U.S. Fish & Wildlife Service

SURROGATE SPECIES VERSION 1.0

EASTERN TALLGRASS PRAIRIE AND BIG RIVERS

Population Objectives Status Report

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S. Blomquist, G. Conover, D. Helmers, R. Drum, L. Mauldin,
N. Chartier, B. Loges, P. Johnsen, A. Kenney, N. Utrup,
R. Russell, C. Ridenour, H. Keuler, C. Rose, D. Becker,
S. Winter, D. Granholm, G. DeAlessio, M. Balogh, M. Mitchell

U.S. Department of the Interior
Fish and Wildlife Service
Midwest Region

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PREPARED BY:

Sean Blomquist, National Wildlife Refuge System, Division of Biological Resources, Oak Harbor, OH
Greg Conover, Fisheries, Large Rivers Coordination Office, Marion, IL
Doug Helmers, National Wildlife Refuge System, Iowa State Private Lands Office, Prairie City, IA
Ryan Drum, Migratory Birds and Science Applications, Bloomington, MN
Louise Mauldin, Fisheries, La Crosse National Fish and Wildlife Conservation Office, La Crosse, WI
Neil Chartier, Migratory Birds, Habitat and Populations Evaluation Team, Fergus Falls, MN
Brian Loges, National Wildlife Refuge System, Division of Biological Resources, Brussels, IL
Peter Johnsen, Fisheries, Carterville National Fish and Wildlife Conservation Office, Carterville, IL
Aleshia Kenney, Ecological Services, Rock Island Field Office, Moline, IL
Nick Utrup, Ecological Services, Twin Cities Field Office, Bloomington, MN
Bob Russell, Migratory Birds, Bloomington, MN
Clayton Ridenour, Fisheries, Columbia National Fish and Wildlife Conservation Office, Columbia, MO
Heidi Keuler, Fisheries, La Crosse National Fish and Wildlife Conservation Office, La Crosse, WI
Connie Rose, National Wildlife Refuge System, Division of Conservation Planning, Bloomington, MN
Drew Becker, Ecological Services, Rock Island Field Office, Moline, IL
Stephen Winter, National Wildlife Refuge System, Upper Mississippi National Wildlife and Fish Refuge, Winona, MN
Dean Granholm, National Wildlife Refuge System, Division of Conservation Planning, Bloomington, MN
Gabriel DeAlessio, National Wildlife Refuge System, Division of Conservation Planning, Bloomington, MN
Mary Balogh, National Wildlife Refuge System, Division of Conservation Planning, Bloomington, MN
Mary Mitchell, National Wildlife Refuge System, Division of Conservation Planning, Bloomington, MN

COVER IMAGE BY:

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EXECUTIVE SUMMARY

We conducted a review of population objectives for all surrogate species in the Eastern Tallgrass Prairie Big Rivers Landscape Conservation Cooperative (ETPBR LCC; Blomquist et al. 2013). Whenever possible, we applied objectives set by existing partnerships, drawing from published planning documents and/or online databases, adjusted to the LCC scale, as needed. We proposed novel objectives when adequate information was available to do so and reviewed information needs for those species where no objectives exist. We gathered, set, and scaled population objectives for 13 of the 22 surrogate species (Table 1) including the original 21 species published in Version 1.0 plus Monarch Butterfly, which was added to the surrogate species list as a flagship species based on guidance from the Director of the Service. Although we haven't officially released a Version 1.1 list, we include Monarch Butterfly here in anticipation of this update. We discuss our approach to reviewing, setting, and scaling population objectives for these 13 species in Appendix 1.

Surrogate species population objective summaries for each species are included in Appendix 2. We summarize known information about each species populations within the ETPBR geography with maps to illustrate the distribution of the species. We describe existing population objectives, along with assumptions entailed in scaling objectives to the LCC scale. We also highlight important areas of uncertainty where more information may be needed, interpret the objectives within the Strategic Habitat Conservation (SHC) cycle, and consider implications for Conservation Design and Outcome-based Monitoring.

Most surrogate species do not have spatially explicit models (SEM). Further progress through the SHC cycle will require development of SEMs because implementation of Conservation Design, the next step in SHC, requires application of these models to the ETPBR geography.

As nine of 22 surrogate species do not have proposed population objectives, the Core Team envisions a phased approach to Conservation Design, applying the best, readily available information while simultaneously developing population objectives and SEMs for the remaining surrogate species. In the first phase, four species that have existing SEMs, Henslow's Sparrow, Pallid Sturgeon, Green-winged Teal, and Mallard, should be assessed for use in Conservation Design within the ETPBR. The second phase consists of implementing the remaining surrogate species with population objectives and SEMs are developed. Finally, species without population objectives will be implemented as objectives and SEMs are developed.

TABLE 1. POPULATION OBJECTIVES AT THE EASTERN TALLGRASS PRAIRIE AND BIG RIVER GEOGRAPHY SCALE FOR 13 SPECIES AND ESTIMATES OF THE TIME REQUIRED FOR THE REMAINING SPECIES.

Spp #	Grp #*	Common Name	*Scientific Name*	Habitat**	Surrogate Approach	Population Estimate	Proposed Population Objective
1	1	Henslow's Sparrow	*Ammodramus henslowii*	Gra	Umbrella	160000 breeding adults	Maintain a stable or increasing population
2	2	Grasshopper Sparrow	*Ammodramus savannarum*	Gra	Umbrella	3,500,000	7,000,000
3	2	Bobolink	*Dolichonyx orizivorus*	Gra	Umbrella	400,000	800,000
4	3	Upland Sandpiper	*Bartramia longicauda*	Gra	Umbrella	63,450	138,408
5	4	Weed Shiner	*Notropis texanus*	Riv	Umbrella	Not available	*Spring 2015*
6	4	Topeka Shiner	*Notropis topeka*	Riv	Umbrella	Not available	*To be determined*
7	4	Blackside Darter	*Percina maculata*	Riv	Umbrella	Not available	*Spring 2015*
8	5	Greater Redhorse	*Moxostoma valenciennesi*	Riv	Umbrella	Not available	Increase the distribution and connectivity between occurrences
9	5, 12	River Redhorse	*Moxostoma carinatum*	Riv	Umbrella, Environmental Indicator	Not available	*Spring 2015*
10	5	Shoal Chub	*Macrhybopsis hyostoma*	Riv	Umbrella	Not available	*To be determined*
11	5	Pallid Sturgeon	*Scaphirhynchus albus*	Riv	Umbrella	Not available	Self-sustaining, genetically diverse population of 10,000 wild adult Pallid Sturgeon with at least 5,000 wild adults within each of the Central Lowland Plains and Interior Highlands management units
12	5	Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	Riv	Umbrella	Not available	Within the Lower Missouri and Middle Mississippi rivers, 680,000 adults (>6 years) with long-term trends indicating regular recruitment, increased size and age structures, and decreased mortality over the next 10 years. In the Mississippi River above Locks and Dam 26, a self-sustaining population that provides for continued

							recreational and commercial harvest and maintains an annual 30-40% spawning potential of the unfished population
13	6, 11	Black Redhorse	*Moxostoma duquesnei*	Riv, Aqu	Umbrella, Environmental Indicator	Not available	*Spring 2015*
14	7	Paddlefish	*Polyodon spathula*	Aqu	Umbrella	Not available	Self-sustaining population that provides for continued recreational and commercial harvest and maintains an annual 30-40% spawning potential of the unfished population
15	8	Green-winged Teal	*Anas crecca*	Pal	Umbrella	487,500	Annually provide a network of seasonally to semipermanently flooded emergent habitats adequate to support 12.5% of the Continental Green-winged Teal population for spring and fall migration periods
16	8	Mallard	*Anas platyrhynchos*	Pal	Umbrella	2,890,000	Annually provide a network of seasonally to semipermanently flooded emergent habitats adequate to support 22% of the Continental Mallard population for spring and fall migration periods
17	8	Pectoral Sandpiper	*Calidris melanotos*	Pal	Umbrella	480,000	528,000
18	9	Marsh Wren	*Cistothorus palustris*	Pal	Umbrella	5,000	7,500
19	9	Virginia Rail	*Rallus limicola*	Pal	Umbrella	Not available	*To be determined*
20	10	Smallmouth Bass	*Micropterus dolomieu*	Riv	Environmental Indicator	Not available	*Spring 2015*
21	12	Pugnose Minnow	*Opsopoeodus emiliae*	Aqu	Environmental Indicator	Not available	Increase the distribution and connectivity between occurrences
22	13	Monarch Butterfly	*Danaus plexippus*	Gra	Flagship	Not available	Increase populations by 10% every three years over the next

	15 years

*Species were selected in groups (or suites) to cover the entire ETPBR geography or key points within the migration cycle. See Blomquist et al. 2013 for more details.

**Gra = Grasslands, Riv = Riverine, Aqu = Aquatic Riverine Backwaters, Pal = Palustine

APPENDIX 1: PROCESSES FOR SCALING AND SETTING SURROGATE SPECIES POPULATION OBJECTIVES IN THE EASTERN TALLGRASS PRAIRIE AND BIG RIVER GEOGRAPHY

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POPULATION OBJECTIVES TEAM AND IMPLEMENATION TEAMS

The Surrogate Species Core Team (Table A1) for the Eastern Tallgrass Prairie and Big River (ETPBR) Landscape Conservation Cooperative (LCC) geography was formed in early July 2014, and the Core Team quickly formed a set of teams, including the Population Objectives Team, to continue to implement surrogate species within the Strategic Habitat Conservation (SHC) framework. Figure A1 shows the relationship of the Population Objectives Team to other Implementation Teams that have been or will be formed to implement SHC for the ETPBR geography.

TABLE A1. CORE TEAM MEMBERS

Team member	Location
Doug Helmers – Team Leader	Iowa State Private Lands Office, Prairie City, IA
Greg Conover - Team Leader	Fisheries, Marion, IL
Sean Blomquist	Ottawa National Wildlife Refuge, Oak Harbor, OH
Gwen White	ETPBR LCC, Bloomington, IN
Timothy Yager	Upper Mississippi National Wildlife and Fish Refuge, Winona, MN
Kraig McPeek	Ecological Services, Rock Island Field Office, Moline, IL
Heather Whitlaw	Ecological Services, Kansas Field Office, Manhattan, KS

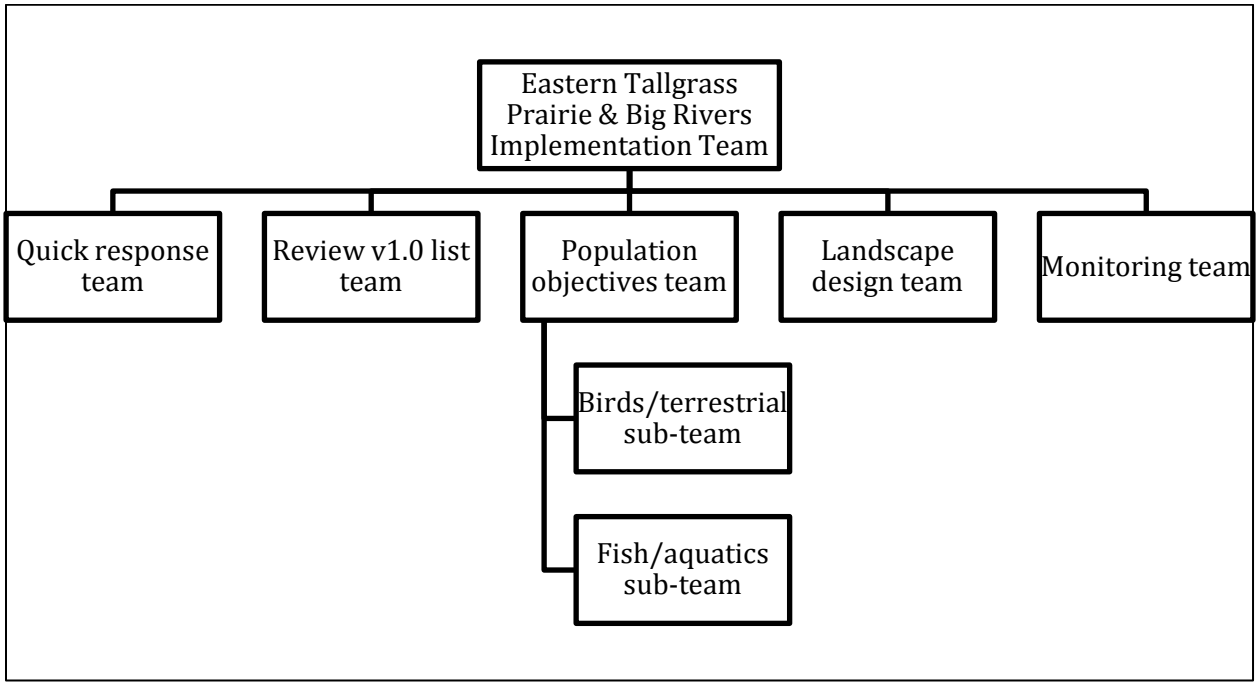


FIGURE A1. ORGANIZATIONAL CHART SHOWING THE RELATIONSHIP OF THE TEAMS RESPONSIBLE FOR IMPLEMENTATION OF SURROGATE SPECIES IN THE EASTERN TALLGRASS PRAIRIE AND BIG RIVER GEOGRAPHY.

POPULATION OBJECTIVES TEAM

The mission of the Population Objectives Team was to develop a process for scaling from large to smaller geographies and vice versa (e.g., range-wide), establish population objectives for the 21 surrogate species on the Version 1.0 list and Monarch Butterfly, provide an assessment of the population objectives, assess available population data and monitoring protocols, and to produce a report on the status of the process by the end of October 2014.

The Population Objectives Team (Table A2) was assembled to include expertise that the Core Team assumed would aid in proposing population objectives. First, taxonomic experts on birds and fishes from the U.S. Fish and Wildlife Service (hereafter, Service) programs were identified. Second, representatives from field stations across the ETPBR geography were identified. Third, Service programmatic representatives were identified. Fourth, personnel with expertise in conservation planning were identified. Given the short timeline and need for intense, focused work, the Core Team chose to include only Service employees, but contacted partners as needed for specific expertise.

As the Version 1.0 list include fish and birds as surrogates for the riverine, aquatic, grassland and palustrine systems, the population objectives team was split into two sub-teams (Figure A1). The Core Team and Conservation Planning staff participated in both sub-teams.

TIMELINE

The Core Team identified five key time points for successfully scaling and setting population objectives for the maximum number of surrogate species as possible between July and October 2014.

- July 9 – Kickoff meeting of Population Objectives Team (online meeting)
- August 20 - Population objectives warboard completed and sub-teams begin work to design processes for setting objectives for remaining species and processes for scaling objectives to ETPBR LCC scale (online meeting)
- September 24 – Sub-teams complete draft objectives for as many missing species as possible and draft processes for scaling objectives (online meeting)
- October 8 – Draft report to Implementation Team and Oversight Team for review
- October 24 – Report to Regional Director and Natural Resources Program Center

TABLE A2. THE POPULATION OBJECTIVES TEAM BY SUB-TEAM.

Team member	Location
	Birds and terrestrial sub-team
Ryan Drum - Coordinator	Migratory Birds and Science Applications, Bloomington, MN
Neil Chartier	Migratory Birds, Habitat and Population Evaluation Team, Fergus Falls, MN
Mike Estey	Migratory Birds, Habitat and Population Evaluation Team, Hartford, KS
Brian Loges	Two Rivers National Wildlife Refuge, Brussels, IL
Doug Helmers	Iowa State Private Lands Office, Prairie City, IA
Bob Russell	Migratory Birds, Bloomington, MN
Brad Strobel	Necedah National Wildlife Refuge, Necedah, WI
Keith Lott	Ecological Services, Columbus Field Office, Columbus, OH
Drew Becker	Ecological Services, Rock Island Field Office, Moline, IL
Stephen Winter	Upper Mississippi National Wildlife and Fish Refuge, Winona, MN
Katie Koch	Migratory Birds, Marquette, MI
Andy Forbes	Migratory Birds, Bloomington, MN
Sean Blomquist	Ottawa National Wildlife Refuge, Oak Harbor, OH
Bob Clevenstine	National Wildlife Refuge System, Rock Island Field Office, Moline, IL
	Fish and aquatics sub-team
Louise Mauldin - Coordinator	La Crosse National Fish and Wildlife Conservation Office, La Crosse, WI
Aleshia Kenney	Ecological Services, Rock Island Field Office, Moline, IL
Heidi Keuler	La Crosse National Fish and Wildlife Conservation Office, La Crosse, WI
Wyatt Doyle	Columbia National Fish and Wildlife Conservation Office, Columbia, MO
Patricia Herman	Columbia National Fish and Wildlife Conservation Office, Columbia, MO
Clayton Ridenour	Columbia National Fish and Wildlife Conservation Office, Columbia, MO
Nick Utrup	Ecological Services, Twin Cities Field Office, Bloomington, MN
Donovan Henry	Carterville National Fish and Wildlife Conservation Office, Carterville, IL
Wayne NelsonStastny	Fisheries, Crofton, NE
Jeromy Applegate	Ecological Services, Columbus Field Office, Columbus, OH
Peter Johnsen	Carterville National Fish and Wildlife Conservation Office, Carterville, IL
Mike Seider	Ashland National Fish and Wildlife Conservation Office, Ashland, WI
Greg Conover	Fisheries, Large Rivers Coordination Office, Marion, IL
Gwen White	ETPBR LCC, Bloomington, IN
Heather Whitlaw	Ecological Services, Kansas Field Office, Manhattan, KS
Kraig McPeek	Ecological Services, Rock Island Field Office, Moline, IL
Sean Blomquist	Ottawa National Wildlife Refuge, Oak Harbor, OH
	Conservation planners
Connie Rose	National Wildlife Refuge System, Bloomington, MN
Dean Granholm	National Wildlife Refuge System, Bloomington, MN
Mary Mitchell	National Wildlife Refuge System, Bloomington, MN
Gabriel DeAlessio	National Wildlife Refuge System, Bloomington, MN
Mary Balogh	National Wildlife Refuge System, Bloomington, MN

INTRODUCTION AND BACKGROUND

Population objectives (i.e., population targets, target goals, levels, desired state, population target levels, and other variations on these themes) span the interface of science and policy. They can be based the current and historical levels of the population or its associated habitat (Groves 2003, Tear et al. 2005, Sanderson et al. 2006) and reflect societal and agency-specific risk tolerances and uncertainty. In the context of SHC, population objectives link actions taken to affect the status of the population to the response of the population in a measurable way and are one measure of success of the Service in meeting its mission (USFWS and USGS 2006, USFWS 2008). In the Conservation Design phase of SHC, they can be used to compare the current state of the population against future scenarios and the ability of the amount and types of habitat on the landscape to support the population. Population objectives can also help decision-makers understand the tradeoffs among ecological and societal objectives within the Service and more broadly.

AVAILABLE POPULATION OBJECTIVES AND POPULATION DATA

The draft Guidance on Selecting Species for Design of Landscape-scale Conservation specified that population objectives for surrogates species should meet the SMART criteria, that is, they are Specific, Measurable, Achievable, Results-oriented, and Time-fixed (or time-specific; Adamick et al. 2004). Population objectives can describe the desired state of the population at a specific scale in a variety of measurable ways including abundance, trends in abundance, vital rates (e.g., survival, mortality), distribution (e.g., occupancy), and demographic variables (e.g., sex ratio).

Ideally, we would use a set of common metrics for population objectives for all surrogate species (e.g., all species have abundance-based objectives). The diverse range of data available for each species and the variety of historical investments in species management made this impossible, currently. For example, Mallards are one of the most studied species of North American wildlife, with an immense amount of information that has been used to develop a suite of models for estimating a variety of demographic parameters. Conversely, little is known of the life history and distribution of the Pugnose Minnow, and there are few estimates of abundance based on statistically robust monitoring data.

For setting population objectives, three different types of data were available depending on the surrogate species. First, distribution data of varying quality were available for all surrogate species Two common sources of this data included Nature Serve Explorer database (http://explorer.natureserve.org/) and Environmental Conservation Online System (https://ecos.fws.gov/). Second, abundance data were restricted to the bird species readily detected by the Breeding Bird Survey (Sauer et al. 2014) and big river fishes through commercial harvests or recovery actions. Finally, vital rate and other demographic data (e.g., survival, mortality, and recruitment) were restricted to commercially harvested species, such as waterfowl, and big river fishes with recovery actions. There was no common source of data for abundance or vital rate information and data exist in a variety of state and federal hosted databases and at field stations (e.g., Pallid Sturgeon Habitat Assessment and Monitoring Program).

IMPLICATIONS OF DATA AND OBJECTIVES FOR EACH SURROGATE APPROACH

The types of surrogate species chosen in Version 1.0 were umbrella species and environmental indicator species (Blomquist et al. 2013), and Monarch Butterfly was added as a flagship species. Flagship species are "chosen for their charisma, to increase public awareness of conservation issues and rally support for the protection of that species' habitat" (Favreau et al. 2006, p. 951 as cited in Caro 2010, p. 245). These species can also be used as umbrellas in some cases. Monarch Butterflies are surrogates for pollinators and may be considered as management umbrella species as well. This decision and more context will be added by the Implementation Team that reviews Version 1.0.

The management umbrella and management indicator approaches are closely tied approaches that both focus on habitat management and are well defined for use within different portions of the SHC cycle. Although the management indicator approach was not specifically mentioned by Blomquist et al. (2013), the use of the umbrella species through the entire SHC cycle, including monitoring, necessitates the use of an indicator approach for monitoring and is a clarification that we make here.

Umbrella species, in general, are useful for planning efforts such as Biological Planning and Conservation Design in SHC. "The umbrella species concept hinges on the assumption that the presence of a certain species in a geographic area indicates that other species will also be present. … Conservation of an umbrella species is believed to protect other species, even if relationships between the umbrella and the community type are poorly established." (Zacharias & Roff 2001, p. 69, as cited in Caro 2010, p. 100). More specifically, a management umbrella species is a "convenient shortcut for managing a reserve or ecosystem such that if the population of one species can be kept viable through safeguards and judicious interventions then it is hoped that population of many sympatric species will maintain positive growth rates" (Caro 2010, p. 100).

A management indicator species is "any species, group of species, or species habitat elements selected to focus management attention for the purpose of resource production, population recovery, maintenance of population viability, or ecosystem diversity" (USFS 1984 as cited in Caro 2010, p. 231). Changes in populations of management indicator species are believed to indicate the effects of management activities on other species and have a long history of use in federal agencies including FWS. Management indicator species can be thought of as a subset of management umbrella species, and these species are useful for planning efforts as well as directing monitoring activities.

An environmental indicator species "represents or summarizes a significant aspect of the state of the environment, natural resource sustainability, and related human activities. They focus on trends in environmental changes, stresses causing them, how the ecosystem and its components are responding to those changes, and societal responses to prevent, reduce, or ameliorate these stresses" (Vandermeulen 1988, p. 63, as cited in Caro 2010, p. 24). We specifically focused our selection of species on fertilizer pollution from agricultural runoff and included both primary effects of nitrogen pollution and secondary effects such as eutrophication.

The biological, spatial, and temporal data available for each species has implications for the metric used for the population objective as well as the inferences that can be drawn from changes in the metric as used to measure the population status relative to the objective. Vagility or home range size, life span, and reproductive rate are three characteristics that are discussed for surrogate species, although the relative importance of these life history characteristics will vary by data, objective type, and surrogate approach. We briefly elaborate on these statements and summarize several cautions and expectations from Caro (2010) about the response of surrogate species.

Distribution data can be expected to show the most rapid response for species with high potential to recover after connectivity is restored or the threat is removed from a local site. Species with a high degree of mobility, dispersal potential, and ability to colonize new areas will show the most rapid response to objectives based on distribution data (e.g., occupancy). Migratory and wide-ranging behaviors have been proposed as desired characteristics of umbrella species because of this potential. However, species with a wide distribution but relatively sedentary movement behavior are better environmental indicators because they will better represent site-specific conditions (e.g., sentinel species).

Abundance data (e.g., number of individuals, trends in abundance) can be to expected show rapid changes for species with shorter life spans and higher reproductive rates. Long generation time and longevity have been proposed as characteristics of umbrella species based on the idea that populations of species that require longer recover times will encompass those with varied response times to amelioration of threats. This assumption is poorly tested (Andelman and Fagan 2000, Seddon and Leech 2008). Potentially, it may be difficult to measure the change in abundance the adult population of a long-lived species by using abundance of adults alone because the adult population can be comprised of "ecological relics" or older individuals that have not reproduced for many years and potentially are too old to reproduce (i.e., have reproductively senesced). Long-lived environmental indicators are desirable in some instances where tracking accumulation of a pollutant over time, but no recommendations are made for the context in which we use environmental indicators.

Vital rate data, such as survival, mortality, and recruitment, are ideal data to describe populations in greater detail than abundance or distribution and can be incorporated in to objectives where available. These types of data are essential for developing population models and estimating population viability, which should serve as the foundation for setting achievable and realistic population objectives that will result in conservation of the species (Groves 2003). Developing effective management strategies also requires identifying the vital rates that will most effectively alter the trajectory of a population. However, identifying key vital rates can be limited by variability across space and time and inadequate demographic data to develop population models free of unrealistic assumptions.

PREVIOUS PROCESSESS FOR SETTING POPULATION OBJECTIVES

A rich history on setting population objectives exists from the fields of conservation biology, wildlife management, and population ecology in the scientific and gray literature (e.g., Groves 2003, Sanderson et al. 2006, Redford et al. 2011, Westwood et al. 2014). The common recommendations for setting population objectives and defining successful species conservation that have emerged from this literature are reviewed below.

Defining success is a key consideration for setting objectives. Success requires consideration of a baseline such as a historical state, a pre-disturbed state (e.g., reference condition), or a theoretical maximum potential (e.g., maximum sustainable yield) (Westwood et al. 2014). Alternatively, success can be defined by the demographic sustainability of the species populations, ability of the species to play the ecological role in the ecosystem, or reliance on human intervention or the allowance for consumptive use (Sanderson et al. 2006). Given the legislative and policy requirements of the Service (e.g., Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act) and the use of species as umbrella and environmental indicators, success in

the SHC context could be minimally defined as keeping the species at adequate abundance to allow the species to play the ecological role in the ecosystem or to allow for consumptive use (Sanderson et al. 2006).

Most components of population objectives come from the perspective of population biology. They should have both a representation component (i.e., how many and where in the geography of interest) and a quality (i.e., viability of the sub-populations or sub-units) component (Groves 2003), and to incorporate the impending predicted changes in climate, the concepts of representation, (genetic, life history, and geographic diversity), resilience (large populations and large habitat patches), and redundancy (multiple populations within geographic units) are important to incorporate as well (i.e., the 3-R framework; Shaffer and Stein 2000). Further, Redford et al. (2011) built upon the 3-R framework and proposed that a species was successfully conserved when it:

(a) is self-sustaining demographically and ecologically,
(b) is genetically robust,
(c) has healthy populations,
(d) has representative populations distributed across the historical range in ecologically representative settings,
(e) has replicate populations within each ecological setting, and
(f) is resilient across the range.

Boor (2014) elaborates on the SMART characteristics with the following proposed characteristics of population objectives:

(a) contain a quantitative threshold with calculable units,
(b) stipulate a timeframe over which they must be met,
(c) explicitly define the spatial extent or population to which they apply,
(d) specify a sampling procedure that includes sample size,
(e) specify a statistical significance level, and
(f) include justification by providing scientific evidence that the criteria define a species whose extinction risk has been reduced to the desired level.

A variety of agencies and organizations have offered guidelines and prescriptive approaches to setting population objectives (e.g., Groves 2003, Petrie et al. 2011), but the challenge with prescriptive approaches is the applicability of the approach to the data available for an individual species or population. Groves (2003) offers the following (paraphrased to be consistent with the terminology used in this document) guiding principles that are applicable in most situations.

(1) Use recommendations from recovery plans and similar documents.
(2) Use the results of population viability analyses.
(3) Account for the rangewide distribution of the species of interest.
(4) Stratify the ecoregion or planning region into subunits.
(5) Pay special attention to wide-ranging species.
(6) Use history as a guide to the past and future.
(7) Examine alternative objectives.
(8) Observe the precautionary principle.

A review scientific and gray literature sources (citations available upon request) resulted in three common conclusions about previous efforts to scale population objectives. First, we failed to identify a common set of recommendations for scaling objectives. Depending on the species, standardized processes for scaling objectives are non-existent or rare (e.g., the same methods were

used shorebirds and landbirds). The efforts that did scale objectives to different spatial scales often occurred when the effort was part of a regional or continental scale initiative. Second, the scaling process for objectives is often species-specific and dependent on the models used and the objectives of the group setting the population objectives. Third, it is common to find population estimates or population objectives that were derived from a combination of occurrence data, habitat preference, and expert opinion. These are difficult, if not impossible, to recreate or rescale. However, because of the long history of work, the plans for birds based on the Breeding Bird Survey (started in 1966; Sauer et al. 2014) and the North American Waterfowl Management Plan (started in 1986; NAWMP 2012), respectively, are more advanced than for waterbirds, marsh birds, and fish.

The guidance from this rich history helped establish consistency for the Population Objective Team while accommodating the diverse data available for surrogate species in the ETPBR geography. These recommendations are benchmarks to work towards as the Team implements SHC. However, in the end population objectives are value-based decisions, established by conservation partnerships wherever possible, and intended to be a cost-benefit-risk-balanced vision for the future.

SETTING POPULATION OBJECTIVES

Assessing the current state of the surrogate species populations and setting population objectives will inform Conservation Design, the next phase in implementing SHC for ETPBR surrogate species (Figure A2). The goal of the Population Objectives Team was to (1) set population objectives at the scale of the ETPBR geography when it was possible with existing data, (2) consolidate relevant information on each surrogate species, and (3) assess the feasibility of developing population objectives for species without existing objectives or methods for assessing population status within our limited timeframe for those species without population objectives. Additionally, The Team documented the results and described the science needs that would allow us to develop population objectives for the species without them.

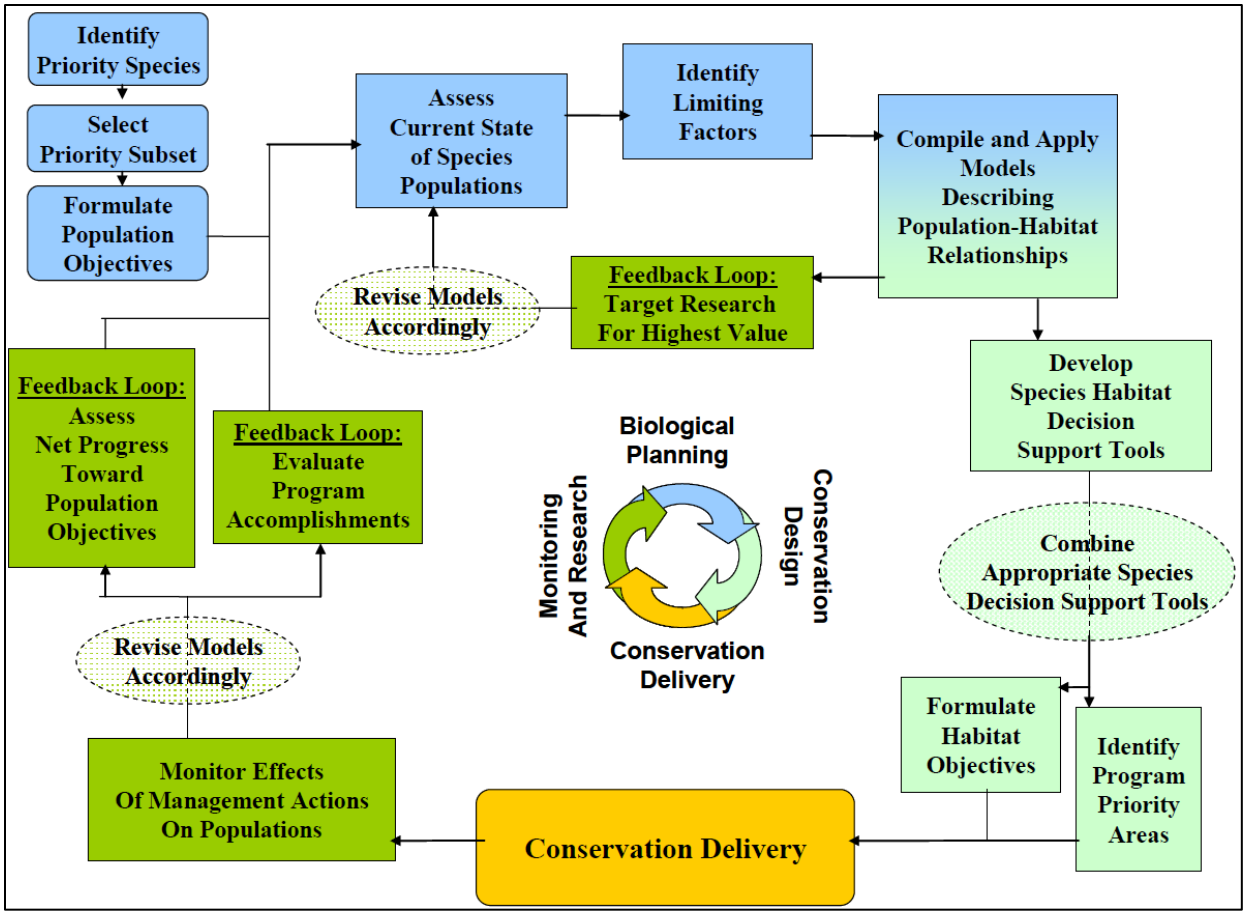


FIGURE A2. STRATEGIC HABITAT CONSERVATION FRAMEWORK FROM STRATEGIC HABITAT CONSERVATION: FINAL REPORT OF THE NATIONAL ECOLOGICAL ASSESSMENT TEAM (USFWS AND USGS 2006)

GATHERING EXISTING INFORMATION AND OBJECTIVES

The Population Objectives Teams used a "warboard" (on a shared Google Sheet) to house the information needs for setting population objectives for each species. The following questions were used to guide information gathering for those for species that had existing population objectives and those that did not have existing objectives.

1. Do population objectives exist for this species?
    a. If NO POPULATION OBJECTIVES EXIST, please skip the remaining questions in this section and answer the questions below.
    If YES…
    b. What is the objective?
    c. What is the geographic scale and location of objectives? Are the objectives within the ETPBR LCC boundary? Do population objectives exist for the entire species range? For the LCC? Have focal areas within the range of the species been identified?
    d. Who set the objectives and what are the relevant citations for the objectives?
    e. What assumptions were made to arrive at the population objective?
    f. What is your level of confidence in the population objective?
    g. How was the population objective spatially modeled? Was it modeled based on some data set(s), landscape features, expert opinion? Please list the specific data sets used (i.e., NLCD, NHI) or the specific landscape features. What statistical analyses were applied?
    h. What do you consider to be the strong points of the study design?
    i. What do you consider to be the weak points of the study design?
2. What is the current population status?
3. Do population model(s) exist for this species? If YES…
    a. Which one is the most used?
    b. What is the geographic scale and location of model?
    c. Who developed the models and what are the relevant citations for the models?
4. Is a habitat objective for the species? If YES…
    a. Who set the habitat objective?
    b. What are the relevant citations?
    c. What assumptions were made to arrive at the habitat objective?
    d. What is your level of confidence in the habitat objective?
    e. How was the habitat objective spatially modeled? Was it modeled based on some data set(s), landscape features, expert opinion? Please list the specific data sets used (i.e., NLCD, NHI) or the specific landscape features. What statistical analyses were applied?
    f. What do you consider to be the strong points of the study design?
    g. What do you consider to be the weak points of the study design?
5. Is a habitat model available for the species? If YES…
    a. Are the models used that exist?
    b. Where was the model developed? Was the model developed within the LCC boundary?
    c. What are the relevant citations?

6. Who are possible species expert(s) for review of population objectives? What is their contact information?
7. List existing partnership(s) (e.g., planning or technical teams) that are appropriate for establishing population objectives for this species.
8. What do we **not** know about this species? What do you wish you know about this species? (i.e., if you had a large pot of money available for the species how would you spend it?)
9. Other comments or notes
10. Do you agree with the potential population target level specified for this species? These were derived from Sanderson (2006) which is available on the Team's Basecamp and Google Drive.

If no population objectives exist, please answer the following questions:

2. Do population estimates exist? If YES…
    a. What is the current population status?
    b. What's the geographic scale of these estimates and where do they occur?
    c. How were the estimates generated?
    d. What are the relevant citations?
3. Is there a population model(s) for this species? If YES…
    a. Is it currently in use or which one is the most used?
    b. What is the geographic scale and location of model?
    c. Who developed the model and what are the relevant citations for the model?
4. Is a habitat objective for the species? If YES…
    a. Who set the objective?
    b. What are the relevant citations?
    c. What assumptions were made to arrive at the habitat objective?
    d. What is your level of confidence in the habitat objective?
    e. How was the habitat objective spatially modeled? Was it modeled based on some data set(s), landscape features, expert opinion? Please list the specific data sets used (i.e., NLCD, NHI) or the specific landscape features. What statistical analyses were applied?
    f. What do you consider to be the strong points of the study design?
    g. What do you consider to be the weak points of the study design?
5. Is there a habitat model for the species? If YES…
    a. Are the models used that exist?
    b. Where was the model developed? Was the model developed within the LCC boundary?
    c. What are the relevant citations?
6. What are the metrics that are currently monitored for this species (e.g., occupancy, abundance, density, catch per unit effort, etc)? Does monitoring occur throughout the entire geographic range of the species in the LCC boundary? (if not, what part?)
7. List any known sub-population structure or list any focal areas that have been identified for this species that are relevant to setting population objectives.
8. Who is a possible species expert for review of population objectives? What is their contact information?

9. List existing partnership(s) (e.g., planning or technical teams) that are appropriate for establishing population objectives for this species.
10. What do we **not** know about this species? What do you wish you know about this species? (i.e., if you had a large pot of money available for the species how would you spend it?)
11. Other comments or notes
12. Do you agree with the potential population target level specified for this species?

APPROACHES TO SCALING POPULATION OBJECTIVES

TERRESTRIAL

The process of setting terrestrial objectives for the bird species varied based on guild of bird. These are summarized below.

LANDBIRD POPULATION OBJECTIVES

Unless there was a species-specific plan (e.g., Henslow's Sparrow, Copper 2007), landbird surrogate species population objectives were based on methods used by Partners in Flight (PIF; Rich et al. 2004). PIF's objective is to "sustain healthy, genetically diverse populations of birds, well distributed across their historical ranges." PIF uses knowledge of population size and trends and historic baselines, as estimated using Breeding Bird Survey (BBS) data (Sauer et al 2014), to which present-day populations can be compared to set Continental-scale population objectives. Depending on these factors, PIF population objectives are to maintain current populations or to return declining populations at least to their numbers in the late 1960s (a date selected because PIF believes that target is achievable and realistic for most species and because prior to the start of the Breeding Bird Survey in 1966, there were no consistent data for most landbird species).

As PIF landbird population estimates are available for the North American Bird Conservation Initiative Eastern Tallgrass Prairie Bird Conservation Region (BCR 22; NABCI 2000), which effectively encompasses the ETPBR LCC boundary. We evaluated BBS ETPBR population trend data to determine whether Continental-scale objectives were appropriate or whether different population objectives were warranted at the LCC scale (Rich et al. 2004, Sauer et al. 2014). If BCR-scale population objectives were warranted, we used PIF methods to propose population objectives at the LCC scale. For Henslow's Sparrow, we accepted Cooper's (2012) population objective.

SHOREBIRD POPULATION OBJECTIVES

The vision of the U.S. Shorebird Conservation Plan (Brown et al. 2000) is to "ensure that stable and self-sustaining shorebird populations are distributed throughout their range and habitats, and that species which have declined in distribution or abundance be restored to their former status to the extent possible at costs acceptable to society." This is a difficult task, because for most shorebird species, it is impossible to establish statistically robust population objectives that meet these goals due to a lack of information about current and past population sizes, conservation risks, and factors limiting populations.

