Section III

FATE AND EFFECTS IN AQUATIC ENVIRONMENTS

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A COOPERATIVE APPROACH FOR MEASURING DIRECT-USE DAMAGES: THE 1992 AVILA BEACH (CALIFORNIA) OIL SPILL

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ABSTRACT: *A cooperative approach was used to estimate natural resource damages from the Avila Beach, California, spill. The approach was cooperative because we, on behalf of Union Oil Company of California (UNOCAL), and the economist working for the State of California shared data collection and damage estimation responsibilities. Cooperative assessments have several advantages, including reduced costs and less duplication. Because this case was not settled when this paper was submitted, we provide no damage estimates.*

On August 3, 1992, an underground pipeline at a Union Oil Company of California (UNOCAL) tank farm in Avila Beach, California, ruptured and released 160 to 500 barrels of crude oil.[1] The oil moved across the ground and flowed down rocky bluffs into San Luis Obispo Bay. Tidal currents then transported the oil around the bay.

The bay is extensively used for recreation, with many opportunities for water-based activities and wildlife viewing. California's equivalent of the Oil Pollution Act of 1990 allows government agencies, acting on behalf of the public, to collect damages for recreation use lost as a result of an oil spill. UNOCAL and trustees from the State of California agreed to undertake a cooperative effort to estimate such direct-use damages.

The first part of this paper discusses the natural resources and recreational services affected by the spill. Then it describes the cooperative approach that we, on behalf of UNOCAL, and an economist working for the California Department of Fish and Game (CDF&G), used to assess recreational damages as a result of the spill. Finally, the paper discribes the method used to estimate these direct-use damages. [Because this case was not settled when this paper was submitted, we provide no damage estimates.]

Natural resources and affected recreation activities

San Luis Obispo (SLO) Bay is located on the coast of central California about halfway between Los Angeles and San Francisco. Figure 1 shows the immediate SLO bay area. The bay has three public beaches, two piers for sport fishing, and two boat launching facilities. Consequently, it is used for water-based recreation by local residents and people throughout central California.

Beach use. Figure 1 shows the three beaches in the bay: Pirates Cove, Avila Beach, and Olde Port Beach. Recreational activities at these beaches differ slightly.

Pirates Cove is a small, narrow beach with rocky areas interspersed with sandy areas. It is a swimsuit-optional beach with no lifeguards or facilities. No other swimsuit-optional beaches exist in the area. The principal access is down a steep path from a parking area to the west. Secondary access is available by a very steep path down the cliffs on the east side. Users come from as far away as Sacramento, with about two-thirds from outside of San Luis Obispo County. Although the beach itself was never closed, the road providing access to the parking area was closed to public traffic during the cleanup operations from August 4 to 24, 1992. Furthermore, cleanup activities occasionally affected use of the beach.

Avila Beach is a large, popular beach located in downtown Avila Beach, California. The Avila Pier divides the beach into east and west portions. Lifeguards are present on the pier, and the beach contains some playground equipment, barbecue pits, picnic tables, and restrooms. Daytime activities include sunbathing, wading, swimming, and boogie boarding. No surfing or boating of any kind is allowed in the water inside the offshore buoys. Because the water temperature is relatively warm and the surf low, this beach is popular with families. On some evenings, people build bonfires here. Most of the people that use this beach come from San Luis Obispo, the five-cities area,[2] and the San Joaquin Valley. All or portions of Avila Beach were closed from August 4 to 11, 1992.

Olde Port Beach is a smaller, less popular beach with no lifeguards, restrooms, or changing facilities; but it has a public-access boat ramp for small boats, such as jet skis, catamarans, and aluminum boats. This beach is also used at night for bonfires and social gatherings. Olde Port was closed to the public from August 6 to 11, 1992.

Sport fishing. Sport fishing is a popular activity that may have been affected by the spill. In the bay area, sport fishermen use the beaches, piers, private boats, and charter boats. Shore fishing takes place mainly along the breakwater in Port San Luis between Olde Port Beach and the Harford Pier (see Figure 1). However, there is some shore fishing at Avila Beach and Olde Port Beach in the early morning and near dusk. Both the pier at Avila Beach and the Harford Pier at Port San Luis are popular fishing sites (see Figure 1).

