Reference SON: *Strategic Discretionary Effort: Ecosystem Modeling – HEC Ecosystem Functions Model*

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Project Development Team (PDT): *Multiple coding teams: HEC-EFM and DFCE, HEC -GeoEFM and ESRI, HEC - EFM Plotter and RMA*

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Keywords: *Ecosystem model, Ecosystem response, Ecosystem dynamics, Planning, HEC-EFM*

[Wiki](#)

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EFM and GeoEFM (Ecological Function Models) Development[1]

Research Need

Most ecosystem models are developed for specific projects and locations. There are few tools that are applicable to a wide range of ecosystems and even fewer that utilize the existing capabilities of hydrologic and hydraulic (H&H) modeling packages to help simulate ecosystem responses to typical project actions (e.g., reservoir reoperations, levee alterations, nonstructural flood risk management measures) in Corps' mission areas. This limits synergies between restoration projects (lessons learned, staff and technology exchanges) and different professional communities in the Corps (e.g., environmental planners, engineers, and regulators).

Improving a software tool that connects H&H to ecosystem dynamics will enable Corps Districts (and other users) to have greater capabilities in the ecosystem planning and management arena specifically in regards to its restoration and water resource missions.

Project Objectives & Plan

HEC-EFM is designed to help study teams determine ecosystem responses to changes in the flow regime of a river or connected wetland. EFM is a generic software tool, applicable to a wide range of ecosystems and works with existing hydrologic databases and hydraulic modeling packages to make predictions of ecosystem responses. Since July 2008, EFM has been available via the web at no cost, and downloaded thousands of times (www.hec.usace.army.mil). This research continues development of EFM and its spatial accessory GeoEFM, which is also web available.

Feature enhancements 2015:
- Completion of habitat suitability features
- Integration of suitability and connectivity features
- Allow users to customize output styles
- Allow flexibility in types of output written
- Enable batch compute

Feature enhancements for 2016:
- HDF data import
- Location-based eco-values
- GeoEFM journal paper
- Map upgrades
- User guidance updates

Feature enhancements for 2017:
- Relative velocity
- Post-processing of patches for index of functionality
- EFM and GeoEFM journal paper about watershed-scale use of statistics
- Enable EFM to track age and origin of simulated communities
- Assess habitat connectivity

Payoff

By advancing new generic software tools, this work unit improves the capabilities of planners and engineers around the Corps who are working in the ecosystem planning and management arena. Products of this work unit will provide immediate utility to a growing EFM user base, as evidenced by recent applications of the software by NWK, NWO, NWP, MVP, and others.

Products

Journal Articles (JAs)

Hickey, J.T., Shafroth, P.B. and Fields, W.L. (2020). Flow-ecology modelling to inform reservoir releases for riparian restoration and management. Hydrological Processes 34, 4576-4591.

Hickey, J.T., Huff, R. and Dunn, C.N. (2015). Using habitat to quantify ecological effects of restoration and water management alternatives. Environmental Modelling & Software. DOI: 10.1016/j.envsoft.2015.03.012.

Julian, D.P., Hickey, J.T., Fields, W.L., Ostadrahimi, L., Maher, K.M., Barker, T.G., Hatfield, C.L., Lutz, K., Marks, C.O., Sandoval-Solis, S. and Lund, J.R. (2015). Decision support for water and environmental resources in the CT River Basin. Journal of Water Resources Planning and Management. DOI: 10.1061/(ASCE)WR.1943-5452.0000538.

Technical Reports (TRs)

U.S. Army Corps of Engineers (2017). HEC-EFM – ecosystem functions model: Quick start guide version 4.0 (CPD-80a), Computer Program Documentation. Hydrologic Engineering Center, Davis, CA. http://www.hec.usace.army.mil/software/hec-efm/documentation/HEC-EFM_40_Quick_Start_Guide.pdf

Conference Presentations/Webinars/Workshops

Multiple web-based trainings and project support activities.

Models and Applications

HEC-GeoEFM is an ArcMap extension developed to support spatial analyses commonly used during applications of the Ecosystem Functions Model (HEC-EFM). Use of HEC-GeoEFM requires a user license for ArcMap. Spatial Analyst and 3D Analyst extensions for ArcMap must also be installed and activated. https://www.hec.usace.army.mil/software/hec-geoefm/

HEC-GeoEFM provides three primary capabilities for users planning ecosystem restoration projects or water management scenarios: 1) management of spatial data sets, 2) computation and comparisons of habitat areas, and 3) assessment of habitat connectivity.

HEC-GeoEFM has been certified for use in USACE Planning Studies by USACE Headquarters as recommended by the National Ecosystem Planning Center of Expertise as being sound in contemporary theory, computationally correct, and compliant with USACE policy.

Project Activities
(Software deployment) EFM 4.0 , online April 2017;
EFM Quick Start Guide, Version 4.0. Links:
http://www.hec.usace.army.mil/software/hec-efm/
http://www.hec.usace.army.mil/software/hec-efm-plotter/
http://www.hec.usace.army.mil/software/hec-geoefm/
http://www.hec.usace.army.mil/software/hec-efm/documentation/HQ_Certification_HEC-EFM_and_HEC-GeoEFM.pdf
http://www.hec.usace.army.mil/software/hec-efm/documentation/ECO-PCX_Certification_HEC-EFM_and_HEC-GeoEFM.pdf

(Software updates), available for download at:
https://www.hec.usace.army.mil/software/hec-geoefm/download.aspx
EFM v 5.0, September 2020
EFM Plotter v 3.0, September 2020
EFM Plotter v 3.1, February 2021
GeoEFM v 2.0, August 2024

(Award) ASCE EWRI Quentin Martin Best Practice-Oriented Paper in 2017. Julian, D.W., Hickey, J.T., Fields, W.L., Ostadrahimi, L., Maher, K.M., Barker, T.G., Hatfield, C.L., Lutz, K., Marks, C.O., Sandoval-Solis, S., and Lund, J.R. (2015). Decision support system for water and environmental resources in the Connecticut River Basin. *Journal of Water Resource Planning and Management.* http://dx.doi.org/10.1061/(ASCE)WR.1943-5452.0000538.

[1]Project Alias – Work Unit Documentation Title: *HEC-EFM (Ecosystem Functions Model)* ERDCWiki Title: *EMRRP: Ecosystem Functions Model*