

JOHN PATRICK FAY

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PROFESSIONAL APPOINTMENTS

Duke University, Nicholas School of the Environment and Earth Sciences

Instructor, Geospatial Analysis Program	2009 – present
Associate in Research, Geospatial Analysis Program	2005 – present

Xylem, Inc.

Contractor, Water Data Analytics Program	2018 - present
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Stanford University

GIS Manager, Center for Conservation Biology	1998 – 2005
GIS Specialist, Jasper Ridge Biological Preserve	1997 – 1998

University of Michigan, School of Natural Resources and Environment

Visiting Lecturer in GIS	1996 – 1997
GIS Manager, SNRE GIS Facility	1994 – 1997
Teaching Assistant, Undergraduate course in Conservation Biology	1993 – 1994
Research Assistant, River Raisin Watershed Project	1992 – 1994

EDUCATION

University of Michigan 1992 - 1996

M.S. in Natural Resources, May 1996
Concentration in Conservation Biology and Ecosystems Management
Thesis: *Using GIS to model non-point source pollution in an agricultural watershed in southeast Michigan*

Bowdoin College 1987 - 1991

B.A. magna cum laude in Biology and Environmental Studies, May 1991

TECHNICAL EXPERTISE

Platforms	Windows (Desktop & Server), Linux
ESRI GIS products	ArcGIS Pro (since 2018), ArcGIS Desktop (since 2003), Arc/Info (since 1993) ArcSDE (since 2007), ArcGIS Server (since 2007)
Remote Sensing	ENVI (since 2000), ERDAS Imagine
Programming	Python, R, Visual Basic, SQL, JavaScript, ArcGIS modeler, AML

TEACHING EXPERIENCE

Advanced Geospatial Analysis (Primary Instructor)

Masters level course covering advanced topics in geospatial analysis. Topics covered include:
Advanced model building in ArcGIS 9.3, Database structure and SQL, writing geoprocessing scripts
using Python, inter-application programming using Python, client/server/web-based GIS.

Geospatial Analysis for Conservation Management (Primary Instructor)

Masters level course on practical applications of GIS to conservation management. Topics covered include: Gap analysis, Ecoregional Planning, Change detection, Fragmentation analysis, Watershed modeling, Habitat modeling (CART, GLM, ROC), Animal movement, and Site optimization for protected area planning.

Environmental Data Analytics (Co-Instructor)

Introductory course teaching how to develop reproducible workflows to gather, organize, manage, analyze, and visualize environmental data. Topics include: versioning using Git/GitHub, coding in R & Python, data exploration, data visualization, statistical analysis, spatial analysis, database management, crafting reports, and interactive dashboards.

Water Data Analytics Bootcamp (Co-Instructor)

Co-developed and ran a 3-session intensive bootcamp on the use of Excel, Tableau, and scripting (Python/R) to gather, organize, query, and visualize publicly available water data to explore issues such as impacts on stream flow, developing water balance spreadsheets, and water quality exceedance frequencies.

Geospatial Analysis for the Human Environment (Co-Instructor)

Masters level course exploring geospatial analysis in the context of human-environment interactions. Topics include: exposure modeling, demographics and dasymetric analysis, hydrologic modeling, network analysis, and spatial statistics.

Fundamentals of Geospatial Analysis (Assisting Instructor)

Introductory course to geospatial analysis using ArcMap 9.3. Topics covered include: Spatial data formats, Map projections, Spatial data sources, GPS, Remote sensing, Vector geoprocessing, Terrain modeling, Spatial interpolation, Cost-path analysis, and Decision support systems. Taught at both the masters and undergraduate levels.

GIS-Based Applications for Conservation Management (Co-Instructor)

A week-long professional course targeted at Land Trust managers presenting geospatial tools on habitat modeling, habitat evaluation, landscape prioritization, and change detection.

Masters Project Co-Advisor

Provided advice and technical guidance to students in the planning, development, and execution of masters projects involving spatial analysis.

