ABSTRACT

To address the potential effects of the magnitudes and time variations in spring flows to the Comal and San Marcos Rivers as specified objectives of the Edwards Aquifer Habitat Conservation Plan (HCP) Phase 1 implementation, a multi-year project was undertaken to develop a mathematical model of elements of the river ecosystem, notably those that influence or control the populations of fountain darter. Model development relied upon the substantial data resources on these river systems, especially the field data collections and laboratory studies carried out under the auspices of the HCP, and built on previous modeling of hydraulics and water quality in these rivers.

This work has resulted in the Fountain Darter Modeling System (FDMS), a computer-based simulation of the fountain-darter populations. Because of the extent and complexity of the river networks, they could not be modeled in their entirety. Instead, FDMS models were created for five study reaches: in the San Marcos, City Park and IH35; in the Comal, the Upper Spring Run, Landa Lake, and the Old Channel. The central modeling concept is that fountain darter numbers are governed mainly by habitat quality, which in turn is principally determined by the species and areal coverage of submerged aquatic vegetation (SAV), by water temperature and by dissolved oxygen. The FDMS simulates the time progression of habitat quality within each study reach, at a spatial resolution of about a meter, and the associated density of darters.

The FDMS is comprised of four major submodels, which address river hydraulics, water quality, submerged aquatic vegetation and the fountain darter population. Model inputs include data on hydrology (i.e., river flows including the springflow components), meteorology, solar radiation, physiography and bathymetry of the river channel, and initial coverages SAV and fountain darter density (numbers). From these inputs, the model produces a time evolution of fountain darter numbers over some specified period of time. Several “scenarios,” which is a set of model inputs extending over a defined period of time, were particularly important for model application: the historical “baseline” period of 2003-2013, used for model development and performance evaluation; the HCP drought regime, and the HCP long-term-average regime.

This model was designed specifically to be used as a management tool, not an academic representation of all ecological processes in these two complex springs / river systems. It therefore embodies a series of postulates about the ecological functioning of the fountain darter that simplify the model and focus on issues needed to be addressed to manage the species. Within the scope of this work, the most important management question that the model was used to address is: What will happen to the Covered Species and their habitats at HCP (Phase 1) allowed flow levels and durations? So far as the fountain darter is concerned the answer is that the darter numbers will be at a level necessary for the sustaining of the species.