STONE ENVIRONMENTAL

Endangered Species Assessment for the Shortnose Sturgeon: Lessons Learned for a National Assessment Process

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Motivation and Objectives

A Step 1 analysis consisting of a preliminary national screening level environmental risk assessment (SLERA) was conducted for chlorpyrifos.

The SLERA and application of additional spatial filters was unable to resolve the majority of aquatic species due to:

- Highly conservative aquatic exposure scenarios
- Use of conservative spray drift models and assumptions
- Vast crop footprints which do not account for classification uncertainty
- Range data with only county-level spatial resolution for some species
- Very conservative (1:1,000,000 mortality) effects metrics

Objective: Develop an approach for refined flowing water modeling that,

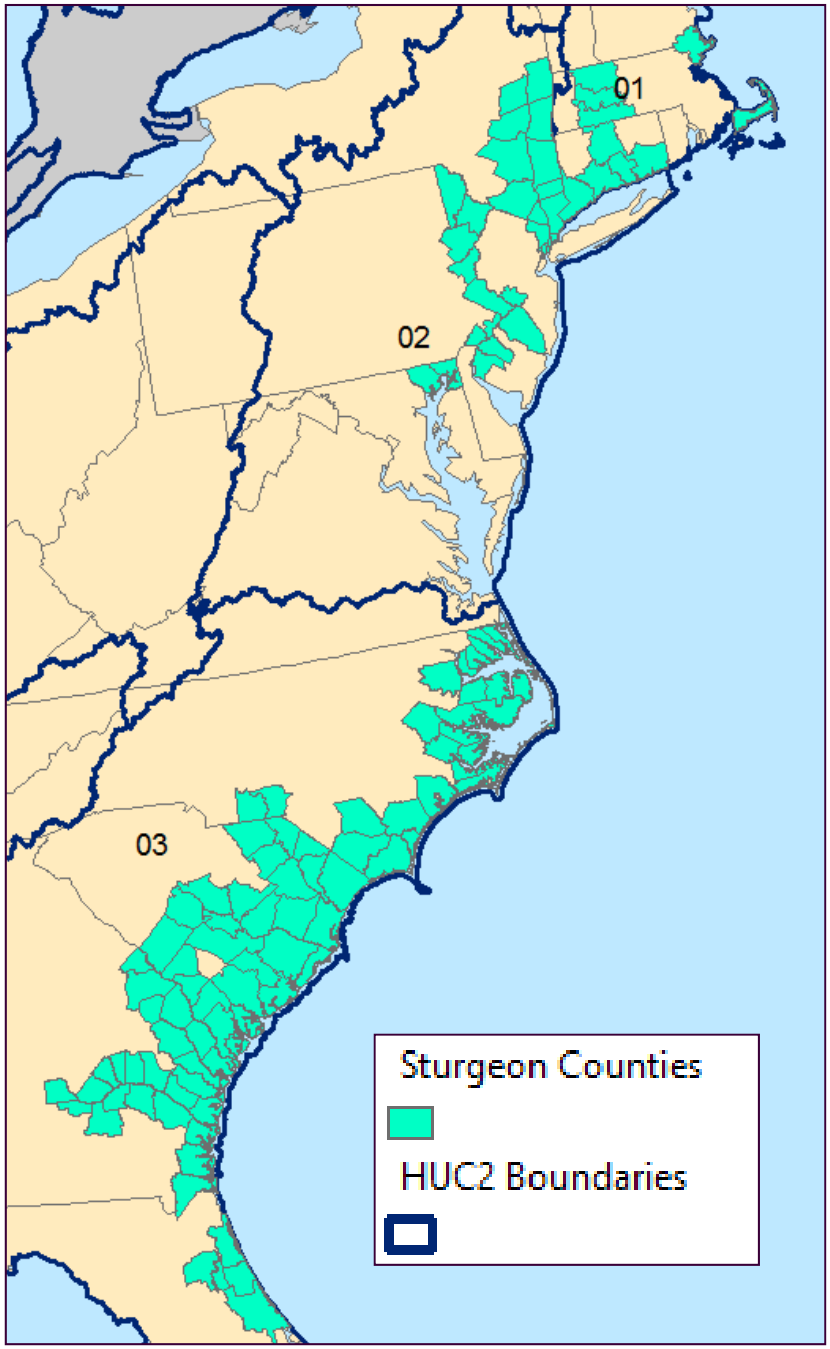
- More realistically predicts EECs across a range of flowing water conditions
- Allows for spatially explicit determination of EECs
- Can be applied to a broad range of species

Study Approach

Develop and apply a flowing water aquatic exposure methodology to evaluate the Shortnose sturgeon.

Focus on a portion of the species range (South Atlantic HUC2).

Evaluate the feasibility of applying the approach more broadly.