Sport fishing also takes place from privately owned boats. Many boats are anchored in the harbor and may be used for fishing. Additionally, small boats can be launched from Olde Port Beach, and larger boats are launched from the mobile hoist or sport launch at Port San Luis. Boats may also enter the bay from outside the area to fish. Finally, Paradise Sport Fishing & Charter Service, located on the Harford Pier, takes people on fishing trips outside the bay.

Although the breakwater area in Port San Luis was not closed

1. When this paper was submitted, no agreement had been reached on the exact amount of oil spilled.

2. The area includes Arroyo Grande, Grover City, Oceano, Pismo Beach, and Shell Beach.

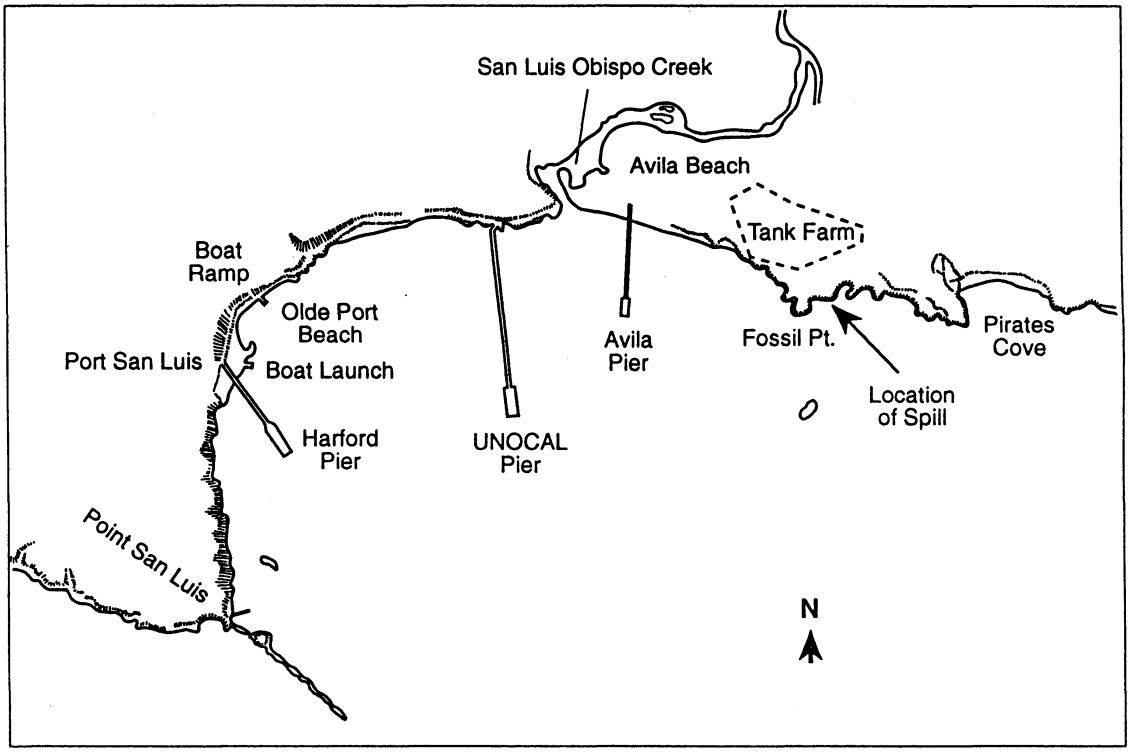

Figure 1. Map of San Luis Obispo Bay

following the spill, sport fishing in that area may have been affected because people mistakenly thought the area was closed, or they did not want to fish through the oil floating on the surface of the water. Similarly, the Avila and Harford Piers were not closed; but fishing from these piers probably decreased following the spill. Fishing from boats probably diminished during the days following the spill for a variety of reasons. People with boats moored in the harbor might not have been able to get to their boats. The Olde Port Beach boat ramp was closed for a few days following the spill. Boats from outside the area may not have been able to enter the bay, and finally, news of the spill may have kept some people from taking fishing trips on charter boats.

