PHABSIM is a mathematical hydraulic model that relates the quantity of physical habitat (as weighted useable area or WUA) to changes in water surface elevation and discharge (Bovee 1982, Nestler *et al*. 1989, Gore and Mead 2008). In the United States, the PHABSIM model is often synonymous with a suite of decision-making protocols called the In-stream Flow Incremental Methodology (IFIM) (Bovee *et al.*1998). PHABSIM has been erroneously thought of as an ecological model that can be used to establish relationships between hydrology and biological endpoints like abundance. In truth, PHABSIM is a stand-alone physical-hydrologic model that predicts habitat availability (Bovee 1982, Gore and Nestler 1988, Nestler *et al*. 1989). A PHABSIM simulation model requires site-specific instream hydraulic measurements at fixed intervals across a series of transects for the reaches of interest within a specific river. Site-specific measurements include open-channel flow characteristics (water surface elevation, depth and velocity), substrate composition, refuge/cover distribution, and species-specific habitat suitability criteria (the actual selection of combined depth/flow/substrate by the organisms of interest). Finally, the output of PHABSIM is a reach-specific estimate of WUA of biota or recreational (canoe and kayak) habitat at a specific discharge. In order to extrapolate this WUA-discharge relationship, the model is calibrated by repeating the hydrologic measurements at three to five discharges spanning the expected annual hydrograph. Thus, the models' predictive ability is best when its application is limited to discharges within the range of those three to five calibration discharges.

In the low gradient, warm water river systems that dominate the southeastern coastal plain region in general and Florida in particular, fish communities can be very diverse and often dominated by a large suite of species with similar habitat needs (Leonard and Orth 1988). Because a

species' habitat use will often shift as a function of the fish community diversity, the species-specific curves are more appropriately thought of as both species and river specific (Freeman *et al.* 1997). Some of these species-specific curves have been developed with funding from the Southwest Florida Water Management District but are sometimes limited in their applicaton throughout the state. Thus, although a single habitat suitability curve, representing one species and life stage combination is typically used for PHABSIM, numerous authors have suggested that, when assessing southeastern coastal plain ecosystems, criteria representing habitat guilds (grouping classes with comparable habitat preferences) would be more utilitarian. These guild-based models group taxa based on their functional preference for particular habitat types, such as shallow-fast riffles in contrast to deep-slow pools, instead of taxonomic status (Leonard and Orth 1988, Welcomme *et al*. 2006). In addition to adopting this recommendation, and because riffles are relatively uncommon in the low gradient rivers of southwest Florida, we limited our times series analyses to the shallow-slow (littoral), deep-fast (main channel), and deep-slow (pool) habitat guilds.

In the case of the Wakulla River, the emergent vegetation and the very dense periphyton covering the substrate make it impossible to accurately describe the channel profile and the velocities and substrates necessary to calibrate the hydrologic subroutine, IVG4. Without accurate calibration the model is not useful. Although there are some purported "desk-top" models for estimating minimum flows, none have been accepted by the courts as a valid means of evaluating and assessing minimum flows and levels. Currently, the IFIM procedure and the model used in the methodology, PHABSIM, have been recognized as a defensible technique (Gore and Meade 2008). Casper et al. (2011) have suggested that if sufficient GIS data are

available, a spatially explicit watershed model (SWAT) could be combined with PHABSIM to make relatively accurate estimates of weighted usable area (WUA), the final output of the model before doing a time-series analysis, without the need for field data. This technique has been tested on a limited number of streams.

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