PROJECT EXPERIENCE

Data Exploration and Synthesis for Duke's *Internet of Water* Program

Developed Python scripts to pull water utility data from various providers (local/state/federal) into a centralized data store, and to query and visualize patterns across spatial and temporal scales. Also worked with local and regional water utilities to identify barriers to automating data collection and sharing, including use of latest sensor technology and metadata standardization.

https://github.com/DataDeviils/NC_WaterData

Geospatial Exploration of Water Usage and Water Quality Data with Xylem Inc.

Geolocated parcel scale water usage data to identify spatial patterns in usage and visualize patterns against remotely sensed imagery and its derivatives (e.g. NDVI). Also developed JavaScript and Python scripts to extract time series data from remote sensors, using Google Earth Engine, to combine with *in situ* water quality sensors as part of a broader project predicting algal blooms in Lake Erie.

Data Synthesis for National Ecosystem Services Economic Accounting: Water Accounts

Lead developer for a Python-based tool that automates extraction of raw water supply and water use data from on-line repositories (USGS, CMIP5) and consolidation of these data into a balance sheet format following the UN's System of Environment-Economic Accounting framework.

<https://github.com/johnpfay/USWaterAccounting>

Geospatial Analysis of Climate Impacts on Arctic Circulation

Developed Python scripts to extract raw Arctic circulation model output and convert it into formats compatible with ArcGIS and a Matlab based connectivity analysis.

<https://github.com/johnpfay/ArcticConnectivity>

Geospatial Toolkit to Prioritize Area for Environmental Mitigation

Lead developer in an ArcGIS based toolkit that ranks catchments across North Carolina in terms of potential aquatic habitat uplift. Work included assembly of a large (>30 GB) networked geodatabase and a hierarchical ArcGIS toolbox to execute >50 Python scripts written to extract data to run a suite of species distribution models (Maxent, GLM, Random Forest) to identify changes in habitat suitability under a set of alternative management scenarios. This project is part of a joint project with UNC to deliver a prioritization tool for the North Carolina Department of Mitigation Services.

<https://github.com/Duke-NSOE/GeoWET>

Literature survey data entry tool for Microsoft Access

Developed a software tool in Microsoft Access/Visual Basic to streamline data entry and synthesis for a literature review project culling data from > 1000 journals into a searchable database on nitrogen applications for agriculture in the US.

Geospatial Habitat Assessment Toolkit ("GeoHAT")

Developed an ArcGIS/Python based toolkit that integrates habitat data and multi-criteria decision analysis to prioritize landscapes for conservation under different management objectives.

<https://github.com/Duke-NSOE/GeoHAT>

Evaluating Water Quality Impacts of Surface Mining in the Central Appalachians

Compiled a spatial database using ArcGIS SDE for the central Appalachian Mountain region consisting of topographic, hydrographic, and surface mining layers. Developed geospatial tools to calculate the total area of surface mining upstream of user supplied water quality monitoring points used to evaluate downstream impacts of mountain top removal.

Assessing Climate Change Impacts on Coastal Ecosystem Services

Developed geospatial tools to automate the download and synthesis of IPCC climate change model data with coastal datasets to explore potential impacts of sea surface temperature rise on coastal ecosystem services.

Geospatial Tools for Creating a Least-cost Pipeline Network for CO2 sequestration

Developed a geospatial toolbox to construct a least cost path pipeline network linking CO2 emission sites to CO2 storage sites across the US.

Greenhouse Gas Offset Evaluation Tool for Afforestation Projects

Developed web-based tool for the [EPA Climate Leaders](#) program to enable users to estimate additional greenhouse gas emission offsets from afforestation projects above a baseline rate determined by historical regional land use changes.

Monarch Butterfly Change Detection Assessment

Developed ArcGIS Models and Python scripts that synthesize multi-year IKONOS imagery classifications to detect areas of illegal deforestation within the Monarch Biosphere Reserve, Michoacan, Mexico.

Global Assessment of Mammal Biodiversity and Conservation Status

Developed Avenue and ArcGIS/Python scripts that interface mammal range polygon datasets with the MARXAN reserve design model to assess mammal conservation status under existing and hypothetical human impact scenarios.

