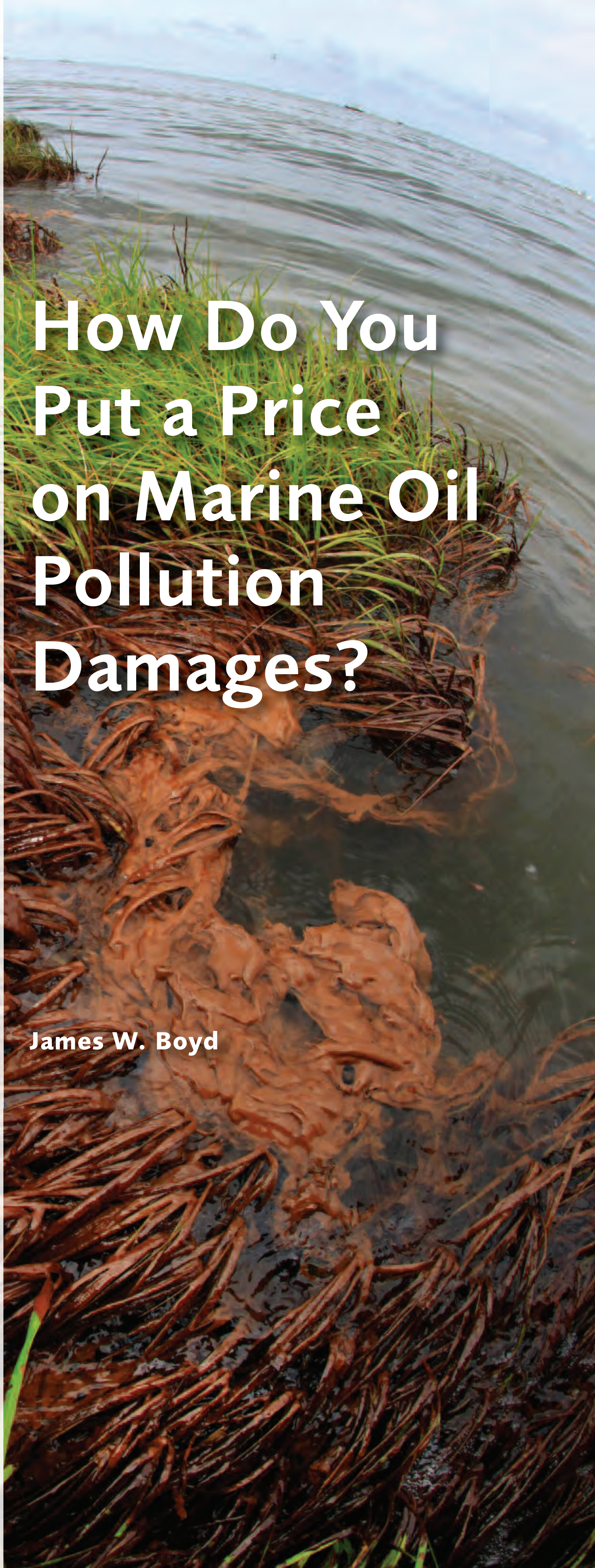

How Do You Put a Price on Marine Oil Pollution Damages?

James W. Boyd

At this writing, the full scope of damages arising from the April 20 explosion of the BP *Deepwater Horizon* oil rig in the Gulf of Mexico—and the massive oil spill—are not yet known but have already far exceeded those from 1989's Exxon *Valdez* incident. How do you put a price on marine damages from events like these? Ecosystems produce wealth, but we often take that wealth for granted because it is freely available to us. But when ecological wealth is lost, people suffer. Gulf communities—in particular those that depend on fisheries and tourism—are painfully aware of this. However, ecological damages of this scale are also likely to trigger broader "ripples" of damage that will not be apparent for years.

In the recent words of Alaskan trustees working on the aftermath of the Exxon *Valdez* spill: "Through hundreds of studies conducted over the past 20 years, we have come to understand that the Prince William Sound ecosystem is incredibly complex and the interactions between a changing environment and the injured resources and services are only beginning to be understood."

It is worth reflecting on why this is true. Many marine accidents result in damages over a wide geographic area (in the *Valdez's* case, 200 miles of shoreline were obviously affected, but measurable biological effects have been found over 1,300 miles of coastline) and over long time periods (20 years after the spill, fewer than half the species affected have recovered to prespill levels).