However, while information is lacking, there is a clear need for conservation action. Thus, Brown et al. (2000) used the best available information to establish population objectives based on the

estimated population size and the current estimate of the status of the species as having experienced recent population declines or not.

WATERBIRD POPULATION OBJECTIVES

No objectives are provided for Virginia Rail due to the paucity of data to inform population estimates and thus, develop population objectives. However, this species, and the waterbird guild in general, may be an important surrogate species because they demonstrate the need for a coordinated multi-state monitoring program to inform population estimates for a species that is not adequately surveyed by the BBS (Conway 2009). In pursuing better monitoring data for Virginia Rail, we could simultaneously acquire better data for a broad array of other "secretive" marshbirds that would allow us to develop more precise population and population trend estimates.

WATERFOWL POPULATION OBJECTIVES

We used waterfowl population objectives established by the Upper Mississippi Great Lakes Region Joint Venture (UMRGL JV; Soulliere et al. 2007). These objectives were derived by estimating the proportion of the continental harvest in the UMRGL JV and Continental population estimates.

AQUATIC

Riverine systems are inherently nested and interconnected across spatial scales (e.g., the river continuum concept, Vannote et al. 1980; hydrologic units, Seaber, et al. 1987). Many aquatic species have a spotty distribution throughout the ETPBR geography and are found as separate occurrences in river or stream reaches, reservoirs, and backwater sloughs and swamps. Such known or historic occurrences may or may not be clustered within a watershed. On a larger scale, adjacent occupied watersheds makes a cluster of occupied watersheds isolated from other occupied watersheds. Such a group of adjacent occupied watersheds may again be isolated from other such groups. Further, at the state or ETPBR scale, nearby groups of adjacent occupied watersheds may form a group isolated from other such groups. Thus, on an increasingly larger spatial scale, we find aquatic species in stream reaches, sub-watersheds, larger watersheds, and finally on the ETPBR scale.

On an increasing biological scale, we could divide the geographic distribution of all aquatic species into local presence, sub-population, population, meta-population, and finally species distribution within the ETPBR geography. Objectives at lower scales cascade upwards. In other words, the objective at a larger scale is predicated upon all objectives at the lower scale being met. All of these scales may not be necessary for all species depending on the species dispersal ability and homogeneity of the species distribution across the ETPBR geography. These scales are described in more detail in the boxes below using maps illustrating the distribution of Pugnose Minnow as an example.

The descriptions in the boxes below rest on two key concepts, occupancy and connectivity. Occupancy is simply, a site where an aquatic species is present. At the stream reach level, it is the fine grained resolution of actual sampling sites or points along a stream. An occupied stream reach is the length of a stream channel where biological surveys sampled the species historically or recently. It may be extended upstream or downstream of sampling locations if suitable habitat has been measured and confirmed to continue beyond the endpoints of sampling locations. A watershed is occupied if the across the whole watershed, one or more stream reaches are occupied. To meet this definition, consider the entire watershed where the species has been sampled recently

or historically and any stream reaches that are believed to have been connected historically or are believed to be currently connected. A population includes the combined watersheds where occupancy has been observed and that are believed to be connected on a regular basis (i.e., many individuals per generation). Meta-population occupancy encompasses a group of connected populations. The extent of a meta-population is the delineated area of all encompassed populations.

Connectivity is the presence of current or historic hydrological and habitat connectivity that would support migration of individuals at each scale. Connectivity can be continuously or intermittent in time. The time scale increases with increasing population scale (e.g., between stream reaches connectivity would be considered within a time frame of a year while between meta-populations the longer time frame of a decade should be considered). Connectivity is a measure of population viability through 1) exchange of genetic material and 2) likelihood for maintaining the population through recolonization of extirpated sites. Generally, key considerations for assessing connectivity include: man-made barriers, natural barriers including fast flowing riffles or cascades, critical flow, distance (<10km for watersheds and populations, Nature Serve), and presence of habitat docking patches, i.e., suitable habitat refuge, during movement. Considerations specific to each scale are described below.

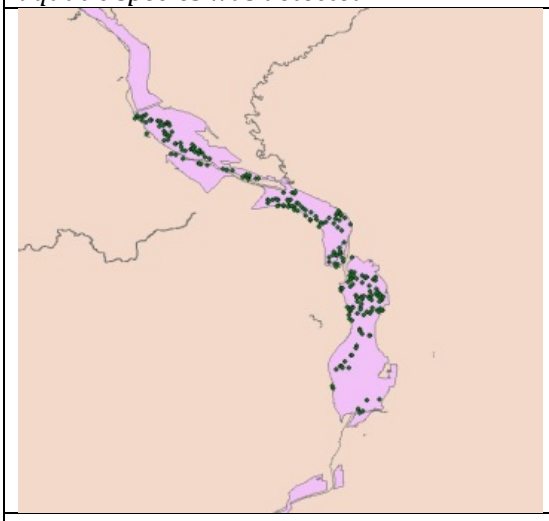
- At the watershed scale, key considerations for assessing connectivity include:
    - No barriers, less than 10 km of unoccupied channel between occupied reaches, and suitable habitat exists between reaches.
    - Movement of fish between occupied stream reaches is not physically impaired year round in all but the most extreme years, it is likely that the species is present in all or large parts of the non-surveyed stream channels between reaches and/or that individuals move between occupied stream reaches on a regular basis.
    - A detailed evaluation of habitat availability should be conducted for stream channels of 10km or more where surveys has been conducted but been unable to find the species.
- At the population scale, key considerations for assessing connectivity include:
    - No barriers or barriers are passable during all but extreme conditions, less than 10 km of unoccupied stream channel between tributary mouths, and suitable habitat exists between watersheds or reaches.
    - Watersheds are annually connected though loss of connection may occur 25% of years but never more than two years in a row
    - Regular exchange of individuals and interbreeding between watersheds when they are connected and exchange of individuals is high enough for multiple watersheds to be considered one interbreeding population.
- At the meta-population scale, key considerations for assessing connectivity include:
    - Barriers are passable at time periods of years to decades, suitable habitat may exist in non-occupied stream channels between populations, and distance less than 50 km.
    - Populations are connected annually or intermittently at least during a 10 year period and regular exchange of individuals between populations may occur at high enough levels to avoid genetic drift, although the numbers being exchanged are low or consists of strays. Exchange may occur as result of higher than normal flow events (i.e., flushing) or occur in one direction (e.g., only downstream).
- Finally, at the LCC scale, key considerations for assessing connectivity include:

- Directly connected through a stream channel, potential for extreme floods to swipe fish downstream from an occupied stream reach in one meta-population to an occupied stream reach of another meta-population.
- Connectivity between meta-populations should not be used as an objective. However, it may be beneficial to identify meta-populations that could be connected sporadically by for instance, high flows that bring fish downstream, potential drift of fry, or rare migration by adult fish.

The development of population objectives for aquatic species uses the above described scaling in setting achievable objectives at different biological and geographic scales. This approach is beneficial because this enables us to measure our success in achieving population objectives that reflects management objectives on different scales. Because abundance estimates do not seem to be available for many streams or populations for most non-game and unlisted species (e.g., Pugnose Minnow, Blackside Darter) and information about species biology is limited in most cases, the objectives can be set as presence and as qualitative objectives. To set scalable population objectives, determine historic situation, determine current situation, and then formulate quantitative objectives.

BOX 1: REACH SCALE

The reach scale is a discrete length of stream channel with a more or less known continuous current or historic occupancy, usually the length of a stream channel where surveys have been conducted and aquatic species sampled. It is the fine grained resolution of continuous sampling sites or points along a stream; the length of a reach is the upper most downstream to the lowest most sampling site where an aquatic species was detected.



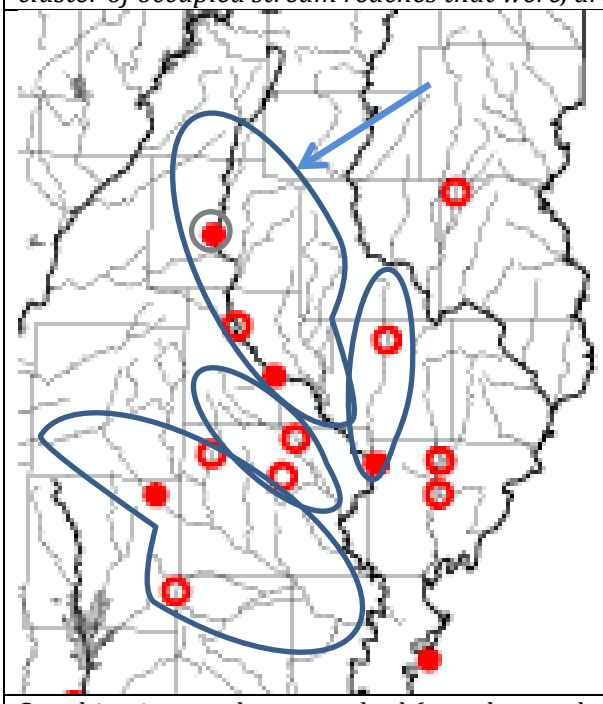
Set objectives at the reach using the following process.

1. Determine the length of the stream channel with historic and current occupancy
2. Rank estimated historic conditions of aquatic species as poor, mediocre, or good. If not possible just rank as presence.
3. Rank estimated current conditions of aquatic species as poor, mediocre, or good. If not possible just rank as presence.
4. Determine aquatic species occupancy condition objective based on sub-objectives set as:
    a. length of stream-reach with occupancy

b. as proportion of samples with the aquatic species c. as average number of the aquatic species collected in samples d. as presence of multiple size classes e. as abundance (e.g., fish per 100-meter stream channel)

BOX 2: WATERSHED OR SUB-POPULATION SCALE

The watershed scale is the watershed that has or had occupied <u>stream reaches</u> that likely were or are continuously connected for migration and exchange of individuals on a seasonal basis. Watershed can be defined at any HUC level and is determined based on density of occupied stream reaches, i.e., a cluster of occupied stream reaches that were, are or could be continuously connected.

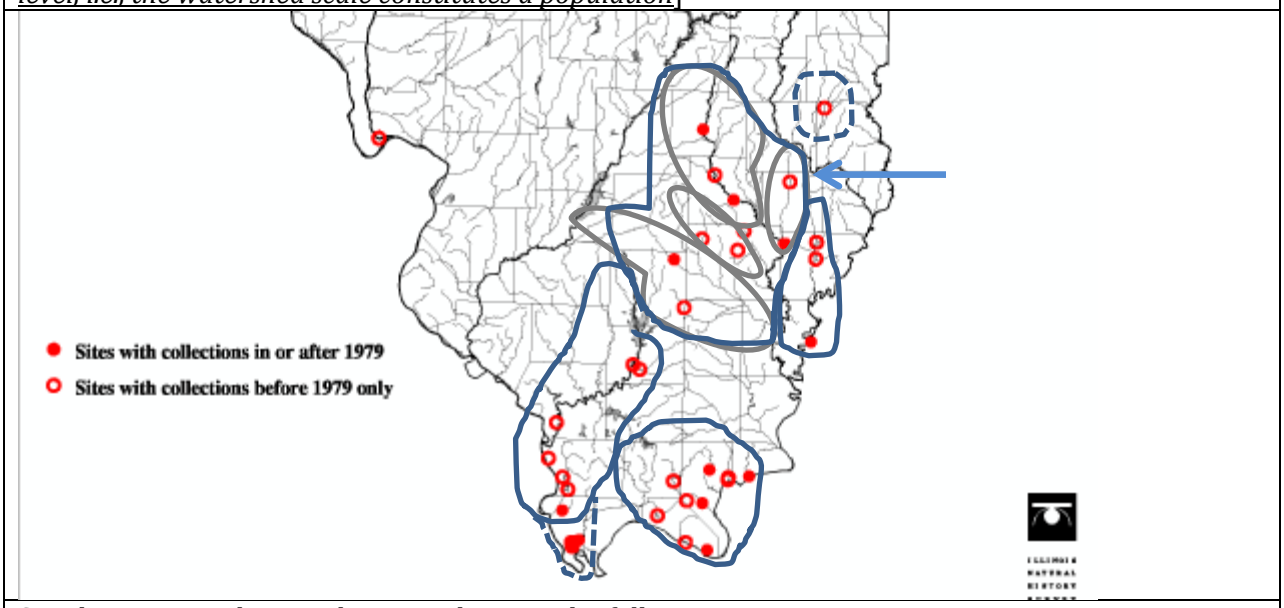


Set objectives at the watershed (or sub-population) scale using the following process:

1. Determine number of occupied stream reaches of different ranks
2. Determine historic short-term connectivity of occupied stream reaches
3. Determine current short-term connectivity of occupied stream reaches
4. Based on 2 through 4, determine watershed scale, i.e., HUC level, that is occupied
5. Set viability objective and sub-objectives as:
    a. meeting all objectives for stream reaches within the watershed
    b. level of connectivity between all reaches
    c. abundance as the sum of abundances in local level objectives

BOX 3: POPULATION SCALE

The population scale is a group of occupied watersheds or stream segments which it is reasonable to believe are or were connected by migration (at least intermittently) on a short-term (annual –every few years) basis. The aquatic species within the watersheds are considered part of the same, discrete interbreeding population. [*Note that the population scale may be equal to the watershed level, i.e., the watershed scale constitutes a population*]

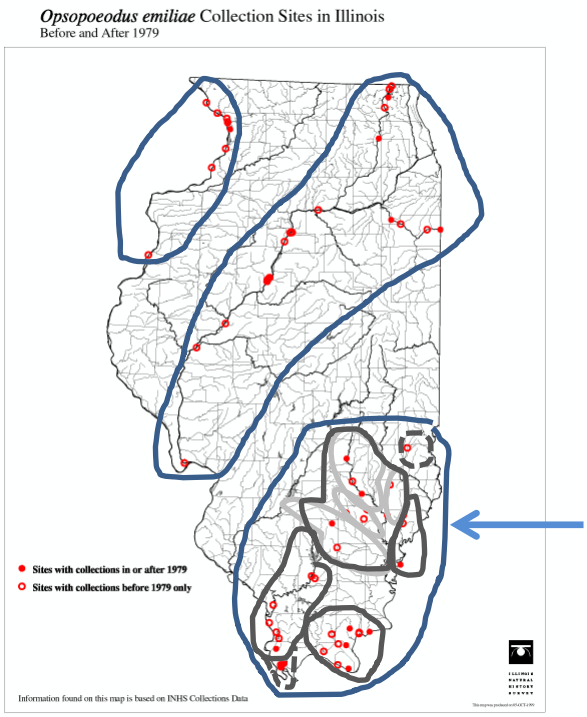


Set objectives at the population scale using the following process:

1. Determine clusters of watersheds that are/were occupied
2. Determine historic connectivity of occupied watersheds
3. Determine current connectivity of occupied watersheds
4. Determine if it provided for independent of dependent population status
5. Set population status objectives and sub-objectives as:
    a. all watersheds where the sub-population(s) meet their objectives
    b. short-term connectivity between watersheds
    c. abundance as sum of abundance objectives at watershed objectives

BOX 4: META-POPULATION SCALE

The meta-population scale is made up of the populations with a migration rate high enough to avoid genetic drift of populations, maintain dependent populations, and re-colonizing extirpated small populations.

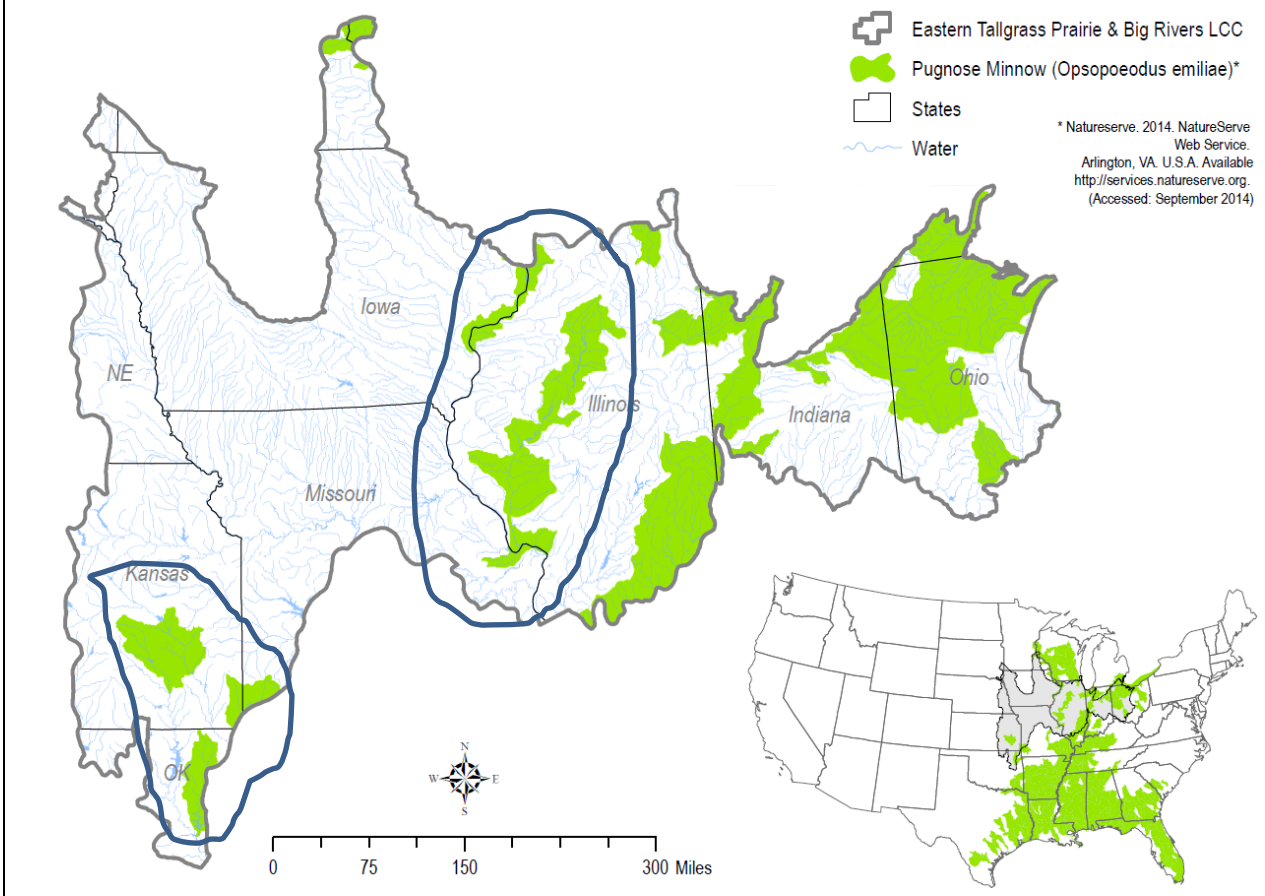


Set objectives at the meta-population scale using the following process:

1. Determine clusters of historic and current populations
2. Determine what populations were likely to exchange individuals on a regular or intermittent basis
3. Determine what populations are likely to exchange individuals on a regular or intermittent basis
4. Use 1 through 3 to determine and delineate the populations that constitute the meta-population
5. Set persistence objective and sub-objectives as:
    a. all populations meet their objectives
    b. connectivity between populations (number of connections, status of connections)
    c. abundance as the sum of abundance objectives on the population scale

BOX 5: LCC SCALE

The LCC scale is the total number of aquatic species meta-populations within the ETPBR



Set objectives at the LCC scale based on the following:

1. Determine the number of meta-populations within the LCC geography
2. Determine the potential for infrequent genetic exchange among meta-populations
3. Set persistence objective and sub-objectives as:
    a. all meta-populations meet their objectives
    b. connectivity on a long-term (many generations) scale between meta-populations
    c. abundance as the sum of abundances set in objectives at the meta-population level

POPULATION OBJECTIVES AND SUMMARIES

We were able to propose population objectives for 13 of 22 surrogate species (Table 1). (Reminder: although Monarch Butterfly was not included on the Version 1.0 list [Blomquist et al. 2013], we include as a flagship species based on guidance from the Service Director.) In the summaries presented in Appendix 2, members of the Population Objectives Team that led the data collection effort for each surrogate species summarize the responses to the "warboard questions" in narrative form. In addition to proposing a population objective when possible, we briefly summarize the

species' range, habitat needs, conservation threats, population status, the process used to develop the population objective (if applicable), and we highlight data needs for further developing population estimates and objectives to be used in Conservation Design, the next step in the SHC cycle. These summaries are intended to introduce the various surrogate species to a broader audience, in general, highlight patterns and gaps in how we deal with population estimates and objectives through the rest of the SHC cycle, and cite the most pertinent references.

RECOMMENDATIONS AND NEXT STEPS

FROM POPULATION OBJECTIVES TO CONSERVATION DESIGN

"Conservation Design is predicated on the belief that the potential to affect populations varies in space in response to site characteristics and landscape context" and the application of empirical or experience-based SEMs predicting patterns in the ecosystem is the outstanding feature of this phase of SHC (USFWS 2008, p. 18). Further progress through the SHC cycle will require "that we understand the relationship between populations and limiting factors" … and the application of SEMs "to target specific management treatments that can remediate the limiting factor" (USFWS 2008, p. 9). Spatially explicit models will help us to understand the current status of each species' population in the ETPBR geography and explore future scenario(s) for meeting the proposed and alternative population objectives (Groves 2003).

Spatially explicit models are the missing component for most surrogate species with proposed population objectives to continue to implement SHC. The "model predictions must be expressed in the same terms as population objectives to (1) estimate the amount of habitat management necessary to attain population objectives; and (2) facilitate estimates of project, program or agency accomplishments and net progress toward population objectives" (USFWS 2008, p. 18). For all of the surrogate species that have population objectives as well as population models or habitat models, we must assess if existing models make these predictions. As we transition to Conservation Design, SEMs must be developed within the ETPBR geography.

The Core Team has envisioned a phased approach to Conservation Design that will evolve as population objectives are developed for the remaining surrogate species (Figure A3). Although Figure 3 presents the transition to the rest of SHC in a linear fashion, simultaneous efforts should be made to address the research and monitoring needs that are discussed in the species summaries to improve our ability to implement Conservation Design. Based on a thorough review of information available for all 22 surrogate species, the Population Objectives Team proposes that the following species have existing population models and/or habitat models and should be assessed for use in Conservation Design:

- Top priorities:
    - Henslow's Sparrow: a SEM has previously been developed using BBS data in other regions (e.g., Thogmartin et al. 2006).
    - Pallid Sturgeon: the Habitat Assessment and Monitoring Program (HAMP) is a critical element of the Pallid Sturgeon Recovery Program and is designed to document and assess the physical and biotic responses to management.
    - Green-winged Teal: the duck-energy–day approach allows for a prediction of carrying capacity for migrating populations.
    - Mallard: the duck-energy–day approach allows for a prediction of carrying capacity for migrating populations.
- Species that deserve immediate consideration after population objectives are set:
    - Weed Shiner: only one spatial model is available for the Weed Shiner in the ETPBR geography. Very little information is known about the current population status

within each of the states, and additional work will be necessary in order to apply this model across the ETPBR geography.

- Blackside Darter: there are a few spatial models and one habitat model available for the Blackside Darter in the ETPBR geography. Additional work will be necessary in order to apply these models across the ETPBR geography and very little information is known about the current population status within each of the states.
- Black Redhorse and Smallmouth Bass: Downstream Strategies (2012a; 2012b) used cross-validation to assess models developed for the Midwestern Fish Habitat Partnerships, but the validation method for these models requires further evaluation before implementing them across the ETPBR geography.

INITIAL CONSIDERATIONS FOR OUTCOME-BASED MONITORING

The purposes of outcome-based monitoring in the context of SHC are to assess (a) the effects of a particular type of management action on habitat and individuals, (b) programmatic and agency accomplishments in terms of population impacts, and (c) progress toward population objectives (USFWS 2008, p. 25). Existing monitoring programs for the ETPBR surrogate species, where available, have not been designed to meet these three goals and will need modification or supplementation for most species (Appendix 2).

For example, BBS (Sauer et al. 2014) is the best monitoring program available for most of the landbird species but does not adequately capture marshbirds or waterfowl during migration. Guild-specific national protocols have been developed but are still in the process of being implemented at a scale large enough to encompass the ETPBR geography consistently. Similarly, much of the fish data comes from state programs, is not collected using a standard protocol, and is not managed in a centralized database.

In addition to assessing if existing monitoring programs meet the three purposes of outcome-based monitoring in SHC, developing and consistently implementing standard protocols and data management for fish and marshbirds will likely be the greatest challenges going forward. This modification and development of ETPBR-wide monitoring for all 22 surrogate species will require substantial investment by the Service and its partners to adequately meet these monitoring needs.

Grp #	Common Name	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15
1	Henslow's Sparrow	p	s	s	s	s	s	s	l	l	l	l	l	m	m	m
2	Grasshopper Sparrow	p	s	s	s	s	s	s	l	l	l	l	l	m	m	m
2	Bobolink	p	s	s	s	s	s	s	l	l	l	l	l	m	m	m
3	Upland Sandpiper	p	s	s	s	s	s	s	l	l	l	l	l	m	m	m
4	Weed Shiner	p	p	p	p	p	p	p	s	s	s	s	s	l	l	l
4	Topeka Shiner	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p
4	Blackside Darter	p	p	p	p	p	p	p	s	s	s	s	s	l	l	l
5	Greater redhorse	p	p	p	p	p	p	p	s	s	s	s	s	l	l	l
5, 12	River redhorse	p	p	p	p	p	p	p	s	s	s	s	s	l	l	l
5	Shoal chub	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p
5	Pallid Sturgeon	p	s	s	s	s	s	s	l	l	l	l	l	m	m	m
5	Shovelnose Sturgeon	p	s	s	s	s	s	s	l	l	l	l	l	m	m	m
6, 11	Black Redhorse	p	p	p	p	p	p	p	s	s	s	s	s	l	l	l
7	Paddlefish	p	s	s	s	s	s	s	l	l	l	l	l	m	m	m
8	Green-winged Teal	p	s	s	s	s	s	s	l	l	l	l	l	m	m	m
8	Mallard	p	s	s	s	s	s	s	l	l	l	l	l	m	m	m
8	Pectoral Sandpiper	p	s	s	s	s	s	s	l	l	l	l	l	m	m	m
9	Marsh Wren	p	s	s	s	s	s	s	l	l	l	l	l	m	m	m
9	Virginia Rail	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p
10	Smallmouth bass	p	p	p	p	p	p	p	s	s	s	s	s	l	l	l
12	Pugnose minnow	p	p	p	p	p	p	p	s	s	s	s	s	l	l	l
13	Monarch butterfly	p	p	p	p	p	p	p	s	s	s	s	s	l	l	l

Biological Planning	p
Conservation Design	s
Conservation Delivery	l
Outcome-based Monitoring	m
Assumption-based Research	r

FIGURE A3. ANTICIPATED TIMELINE FOR IMPLEMENTATION OF STRATEGIC HABITAT CONSERVATION FOR THE 22 SURROGATE SPECIES FOR THE EASTERN TALLGRASS PRAIRIE AND BIG RIVER GEOGRAPHY

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APPENDIX 2: POPULATION OBJECTIVE SUMMARIES BY SURROGATE SPECIES

In this section, we summarize the available information about each surrogate species and discuss the population objectives (if available) and implications for the next steps of the Strategic Habitat Conservation (SHC) cycle. We include maps to illustrate the distribution of the species and highlight areas of data gaps. These summaries are intended to introduce the surrogate species and the relevant state of knowledge to a broad audience. Species population objective summaries are ordered according to species number and group as listed below with hyperlinks to each species. Because of the large geographic extent, species were grouped to cover the entire ETPBR geography as well as to consider key times of migration in the annual cycle of migratory birds (Blomquist et al. 2013).

POPULATION OBJECTIVE SUMMARIES BY SURROGATE SPECIES

Species #	Group #	Common Name
1	1	Henslow's Sparrow
2	2	Grasshopper Sparrow
3	2	Bobolink
4	3	Upland Sandpiper
5	4	Weed Shiner
6	4	Topeka Shiner
7	4	Blackside Darter
8	5	Greater Redhorse
9	5, 12	River Redhorse
10	5	Shoal Chub
11	5	Pallid Sturgeon
12	5	Shovelnose Sturgeon
13	6, 11	Black Redhorse
14	7	Paddlefish
15	8	Green-winged Teal
16	8	Mallard
17	8	Pectoral Sandpiper
18	9	Marsh Wren
19	9	Virginia Rail
20	10	Smallmouth Bass
21	12	Pugnose Minnow
22	13	Monarch Butterfly

HENSLOW'S SPARROW

By Ryan Drum and Neil Chartier

ETPBR geography population estimate: 160,000 breeding adults

ETPBR geography population objective: Maintain a stable or increasing population

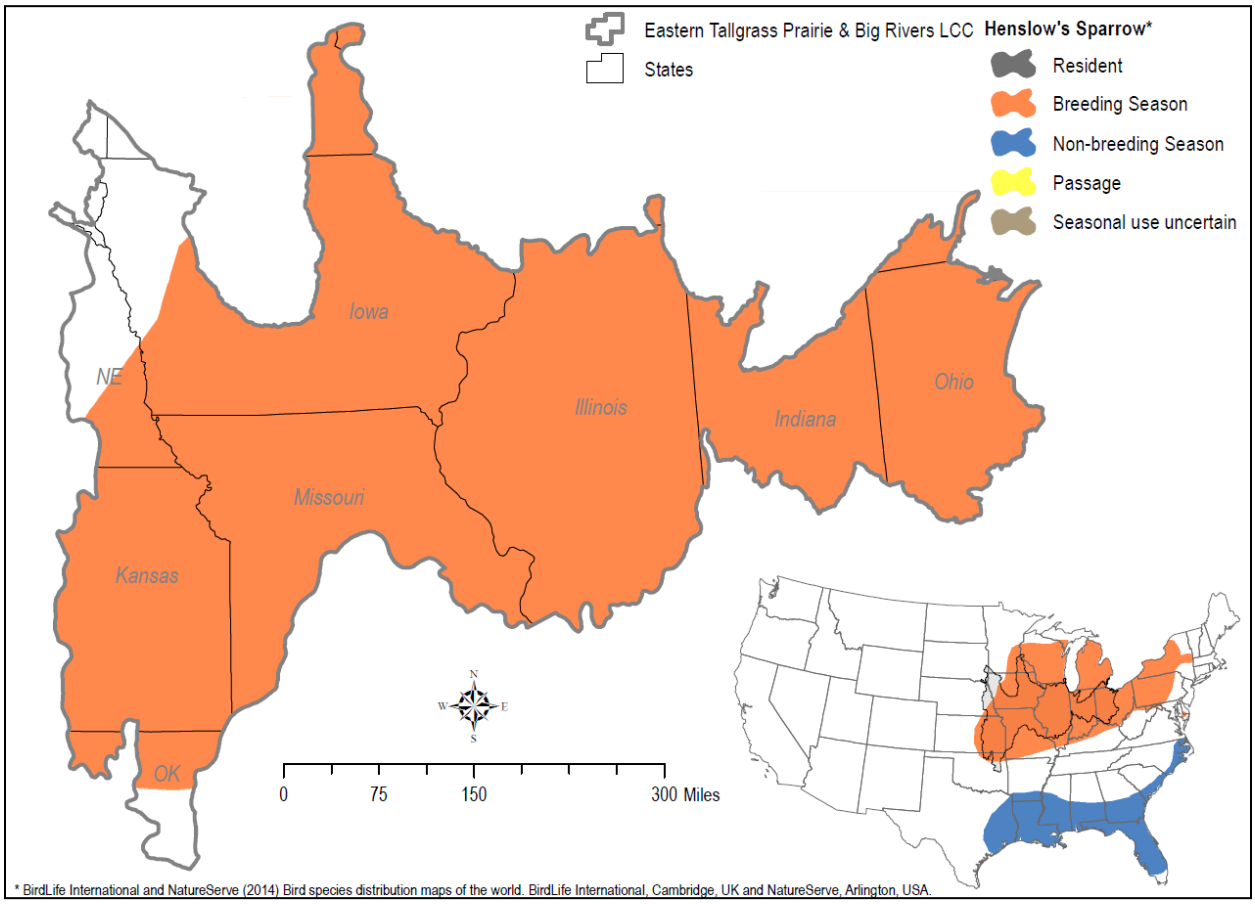
Henslow's Sparrow (*Ammodramus henslowii*) is an "umbrella" surrogate species selected to represent other Service trust species inhabiting tall and idle grasslands throughout the ETPBR geography (Blomquist et al. 2013).Henslow's Sparrow is a migratory songbird that requires relatively large patches of grassland habitat, dense vegetation structure and a well-developed litter layer. They breed locally in grassland habitats throughout the Northeast and Midwest U.S. and southern Ontario, Canada; they winter in southern U.S. coastal states, predominantly in fire-dependent longleaf pine forest habitat (Cooper 2012).

Photo by Jerry Goldner.

Partners in Flight (PIF 2013) estimates that approximately 40% of the total Henslow's Sparrow population breeds within the ETPBR geography. The population is thought to rely heavily on habitat provided by the USDA-Conservation Reserve Program (CRP), temporary conservation agreements that often provide dense grassland habitat required by Henslow's Sparrow. Ongoing declines in CRP are expected to have negative impacts on population trends; woody shrub encroachment into grasslands and early hay harvest also pose threats to this species, along with winter habitat availability and quality. Maintaining population levels within the ETPBR will likely be important for regional and continental population stability and will depend on mitigating habitat losses, particularly those associated with CRP agreement expirations and subsequent grassland conversion to cropland. In addition to protecting or restoring grassland habitat, managing for tall, dense grassland structure and the timing of hay harvest will be important for this species. Conservation actions for Henslow's Sparrow will likely benefit a wide array of other grassland-dependent species (Cooper 2012).

POPULATION STATUS

Henslow's Sparrow has been identified as a "bird of management concern" and a "focal species" by the Service and is listed federally as an endangered species in Canada. The American Bird Conservancy (ABC) classifies this species as a Red List species (ABC 2007), while PIF classifies Henslow's Sparrow as a "Watch List Species in Need of Immediate Action" (Rich et al. 2004). The state listing status varies by state, with several states within the ETPBR listing Henslow's Sparrow as Threatened or Endangered. Most State Wildlife Action Plans in the ETPBR include this species as a Species of Greatest Conservation Need (SGCN) (Cooper 2012).



PIF estimates that the continental population of Henslow's Sparrow consists of 400,000 birds, with approximately 160,000 birds (40.5% of the total population) breeding within the ETPBR (Bird Conservation Region 22; PIF 2013). These estimates are derived using Breeding Bird Survey (BBS) data, where average birds per BBS route are extrapolated based on area surveyed and additional "detection adjustments" (Blancher et al. 2007). However, BBS coverage for Henslow's Sparrow is considered to be "imprecise", thus caution should be used when estimating population sizes based on BBS data (Sauer et al. 2014).

State	Henslow's Sparrow State Listing Status	State Wildlife Action Plan SGCN
Illinois	Threatened	Y
Indiana	Endangered	Y
Iowa	Threatened	Y
Kansas	Species of Concern	Y
Michigan	Threatened	Y
Minnesota	Endangered	Y
Missouri	Species of Concern	N
Nebraska	No Status	Y
Ohio	Species of Concern	Y
Oklahoma	No Status	Y
South Dakota	No Status	N
Wisconsin	Threatened	Y

POPULATION TRENDS

The BBS has detected long- and short-term increases in Henslow's Sparrow population trend estimates in the ETPBR. However, while the BBS is the best available monitoring data for Henslow's Sparrow, caution should be used when interpreting these results (Sauer et al. 2014).

1966-2012: +3.64% (95% Credible Interval Range: 1.12% – 5.51%)

2002-2012: +8.06% (95% Credible Interval Range: 3.37% – 13.59%)

POPULATION OBJECTIVE

A Henslow's Sparrow population objective was previously established by the Upper Mississippi Great Lakes Region Joint Venture (Potter et al. 2007). However, objectives were based on 2004 estimates which have since changed (PIF 2013).

More recently, Cooper (2012) proposed a national objective to "maintain a stable or increasing range-wide population trend as measured by the BBS and a stable or expanding distribution." Stepping-down this range-wide objective to the ETPBR equates to maintaining a stable or increasing population trend as measured by the BBS and a stable or expanding distribution.

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

Spatial models for this species are not currently available for the ETPBR and BBS-based modeling options are limited. A conservation design strategy for Henslow's Sparrow could attempt to utilize BBS data to build a spatially explicit model (SEM) for Henslow's Sparrow; SEMs have previously been developed for Henslow's Sparrow using BBS data in other regions (e.g., Thogmartin et al. 2006). However, such models may have severe limitations for this species in this geography due to low statistical confidence in BBS estimates (i.e., small sample size and/or high variability) and the lack of habitat data associated with BBS surveys. A new study, potentially following BBS methodology with additional sampling effort will be initiated in 2015 by Michael Estey of the Habitat and Population Evaluation Team (Hartford, KS) for the Flint Hills Region of Kansas and field work is scheduled for completion in 2016. BBS data are currently inadequate to attempt modeling for the FH ecoregion, and this study will attempt to develop adequate data for model development linking landscape habitat data with population response similar to the work by Lituma (2014). Additional work will be necessary to explore the validity of extrapolating models from other geographies, posing significant challenges in terms of statistical validity, or exploring habitat and abundance or occurrence relationships to landscape habitat parameters using readily available datasets, which is limited to BBS survey data, National Landcover Data, and other anecdotal survey information that is typically not randomly sampled in such a way as to inform robust spatial models throughout the ETPBR.

As currently described in the conservation plan for Henslow's Sparrow (Cooper 2012), "success" for this species is defined in terms of BBS survey trends that are known to be inadequately sensitive to change in this geography. This is problematic and implies additional attention should be given to the capacity for accurately estimating total population levels with reasonable statistical confidence and monitoring population levels to ensure population change is indeed measurable; similar

challenges likely face many other grassland birds. Monitoring and subsequent spatial modeling efforts would greatly benefit from additional grassland-focused bird surveys designed specifically to inform spatial models that directly link landcover with abundance estimates.

Further, the degree to which wintering habitat is a limiting factor is largely unknown. Research suggests this species is dependent on fire processes on the wintering grounds (Cooper 2012); opportunities may exist to explore this relationship further to inform annual cycle models for this species.

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GRASSHOPPER SPARROW

By Neil Chartier and Ryan Drum

ETPBR geography population estimate: 3,500,000

ETPBR geography population objective: 7,000,000

Grasshopper Sparrow (*Ammodramus savannarum)* is an "umbrella" surrogate species selected to represent other Service trust species inhabiting mid-height and idle grasslands throughout the ETPBR geography (Blomquist et al. 2013). Grasshopper Sparrow is a small, inconspicuous, bird considered to be a grassland obligate. Its breeding range extends from southern Canada to Jamaica, Hispaniola, and Central America, and across much of the U.S.; it winters from North Carolina to Florida, west to southern Arizona, and south to Mexico, Cuba, Jamaica, Hispaniola, and Central America. Although this species appears to have a wide distribution across much of temperate North America, it often breeds locally and is considered rare to uncommon in much of its range (Vickery 1996). Grasshopper Sparrow's average territory size is small (<2 ha), but they are known to be area-sensitive, preferring large grassland areas greater than 8 ha in size (Dechant et al. 2003, Slater 2004). In the ETPBR, within open grasslands of suitable patch size, they prefer dryer grasslands of intermediate height with clumped vegetation interspersed with patches bare ground, moderately deep litter, and sparse coverage of woody vegetation (Dechant et al. 2003).