Pleasure boating. SLO Bay is used for motor boating and sailing. Some of the boats used for these activities are anchored in the harbor. Others are launched from hoists at Port San Luis or at the ramp at Olde Port Beach. Finally, some motorboats and sail boats apparently come into the bay from coastal areas to the south or north.

The spill probably reduced motor boating and sailing while the boat ramp and hoists were closed, and possibly for awhile after they re-opened. Furthermore, some people were probably not able to get to boats anchored in the harbor. Finally, the San Luis Yacht Club canceled a scheduled race as a result of the spill and may have had other activities disrupted.

Other water-related recreation. The bay is a local but important site for jet skiing because of its easy access and modest surf. The jet skis are launched at the Olde Port Beach boat ramp, predominantly on weekends. During the time Olde Port Beach was closed, jet skiing probably declined in the bay.

Wind surfing boards are launched from the Avila and Olde Port Beaches. Given other nearby opportunities for wind surfing, like Morro Bay, such activity is probably modest; but it may have been reduced as a result of the spill.

SLO Bay has good access and interesting coves and marine life, which make it attractive to ocean kayakers. Most kayaking takes place near Fossil Point. Two businesses offer guided tours, and many places rent kayaks. Although SLO Bay is a popular local spot, it also attracts people from all over the state. Thus, there may have been some reduction in ocean kayaking following the spill.

Parts of SLO Bay are used for SCUBA diving. Much of the activity is related to classes given in the area. Some of these were canceled or moved to other locations after the spill. The UNOCAL pier (see Figure 1) is a popular diving spot, as are the kelp beds near Fossil Point. It is possible that SCUBA diving decreased following the spill.

Wildlife viewing. The bluffs near Fossil Point are used for viewing birds, seals, and other wildlife. Because it was the staging area for the cleanup operations, it was closed to the public from August 4 to 24. The mouth of San Luis Creek attracts some birders, but it is not a prime location because it is surrounded by developed, privately owned land. Wildlife viewing in this area was possibly reduced as a result of the spill.

Cooperative assessment approach

UNOCAL and CDF&G agreed to conduct a cooperative assessment in order to lower assessment costs, avoid duplication, and share limited personnel resources. UNOCAL and CDF&G worked together to draft a written agreement to govern the cooperative approach. Both parties suggested language and discussed and revised the agreement until both were satisfied. Once finalized, officials from UNOCAL and CDF&G signed the agreement.

The cooperative agreement had two phases. The first phase covered data collection; and the second phase, damage estimation.

Data collection. Phase 1 of the cooperative agreement listed the potentially affected resources and services, and identified the kinds of data to collect. The agreement assigned data collection responsibilities to both UNOCAL and CDF&G.

One of our first efforts was to count users on the affected beaches. Beginning on August 14, 1992, we began counting the people on the strand and swimming at Avila Beach and Olde Port Beach four times daily (11:00 a.m., 1:00 p.m., 3:00 p.m., and 5:00 p.m.). Counts began at Pirate's Cove on August 26, 1992. All counts were continued through September 20, 1992. An evening count (at 7:00 p.m.) was also conducted at Avila and Olde Port Beaches on September 4 to 7, 10 to 13, and 17 to 20, 1992.

A standard counting sheet template was drawn up and used by the counters. On this template, counters recorded the date and time, weather information (sky conditions, wind conditions, relative air temperature, and precipitation), and counts of the number of adults and children. In addition, a standard protocol was implemented to ensure comparable data quality. Two counters were assigned at Avila Beach,

tallying adults as they walked in one direction and children as they walked in the opposite direction. A third counter was added on weekends and holidays to ensure accuracy. At Olde Port Beach, children and adults were counted in a single pass on the beach. A single worker counted users at Pirate's Cove. Copies of the completed templates were given to CDF&G.

In addition to the beach-user counts, the Port San Luis harbor patrol began tallying the number of jet skis, catamarans/day sailors, kayaks/canoes, divers, and wind surfers during their routine patrols. These counts began on August 10 and continued through September 8.