The effect on water quality of such a spill can have a range of side effects that develop over a period of years or decades. In the short term, oil spills will deplete herring and other cornerstones of the marine food chain. In turn, this effect on food stocks affects the viability of species dependent on them. These biological effects can take years to play out and, in turn, human uses dependent on these ecological endpoints may be affected for years as well.

Legal Recourse

Marine vessel, terminal, and harbor operations can generate a range of legal damages arising from liability for response and cleanup costs, damages to private property, and damages to public natural resources. Public resources that can be affected include water quality, beach and other coastal recreational resources, coral reefs, commercial and recreational fisheries, sea grass beds, and habitats for bird and other animal populations. They are in the public domain, neither owned nor traded, but nonetheless clearly economically and socially valuable.

Liability for lost public goods and services is an established legal principle in this country. In U.S. waters, owners and operators can be held liable for natural resource damages (NRDs) and must "make the environment and public whole" following a pollution event. In economic terms, this means calculating monetary damages equivalent to the social benefit lost as a result of a release, grounding, or other marine event.

At a conceptual level, NRDs require us to measure lost ecological wealth. Doing so requires knowing two things: how natural systems produce valuable biophysical goods and services, and the values of those goods and services.

Within ecology and economics, *assessment of ecosystem goods and services* is a growing area of inquiry. Broadly put, ecosystem services refers to the dependence of economic wealth and human well-being on natural systems. While the promise of a cohesive framework for assessing all types of damages is not yet realized, many scholars are working toward this goal through more rigorous conceptualization and communication of the links between changes in natural systems and effects on human welfare.

Such a framework is a powerful tool for calculating natural resource damages (and marine damages specifically). Lost ecosystem goods and services are the right metric to internalize social costs and make the public whole following a marine pollution or damage incident. Given this equivalence between damages and lost goods and services, the calculation of marine damages can and will hinge on the degree to which ecosystem goods and services can be understood and valued.

Widespread confusion exists over how to account for ecosystem goods and services that are lost or gained. Complex natural systems stymie the search for clear causal relationships between a spill and many of the damages they cause. This leads to legitimate disagreement over the magnitude of legal liability.

But just because damages to food webs (and long-run fishery productivity) or coastal marshes (and their ability to prevent flooding) are difficult to precisely quantify does not mean those damages aren't real and economically significant. The discipline of treating natural systems as sources of wealth provides a guide to the kinds of information and analysis necessary to establish ecologically and economically defensible damages.

Natural Resources in the Public Trust

Natural resource damages are physical damages to land, fish, wildlife, biota, air, water, and groundwater. They typically relate to adverse changes in the health of a habitat or species population and in the underlying ecological processes on which they rely. The analytical challenge is to convert these physical damages into the economic consequences of that damage. To do so requires understanding of the larger biophysical system of which the damaged resource is a part.

Liability for events that damage resources is established in the United States under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Oil Pollution Act (OPA), and the National Marine Sanctuaries Act (NMSA). Earlier, the Deepwater Port Act of 1974 and the Clean Water Act amendments of 1977 introduced NRD liability to U.S. federal law. These statutes create a compensable monetary liability for damage, which in turn requires calculation of the monetary value of the damage.

Restoration, assessment, and settlement of NRD claims are undertaken by federal, state, and tribal trustees. Only governmental trustees can seek natural resource damages, though private plaintiffs—if they can show a concrete harm to a legally protected, collective interest in a resource—can compel action on the part of these trustees. Injury to a natural resource alone is insufficient to establish liability.

For example, under the OPA, the National Oceanic and Atmospheric Administration is the federal trustee for claims arising from marine injuries, while the U.S. Department of Interior is responsible for claims arising under CERCLA. Rules guide the agencies' respective NRD assessment procedures and act as a blueprint for the determination of appropriate restoration actions and damages.

In practice, calculation of natural resource damages has proven difficult and controversial. When economic value is lost in a market setting, damages can be based on production, inputs, inventories, sales, and price data. Pertinent economic data already collected by both private firms and governments are available as a basis for the damage calculation. NRDs, by definition, are damages to public goods for which market data are not available.