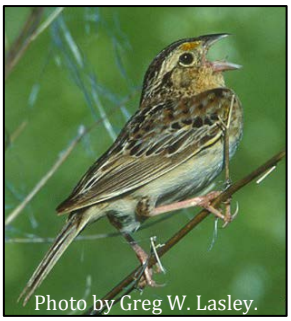
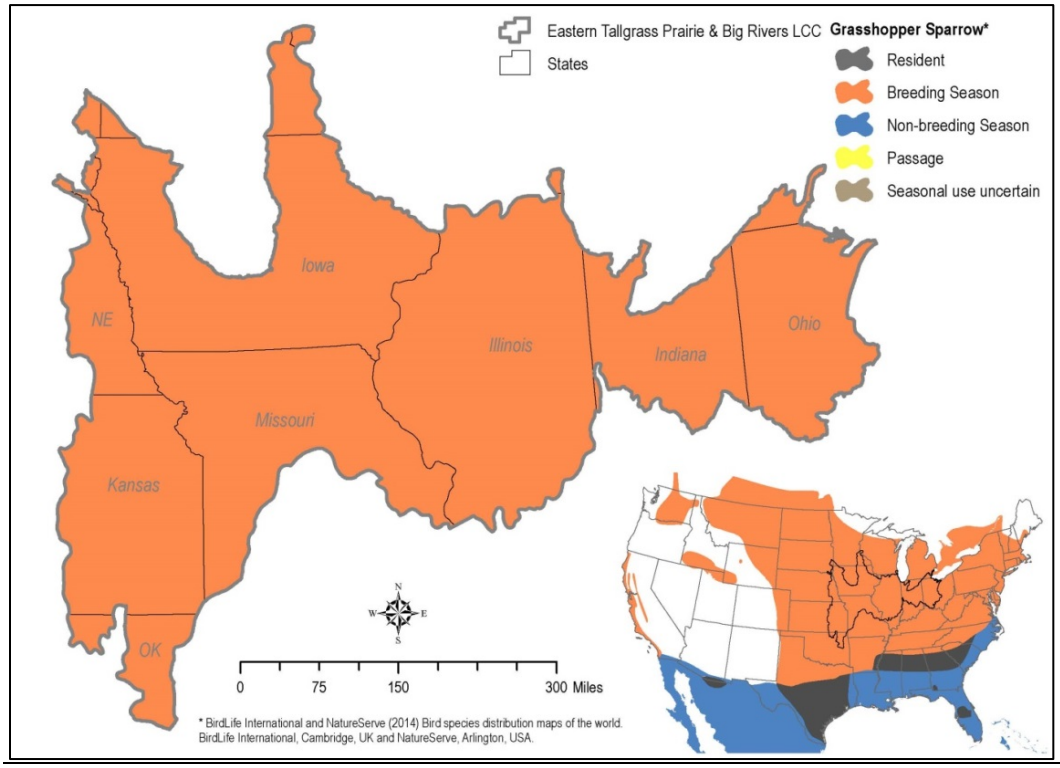


Photo by Greg W. Lasley.

The most serious threats to Grasshopper Sparrow's breeding habitat are habitat loss, fragmentation, and degradation due to agricultural and urban development; reforestation; altered grazing and fire regimes that often fail to replicate the natural dynamics under which this species and its habitat evolved; and burning, plowing, and mowing during the nesting season (Slater 2004). As with other ground-nesting birds, high populations



of predators like raccoons, skunks and feral or free-roaming house cats have also contributed to this species' decline. Increasing population levels within the ETPBR will likely depend on mitigating habitat losses.

POPULATION STATUS

Grasshopper Sparrow has been identified as a "bird of management concern" and a "focal species" by the Service. Partners in Flight (PIF) classify Grasshopper Sparrow as a "Stewardship Species" (Rich et al. 2004) and most State Wildlife Action Plans in the ETPBR classify it as a "Species of Greatest Conservation Need" (SGCN).

State	Grasshopper Sparrow State Listing Status	State Wildlife Action Plan SGCN
Illinois	No Status	Y
Indiana	No Status	N
Iowa	No Status	Y
Kansas	No Status	Y
Michigan	No Status	Y
Minnesota	No Status	Y
Missouri	No Status	N
Nebraska	No Status	N
Ohio	No Status	Y
Oklahoma	No Status	N
South Dakota	No Status	N
Wisconsin	Special Concern	Y

PIF estimates approximately 3.5 million birds breed within the ETPBR LLC (Bird Conservation Region 22), 11.3% of the total population (PIF 2013). These estimates are derived using Breeding Bird Survey (BBS) data, where average birds per BBS route are extrapolated based on area surveyed and "detection adjustments" (Blancher et al. 2007).

POPULATION TRENDS

The BBS has detected "significant" long- and short-term declines in Grasshopper Sparrow population trend estimates in the ETPBR (Sauer et al. 2014):

1966-2012: -4.06% (95% Credible Interval: -4.76, -3.39)

2002-2012: -4.99% (95% Credible Interval: -6.95, -3.29)

POPULATION OBJECTIVE

A continental population objective that called for maintaining the current Grasshopper Sparrow population size was previously established by PIF (Rich et al. 2004). However, when significant declines at the regional level are detected, PIF recognized that their continental perspective should not prevent setting a more aggressive population objective that used regionally-derived trend data to develop regional population and habitat objectives.

For species that have undergone "severe" declines of 50% or more over 30 years, the PIF objective is to double the current population over the next 30 years (Rich et al. 2004). Within the ETPBR geography, from 1982 to 2012, the Grasshopper Sparrow population has undergone a "severe" decline of approximately 70%. [Note: the 1982 EBRTG LCC population size (11,550,000) was

calculated using the BBS rate of decline from 1966-2012 (-4.06% per year), and back calculating the population size, using the 2012 population (3,500,000) as starting point.] Therefore it may be appropriate to adopt a more aggressive ETPBR population objective. The proposed objective is to double the current population (Rich et al. 2004).

- 2012 population = 3.5 million
- Goal = 7 million
- Deficit = 3.5 million
- Minimum new habitat area required to eliminate deficit (Potter et al. 2007):
  - 3.5 million ha = 3.5 million (pop. deficit)/2 (birds/breeding pair) * 2 ha (habitat area used/pair; Slater et al. 2004)

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

"Success" for Grasshopper Sparrow in the ETPBR is defined as increasing the population by 3.5 million birds to reach a population objective of 7 million birds by 2034. Measuring progress towards this goal requires the ability to detect changes in population size. While the BBS is currently the best available monitoring data for this species, it is important to note the BBS was designed to estimate population trends, not produce population estimates. Developing a robust statistical monitoring program is needed to increase our capacity to detect population changes with greater statistical confidence. In the absence of a statistically robust sampling framework, we will be forced to rely on an expert opinion model that lacks statistical confidence and is thus greatly limited in the ability to meaningfully assess outcomes of alternative conservation design strategies and future scenarios. Monitoring data, collected together with landscape habitat data, could then be used to inform a Grasshopper Sparrow spatially explicit model (SEM). A SEM that predicts Grasshopper Sparrow abundance in the ETPBR based on relationships to landscape habitat parameters is a critical science need because a SEM will be needed to develop a Grasshopper Sparrow conservation design strategy, the next step in implementation Strategic Habitat Conservation for surrogate species.

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Sauer JR, Hines JE, Fallon JE, Pardieck KL, Ziolkowski, Jr. DJ, Link WA. 2014. The North American Breeding Bird Survey, results and analysis 1966 - 2012. Version 02.19.2014. Laurel, Maryland: USGS Patuxent Wildlife Research Center.

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BOBOLINK

By Neil Chartier and Ryan Drum

ETPBR geography population estimate: 400,000

ETPBR geography population objective: 800,000

Bobolink (*Dolichonyx oryzivorus)* is an "umbrella" surrogate species selected to represent other Service trust species inhabiting mid-height grasslands and haylands throughout the ETPBR geography (Blomquist et al. 2013). Bobolink is migratory songbird considered to be an obligate grassland species. It breeds in the U.S. and Canada from British Columbia and Alberta in the west to Newfoundland in the east, and as far south as West Virginia; they overwinter in southern Brazil and northern Argentina (Martin and Gavin 1995). It breeds more or less continuously throughout this range wherever suitable habitat exists, although distribution is patchy in the western and southern portions of the breeding range (Martin and Gavin 1995).

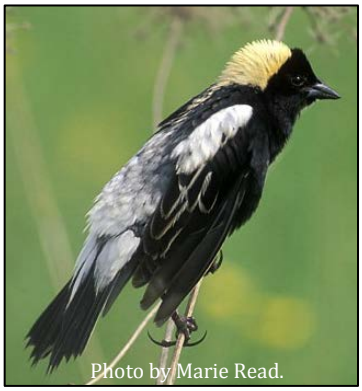


Photo by Marie Read.

During the breeding season, Bobolink prefer habitat with moderate to tall vegetation, moderate to dense vegetation, moderately deep litter, and without the presence of woody vegetation. Bobolink are found in native and tame grasslands, haylands, lightly to moderately grazed pastures, no-till cropland, small-grain fields, oldfields, wet meadows, and planted cover (Dechant et al. 2001). Area sensitivity has been reported for Bobolinks in some studies, but not in others (reviewed in Keyel et al. 2012).

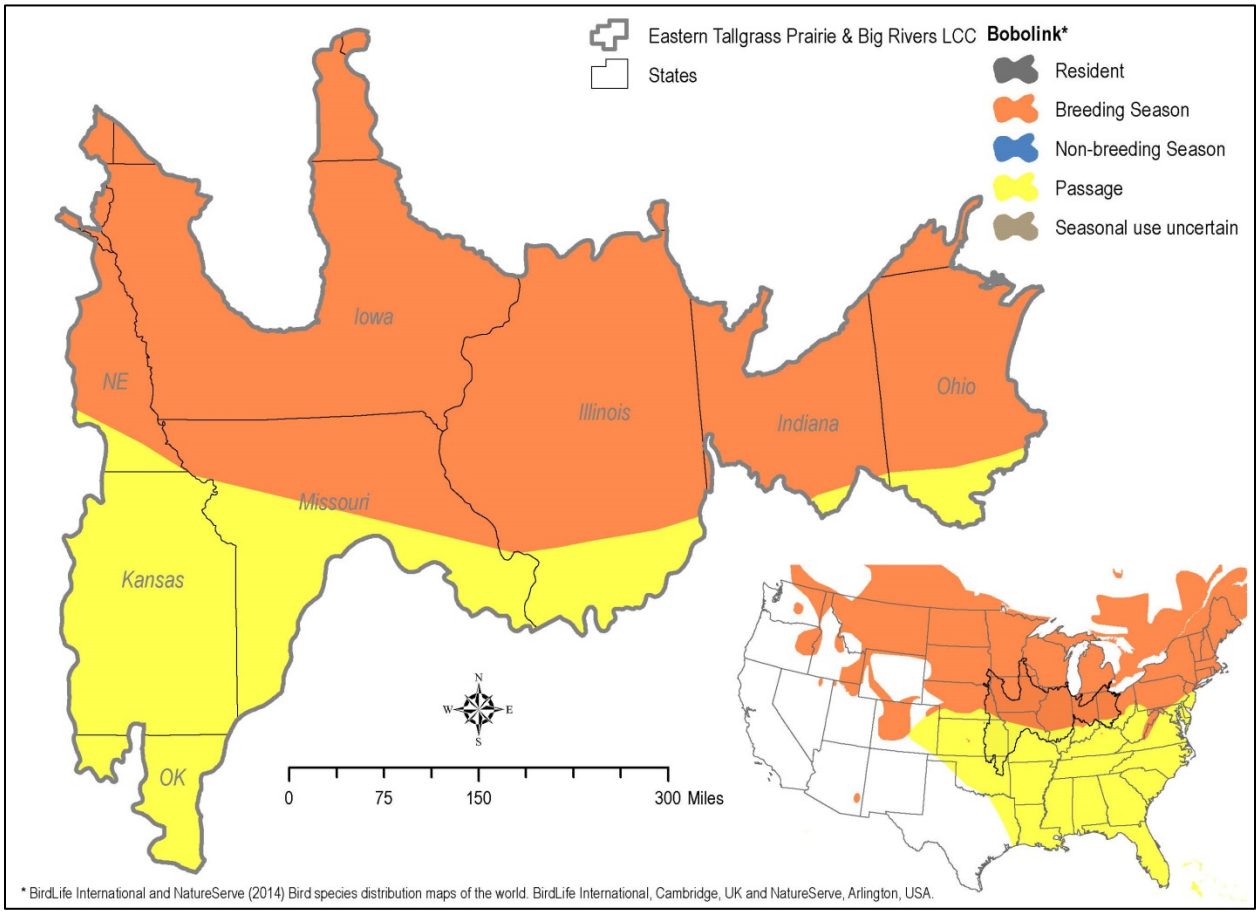
The most serious threats to Bobolink breeding habitat include habitat loss and fragmentation. Farming techniques, including frequent rotation of hayfields, early and more frequent mowing of hay, decreased vegetative diversity, and the change from warm-season to cool-season grasses, have rendered agricultural fields less favorable for nesting Bobolink (Herkert 1997); they are also likely to decline in response to conversion of USDA- Conservation Reserve Program (CRP) grasslands and may be vulnerable to agricultural pesticides on the breeding grounds (Mineau and Whiteside 2013) and further exposed to lethal doses of toxic pesticides at stopover sites in rice fields of South America (Renfrew and Saavedra 2007). In addition, Bobolink are persecuted as agricultural pests in their wintering range. Increasing population levels within the ETPBR will likely depend on mitigating habitat losses and restoring large grassland landscapes.

State	Bobolink State Listing Status	State Wildlife Action Plan SGCN
Illinois	No Status	Y
Indiana	No Status	N
Iowa	No Status	Y
Kansas	No Status	Y
Michigan	No Status	Y
Minnesota	No Status	Y
Missouri	No Status	N
Nebraska	No Status	N
Ohio	Species of Concern	Y
Oklahoma	No Status	N
South Dakota	No Status	N
Wisconsin	Special Concern	Y

POPULATION STATUS

Bobolink has been identified as a "bird of management concern" and a "focal species" by the Service. Most State Wildlife Action Plans in the ETPBR classify it as a "Species of Greatest Conservation Need" (SGCN).

Partners in Flight (PIF) estimates approximately 400,000 birds breed within the ETPBR (Bird Conservation Region 22), 5.1% of the total population (PIF 2013). These estimates are derived using Breeding Bird Survey (BBS) data, where average birds per BBS route are extrapolated based on area surveyed and "detection adjustments" (Blancher et al. 2007).



POPULATION TRENDS

The BBS has detected "significant" long- and short-term declines in Bobolink population trend estimates in the ETPBR geography (Sauer et al. 2014):

1966-2012: -3.55% (95% Credible Interval: -4.63, -2.56)

2002-2012: -0.89% (95% Credible Interval: -3.88, 2.38)

POPULATION OBJECTIVE

A continental population objective that called for maintaining the Bobolink population size was previously established by PIF (Rich et al. 2004). However, when significant declines at the regional level are detected, PIF acknowledges that the continental perspective should not prevent setting a more aggressive population objective that used regionally derived trend data to develop regional population and habitat objectives.

For species that have undergone "severe" declines of 50% or more over 30 years, the PIF objective is to double the current population over the next 30 years (Rich et al. 2004). Within the ETPBR, from 1982 to 2012, the Bobolink population has undergone a "severe" decline of approximately 65%. [Note: the 1982 ETPBR population size (1,139,103) was calculated using the BBS rate of decline from 1966-2012 (-3.55% per year), and back calculating the population size, using the 2012 population (400,000) as starting point.] Therefore it seems appropriate to adopt a more aggressive ETPBR population objective. The proposed objective is to double the current population (Rich et al. 2004), though a national Bobolink planning effort is currently underway that may establish updated national and regional population objectives for this species (MCBMP 2014).

- 2012 population = 400,000
- Goal = 800,000 (From 1982 BBS-based estimates)
- Deficit = 400,000
- Minimum new habitat area required to eliminate deficit (Potter et al. 2007):
  - 200,000 ha = 400,000 (pop. deficit)/2 (birds/breeding pair) * 1 ha (habitat area used/pair; territory size varies from habitat to habitat: mixed hayland: 0.45 to 0.69 ha; sparsely vegetated pastures ≤ 2.5 ha [Dechant et al. 2001])

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

"Success" for Bobolink in the ETPBR would be defined as increasing the population by 400,000 birds to reach a population objective of 800,000 birds. Measuring progress towards this goal requires the ability to detect changes in population size and presumably also to explain the cause of population change. While the BBS is currently the best available monitoring data for this species, it is important to note the BBS was designed to estimate population trends, not produce population estimates. Developing a species-specific monitoring program is needed to increase our capacity to detect population changes with greater statistical confidence. In the absence of a statistically robust sampling framework, we will be forced to rely on an expert opinion model that lacks statistical confidence and is thus greatly limited in the ability to meaningfully assess outcomes of alternative conservation design strategies and future scenarios. Monitoring data, collected together with predictive habitat variables, could be used to inform a Bobolink spatially explicit model (SEM). A SEM that predicts Bobolink abundance in the ETPBR based on relationships to landscape habitat context is a critical science need because a SEM will be needed to develop a Bobolink conservation design strategy, the next step in implementing Strategic Habitat Conservation for surrogate species. Additionally, understanding the migration and wintering ecology and associated spatial distribution for this species will be important in determining limiting factors.

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UPLAND SANDPIPER

By Neil Chartier and Ryan Drum

ETPBR geography population estimate: 63,450

ETPBR geography population objective: 138,408

Upland Sandpiper (*Bartramia longicauda)* is an "umbrella" surrogate species selected to represent other Service trust species inhabiting open, short, patchy grasslands throughout the ETPBR geography (Blomquist et al. 2013). Upland Sandpiper is a migratory shorebird considered to be an obligate grassland species. The main (contiguous) portion of their breeding range extends from southern Canada south to the central U.S., and from the Rocky Mountains east to Appalachian Mountain region; their main wintering areas are grasslands in Argentina, Colombia, Ecuador, and Uruguay (Houston et al. 2011). During the breeding season, Upland Sandpiper prefer dry grassland habitats, with moderate grass cover, low to moderate forb cover, minimal woody cover, moderate to high litter cover, and little to no bare ground (Houston et al. 2011). However, depending on the stage of the breeding season, Upland Sandpiper typically require a mosaic of three different but nearby grassland habitats: during courting, it needs perches and low vegetation for visibility; during nesting, higher vegetation to hide its nest; and during supervision of young, lower vegetation They tend to respond favorably to a grassland habitat mosaic that includes moderate disturbance from grazing and/or fire. (Houston et al. 2011).

Photo by Brian L. Sullivan.

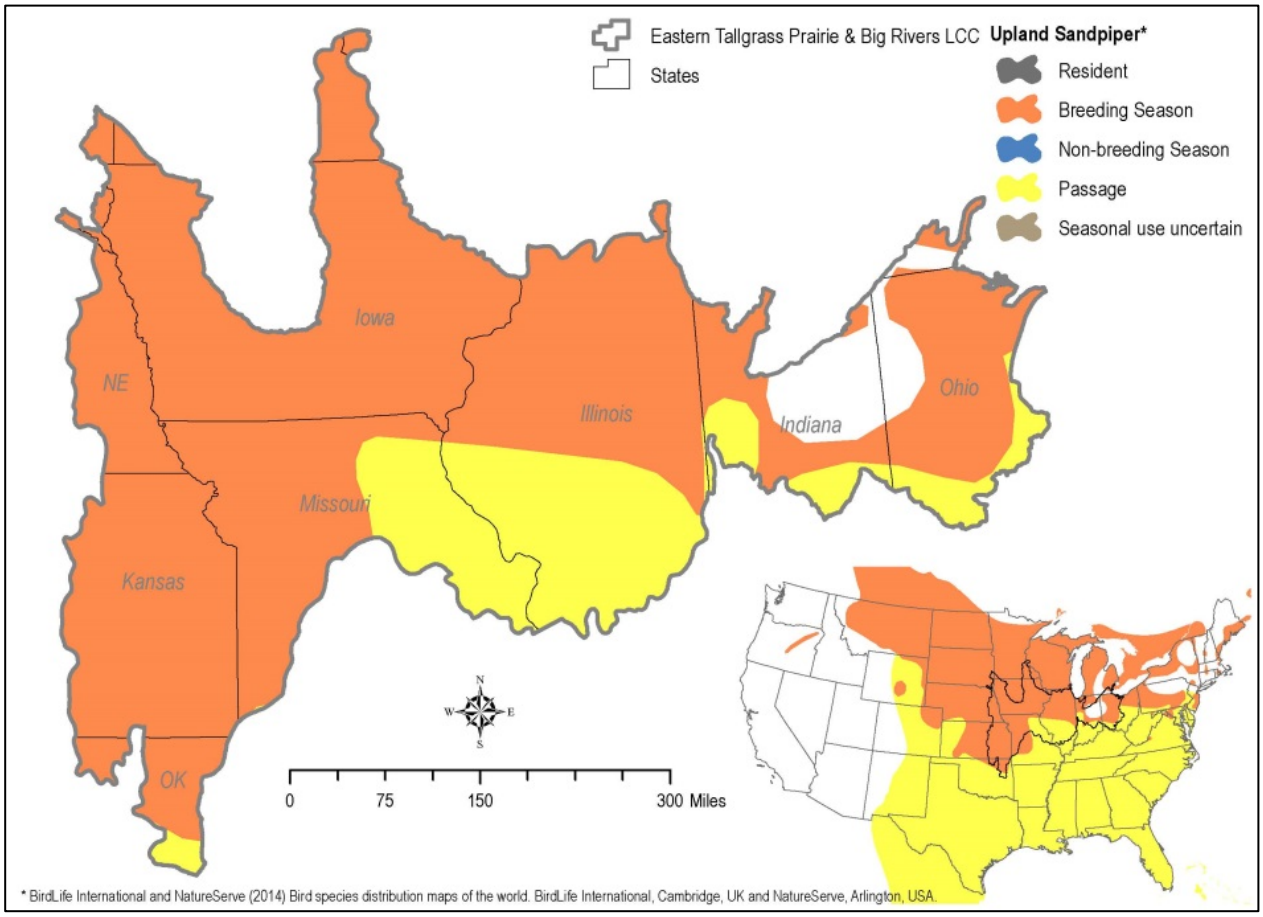
The most serious threats to Upland Sandpiper breeding habitat are habitat loss due to fragmentation by urbanization and cultivation, and natural forest succession. Additional threats include woody vegetation encroachment, and burning, plowing, and mowing during the nesting season. Increasing population levels within the ETPBR geography will likely depend on mitigating habitat losses. In addition to protecting or restoring grassland habitat, managing for a mosaic grassland habitat conditions will be important for this species. Ongoing declines in Conservation Reserve Program (CRP) agreements will likely also have negative impacts on the population trend due to habitat loss and fragmentation.

State	Upland Sandpiper State Listing Status	State Wildlife Action Plan SGCN
Illinois	Endangered	Y
Indiana	Endangered	Y
Iowa	No Status	Y
Kansas	No Status	Y
Michigan	No Status	Y
Minnesota	No Status	Y
Missouri	No Status	N
Nebraska	No Status	N
Ohio	Endangered	Y
Oklahoma	No Status	Y
South Dakota	No Status	N
Wisconsin	Threatened	Y

POPULATION STATUS

Upland Sandpiper has been identified as a "bird of management concern" by the Service and a "focal species" by both the Service and the Upper Mississippi and Great Lakes Region Joint Venture (Potter et al. 2007). It is also considered a shorebird species of "high conservation concern" (USSCP 2004). Within the ETPBR geography, several states list Upland Sandpiper as Endangered and most State Wildlife Action Plans classify it as a "Species of Greatest Conservation Need" (SGCN).

Andres et al. (2012) estimate that the North American Upland Sandpiper population is approximately 750,000 birds. Approximately 63,450 birds (8.5% of the total population; Potter et al. 2007) breed within the within the ETPBR LLC geography (Bird Conservation Region 22). These estimates are derived using Breeding Bird Survey (BBS) data, where average birds per BBS route are extrapolated based on area surveyed and "detection adjustments" (Blancher et al. 2007).



POPULATION TRENDS

The BBS has detected "significant" long- and short-term declines in Upland Sandpiper population trend estimates in the ETPBR geography (Sauer et al. 2014):

1966-2012: -1.71% (95% Credible Interval: -2.55, -0.91)

2002-2012: -1.19% (95% Credible Interval: -3.08, -0.56)

POPULATION OBJECTIVE

The population size estimate and proposed population and habitat objectives were based on Brown et al.'s (2000) criteria, while using Potter et al.'s (2007) methods and updated population and trend data (Andres et al. 2012, Saur et al. 2014). The proposed objective is to restore the population to the "level that probably existed" in 1966, when BBS population trend analysis began (Brown et al. 2000). [Note: the 1966 EBRTG LCC population size (138,408) was calculated using the BBS-based estimated rate of decline from 1966-2012 (-1.71%/year), and back calculating the population size, using the 2012 population (63,450) as starting point.]

- 2012 population: 63,450 = 750,000 (continental population; Andres et al. 2012.) x 0.0846 (% population in ETPBR; Potter et al. 2007))
- Goal = 138,408 (based on 1966 BBS-based population estimate)
- Deficit = 74,958
- Minimum new habitat area required to eliminate deficit:
  - 374,790 ha = 74,985 (population deficit)/2 (birds/breeding pair) * 10 ha (habitat area used/pair; Potter et al. 2007)

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

"Success" for Upland Sandpiper in the ETPBR geography would be defined as increasing the population by 74,958 birds to reach a population objective of 138,408 birds. Measuring progress towards this goal requires the ability to detect changes in population size. While the BBS is currently the best available monitoring data for Upland Sandpiper and Potter et al. (2007) described BBS data as "adequate" for monitoring trends for this species, it is important to note the BBS was designed to specifically to estimate population trends, not to produce population estimates nor to evaluate alternative scenarios based on future landcover change. A statistically robust monitoring program is needed to increase our capacity to accurately estimate population numbers, detect population changes, and establish relationships with landcover change with greater statistical confidence. In the absence of a statistically robust sampling framework, we will be forced to rely on an expert opinion model that lacks statistical confidence and is thus greatly limited in the ability to meaningfully assess outcomes of alternative conservation design strategies and future scenarios. Monitoring data, collected together with landscape habitat data, could be used to inform the development an Upland Sandpiper spatially-explicit model (SEM). A SEM that predicts Upland Sandpiper abundance in the ETGBR based on relationships to landscape habitat parameters will be needed for conservation design, the next step in implementing Strategic Habitat Conservation for surrogate species.

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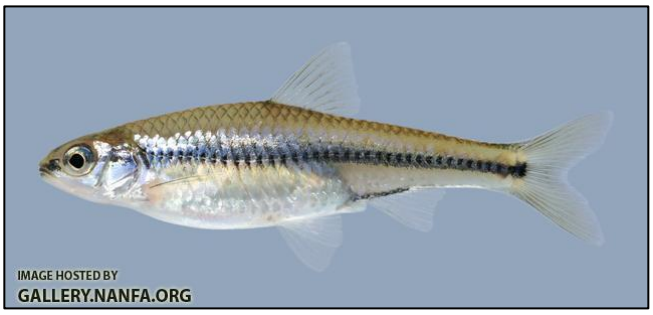
WEED SHINER

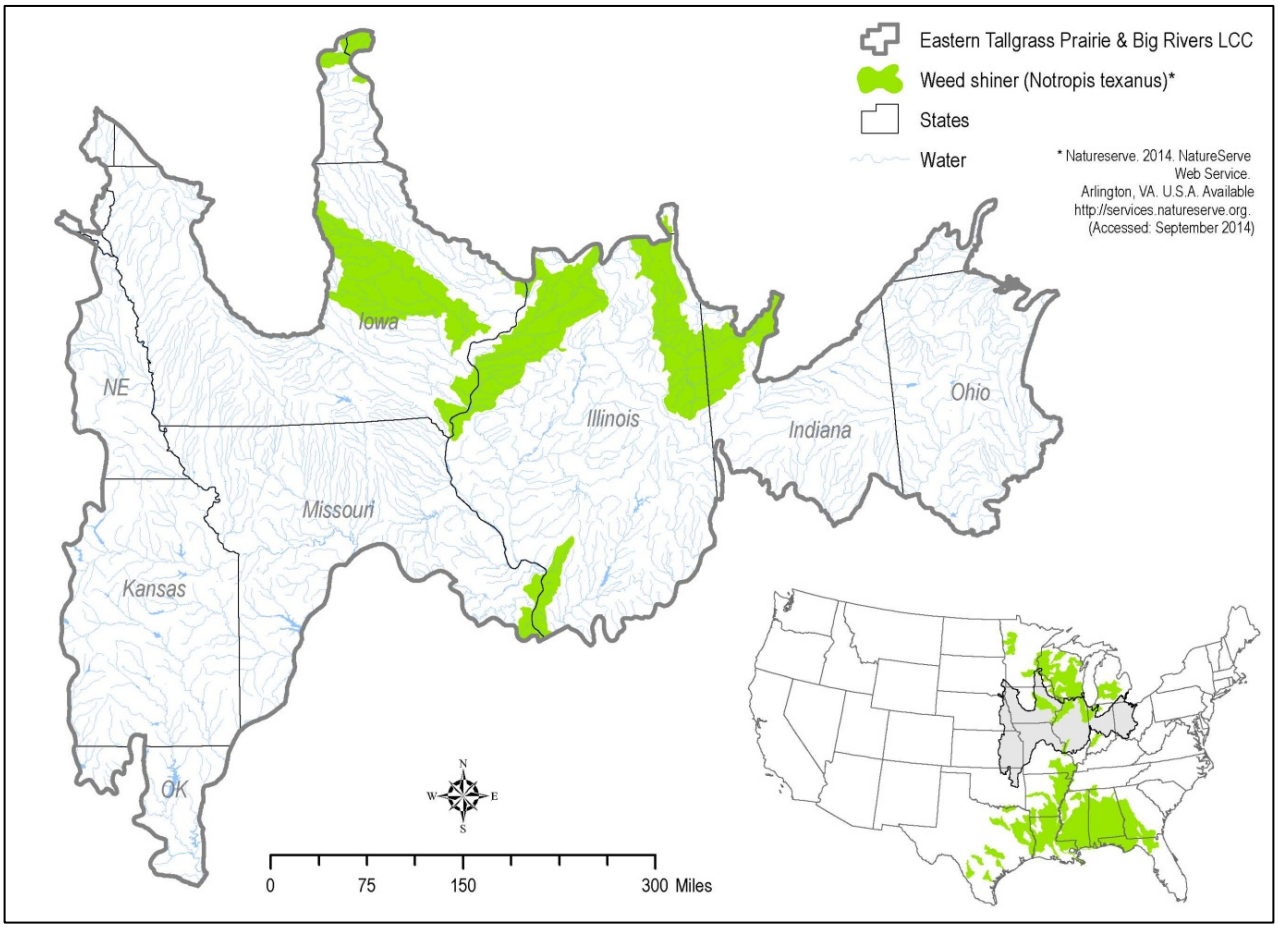
By Aleshia Kenney

ETPBR geography population estimate: Not available

ETPBR geography population objective: The status and information needs for setting a population objective will be gathered from the states and will be addressed by Spring 2015.

Weed Shiner (*Notropis texanus*), an "umbrella" surrogate species for the ETPBR geography, is characteristic of quiet, protected areas along the margins of stream channels, over a substrate consisting of silt-free sand or small gravel. It often prefers low-gradient streams and sparsely vegetated ditches (Pflieger 1997). Weed Shiners are most abundant in sand-bottomed creeks with some submerged aquatic vegetation. They have also been known to occupy sloughs and larger rivers like the Mississippi River (Smith 2002). Despite its name, the Weed Shiner is not necessarily associated with aquatic vegetation (Becker 1983; Douglas 1974; Etnier and Starnes 1993; Harlan et al. 1987; Pflieger 1997). Habitat degradation, increased siltation and turbidity from the loss of riverine vegetation, widespread deforestation, and





wetland alteration are likely reasons for the decline of this species (Smith 1979). The Weed Shiner is found in the lowlands in Lake Michigan, Hudson Bay and the Mississippi River basin (Page and Burr 2011). The species is common in the southern part of its range, but uncommon and localized in the north (which includes the ETPBR).

The quiet, unvegetated, sandy bottoms of low-gradient streams and backwater sloughs of big rivers in which Weed Shiners evolved met the habitat and life history requirements of other native riverine fishes. Conservation actions for Weed Shiners are expected to benefit a wide array of other small stream and backwater slough dwelling species that prefer silt free habitats and high water quality. Weed Shiner was chosen as part of a group of three umbrella species to represent other trust species inhabiting small streams and backwater sloughs with high water quality throughout the ETPBR geography (Blomquist et al. 2013).

POPULATIONS STATUS

The Weed Shiner is found in five states within the ETPBR geography. It has been identified as an endangered species in Iowa (Harlan et al. 1987) and Illinois (Smith 2002) and also as a "species in greatest need of conservation" in both of those states. It is presumed to be extirpated from Michigan, but if it is found it will be reclassified as threatened (Michigan Natural Features Inventory). In Illinois it is more abundant in north and central Illinois, but probably was never an abundant species (Smith 2002). In Iowa it is considered a rare species and reaches its greatest abundance in the Mississippi River (Harlan et al. 1987). At the turn of the twentieth century, the Weed Shiner was also collected in the Cedar and Iowa Rivers. One recent collection was made of the Weed Shiner in the Skunk River watershed (Olson 1998). In Missouri the Weed Shiner is widely distributed and rather common in the lowlands of southeastern Missouri (Pflieger 1997). Little is known about the Weed Shiner in Indiana and Minnesota.

State	Weed Shiner State Listing Status	State Wildlife Action Plan SGCN
Illinois	Endangered	Y
Indiana	No Status	N
Iowa	Endangered	Y
Kansas	Not present	N
Michigan	Presumed Extirpated	N
Minnesota	No Status	N
Missouri	No Status	N
Nebraska	Not Present	N
Ohio	Not Present	N
Oklahoma	Not Present	N
South Dakota	Not Present	N
Wisconsin	Special Concern	N

POPULATIONS TRENDS

Relatively poor statewide surveys for this species make population and trend estimates difficult to interpret. The state of Illinois performs fish surveys of all the basins in the state every five years. This survey data goes back 20-30 years, so trend data within this state could be developed. The remaining four states occupied by this species in the ETPBR have mostly presence data.

POPULATION OBJECTIVE

A Weed Shiner population objective was established by the Illinois State Wildlife Action Plan. It stated that populations at all currently occupied locations are maintained and populations are re-

established at 50% or more of historic locations where suitable habitat persists or can be restored (Illinois Comprehensive Wildlife Conservation Plan and Strategy 2005). It would be difficult to extrapolate this across the ETPBR range due to the fact that little is known about the population of Weed Shiners, and what is known is mostly presence data. However, the presence data usually contains stream characteristics at the time of finding (substrate, vegetation presence, flow, water quality, etc.). This data could be used to develop a habitat objective for the Weed Shiner based on the fact that they prefer high quality, silt-free streams and sloughs. For example, a habitat objective could be to reduce silt in several streams throughout the range of the Weed Shiner, thereby extending the range of this species, along with other species that also prefer silt-free, slow-moving habitats.

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

Only one spatial model is available for the Weed Shiner in the ETPBR geography. Additional work will be necessary in order to apply this model across the ETPBR range. Very little information is known about the current population status within each of the states. Additional work will be necessary to explore the validity of extrapolating models from other geographies, or exploring habitat and occurrence relationships to landscape habitat parameters using readily available datasets, which is limited to state survey data.

Increased state monitoring and subsequent spatial modeling efforts would greatly benefit the ability to accurately identify areas occupied by the Weed Shiner. These surveys should monitor abundance of Weed Shiners linked with instream habitat characteristics to further populate the spatial models that exist.

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TOPEKA SHINER

By Nick Utrup

ETPBR geography population estimate: Not available

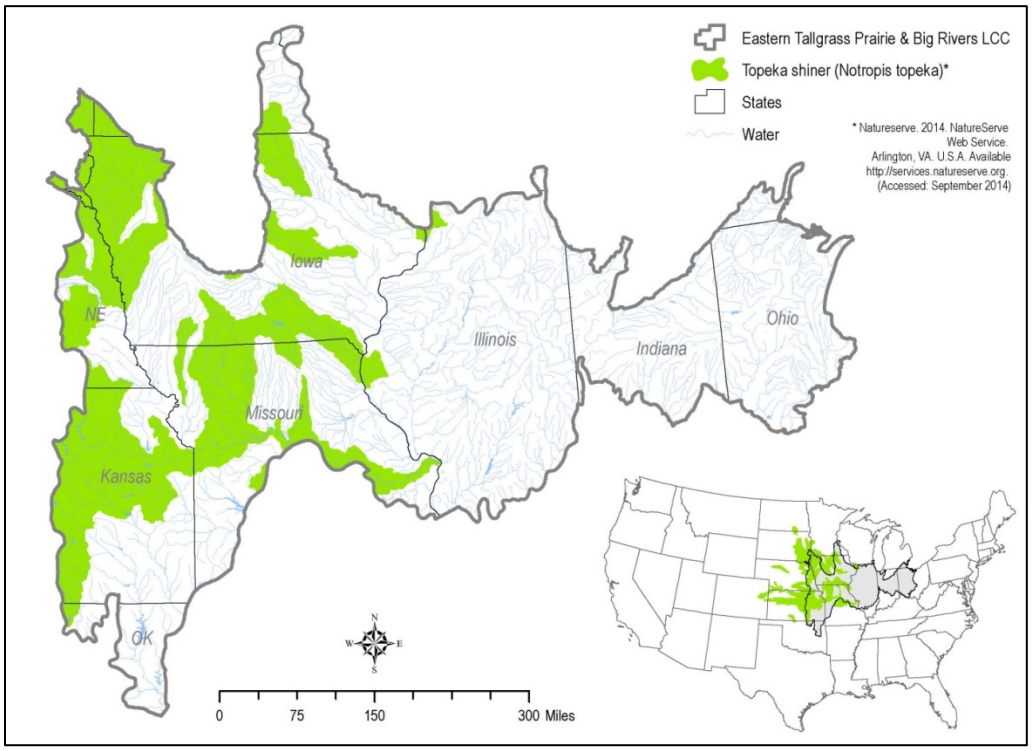
ETPBR geography population objective: Population objectives to be determined based on the Species Status Assessment.

Topeka Shiner (*Notropis topeka*), an "umbrella" surrogate species for the ETPBR geography, is a small, stout minnow, not exceeding 75 millimeters (3 inches) in total length. The head is short with a small, moderately oblique mouth. The Topeka Shiner is characteristic of small, low order (headwater), prairie streams and is often documented in off-channel habitat, such as backwaters, oxbows, and livestock farm ponds (Bakevich et al. 2013; Thomson and Berry 2009). Many of the streams that Topeka Shiners inhabit exhibit perennial flow. At times when surface flows cease or slow, off-channel sites offer refuge by providing water conditions that are maintained by percolation through the streambed or groundwater seepage. The predominant substrate types within Topeka Shiner streams are gravel, cobble, and sand. However, the species can exist in streams and off-channel pools with varying degrees of sedimentation, but usually in proximity to cleaner substrates. Topeka Shiners most often occur in pool and run areas of streams, seldom being found in riffles.

