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Evaluation of Environmental Damage by the *Exxon Valdez* Incident

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Introduction

I am pleased to be here with you today at the conference. I have had the honor of serving as the Executive Director of the *Exxon Valdez* Oil Spill Trustee Council since 1994. There have been larger oil spills than the *Exxon Valdez* oil spill, but none that involved the release of such a large quantity of oil into such a rich and pristine environment. From the first day, this oil spill engaged the imagination and concern of the public, and created an interest that still exists to this day, nearly fourteen years later. I will first give you some background on the spill, the original extent of the injury, the valuation of damages, and the status of recovery today.

The oil

Alaska North Slope crude oil is produced along the northern coast of Alaska in various fields such as Prudhoe Bay and Kuparuk. The oil is heavy crude, highly toxic and slow to disperse when released into the environment. It is gathered in Prudhoe Bay and sent 800 miles through a pipeline to an ice-free terminal in Valdez, Alaska. From there the oil is loaded on tankers and shipped south, through Prince William Sound, down to Washington or California, where it is refined and distributed for use.

The Spill

On Thursday evening March 23, 1989, the *Exxon Valdez*, a very large crude carrier and one of Exxon's two largest oil tankers, left the Port of Valdez bound for Long Beach, California. Due to a variety of human errors, the ship was directed off course and shortly after midnight on Friday March 24, 1989, struck Bligh Reef and fetched up hard aground.

The grounding punctured the single-hulled vessel, resulting in the rupture of eleven of the vessel's crude oil tanks and releasing over 11 million gallons of crude oil into the pristine environment of Prince William Sound. It was the largest oil spill in United States history.

Response

For almost three days, the weather in Prince William Sound was unusually quiet. However, Alyeska Pipeline Company, the initial responder, was not ready and few pieces of equipment were in the area in a timely manner. There was little or no containment boom deployed and what was in the water was of little help. A test burn was conducted, which worked to some extent, but the water content of the oily mousse soon made burning impractical or impossible. Although dispersants were a primary response tool, and were tested with somewhat inconclusive results, Exxon and Alyeska had neither sufficient dispersant or equipment to adequately deploy it.

In any event, a natural gyre and the weather soon put an end to any hope of containment. A severe winter storm blew into Prince William Sound, and the oil slick quickly went from a relatively compact mass to a widely dispersed uncontrollable collection of patches and streaks. Oil began to hit the beaches of western Prince William Sound, overwhelming almost all efforts to stop it.

Over the next five and a half months, the cleanup operations grew exponentially, ultimately becoming the largest private project in Alaska since construction of the Trans-Alaska Pipeline, with over 11,000 people working on cleanup at its high point. At times

it looked like an invasion force had entered Prince William Sound. About $2 billion total was spent over the four year period to clean up more than 1,500 miles of oiled shoreline that stretched nearly 500 miles.

But even as cleanup continued, government officials began to plan for the day when it ended. They began to ask questions, such as: What is the injury to the environment? What can be done to restore it? What will it cost and how can we pay for it? Those questions led to the conclusions that the state and federal governments, working together, must assess the extent of the damages to the environment, value those damages, require Exxon to pay for them, and use the money received to restore the damages.

Assessment

The single biggest problem with assessing the extent of environmental damage caused by the oil spill was that, with a few exceptions, there was little baseline information on the natural resources in the oil spill area. As the spill expanded some scientists raced to gather data ahead of oil hitting the beaches. However, the spill was too big and too fast for much of this. Even where data existed, such as data on local salmon runs, the natural variation in those resources made pre-spill and post-spill comparisons suspect. Thus, to document the extent of damages, one of the crudest measures, a body count, became a primary yardstick for describing the damage to the public. Much of the early science program was oriented toward documenting injuries and changes in populations of single species, rather than entire ecosystems, and by tracking the fate and persistence of the oil.