A further, and more serious, complication is the need to understand how physical damages to a given resource damage other parts of the biophysical system. For example, ship "groundings" that damage sea grass beds also damage the species that rely on sea grass for habitat. Similarly, oil spills don't just create oily beaches, they also disrupt a broader range of ecological processes that ultimately can affect wetlands, commercial fisheries, recreation, and species abundance for years to come, as news reports about the ruptured BP oil well in the Gulf of Mexico attest.

Current Damage Assessment Practices

Government trustees understandably have found it difficult to measure lost ecosystem goods and services. As an alternative, agencies have focused on a more practical route to damages: namely, reliance on resource replacement cost as the measure of damages. For example, if an oil spill damages sea grass, the objective is to replace the sea grass. What does it cost to replace the sea grass? That "procurement cost" becomes the measure of damages. Superficially, this strategy avoids the need to measure lost social wealth, since the point is to simply "replace the wealth" via restoration. And clearly it is much easier to solicit restoration bids and use those monetary costs as a concrete focus in damage negotiations (as opposed to conducting a broad ecological and economic assessment of lost goods and services).

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There are drawbacks to this approach, however, the most obvious being that replacement costs have nothing to do with the actual social damage that has occurred (the benefits of goods and services forgone). In some cases, replacement costs may vastly exceed the social damages they are meant to repair. In other cases, replacement costs may vastly underrepresent the social damages caused by the proximate injury.

A damaged sea grass bed or coral reef may be restorable at an estimable cost. But it is possible that the bulk of social costs arise from damages to other resources dependent on the sea grass or coral reef. If these resources are not replaced—as is generally the case—replacement costs may fall significantly short of the real social damage. In either case, replacement cost as the damage measure fails to achieve the main legal and economic principle in play: the desire to have polluters internalize the full costs of their behavior.

Ecosystem Services Assessment

Ecosystem services are the benefits of nature to households, communities, and economies. The term is interpreted in a variety of ways but conveys an important idea: ecosystems are a tangible source of economic wealth. This is intuitively obvious and consistent with the entire concept of resources in the public trust. What is less obvious is how that wealth is to be measured.

Because environmental goods and services are not traded in conventional markets, economists lack information on the prices paid for those goods and services—we don't explicitly pay a price for the glorious view. Of course, just because something doesn't have a price doesn't mean it is not valuable; the challenge, then, is to get people to reveal the value they place on it.

There are two ways to carry this out. First, we can get people to state their preferences by asking them questions designed to elicit value. Second, we can look to people's behavior and infer natural resource benefits from that behavior. Houses near beautiful scenery sell for more than houses without scenery, for example. When people spend time and money traveling to enjoy natural resources, they signal the value of those resources or reveal their preferences.

Determining the units or the quantities people place value on is another challenge. A grocery store is full of cans, boxes, loaves, and bunches; the number of these units bought yields a set of quantity measures to which prices can be attached. But public, nonmarket environmental goods and services don't come in convenient quantifiable units. Put another way, what are the physical damages that can be attached to economic losses?

Ecosystem services analysis explicitly demands a linkage between ecological outcomes and economic consequences. It is important to get the units right—or at least be able to clarify why we use the units we do. The challenge lies in disentangling complex natural systems into more discrete commodity units so that natural scientists and economists can use the same terms to describe ecological changes in the same way.

Conclusion

Measuring ecosystem goods and services is not easy and it is often not practical except where funding for large-scale monitoring and statistical assessment is available. However, development of these methods is proceeding. When the physical and social sciences of ecosystem goods and services evaluation develop into a more mature phase, the implications for marine liability damages will be direct and material to plaintiffs, trustees, and the courts.

A positive outcome of the disaster would be the deployment of more comprehensive ecological monitoring of conditions in the Gulf and other marine systems.

The insights and principles behind ecosystems services research are of immediate relevance to trustees who want to be in a position to calculate the most accurate damages possible (in order to serve the deterrent and compensatory goals of liability law). Assessment based around ecological endpoints will lead to more coordinated, comprehensive, and cost-effective biophysical and economic analyses of damages.

But it deserves emphasis that the ecological and economic damages caused by the BP *Deepwater Horizon* spill are likely to be very significant and far-reaching, even if they are difficult to calculate with precision. This leaves us with a knotty question for public policy and the courts: how do we appropriately penalize a polluter when we may never actually know the damages they caused? A meaningful penalty is surely called for. But given current scientific and economic knowledge, the scale of that penalty is more likely to be resolved by Congress than by scientists. ■