A second major data collection effort involved interviews with key informants, individuals likely to be knowledgeable about certain aspects of local recreation. We worked cooperatively with the CDF&G economist to develop several templates for the interviews, which contained questions about typical recreation use, if and how it was different after the spill, and other sites that users might visit. The people that we interviewed worked as lifeguards and in beach businesses (restaurants, retail businesses), diving shops, boating businesses (such as kayak and jet ski rentals, guided tours, instructors), bait and tackle shops, sailing/yacht clubs, charter boat businesses, and conservation organizations.

We and CDF&G each conducted some of these interviews: Our interviews took place September 12 to 15, 1992, and CDF&G's on September 30 and October 1, 1992. If the key informant agreed, the interviews were tape recorded. Copies of both the completed forms and cassette tapes were exchanged between us and CDF&G.

We made an effort to get at least two of every kind of key informant. In addition to interviewing in the affected area, we also included key informants at substitute areas. (For example, we interviewed lifeguards and beach businesses in Pismo Beach, south of Avila Beach, and boating businesses in Morro Bay, north of Avila Beach.) Table 1 summarizes the types and locations of interviews conducted.

We and CDF&G also collected other types of data. Some use information had been collected historically. For example, the Avila lifeguards kept a daily log of relative attendance (low, medium, high). We obtained these daily estimates going back to 1988. When we instituted the beach counts, the lifeguards also began estimating users at 1:00 p.m. The county Department of Parks and Recreation had historical attendance estimates at other nearby beaches, and we obtained copies of these. The bait and tackle shop in Port San Luis kept monthly records on the number and type of fish caught. The water taxi service, which transports people to moored boats, kept historical records of the number of trips made. Furthermore, the charter fishing business located on the Harford Pier had monthly data on the number of customers and fish caught going back several years. The Harbor District at Port San Luis had records on the number of moored boats and the number of boats launched in the mobile hoists and sport launches. In addition, we collected daily weather information for the summer months, going back to 1988.

In addition to these routine records, we were able to collect other information that, although not routine, was also helpful. For example, the county planning department had conducted traffic counts on the roads approaching Avila Beach because they were considering some road work. It had also done a study on beach use at Avila Beach a few years ago because they were considering additional parking. A developer considering installment of rail service to Avila Beach had made a study that contained estimates of beach use.

Table 1. Number and types of key informant interviews

Type of key informant	Avila Beach	Pismo Beach	Morro Bay	Other area
Lifeguards	3	2	—	—
Beach businesses	6	3	—	—
Boating clubs/guided tours	3	—	1	2
Diving shops	1	1	—	1
Kayak/jet ski rentals	2	—	1	—
Charter fishing businesses	1	—	2	—
Bait and tackle shops	2	2	—	—
Harbor patrol	3	—	1	—
Wildlife/conservation organizations	3	—	—	—

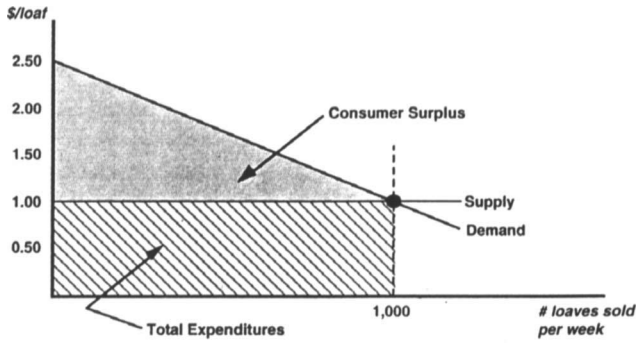

Figure 2. Demand and supply for loaves of bread

Finally, we and the CDF&G economist collected recreation valuation articles. We divided the responsibility for collecting articles by source (economic journals and recreation bibliographies). These articles then were used in estimating damages.

Damage estimation. After the data collection was complete and the information exchanged, we began the damage estimations. As part of our cooperative agreement, we had already determined a general approach for measuring damages. This is described more fully in the next section. Because we had sufficient data, both parties agreed that lost user days for certain recreation activities could be analyzed using statistical techniques. Regardless of the statistical approach, the agreement provided that assumptions, outside data sources, and statistical results (when relevant) must be included in the report prepared for the other party. Both parties reserved the right to conduct their own analysis of any activity after reviewing the other party's damage estimates.