Development of a Refined Exposure Modeling Approach for Flowing Water Bodies

Requirements for modeling approach:

- Spatially explicit
- Account for variability in environmental conditions and agronomic practices
- Allow flexibility in refinement options (e.g., pesticide use, probabilistic inputs)

Flowing water modeling methodology:

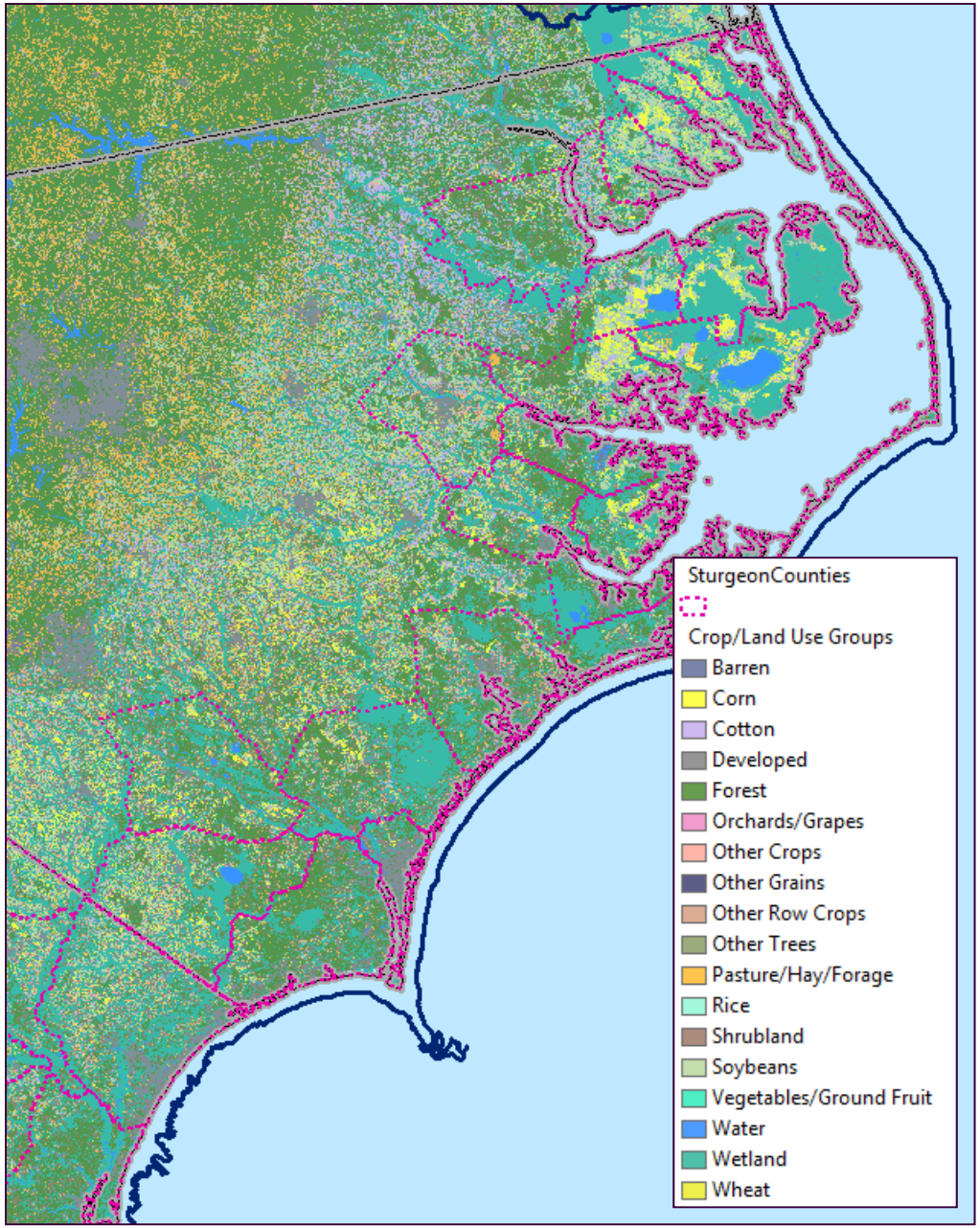
- Apply PRZM5 to generate daily time series of runoff, sediment, soluble pesticide, and sorbed pesticide loadings for each catchment
- Use the NHDPlus V2 flow connectivity attributes to determine the routing of catchments downstream
- Route the flow, sediment, and pesticide using the Soil and Water Assessment Tool model (SWAT)
- Simulate chlorpyrifos annual maximum EECs at the NHDPlus catchment scale

Crop Groupings and Land Use Analysis

Use 5 years (2010 – 2014) of USDA Cropland Data Layer (CDL) to classify crops and land use.

Group into 11 agricultural crop groups and 7 non-agricultural land use groups based on dominant class from 5 years:

- Ag Classes: corn, cotton, orchards/grapes, other crops, other grains, other row crops, pasture/hay, rice, soybeans, vegetables/ground fruit, wheat
- Non-Ag Classes: barren, developed, forest, other trees, shrubland, water, wetland



Soils Analysis

USDA SSURGO soils database used to characterize soils.

