

Report on databases and tools available to assess the vulnerabilities of human communities to oil spills



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Introduction

Incorporating information on the human dimensions impacts and vulnerability to oil spills requires developing an understanding of social systems and their relationships to the natural environment in specific places. As described in the guidance document and related publications (e.g., Weblor and Lord 2010), building this background requires engaging with complex processes. Social systems and their vulnerabilities are multifaceted, variable, and dynamic. There are many sources of information that can inform a vulnerability analysis, although these vary in coverage, quality, and effort required to gather them. This report focuses on electronic data sources that can be used as a practical, efficient first step in assessing vulnerabilities. We provide both this overview of databases and concise summaries of each database reviewed. Our purpose here is complement the information provided in the guidance document by both pointing out resources for planning and identifying limitations in the availability of data related to human dimensions impacts and vulnerabilities. We also supplement the guidance document with some additional information on possible next research steps

We have reviewed over 50 online sites, many of which bring together numerous data sets relevant to human dimensions impacts and vulnerability. Our focus is on resources providing US national coverage. For this initial analytical step, we sought a wide variety of indicators for factors related to vulnerability including levels of exposure, sensitivity, and resilience. These sites and data sets are primarily those maintained by a diverse set of federal

Table 1: Human Dimension Impacts of Oil Spills

Health

- Acute health
- Chronic health
- Injuries
- Mental anguish
- Mental trauma and depression

Social

- Change in behaviors
- Change in relationships and interaction
- Change in make-up of community
- Infrastructure and social services
- Stigmatization
- Unfair treatment

Cultural

- Degradation of natural heritage
- Interruption of customary activities
- Violation, damage, destruction of cultural sites

Economic

- Change in income
- Costs
- Damage to tangible private property
- Disruption of normal economic activities
- Lost livelihoods

Experience and Use of Natural Environment

- Access to natural environment and infrastructure
- Deterioration in non-market use
- Impaired experience
- Loss of recreation opportunity
- Quality and availability of housing
- Quality of community infrastructure

Governance

- Crime enforcement
- Hearings and new legislation or regulation
- Participation
- Preparedness and capacity of response and planning
- Quality of everyday government functions

agencies tasked with data collection activities. There are also many state and local databases, some of which are noted in conjunction with their national counterparts, which may provide further assistance in more detailed local and regional analyses.

The investigation into databases was guided by the project literature review, which identified impacts and factors contributing to vulnerability from past spills. Information was organized into a table of impacts (Table 1) and online searches were conducted to identify databases which covered factors contributing to vulnerability. These databases are each evaluated according to a structured set of attributes including a description of the information provided and its potential relevance to spill planning, temporal and geographic resolution, as well as data source, sample, and format. Summaries of each database also include the web address, access and use constraints, and contact information. Some of these databases provide more relevant information than others, but we have included a broader set to illustrate the diversity of information.

While these datasets provide insight into some important issues, there are significant limitations. Typically, these data were not collected with the goal of supporting a vulnerability assessment and none were designed to inform oil spill impacts specifically. As a consequence, data provide only indicators of the well-being of different aspects of the social system - from individuals to economic sectors to community governance and well-being – rather than an integrated view of the system of interest which includes parts and linkages. Further, these are often maintained by different agencies in different locations. There are also differences in the frequency of data collection, the sampling methodologies, and methods of data aggregation. These factors contribute to difficulties in fully capturing the detail and diversity of places and the dynamics of vulnerability. There are other important factors contributing to vulnerability which are not easily captured in a standardized set of indicators appropriate for transferring among places because many aspects of vulnerability may be the result of the unique characteristics of a place. Other factors contributing to vulnerability may only be collected through detailed, place-based research projects.

This summary first addresses the availability of indicators for different impact categories. It then looks in greater detail at the coverage of potentially impacted economic sectors, groups and communities and availability of information on the dimensions of vulnerability -- exposure, sensitivity, and resilience. It then considers the geographic and temporal scales of data collection and reporting. Finally, factors influencing the ease-of-use for these data are also addressed.

Impact Categories

General

Oil spills and the associated response activities may result in a variety of disruptions and losses to communities during both the immediate emergency stages and the longer recovery periods. Information to inform of vulnerability assessment for different types of impacts varies considerably. There are several resources which bring together multiple data sets in order to provide an integrated view of community characteristics. These

include information on demographics, economics, housing, education, and other social indicators of well-being. The *American FactFinder* tool produced by the U.S. Census Bureau is a convenient way to get an overview of community characteristics. The *Spatial Trends in Coastal Socioeconomics* is particularly useful in emphasizing attributes of coastal communities. The *Community Economic Development HotReport* is intended to provide data relevant to communities experiencing economic disruption, but it is not as up-to-date as other sources. Many other databases provide information related to multiple types of vulnerability, which can be related to one another. In organizing database summaries and this discussion, we have categorized these databases according to their primary contribution recognizing that many may overlap several categories.