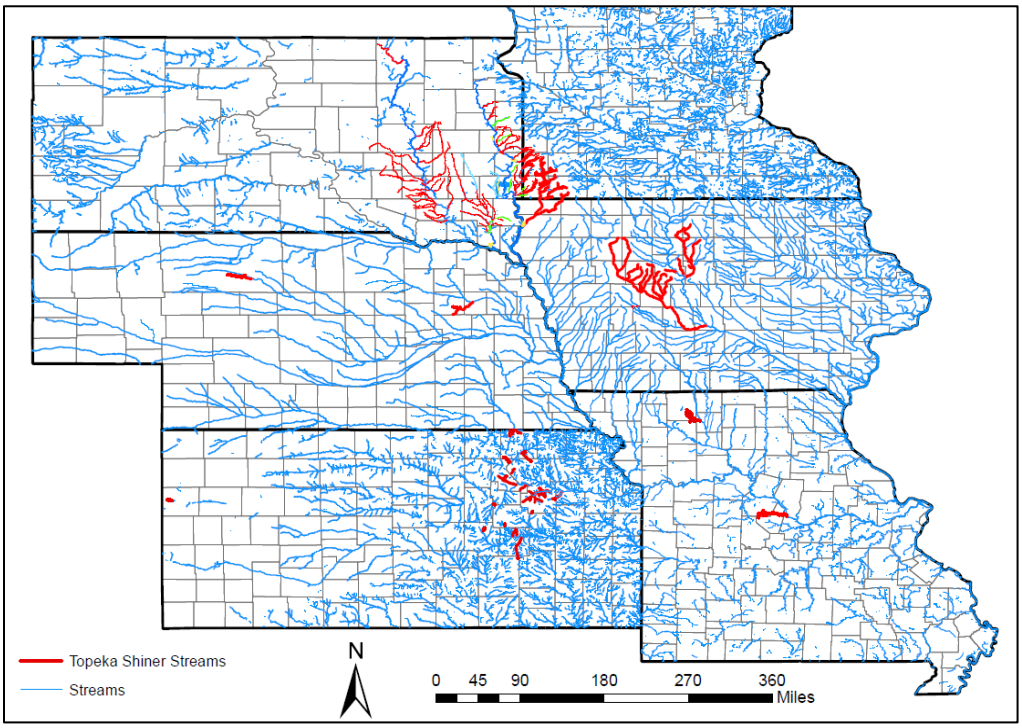
Photo by Konrad Schmidt

Life history and food use studies have been completed, including age composition, growth curves, spawning studies, clutch sizes, and diet composition. The Topeka Shiner is an opportunistic omnivore, feeding on aquatic insects, microcrustaceans, larval fish, algae, and detritus (Hatch and Besaw 2001). Dahle (2001) discovered 4-year classes in individuals from Minnesota, dominated by age 0- and age 1-year classes. He also found that: the species is a multiple clutch spawner; clutch size was smaller than previous studied specimens from Kansas; and that relative abundance was higher in off-channel habitat than instream habitat. Kerns and Bonneau (2002) reported: the number of mature ova increased with length, weight, and age of the female; and that only 62 percent of age-1 females were mature, compared with 100 percent of age-2 females. Stark et al. (2002) studied the natural history of an isolated population in Kansas, documenting feeding, reproduction, and interspecies activities from spring through summer. Winston (2002) observed the spatial and temporal associations of other stream species with the Topeka Shiner, suggesting interspecific actions with other species during some life stages of the Topeka Shiner.

The Topeka Shiner is known to occur in portions of South Dakota, Minnesota, Kansas, Iowa, Missouri, and Nebraska. Topeka Shiner darter was chosen as part of a group of three umbrella species to represent other trust species inhabiting small streams and backwater sloughs with high water quality throughout the ETPBR geography (Blomquist et al. 2013).



Distribution of the Topeka Shiner showing currently occupied and historically occupied watersheds within the ETPBR geography.



Distribution of the Topeka Shiner showing only currently occupied streams.

POPULATIONS STATUS

The Topeka Shiner was once distributed throughout the Missouri River drainage, mainly within the headwaters of prairie streams, but currently only occurs in portions of South Dakota, Minnesota, Kansas, Iowa, Missouri, and Nebraska. The Topeka Shiner is federally listed as an endangered species under the Endangered Species Act. The USFWS has assigned a recovery priority number of 8C to the Topeka Shiner. This priority indicates that the Topeka Shiner is recognized by full species status, is presently subject to a moderate degree of threat, and has some degree of conflict between the species' conservation efforts and economic development associated with its recovery. The species is also listed as endangered by the State of Missouri, as threatened by the states of Kansas and Iowa, and as a species of special concern in Minnesota. The protected status prohibits the killing or collecting of Topeka Shiners. The Topeka Shiner has no conservation classification in the states of South Dakota and Nebraska.

State	Topeka Shiner State Listing Status	State Wildlife Action Plan SGCN
Illinois	Likely Extirpated	N
Indiana	Not present	N
Iowa	Threatened	Y
Kansas	Threatened	Y
Michigan	Not present	N
Minnesota	Species of Concern	Y
Missouri	Endangered	Y
Nebraska	Not listed	Y
Ohio	Not present	N
Oklahoma	Not present	N
Wisconsin	Not present	N
South Dakota	Not listed	N

Recently, the USFWS conducted a 5-year review of the status of the Topeka Shiner. As part of this review, the USFWS solicited information from the public, concerned governmental agencies, tribes, the scientific community, industry, environmental entities, and other interested parties pertaining to the Topeka Shiner. Also contacted were State fishery/natural resource agencies, applicable USFWS Field and Regional offices, knowledgeable individuals from academia, and the Topeka Shiner Recovery Team. Based on recommendations from this review, the USFWS is currently conducting a Species Status Assessment to determine current population status and trends throughout the range, including the species Resiliency, Redundancy, and Representation.

The preliminary status in each state is briefly summarized below (*from* USFWS 2009):

South Dakota – In South Dakota, new information indicates a much larger distribution of the species than was known at the time of listing (69 FR 71071, December 08, 2004; Wall et al. 2001; Wall and Thompson 2007). Topeka Shiners were known at 11 localities in the Vermillion and James River watershed at the time of listing, and were believed extirpated from the Big Sioux River drainage (69 FR 71071, December 08, 2004). Since listing, Topeka Shiners have been captured from an additional 48 streams, including many from the Big Sioux River watershed (Wall pers. comm. 2006). A South Dakota State University/U.S. Geological Survey Geographic Information Systems modeling study helped identify many of the potential sites now known to be occupied (Wall et al. 2001). Off-channel sites in the form of livestock watering holes (dugouts) have been found to harbor Topeka Shiners in South Dakota. These off-channel sites may represent important habitat for the species within the floodplains of occupied streams (Thomson 2008). Resampling at various levels (ranges from 2- to 9-years of collection data per stream) has occurred at 28 (46 percent) of the 59 known occupied streams in South Dakota. Topeka Shiner records were collected in these streams at numerous locations, during different seasons and various years with no loss of occupied waterways detected in South Dakota since the species was listed. Of the remaining 31 streams

lacking resampling data, 10 were found to be occupied only recently (2004-2007); additional occupied streams may be identified with future survey efforts. The present distribution encompasses most of the known historic range of the species in this State (Wall et al. 2004; Wall and Thompson 2007). From 2004 to 2006, the South Dakota Department of Game, Fish and Parks conducted a 3-year monitoring study. Three sites within each of eleven known occupied streams were sampled over the course of 3 years. Topeka Shiners were found to be present in all 11 streams and at 76 percent (25 of 33) of sample sites. Sample sites included both new areas and locations where Topeka Shiners had previously been documented. Topeka Shiners were discovered at 12 (67 percent) of 18 new sampling locations and at 12 (86 percent) of 14 sites where Topeka Shiners had previously been documented. Collection records at 5 sampling sites exceeded the highest number of Topeka Shiners previously caught at single sites in each of their respective streams, including 1 record of 964 individuals (Wall and Thomson 2007). Additional monitoring is planned from 2010 to 2012 (Wall and Thompson 2007). This monitoring program was implemented as part of the State's management plan (Shearer 2003).

Minnesota – In Minnesota, Topeka Shiners were known from 15 locales in 8 streams in the Rock and Big Sioux River watersheds at the time of listing (69 FR 71071, December 08, 2004). The species is now known from 75 sites in at least 17 named streams (Baker pers. comm. 2006). The species is now believed to be widely distributed in the Rock and Big Sioux River watersheds in Pipestone, Nobles, and Rock counties, with an additional number of occurrences in adjoining Murray and Lincoln Counties (Ceas and Larson 2008). The species also has been discovered to inhabit off-channel floodplain pools adjacent to these streams (Berg and Anderson 2004). An annual monitoring program to determine population distribution and trends in Minnesota began in 2004 (Ceas and Anderson 2004). After 5 years of monitoring, these researchers concluded that: the species has a widespread distribution across its known historical range; stream segments that do not produce Topeka Shiners tend to be continuously flowing "raceways;" and stream segments with an abundance of suitable habitat produced higher numbers of specimens (Ceas and Larson 2008).

Kansas – In Kansas, Topeka Shiners were extant in several watersheds within the Kansas and Cottonwood River basins at the time of listing (69 FR 71071, December 08, 2004). These populations were largely restricted to portions of the Flint Hills region. An additional isolated population was known from Wallace County, near the Colorado border in the Smoky Hill River watershed. Since listing, portions of these watersheds have been sampled. Topeka Shiners in the Kansas River watershed appear stable in most areas sampled (Kansas Department of Wildlife and Parks 2006; Kansas Department of Wildlife and Parks 2007; Stark 2007; Davis 2008). However, several sub-basins of Mill Creek sampled by Davis in 2008 yielded no specimens (Davis 2008). These areas are scheduled for resampling in 2009 (Tabor pers. comm. 2009). Collections from the Cottonwood River basin suggest a contraction in range and distribution (Simmons pers. comm. 2006). The Wallace County population is now believed extirpated, resulting in the elimination of the last known population of the species in Kansas west of the Flint Hills (Tabor pers. comm. 2009). The Kansas Department of Wildlife and Parks' Comprehensive Wildlife Conservation Plan (2005) lists the Topeka Shiner as declining in Kansas.

Iowa – At the time of listing, the Topeka Shiner was known extant at 10 sites in 4 tributaries to the North Raccoon River watershed, from 2 sites in the Boone River watershed, and 1 site immediately adjacent to the Minnesota border in the Big Sioux/Rock River watershed (63 FR 69008, December 15, 1998). Since 1999, the species has been captured from streams or off-channel pools of 16 tributaries to the North Raccoon River and from 5 off-channel pools adjacent to the mainstem North Raccoon River. The species also has been captured in low numbers from 2 tributaries in the Des Moines River and in 5 tributaries of the Boone watershed (Menzel pers. comm. 2002; Clark

2000; 67 FR 54262, August 21, 2002; Bogenschutz pers. comm. 2005; Howell pers. comm. 2006). Within Big Sioux/Rock River watershed, the species has been captured in low numbers in 2 other tributaries of the Big Sioux/Rock River watershed (Menzel pers. comm. 2002; Clark 2000; 67 FR 54262, August 21, 2002; Bogenschutz pers. comm. 2005; Howell pers. comm. 2006). The North Raccoon River watershed currently comprises approximately 95 percent of the Topeka Shiner's current geographic range in Iowa. Between 2001 and 2007, the USFWS coordinated with several landowners in the North Raccoon River watershed, restoring eight areas of off channel habitat, and one in-channel structure to create additional pool habitat for Topeka Shiner. Additionally in 2007, the USFWS's Rock Island Field Office began a formal study of off-channel habitats to determine population abundance and trend information, including both restored and natural occurring off-channel habitat. In 2007, 18 off-channel habitats were sampled with a total of 2,486 fish captured (25 Topeka Shiners); in 2008, 11 areas were sampled resulting in a total of 4,030 fish (28 Topeka Shiners); and in 2009, 10 areas were sampled, capturing 8,608 fish (630 Topeka Shiners) (McPeek in litt. 2009). However, it was noted that 2 oxbows restored in 2001 contributed 591 of the total 630 Topeka Shiners captured. This annual study is planned to continue into the future. Twelve additional off channel restorations were completed in 2008-2009, with more planned. Iowa State University plans to begin a 2-year study in 2010, analyzing both off-channel and in-channel habitat types; and also plans to resample sites visited in 1997-2001 (McPeek in litt. 2009). In 2005, 42 sites in the East Des Moines and Winnebago River watersheds were sampled (Howell 2007). Approximately 3.5 miles of stream (349 seine hauls) were sampled, and no Topeka Shiners were captured (Howell 2007). Efforts to capture the species elsewhere in the Des Moines, Boone, Big Sioux/Rock River, and Iowa watersheds have been unsuccessful. Surveys for the species in the Cedar and Shell Rock River watersheds (presently assumed extirpated) are planned, but have not been implemented.

Missouri – In Missouri, three populations were believed extant at the time of listing (69 FR 71071, December 08, 2004). At present, two populations exist in the wild (Missouri Department of Conservation1999; Paukert et al. 2007). The Bonne Femme Creek watershed population is now presumed extirpated (Paukert et al. 2007). The last collection of the species from this stream occurred in 1997 (Kerns pers. comm. 2006). The Missouri Department of Conservation completes annual surveys to determine population distribution and trends per their State Action Plan for the Topeka Shiner (Missouri Department of Conservation 1999; Kerns pers. comm. 2006). The distribution of the species is stable in Moniteau Creek, and the species appears to be in decline in the Sugar Creek watershed (Kerns pers. comm. 2007).

Nebraska – In Nebraska, the Topeka Shiner was believed extant in two streams in Cherry and Madison counties at the time of listing (69 FR 71071, December 08, 2004). The last capture of the species from these streams occurred in 1989 and 2000, respectively (Cunningham pers. comm. 2006). Access is now prohibited at the Cherry County site (Cunningham pers. comm. 2006). However, a single Topeka Shiner was found in a small stream in Cherry County in 2006 approximately 6 miles from the previous record site as of 2006 (Fritz pers. comm. 2009). This record confirms the continuing existence of the species in that area as of 2006 (Fritz pers. comm. 2009). It is unknown whether the species continues to exist in Madison County.

POPULATIONS TRENDS

Recent information from the ongoing Species Status Assessment indicates a decline since listing (1999) in species presence, range, and abundance in Minnesota, Iowa, Kansas, Nebraska, and Missouri. Data collected from sites in South Dakota have not been sufficient enough to discern any

significant trends but do suggest a decline in the number of repeat samples with species presence. The Species Status Assessment will provide better details and should be complete within 6 months.

POPULATION OBJECTIVE

No population objectives at this time, however, work is underway to complete a Recovery Plan, which will likely take up to two years to complete. The Species Status Assessment (currently underway and to be completed within 6 months) will provide a general understanding of the current population trends and will inform the development of population objectives.

IMPLICATIONS AND RECOMMENDATIONS FOR CONSERVATION DESIGN AND MONITORING

It is understood that altered hydrology is a major driver in the current and future status of the species. Altered hydrology could come from many stressors, including agriculture, climate change, groundwater withdrawal, lack of connectivity and alterations to the stream channel.

Increased state monitoring and subsequent spatial modeling efforts would greatly benefit the ability to accurately identify population status and trend in relative abundance and occupancy. In addition to monitoring, conservation measures should be considered that would improve access to off-channel and backwater habitats within the Topeka Shiner range. Any modifications or restoration efforts should also consider contribution of groundwater and reduction in the number of introduced predator fish. Along with in-stream restoration, measures should be taken to reduce or attenuate tiling discharge from farm fields.

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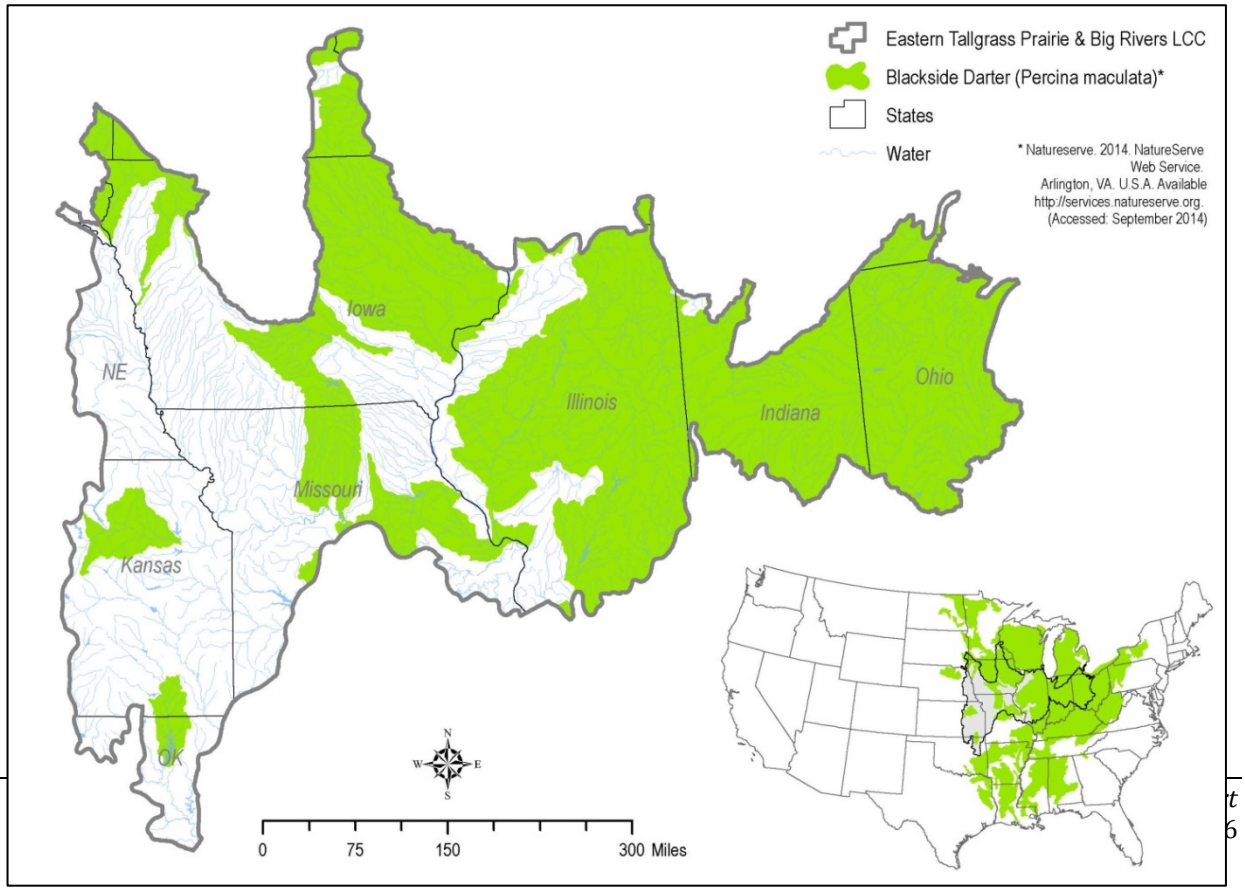
BLACKSIDE DARTER

By Aleshia Kenney

ETPBR geography population estimate: Not available

ETPBR geography population objective: The status and information needs for setting a population objective will be gathered from the states and will be addressed by Spring 2015.

Blackside Darter (*Percina maculata*), an "umbrella" surrogate species for the ETPBR geography, is characteristic of medium to moderately large, sparsely vegetated streams having low or moderate gradients, permanent flow, and gravelly or sandy bottoms (Pflieger 1997). Blackside Darters are most abundant in firm-bottomed pools of creeks and small rivers, but they sometimes ascend into headwaters (Smith 2002). Adults usually are found in gravelly riffles, runs, and shallow pools having sufficient current to maintain a substrate that is largely free of silt. The young commonly occur in backwaters, among accumulations of sticks, leaves, and other debris (Pflieger 1997). The Blackside Darter is highly intolerant of considerable siltation (Etnier and Starnes 1993) and organic pollutants such as mine wastes (Trautman 1981). The Blackside Darter is widespread in the United States and Canada, and is found throughout the Hudson Bay, Great Lakes - St. Lawrence, and Mississippi River Basin (Page and Burr 2011). Although



this species is widely distributed, it generally exists in low-population densities (Pflieger 1997). Pflieger theorized that Blackside Darters were more abundant and widely distributed before the extensive channelization of prairie streams and ditching and draining of parts of their habitat.

The sparsely vegetated tributary rivers, with enough flow to maintain a silt free bottom in which Blackside Darters evolved met the habitat and life history requirements of other native small-river fishes. Conservation actions for Blackside Darters are expected to benefit a wide array of other creek and small river species that prefer silt free habitats. Blackside Darter was chosen as part of a group of three umbrella species to represent other trust species inhabiting small, permanent flow rivers throughout the ETPBR geography (Blomquist et al. 2013).

POPULATIONS STATUS

Blackside Darter has been identified as a threatened species in Kansas (Cross and Collins 1995) and South Dakota, and as a "species in greatest need of conservation" in Iowa, Nebraska, and Oklahoma.

State	Blackside Darter State Listing Status	State Wildlife Action Plan SGCN
Illinois	No Status	N
Indiana	No Status	N
Iowa	Species of Concern	Y
Kansas	Threatened	Y
Michigan	No Status	N
Minnesota	No Status	N
Missouri	No Status	N
Nebraska	Species of Concern	Y
Ohio	Species of Concern	N
Oklahoma	Species of Concern	Y
South Dakota	Threatened	Y
Wisconsin	No Status	N

POPULATIONS TRENDS

Relatively poor statewide surveys for this species make population and trend estimates difficult to interpret. The state of Illinois performs fish surveys of all the basins in the state every five years. This survey data goes back 20-30 years, so trend data within this state could be developed. The rest of the states throughout the ETPBR have mostly presence data for the Blackside Darter.

POPULATION OBJECTIVE

There are currently no population objectives developed for the Blackside Darter. However most of the states within the ETPBR have occupancy data along with stream characteristics at the time of finding (substrate, vegetation presence, flow, water quality, etc.). This data could be used to develop a habitat objective for the Blackside Darter based on the fact that they prefer clear, silt free streams. For example, a habitat objective could be to reduce silt in several streams throughout the range of the Blackside Darter, thereby extending the range of this species, along with other species that also prefer silt free habitats.

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

There are a few spatial models and one habitat model available for the Blackside Darter in the ETPBR geography. Additional work will be necessary in order to apply these models across the ETPBR range. Very little information is known about the current population status within each of the states. A conservation design strategy for Blackside Darter could attempt to utilize the existing

spatial models across the ETPBR geography. However, such models may have severe limitations for this species in this geography due to lack of abundance data and lack of habitat data associated with presence surveys. Additional work will be necessary to explore the validity of extrapolating models from other geographies, or exploring habitat and occurrence relationships to landscape habitat parameters using readily available datasets, which is limited to state survey data.

Increased state monitoring and subsequent spatial modeling efforts would greatly benefit the ability to accurately identify areas occupied by the Blackside Darter. These surveys should monitor abundance of Blackside Darters linked with instream habitat characteristics to further populate the spatial models that exist.

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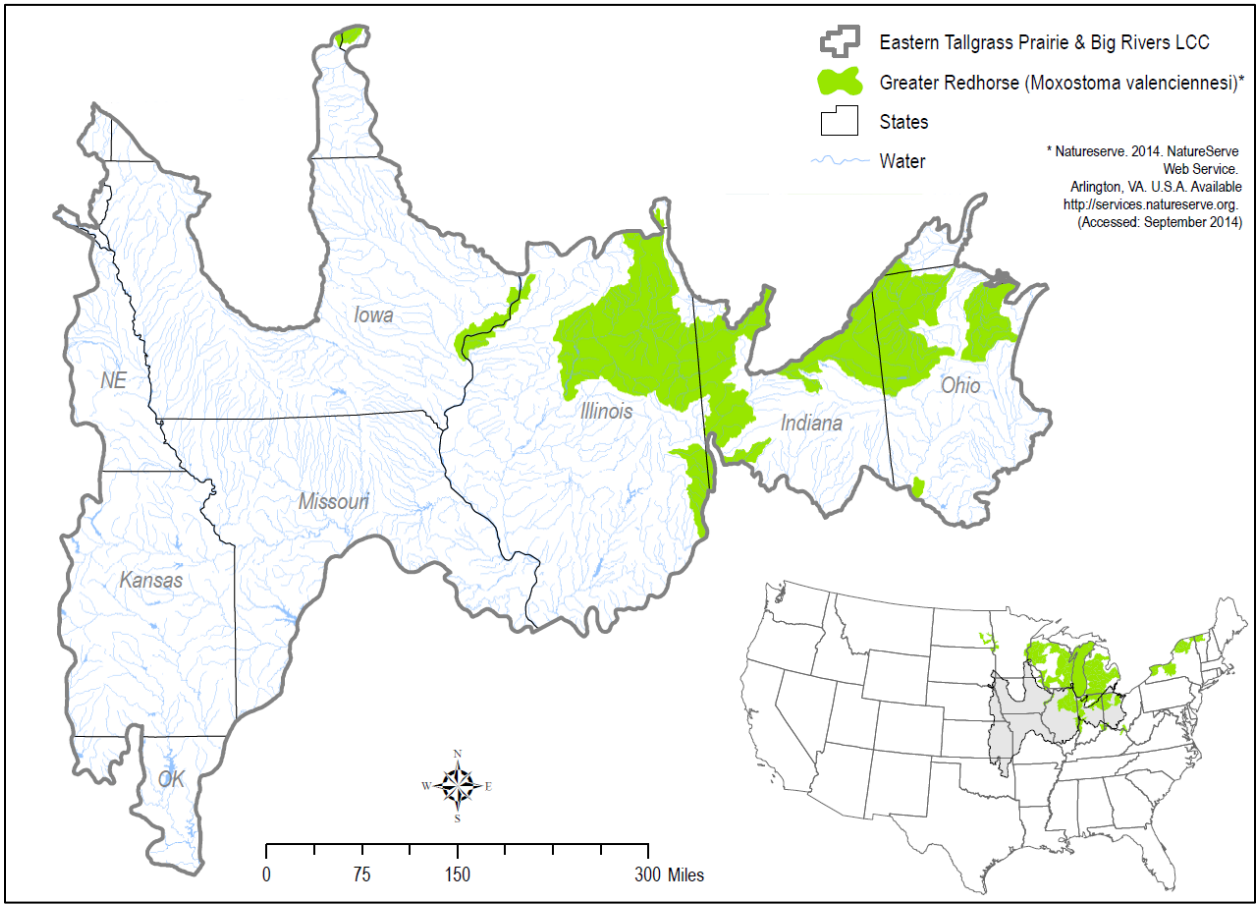
GREATER REDHORSE

By Peter Johnsen

ETPBR geography population estimate: Not available

ETPBR geography population objective: Increase the distribution and connectivity between occurrences

Greater Redhorse (*Opsopoeodus emiliae*) is an "umbrella" surrogate species (Blomquist et al. 2013). Greater Redhorse is a relatively large-sized benthic invertivore fish reaching a length of up to about 620 mm. It is found mostly in warm, moderate to fast flowing medium-sized to large rivers. It sometimes also occurs in river reservoirs and lakes (Scott and Crossman 1973, Hocutt and Wiley 1986). It seems to need clear and clean water with low turbidity and siltation. The species occurred from Ohio River and its tributaries north to rivers and streams in southern Québec (Page and Burr 1991). In the US, the center of distribution includes Wisconsin and Michigan. The ETPBR geography captures the southern edge of the species range with Greater Redhorse being found as multiple spotty occurrences within the states of Illinois, Indiana, and Ohio. It has been reported in the Mississippi River along the border between Iowa and Illinois. In Ohio it is



found in rivers draining into Lake Erie. The species is believed extirpated from the Ohio River drainage in Ohio and Kentucky though the historic records of these occurrences are questionable (Trautman 1957, Burr and Warren 1986).

The distribution of Greater Redhorse is declining in its southern range (Page and Burr 1991). Several states within the ETPBR geography list Greater Redhorse as Threatened or Endangered (Table 1). Although chosen as an umbrella species, the species could also serve an indicator of degraded water quality from both point and non-point pollution and sediment input into streams and this addition should be assess as implementation of SHC proceeds. Maintaining population levels and distribution within the ETPBR geography is important for species diversity and for maintaining population viability at the southern edge of its natural range. Conservation efforts will depend on mitigating habitat losses and degradation, especially those associated with urban and agricultural run-off and land erosion as well as reconnecting occurrences.

Conservation actions for Greater Redhorse will likely benefit fauna dependent on medium-to-large sized fast-flowing rivers with clean and clear water and medium-to-coarse bottom substrate. Greater Redhorse was chosen as part of a group of five umbrella species to represent other trust species inhabiting medium to large, permanently flowing, warm rivers throughout the ETPBR geography.

POPULATION STATUS

Illinois and Indiana list the Greater Redhorse as endangered and Ohio list it as threatened. It is not listed as Endangered or Threatened or considered a Species of Concern under the U.S. Endangered Species Act. It is not listed in Canada. The species has not yet been assessed for the IUCN red list.

State	Greater Redhorse State Listing Status	State Wildlife Action Plan SGCN
Illinois	Endangered	Y
Indiana	Endangered	Y
Iowa	Not listed	Y
Kansas	Likely Extirpated	N
Michigan	Not listed	N
Minnesota	Not listed	Y
Missouri	Not present	N
Nebraska	Not present	N
Ohio	Threatened	N
Oklahoma	Not present	N
South Dakota	Not present	N
Wisconsin	Special Concern	Y

Though no explicit studies of Greater Redhorse sub-population structure could be found, the species distribution seems to consist of multiple isolated populations. This may both be a consequence of the natural history of the species and a consequence of habitat degradation and extirpation between occupied stream reaches caused by human activities.

The species is considered extirpated from many of its historic locations within the ETPBR and most states report a declining distribution. The species is believed to have been extirpated from the Ohio River drainage and its historic southernmost distribution in the Mississippi River. The only recorded observation of this species in Kansas dates back to 1888 (Burr and Warren 1986).

The Nature Serve database (http://explorer.natureserve.org/) list the species as likely occurring at over 100 locations with a global abundance estimated to range between 100,000 to a million. Based on general statements and estimates of number of individuals indicate that large populations are

limited to a few locations. No population estimates for individual locations within the ETPBR could be found. Condition of occurrences are roughly estimated to be 50% good and 50% fair in Illinois and Indiana; and excellent in two drainages, fair in two and poor in one in Ohio (Nature Serve 2014).

State agencies have identified loss of clear and clean water, medium-to-coarse bottom substrate, and continuous connected large rivers reaches as reasons for the species decline. Introduction of fine sediment and silt from upstream erosion caused by land modifications and agriculture, pollution from urban and agricultural run-off, removal of riparian vegetation buffers, and construction of dams and channelization of streams are likely major causes of observed adverse habitat modifications.

POPULATION TRENDS

Lack of monitoring programs for this species makes it difficult to estimate population abundances and trends. However, comparing historic with current observations indicate an increasing decline in distribution over time. Given the presence of local extirpations and the decline in distribution, it is reasonable to assume that abundances have declined at many locations, for most populations, and for the whole ETPBR geography.

POPULATION OBJECTIVE

None of the states covered by the ETPBR geography have established population objectives for this species. The USDA Forest Service, Eastern Region, has conducted a Greater Redhorse conservation assessment for Chippewa National Forest in Minnesota, and in Chequamegon-Nicolet and Huron-Mainstee National Forests in Wisconsin (Healy 2002, in prep.). The purpose of this assessment is to provide information to prepare Conservation Approaches and a Conservation Strategy to conserve the Greater Redhorse within the forests, but these documents do not include a population objective. A species objective based on increasing occurrences/distribution, connectivity between occupied habitats, and population targets for individual populations can be developed based on existing information.

A preliminary, proposed objective is to increase the distribution and connectivity between occurrences within the ETPBR geography. This preliminary objective will be developed as population data is gathered from State partners.

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

Spatial models for this species are not currently available for the ETPBR geography. A conservation design strategy for the Greater Redhorse could attempt to utilize conservation approaches and strategies that are being developed by the USDA National Forest, Eastern Region (Healy 2002, in prep.). Population objectives and/or conservation strategies should be coordinated with the Upper Midwest and Great Lakes LCC geography as most of the Greater Redhorse distribution falls within that geographic area.

A scaled population objective could be set for this species based on existing distribution data and future monitoring programs. The Greater Redhorse is found at discrete, primarily isolated

occurrences within the ETPBR geography. Presence maps have been published for several states and data can be extracted from fisheries databases. State agencies and program managers could be contacted to access the original occurrence data that were used to develop maps and information about the locations that have been surveyed. Objectives could then be developed at different scales based on information about historic and current occurrences. Objectives could consist of distribution, connectivity, and abundance targets. Though no abundance estimates exist for populations, abundance objectives for each population could be developed based on general knowledge of what abundance would be needed to 1) provide for genetic and biological sustainability and 2) to minimize the probability of extirpation as a result of a catastrophic decline. The scaling of objectives would be achieved by setting objectives for stream reaches that are rolled into objectives for watersheds which again is rolled into objectives for populations and finally into objectives for metapopulations. Developing a species objective and conservation strategy for Greater Redhorse would require substantial effort in finding the original data used to develop presence maps and gathering information about the stream reaches where the species are or were observed. Long-term population or distribution assessments and monitoring programs will have to be developed as part of a conservation strategy for this species as no ongoing efforts or programs seems to exist within the ETPBR geography.

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STATE AGENCY WEBSITES

Fisheries and Oceans Canada
http://www.dfo-mpo.gc.ca/species-especes/listing-eng.htm
Illinois Department of Natural Resources
http://www.dnr.illinois.gov/espb/Pages/default.aspx
Illinois Department of Conservation, Natural Heritage Database
http://dnr.state.il.us/conservation/naturalheritage/inhd.htm
Indiana Department of Natural Resources, Non-game and Endangered Wildlife
http://www.in.gov/dnr/fishwild/2356.htm

Iowa Rivers Information System, Fish Atlas
http://maps.gis.iastate.edu/iris/fishatlas/
Greater Redhorse Information
http://maps.gis.iastate.edu/iris/fishatlas/IA163947.html
Kansas Department of Wildlife, Parks, and Tourism; Threatened and Endangered Wildlife
http://kdwpt.state.ks.us/Services/Threatened-and-Endangered-Wildlife
Michigan Natural Feature Inventory, Rare Species Explorer
http://mnfi.anr.msu.edu/explorer/search.cfm
Missouri Department of Conservation
http://mdc4.mdc.mo.gov/applications/mofwis/Mofwis_Search1.aspx
Minnesota Department of Natural Resources, Endangered and Threatened Species
http://www.dnr.state.mn.us/ets/index.html
Minnesota Species of Greatest Conservation Need
http://archive.leg.state.mn.us/docs/2006/other/060316/www.dnr.state.mn.us/cwcs/strategy.html
Ohio Department of Natural Resources, Division of Wildlife, State Listed Species
http://wildlife.ohiodnr.gov/species-and-habitats/state-listed-species
Greater Redhorse Information
http://wildlife.ohiodnr.gov/species-and-habitats/species-guide-index/fish/greater-redhorse
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http://www.wildlifedepartment.com/wildlifemgmt/endangeredspecies.htm

RIVER REDHORSE

By Nick Utrup

ETPBR geography population estimate: Not available

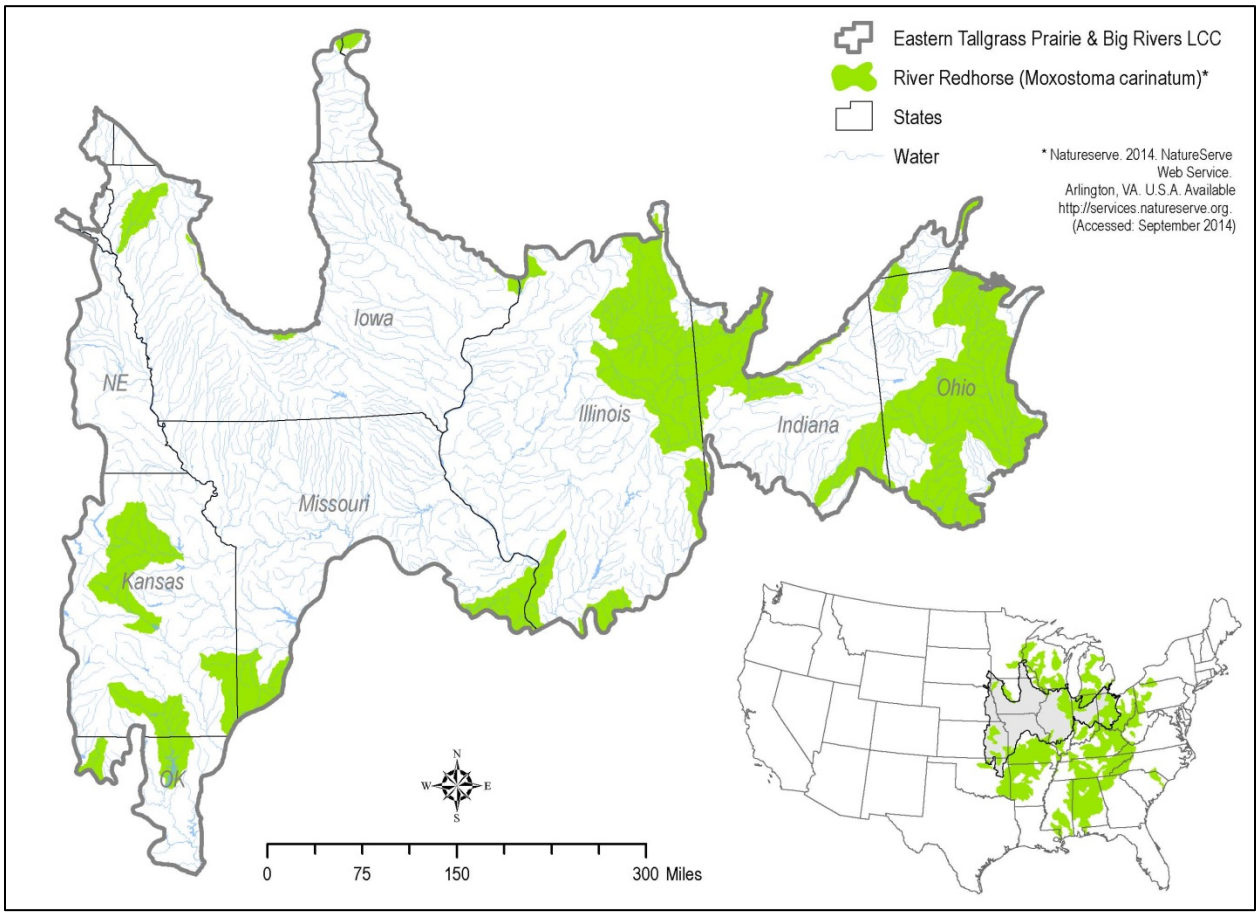
ETPBR geography population objective: The status and information needs for setting a population objective will be gathered from the states and will be addressed by Spring 2015.

River Redhorse (*Mosostoma carinatum*), an "umbrella" and "environmental indicator" surrogate species for the ETPBR geography, is a bottom-oriented, late-maturing, long-lived and large-bodied sucker that requires large interconnected riverine habitat to fulfill the need of all life stages. Specimens generally attain a size around 500 mm (~20 inches; Campbell 2001). The River Redhorse is described as an intolerant species and is often used as an indicator of good water quality (Trautman 1981; Pflieger 1997; ODNR 2014). River Redhorse have been documented to prefer habitats with moderate to swift current, riffle-run habitat and clean coarse substrates (Scott and Crossman 1973; Becker 1983; Yoder and Beaumier 1986; Pflieger 1997). Yoder and Beaumier (1986) observed densities eight times greater in locations of preferred habitat compared to areas of poor water quality, altered habitat, heavy siltation, or areas that are pooled or impounded (Philips et al. 1991).

River Redhorse possess large, molar-like throat teeth (pharyngeal teeth) that distinguish them from other redhorse species and show a special adaptation for crushing mollusk shells (Phlieger 1997). While both males and females are large bodied, attaining sizes in excess of 700 mm (>27 inches), males are usually shorter and lighter than females (Campbell 2001). River Redhorse have been speculated to reach sexual maturity between 3 and 5 years and have been documented in the Mississippi River to reach 28 years in age (Tatum and Hackney 1970; Huston 1999; Campbell 2001).

Depending on the development of the pharyngeal teeth, diet varies between soft and hard bodied prey. In early pharyngeal arch and teeth development, young River Redhorse feed mostly on insect larvae and microcrustaceans (COSEWIC 2006). Stomach contents are generally dominated by *Ephemeroptera* and *Trichoptera* larvae, though River Redhorse prefer mollusks to a much greater degree than other redhorse species, likely because of their specialized pharyngeal teeth (COSEWIC 2006).