Global Biodiversity/Carbon Richness Evaluation

Combined global datasets from different agencies using ArcGIS to examine correspondence among areas of high biodiversity, areas of high carbon availability, and areas where conservation projects are generally successful.

North American Ecoregion Assessment

Developed macros and other scripting tools in Avenue to query taxonomic databases of species presence/absence in North American Ecoregions and compare results to other spatial databases to examine diversity in relation to physical factors and human influences.

Species Range Mapping Tool for Madagascar

Created an ArcView extension and stand-alone VB application that predicts species ranges from point observation databases and known limitations on species distributions.

Species Prediction Model for Butterflies in Central Nevada

Combined GPS field data with spatial datasets derived from USGS DEM and DLG data, climate data, and satellite imagery to generate inputs for testing Bayesian modeling techniques to predict species butterfly richness and occurrence in central Nevada mountains.

Spatial Analysis of Pollination in Central California

Classified a Landsat 7 TM satellite image into a land cover thematic map using ENVI image processing software. Developed spatial models to relate this map in to field data to examine correlations between pollination efficiency and distance to native and agricultural land covers.

Regional Prioritization/Reserve Design: Calakmul, Chiapas, Oaxaca, and Ecuador

Prepared data, provided real-time spatial analyses, and generated cartographic output for 3-day on-location workshops to prioritize landscapes for biological conservation. Workshops were held for (1) the Calakmul Biosphere Reserve, Campeche, Mexico; (2) Chimalapas Region, Chiapas/Oaxaca, Mexico (3) Parque Nacional Podocarpus, Ecuador; (4) Sierra Norte de Oaxaca, Mexico; and (5) Sierra Costera de Oaxaca, Mexico.

Biogeography of Moths in Costa Rica

Devised a spatially explicit model for comparing moth diversity to habitat fragmentation and ecosystem service delivery in and around Las Cruces Biological Station, Costa Rica.

General GIS Support for Jasper Ridge Biological Preserve/Stanford Planning Dept.

Provided project support, consulting, and limited instruction for GIS-related studies at the Jasper Ridge Biological Preserve and the Stanford Planning Department. Assembled spatial databases, organized instructional workshops on use of GIS/GPS, and provided casual support to students, faculty, and staff using GIS in various research projects.

PUBLICATIONS

Lovette, JP, Duncan, JM, Smart, LS, Fay, JP, Olander, LP, Urban, DL, Daly, N, Blackwell, J, Hoos, AB, García, AM, and Band, LE. ["Leveraging Big Data Towards Functionally-Based, Catchment Scale Restoration Prioritization."](#) *Environmental Management* 62, no. 6 (December 2018): 1007-1024.

Bernhardt, ES, Lutz, BD, King, RS, Fay, JP, Carter, CE, Helton, AM, Campagna, D, and Amos, J. ["How many mountains can we mine? Assessing the regional degradation of Central Appalachian rivers by surface coal mining."](#) *Environ Sci Technol* 46, no. 15 (August 7, 2012): 8115-8122.

Goodall, J. L., J.P. Fay, and D.L. Bollinger. ["A software library for quantifying regional-scale nitrogen transport within river basin systems."](#) *ENVIRONMENTAL MODELLING & SOFTWARE* 25, no. 12 (December 2010): 1713-1721.

Luck, GW, Chan, KMA, and Fay, JP. ["Protecting ecosystem services and biodiversity in the world's watersheds."](#) *CONSERVATION LETTERS* 2, no. 4 (August 2009): 179-188.

Sekercioglu, CH, Schneider, SH, Fay, JP, and Loarie, SR. ["Climate change, elevational range shifts, and bird extinctions."](#) *Conservation Biology : the Journal of the Society for Conservation Biology* 22, no. 1 (February 2008): 140-150.

Fleishman, E., R. Donnelly, R. Reeves, and J. Fay. 2007. Applications of nestedness analysis to biodiversity conservation in developing landscapes. *Landscape and Urban Planning*. 81:271-281.