Following the oil spill, animal carcasses were found in large numbers, including approximately 21,000 murres, 1,100 marbled murrelets, 838 cormorants, 151 bald eagles, and 1,000 sea otters. However, this measure clearly understated the actual losses since animal carcasses sank or were never discovered in the huge area covered by the oil spill. As an example, even though "only" about 21,000 murre carcasses were found, the estimated total loss, based on studies done at the time, was 250,000. This was about 40% of the pre-spill population of the oil spill area. Immediate mortalities were estimated to include 2,800 sea otters, 300 harbor seals and 22 killer whales.

No oiled killer whale carcasses were found following the oil spill, but 14 out of the 36 killer whales in the resident Prince William Sound pod disappeared in 1989 and 1990. During that same period, no whales were born in that pod, and the pod's complex social structure appeared to be deteriorating. The link between these losses is circumstantial – but the public and the Trustee Council have continued to monitor killer whales and report regularly on their status.

Another case of circumstantial evidence of injury was with Pacific herring in Prince William Sound. That population collapsed in 1993, the first year when large numbers of herring from eggs spawned on oiled shorelines in 1989 were recruited to the spawning population. Subsequent studies have shown that the collapse was due to a usually latent viral disease and that exposure to hydrocarbons – a known stressor – can induce its expression. It can't be "proven" that in this case, the oil spill was the "stressor".

However, this ecologically vital and commercially important species has yet to recruit the kind of large year-class that is essential for full recovery.

Sublethal injuries to natural resources were even more subtle. For example, following the oil spill cutthroat trout in oiled streams grew more slowly than those in unoiled streams, possibly as a result of reduced food supplies or exposure to oil. Reduced growth rates may lead to reduced survival.

An even more complex problem arose with pink salmon. Pink salmon in the Sound are both wild and hatchery raised. Wild pink salmon spawn in intertidal areas as well as in streams. These fish spawned in an oiled intertidal zone, swam through oiled waters and ingested oil particles and oiled prey as they foraged in the Sound and emigrated to the sea. As a result, post-spill studies indicated three types of injury. First, growth rates in juvenile salmon from oiled areas of Prince William Sound were reduced; second, there was increased egg mortality in oiled versus unoiled streams; and third, genetic damage appears to have occurred. Trustee Council researchers have shown that even very low concentrations of weathered oil can have toxic effects on early life stages of pink salmon.

Thus, we know there was injury to wild pink salmon stocks from the oil spill, but the question remains, to what extent. Natural variability in wild pink salmon in the Sound is huge, ranging in the years before the oil spill from a high of 21 million fish in 1984 to a low of 1.8 million in 1988. Since the oil spill, the return has varied from a high of 14.4 million in 1990 to a low of 2.2 million in 1992. While we can monitor growth and egg

mortality rates to assess recovery, it is very difficult, in light of the natural variability, to determine the effect on Prince William Sound pink salmon stocks that can be attributed to the spill.

The oil-related loss of about 300 harbor seals was added to a pre-spill decline in its Prince William Sound population. This decline continues today, for reasons probably not related to the oil spill.

In summary, while we know there was tremendous immediate injury to individual species, there was, and is, much uncertainty as to the exact amount of that injury.

Valuation

As difficult as it seemed to be to assess the extent of injury to natural resources, placing a dollar value on that injury was even more daunting. What is the value of an otter, a seal or a common murre? What is the financial cost of a cutthroat trout that grows slower? To answer these questions, state and federal lawyers looked, for the most part, to the value of the services that these resources provide to people, such as sport fishing and tourism.

One of the first studies initiated was a "replacement cost" analysis. This study estimates the value of injuries to natural resources based on the costs of relocation of adult animals from areas where they are abundant, the replacement of animals, and the rehabilitation of injured animals.

Relocation costs are the costs of capturing an animal, acclimating it to a new location and releasing it in that location. Thus, for example with eagles, the costs of capture and relocation were $1,000 - $1,500 per eagle. However, eagles tend to "home" so this cost was not truly indicative of the costs of replacing a breeding pair. Because this factor is not well understood, this number was not particularly useful for setting value.

Replacement costs are essentially the cost of raising young animals to maturity. Again looking at eagles, there have been several efforts to raise young eagles and introduce them into the wild. One of these efforts reported a cost of approximately $22,500 to successfully produce one adult eagle living in the wild. Another had costs of $12,500 - $15,000 per eagle, while a third reported costs of about $21,500.