Health

Measures of health and well-being are used for many purposes and so receive good coverage and sophisticated tools to promote access. These data are available as tables and in geospatial formats. Health information provides data on existing sensitivities due to existing health burdens. In addition, indicators of communities which are currently underserved and are likely to struggle with access to adequate service in the event that it still requires additional care (see *Health Resources and Services Administration*).

Social

Vulnerability varies considerably among groups and communities for many reasons. The US Census Bureau data provides useful indicators in a range of geographical scales from coarse to as small as census blocks typically including several hundred people and allow insight into conditions at a place. There are hundreds of variables, but the most important for this purpose are those which indicate the size of population and workforce and populations may be particularly the sensitive to health, social, or economic impacts. Census variables, such as percentage of households where English is spoken at home, fluency in English, and educational levels can inform the design of risk communication materials and that of community involvement and assistance programs to assure broad accessibility. Data on other languages commonly spoken in a community are not collected, but data on ethnicity and race can provide direction to further local research. The census reports on Native American populations, but these demographic data do not identify important cultural connections to the environment and places. Contacts for tribal governments and Native American organizations are available at http://www.usa.gov/Government/Tribal_Sites/index.shtml. The census is conducted every 10 years so this data can become outdated and fail to reflect recent changes in population characteristics, although interim estimates for 2005 are available. Starting in December 2010, the US Census began to report American Community Survey estimates for communities of all size and incorporate these data into the *American FactFinder*. In the future, these estimates will be released annually and allow more insight into processes of change.

Cultural

Information on cultural resources and practices at risk is more difficult to obtain. This is in part because relevant types of data are not consistently collected and in part because some aspects of local and group cultural values are very difficult to identify and track.

National coverage is primarily collected by the National Park Service in their efforts to identify and protect historical and archaeological resources. The archaeological database is based on data from 1991 to 1993. In this case, it is advisable to look to the State Historic Preservation Officers for more up-to-date and geographically specific information. Other resources provided by the Park service include sites on the National Register of Historic Places and National Historic Landmarks. These two programs provide information on some of the most important sites in the US, but they are not comprehensive and investigations into cultural impacts should consult local authorities about locations and characteristics of locally valued resources.

Economic

The topic of economic impacts receives one of the highest levels of coverage both in data, and in some cases, the development of tools for processing economic impacts and estimating multiplier effects of disruption (e.g., *Marine Recreational Information Program and the National Ocean Economics Program* (these are included with social impacts because they consider coastal communities). There are numerous sources of data on local employment, income levels, and business and industry composition. Data sets in this category are subdivided into categories of employment, industries, infrastructure, local economies, and navigation. These data can be broadly indicative of existing stresses in communities and the level of dependency on resources affected by the oil spill. This type of data is also typically updated more frequently than others, so for example quarterly workforce indicators are available. There are some limitations in these data as the local significance of some vulnerable industries, including fisheries and tourism, are difficult to discern in the standard North American Industrial Classification System (NAICS) coding used by most agencies. More detailed resources are available from *Local Employment Dynamics, State Partners*.

Experience and Use of Natural Environment

The potential severity of impacts to the experience of being out of doors and uses of the natural environment can be informed by considering at types and degree of existing uses. There have been several efforts to collect these data at the national level. In addition there are some occasional studies on subsistence use of marine resources, but these are for Northeast only (see *Marine Recreation Information Program*). Other data on recreational uses overlaps with some of the databases included under economics, but in general, understanding local detail of recreational uses is limited by reporting data aggregated at the state level. Again, local investigations would be necessary to address this aspect of a vulnerability assessment.

Governance

The long-term impact of a spill is shaped in part by the sensitivities and resilience of the governance systems. While the importance of local and intergovernmental/interagency coordination is broadly acknowledged, data representing these factors are not systematically collected on a national level. A few relevant data sources do exist. The *Public Access to Court Electronic Records* database reflects the complexity and duration of court cases which can be stressful for individuals, households, and communities. Information on local community revenue sources which might be affected by oil spill

related disruptions are not available. Although state or local government finance information is collected, local information is aggregated at the state level in the Census Bureau reporting (*State and Local Government Finance*).

Fisheries

The local significance and potential impact on the fishing industry, one highly likely to be disrupted oil spills, is difficult to gauge from these data sources for several reasons. In NAICS reporting, fisheries employment and income are often aggregated with forestry and mining data so direct employment information about the sector is obscured. Other standard reporting categories such as warehousing or food processing are also generalized in a way that does not allow one to see commodity chains, or the local structure of horizontal and vertical linkages associated with the fishing industry. The Coastal and Ocean Economics features of the *National Ocean Economics Program* site offer data on ocean and coastal employment for a subset of counties and portions of counties in each state that address some of these limitations. These data give a sense of dependency on coastal and marine resources although with data from 2008 and 2004, respectively. There are some tools available through the *Fisheries Economics of the US* site that this topic will depend on greater local research. Some additional information is also provided by studies conducted through regional *Fisheries Management Councils*, *Marine Information Recreational Program*, and *Fisheries Communities of the US* (2006) study, which covers larger population areas.