Soils were grouped into 600 possible bins based on:

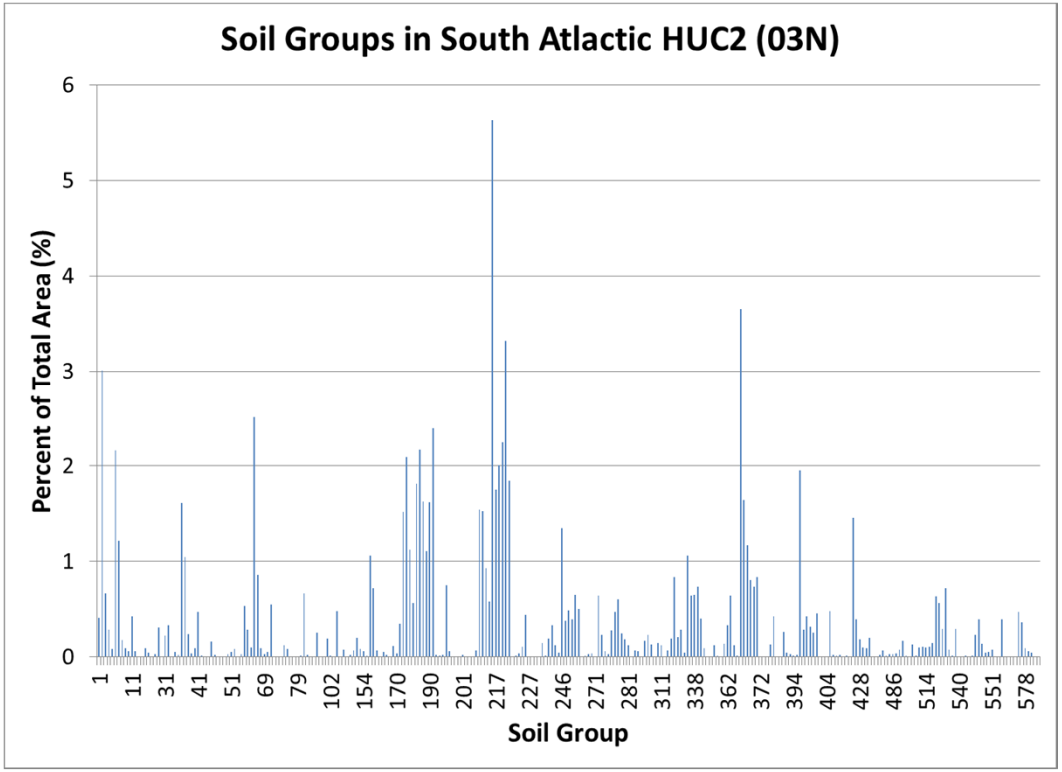
- Hydrologic Soil Group
- Slope
- Organic carbon in surface layer
- USLE K-factor (erodibility)

Representative properties were assigned to each bin based on the dominant soil component in each bin.

Most common bin represented 5.6% of area.

Parameters and ranges for grouping like soils

Soil Hydrologic Group	Surface USLE K Factor	Surface Organic Carbon (%)	Land Slope (%)
A	< 0.1	< 0.5	<2
B	0.11 - 0.2	0.5 - 2	2 - 5
C	0.21 - 0.32	2 - 4	5 - 10
D	0.33 - 0.43	4 - 6	10 - 15
	0.44 - 0.64	6 - 8	>15
		> 8	