Rehabilitation costs for injured animals was a third option. In 1989 Exxon spent about $100,000 per eagle in its rehabilitation program for animals injured by the oil spill. Looking at all of these figures, eagles were valued at about $22,000 per bird.

Sportfishing

Sportfishing was an activity clearly impacted by the oil spill. It is also an activity for which there is historic data. In 1989 the number of anglers decreased by 13%, the days fished decreased by 6%, and the fish caught decreased by 10%. To place a value on this decrease, economists, through interviews with anglers, determined that the average person spent $250 a day to fish in this area. This was assumed then to be the value to an average person of the fishing experience. By multiplying this value by the number of lost

angler days (124,185), economists determined that the lost value of sportfishing in 1989 was approximately $31 million.

Tourism

The impact of the oil spill on tourism was measured by surveys of planned and actual visitors to the state and the general population. These surveys indicated that visitor spending in 1989 decreased 8% in Southcentral Alaska and 35% in Southwest Alaska. In the spill area 59% of businesses reported cancellations. Of visitors who actually traveled to Alaska, 16% reported that the oil spill affected their travel plans and half of these said they avoided Prince William Sound altogether. The result was an estimated loss of $19 million in 1989. The impact in 1990 was much less severe, and since then, there has been little long term impact, although some recreation providers still avoid certain oiled beaches and report fewer wildlife sightings.

Passive Use

Ironically, the largest damage, in monetary terms, came not from the direct use of injured resources by individuals such as sport or commercial fishermen but rather, from people who have only an indirect connection to Prince William Sound. These uses are called "passive uses" and include the loss felt by people who have not visited the oil spill area but wish to visit some day, those who have no plans to use the area but want their children to have the opportunity and those who have no plans for direct use but simply value the fact that unspoiled wilderness exists. If lands or waters or wildlife are despoiled,

you have suffered a loss, and that loss can be measured by the amount of money you were willing to give to see that they remained unspoiled.

How then does one measure passive loss for an event such as the *Exxon Valdez*, and can that measurement stand up in court in an action to recover damages.

To answer this question the State of Alaska brought together a team of the most prominent economists in the country working in the area of measurement of passive loss. Peer review for the team was provided by Dr. Robert Solo, a recipient of the Nobel prize for economics. Ultimately, the state spent over $3 million to complete the study measuring lost passive use.

The most accepted measurement of passive loss at the time was through a method called continent valuation. In essence this calls for determining the loss suffered by individuals through a public opinion survey that could be extrapolated across the population that was injured. Although the theory of this methodology was well developed and used on a number of occasions, it had never been tested in court and was controversial among economists. For that reason whenever the state was presented with a choice on how to design or administer the survey, they always opted for the more conservative, defensible path.

First, it was necessary to determine the population that suffered the loss. Because of the extent and depth of the public knowledge and feelings about the *Exxon Valdez* oil spill, it was clear that the appropriate population was the nation.

The key to measurement of lost passive use is to design and implement a survey through which people are asked how much they value the attribute that is lost. This can be done by measuring either the amount a person would be willing to pay to prevent the oil spill or the amount a person would be willing to accept to allow it to happen. Studies have shown that use of a willingness to pay concept is more conservative and defensible, and for that reason it was the approach taken.

Once this decision was made the team set about to design a survey that would answer the question in the most accurate manner: focus groups, test surveys and pilot surveys were used. Conservative numbers to describe the damages were used. Damages claimed by other litigants, such as commercial fishermen, were not included.

The survey was given in person to 1,200 persons, and not in Alaska. Over 90% of the respondents were aware of the oil spill. The survey results, after being run through a series of complicated formulas, found a median willingness to pay of $31 per household. Multiplied by the number of English-speaking households in the United States (nearly 91 million), the total passive use damages came to $2.8 billion.