We divided the damage estimation work by recreation activity. We estimated damages for night beach use at Avila Beach, beach use at Pirate's Cove and Olde Port, ocean kayaking, jet skiing, day sailing, wind surfing, and nature viewing. CDF&G was responsible for estimating direct-use damages for day use at Avila Beach, motorized boating, sport fishing from charter boats, pier and shoreline fishing,[3] and SCUBA diving. When these analyses were complete, we exchanged reports.

Methodology for measuring natural resource damages

We used a transfer methodology to estimate damages. This technique adapts existing valuation studies to the site of interest. The transfer methodology values recreation activities based on consumer surplus, the proper measure of economic values.

Consumer surplus. Under the natural resource damage assessment (NRDA) regulations, consumer surplus is the basis for valuing foregone natural resource services. The concept of consumer surplus follows from the economic concepts of supply and demand. Figure 2 shows a demand function for loaves of bread, which describes the maximum quantity of an item—loaves of bread—that individuals would be willing to purchase in a given time period at various prices. The downward slope of the curve indicates that people will purchase larger quantities of the item at lower prices than at higher prices. The figure assumes that other factors that influence demand besides price (such as income, the price of related goods, and tastes or preferences) are constant. The demand for a nonmarket service like beach use is similar, with the "price" being the sum of entrance fees, travel costs to the beach, opportunity costs of time, and the like, and the measure of quantity being called "user days," the number of days people participate in a recreation activity. The demand function provides a systematic way of measuring the value people place on products and services.

In the loaves of bread example, we see that if the price of bread is $1

3. During the analysis phase, CDF&G concluded that the available data were not sufficient to produce plausible estimates of pier and shoreline fishing.

per loaf, we can expect 1,000 loaves to be purchased for a total expenditure of $1,000. When the price is $2 per loaf, however, fewer people are willing to buy bread, and when the price is $2.50, no one buys it, presumably buying substitutes, like rice, instead. The area under a demand curve measures the maximum willingness to pay (WTP) for a given amount of a product or service. In this instance, the total WTP for 1,000 loaves of bread is $1,750, determined by calculating the area under the demand curve for the 1,000 loaves of bread. The difference between what people would be willing to pay and the amount they actually pay ($1,000) is $750. This difference for the 1,000 loaves of bread is known as consumer surplus. It is a dollar measure of the amount of satisfaction that people receive from consuming bread over and above what they actually pay for it.

Economists use consumer surplus to value natural resource services, employing several methods for measuring it. Two of the most common methods are contingent valuation (CV) and travel cost. With CV, economists use carefully designed surveys to ask people how much they would be willing to pay for a given amount of a natural resource service over and above what they actually pay (their consumer surplus). With travel cost models (and the more recent and sophisticated refinement known as random utility models), economists observe people's actual recreation behavior, and estimate the distance they travel to a site, and the gasoline and time they use to do so. This information is then used to estimate recreationists' consumer surplus for the site.

Transfer methodology. We could have used these methods to measure people's value for the services affected by the Avila Beach spill. However, in cases where potential damages are likely to be relatively small, conducting expensive CV or travel cost studies is not cost effective. In such cases, the transfer methodology is used to assess damages. In a transfer study, the analyst uses site-specific information to determine the number of user days for expected use in the absence of the spill (baseline use) and actual use during the postspill period. The analyst can then compute the number of user days foregone by subtracting postspill use from baseline use. Rather than estimating values per user-day for the specific site, the analyst selects them from existing studies of similar sites and transfers them to the site of interest. These user-day values may be adjusted to reflect the availability of substitutes or for other differences between the site in the study and the site being analyzed. Damages are then the product of foregone user days and the value per user day.

A transfer study involves several steps. It begins by identifying potentially affected resources and understanding the services that they provide. In this case, this step included identifying the types of recreational activities that the resources support, the level of that recreational activity, the demographics of people who used the resource, and potential substitute sites that people could use in lieu of the injured resources. In the case of the Avila Beach spill, we accomplished most of this work through our key informant interviews, site visits, and informal discussions with users.