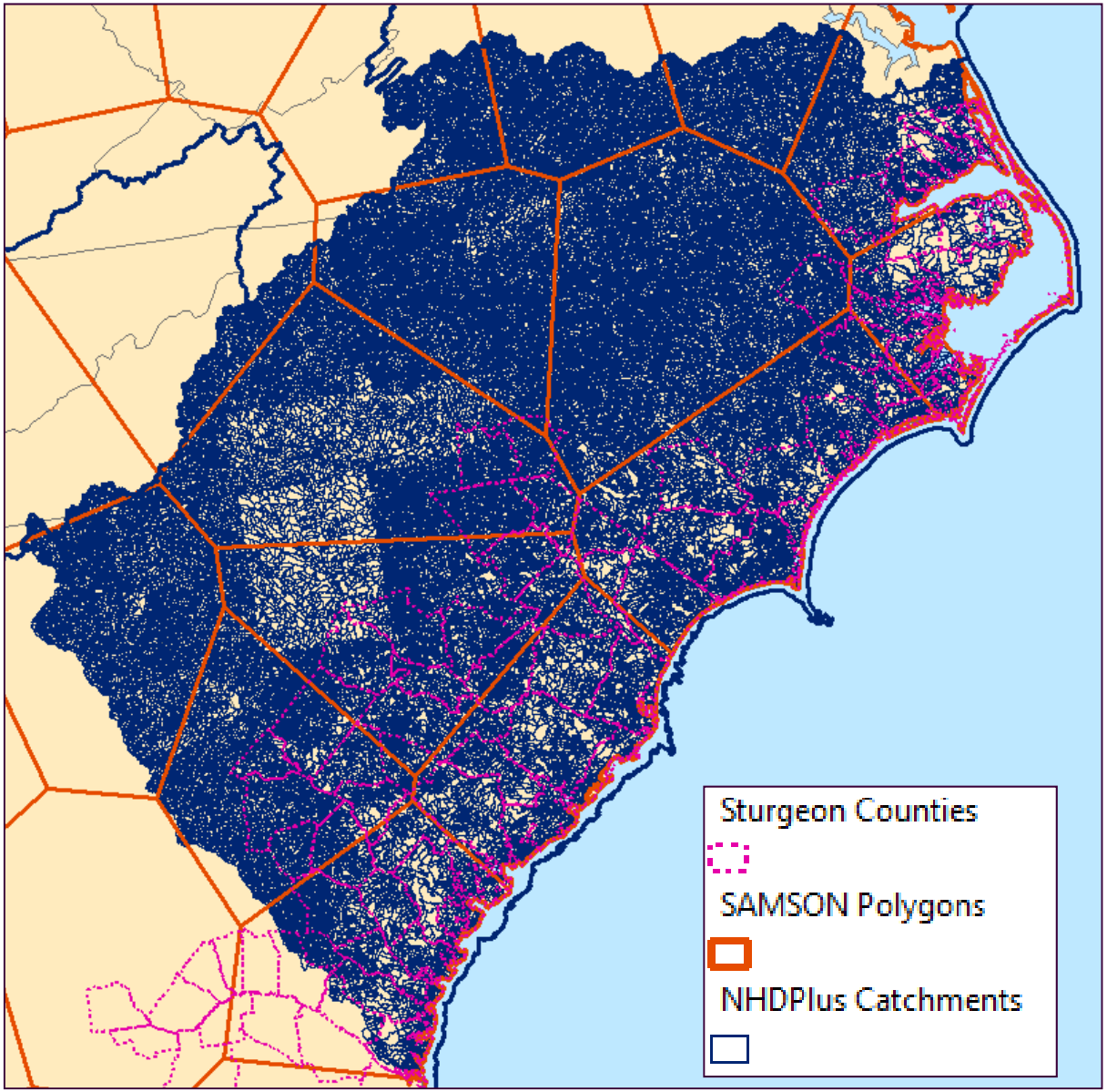


Weather Data

30-year daily time series from the EPA SAMSON dataset served as the weather data source.

17 different SAMSON stations were located within the study area (HUC2 03N).

SAMSON stations were assigned to catchments based on proximity.



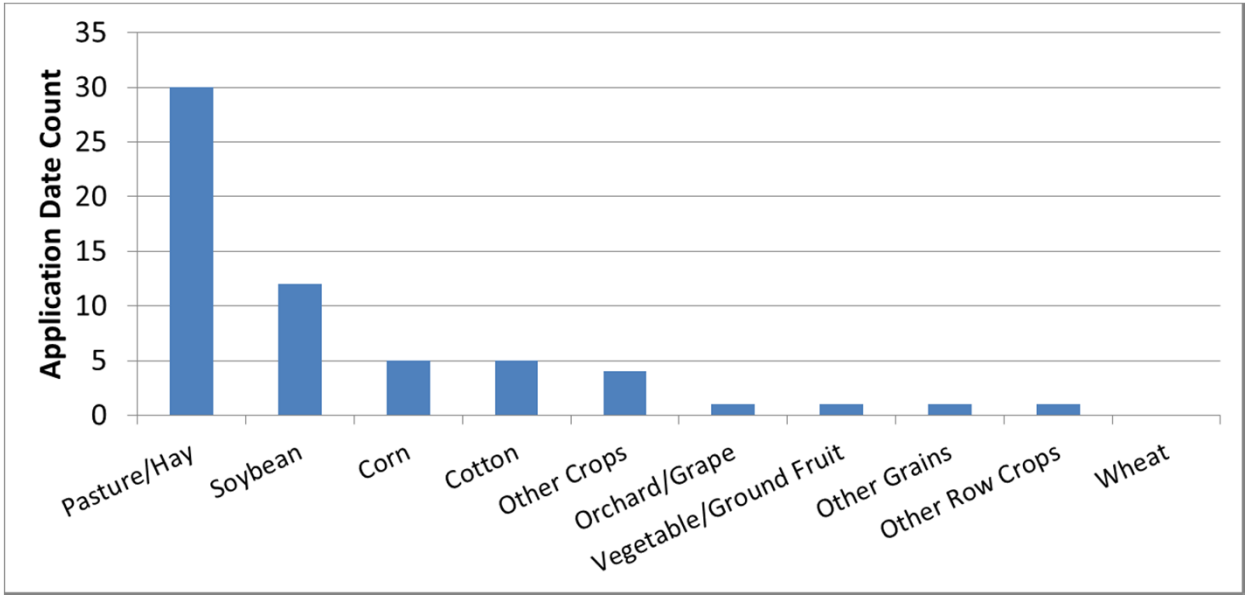
Pesticide Application Timing

The crop with the most vulnerable use pattern within each crop group was chosen and an application window was determined for that crop based on:

- Chlorpyrifos typical application dates
- PRZM scenario emergence to harvest dates

The amount of variability in application timing for each crop was based on the relative acreage of that crop within the HUC2.