Many coastal communities benefit from tourism, although the characteristics of tourism may vary considerably. Tourism may be year round or seasonal; it may be narrowly focused on beach recreation or more broad diversified into fishing, boating, and other outdoor recreation. Data on the significance of tourism for local community are difficult to obtain. Data on the number of people employed and income levels are currently collected using two NAICS categories NAICS 71: Arts, entertainment, and recreation and NAICS 72: Accommodation and food services. Because these categories divide tourism related endeavors and include local consumption along with tourism related consumption, it is difficult to determine the value of tourism for a community. The US Bureau of Economic Analysis (BEA) and state labor market offices provide information for smaller geographical units such as counties and metropolitan areas. While some data exist on outdoor recreational uses, these are reported at the state level. Efforts to find a website that provided a single point of access to state tourism offices and data sets were not successful. Those found had not been maintained and many of the links were broken. Information on international tourism is collected by the US Census Bureau for major ports and airport destinations only. With the exception of quarterly employment data, data collected did not provide information on seasonal variations in tourism demand.

Other community characteristics that shape vulnerability are not monitored as closely but may contribute to significant impacts. Some examples include informal sector employment cases in which income is not reported and there is no documentation to support loss claims; subsistence harvesting of fish, shellfish, or other foods to supplement

household diet; and recreational uses. There have been a few studies of these topics, but consistent coverage that distinguishes local conditions is not uniformly available.

Exposure, Sensitivity, and Resilience

Vulnerability is composed of three dimensions -- exposure, sensitivity or potential for greater severity of impact, and resilience or the capacity to cope and recover from impacts. All these dimensions contribute to overall impact on a community and groups within the community. Of the three, exposure is best covered by available data, although as noted in other sections of this document there are limitations in the geographic and temporal resolution as well as in the types of activities monitored and reported. For example, information on archaeological sites is reported by density of sites per square mile within a county. That reporting approach makes it difficult to determine whether there are sites at risk from spill while concealing locations also protects sites from potential theft or vandalism. Many other types of exposure data are also reported at the state level making it difficult to determine the level of exposure any particular locale.

Data related to the sensitivity of people and communities are also available for many potential impacts often because these data are relevant to other types of vulnerability as well. Relevant data are available for health (e.g. underserved areas or prevalence of existing health conditions), economic well-being (e.g., unemployment rates and employment in industries closely linked to marine or freshwater resources), social and some cultural impacts (e.g., National Historical Landmarks). However, data on potential cultural impacts which may be best known to smaller groups within communities are not collected and reported across the nation. Factors which may shape sensitivity to impacts on governance or diminished experience of the natural environment were not identified in the datasets reviewed.

Resilience, or the ability to recover from impacts has received at least attention in scholarship and its least represented in data identified. The factors which contribute to quick recovery are often related to the response effort itself and so are ephemeral and collecting them is not typically a high priority during response periods. Consequently, those learning opportunities are often lost. In the case of the *Exxon Valdez*, recovery has also been related to the ongoing stress of lawsuits, a factor that cannot be predicted (see CIVIC database). Some community-based factors which have been identified include economic dependency on resources, low economic diversity, and geographic isolation (see CIVIC database). Other community characteristics which may be important are more difficult to measure consistently on a nationwide basis because of the variability among places. For instance, social capital or the responsibilities and obligations of reciprocity that provide support individuals can come from many sources within the community and some places may depend more on religious organizations while others rely on family ties, other social service organizations, or work place-based programs. Data on these factors is not collected for the nation and would be difficult to interpret given the diversity of the US and territories. Likewise, indicators of governmental capacity to work effectively in an emergency, such as past experience with disasters, level of staffing versus standard workload, are not consistently recorded although they

may be available from some state, regional, and local officials aware of relative capacities.

These dimensions of vulnerability change over time and may be altered by the interactions of multiple stresses occurring simultaneously (e.g. a recession and a disruption of fishing) or in sequence. In some cases, such the *Bouchard-120* spill in Buzzards Bay, a past accident increase resilience by serving to increase awareness, preparedness and coordination among government entities (Lord et al. 2010), while the *DAARP* database provides information on past spills, it does not include an standardized evaluation of changing response capacity.