Boggs, C.L., C. Holdren, I.G. Kulachi, T.C. Bonebreak, B.D. Inoye, J.P. Fay, A. McMillan, E.H. Williams, and P.R. Ehrlich. 2006. Delayed population explosion of an introduced butterfly. *Journal of Animal Ecology* 75: 466-475.

Ceballos, G., P.R. Ehrlich, J Soberon, I. Salazar, and J.P. Fay. 2005. Global mammal conservation: What must we manage? *Science* 309(5734): 603-607.

Fleishman, E., J.R. Thomson, R. Mac Nally, D.D. Murphy, and J.P. Fay. 2005. Predicting species richness of multiple taxonomic groups using indicator species and genetic algorithms. *Conservation Biology* 19:1125-1137.

Seto, K. C., E. Fleishman, J. P. Fay, and C. J. Betrus. 2004. Linking spatial patterns of bird and butterfly species richness with Landsat TM derived NDVI. *International Journal of Remote Sensing* 25: 4309-4324.

Kremen, C., N. M. Williams, R. L. Bugg, J. P. Fay, and R. W. Thorp. 2004. The area requirements of an ecosystem service: Crop pollination by native bee communities in California. *Ecology Letters* 7: 1109-1119.

Kremen, Claire, David C. Lees, and John P. Fay. 2003. Butterflies and Conservation Planning in Madagascar: From Pattern to Practice. In *Butterflies: Ecology and Evolution Taking Flight* Carol L. Boggs, Ward B. Watt, and Paul R Ehrlich, eds.

Niles, John O., Sandra Brown, Jules N. Pretty, Andrew S. Ball and John P. Fay. 2003. Potential carbon mitigation and income in developing countries from changes in use and management of agricultural and forest lands. In *Capturing Carbon and Conserving Biodiversity: The Market Approach*. Ian R. Swingland, ed.

Niles, John O.; Kremen, Claire; Fay, John P. 2003 A tropical forest meta-analysis: Ecological and conservation findings; *Ecological Society of America Annual Meeting Abstracts; v.88, p.252*.

Fleishman, Erica; Nally, Ralph Mac; Fay, John P. 2003. Validation tests of predictive models of butterfly occurrence based on environmental variables. *Conservation Biology*; v.17, no.3, p.806-817.

Mac Nally, R., E. Fleishman, J.P. Fay, and D.D. Murphy. 2003. Modeling butterfly species richness using mesoscale environmental variables: model construction and validation. *Biological Conservation*; v.110, no.1, p.21-31.

Fleishman, E., R. Mac Nally, J.P. Fay, and D.D. Murphy. 2001. Modeling and predicting species occurrence using broad-scale environmental variables: an example with butterflies of the Great Basin. *Conservation Biology*; v.15, no.6, p.1674-1685.

Ricketts, T.H., G.C. Daily, P.R. Ehrlich, and J.P. Fay. 2001. Countryside biogeography of moths in a fragmented landscape: biodiversity in native and agricultural habitats; *Conservation Biology* 15(2):378-388.

Fleishman, E., J.P. Fay, and D.D. Murphy. 2000. Upsides and downsides: contrasting topographic gradients in species richness and associated scenarios for climate change; *Journal of Biogeography* 27:1209-1219.

Galindo-Leal, C., S. Weiss, J. Fay, and B. Sandler. 2000. Conservation priorities in the greater Calakmul Region, Mexico: correcting the consequences of a congenital illness; *Natural Areas Journal* 20(4).

Kremen, C., Niles, J., Dalton, M., Daily, G., Ehrlich, P., Fay, P., Grewal, D. and R. P. Guillery. 2000. Economic incentives for forest conservation across scales. *Science*. 288:1828-1832.

Sandler B, S. Weiss, J. Fay, E. Martínez, and C. Galindo-Leal. 1999. Deforestation and identification of vegetation associations in Calakmul Biosphere Reserve in southern Mexico through remote sensing. Final Report to World Wildlife Fund - México, Mexico D.F. 38 pp.

Allan, J. D., D. L. Erickson, and J. P. Fay. 1997. The influence of catchment land use on stream integrity across multiple spatial scales. *Freshwater Biology* 37: 149-161.