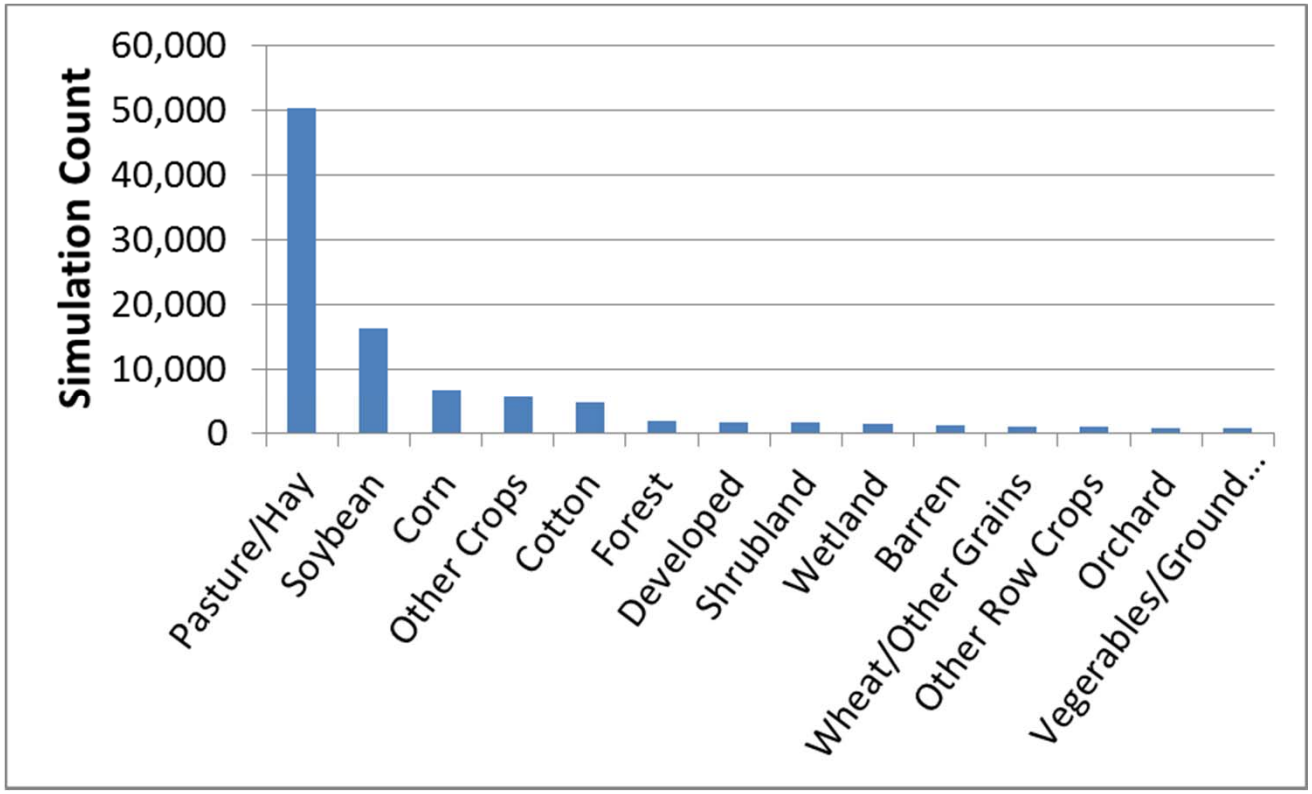
- This constraint was driven by computational efficiency and may be relaxed to allow greater application date variability in future simulations



PRZM5 Simulations of Runoff, Sediment, and Pesticide Time Series

A total of 94,637 PRZM5 simulations were generated for unique combinations of:

- Crop/land use group
- Soil bin
- Weather time series
- Application date



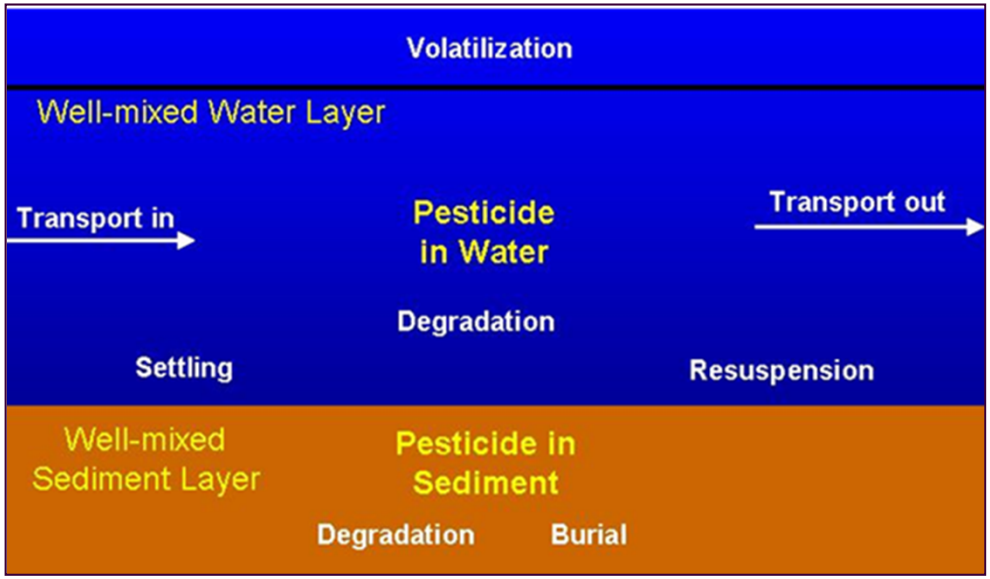
The highest number of simulations was for the pasture/hay crop group, which required 50,220 simulations.

