Relationships Between Environmental Changes, Contaminant Trends, and Human and Wildlife Health Along the Rio Grande from Laredo, Texas, to the Gulf of Mexico

Purpose: Provide public health specialists with a tool that will aid them in identifying human populations at risk for health-related problems based on environmental quality.

Project Objective: to determine if evidential relationships between general environmental or water quality variables and fish or human health can be detected.
Approach: The objective will be accomplished with two primary tasks. We will utilize a weights-of-evidence and weighted logistic regression approach by applying geospatial statistical tools to consider the spatial relationship of various indicators of environmental quality (e.g., contaminants, water quality, soil geochemistry, land use) relative to measures of fish and human health.

Project Background:
Human populations have so greatly impacted the environment that most all ecosystems are stressed to varying degrees. The type, magnitude and rate of these anthropogenic changes, as well as an ecosystems' ability to buffer change, will be reflected in the overall health of the environment and consequently may provide important information about human health conditions. Under that premise, the U.S. Geological Survey (USGS) Border Environmental Health Initiative (BEHI) has described, documented, and depicted environmental quality along the US-Mexico border through integration of US and Mexican datasets and made this information publicly available. A second goal of this initiative is to foster and support the use of these integrated datasets to examine and analyze the linkages between human health and environmental health.

The watersheds within the Lower Rio Grande basin in the counties of Hidalgo and Cameron Texas were chosen as the study area for this 2-year project begun in 2007. The analyses will apply a GIS-based quantitative weight-of-evidence and weighted logistic regression (WOE/WLR) model in an attempt to associate identified areas of poor environmental quality with areas where human health may also be impaired. This method is a multi-dimensional application of an epidemiological-based approach and will be applied in threephases. The WOE/WLR model will first be used to characterize water bodies of good and poor environmental quality using extant environmental data (e.g., contaminants in biota, potential sources of contaminants, water quality, soil geochemistry, land use and land cover trends) based on the known biological condition (ie., impairment of fish health) for a subset of the water bodies (training sites) in the study area. Once the appropriate environmental stressors associated with the biological condition are identified, then spatial interpolation predicts distribution of the biological condition throughout the study area. Finally, geostatistical methods will be used to determine if there is an association between the distribution of fish health and that of human health using a general human health indicator. Using this approach, linkages between potential environmental stressors and human health may be identified for further investigation.

To date, researchers have identified and prepared environmental data sets and optimized model parameters. Water bodies that will be used as the training sites for the model have been identified and a protocol to evaluate fish health at these sites has been established. A general human health indicator (school absentee rates) and potentially more specific indicators of exposure to environmental pollutants (from birth and death statistics) have also been identified. These large data sets, obtained for the two counties, will allow us to test the hypothesis that at the landscape-level a positive spatial association exists between the occurrence of poor fish health and poor human health.

Expected Outcomes:
Results will provide county-level maps for the Lower Rio Grande Valley depicting predicted probability distributions of biological impairment based on fish health, identification of those environmental stressors that most strongly predict impairment, and correlations of measures of human health with predicted areas of poor environmental health.

Project Contacts: Diana Papoulias, PhD Biologist,(dpapoulias@usgs.gov), Jim Stefanov, Hydrogeologist (jestefan@usgs.gov), Jean Parcher, Geographer (jwparcher@usgs.gov), Ric Page, Geologist (rpage@usgs.gov)
Key Collaborating Institutions: Pan American Health Organization, Texas State Department of Health Services, University of Texas School of Public Health, Wright State University.