The moderate to swift current, riffle-run habitat with clean coarse substrates also supports the habitat and life history requirements of other native medium- to large-river fishes. Conservation actions for River Redhorse are expected to benefit a wide array of other medium- to large-river warm-water species that prefer clean coarse substrates and riffle-run habitats. River Redhorse was chosen as part of a group of five umbrella species to represent other trust species inhabiting medium to large, permanently flowing, warm rivers throughout the ETPBR geography (Blomquist et al. 2013). River Redhorse was also chosen as the environmental indicator species to



represent the effect of nitrogen pollution and eutrophication on other trust species inhabiting medium to large, permanently flowing rivers throughout the ETPBR geography.

POPULATIONS STATUS

Though current population status throughout the entire ETPBR geography is unknown, the River Redhorse is listed as a threatened species in Wisconsin and Illinois and a species of concern in Ohio and Kansas. More information is needed from the states to identify populations and determine status.

State	River Redhorse State Listing Status	State Wildlife Action Plan SGCN
Illinois	Threatened	Y
Indiana	Not listed	N
Iowa	Not listed	Y
Kansas	Species of Concern	Y
Michigan	Not listed	N
Minnesota	Not listed	N
Missouri	Not listed	N
Nebraska	Not present	N
Ohio	Species of Concern	Y
Oklahoma	Not listed	N
South Dakota	Not present	N
Wisconsin	Threatened	Y

POPULATIONS TRENDS

Lack of monitoring programs for this species makes it difficult to estimate population abundances and trends. In Illinois, populations seem to be stable or increasing in part of its range within the ETPBR geography. In Wisconsin, River Redhorse does not appear to have any sort of major up or down trend since the 1970's and the current species status in WI is threatened based on only 25-30 documented occurrences. The benchmark in Wisconsin is for River Redhorse to occur within at least 40 discrete locations (e.g., individual waterbody or well-defined [i.e., by dams, waterfalls, major confluences] reach of river).

POPULATION OBJECTIVE

None of the states covered by the ETPBR geography have established specific population objectives for this species. Statewide objectives generally mention the goal of maintaining a certain level of occupancy (John Lyons personal communication, Wisconsin Department of Natural Resources) or distribution (Metzke et al. 2012) within the state. It was identified in Illinois' Comprehensive Wildlife Conservation Plan and Strategy that populations at all currently-occupied locations are maintained and re-established at 50% or more of historic locations where suitable habitat persists or can be restored (IL DNR 2005). In Wisconsin, the benchmark is for River Redhorse to occur within at least 40 distinct locations in the state.

IMPLICATIONS AND RECOMMENDATIONS FOR CONSERVATION DESIGN AND MONITORING

Spatial models for this species are not currently available for the ETPBR geography. A scaled population objective could be set for this species based on existing distribution data and future monitoring programs. The River Redhorse is found as discrete occurrences within the ETPBR geography. Presence maps have been published for several states and data can be extracted from fisheries databases. State agencies and program managers could be contacted to access the original occurrence data that were used to develop maps and information about the locations that have been surveyed. Objectives could then be developed at different scales based on information about historic and current occurrences. Objectives could consist of occupancy, distribution, connectivity, and abundance targets. Though no abundance estimates exist for populations, abundance objectives for each population could be developed based on general knowledge of what abundance would be needed to 1) provide for genetic and biological sustainability and 2) to minimized the probability of extirpation as a result of a catastrophic decline. Developing a species objective and conservation strategy for River Redhorse would require substantial effort in finding the original data used to develop presence maps, identifying populations, and gathering information about the stream reaches where the populations are or were observed. Long-term population or distribution assessments and monitoring programs will have to be developed as part of a conservation strategy for this species as no ongoing efforts or programs seems to exist within the ETPBR geography.

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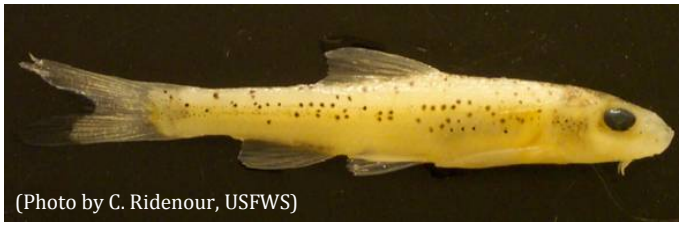
SHOAL CHUB

By Clayton Ridenour

ETPBR geography population estimate: Not available

ETPBR geography population objective: Population objectives will be determined based on current and planned research.

Shoal Chub (*Macrhybopsis hyostoma*), an "umbrella" surrogate species for the ETPBR geography, is one of three ecologically similar *Macrhybopsis* spp. that predominantly persists in large rivers throughout the ETPBR geography. However, they are widespread in the Mississippi River basin and in streams of the western Gulf Slope of the United States (Eisenhour 1997, 1999). It is a small bodied minnow with a life span usually not exceeding four years and is reproductively mature by the second year of life. In big rivers like the Missouri and Mississippi Rivers, Shoal Chub occur over sand and gravel substrates, but tend to be found in slightly shallower and slower velocity habitat types than the closely associated sturgeon chub and sicklefin chub (Ridenour et al. 2009). Its distinctive species characteristics of a relatively large eye, concentrated anterior taste buds but on a short snout, long ventral barbles at the corner of the mouth, and peppered pigmented coloration suggests an ecomorphologically suited for a wide range of fluvial environments.


(Photo by C. Ridenour, USFWS)

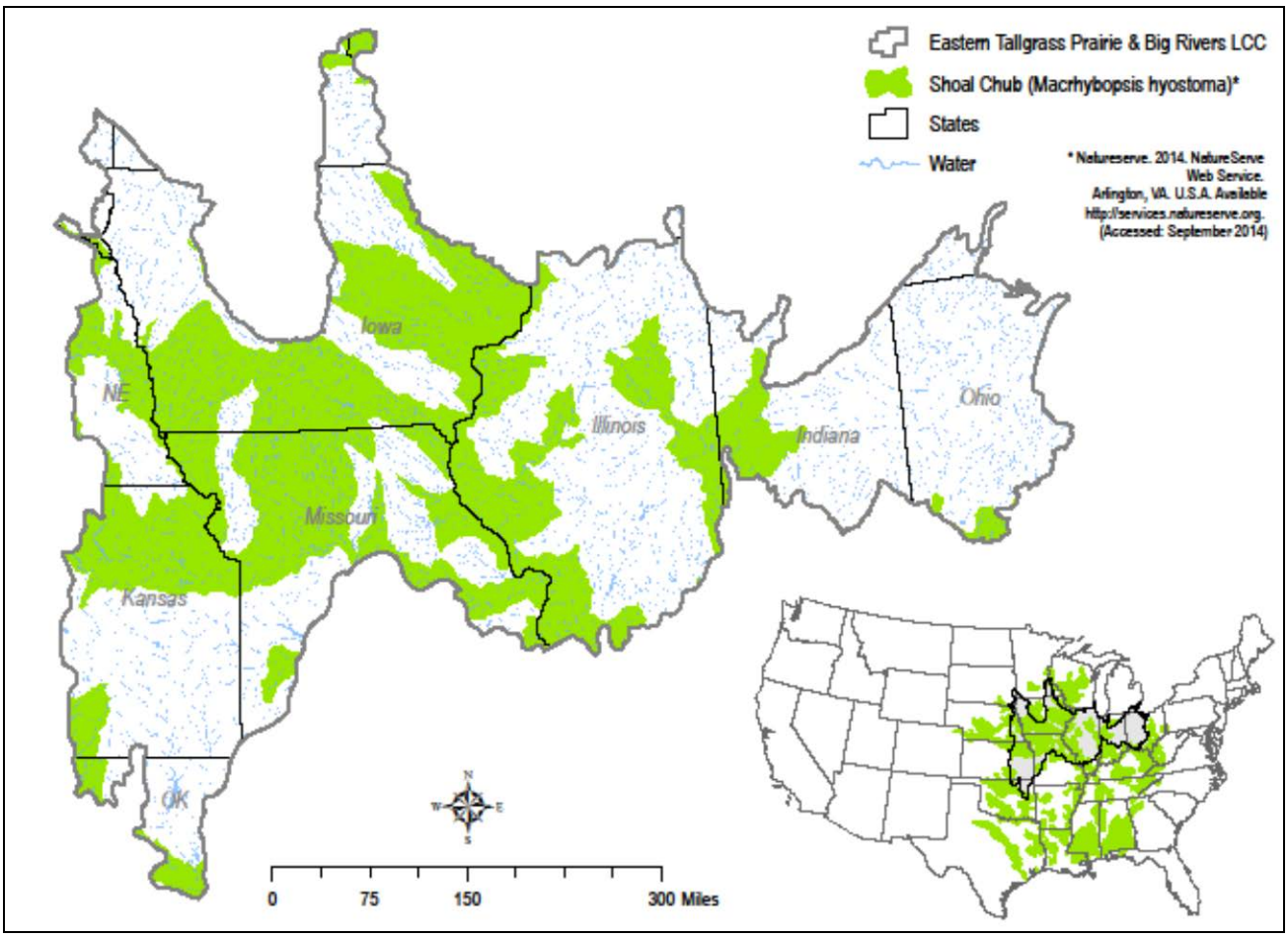
POPULATION STATUS

Where they are found, their populations appear to be stable (Grady and Milligan 1998). However, populations are susceptible to periods of high mortality (Herman et al. 2014; Wrasse et al. 2014).

State	Shoal Chub State Listing Status	State Wildlife Action Plan SGCN
Illinois	No status	N
Indiana	No status	N
Iowa	No status	Y
Kansas	No status	N
Michigan	No status	N
Minnesota	No status	Y
Missouri	No status	N
Nebraska	No status	N
Ohio	No status	Y
Oklahoma	No status	N
South Dakota	No status	N
Wisconsin	Threatened	Y

POPULATION TRENDS

Existing data from a Missouri River long term monitoring project since 2003 is variable (Albers et al. In Review), it suggests populations of Shoal Chub in large rivers like Missouri River may operate on cyclic pattern. Shoal Chub have been generally more abundant and commonly collected in standard



monitoring gears than Sturgeon Chub or Sicklefin Chub in systems where they co-occur. The comparatively large eye of Shoal Chub suggests it may be better suited for life in environments with reduced turbidity than co-occurring *Macrhybopsis* spp. with small eyes like sturgeon chub and sicklefin chub. The USGS is currently conducting research intended to produce a river fish community population growth model to include Shoal Chub, ultimately to forecast the effects of climate change on population dynamics.

POPULATION OBJECTIVE

There are no known population objectives explicitly quantified for Shoal Chub at this time, however Shoal Chub may be used as an indicator species to Pallid Sturgeon because of their direct link in the food web (Gerrity et al. 2006). There is limited empirical research work, and it appears that no metapopulation analysis on Shoal Chub has been synthesized across their range. However, existing and new research conducted by USGS in the Missouri River and Kansas River: is anticipated to address Shoal Chub bioenergetics and role in the fish community food chain; establishes laboratory controlled spawning parameters and explores habitat selection under differing food availability in the laboratory (DeLonay et al., in review).

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

Shoal Chub's persistence in a range of fluvial environments makes it an acceptable candidate to help assess ecosystem status of medium to large rivers in the ETPBR geography. Their short life span rapid growth to reproductive maturity would be conducive for monitoring and evaluating the effects of habitat management actions and climate change.

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PALLID STURGEON

By Greg Conover

Description extensively relies on information from the Revised Recovery Plan for the Pallid Sturgeon (USFWS 2014).

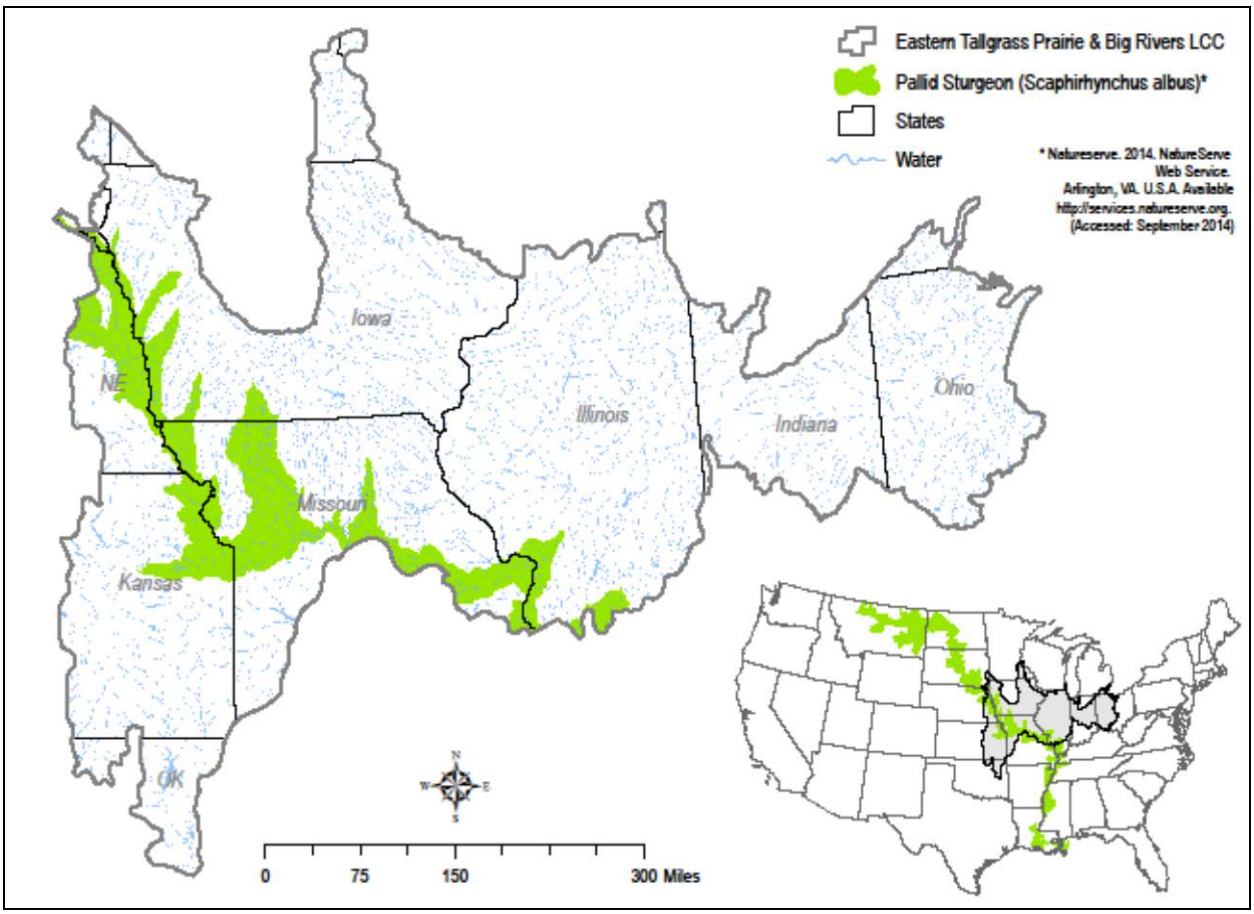
ETPBR geography population estimate: To be determined

ETPBR geography population objective: Self-sustaining, genetically diverse population of 10,000 wild adult Pallid Sturgeon with at least 5,000 wild adults within each of the Central Lowland Plains and Interior Highlands management units

Pallid Sturgeon (*Scaphirhynchus albus*), an "umbrella" surrogate species for the ETPBR geography, is a bottom-oriented, large river obligate fish adapted to the pre-development habitat conditions that historically existed in the Missouri and Mississippi rivers (USFWS 2014, Kallemeyn 1983). These conditions generally can be described as large, free-flowing, warm-water, and turbid rivers with a diverse assemblage of dynamic physical habitats. Pallid Sturgeon inhabit the Missouri and Mississippi rivers from Montana to Louisiana and the lower reaches of some larger tributaries within the ETPRB geography including the Platte and Kansas rivers. Although the reported distribution of Pallid Sturgeon includes the Mississippi River as far north as Keokuk, IA, the historical range of the species in the Mississippi River above the Missouri River confluence is uncertain. There are few historical (pre-listing) records of Pallid Sturgeon from the Mississippi River, possibly due to a lack of systematic fish collections from that portion of the range. Following construction of a series of six high-head navigation dams and one low-water dam in this reach largely during the 1930s, Bailey and Cross (1954) remarked that the species in this portion of the Mississippi River is likely represented by "stragglers from down river."

Modification of the large river environment for navigation and flood control over the course of nearly 200 years has greatly reduced the river's ability to satisfy the life history requirements of Pallid Sturgeon by: 1) blocking movements to spawning and feeding areas; 2) affecting historical genetic exchange among reaches, (i.e., reducing or eliminating emigration and immigration); 3) decreasing turbidity levels by trapping sediment in reservoirs; 4) reducing distances available for larvae to drift; 5) altering water temperatures; 6) altering conditions and flows in spawning areas; 7) altering flows and temperatures associated with spawning movements; and 8) possibly reducing food sources by lowering productivity (Bowen et al. 2003; Hesse et al. 1989; Keenlyne 1989; USFWS 2000a).

The unaltered large-river ecosystem characterized by floodplains, backwaters, chutes, sloughs, islands, sandbars, and a dynamic main channel in which Pallid Sturgeon evolved met the habitat and life history requirements of other native large-river fishes. Conservation actions for Pallid Sturgeon are expected to benefit a wide array of other obligate large-river species. Pallid Sturgeon



was chosen as an umbrella species to represent other trust species inhabiting large rivers throughout the ETPBR geography (Blomquist et al. 2013).

POPULATIONS STATUS

The Pallid Sturgeon was listed as endangered under the Endangered Species Act in 1990 (55 FR 36641-36647). Pallid Sturgeon are listed as state endangered in Illinois, Missouri, Kansas, Iowa and Nebraska. According to the International Union for Conservation of Nature (IUCN) the Pallid Sturgeon continues to face a very high risk of extinction in the wild and has been assigned Endangered (A4ce) status.

Because the Pallid Sturgeon was not recognized as a species until 1905, little detailed information is available concerning early abundance. Although considered to be nowhere common, Bailey and Cross (1954) indicated that Pallid Sturgeon were considerably more abundant in larger turbid rivers than in clear or moderately turbid waters. Pallid Sturgeon observations and records have increased with sampling effort following the species listing as a federally endangered species.

Steffensen et al. (2012) generated an annual population estimate for wild Pallid Sturgeon in the reach of the Missouri River extending from the Platte River confluence downstream 80.5 Rkm (50 Rmi). Their results estimated wild Pallid Sturgeon at 5.4 to 8.9 fish/Rkm (8.7 to 14.3fish/Rmi). Extrapolating these estimates to the entire lower Missouri River suggests that the wild population

may consist of as many as 5,991 mature individuals (Steffensen et al. 2013). Garvey et al. (2009) generated an estimate of 1,600 (5 fish/Rkm, 0.8 fish/Rmi) to 4,900 (15.2 fish/Rkm, 24.5 fish/Rmi) Pallid Sturgeon for the middle Mississippi River (i.e., mouth of the Missouri River downstream to the Ohio River confluence). In 2009, a sturgeon survey in the Upper Mississippi River captured a single Pallid Sturgeon below lock and dam 25 near Winfield, Missouri (Herzog in litt., 2009).

Recovery Unit	Objective	Population Estimate*
Central Lowlands	5,000	3,954
Interior Highlands	5,000	6,877

**Example numbers. Actual estimates are being compiled.*

POPULATIONS TRENDS

The Revised Recovery Plan for Pallid Sturgeon (USFWS 2014) reports that the numbers of wild Pallid Sturgeon collected in the Missouri, Mississippi and Atchafalaya rivers are higher than initially documented when the species was listed; however, the observed increases are the result of increased monitoring efforts, improvements in sampling techniques, and greater emphasis on research in the impounded portion of the range. Within the ETPBR geography, evidence of limited recruitment exists in both the Missouri and Mississippi rivers.

Despite increased efforts, data regarding recruitment, mortality, habitat use, and abundance remain limited. The population has not been fully quantified, making population trends difficult to assess. In general, the IUCN reports that current trends of Pallid Sturgeon populations are variable from decreasing in the upper part of the range (i.e., Missouri River above Gavins Point Dam) to stable in the lower part of their range (i.e., Atchafalaya River) to unknown in the middle portion of their range (i.e., Mississippi River).

Since 1994, the Pallid Sturgeon Conservation Augmentation Program (PSCAP) has released hatchery-reared Pallid Sturgeon within the Missouri River, portions of the Yellowstone River, and sporadically in the Mississippi River. The population in the Missouri River may be stabilizing as a result of the PSCAP, but remains neither self-sustaining nor viable (Steffensen 2012; Steffensen et al. 2013). However, if supplementation efforts were to cease, the species would once again face local extirpation within several reaches.

POPULATION OBJECTIVE

The U.S. Fish and Wildlife Service (2014) has established four recovery priority management areas to focus recovery efforts at locales believed to have the highest recovery potential. The Central Lowlands Plains Unit is defined as the Missouri River from Fort Randall Dam, South Dakota to the Grand River confluence with the Missouri River in Missouri and includes important tributaries like the lower Platte and lower Kansas rivers. The Interior Highlands Management Unit is defined as the Missouri River from the confluence of the Grand River to the confluence of the Mississippi River, as well as the Mississippi River from Keokuk, Iowa to the confluence of the Ohio and Mississippi rivers. The complete range of the Pallid Sturgeon in the ETPBR geography lies within these two recovery units.

The population objective for range-wide recovery of the Pallid Sturgeon is a self-sustaining genetically diverse population of 5,000 adult Pallid Sturgeon maintained within *each* management unit for 2 generations (20-30 years). In this context, a self-sustaining population is described as a spawning population that results in sufficient recruitment of naturally-produced Pallid Sturgeon into the adult population at levels necessary to maintain a genetically diverse wild adult population in the absence of artificial population augmentation. Metrics suggested to define a minimally sufficient population would include incremental relative stock density of stock-to-quality-sized naturally produced fish (Shuman et al. 2006) being 50-85 over each 5-year sampling period, catch-per-unit-effort data indicative of a stable or increasing population, and survival rates of naturally produced juvenile Pallid Sturgeon (age 2+) equal to or exceeding those of the adults. Additionally, in this context a genetically diverse population is defined as one in which the effective population size (N_e) is sufficient to maintain adaptive genetic variability into the foreseeable future ($N_e \geq 500$), conserve localized adaptions, and preserve rare alleles.

The population objective for Pallid Sturgeon in the ETPBR geography is a self-sustaining genetically diverse population of 5,000 wild adult Pallid Sturgeon maintained within each of the Central Lowland Plains and Interior Highlands management units.

IMPLICATIONS AND RECOMMENDATIONS FOR CONSERVATION DESIGN AND MONITORING

The Pallid Sturgeon recovery team identified five factors that limit the species from meeting its population objective: 1) activities which affect in-river connectivity and the natural form, function, and hydrologic processes of rivers; 2) illegal harvest; 3) impaired water quality and quantity; 4) entrainment; and 5) life history attributes of the species (i.e., delayed sexual maturity, females not spawning every year, and larval drift requirements). These limiting factors provide a framework for the implementation of conservation actions to restore the species to healthy population levels.

The recovery plan includes an Implementation Schedule that outlines recovery tasks, task priorities, task descriptions, task duration, and estimated task costs (2014-2047). The recovery plan also includes a Recovery Outline/Narrative that describes recovery tasks believed necessary to recover Pallid Sturgeon within each management unit.

Considerable effort is currently being expended to monitor and assess Pallid Sturgeon populations and habitat within much of the species range in the ETPBR geography. A partnership of federal agencies, state agencies and academia are implementing a Pallid Sturgeon Population Assessment on the Missouri River. The study has multiple objectives including an evaluation of annual and long-term trends in Pallid Sturgeon population abundance, distribution, habitat utilization, population structure and population dynamics. The study similarly evaluates annual and long-term trends for a suite of other native Missouri River fish, including three chub species that are the main forage for Pallid Sturgeon. The Habitat Assessment and Monitoring Program (HAMP) is a critical element of the Pallid Sturgeon Recovery Program and is designed to document and assess the physical and biotic responses to main channel shallow-water habitat creation on the Missouri River below Gavins Point Dam (Schapaugh et al. 2010). Results of the Pallid Sturgeon Habitat Assessment and Monitoring Program and the Pallid Sturgeon Population Assessment will contribute to both conservation design and monitoring.

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Map depicting the Central Lowlands Management Unit. Source: Revised Recovery Plan for Pallid Sturgeon (USFWS 2014).

Map depicting the Interior Highlands Management Unit. Source: Revised Recovery Plan for Pallid Sturgeon (USFWS 2014).

SHOVELNOSE STURGEON

By Greg Conover.

ETPBR geography population estimate: Not available

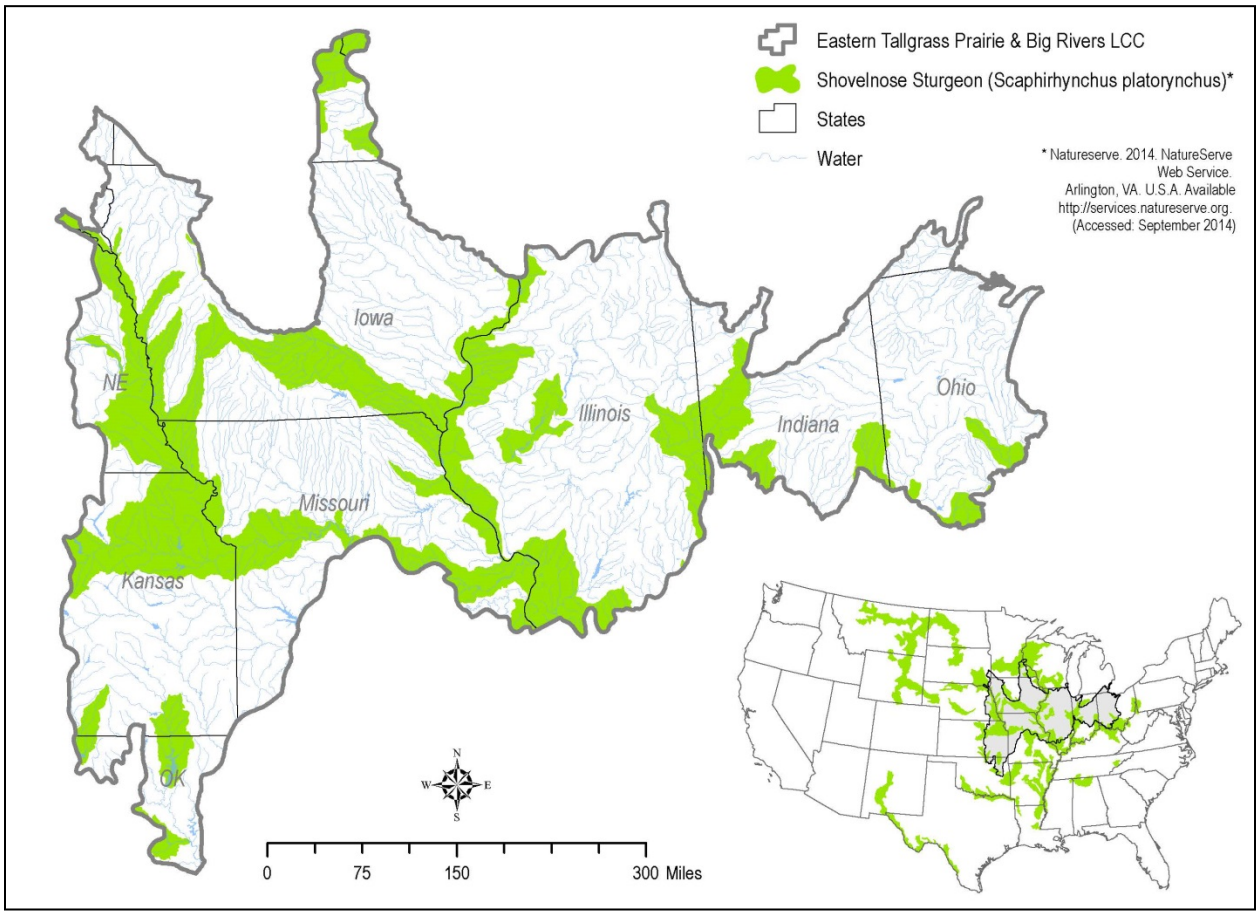
ETPBR geography population objective: Within the Lower Missouri and Middle Mississippi rivers, 680,000 adults (>6 years) with long-term trends indicating regular recruitment, increased size and age structures, and decreased mortality over the next 10 years. In the Mississippi River above Locks and Dam 26, a self-sustaining population that provides for continued recreational and commercial harvest and maintains an annual 30-40% spawning potential of the unfished population

Photo: Ohio Division of Wildlife

Shovelnose Sturgeon (*Scaphirhynchus platorynchus*) is an umbrella surrogate species selected to represent riverine species in large rivers and mid-size tributaries in the ETPBR geography (Blomquist 2013). Shovelnose Sturgeon is the smallest, widest-ranging freshwater sturgeon species in the United States and is indigenous to the Mississippi River drainage (Keenlyne 1997). Shovelnose Sturgeon is sympatric with the Pallid Sturgeon (*Scaphirhynchus albis*) throughout the Missouri River and the Mississippi River downstream of the Missouri River confluence. However, Shovelnose Sturgeon also occurs in the pooled portion of the Upper Mississippi River, the Wabash River, and numerous large tributaries throughout the ETPBR.

Similar to Pallid Sturgeon, the Shovelnose Sturgeon is an ancient species adapted to the pre-development conditions that historically existed in the Missouri and Mississippi rivers. These conditions generally can be described as large, free-flowing, warm-water, turbid rivers with a diverse assemblage of dynamic physical habitats (USFWS 2014, Kallemeyn 1983). Shovelnose Sturgeon are bottom dwelling inhabitants of sandbars and open channels, often in areas of high current with sand or gravel (Robison and Buchanan 1988, Pflieger 1975). Long distance migrations of Shovelnose Sturgeon are common, particularly related to spawning (DeLonay et al. 2007, Robison and Buchanan 1988, Becker 1983, Coker 1930). Shovelnose Sturgeon use a diversity of habitats at different life stages (e.g., larval, juvenile, adult) and to fulfill different life history requirements (e.g., spawning, nursery and feeding) (Becker 1983). Access to suitable habitat types through river connectivity is crucial to Shovelnose Sturgeon population viability (Hamel et al. 2014).

Shovelnose Sturgeon populations have been reduced over the last 100 years by degraded water quality, over-fishing, habitat alteration and the loss of lotic habitats (Keenlyne 1997, Robison and Buchanan 1988, Becker 1983, Carlson and Pfleiger 1981). Habitat improvements that restore dynamic functions and habitat features to large rivers and improve Shovelnose Sturgeon populations are expected to provide improvements for other large river aquatic species, including several native mollusk species (e.g., *Quadrula pustulosa,* Pimpleback; *Obovaria olivaria,* Hickorynut; and *Lampsilis teres,* Yellow Sandshell) for which Shovelnose Sturgeon host glochidia (larvae) (Becker 1983, Coker 1930).



POPULATIONS STATUS

The distribution and abundance of Shovelnose Sturgeon have been reduced due to the altered riverine environment brought about by the intensive management of large rivers for navigation, flood control, and power generation (DeLonay et al. 2007, Keenlyne 2007). In particular, dams have blocked spawning migrations, isolated populations, destroyed rearing and spawning habitats, and altered food supply as well as changed flow, turbidity and temperature regimes (Dryer and Sandvol 1993). The International Union for Conservation of Nature (IUCN 2014) lists Shovelnose Sturgeon as vulnerable based on continued impacts of dams and the potential for over-exploitation.

Several states allow sport and commercial harvest of Shovelnose Sturgeon (Keenlyne 1997; Table 1). Shovelnose Sturgeon has been an important commercial species for over 100 years (Coker 1930) and has become increasingly important since the collapse of Russian sturgeon stocks (Bettoli et al. 2008, Koch et al. 2008, Colombo et al. 2007, Quist et al. 2002). Keenlyne (1997) reported significant commercial harvest of Shovelnose Sturgeon from the Mississippi River upstream from the mouth of the Ohio River, the lower Missouri River, and the Wabash River.

The U.S. Fish and Wildlife Service (USFWS) listed Shovelnose Sturgeon as threatened under the similarity of appearance (SOA) provision of the Endangered Species Act (U.S. Federal Register 75 FR 53598, September 1, 2010) in areas where Shovelnose Sturgeon and Pallid Sturgeon coexist. The

Shovelnose Sturgeon listing was not based on an assessment of the status of the Shovelnose Sturgeon population, but was done in response to the threat of accidental and illegal harvest of the federally endangered Pallid Sturgeon. Nevertheless, the threatened status prohibits commercial harvest of Shovelnose Sturgeon in a large portion of the species range within the ETPBR geography. Over-exploitation remains a concern for the viability of Shovelnose Sturgeon populations in the pooled portion of the Upper Mississippi River (Tripp et al. 2009, Koch 2008).

Table 1. Status, classification and type of fishery for Shovelnose Sturgeon by state within the ETPBR geography (Source: Keenlyne 1997).

State	Population Status	Classification	Type of Fishery
Illinois	Unknown	Sport/Commercial	Sport and Commercial
Indiana	Unknown	None	Sport and Commercial
Iowa	Stable	Sport/Commercial	Sport and Commercial
Kansas	Unknown	Sport	Sport
Michigan	Not present	Not present	Not present
Minnesota	Stable	Sport/Concern	Sport
Missouri	Unknown	Sport/Commercial	Sport and Commercial
Nebraska	Stable	Sport	Sport
Ohio	Unknown	Endangered	None
Oklahoma	Unknown	Special Concern	None
South Dakota	Unknown	Protected	None
Wisconsin	Unknown	Sport/Commercial	Sport and Commercial

POPULATIONS TRENDS

Keenlyne (2007) conducted a status review of Shovelnose Sturgeon using a questionnaire sent to all 24 states within the species historic range. Three states in the ETPBR geography considered Shovelnose Sturgeon populations to be stable since 1990; the eight remaining states did not have sufficient data to make trend analysis of this species (Table 1).

The USFWS listed Pallid Sturgeon as endangered under the Endangered Species Act in 1990 (U.S. Federal Register 55 FR 36641, September 6, 1990). The U.S. Army Corps of Engineers (USACE) is required to consult with the USFWS to determine the potential effects of proposed actions on threatened or endangered species. In 2000, the USFWS issued a Biological Opinion (amended in 2003) that found that actions proposed by USACE in the Missouri River would jeopardize the continued existence of three federally listed species, including Pallid Sturgeon. The Biological Opinion recommended recovery actions that are carried out by the Missouri River Recovery Program (MRRP), such as creating sandbar habitat and shallow water habitat, as well as propagation efforts (USACE 2014b). One component of the MRRP is the Pallid Sturgeon Population Assessment Project, which includes monitoring and data collection throughout the Missouri River system to evaluate annual results and long-term trends in population abundance, geographic distribution, and habitat usage of several native Missouri River fishes, including Shovelnose Sturgeon (USACE 2014c). For recovery purposes, the Missouri River has been divided into 15 different segments. Segment Areas 10 through 15 include the Missouri River from Gavins Point Dam, Nebraska/South Dakota, to the mouth of the Missouri River at St. Louis, MO, essentially the

Missouri River within the ETPBR geography. Monitoring and data collection for the MRRP began in 2006. Data are collected and reported separately for each segment area. Trends in Shovelnose Sturgeon catch rates were reported for some segment areas in the 2012 MRRP annual report; in general, catch rates within the ETPBR appear to be stable over the last several years (USACE 2014a).

Bajer and Wildhaber (2007) developed a deterministic age-based population dynamics model for Shovelnose Sturgeon populations in the Lower Missouri River (i.e., from Gavins Point Dam, South Dakota to the confluence of the Missouri and Mississippi rivers in St Louis, Missouri). The model predicted the Shovelnose Sturgeon population in this river reach to be declining at 1.65% annually. The authors concluded that relatively slight improvements in survival rates of larvae, juvenile, and young adults have the potential to substantially increase the Shovelnose Sturgeon population growth rate in the Lower Missouri River.

Concern over increased commercial harvest of domestic roe-bearing species for caviar following the collapse of Caspian sea sturgeon stocks and subsequent bans on caviar imports has resulted in numerous assessment of Shovelnose Sturgeon populations over the last two decades (e.g., Hamel et al. 2014, Koch et al. 2009, Tripp et al. 2009, Colombo et al. 2007, Kennedy et al. 2007, Quist et al. 2002, Morrow et al. 1998). While these studies provide a snapshot of population characteristics in different portion of the species range, good trend data are not available on the age structure, growth rates or mortality rates for the population. The best trend data on population characteristics appears to be for the Middle Mississippi River (i.e., 200 mile reach between the confluence of the Missouri River and the confluence of the Ohio River). Tripp et al. (2009) assessed trends in Shovelnose Sturgeon population characteristics in the Middle Mississippi River from 2002-2006 and concluded that the resident population is on a declining trajectory because mortality is increasing, recruitment is declining, and somatic growth rates are declining. These results were similar to those of Colombo et al. (2007) who assessed Shovelnose Sturgeon population characteristics in this same reach during 1995-2001. A current assessment of the population since the closure of the Shovelnose Sturgeon fishery in this reach of the Mississippi River by the SOA listing in 2010 has not been published.

POPULATION OBJECTIVE

There are no published population objectives, population estimates or habitat models for Shovelnose Sturgeon. The species is distributed throughout the large rivers and tributaries of the ETPBR geography. Distribution throughout this portion of the species range does not appear to be limited and would not be expected to increase substantially in the absence of dam removal.

Shovelnose Sturgeon is managed differently across the ETPBR geography. Commercial harvest is illegal throughout the Lower Missouri River and in the Mississippi River below the Missouri River confluence. Illinois, Iowa, and Missouri manage a commercial Shovelnose Sturgeon fishery in the Mississippi River above Locks and Dam 26 near St. Louis, Missouri. The amount of monitoring and types of data collected for this species also varies between the commercially harvested and un-exploited portions of the species' range. Extensive annual and long-term trend data are available on the abundance, distribution, and habitat use of Shovelnose Sturgeon in the Lower Missouri River and long-term population data have historically been collected from the Middle Mississippi River. Abundance and population demographic data for Shovelnose Sturgeon in the Mississippi River above Locks and Dams 26 are not sufficient to provide population trends. For these reasons, two

different population objectives are proposed for Shovelnose Sturgeon in the ETPBR geography. The proposed population objectives should be considered draft until coordinated with partners familiar with the monitoring and data collection efforts throughout the Missouri and Mississippi rivers.

Garvey et al. (2009) used unpublished mark-recapture data to calculate a "rough" population estimate for Shovelnose Sturgeon in the Middle Mississippi River. The researchers generated an estimate of 136,000 adult (>6 years) Shovelnose Sturgeon (upper 95%: 160,000; lower 95%: 116,000) in this 200 mile (322 km) reach of the Mississippi River. This estimate equates to a range of approximately 580-800 adult Shovelnose Sturgeon/rm (360–497/rkm). This estimate was extrapolated to the 800 mile reach of the Lower Missouri River to calculate a single population objective for this portion of ETPBR geography. An analysis of genetic stock structure determined that Shovelnose Sturgeon in the Lower Missouri and Middle Mississippi rivers are a single mixed population (Schrey et al. 2009) and supports the use of a single population target for these areas.