In the second step, the researcher evaluates the extent of the injury and estimates the loss of services. After estimating the baseline level of use of the resource, the researcher subtracts the postspill level of use to arrive at the change in use as a result of the spill. Figure 3 illustrates this calculation. The baseline is at a peak during the summer months, but then falls after Labor Day. The postspill use falls dramatically as the beaches close following the spill, and then gradually increases as people return when the beaches reopen until the postspill use is again equal to the baseline. The difference between these two lines is the foregone user days.

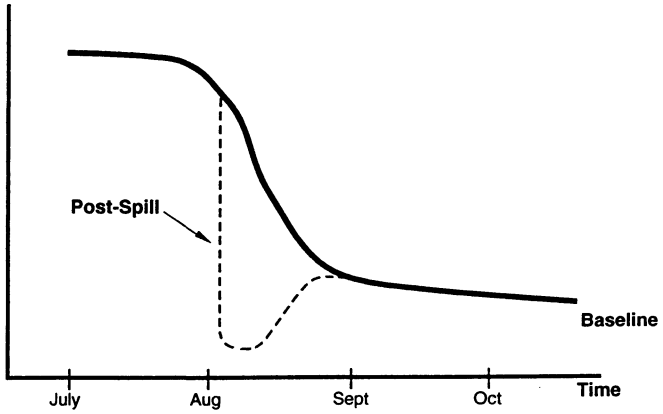

Figure 3. Baseline and postspill user days

If a study can be implemented soon after the spill, good postspill data can be collected. In this case, for example, we quickly began counts of users at the beach and interviewed key informants. Unfortunately, quality baseline information is often difficult to find. While we had excellent logs from the charter fishing operations, the lifeguard logs of past beach attendance were qualitative (high, medium, and low) and not very reliable. Information on more minor recreational activities such as kayaking or jet skiing was even more scant, forcing us to rely on our key informant interviews for baseline information.

In cases where baseline data are poor, the analyst cannot always rely on a simple subtraction of postspill use from the baseline use over a long time period. Referring again to Figure 3, imagine a case where the analyst has baseline information for July and August only. By extending this baseline into the autumn, he or she would then overstate the true baseline, and, when subtracting the observed postspill use, would overstate the extent of the foregone services. Thus, the analyst must often make judgments about the length of time over which to extend the analysis.

Even when good historical data are available, it may still be difficult to estimate baseline use. The proper interpretation of the baseline is not the use level in past years, but rather what the use level would have been in the year the spill occurred. If such factors as the weather or the health of the regional economy are substantially different during the time of the spill compared to previous years, historical data may not accurately measure the baseline.

The third step of a transfer study is where the actual transfer occurs. In this step, researchers review the economic literature to find studies that value the services that were affected. These studies, which provide the consumer surplus values that are multiplied by the number of lost user days to arrive at total damages, must be carefully chosen to meet several criteria. First, the studies must use sound methodologies. In the words of Myrick Freeman,[2] only those studies that "pass scientific muster" should be used in a transfer. Second, the studies should be done at a site that is as similar to the affected resource as possible, in terms of the physical features of the resource and the demographics of the users. A study of beach use at Martha's Vineyard, for example, would not be a good candidate for transfer to Avila Beach, because of differences in the beaches, water, weather, and users. The study should also be done at a site with substitute possibilities similar to the affected resource to avoid biasing the estimates. If the study site is relatively commonplace in its area, for example, it will tend to be valued less by its users, making it a poor candidate for transfer if the affected resource is relatively unique.

Even after a thorough search, it is rare to find a perfect study. However, before making the transfer, the analyst can adjust the values to match the affected site better or to correct for methodology problems. The analyst can do this with a simple adjustment, using subjective judgments or using suggestions from meta analyses that attempt to control statistically for differences in studies, to ratchet the values up or down by some factor.[5,6] In the most complex level of transfer, the analyst can adjust for differences by using a regression model from the study site (if one is available), with site and socioeconomic characteristics as the explanatory variables, and applying the values of these variables from the affected site.

