stuck in screening level analysis, need additional assessment for NRD to determine service losses.

Recommendations based on earlier NRDA case work

- Major challenge of NRD is lack of certainty in the process. If DOI regulations are too general, they will not address issue of uncertainty; rules and process will not be clear for either Trustees or PRPs.
- Cautions that if Subcommittee recommends using Technical Guidance Documents to address NRD assessment methods, process can be very slow to issue such guidance.

C. CHRONOLOGY OF SUBCOMMITTEE'S WORK

Past Meetings

Full Committee – November 30 – December 1, 2005, Shepherdstown, WV

Full Committee – March 2, 2006, Washington, DC

Subcommittee – May 2-3, 2006, Seattle, WA

Full Committee – July 26-27, 2006, Denver, Colorado

Full Committee – November 30-31, 2006, Washington, DC

Past Subcommittee Conference Calls

December 21, 2005; January 12, 18, and 31, 2006; February 23, 2006; March 23, 2006; May 18, 2006; June 23, 2006; August 30, 2006; September 20, 2006.

Past Conference Calls – Subcommittee and Outside Experts

April 10, 2006 – Huguenin, Jenkins and Lipton

April 13, 2006 – Ginn and written input from Kirschner

April 19, 2006 – Unsworth/Donlon

Date ??? - Written input from Mancini

D. RESEARCH MATERIALS USED FOR DISCUSSION/ANALYSES

E. GLOSSARY OF TERMS AND DEFINITIONS

Term	Definition
Individual	A particular being or thing as distinguished from a class, species, or collection. (*Webster's Seventh New Collegiate Dictionary*.)
Population	A group of individuals of one species in an area, though the size and nature of the area is defined, often arbitrarily, for the purposes of the study being undertaken. (Begon *et al*. 1996. *Ecology: Individuals, Populations, and Communities; 3rd Ed*.)
Community	The species that occur together in space and time. (Begon *et al*. 1996. *Ecology: Individuals, Populations, and Communities; 3rd Ed*.)
Habitat	Place where a microorganism, plant or animal lives. (Begon *et al*. 1996. *Ecology: Individuals, Populations, and Communities; 3rd Ed*.)
ERA	Ecological risk assessment is a process for systematically evaluating how likely it is that **adverse** ecological effects may occur as a result of exposure to one or more **stressors** (EPA, http://www.erg.com/portfolio/elearn/ecorisk/html/intro)
NRDA	Natural resource damage assessment is the process, often undertaken following the release of oil or regulated hazardous substances, by which trustees determine the nature and extent of injuries to natural resources and the restoration actions needed to reverse those losses (DARRP "Natural Resource Damage Assessment" one-pager 09/01/06)
Services	Natural resource services are those functions resources provide humans and/or other resources in the ecosystem. Examples of services include provision of feeding, breeding, and nursery habitat; primary and secondary production; nutrient cycling, and the opportunity for recreation. (pers. comm. Dr. Steve Thur, NOAA natural resource economist)
Acceptance criteria	
Ecosystem	A holistic concept of the plants, the animals habitually associated with them, and all the physical and chemical

	components of the immediate environment or habitat which together form a recognizable self-contained entity. (Begon *et al*. 1996. *Ecology: Individuals, Populations, and Communities; 3rd Ed*.)
Practicable	According to Black's Law Dictionary: practicable, adj. (of a thing) reasonably capable of being accomplished; feasible. Black's Law Dictionary, p. 1191. Seventh Edition, Bryan A. Garner (Editor in Chief). West Group Publishers, St. Paul, MN 1999.

F. Clarification of Subcommittee Assignment (Input from John Carlucci regarding Subcommittee's assignment based on discussions held at the July 26-27, 2006 full FACA Committee meeting in Denver, Colorado)

Roger,

Since you couldn't attend, you asked me for my recollection of the instructions given to subcommittee 1 after the last FACA Committee meeting in Denver.

It is fair to say that Pat Casano and I had a lot of input into the discussion after the subcommittee 1 presentation. Craig Potter, Barry Hartman, Lisa Gover, Bill Bresnick, Ralph Stahl, and others also had significant input -- along with Barbara and Dale.

It was pretty clear by the end that there were two focal points you're subcommittee was asked to deal with by the next meeting. In fact, I recall that Bill Bresnick summarized the charge and the end of the discussion, and there was agreement around the room.

The first focal point was an analysis of contrasting positions on the appropriate level for determining and quantifying natural resource injury. Craig Potter and Pat Casano articulated the position that the words "population, habitat, or ecosystem" in the current NRD regulations rightly represent a threshold for determining injury -- and that impairment to organisms below those levels is, in a sense, "per se" not significant (i.e., not constituting "injury" under the rule). The converse position -- posited by some trustee reps and me -- was that the OPA paradigm of "scaling" restoration to the level of injury determined (i.e., injury to a few organisms = a relatively small restoration, while injury validly determined to a larger scale of organization -- whether local or regional populations, communities, habitats, or ecosystems = a more robust restoration) makes identifying a threshold number of organisms that must be impaired for all cases in all places before a NRD can proceed irrelevant. I remember that at one point I characterized this debate as the "assimilative capacity" for impairment position vs. the scaling restoration to the level of injury validly determined position.

The second focal point was the identification of some reliable injury determination and quantification techniques along with some guidance -- if possible -- on the level of organization -- individual, population, community, habitat, etc. -- the methodology would be most useful for.

That's my recollection, and I'm pretty sure the minutes will reflect these discussions. You should also check with other folks (both on your team and mentioned in this e-mail) who were in attendance. Don't hesitate to contact me if you want to discuss this further, either one on one, or with your group.

John C.

The first was analysis on the issue -- put forward in clear terms by Craig and Pat -- that the words "population, habitat, and ecosystem" in the current rule reflect a "trigger" for injury -- and that any impairment to an organism or organisms that cannot be said to be on the "population, habitat, or ecosystem" level is not "injury" as defined by the rule, and is per se not significant (representing a sort of assimilative capacity for impairment) VERSUS the OPA paradigm of just "scaling" the restoration to reflect the level of analysis for injury (e.g., a few injured organisms determined and quantified = a small restoration project dealing with a few organisms -- the more injury validly determined, the more restoration to address it, etc.)

The second issue was identifying (as examples) reliable injury determination and quantification techniques, and, if possible, giving guidance on the scale of analysis (individual, local population, regional population, community, habitat, etc.) the methodology would be most useful for.

That's my recollection. I'll check with Pat and some others to see if they remember the same. You should also check with folks on your team who were there. Don't hesitate to contact me if you need anything else, or want to discuss further, either one on one or with your group as a whole.

John C.