The population objective for Shovelnose Sturgeon **in the Lower Missouri and Middle Mississippi rivers is 680,000 adults (>6 years) with long-term trends indicating regular recruitment, increased size and age structures, and decreased mortality over the next 10 years.**

The population objective for Shovelnose Sturgeon **in the Mississippi River above Locks and Dam 26 is a self-sustaining population that provides for continued recreational and commercial harvest and maintains an annual 30-40% spawning potential of the unfished population.**

Indiana manages a commercial Shovelnose Sturgeon fishery in its inland rivers (Wabash, White, East Fork White, and West Fork White rivers), however commercial fishing activities in the Wabash River are restricted to the reach downstream from Lafayette, Indiana (Kennedy et al. 2007). The Wabash, White, East Fork White, and West Fork White rivers are all tributaries to the Ohio River and mostly it is the upper reaches of these drainages that lie within the ETPBR geography. Population objectives for Shovelnose Sturgeon in the Ohio River drainage should be linked to population objectives established for this species as part of the Appalachian Landscape Conservation Cooperative (LCC) if it is selected as a surrogate species for that geography.

IMPLICATIONS AND RECOMMENDATIONS FOR CONSERVATION DESIGN AND MONITORING

The population objective for Shovelnose Sturgeon in the Lower Missouri and Middle Mississippi rivers is a simple extrapolation of a population estimate calculated for the Middle Mississippi River that is recognized by the author as a "crude" estimate (Garvey et al. 2009). Sufficient data likely exists for the Lower Missouri River to calculate a more refined population estimate. The USACE is funding an on-going population assessment of Pallid Sturgeon in the Middle Mississippi River that may enable the calculation of an improved Shovelnose Sturgeon population estimate.

Monitoring of Shovelnose Sturgeon populations to detect population level throughout the ETPBR geography will require extensive data collection on an annual basis, particularly for commercially harvested populations. Gear power analysis calculations (Garvey et al. 2009) indicate that extreme effort and funds are needed to undertake a statistically valid large river sturgeon investigation. Considerable effort is currently being expended to monitor and assess Pallid Sturgeon populations

in the Lower Missouri River and to a lesser extent in the Middle Mississippi River. These monitoring efforts for Pallid Sturgeon provide extensive data on Shovelnose Sturgeon, will provide a framework from which future monitoring plans should be developed, and will be a crucial information source for conservation design. Conservation design and monitoring plans should be developed in close coordination with USFWS offices, USACE, and state partners implementing the Missouri River Restoration Program, and particularly the Pallid Sturgeon and Associated Fish Community Population Assessment Project (http://moriverrecovery.usace.army.mil/mrrp/f?p=136:155:33167502655810::NO::PIS_ID:44).

No large-scale monitoring efforts for Shovelnose Sturgeon exist in the Mississippi River above Locks and Dam 26 near St. Louis, MO. Conservation design and monitoring in this portion of the Mississippi River will be a much greater challenge.

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[USACE] U.S. Army Corps of Engineers. 2014b. Missouri River Recovery Program. Available: http://moriverrecovery.usace.army.mil/ (September 2014)

[USACE] U.S. Army Corps of Engineers. 2014c. Missouri River Recovery Program, Pallid Sturgeon population assessment. Available: http://moriverrecovery.usace.army.mil/mrrp/f?p=136:153:::NO::P153_PROJECTID:90 (September 2014)

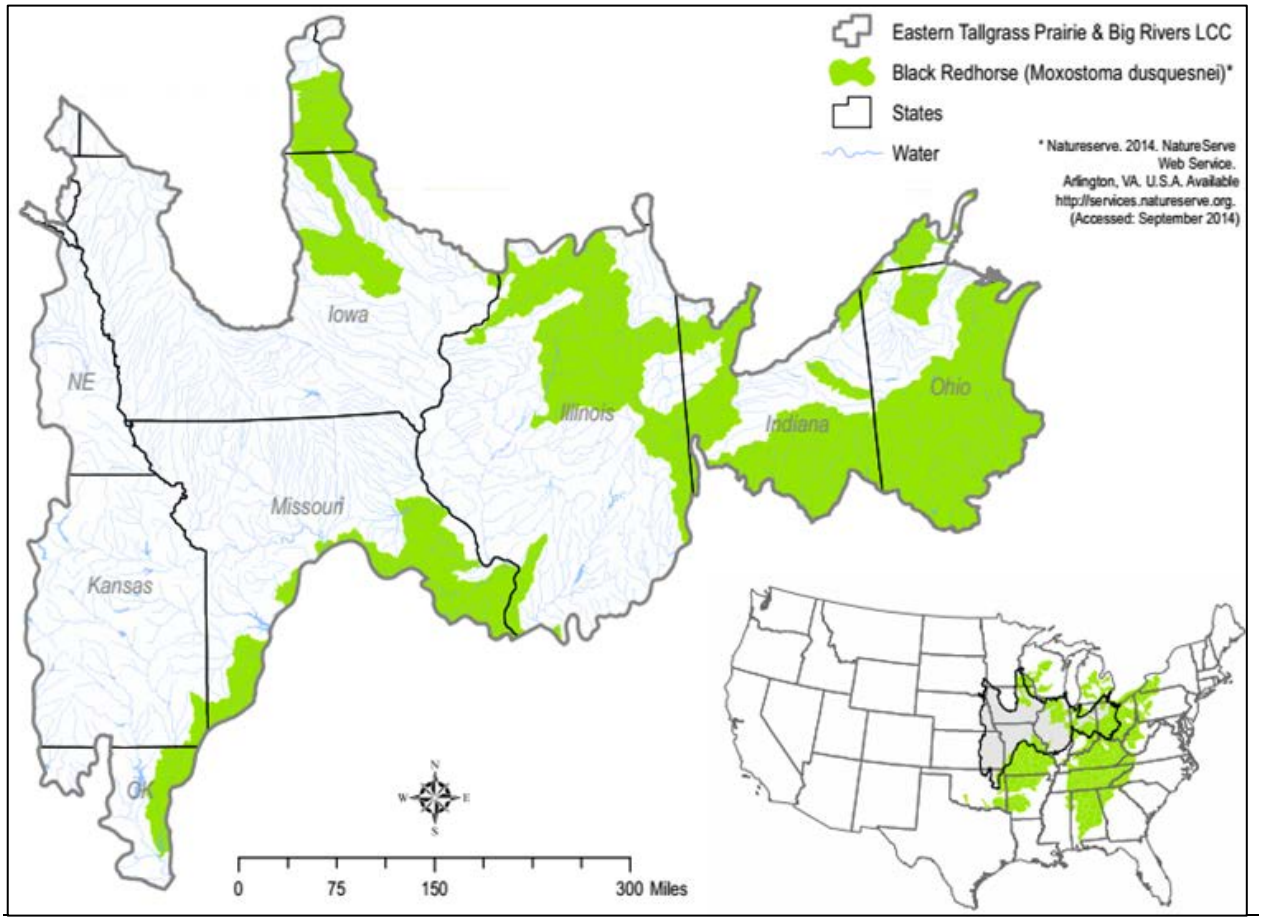
BLACK REDHORSE

By Heidi Keuler and Louise Mauldin

ETPBR geography population estimate: Not available

ETPBR geography population objective: The status and information needs for setting a population objective will be gathered from the states and will be addressed by Spring 2015.

Black Redhorse (*Moxostoma duquesnei*), a member of the Sucker family (Catostomidae), is an "environmental indicator" and "umbrella" surrogate species for the ETPBR geography. The Black Redhorse is an indicator of good quality habitat and occurs in higher-gradient small to medium-sized streams with rapidly moving , cool, clear water, over a rocky substrate with little sedimentation or pollutants (Becker 1983). It is listed as a Species of Greatest Conservation Need (SGCN) for Iowa, Illinois, Kansas, Michigan, Minnesota, Mississippi, New York, and Wisconsin. The Black Redhorse is usually absent from headwater streams less than 3 m (10 ft) in width (Jenkins 1970). Bowman (1970) reported that in Missouri, Black Redhorse have the greatest biomass in streams with an average annual discharge of

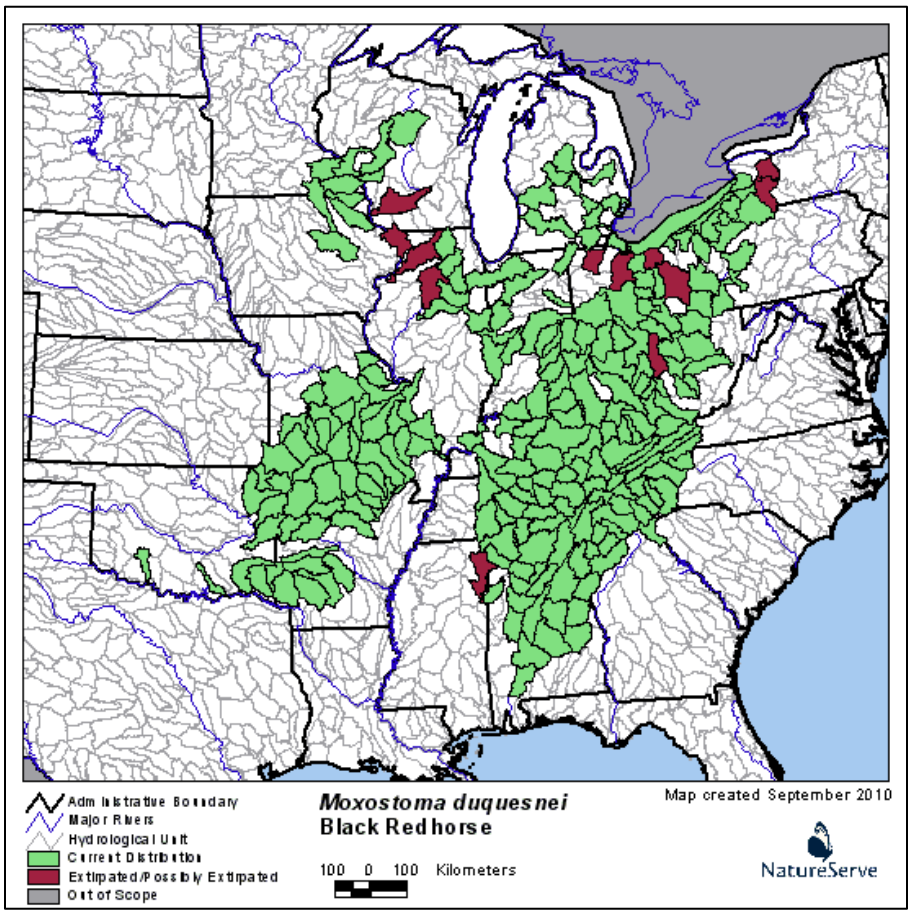


500-600 cfs. Also in Missouri, young of the year have been observed in beds of water willow (*Justicia Americana*), in quiet pools. Several sources, (Harlan et al. 1987; Phillips et. al. 1982; Robison and Buchanan 1988; Trautman 1981) state the Black Redhorse has a low tolerance for siltation, turbidity, pollution and low gradients. The species rarely inhabits impoundments (Etnier and Starnes 1993; Page and Burr 1991).

The Black Redhorse is a benthic fish that is found over substrate consisting of bedrock, gravel, and some sand (Becker, 1983). In Missouri, spawning habitat substrate consisted of about 70% rubble, 10% rocks and 20% sand and gravel (Bowman 1970). Becker (1983) stated that the redhorse may travel 9.7 km (6 mi) to spawn in gravel and fine rubble in runs or riffles about 0.2-0.6 m (0.5-2.0 ft) deep in late April in when the water temperature reach 13.3-22.2°C (56-72 °F).

In North America, the Black Redhorse is restricted to the Atlantic and Gulf drainages. It is found from Alabama and Mississippi in the south to Ontario and Michigan in the north and from New York in the east to Oklahoma and Minnesota in the west. In the ETPBR geography, it is found in Southeast MN, Northeast IA, Southern MO, Northern IL, much of OH, and Eastern OK.

The rapidly moving, cool, clear water habitat with clean rocky substrate substrates also supports the habitat and life history requirements of other native medium- to large-river fishes. Conservation actions for River Redhorse are expected to benefit a wide array of other medium- to large-river cool water species. Black Redhorse was chosen to represent other trust species inhabiting medium to large, permanently flowing cool rivers throughout the ETPBR geography (Blomquist et al. 2013). Black Redhorse was also chosen as the environmental indicator species to represent the effect of nitrogen pollution and eutrophication on other trust species inhabiting medium to large, permanently flowing cool rivers throughout the ETPBR geography.



POPULATION STATUS

The Black Redhorse is listed as a threatened or endangered species in the northern end of its range in Ontario, Canada, Michigan, and Wisconsin. The greatest distribution of the Black Redhorse appears to be in Iowa, Illinois, Indiana, Missouri, and Ohio. In Missouri, the species is present primarily outside of

the LCC boundary in the Ozark region. The species is common in Ohio and Indiana with an increased presence in Illinois.

Both the International Union for Conservation of Nature and Natural Resources (IUCN) and Nature Serve state that the exact Black Redhorse population is unknown, but relatively large in its range.

Limiting Factors

Possible threats to Black Redhorse may include: siltation/sedimentation, nutrient runoff (phosphorus, nitrogen), excess algae (i.e., periphyton), chemical pollutants, altered flow regimes, channelization or channel modifications such as gravel mining, and fragmented habitat through dams, impoundments, high waterfalls, urbanization/development, road crossings, and agriculture. The spawning necessities such as substrate type, water flow, and stream size may have contributed to the low numbers in Wisconsin (Becker, 1983).

POPULATION TRENDS

The IUCN reports that the total adult population size is unknown, but relatively large over its range. The trend over the past 10 year or three generations is uncertain, but likely to be relatively stable or slowly declining overall (iucnredlist.org). Populations in Illinois, Ohio, Indiana, Missouri, and Minnesota are stable.

State	State Listing Status	State Wildlife Action Plan Species of Greatest Conservation Need	Population Trend
Illinois	No Status	Y	Increasing
Indiana	No Status	N	Common
Iowa	Threatened	Y	Unknown
Kansas	No Status	Y	Imperiled
Michigan	Threatened	Y	Unknown
Minnesota	Special concern	Y	Stable
Missouri	No Status	N	Common
Nebraska	No Status	Y	Unknown
Ohio	No Status	N	Common
Oklahoma	No Status	N	Secure
Wisconsin	Endangered	Y	Unknown
South Dakota	No Status	N	Unknown

In Canada, Bunt et al. (2013) found that the locations of populations of Black Redhorse in the Grand River may be related to the presence of groundwater, suggesting that these areas that provide refuge from poor water quality and extreme temperatures in the summer. This may require further investigation in the ETPBR geography to see if these areas should be protected or targeted for stream enhancement projects.

POPULATION OBJECTIVE

An occupancy type population objective is the most appropriate metric for the Black Redhorse based on the distribution of the species across the ETPBR geography and the trend of the species ranging from imperiled to common across the ETPBR states. The timeline for setting a Black Redhorse occupancy type population objective should take approximately 5-6 months. Black Redhorse count data should be requested from the appropriate LCC states. Requested data should come from all seine and electrofishing gear types and include: sample identification code, GPS coordinates, site/station, sample #, date, stream name, gear type, effort (Electrofishing time: hr or min) and distance, if available. Physical habitat measurements are not always collected by field personnel; however, if available, depth, substrate, cover/habitat type, and temperature should be requested. Similar to Smallmouth Bass, it will likely take 1-2 months for all data to be received, compiled, and formatted for use. Development of a probability-based model to predict distribution of occurrence for Black Redhorse is a recommended approach for scaling occurrence across the ETGPBR geography and setting population objectives for the species.

Downstream Strategies (2012a; 2012b), a GIS consulting firm, used a statistical modeling framework called boosted regression tree (BRT) to relate local response variables (ie. presence, abundance, species richness) to landscape-based predictor variables for the Midwestern fish habitat partnerships. The National Hydrography Dataset (NHD plus) were used in the modeling effort. Predictor variables were compiled at multiple spatial scales including the regional scale (ie. ecoregion), the network scale (ie. upstream catchments and local catchment), and the local scale (ie. single 1:100k NHD stream catchment).

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

Modeling fish species distribution can be an effective conservation tool and these types of models play an increasingly important role in conservation and management (Olden and Jackson 2002; Daulwalter and Rahel 2008; Hayer et al. 2008). Species distribution models can be used to clarify species-habitat relationships and identify important stressors influencing species occurrence. The models may also be used to identify and prioritize management actions and compare changes in distribution and abundance over time.

Sindt et al. (2012) emphasizes that models should be reviewed for accuracy to gauge confidence in the predictions and identify limitations before use in conservation planning. The type of model, spatial scale, data sources, species characteristics, and species occurrence influences the accuracy and utility of the model (Manel et al. 2001; Olden and Jackson 2002; Vaughan and Ormerod 2003; McPherson et al. 2004; Ruiz and Peterson 2007). Downstream Strategies (2012a; 2012b) used a cross validation method described by Elith et al. (2008) to assess models developed for the Midwestern fish habitat partnerships. Use of an independent dataset is suggested to be the most robust approach to assess accuracy of a model (Vaughan and Ormerod 2005; Sindt et al 2012). Validation method for the Black Redhorse model should be further discussed.

Regular fish community monitoring efforts, including various forms of electrofishing and seining, are being conducted similarly across state natural resource agencies. Existing state agency monitoring efforts and standard sampling protocols should be utilized as much as possible for data consistency. Monitoring could be assisted with several partners within the fish habitat partnerships. A pre and post monitoring regime for Black Redhorse and Smallmouth Bass may be

outlined in the planning stages of selected restoration efforts and reference sites. Detecting change in fish response will depend on the types of upland, riparian, and in-stream actions implemented, scale (catchment, HUC 12, HUC8) of actions implemented, and time period of implementation (single vs. multiple years).

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PADDLEFISH

By Greg Conover

ETPBR geography population estimate: Not available

ETPBR geography population objective: Self-sustaining population that provides for continued recreational and commercial harvest and maintains an annual 30-40% spawning potential of the unfished population

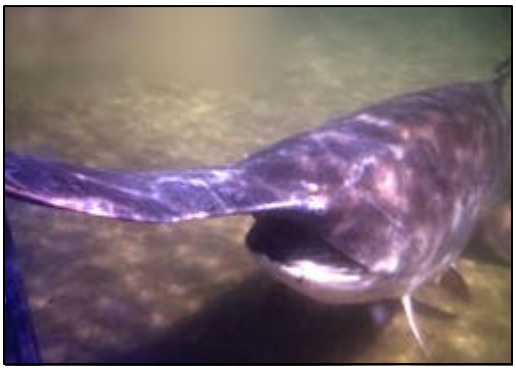
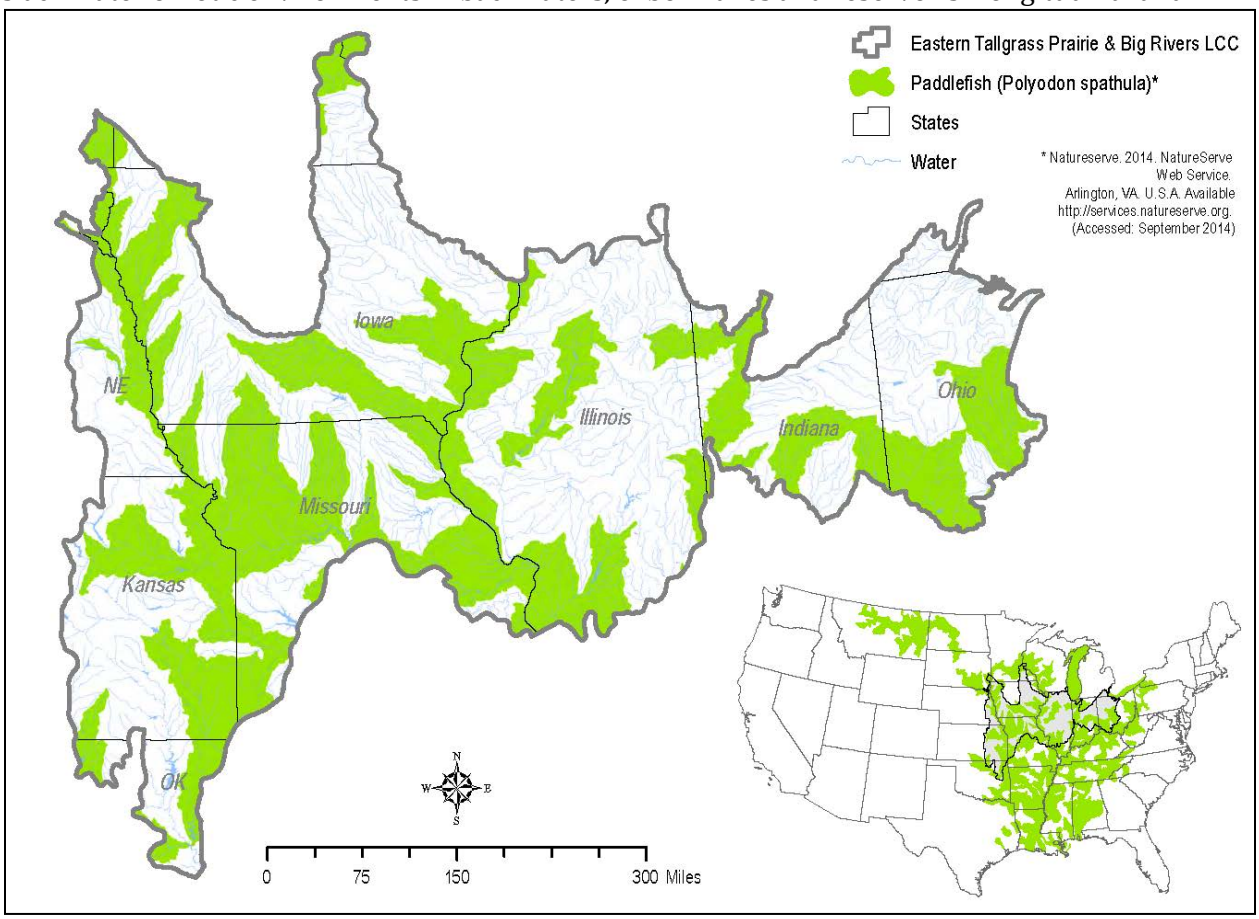


Photo Credit: USGS

Paddlefish (*Polyodon spathula*) are large, pelagic, planktivorous fish that are endemic to the Mississippi River Basin and some tributaries to the Gulf of Mexico. Paddlefish were historically abundant in medium- to large-sized river systems throughout much of the central United States (Burr 1980; Jennings and Zigler 2009). Paddlefish are a mostly-riverine species capable of migrating great distances through river systems when barriers are not present (Russell 1986). Paddlefish occupy a diversity of habitats including high velocity main channel and tailwater races below dam, low velocity side channel and off channel habitats, and slack water or lotic environments in backwaters, oxbow lakes and reservoirs. Longitudinal and



lateral connectivity are vital to the Paddlefish's ability to access a diversity of riverine habitats, including isolated backwater and floodplain lakes, to fulfill their life history requirements. Paddlefish are an "umbrella species" for both riverine and aquatic species in the ETPBR geography.

Numerous factors have been implicated in declining range and abundance of Paddlefish stocks. Overexploitation coupled with river modifications such as channelization, levees, and dams have likely had the greatest effects (Graham 1986). Nearly all of the large rivers within the native range of Paddlefish have been modified for hydropower, navigation, and flood control. The resulting changes in river hydrology and morphometry have degraded water quality, disrupted spawning cues and reduced available spawning and nursery habitats, thereby limiting reproductive success (Sparrowe 1986; Unkenholz 1986; Pierce et al. 2011). Exploitation, legal and illegal, is a renewed threat to Paddlefish populations as their eggs are a high-grade substitute for sturgeon caviar and yield a high price for commercial fishers (Henley et al. 2001). The two principal threats to Paddlefish over the last two decades has remained habitat loss and overfishing (Bettoli 2006).

POPULATIONS STATUS

The USFWS was petitioned in 1989 to list Paddlefish as threatened under the Endangered Species Act. Paddlefish were classified in 1992 as a species-of-special concern under the Endangered Species Act, indicating that the data needed to assess the status of the species are lacking (Allardyce 1992). Specifically the USFWS found that empirical data on Paddlefish population size, age structure, growth, and harvest rates across the species' range were almost completely absent (Allardyce 1992). The USFWS discontinued the use of its list of species-of-special-concern in 1996 (Jennings and Zigler 2000).

State	Classification	Population Status*
Illinois	Sport and Commercial	Stable/Increase
Indiana	Protected	Stable
Iowa	Sport	Stable/Unknown
Kansas	Sport	Stable
Michigan	Not present	Not present
Minnesota	State Threatened	Stable/Increase
Missouri	Sport and Commercial	Stable
Nebraska	Sport	Stable
Ohio	State Threatened	Stable
Oklahoma	Sport and Commercial?	Increase
South Dakota	Sport	Stable
Wisconsin	State Threatened	Stable

*Source: Bettoli et al. 2009; Indiana Division of Fish and Wildlife 2012

Concern for Paddlefish populations prompted the USFWS to recommend that Paddlefish be protected through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Paddlefish were added to CITES Appendix II in 1992, providing a mechanism to curtail illegal trade in Paddlefish and their parts (Allardyce 1992). Appendix II includes species not necessarily threatened with extinction, but which may become threatened if trade is not controlled (www.cites.org).

Paddlefish are currently reported from 22 states in the Mississippi River Basin and have been extirpated from four additional basin states on the periphery of their historic range: Maryland, New York, North Carolina, and Pennsylvania. Paddlefish populations are distributed throughout the large rivers and many reservoirs of the ETPBR geography, however their status varies among individual states (Table 1). Paddlefish are listed as State Threatened in Ohio, Wisconsin and Minnesota, and are a protected species in Indiana. Illinois, Iowa, Kansas, Missouri, Nebraska, Oklahoma and South Dakota all manage recreational fisheries for Paddlefish within portions of the

ETPBR. Commercial fisheries are also managed by Missouri (Mississippi River) and Illinois (Mississippi and Illinois rivers).

POPULATION TRENDS

Following a period of intensive commercial harvest in the late 1800s and the construction of large dams over the last 100 years, Paddlefish populations experienced long-term declines (Unkenholz 1986). During an evaluation of the species status in the late 1980s and early 1990s, the USFWS determined that despite a paucity of empirical data most fishery biologists in the Paddlefish's historic range thought that although several population segments probably were not self-sustaining, the remaining populations in most states were at least stable at low levels (Allardyce 1992). Considerable effort has been directed at evaluating Paddlefish populations since then and the general status of Paddlefish range-wide has improved (Jennings and Zigler 2009). By 2006, Paddlefish populations were considered stable or increasing throughout most of their distribution (Bettoli et al. 2009).

The Mississippi Interstate Cooperative Resource Association (MICRA) is an organization of the 28 Mississippi River basin states that coordinates efforts to improve management of interjurisdictional fishery resources. Uncertainty about the status of Paddlefish populations in the basin prompted MICRA to initiate a large-scale multi-state, multi-year coded wire tagging effort to assess Paddlefish stocks throughout the Mississippi River Basin in 1995. This project examines Paddlefish habitat use, distribution, movement, extent of harvest, and population status in the Mississippi River Basin. Since the project began, 22 states have participated by collecting biological information and /or by tagging wild and hatchery-reared Paddlefish (Grady et al. 2005). Participating biologists were most concerned with sampling large numbers of Paddlefish for greatest efficiency tagging wild-caught fish and recovering tagged fish, rather than conducting systematic surveys throughout the basin and across habitat types. Although considerable data have been collected on Paddlefish throughout the Mississippi River Basin over the last 20 years, data tend to be concentrated in only a few sporadic geographic locations. In the ETPBR geography, most population data on Paddlefish are from the Missouri River immediately below Gavin's Point Dam; Mississippi River Pools 13, 14 and 26; and a backwater lake in the lower Illinois River.

POPULATION OBJECTIVE

There are no published population objectives, population estimates or habitat models for Paddlefish. The distribution of Paddlefish throughout the ETPBR geography is not limited, despite the effects of dams on migration. As previously described, range-wide abundance data are lacking. Distribution or abundance metrics are not recommended as metrics for evaluating the effectiveness of conservation delivery actions on the Paddlefish population in the ETPBR geography.

Several states within the Mississippi River Basin and ETPBR geography manage recreational or commercial fisheries for Paddlefish (Bettoli et al. 2009), however state-specific fishing regulations vary and are not based on a unified management methodology (Sharov et al 2014). Fishing mortality can have a large influence on the reproductive potential of Paddlefish populations (Boreman 1997) and therefore overall sustainability. Regulations are used to prevent overfishing (Combs 1986; Quinn 2009; Scholten 2009) and many states attempt to periodically assess population metrics (Sharov et al. 2014;Tripp et al. 2012; Arkansas Fish and Game Commission 2008; Mestl et al. 2005; Henley et al. 2001). Although basic life history parameters for most stocks are sufficiently described, fishery dependent information such as time series of catch, indices of abundance or systematic age and size structure data are very limited or absent (Sharov et al. 2014).

Due to the migratory nature of Paddlefish, and their similar demographic characteristics, the use of a single, basin-wide approach when evaluating riverine Paddlefish populations should be used (Hupfeld 2014). Currently, very few estimates of fishing mortality are available for local stocks, and there are no clearly determined biological reference points that define targets or limits for population size and fishing mortality rates for management purposes (Sharov et al. 2014). The USFWS and the Association of Fish and Wildlife Agencies (AFWA) are working with the states through MICRA to establish coordinated management goals to avoid recruitment overfishing and population collapse (Sharov et al. 2014).

The Mississippi River Basin states are considering recommendations for using a range of biological reference points to manage Paddlefish populations and are working cooperatively to collect the data necessary to calculate current estimates of fishing mortality and stock sizes. Sharov et al. (2014) proposed fishing mortality (F) values corresponding to 30 and 40% spawning potential of the unfished population (F30% and F40%) as limit and target reference points for Paddlefish.

A population objective based on vital rates of the Paddlefish population across the ETPBR geography is considered the most appropriate approach to evaluate population viability and long-term trends.

The population objective for Paddlefish in the ETPBR geography is a self-sustaining population that provides for continued recreational and commercial harvest and maintains an annual 30-40% spawning potential of the unfished population.

IMPLICATIONS AND RECOMMENDATIONS FOR CONSERVATION DESIGN AND MONITORING

Currently, no states use biological reference points to manage their Paddlefish fishery, and exploitation or mortality rates are not estimated annually in most regions to compare with reference points (Sharov et al. 2014). The proposed population objective is based on current discussion among states managing recreational and commercial Paddlefish fisheries. The population objective should be considered draft until such time as the states formally adopt target and limit reference point for management of Paddlefish stocks. Successful implementation of a vital rate based population objective will be dependent upon the regular collection of data necessary to calculate estimates of fishing mortality, stock size and spawning potential of the unfished population.

Monitoring Paddlefish populations in the ETPBR will be very resource intensive given the species' geographic distribution and data requirements. States managing Paddlefish fisheries desire to regularly monitor exploited populations, but are often unable to due to the resource requirements. Successful implementation of the proposed population objective and subsequent monitoring will be dependent upon coordinated efforts between USFWS and the states.

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GREEN-WINGED TEAL

By Brian Loges

ETPBR geography migrating population estimate: 487,500

ETPBR geography migrating population objective: Annually provide a network of seasonally to semipermanently flooded emergent habitats adequate to support 12.5% of the Continental Green-winged Teal population for the spring and fall migration periods.

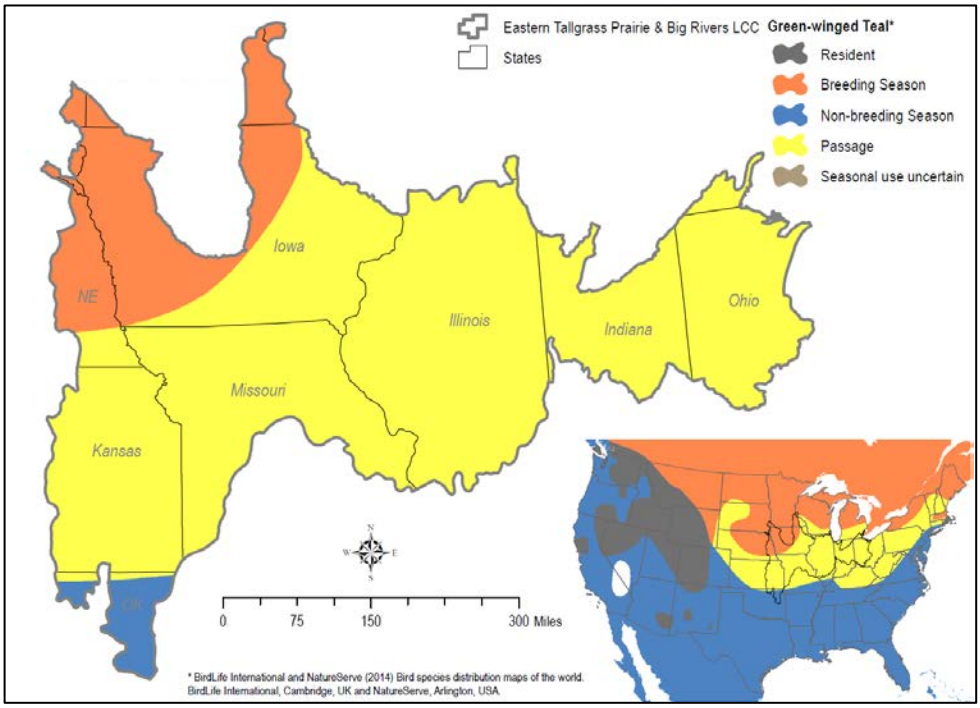
A popular game bird throughout the LCC, the Green-winged Teal (*Anas crecca*) is an "umbrella" surrogate species selected to represent other Service trust species benefiting from the maintenance and protection of palustrine emergent wetlands throughout the ETPBR geography (Blomquist et al. 2013).

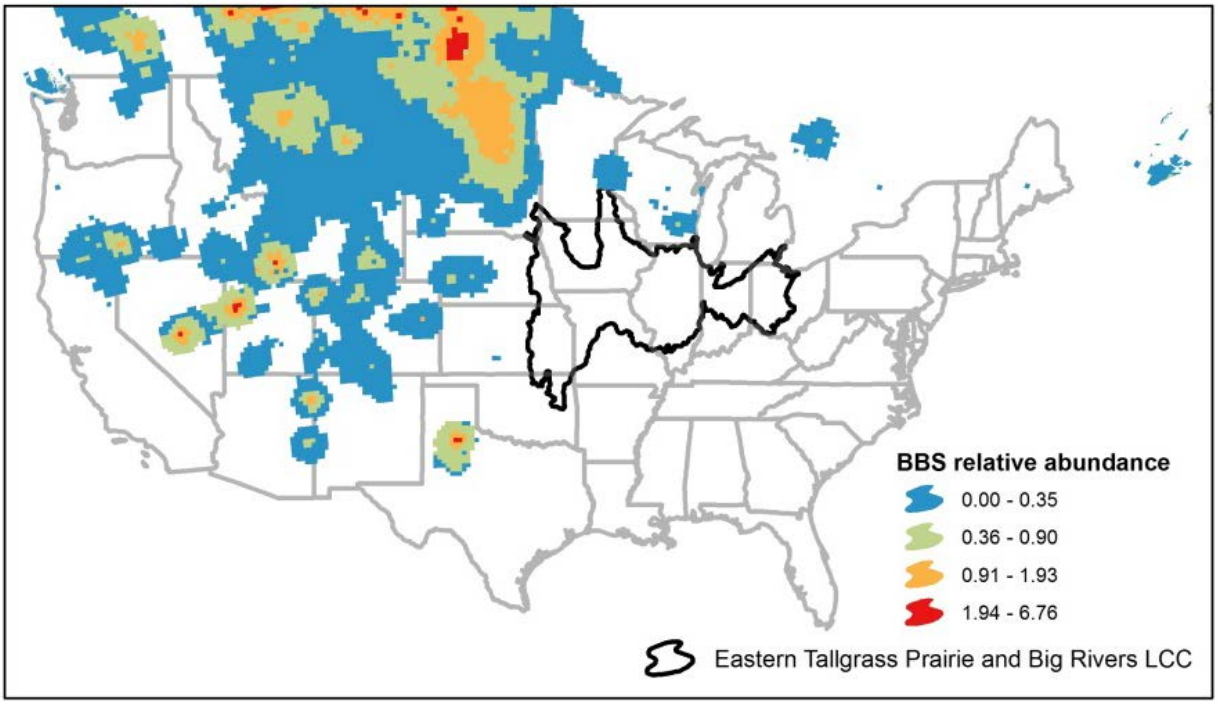
Alan D. Wilson

POPULATION STATUS

As an estimate from the traditional survey area placed the Green-winged Teal breeding population estimate at 3.44 million in 2014 (USFWS 2014). The bulk of this production breeds within the Dakotas and central Canadian provinces. In a full life cycle context, the region plays a critical role in supporting birds that breed outside the BCR during the fall migration and spring migrations.

Although Midwinter waterfowl inventory counts are an unreferenced index of wintering populations, totals can be used to represent a wintering population if limitations are acknowledged (Heusman 1999). Wintering estimates as an average of 2000-2014 MWI counts for the zones that predominantly fall into BCR 22 averaged 3,256 birds with a peak of 11,099 birds in 2012.





Green-winged Teal distribution during the breeding season based on 1966-2012 Breeding Bird Survey Results for the ETPBR geography and the lower 48 states. Date credit: Sauer et al. 2014.

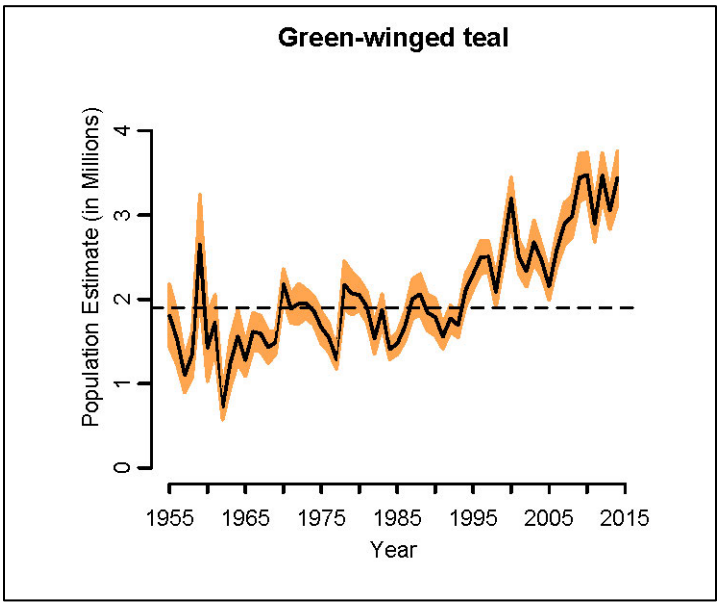
POPULATION TRENDS

The continental green-winged population is cyclic and influenced by habitat conditions on the midcontinent breeding grounds (Krapu 1983). Annual Waterfowl Breeding Population and Habitat Surveys estimate breeding population across the principal breeding areas of North America. For the past twenty years Green-winged Teal population estimates in the traditional survey area have exceeded NAWMP goal of 1.9 million birds (USFWS 2014).

POPULATION OBJECTIVE

The UMRGL JV used a proportion of the continental teal harvest occurring in the JV, 12.5%, to frame a migration estimate for both seasons (Soulliere et al. 2007). This estimate was converted to goal of supporting 0.49 million birds for both migrations based on 1994-2003 continental breeding populations. To account for the cyclic nature of continental populations, the proportion is maintained as a benchmark in the population objective with a measurable attribute of acres required to support that portion of the continental population in spring and fall migrations.

The proportion of green winged teal is minor and limited to extremities of the LCC. Breeding population objectives will not be developed for the LCC. MWI counts in BCR 22 in 2014 totaled less than 1% of the 2013 traditional survey area breeding population. Wintering objectives will not be developed.



Breeding population estimates Green-winged Teal (in thousands) for regions in the traditional survey area, 90% confidence intervals, and North American Waterfowl Management Plan population goals (dashed line). (USFWS 2014).