The fourth and final step in the transfer process provides the total value of the natural resource damages. For each type of service identified, the adjusted per-user-day consumer-surplus estimate from the transferred study is multiplied by the number of user days foregone.

This transfer methodology has two main advantages. First, as mentioned above, the transfer study can be completed in less time and with fewer resources than full-scale studies. Second, the transfer methodology uses consumer surplus, the theoretically correct concept of economic value. Other approaches, such as measuring damages by the cost of replacement, while also easy to employ, do not have this conceptual advantage.

Despite these advantages, the transfer methodology in not without its limitations. One limitation is that existing studies are not available for some recreation activities. To the best of our knowledge, many of the recreation activities that take place on a small scale at Avila Beach, such as jet skiing and ocean kayaking, have not been valued. In these

cases the analyst is often forced to use an arbitrary value, or a large range of values from other recreation activities that might be similar. A second limitation is that, in transferring a study, the analyst transfers any weaknesses of that study. Although the analyst can identify and adjust for many of these weaknesses, this process itself raises another concern: the need for the analyst to make many subjective assumptions. These may be assumptions about the baseline level of use or change in use due to the injury to the resource, or may be assumptions about how best to transfer a valuation study. Kerry Smith shows that two studies that used the transfer methodology to value the benefits of limiting effluent discharges from pulp and paper mills[1,3] reached different results because of different assumptions.[4] A good transfer study will identify its weaknesses, and will include a sensitivity analysis to capture the importance of some of the analyst's judgments.

Summary and conclusions

Regardless of the circumstances of a particular oil spill, the first step in assessing natural resource damages is to identify potentially affected natural resources and the services they provide. The direct-use services affected by the 1992 Avila Beach oil spill included beach use, sport fishing, other water-related recreation (such as ocean kayaking), and possibly wildlife viewing.

UNOCAL and the trustees chose a cooperative approach to determining direct-use damages from the Avila Beach oil spill. This had several advantages. First, assessment costs could be reduced by dividing the data collection, and possibly the analysis of these data, between representatives of the potentially responsible party and the trustees. A cooperative approach also avoids duplication of effort and yields more results when personnel resources are limited. However, this approach requires an agreement between the Potentially responsible party and trustees regarding what information should be collected and how that information should be collected. Similarly, if the analysis of the collected data is divided between the two parties, then some agreement on the methodology for this analysis is also needed. Otherwise, each party will not accept the data and/or analysis of the other party, leading to separate data collections and/or analyses anyway.

In the Avila Beach spill we initiated daily counts of users of the affected beaches. We then worked with the CDF&G economist in developing questionnaires and in interviewing key informants about the recreation effects of the spill. We also cooperatively reviewed the economic literature for relevant recreation valuation studies. Finally, we estimated damages for some recreation activities while the CDF&G economist estimated the damages for others, using the jointly collected data and studies. To our knowledge this is the only cooperative assessment of direct-use damages from an oil spill.

We estimated direct-use damages from the Avila Beach oil spill using the transfer methodology. This methodology combines site-specific information on the magnitude of foregone natural resource services with values for such services from existing studies of other locations. While this approach only provides approximate estimates of direct-use damages, it is much less costly than conducting original studies of these damages. Consequently, the transfer methodology is the most cost-effective approach for estimating direct-use damages when the magnitude of such damages is likely to be relatively small.

Several challenges arise in using the transfer methodology to estimate direct-use damages. First it is difficult to estimate baseline use of the affected area if historical data are not available. Even if historical data are available, these data should be adjusted to reflect possible nonspill influences on recreational uses of the affected area following the spill. For example, adverse weather conditions following a spill will reduce recreational uses of the spill area even if a spill had not occurred. Thus, the baseline should be adjusted to reflect expected use of the affected area in the absence of the spill properly. In areas where information on recreation activities is not routinely collected, some data collection may be needed to get information on postspill use of the affected area. Finally, in most instances no recent study of the value of the recreational uses of the affected area is available. Consequently, a study of recreational uses of some other area must be used for the estimation of direct-use damages. This may require some adjustment of the values from these other studies for the damage assessment. Often, such adjustments are rather subjective, relying on the judgment and experience of the analyst

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