Each PRZM run was assigned an area “weight” and the catchment total daily time series of runoff, sediment, soluble, and sorbed pesticide was determined.

SWAT Model Routing of NHDPlus Catchments

The SWAT model was used to route PRZM-generated runoff, sediment, and pesticide down the NHDPlus flow network.

SWAT accounts for sediment dynamics and pesticide environmental fate processes in the water column and bed sediment.



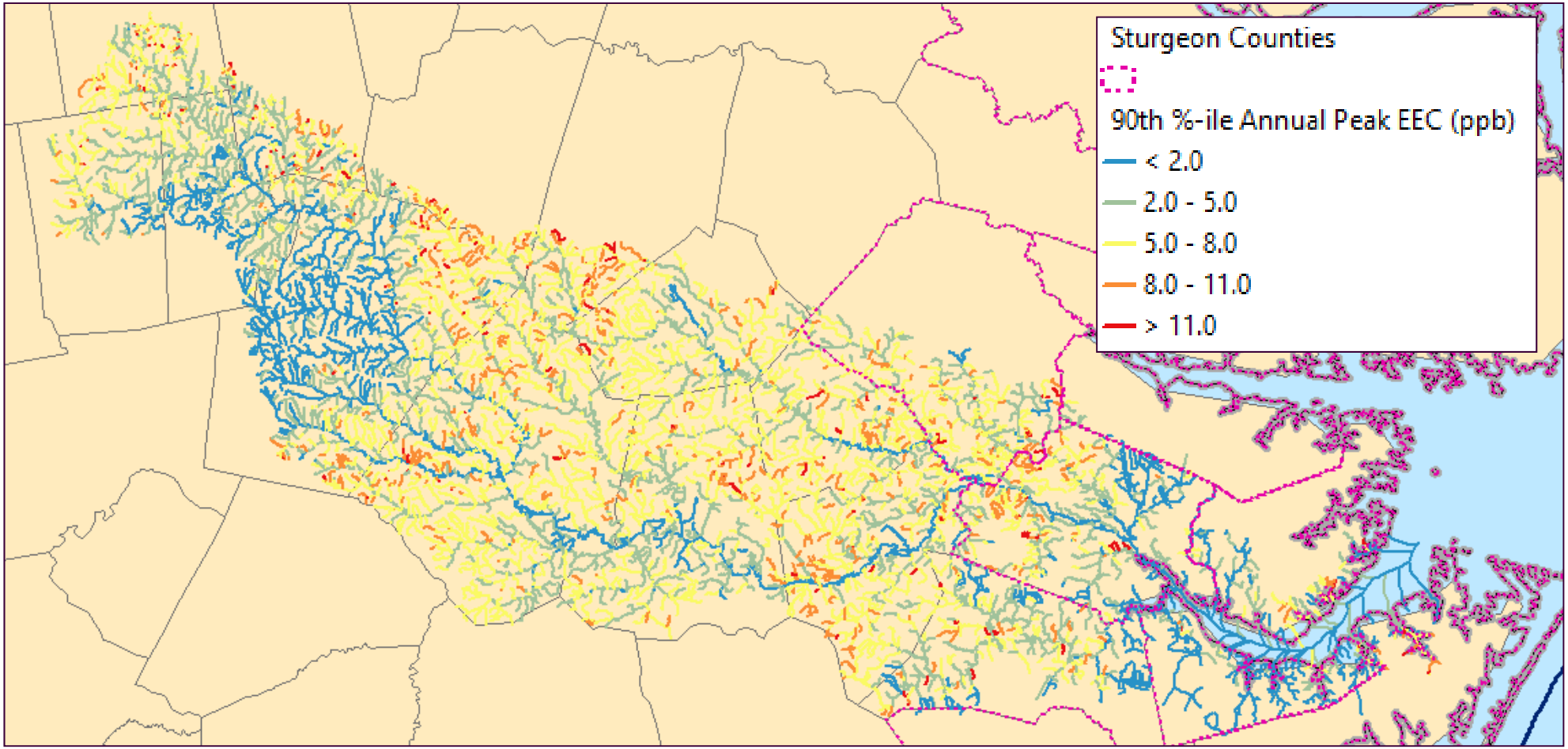
SWAT channel parameters were obtained from NHDPPlus flowline attributes and SWAT default parameters.

- Catchment flow connectivity: NHDPlus attributes
- Channel slope: NHDPlus attributes
- Channel width/depth: SWAT defaults (based on drainage area)
- Baseflow: NHDPlus mean flow attribute and USGS baseflow fraction

Simulation of Spatially Distributed EECs

A single, conservatively parameterized PRZM/SWAT simulation was run to estimate concentrations throughout a large portion of the habitat.

