Increasing Environmental Department Profitability: The Costs of Minimal Compliance (Newsletter)*

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In early 1990 an environmental NGO sued the Oregon Dept. of Environmental Quality and a regional sewage treatment agency because phosphorus levels in a Willamette River tributary exceeded state MCLs, and the agency's treatment facility discharged treated water into that tributary. A circuit court judge set a very low phosphorus MCL for that tributary and ordered the sewerage agency to meet it. After spending a large sum of money to remove all phosphorus from the treated water prior to discharge, someone got the idea to analyze the tributary basin's soils. Those soils are naturally high in phosphorus and the river would exceed the mandated MCL even if man never settled in that valley. The agency spent several million dollars on treatment that had no effect on the natural concentrations of phosphorus in the river. Rate payers were not happy with that. Not knowing why your reported values exceed threshold MCLs can also be very costly.

Providing regulators with the minimum information they require meets all their needs and none of yours. This minimal information does not provide any basis for solving problems or effectively managing environmental risks. The basic reason is that regulators are focused exclusively on 'what' and not 'why,' and your understanding 'why' allows you to manage your environmental risks, anticipate issues before they reach crisis level, solve and avoid problems, and increase environmental department profitability by decreasing corporate expenses.

Because regulators focus on 'what' analyses accompanying reported environmental data also focus on 'what.' It is common to see t-tests and analyses of variance (ANOVA) comparing observed values at different locations or times. However, knowing that observed values differ spatially and temporally provides no insights into why they differ. There are many options for exploring why values are those observed and they all include potential explanatory ('independent') variables in addition to the response ('dependent') variable(s). The statistical analyses that explain 'why' are regression models. Environmen-

tal data are rarely linear so linear regression models are usually inappropriate; chemical data are most commonly fit by log-linear regression models while biological data are counts that require logistic regression models. Often a data-specific type of regression model is required.

As an example: 20+ years of data about tropical bat vocalizations associated with species and location (the Central American country in which they are commonly found). While the relationships of location and species to vocalization are linear, regular linear regression models do not allow identification of bat species by its vocalizations or location. That is because linear regressions compare the range of the explanatory variable (e.g., location or vocalization) with the mean value of the response variable (e.g., species). However, quantile regression (a specialized form of linear regression) allows robust prediction of species based on vocalization and location.

The presence of fish in a stream or river reach may not be constant if the water levels, temperature, flow rates, and other environmental conditions vary by season. Water chemistry constituents will also increase in concentration when water levels are low. Adding these explanatory variables to your environmental data analyses prior to submitting reports to regulators provides answers to the 'why' of observed values and provide greater insights than do answers to the 'what' of those values. Explaining the reported values supports negotiation or litigation, if all else fails.

It is common to be able to answer many 'why' questions from existing data. When explanatory data are not available, they can be added to future data collection efforts with the appreciation of the value they bring and the knowledge of how they will be used to explain the concentrations of chemicals and presence/absence or abundance of fish and wildlife. They also allow you to separate natural variability from anthropogenic effects.

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