Geographic Scale

For each data set, we report on the geographic scale represented. This is a significant consideration because of vulnerability is first a matter of exposure in a place with distinct characteristics rather than generalized conditions for large areas. Fortunately, many databases have incorporated web-based mapping utilities or the ability to generate customized reports for localities based on a variety of geographic units. These tools are particularly useful ways of visualizing data.

Data reporting practices limit the utility of some databases. For many of the databases, local information is aggregated and reported at the statewide level. Examples of this include information on outdoor and coastal recreation activities. It is not possible to discern whether coastal recreation activities are concentrated in one part of the state or another, or focused on parks/other public lands or on private properties. This is also the case for information on local government finances. A second major consideration relates to the lack the social, economic, healthcare and governmental resources in smaller communities. Data on these smaller communities is less commonly available because some data collection efforts, designed for other purposes, focus on the largest entities (e.g., the top 50 ports or major coastal cities). The US Census Bureau privacy practices also restrict reporting on some attributes of smaller communities in order to protect the identities and personal information of residents. While that is understandable and appropriate, it also means that some potentially impacted groups and populations are not clearly visible in reported data and additional care must be taken to reach out at the local level and on the ground to avoid missing important contacts.

Temporal Resolution

The frequency of data collection is a critical consideration because vulnerability is a dynamic trait that changes over time as multiple factors and stresses emerge, interact, and diminish. For each of the data sets described, we note how frequently data are collected and, where possible, how frequently websites are updated. Many of the datasets relevant to oil spill vulnerability are collected annually or less often. As an extreme example, information on the density of archaeological sites is based on information collected between 1991 and 1993. Detailed census data are currently a decade old, although there are intermediate estimates available many of the sites which aggregate and report on

coastal communities use the 2000 census information. These less frequently collected data sets may not represent more recent or emerging trends and may fail to capture recent events, such as the recession. Census plans to release annual estimates for communities of all sizes will reduce this issue. A few datasets stand out due to the frequent updates. These include national labor statistics from the Bureau of Economic Analysis, information on medically underserved areas and populations, and US Army Corps of Engineers information on navigation.

Data Format and Consistency

Data consistency is a significant concern in seeking to understand vulnerability in different places around the nation. Most of the data sets reviewed here seek to provide national coverage and the associated documentation on their respective websites details consistent methodologies. In a few cases however, data are collected by state level reporting mechanisms and then assembled at the national reporting site. The specifics of state level reporting mechanisms can differ according to regulations. These instances are noted in the database description and comments. For example, information on the number of boats in a state is derived from the number of licenses sold and licensing requirements differ (e.g. not all states require licenses for canoes, sailboats under 15 feet, and so on). The *Local Employment Dynamics* links to state labor and employment offices for all areas except Massachusetts, Puerto Rico, and New Hampshire. These sites typically provide some of the most up-to-date and geographically specific information on employment trends, however it is necessary to be attentive to differences in the data collection and reporting. In other cases, such as the Marine Fisheries Councils and the US Army Corps of Engineers, the main national webpages link to regional counterparts. While these regional counterparts collect much of the same data, their websites are organized differently so each website involves a different navigation pathway to find the information.

Data Access

None of these sites restrict access to data, however none are designed to generate reports on potential vulnerability to oil spills so gathering this information requires reconciling information from a number of places. The limitations in the treatment of temporal and geographic scale have been noted above. There are several other practical considerations. The way in which data are reported and made available differs among sites. Many sites provide online mapping, but only a few allow the export of shape files or associated data tables. The US Census Bureau has exceptional mapping capacities and spatial data archives, however the enormous volume of data does require some additional skill with GIS techniques. For those particularly interested in spatial data, there are some sites assembling links to state level and additional agency resources (eg., <http://www.gispilot.com/> or <http://www.mass.gov/mgis/giswww.htm>). Among those sites which present data in tabular formats, some facilitate export to Excel files, some generate tables which can be downloaded, and others provide PDF files. Depending on the focus of the vulnerability assessment, summarizing the appropriate data may require a considerable effort in creating consistent formats.

The diversity in data sources poses challenges to the ease of access and use as well as the interpretation and coverage issues identified above. As is apparent from the discussion, useful information is collected and provided by a wide variety of agencies at a large number of data sites.

There are several sites which have attempted to minimize these obstacles by creating data archives and query tools which can draw data from a variety of sources. These include *American FactFinder*, *Economic HotReports*, *Digital Coast*, and *Spatial Trends in Coastal Socioeconomics*. These tools offer an important convenience in assembling diverse data sources as they can significantly reduce the number of websites the researcher might consult to draw together a set of information. The convenience, in at least a few cases, comes with some cost to data quality. In the case of the Economic Hot Reports, the data assembled are always not the most recent available directly from the original source, nor do they all represent the same year, but the site does provide a useful listing of employment in various industrial and business sectors. The *American Factfinder* reports on community are more effective in this regard.

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