Settlement

Even though this approach had been used conservatively, problems remained in obtaining this amount through the courts. The methodology was controversial and never tried in court. There were some methodological problems that other economists said should reduce the amount by 50%. Taking these uncertainties into account, the state felt the claim was worth somewhat less than half of its face value. $1 billion was decided upon as an acceptable amount for purposes of settlement.

With a federal criminal trial looming on the horizon, Exxon was interested in settling its disputes with the governments. On August 28, 1991, a Memorandum of Agreement setting out the rules by which the governments would work together to recover and spend any settlement money received from Exxon was approved by the federal district court. In late September the governments and Exxon signed a civil settlement agreement and Exxon and the United States reached a criminal plea agreement. These agreements were approved by the court on October 8, 1991.

Under the civil settlement agreement, the governments were to receive $900 million from Exxon over a 10 year period, with a provision for payment of an additional $100 million for damages not known at the time of the settlement. The money was to be used to reimburse the governments for their expenses in the oil spill, to pay for any additional cleanup, and to pay for restoration. Through the criminal judgment, Exxon was to pay each government $50 million in criminal restitution and $25 million to the United States for a criminal fine.

Restoration

The Memorandum of Agreement between the State of Alaska and the United States governments called for the expenditure of settlement money to be overseen by six Trustees – three federal and three state. The trustees created a Trustee Council in Alaska to handle the day to day decisions on expenditures. The Council hired independent professional staff that report directly to them. The Council also had to decide on a general outline of how to spend the settlement monies.

Early on there was much discussion by the public as to whether the money should be used for scientific research, direct restoration activities, habitat acquisition, or oil spill prevention. Some advocated spending most of the money on injured natural resources; others felt that people who suffered from the spill should benefit directly.

State and federal lawyers determined that some of these were not legally permissible – such as prevention of future oil spills. Following a massive public outreach process, the Trustee Council decided on what became known as a "balanced and comprehensive" plan for restoration: money for habitat protection, scientific research, and direct –hands on – restoration. The Council also adopted the request of the public to not spend all of the money as it came in, but to set some aside in a reserve account for long term restoration activities.

The Trustee's scientific advisors argued that an essential first step was to prevent further harm to the habitats on which stressed fish and wildlife populations depend. The public agreed, and to date, the Trustees have protected about 650,000 acres of privately-owned lands in the spill area at a cost of close to $400 million, lands important for marbled murrelets and other birds, salmon and other fish, and marine mammals.

The research and monitoring program had three main purposes: to track injury and recovery; to understand the ecological factors that influence productivity and, therefore, recovery; and to improve resource management and stewardship.

Public Involvement

The public has always been a major partner in the restoration effort. The Trustee Council has a 20-member Public Advisory Committee, holds public meetings throughout the spill-impacted area, and seeks public comment on all activities. This is not always easy since the Council's program is somewhat restricted and there are numerous, diverse audiences, including isolated Alaska Native villages, commercial fishing interests, urban dwellers, and scientists.

Recovery 14 Years after the Spill

The Trustee Council established a list of resources which suffered population-level injuries due to the spill. Our goal is to get these populations back to the level they would have been if the spill had not occurred. However, many of these resources are also experiencing the effects of other natural and human factors, resulting in significant

population declines. A major concern with lingering oil effects is how the changes in overall population or abundance from the initial oil-related damage may combine with other kinds of changes and disturbances in the marine ecosystem. Recovery objectives are as specific and measurable as possible, but placement of a resource in a discrete category requires considerable judgment on the part of the Trustee Council, and in fact, may not necessarily reflect a resource's overall status or health.

Of the 29 species on the list of injured resources, seven have now been declared "Recovered" from the effects of the oil spill: archaeological resources, bald eagles, black oystercatcher, common murre, pink salmon, river otter, and sockeye salmon.

Eight other resources are considered to have made substantive progress toward recovery and are listed as "Recovering".

For some species, we know very little about the actual extent of the original injury, the overall population and life history, or the status of recovery. These are called "Recovery Unknown": cutthroat trout, Dolly Varden, Kittlitz's murrelets, rockfish, and subtidal communities. We may never get enough information to take them off this list.