90th percentile (1 in 10-year) annual maximum concentrations were mapped back to NHDPlus flowlines.



Comparison of (Preliminary) Refined EECs with Screening Level: Acute EECs

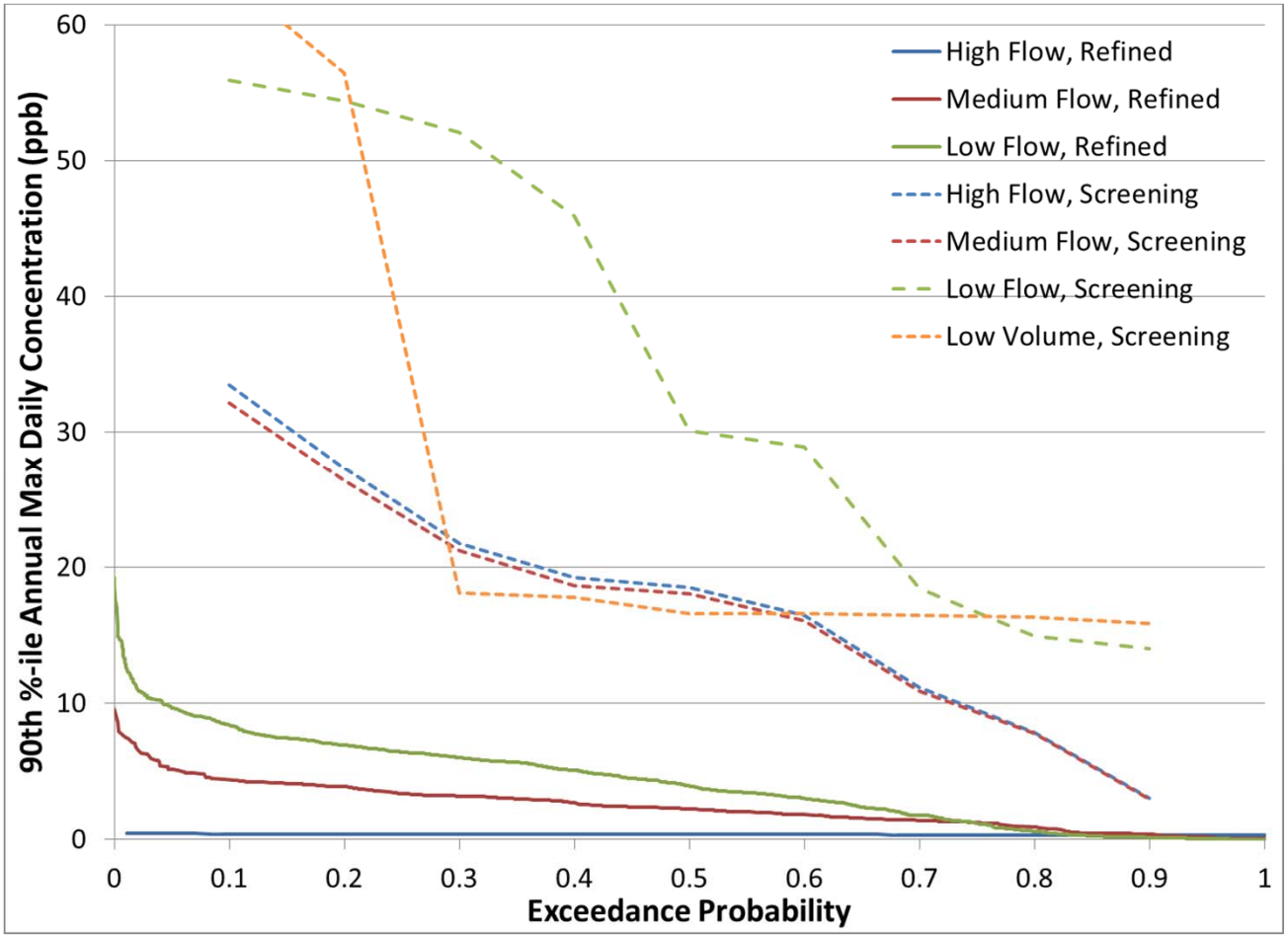
Cumulative distributions for refined EECs based on habitat length – weighting of 90th percentile annual daily maximums.

EEC distributions for screening-level based on 9 SWCC scenarios.

