

Environmental Conditions

10.1 Inadequate Data

No matter the size or importance of a proposed project, there are constraints of time, money, and practicality that can affect how data are collected. Even the most carefully and accurately measured data are limited in meaning and use without metadata¹ to provide their context. For environmental impact assessments, metadata describing space, time, and relative position are necessary for the development of fuzzy sets that accurately reflect the underlying semantics of the model. It is not enough to know the size of all wetlands, the number of tree species, or the number of songbird species identified on the project site. To express these data properly in fuzzy term sets the practitioner must know where these components are located, their spatial relations to each other and other environmental components, when the data were collected, and the relative amounts of each data type. By now, almost everyone understands the importance of spatial and temporal context for baseline conditions. Relative amount is not as well known or appreciated.

Relative amount is a partial answer to the question of the importance or value of an environmental component. Size, distance, and similar measurements gain meaning (e.g., in terms of *significance*; see Section 11.3 on page 149) when they are represented as membership values in one or more fuzzy sets. Is the amount of wildlife habitats on

¹ Data about data.

the project site small, moderate, or large; is it *adequate*? Are distances to similar wildlife habitats close or far? Are the values of these habitats considered poor, fair, good, or excellent? Expressing the measured values as fuzzy memberships gives them more easily understood values and allows for considerable analyses and interpretation. Missing and incomplete data can be partially or completely compensated by using qualitative data expressed directly as fuzzy numbers.

Measured values (including those for socioeconomic components) are converted from crisp to fuzzy numbers in the environmental impact assessment model. Therefore, there is no reason to exclude other fuzzy numbers collected as qualitative observations that augment measured data. For example, drive-by surveys² can yield data such as “very many Canada geese were feeding on the pastureland,” “there was an unpleasant odor detected along the western boundary of the site,” “after last week’s rains there are extensive erosion rills visible on the bare slopes,” or “the noise from the nearby chemical plant was very loud at the base of the tree on which the bald eagles had built their nest.” Without the use of fuzzy sets to capture potentially meaningful data on odors, noise, and relative abundances, these components would not be incorporated into the environmental impact assessment, and decisions based on the assessment will not be as well informed.

The use of such qualitative data was a valuable contribution to an assessment of changes to the seabed beneath pens of a salmon farm in the Red Sea ([32]). The seabed conditions under fish “corrals” is best described by the abundance and types of fauna and flora plus chemical analyses of sediment cores. Ideally, all collected data would be quantitative and carefully measured. But, with many pens, limited time, or rough seas, compromise was required. It was much quicker for a diver to record that the seabed had “very little seaweed, a few crabs, and thick patchy bacterial mats.” To actually quantify that in terms of the biomass of seaweed, number of crabs per square meter, and thickness and percentage cover of mats requires special equipment and additional dive time; qualitative data—properly handled—is equally meaningful and valuable in assessing the impacts of the activity.

² Anecdotal reports from residents may also be used if deemed credible or of sufficient value. As will be seen in later sections such data will not unduly distort the results of the model.