The list of eight species "Not Recovering" is our greatest concern. These are the species which are having continued long-term declines in population, suffered severe losses during the spill, or show continuing effects from the spill. They include: common loon,

three species of cormorants, harbor seal, harlequin duck, Pacific herring, and pigeon guillemot.

Lingering Oil Effects

Shoreline surveys in 2001 and 2002 found beaches in Prince William Sound still contaminated with oil equivalent to about 28 acres total. The results were surprising: more oil was found than expected, especially in the subsurface; subsurface oil was less weathered and more toxic; and oil was found lower in the intertidal, closest to the zone of biological production.

Other Trustee Council studies indicate that recovery of sea otters and harlequin ducks in the heavily oiled region of western Prince William Sound has not occurred, with continuing oil exposure suspected as a factor. Additional research on the bioavailability of this oil is being conducted, as well as on the potential impacts of this continued exposure.

The conceptual model of this continuing injury is that oil still remains deep in the cobble beaches, under mussel beds, and in the subtidal zone. Oil is now making its way into the food web, contaminating prey that is consumed by sea ducks, such as harlequin ducks, and by sea otters. That ingested oil is being metabolized, and the metabolic products are causing tissue damage.

GEM Program

Because it will be increasingly difficult over time to separate out an oil spill effect from some other factor affecting a species, the Trustee Council decided to use its remaining funds – about $100 million – to establish an endowment for long term monitoring and research in the oil spill area – essentially the northern Gulf of Alaska. This program – called GEM – represents the Council's ongoing legacy for promoting recovery of the spill-affected region by understanding the natural and human-caused changes to marine ecosystems and marine species.

It is becoming increasingly clear that climate and oceanography play major roles in controlling biological processes and populations of fish and wildlife important to people. In fact, long-term monitoring now shows a major regime shift in the northern Gulf of Alaska, with an ecosystem dominated by shrimp in the early 1970s, changing to one dominated by cod and flatfish in the 1990s.

Added to natural ecosystem changes, we know that human activities play a prominent role in this marine system and may have unintended consequences on the overall ecosystem dynamics.

Human Effects

The governments' settlement with Exxon was for damages to the "public's natural resources". As for the people of the spill-impacted area, the event that took place on Good Friday 1989 still has significant psychological and economic impacts. It would be

hard to overstate the psychological trauma that the spill imposed upon the people who live in the spill area and were most affected by it. The Native Alutiiq people still call it "The Day the Water Died," although we now know that that did not in fact happen and that there has been remarkable overall recovery.

The *Exxon Valdez* oil spill has all the characteristics of a technological disaster:

- ?? It was caused by human error.
- ?? It resulted in contamination of the biosphere.
- ?? The incident eroded families and communities.
- ?? There were physiological impacts – stress-related illnesses, higher incidents of alcoholism.
- ?? The incident resulted in litigation that is still not resolved – 14 years later.
- ?? And, it has an ambiguous ending. There is still uncertainty about the extent of injury and the status of recovery.

It has not been lost on the people that the governments were able to settle their claims with Exxon, but private citizens haven't. At the trial for the private plaintiff claims in 1994, the jury found compensatory damages for commercial fishermen in the amount of approximately $287 million, with another $3.5 million to other claimants such as subsistence users, municipalities and area businesses. The jury also assigned $5 billion in punitive damages. The private litigation is under appeal by Exxon and is still working its way through the federal court system.

Conclusions

We now know that oil spill effects can be subtle, indirect, long-term, and sometimes, not immediately evident, such as the impact of small amounts of weathered oil – over a very long time -- on sea otters and harlequin ducks. Oil spills don't happen in a vacuum; spill effects are added to those of natural changes, such as El Nino, and other human actions unrelated to oil spills, such as fisheries harvests. We also know that you can't possibly have all the answers at the beginning, so it's important to develop a restoration program that is flexible and that can be modified and adapted as additional information is acquired.

The Trustee Council has determined that for the long term, it will be our understanding and our ability to share information that will determine the future of the Gulf of Alaska ecosystem and the people who depend on it.