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

A conservation design strategy for nonbreeding Green-winged Teal should target the objective measurable in terms of habitat acres available for the migration period. At a minimum, an approach to quantifying either a surplus or deficit of PEM habitats should be developed. However just ensuring acres are present across the BCR assumes birds have a perfect knowledge of the location of habitats, ignores the spatial arrangement of the targeted acres, and does not account for availability of habitats as influence by disturbance and seasonal hydrology. A strategic approach to habitat restoration and maintenance should account for characteristics beyond broad habitat classes and be customized to the spring and fall migration. For example, Stafford et al. (2010) modeled fall wetland use of Mallards in the Illinois River Valley for multiple wetland characteristics. Refuge and area were found to be positively associated with Mallard use while candidate models based on habitat subtypes were not competitive. The refuge status of targeted acres for the fall migration should be addressed.

In order to adequately support migrating population, migration habitats also need to provide adequate food resources to replenish calories burned in migration events and build spring fat reserves critical to success on the breeding grounds. Mallards returning to breeding grounds in good condition are more likely to nest, initiate earlier and have larger clutches (Devries et al. 2008). When applied to mass estimates from various wetland habitats metabolizable energy estimates (Checkettt et al. 2002, Petrie et al. 1998, Kaminski et al. 2003) can be used to derive carrying capacity estimates for discrete areas (Brasher et al. 2010, Bowyer et al. 2005,Bowyer et al. 2005, Gray et al., Straub et al 2012.). The duck-energy–day approach also allows for a prediction of carrying capacity based on generalized Kcal values by habitat type for spatially defined areas. At the local scale carrying capacities can be compared to observed use to identify energetic surpluses or deficits within management areas. The same approach can be applied to BCR population estimates,

in terms of kcals required for the fall and spring migrations, provided that the habitat classes can be quantified at the BCR scale and placed in a migration context as a series of stop-over sites or complexes.

It is expected that habitat objectives developed under the surrogate species approach will mirror those developed by the UMRGLJV.

UMRGL JV habitat and maintenance objectives for acres of shallow semi-permanent marsh in BCR 22 for 7 predominant states within the BCR (Pierce et al. 2014 and Kahler et al. 2014) .

	IA	IL	IN	KS	MO	NE	OH
Acres for maintenance	94,670	185,754	39,048	87,544	197,551	146,520	62,229
Acres for restoration	988	2,124	924	627	840	282	4,199
Acres on landscape	128,878	176,253	47,928	28,905	147,868	23,166	56,552

To assess the relationship between bird use and habitat availability, monitoring programs should document habitat characteristics concurrently with nonbreeding use. Monitoring other wetland dependent wildlife as other waterbird guilds, amphibians, or even fish on similar spatial and temporal scales would provide insight on the species represented by this umbrella approach.

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MALLARD

By Brian Loges

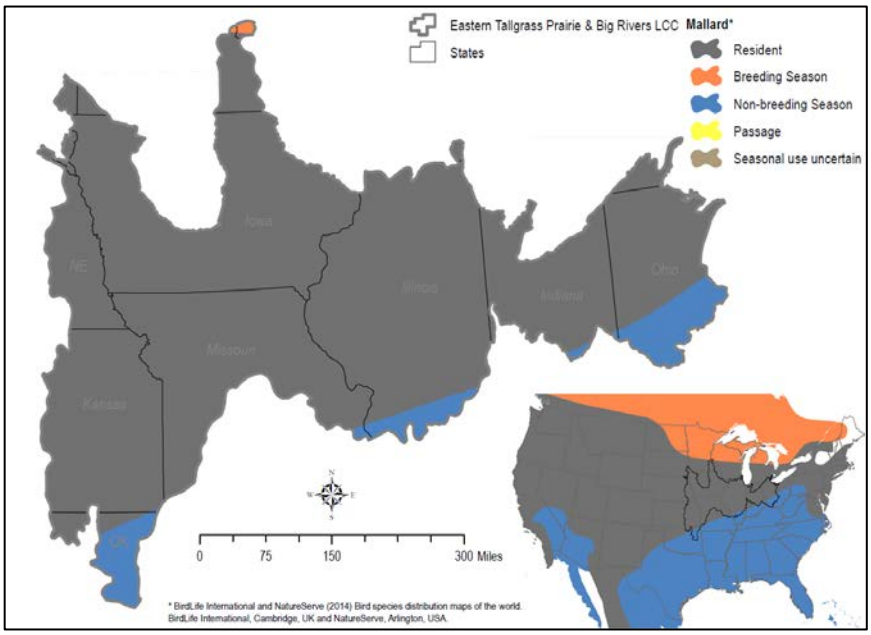
ETPBR geography migrating population estimate: 2,890,000

ETPBR geography migrating population objective: Annually provide a network of seasonally to semipermanently flooded emergent habitats adequate to support 22% of the Continental Mallard population for the spring and fall migration periods.

An ubiquitous breeding species and popular game bird throughout the LCC, the Mallard (*Anas platyrhynchos*) is an "umbrella" surrogate species selected to represent other Service trust species benefiting from the maintenance and protection of palustrine emergent wetlands throughout the ETPBR geography (Blomquist et al. 2013). For non-breeding habitat purposes, The Upper Mississippi River and Great Lakes Region Joint Venture also placed Mallard in a guild benefiting from similar a similar habitat class, shallow semi-permanent marsh. (Thogmartin et al. 2011).

POPULATION STATUS

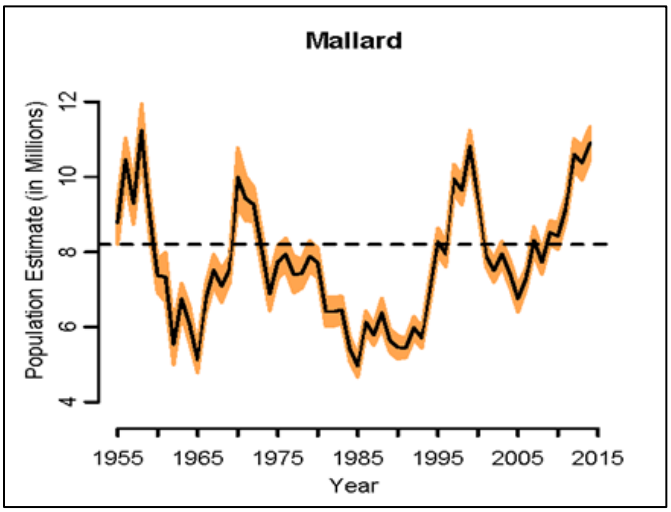
As an estimate that incorporates the traditional survey area, eastern survey and other regions, the continental Mallard population exceeded 13 million in 2014 (USFWS 2014). The bulk of this production breeds within the Dakotas and central Canadian provinces, although an estimated 200,000 birds breed in Bird Conservation Region (BCR) 22 (Soulliere 2007). In a full life cycle context, the region plays a critical role in supporting birds that breed outside the BCR during the fall migration and spring migrations.



Although Midwinter waterfowl inventory counts are an unreferenced index of wintering populations, totals can be used to represent a wintering population if limitations are acknowledged (Heusman 1999). Wintering estimates as an average of 2000-2014 MWI counts for the zones that predominantly fall into BCR 22 averaged 410,840 birds.

POPULATION TRENDS

The continental Mallard population is cyclic and influenced by habitat conditions on the midcontinent breeding grounds (Krapu 1983). Annual Waterfowl Breeding Population and Habitat Surveys estimate breeding population across the principal breeding areas of North America. Since 2008 Mallard populations estimates in the traditional survey area have exceeded NAWMP goal of 8.2 million birds (USFWS 2008).



Breeding population estimates for Mallard (in thousands) for regions in the traditional survey area, 90% confidence intervals, and North American Waterfowl Management Plan population goals (dashed line). (USFWS 2014).

POPULATION OBJECTIVE

The UMRGL JV used a proportion of the continental Mallard harvest occurring in the JV, 22%, to frame a migration estimate for both seasons (Soulliere et al. 2007). This estimate was converted to goal of supporting 2.89 million birds for both migrations based on 1994-2003 continental breeding populations. To account for the cyclic nature of continental populations, the proportion is maintained as a benchmark in the population objective with a measurable attribute of acres required to support that portion of the continental population in spring and fall migrations.

The proportion of Mallards that breed in the UMRGLJV of the total migrating population is less than 10%. Breeding population objectives will not be developed for the LCC. MWI counts in BCR 22 in 2014 totaled 410,840 birds or 3.25% of the 2013 continental breeding population. Wintering objectives will not be developed.

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

A conservation design strategy for nonbreeding Mallards should target the objective measurable in terms of habitat acres available for the migration period. At a minimum, an approach to quantifying either a surplus or deficit of PEM habitats should be developed. However just ensuring acres are present across the BCR assumes birds have a perfect knowledge of the location of habitats, ignores the spatial arrangement of the targeted acres, and does not account for availability of habitats as influence by disturbance and seasonal hydrology. A strategic approach to habitat restoration and

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In order to adequately support migrating population, migration habitats also need to provide adequate food resources to replenish calories burned in migration events and build spring fat reserves critical to success on the breeding grounds. Mallards returning to breeding grounds in good condition are more likely to nest, initiate earlier and have larger clutches (Devries et al. 2008). When applied to mass estimates from various wetland habitats metabolizable energy estimates (Checkett et al. 2002, Petrie et al. 1998, Kaminski et al. 2003) can be used to derive carrying capacity estimates for discrete areas (Brasher et al. 2007, Bowyer et al. 2005, Gray et al., Straub et al. 2012). The duck-energy–day approach also allows for a prediction of carrying capacity based on generalized Kcal values by habitat type for spatially defined areas. At the local scale carrying capacities can be compared to observed use to identify energetic surpluses or deficits within management areas. The same approach can be applied to BCR population estimates, in terms of kcals required for the fall and spring migrations, provided that the habitat classes can be quantified at the BCR scale and placed in a migration context as a series of stop-over sites or complexes.

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To assess the relationship between bird use and habitat availability, monitoring programs should document key habitat characteristics concurrently with bird use during the entire nonbreeding period. Monitoring other wetland dependent wildlife as other waterbird guilds, amphibians, or even fish on similar spatial and temporal scales would provide insight on the species represented by this umbrella approach.

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PECTORAL SANDPIPER

By Bob Russell, Doug Helmers, and Drew Becker

ETPBR geography population estimate: 480,000

ETPBR geography population objective: 528,000

Pectoral Sandpiper (*Calidris melanotos*) is an "umbrella" surrogate species selected to represent other Service trust species that are late migrants inhabiting mudflats and other shallow water habitats throughout the ETPBR geography (Blomquist et al. 2013). Pectoral Sandpipers are a medium-sized migratory shorebird that utilizes wet meadows and shallow mudflats, and often flooded agricultural fields throughout the ETPBR. They are long distance migrants spending the winter months in South America and breeding on the coastal tundra of North America. They migrate through the ETPBR geography in the mid to late-spring and back in early fall.

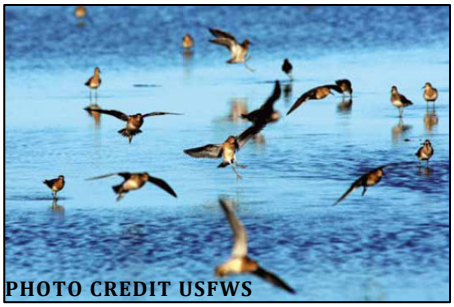


PHOTO CREDIT USFWS

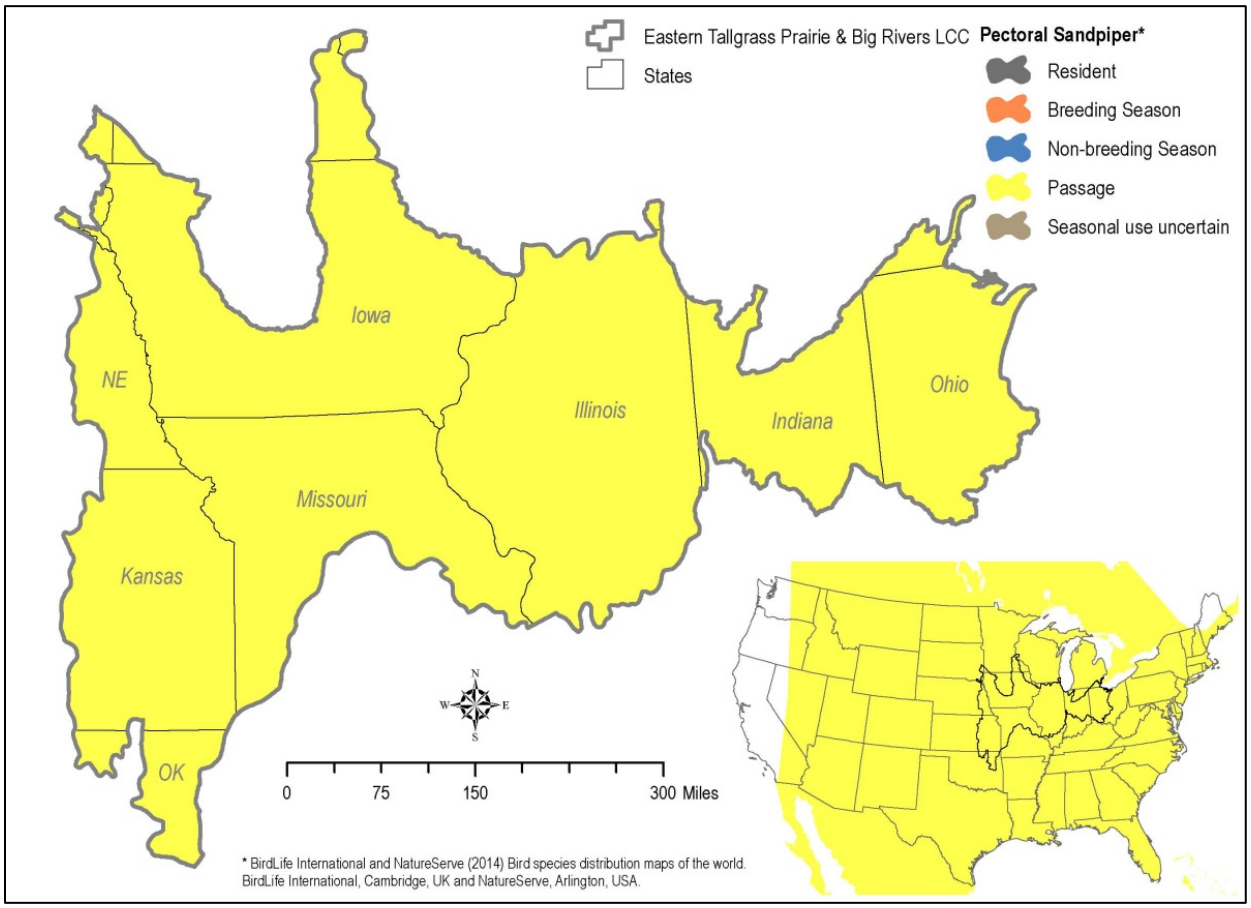
Based on e-bird counts approximately 30% of the global population utilizes the ETPBR geography as stopover habitat. This habitat is often temporary or ephemeral wetlands and flooded agricultural fields, the quality of which is heavily reliant upon the Swampbuster provisions of the 1985 USDA Food Security Act. USDA conservation practices such as cover crops with drainage water management and wetland restoration can provide additional habitat through conservation programs such as the Environmental Quality Incentives Program (EQIP). Within the ETPBR geography, only Kansas lists the species as a Species of Greatest Conservation Need within the state wildlife action plan.

POPULATION STATUS AND TRENDS

Andres et al. (2012) estimates Pectoral Sandpiper continental population at 1,600,000 with a 95% range of 1.13 M – 2.07 M. Although the population is a higher estimate than the original 2006 estimate of 500,000, it is still felt that the population is declining and the newer estimate wraps better survey methodology and breeding ground surveys into the figures.

Based on E-bird high counts and state bird book literature review of migration patterns and high counts, the following percentages of the total population were assigned to the four flyways with estimated population in parentheses.

Pacific: 1% (16,000)
Central: 65% (1,040,000)
Mississippi: 30% (480,000)
Atlantic: 4% (64,000)



The width of the ETPBR geography (Bird Conservation Region 22, The Tallgrass Prairie) is approximately 722 miles from Lincoln, Nebraska east to Columbus, OH. Assuming that shorebirds migrate at approximately 4000 feet altitude, an individual bird migrating north or south could see available habitat for 25 miles east or west of its route or 50 miles overall. Across the Midwest landscape there would thus be 14 longitudinal corridors (722 divided by 50) that northbound or southbound shorebirds might take during migration and for which habitat would need to be provided. Since some migrating shorebirds that rely on ephemeral habitats do not always follow the same routes each year, we would want to provide additional shorebird habitat for a series of longitudes along which Pectoral Sandpipers might occur based on seasonal winds, precipitation events including winter snow melt, spring flooding, summer rainfall and evapotranspiration rates.

POPULATION OBJECTIVE

Assuming a population of 480,000 Pectoral Sandpipers migrating through the Mississippi flyway and the average mass of an individual bird is 60 grams. Each bird would require 12g of food/day to maintain existence metabolism and gain fat for migration. The average length of stay at a stopover site is 10 days an individual bird would need a 120 grams of food.

For the purpose of proposing the amount of habitat required to support migrating shorebirds, we have assumed that habitat will be provided primarily in the form of shallow water managed to create optimal foraging depths for shorebirds and about 2 g of benthic invertebrates are available per square meter (D. Helmers, pers. comm.). Consequently, an average Pectoral Sandpiper requires

about 6 m^2 of foraging habitat each day. Over the duration of an assumed 10-day migration period, each shorebird migrating through the ETPBR geography would therefore require 60 m^2 (0.006 ha) of managed foraging habitat. Assuming an equal habitat need for each of the 480,000 Pectoral Sandpipers that we assume move through the Mississippi flyway during migration results in an overall habitat objective of 2,880 ha (ca. 7,100 acres) during migration.

In order to increase the regional population by 10% (a bare minimum percentage that might be detectable on winter or summer surveys) or 48,000 birds to a total of 528,000, then we would parse out approximately 3,420 birds per 50 mile segment that we would want to provision. The food needs of these 3,420 birds would be 410,400 g or 5,760,000g for the 48,000 birds (the regional forage need) and the amount of acreage that would support the 3,420 birds would be 20.5 ha (ca. 50 ac) per longitude or 287 ha (ca. 710 ac) across the ETPBR geography. If we assume we want to reach this objective in 10 years we could potentially increase the amount of new habitat required by 10% each year or 28.7 ha across the region.

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

Spatial models for this species are not currently available for the ETPBR geography and e-bird based modeling options are limited. BBS data is not a practical tool due the timing of the bird's migration. A conservation design strategy for Pectoral Sandpipers could attempt to utilize e-bird data. Additionally, The U.S. Fish and Wildlife Service, the Joint Ventures, and the Flyway Councils developed the Integrated Waterbird Management and Monitoring program. This project combines standardized monitoring and modeling at flyway, regional, and local scales to guide future management decisions about where to focus time and other resources on habitat management and restoration. This program could potentially be used to monitor trends in Pectoral Sandpiper population status.

The degree to which wintering and breeding habitat is a limiting factor is largely unknown. Opportunities may exist to explore the stressors this species faces during other portions of its life cycle.

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MARSH WREN

By Neil Chartier, Stephen Winter, and Ryan Drum

ETPBR geography population estimate: 5,000

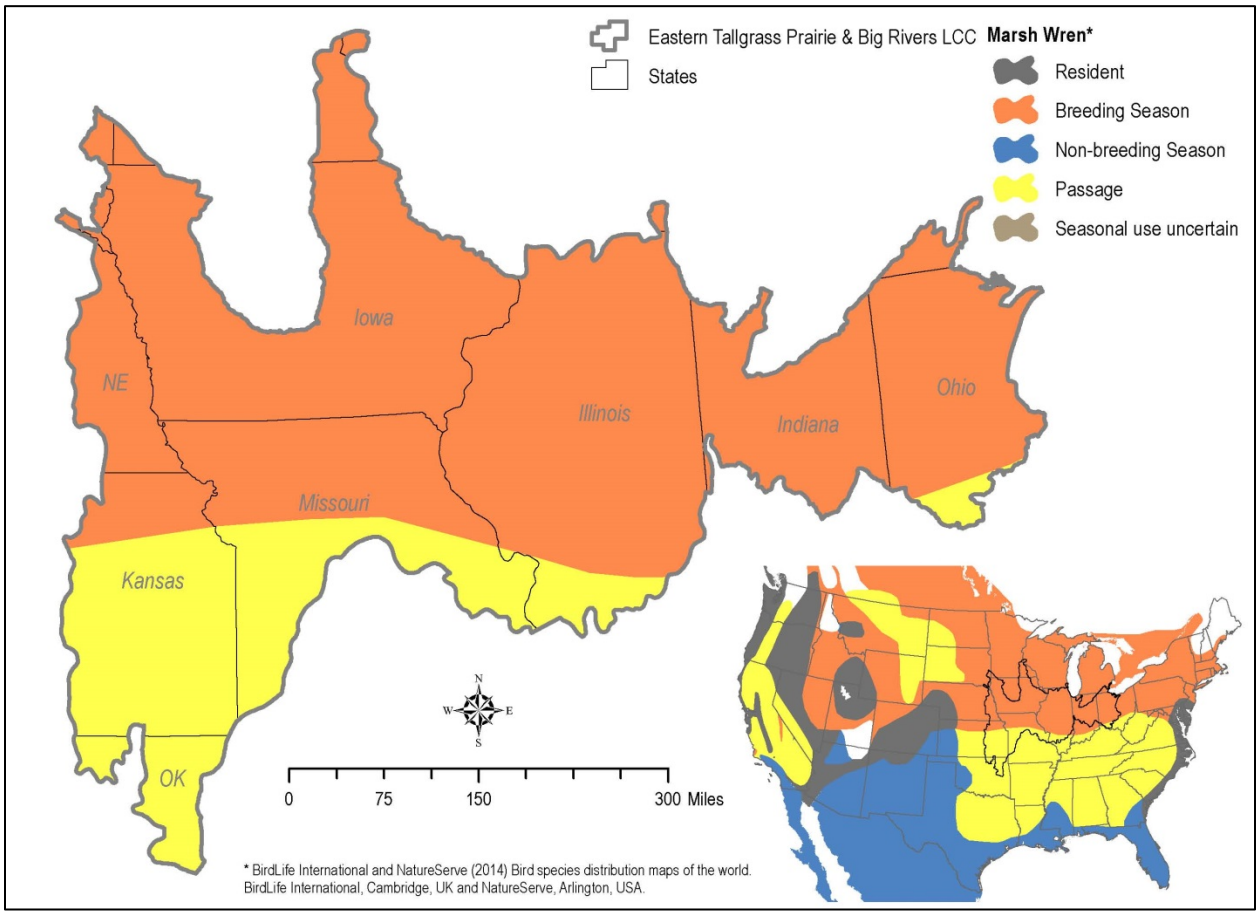
ETPBR geography population objective: 7,500

Marsh Wren (*Cistothorus palustris)* is an "umbrella" surrogate species selected to represent other Service trust species inhabiting emergent marshes throughout the ETPBR geography (Blomquist et al. 2013). Marsh Wren is a small, insectivorous, obligate wetland-breeding passerine. The northern boundary of its breeding range extends from British Columbia through the Prairie Provinces and Great Lakes States to the Atlantic Coast of New England and the Maritime Provinces; the southern boundary extends from the Atlantic Coast through the Appalachians, the Midwest and Central Great Plains, to the Colorado Plateau and Great Basin (Kroodsma and Verner 2014). During the winter, Marsh Wren can be found in coastal marshes and tidal rivers from New Jersey southwards to Florida, Texas, Baja California and central Mexico. In mild conditions, this species may winter as far north as it breeds, and it is resident year-round in some parts of its range, including some areas of Missouri and southern Illinois (Kroodsma and Verner 2014). In the ETPBR, Marsh Wren occupy seasonal, semipermanent, or permanent wetlands with dense, mixed, or monotypic stands of emergent aquatic vegetation (Kroodsma and Verner 2014).

Photo by Marie Read.

The most serious threats to Marsh Wren's breeding habitat are habitat loss due to the filling or draining of marshes for agriculture or development and habitat degradation due to invasion of marshes by woody vegetation (Kroodsma and Verner 2014). Increasing population levels within the ETPBR will likely depend on mitigating habitat losses, protecting and restoring wetlands with extensive cattail and/or bulrush cover. This species may also be negatively impacted by invasive vegetation such as reed canary grass (*Phalaris arundinacea*) (Zimmerman et al. 2002).

State	Marsh Wren State Listing Status	State Wildlife Action Plan SGCN
Illinois	No Status	Y
Indiana	Endangered	Y
Iowa	No Status	N
Kansas	No Status	N
Michigan	No Status	Y
Minnesota	No Status	Y
Missouri	No Status	Y
Nebraska	No Status	N
Ohio	Species of Concern	Y
Oklahoma	No Status	N
South Dakota	No Status	N
Wisconsin	No Status	N



POPULATION STATUS

Marsh Wren has been identified as a "bird of management concern" by the Service. Half of the State Wildlife Action Plans in the ETPBR classify this species as a "Species of Greatest Conservation Need" (SGCN).

Partners in Flight (PIF) estimates that approximately 5,000 birds (0.10% of the total population (PIF 2013) breed within the ETPBR geography (Bird Conservation Region 22). These estimates are derived using Breeding Bird Survey (BBS) data, where average birds per BBS route are extrapolated based on area surveyed and "detection adjustments" (Blancher et al. 2007). However, it should be noted that this species in known to be poorly monitored by the BBS (Sauer et al. 2014).

POPULATION TRENDS

The BBS has detected "non-significant" long- and short-term declines in Marsh Wren population trend estimates in the ETPBR geography (Sauer et al. 2014). The BBS-based trends are thought to be "unreliable" due to the low number of detections on BBS routes and thus caution should be used when interpreting them for Marsh Wren (Sauer et al. 2014). However, the BBS is currently the best available data source for this species. Trends for Marsh Wren within the ETPBR geography are as follows (Sauer et al. 2014):

1966-2012: -1.80% (95% Credible Interval: -12.38, 8.79)

2002-2012: -1.56% (95% Credible Interval: -32.02, 41.83)

POPULATION OBJECTIVE

A continental population objective that called for maintaining the current Marsh Wren population size was previously established by PIF (Rich et al. 2004). However, when significant declines at the regional level are detected, PIF acknowledges that their continental perspective should not prevent setting a more aggressive population objective that use regionally derived trend data to develop regional population and associated habitat objectives.

For species that have undergone moderate declines (15–50% over 30 years), the PIF objective is to increase the population by 50% over the next 30 years (Rich et al. 2004). Within the ETPBR, from 1982 to 2012, the Marsh Wren population has undergone a "moderate" decline of approximately 41%. [Note: the 1982 ETPBR population size (8,539) was calculated using the BBS rate of decline from 1966-2012 (-1.80%/year), and back calculating the population size, using the 2012 population (5,000) as starting point.] Therefore it may be appropriate to adopt a more aggressive ETPBR population objective. For species that have undergone moderate declines (15–50% over 30 years), the PIF objective is to increase the population by 50% over the next 30 years (Rich et al. 2004). The proposed objective is to increase the population by 50%:

- 2012 population = 5,000
- Goal = 7,500 (Based on 1982 population estimate)
- Deficit = 2,500
- Minimum new habitat area required to eliminate deficit (Potter et al. 2007):
  - 450 ha = 2,500 (pop. deficit)/2 (birds/breeding pair) * 0.36 ha (habitat area used/pair; Lazaran et al. 2013)

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

Using the proposed population objective, "success" for Marsh Wren in the ETPBR would be defined as increasing the population by 2,500 birds to reach a population objective of 7,500 birds. Measuring progress towards this goal requires the ability to detect changes in population size. While the BBS is currently the best available monitoring data for this species, it is important to note the BBS was designed to estimate population trends, not produce population estimates, and furthermore it does not adequately sample emergent wetlands (Conway 2009). Currently, there is not a statistically robust monitoring program that capable of informing "success" in terms of this species' population objective. Thus, a monitoring program is needed to increase our capacity to detect population changes with greater statistical confidence and to link populations with predictive habitat variables. The Standardized North American Marsh Bird Monitoring Protocol (SNAMBMP), which lists Marsh Wren as a potential "non-focal species," uses survey methodology intended for use on National Wildlife Refuges and other protected areas across North America (Conway 2009). While states have increasingly adopted the SNAMBMP, survey efforts are not currently consistent throughout the ETPBR, nor do they all record Marsh Wren. If this survey were to include Marsh Wren as a focal species and expand to sample non-protected areas consistently throughout the ETPBR, the monitoring data, collected together with landscape habitat data, could

potentially be used to inform a Marsh Wren spatially explicit model (SEM). A SEM that predicts Marsh Wren abundance in the ETGBR LCC geography based on relationships to landscape habitat parameters will be needed for conservation design, the next step in implementing Strategic Habitat Conservation for surrogate species. In the absence of a statistically robust sampling framework, we will be forced to rely on an expert opinion model that lacks statistical confidence and is thus greatly limited in the ability to meaningfully assess outcomes of alternative conservation design strategies and future scenarios. In the absence of a statistically robust sampling framework, we will be forced to rely on an expert opinion model that lacks statistical confidence and is thus greatly limited in the ability to meaningfully assess outcomes of alternative conservation design strategies and future scenarios.

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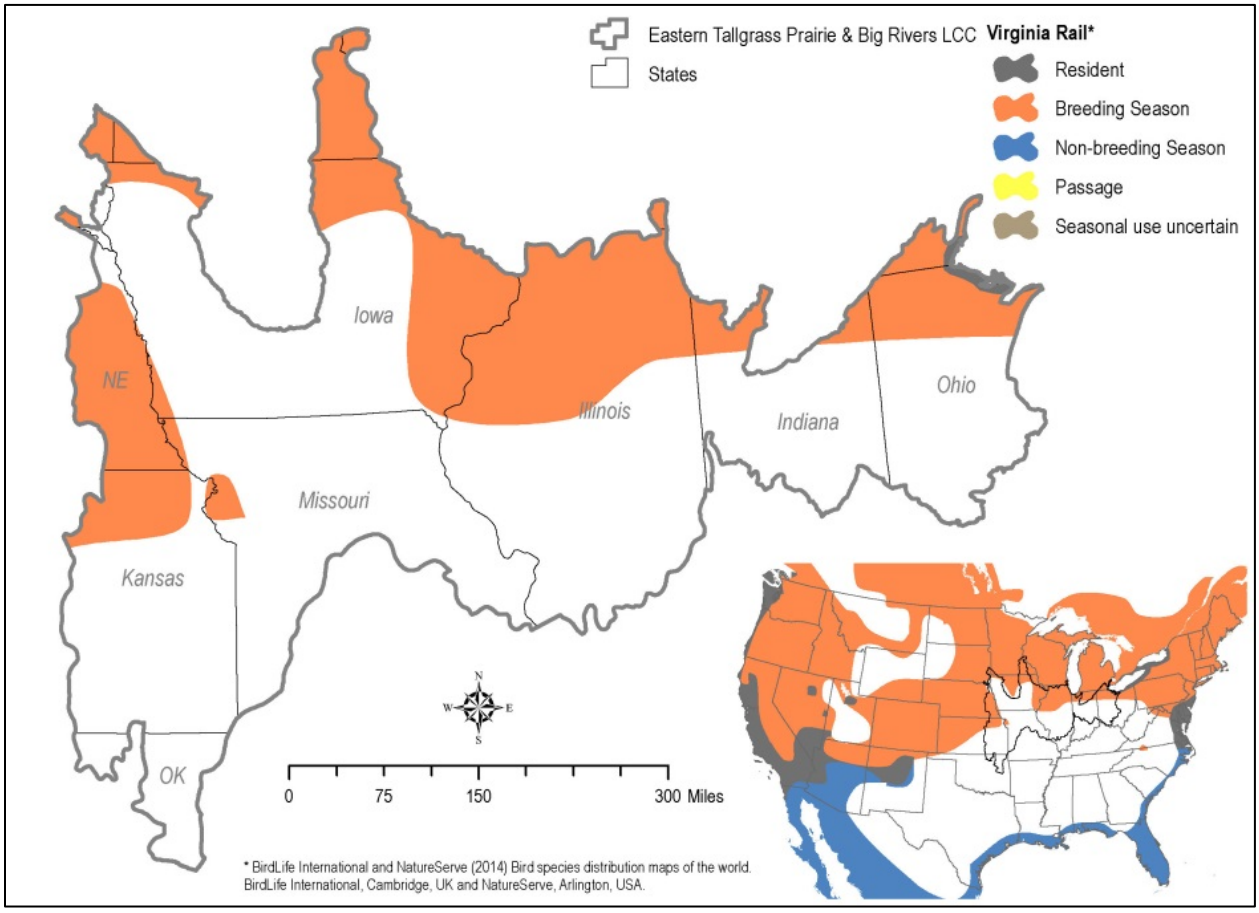
VIRGINIA RAIL

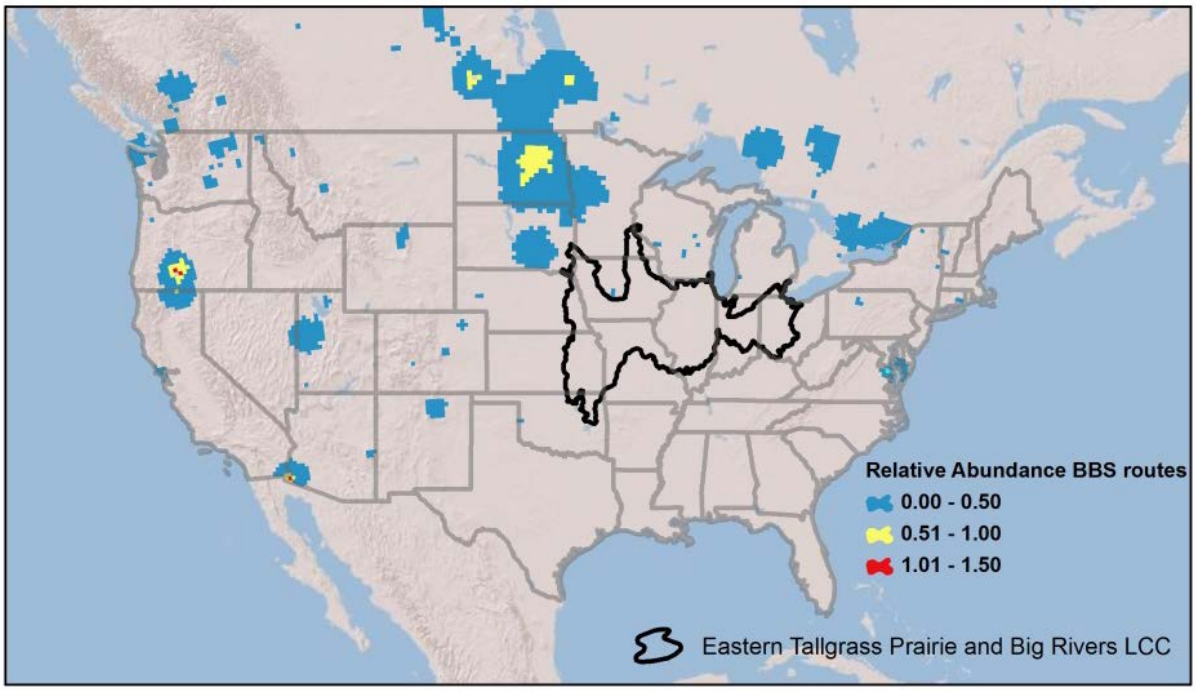
By Brian Loges

ETPBR geography migrating population estimate: Not available

ETPBR geography migrating population objective: Population objectives to be determined based on the assessment of migration habitat requirements.

A sporadic breeder and a secretive migrant marshbird within the LCC, the Virginia Rail (*Rallus limicola*) is an "umbrella" surrogate species selected to represent other Service trust species benefiting from the maintenance and protection of palustrine emergent wetlands throughout the ETPBR geography (Blomquist et al. 2013). Virginia Rails use shallowly flooded emergent wetlands with an abundant invertebrate food source for breeding habitat while migrant birds will utilize both early successional (moist-soil) or perennial dominated marshes (Zimmerman 2002, Sayre and Rundle 1984).





Virginia Rail distribution during the breeding season based on 1966-2012 Breeding Bird Survey Results. Date credit: Sauer et al. 2014.

POPULATION STATUS

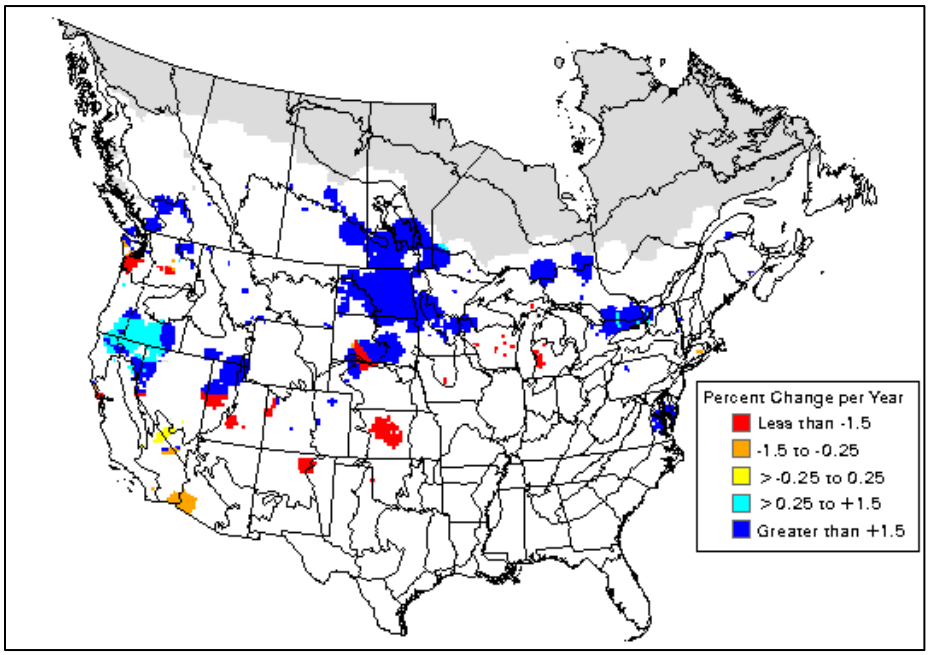
Rangewide, continental, or LCC population estimates are not available although the species can be described as widespread and abundant when suitable habitat exists (Beyersbergen et al. 2004, Conway 1995). Although a game species in many states, hunting effort and harvests are low in all states and limited in use for estimating nonbreeding populations (USFWS 2013). This rail occurs in the LCC as an "edge of range" breeding bird and is consequently listed by eight states as a state-level species of conservation concern as denoted by a status of critically imperiled (S1), imperiled (S2) or Vulnerable (S3).

State	Virginia Rail State Listing Status	State Wildlife Action Plan SGCN
Illinois	S3	N
Indiana	S3b, Endangered	N
Iowa	S3bS3n	N
Kansas	S2bS3n	N
Michigan	S3S4	Y
Minnesota	Snrb	Y
Missouri	S2	Y
Nebraska	S4	N
Ohio	S3, Special Concern	Y
Oklahoma	S1b	N
South Dakota	S5b	N
Wisconsin	S3b	N

POPULATION TRENDS

Population indices produce by the Marsh Monitoring Program indicate decline in the great lakes basin (Crewe et al. 2006). BBS trends from 1966-2012 indicate an increasing trend in the prairie potholes and eastern prairie parklands (Sauer 2014). Despite biases associated with using breeding

bird survey data for secretive marshbirds, trends from BBS data may be the best available for core breeding areas (Conway 1995).



Virginia Rail trend map as a weighted average of yearly change from 1966-2010 Breeding Bird Surveys (Sauer et al. 2014).