- Medium and high flow scenarios include a PCA of 0.52

Refinement lowered the annual max daily EECs by approximately:

- Low Flow: 85%
- Medium Flow: 86%
- High Flow: 99%

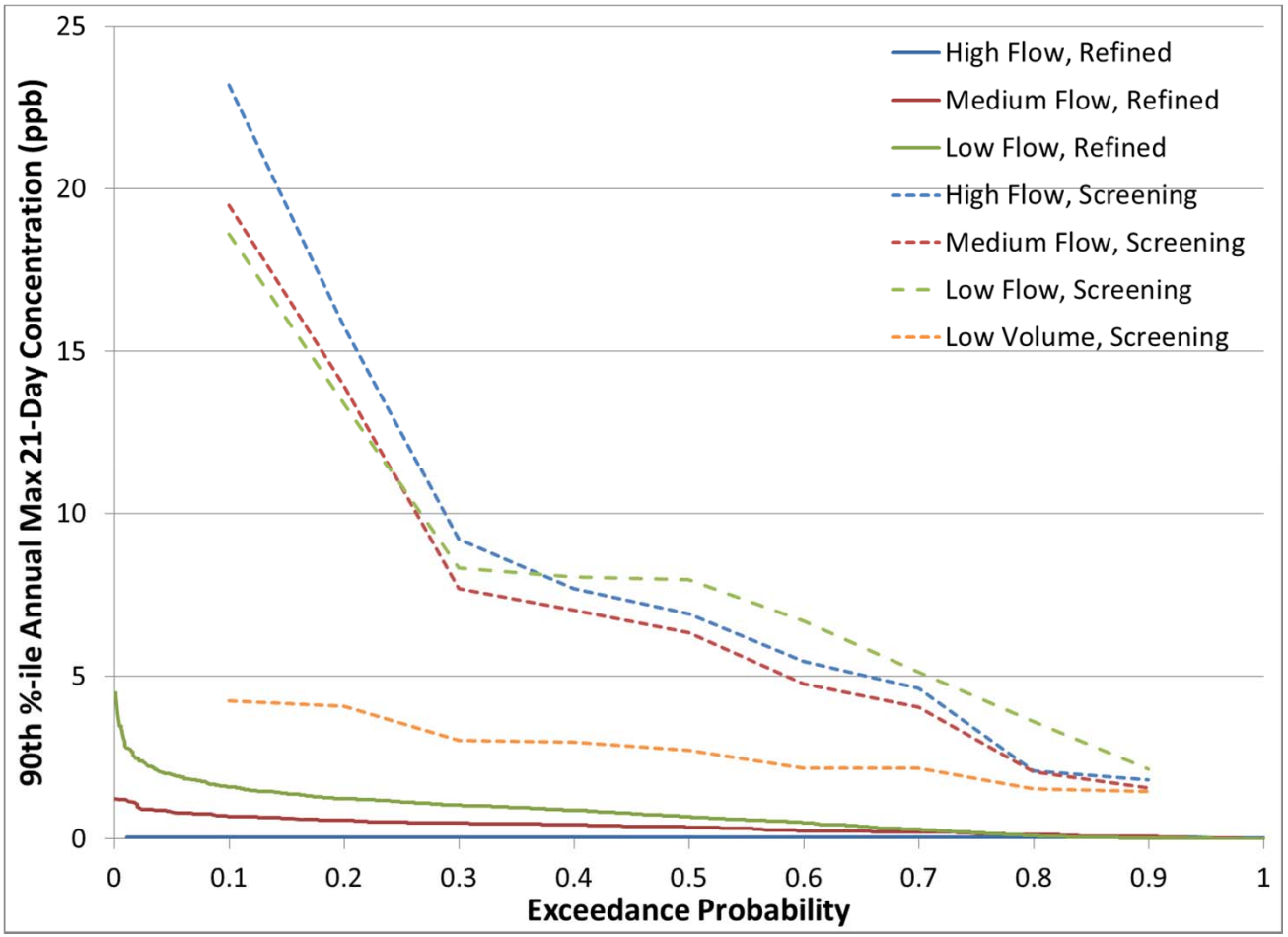


Differences between Screening Level and Refined for Chronic (21-day) EECs were Greater than Acute

Cumulative distributions for refined EECs based on habitat length – weighting of 90th percentile annual daily maximums.

EEC distributions for screening-level based on 9 SWCC scenarios.

- Medium and high flow scenarios include a PCA of 0.52



Next Steps in Development of Refinement Approach

This initial assessment is based on a single conservatively parameterized PRZM/SWAT simulation. Conservative factors include:

- 100% Percent Treated Area
- Likely overestimation of some potential use sites (i.e., pasture/hay)
- Worst case use patterns for entire crop group
- Low variability in application dates for some crops
- Limited spatial rainfall variability from SAMSON network
- No accounting for storm-driven subsurface contributions to channel flow
- Assumed daily duration of peak exposure

The next iteration of this refined analysis will include:

- Revisiting the conservatism in the items listed above
- Taking a probabilistic approach by running an ensemble of simulations
- Completing simulations for sturgeon habitat in the entire HUC2 unit
- A comprehensive consideration of the effects side of the risk assessment

Summary and Conclusions

There is a need for refined exposure modeling tools and approaches to address potential effects to many aquatic endangered species, particular for flowing water habitat.

An initial application of a spatially distributed PRZM/SWAT model at the NHDPlus catchment scale has shown promise in predicting reasonable EECs in the Shortnose sturgeon habitat given conservative inputs.

The high resolution, spatially explicit EECs generated from this approach will provide value at both Step 2 (LAA/NLAA) and if necessary, in population modeling conducted in Step 3.

The modeling approach demonstrated in this case study will see additional development and refinement, and will provide the basis for an effects determination that will be completed in the next phase of the study.

Thank you.

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