POPULATION OBJECTIVE

There are currently no population objectives developed for the Virginia Rail. Although many states within the ETPBR geography have small populations of breeding Virginia Rails, developing objectives for migrating populations will be most appropriate. The ETPBR LCC is geographically positioned directly between breeding grounds and wintering areas of the Atlantic and Gulf Coastal Plain.

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

Providing migration habitat should be the focus of a conservation design for BCR22. Quantifying habitat objectives will be problematic without estimates for population size, stop-over duration, and metabolic demands during migration. All represent high priority information needs for establishing migration habitat objectives.

Density estimates coupled with a population estimate of migratory populations may suffice for quantifying acres. Two ongoing migration studies in Missouri are collecting secretive marshbird occupancy and habitat data (Fournier, et al. 2014 and Hill et al. 2014). With an adequate number of Virginia Rail observations, this data could be used to develop a habitat objective for migrant Virginia Rails incorporating water depth and successional stage of emergent vegetation.

Detection of secretive marshbirds confounds all monitoring efforts designed to estimate populations or predict habitat associations. Despite significant progress towards a standardized national monitoring approach, additional research is needed to answer questions regarding detection probability for marshbird surveys (Conway and Gibbs 2011). If habitat associations can be matched to a quantitative utility for migrating Virginia Rails, habitat acres could serve as the measurable attribute for the objective and monitoring.

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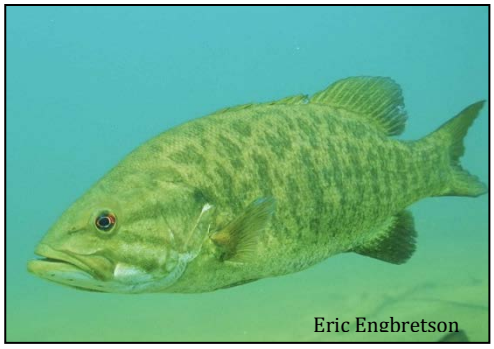
SMALLMOUTH BASS

By Louise Mauldin

ETPBR geography population estimate: Not available

ETPBR geography population objective: The status and information needs for setting a population objective will be gathered from the states and will be addressed by Spring 2015.

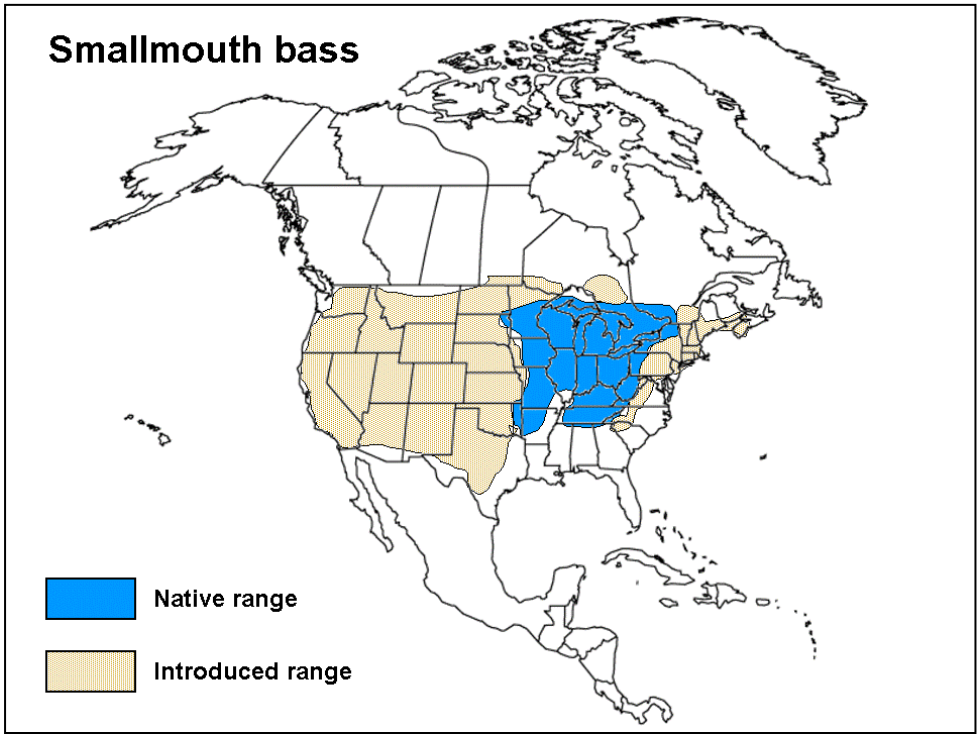
The Smallmouth Bass (*Microterous dolomieui*) is an "environmental indicator" surrogate species for the ETPBR geography. The Smallmouth Bass is a popular sport fish throughout the United States; however, the species has been widely introduced outside its native range (Lee 1980). The native range for Smallmouth Bass stretches from northern Minnesota and Ontario in the north to northern Alabama, southern Arkansas, and eastern Oklahoma in the south and from eastern South Dakota in the west to western Vermont and Quebec in the east. Within the ETPBR geography, native riverine Smallmouth Bass are found throughout the Mississippi River drainage in Iowa, Minnesota, Missouri, Wisconsin, and Illinois; the Ohio River drainage in Indiana and Ohio; and the Arkansas River drainage in Missouri, Kansas, and Oklahoma.


Eric Engbretson

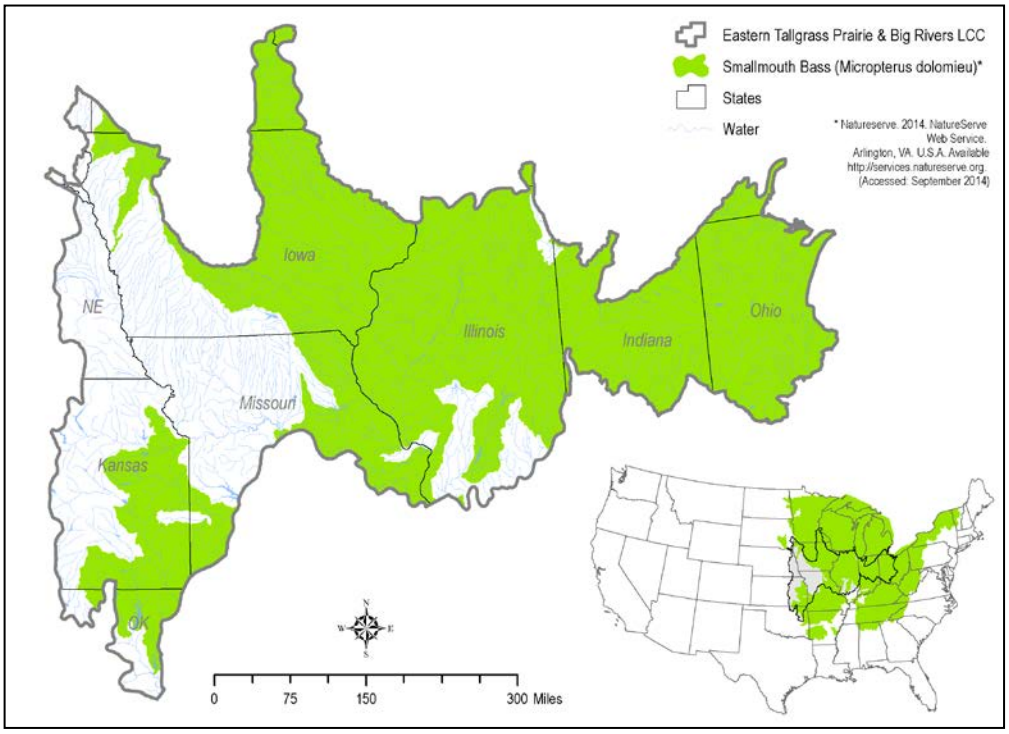
Two genetically distinct subspecies of Smallmouth Bass are recognized within the ETPBR geography (Hubbs and Bailey 1940, Stark and Echelle 1998). The northern Smallmouth Bass (*Microterous dolomieui dolomieui*) is found through most of the species' range and the Neosho Smallmouth Bass (*Microterous dolomieui velox*) is limited to the Neosho River drainage of the Arkansas River basin in southwestern Missouri, Arkansas, and Oklahoma.

In lotic environments, Smallmouth Bass inhabit cool, clear, waters of small streams and moderate to large size rivers. They prefer rivers and streams of moderate gradient, rocky substrate, intermediate depths, and low turbidity (Becker 1983, Lyons 1991, Etnier and Starnes. 1993, Pflieger 1997). Preference for substrate primarily ranges from pebble, gravel, and cobble to boulder and bedrock (Munther 1970, Rankin 1986, Sechnick et al. 1986, Todd and Rabeni 1989, Lyons 1991, Fore et al. 2007). Depending on season, diel period, and habitat availability, Smallmouth Bass have a strong affinity for cover including pools, fallen trees, logjams, rootwads, woody debris, undercut banks, and boulders (Todd and Rabeni 1989). The cover provides a break in the current for bass to rest and ambush prey such as crayfish and small fish.

Because Smallmouth Bass occupy a range of habitats from small order streams to large order rivers and are sensitive to environmental disturbance such as eutrophication, sedimentation and organic pollution, the species can potentially represent a wide variety of fish species utilizing the same type of habitat. Species that have been collected with Smallmouth Bass in cool and warm water rivers and streams depending on location within the watershed include: Northern Rock Bass, Hornyhead Chub, White Sucker, Ozark Minnow, Sand Shiner, Bigmouth Shiner, Rosyface Shiner (Carmine Shiner), Golden Redhorse, Shorthead Redhorse, Black Redhorse, Rainbow Darter, Blackside Darter, and a host of other species.



Native and introduced range of the Smallmouth Bass (Becker 1983).



Distribution of the Smallmouth Bass within the ETPBR geography. Map includes introduced distribution of Smallmouth Bass in the Missouri River drainage in western Iowa, southwestern Minnesota, and eastern Kansas.

POPULATION STATUS

Smallmouth Bass are generally widespread and common across the ETPBR states. The recreational fish is listed as a species of greatest need of conservation in Illinois (IL DNR 2005) and is one of several focal species for the Fishers and Farmers and the Driftless Area Restoration Effort fish habitat partnerships (Fishers and Farmers Partnership 2014, Mauldin and Hastings 2014).

LIMITING FACTORS

State	Smallmouth Bass State Listing Status	Native drainage	Population Trend
Illinois	Species of greatest conservation need	Mississippi	Increasing
Indiana	Common	Ohio	Stable
Iowa	Common	Mississippi	Stable
Kansas	Unknown	Arkansas	Unknown
Michigan	Unknown	Mississippi	Unknown
Minnesota	In Review	Mississippi	In Review
Missouri	Common	Mississippi, Arkansas	In Review
Nebraska	Common	None	Unknown
Ohio	Common	Ohio	Stable
Oklahoma	Common	Arkansas	Stable
South Dakota	Common	Mississippi	Unknown
Wisconsin	Common	Mississippi	Stable

Poor land management practices have resulted in negative impacts to Smallmouth Bass and other native species. Intensive row-crops and overgrazing on highly erodible soils, loss of riparian vegetation to row crops and grazing, and dominance of invasive riparian vegetation have increased stream bank erosion and sediment and nutrient inputs to rivers and streams resulting in declines in the presence and abundance of Smallmouth Bass (Lyons et al. 1988, Paragamian 1991, Belsky et al. 1999, Lyons et al. 2000). Excessive sedimentation has reduced the availability of gravel and cobble essential for spawning and feeding and has filled in pools needed for cover by Smallmouth Bass and other species. Elevated turbidity levels have shown to decrease Smallmouth Bass reactive distance to prey (Sweka and Hartman 2003), in addition to area avoidance, redistribution, changes in activity, and decreased foraging ability (Sweka and Hartman 2001a, Sweka and Hartman 2001b).

Fertilizer run-off from farms continues to be a threat with run-off during rain storms causing short-term (a few hours) but severe declines in dissolved oxygen (<1 mg/l), resulting in fish kills that have devastated Smallmouth Bass populations (Forbes 1985, Mason et al. 1991, Graczyk 1993). Altered hydrology and habitat fragmentation from the presence of lowhead dams have also impacted Smallmouth Bass and other fish species by impeding essential seasonal movements on rivers and creating impoundments that inundate flowing-water habitats (Kanehl et al. 1997, Lyons and Kanehl 2002).

POPULATION OBJECTIVE

Trends in abundance (CPUE) are routinely used by natural resource agencies over decades to assess and compare Smallmouth Bass river populations and it is the recommended approach for setting population objectives for the species. Trends in size, age structure, mortality and exploitation are also used to help manage populations. Relative abundance is usually expressed as catch per hour or catch per length of stream/river sampled. Because monitoring efforts and studies of Smallmouth Bass date back prior to the 1970s, state natural resource agencies have substantial datasets from established long-term monitoring sites, special management areas, and other sites/streams of interest. Catch-per-effort data tends to be less precise, but the metric is suggested over population estimates as CPUE accurately tracks true fish counts and is more cost effective (Lyons and Kanehl 1993).

The timeline for setting Smallmouth Bass population objective encompassing trends in CPUE should take approximately 6-7 months. Smallmouth Bass data should be requested for all native river drainages from the ETPBR states. Smallmouth Bass count data should be requested from fish community and sport fish only electrofishing samples (gear: boat boom, tow and/or backpack). Data requested should include: sample identification code, GPS coordinates, site/station, sample #, date, stream name, gear, effort (time:hr or min) and distance, if available. Habitat measurements are not always collected by field personnel; however, if available, depth, substrate, cover/habitat type, and temperature should be requested. It will likely take 1-2 months for all data to be received, compiled, and formatted for use. Development of a probability-based model to predict distribution of occurrence for Smallmouth Bass and CPUE is a recommended approach to help set population objectives and across the ETPBR geography.

Downstream Strategies (2012a, 2012b), a GIS consulting firm, used a statistical modeling framework called boosted regression tree (BRT) to relate Smallmouth Bass presence (local response variable) to landscape-based predictor variables for the Fishers and Farmers and Driftless Area Restoration Effort fish habitat partnerships in 2012. Predictor variables were compiled at multiple spatial scales including the regional scale (i.e., ecoregion), the network scale (i.e., upstream catchments and local catchment), and the local scale (i.e., single 1:100k National Hydrography Dataset stream catchment).

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

Development of "next generation" habitat models based from Downstream Strategies' boosted regression tree analysis framework may help refine the important natural quality (ie. soils, geology) and human induced stressor (i.e., dams, cattle density) variables influencing the distribution and relative abundance of the species across the ETPBR geography. The models may also be used to identify and prioritize management actions and compare changes in distribution and abundance over time.

Smallmouth Bass populations vary considerably between and within river systems (McClendon and Rabeni 1987, Sowa and Rabeni 1995). Reach level habitat related variables collected from field sampling are important in characterizing the distribution and abundance of the species within streams and are valuable for inclusion in development of the models.

Sindt et al. (2011) emphasizes that models should be reviewed for accuracy to gauge confidence in the predictions and identify limitations before use in conservation planning. The type of model, spatial scale, data sources, species characteristics, and species occurrence influences the accuracy

and utility of the model (Vaughan and Ormerod 2003; McPherson et al. 2004; Ruiz and Peterson 2007). Downstream Strategies (2012a; 2012b) used a cross validation method described by Elith et al. (2008) to assess Smallmouth Bass and other models developed for the Midwestern fish habitat partnerships. Use of an independent dataset is suggested to be the most robust approach to assess accuracy of a model (Vaughan and Ormerod 2005; Sindt et al 2011). The validation method for the new models should be further discussed.

Regular fish community and sport fish monitoring efforts are conducted by state natural resource agencies. In most cases, boat, tow barge, and backpack electrofishing monitoring efforts are standardized across the program within each state and are similar among the ETPBR states. Existing state agency monitoring efforts and standard sampling protocols should be utilized as much as possible for data consistency. Monitoring could be aided with other partners within the fish habitat partnerships.

A pre- and post- monitoring regime using occupancy and trends in CPUE of all sized Smallmouth Bass may be outlined in the planning stages of selected restoration efforts and associated reference sites. Detecting change in fish response will depend on the types of upland, riparian and in-stream actions implemented, scale (catchment, HUC 12, HUC8), and time period of implementation (single vs. multiple years).

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PUGNOSE MINNOW

By Peter Johnsen

ETPBR geography population estimate: Unknown

ETPBR geography population objective: Increasing distribution and connectivity between occurrences

Pugnose Minnow (*Opsopoeodus emiliae*) is an Environmental Indicator surrogate species selected to represent loss of free-flowing and connected rivers, streams and associated wetlands; and water pollution related to agricultural fertilizers throughout the ETPBR geography (Blomquist et al. 2013).Pugnose Minnow is a small fish reaching a length of up to 64 mm. It is mostly found in warm backwaters, vegetated pools, or sluggish streams with clear, clean water and bottom substrate with a high content of organic material. The species occurs in the Mississippi and Ohio Rivers and their tributaries and in streams and rivers from Texas to Florida (Page and Burr 1991). Within the ETPBR geography, the species is not known to occur within the state of Nebraska and its distribution in Iowa is restricted to the Mississippi River along the border with Illinois. It has a limited distribution within Missouri. It is found as multiple spotty occurrences within the states of Illinois, Indiana, and Ohio. Occurrences of the species are also reported from Kansas and Oklahoma.

Chad Thomas

The distribution of Pugnose Minnow has declined substantially over the last decades and been lost at several locations where they were known to exist historically. Multiple states list the species as endangered or as a species of special concern. The species is an indicator of degraded water quality from both point and non-point pollution and sediment input into streams. It is also sensitive to channelization of streams and rivers. The ETPBR geography covers most of the species northern US distribution. Maintaining population levels within this area is important for species integrity and for maintaining its natural range. Conservation efforts will depend on mitigating habitat losses and degradation, especially those associated with agricultural run-off and erosion and stream modifications for water drainage and management. Conservation actions for Pugnose Minnow will likely benefit fauna dependent on aquatic habitat with slow water currents, clean and clear water, accumulation of organic material, and presence of aquatic vegetation. A species objective based on increasing occurrences/distribution, connectivity between occupied habitats, and population targets for individual populations could be developed based on existing information.

POPULATION STATUS

Several states within the ETPBR geography list Pugnose Minnow as Threatened, Endangered, or of special concern. It is not listed as Endangered or Threatened or considered a Species of Concern under the U.S. Endangered Species Act. The Committee on the Status of Endangered Wildlife in Canada (COSWIC) has assessed the Pugnose Minnow as "Threatened" (COSWIC 2012). The IUCN

grade the species as of "Least Concern" on its Red List (http://www.iucnredlist.org/details/202338/0).

State	Pugnose Minnow State Listing Status	State Wildlife Action Plan SGCN
Illinois	Not listed	Y
Indiana	Considered Rare	N
Iowa	Special Concern	Y
Kansas	Likely Extirpated	N
Michigan	Endangered	N
Minnesota	Not listed	Y
Missouri	Not listed	Y
Nebraska	Not present	N
Ohio	Endangered	Y
Oklahoma	Not listed	N
South Dakota	Not present	N
Wisconsin	Special Concern	N

Though no explicit studies of Pugnose Minnow sub-population structure could be found, the species distribution seems to consist of multiple isolated populations. This may both be a consequence of the natural history of the species and a consequence of habitat degradation and extirpation between occupied stream reaches caused by human activities.

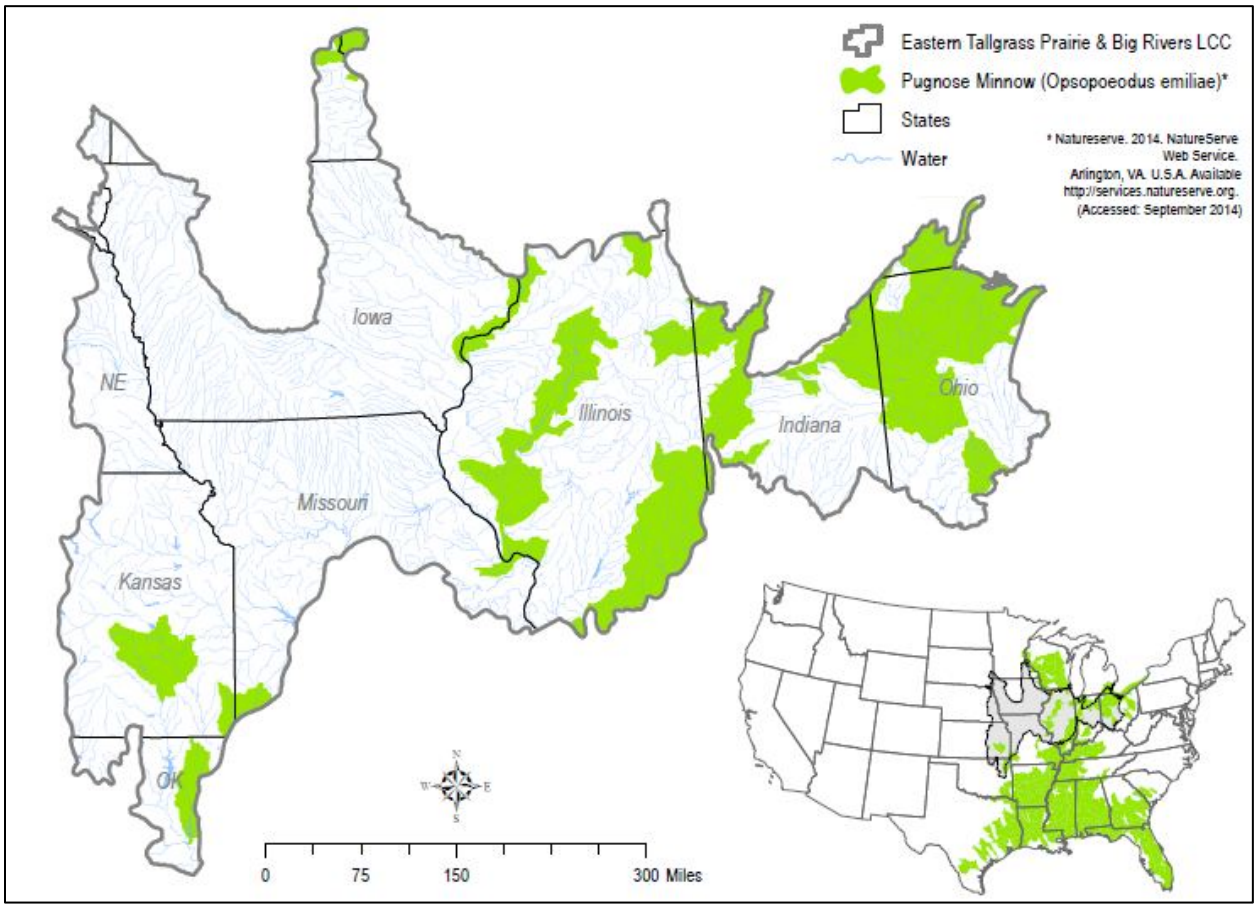
The map below gives an overview of Pugnose Minnow distribution based on both recent and older reported observations. The species is considered extirpated from many of its historic locations within the ETPBR geography and most states report a declining distribution. The species is believed to have been extirpated from the State of Kansas during the drought of the 1930s (Cross and Collins 1995, Potts and Collins 2005). The only recorded observation of this species in the state is three specimens collected in Woodson County in 1931 (Cross and Collins 1995). Data from the Upper Mississippi River Restoration Long Term Resources Monitoring Program indicate a declining presence and loss of Pugnose Minnow in pools in the Upper Mississippi river (LTRMP Treemap Analysis Tool, USGS website).

Abundance estimates for the species as a whole, on a regional level, or on a local scale could not be found. However, given the presence of local extirpations and the decline in distribution, it is reasonable to assume that abundances have declined at many locations, for most populations, and for the whole ETPBR geography.

State agencies have identified loss of water bodies with slow moving water currents, clean and clear water, aquatic vegetation, and organic bottom substrate as reasons for the species decline. Introduction of sediment and silt from upstream erosion, pollution from urban and agricultural run-off, and channel modifications are likely major causes of observed adverse habitat modifications.

POPULATION TRENDS

Lack of monitoring programs for this species makes it difficult to estimate population abundances and trends. However, comparing historic with current observations indicate an increasing decline in distribution over time.



POPULATION OBJECTIVE

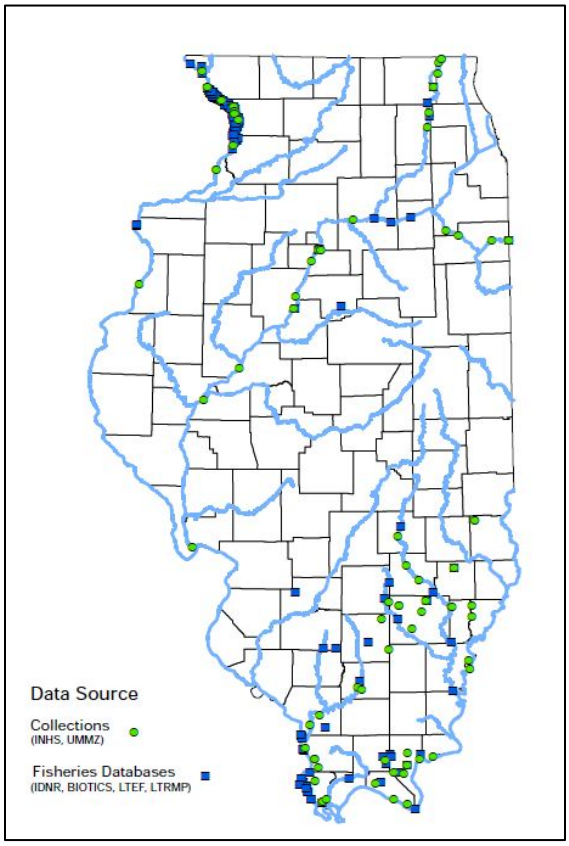
None of the states in the ETPBR geography have established population objectives for this species. In Canada, the species was listed as of Special Concern in 1985 and as Threatened in 2012. Consequently, Fisheries and Oceans Canada has developed a management plan (Edwards and Staton 2009), and quantified recovery targets and required habitat (Young and Koops 2012) for Canadian populations of Pugnose Minnow.

A preliminary, proposed objective is to increase the distribution and connectivity between occurrences within the ETPBR geography. This preliminary objective will be developed as population data is gathered from State partners.

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

Spatial models for this species are not currently available for the ETPBR geography. A conservation design strategy for Pugnose Minnow could attempt to utilize the models developed by Fisheries and Ocean Canada (Young and Koops 2012). The model estimates a Minimum Viable Population which is defined as a population with a 0.1 extinction probability over a 100-year period. The estimated Minimum Viable Population ranged from about 200,000 to 6.4 million adults (1+) depending on the values used for different parameters in the model such as population trajectory direction (increasing, equilibrium, declining), probability of catastrophic decline (5, 10, or 15 % chance of a

50% population decline), and extinction threshold (1 or 50 females). However, the model may have limitations for this species due to lack of basic information. Data for developing a population target is missing, ranging from knowledge of its biology to true vital rates (life stage expected survival, number of spawning events, fecundity per spawning event, and expected life time survival). The Fisheries and Ocean Canada also estimated that 2 to 200 hectares of suitable habitat would be required to establish a viable population.



However, a scaled population objective could be set for this species based on existing distribution data and future monitoring programs. The Pugnose Minnow is found as discrete occurrences within the ETPBR geography. Presence maps have been published for several states and data can be extracted from fisheries databases (e.g., map of Illinois). State agencies and program managers could be contacted to access the original occurrence data that were used to develop maps and information about the locations that have been surveyed. Objectives could then be developed at different scales based on information about historic and current occurrences. Objectives could consist of distribution, connectivity, and abundance targets. Though no abundance estimates exist for populations, abundance objectives for each population could be developed based on general knowledge of what abundance would be needed to 1) provide for genetic and biological sustainability and 2) to minimized the probability of extirpation as a result of a catastrophic decline. The scaling of objectives would be achieved by setting objectives for stream reaches that are rolled into objectives for watersheds which again is rolled into objectives for populations and finally into objectives for metapopulations. Developing a species objective for Pugnose Minnow would require substantial effort in finding the original data used to develop presence maps and gathering information about the stream reaches where the species are or were observed.

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STATE AND FEDERAL AGENCY WEBSITES

Fisheries and Ocean Canada, Aquatic Species at Risk, Pugnose Minnow Information
http://www.dfo-mpo.gc.ca/species-especes/species-especes/pugnoseminnow-petitbec-eng.htm
Illinois Department of Natural Resources
http://www.dnr.illinois.gov/espb/Pages/default.aspx
Illinois Department of Conservation, Natural Heritage Database
http://dnr.state.il.us/conservation/naturalheritage/inhd.htm
Indiana Department of Natural Resources, Non-game and Endangered Wildlife
http://www.in.gov/dnr/fishwild/2356.htm
Iowa Rivers Information System, Fish Atlas
http://maps.gis.iastate.edu/iris/fishatlas/
Pugnose Minnow Information
http://maps.gis.iastate.edu/iris/fishatlas/IA163876.html
Kansas Department of Wildlife, Parks, and Tourism; Threatened and Endangered Wildlife
http://kdwpt.state.ks.us/Services/Threatened-and-Endangered-Wildlife
Michigan Natural Feature Inventory, Rare Species Explorer
http://mnfi.anr.msu.edu/explorer/search.cfm
Pugnose Minnow information
http://mnfi.anr.msu.edu/explorer/species.cfm?id=11343
Missouri Department of Conservation
http://mdc4.mdc.mo.gov/applications/mofwis/Mofwis_Search1.aspx
Minnesota Department of Natural Resources, Endangered and Threatened Species
http://www.dnr.state.mn.us/ets/index.html
Minnesota Species of Greatest Conservation Need
http://archive.leg.state.mn.us/docs/2006/other/060316/www.dnr.state.mn.us/cwcs/strategy.html
Ohio Department of Natural Resources, Division of Wildlife, State Listed Species
http://wildlife.ohiodnr.gov/species-and-habitats/state-listed-species
Pugnose Minnow Information
http://wildlife.ohiodnr.gov/species-and-habitats/species-guide-index/fish/pugnose-minnow
Oklahoma Department of Wildlife Conservation
http://www.wildlifedepartment.com/wildlifemgmt/endangeredspecies.htm

MONARCH BUTTERFLY

By Doug Helmers

ETPBR geography population estimate: Not available

ETPBR geography population objective: Increase populations by 10% every three years over the next 15 years

The Monarch Butterfly *(Danaus plexippus plexippus*) is one of the most recognizable butterflies in North America and is a "flagship" surrogate species selected for the ETPBR geography. The monarch is a migratory butterfly which requires milkweed plants upon which to rear their larvae and nectar sources to sustain the adults during reproduction. Nectar sources are also required by the butterflies to fuel the fall migration as well as the spring flights northward. They breed in grasslands and agricultural lands throughout the United States and southern Canada and winter in Mexico, California and parts of Florida.

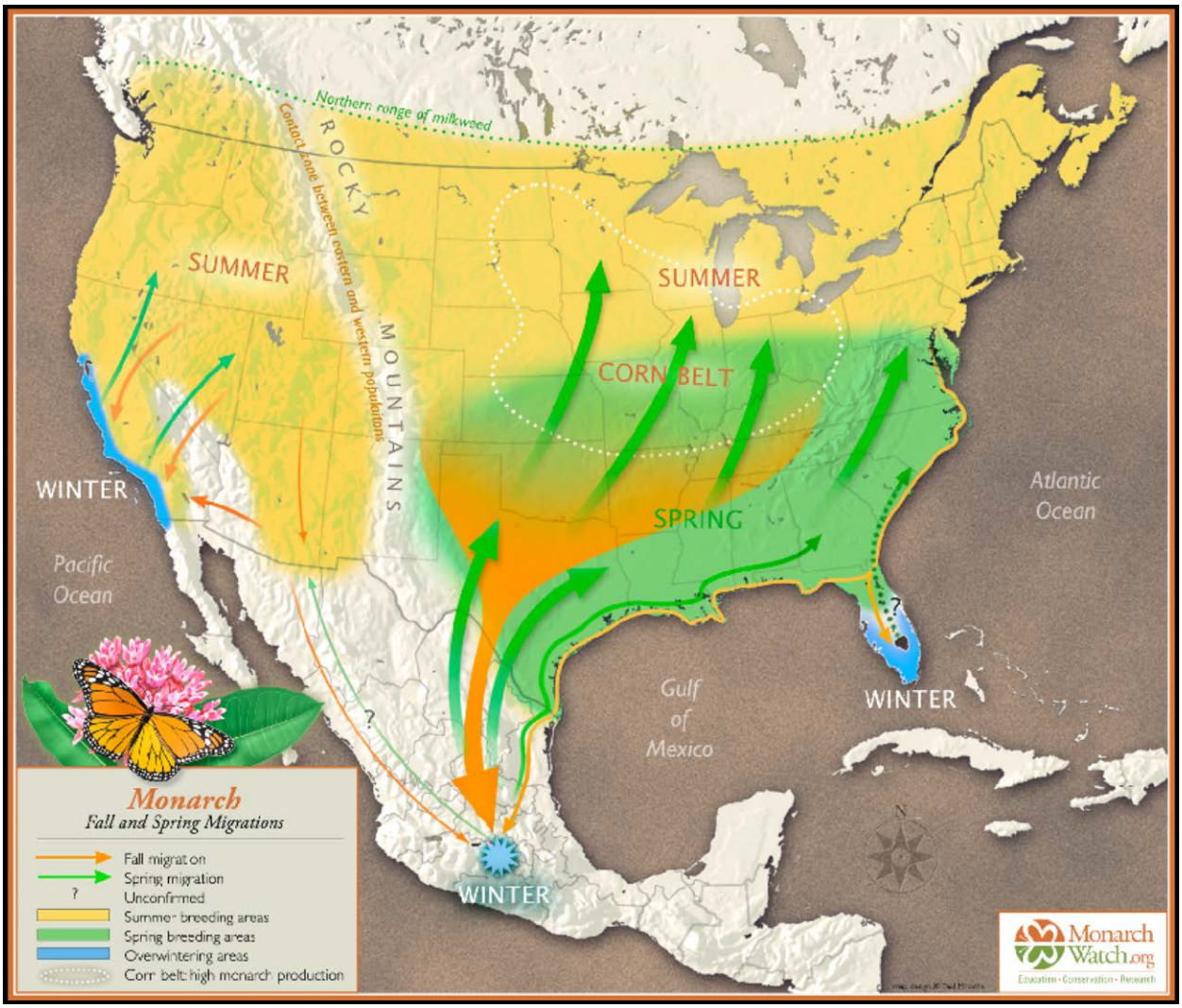
Approximately 50% of the eastern populations of Monarch Butterflies breed in agricultural fields within the ETPBR geography (Hobson et al. 1999) and these fields were commonly colonized by Common Milkweed (*Asclepias* species). Chemical-intensive agriculture, increasing acreage converted to row crops, and mowing/herbicide treatment of roadsides have contributed to a decline of milkweed, the only food source for monarch caterpillars. Ongoing declines in lands enrolled in the Conservation Reserve Program (CRP) are expected to have negative impacts on population trends; woody shrub encroachment into grasslands and savannas and the timing of management practices also pose threats to this species, along with winter habitat availability and quality. Maintaining population levels within the ETPBR geography will likely be important for regional and continental population stability and will depend on mitigating habitat losses, particularly those associated with herbicide resistant crops, as well as CRP agreement expirations and subsequent grassland conversion to cropland. In addition to protecting or restoring grassland and savanna habitat, managing for grasslands for a high diversity of forbs and the timing of management, such as prescribed fire, will be important for this species.

Monarch Butterfly was chosen as a flagship surrogate species to represent other pollinator species inhabiting grasslands throughout the ETPBR geography. Conservation actions for the Monarch Butterfly will likely benefit a wide array of other pollinator species.

POPULATION STATUS AND TRENDS

The Monarch Butterfly winter roosts in Mexico and California were designated as threatened phenomena by the International Union for Conservation of Nature and Natural Resources (IUCN) in the IUCN Invertebrate Red Data Book in 1983 (Wells et al. 1983, Malcolm 1993). This was the first designation for a biological phenomenon, as opposed to a species, in the history of international conservation. It recognizes the fact that the migratory phenomenon, which involves millions of monarchs migrating to distant overwintering sites each year, is imperiled, even though the species as a whole is not in danger of extinction.

The Monarch Joint Venture through the World Wildlife Fund estimates the number of monarchs from east of the Rockies has declined from occupying an overwintering area of 7.8 hectares in the 1994-1995 overwintering season (the first year data are considered to be reliable), to occupying an area of only 0.67 hectares in the 2013-2014 overwintering season, a decline of more than 90 percent from the 20-year average, and a decline of 97 percent from the 1996-1997 population high (Rendón-Salinas and Tavera-Alonso 2014).



To estimate overall abundance of monarchs that overwinter in inland Mexico, scientists rely on the combined area of overwintering colonies because it is a direct measure of the entire migratory population (Brower et al. 2012b, p. 328). On-the-ground counts have resulted in estimates of 10 to 60 million butterflies per hectare of trees occupied, with 50 million monarchs per hectare being used as a standard estimate of overwintering butterfly numbers (Slayback et al. 2007). Monarch numbers in winter roosts generally correlate with numbers produced during breeding in a given season, although variable mortality does occur during migration.

Wassenaar and Hobson (1998) determined that half of the overwintering monarchs had "originated from a fairly restricted part of the breeding range, including the states of Kansas, Nebraska, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, and Ohio, corresponding to an area of intense corn, soybean, and dairy production in the Midwestern United States"

POPULATION OBJECTIVE

Monarch Butterfly population objectives have not been established for the ETPBR geography. The development of a population objective seems warranted due to dramatic declines in the past two decades. The North American population as recently as the mid-1990s numbered nearly one billion butterflies. The loss of milkweed, habitat loss and the degradation of overwintering sites has reduced the population to approximately 35 million butterflies as of winter 2013-2014. A reasonable assumption to reverse this precipitous decline would be a goal to increase populations by 10% every three years over the next 15 years to stabilize this decline.

IMPLICATIONS FOR CONSERVATION DESIGN AND MONITORING

The North American Monarch Conservation Plan (2008) identified 5 objectives which are of the most immediate importance and have the most potential for trilateral cooperation. Three of these can be address through the Services' Strategic Habitat Conservation process for the Monarch.

1) Address threats of habitat loss and degradation in the flyway. Effective flyway conservation requires immediate management actions. These actions must be supported by research and monitoring to identify the habitat types and locations that are most important to monarchs during their spring and autumn migrations, and by an understanding of how human activities affect the availability and suitability of these habitats.

2) Address threats of loss, fragmentation, and modification of breeding habitat. Breeding habitat conservation will require better understanding of monarch host plants, including how land use practices affect the distribution and abundance of numerous milkweed (*Asclepias*) species. Land use practices that support monarch breeding should be encouraged among government agencies, private conservation organizations, and public and private landowners.

3) Monitor monarch population distribution, abundance, and habitat quality, including water availability. Government and nongovernmental agencies should support the development and dissemination of a monitoring program, and a diagnosis of biological and socioeconomic drivers of monarch population dynamics. Coordinated monitoring throughout the monarch's annual cycle and open sharing of the data are key to understanding the status of the population and effectiveness of conservation actions.

Currently a group of key stakeholders and scientists from Mexico, the U.S., and Canada are holding a workshop to synthesize the available data and develop a spatially explicit restoration plan. Specific goals of the workshop are to (a) To determine both the levels and spatial configuration of milkweed and nectar habitat that must be restored to increase vital rates and forestall further population declines through the exploration of restoration and policy scenarios; (b) identify the most critical locations for milkweed and nectar habitat restoration; (c) develop a methodology to study and understand specific properties of habitat restoration actions that most promote monarch production and can be tied to conservation targets; (d) develop a plan for adaptively monitoring and managing restoration activities as they progress; (e) discuss the potential for citizen science engagement in restoration efforts. This work will be critical in developing conservation designs and monitoring protocols for monarch butterflies within the ETPBR geography.

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