Ecoregional Conservation in the Osage Plains/Flint Hills Prairie

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This report may be cited as:
The Nature Conservancy, Osage Plains/Flint Hills Prairie Ecoregional Planning Team. 2000. Ecoregional Conservation in the Osage Plains/Flint Hills Prairie. The Nature Conservancy, Midwestern Resource Office, Minneapolis, MN. 48 pp. + 73 appendices.

Front cover photographs: Harvey Payne

The mission of The Nature Conservancy
is to preserve the plants, animals,
and natural communities
that represent the diversity of life on Earth
by protecting the lands and waters they need to survive.

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Executive Summary

The Osage Plains/Flint Hills (OPFH) ecoregion encompasses nearly 31,000 square miles, occupying a portion of west-central Missouri, northeastern Oklahoma and much of eastern Kansas. As the name suggests, the ecoregion is characterized by two distinct landforms, the Flint Hills and Osage Plains. The Flint Hills landform is dominated by gently sloping, prairie-dominated hills of limestone and shale, with an elevational relief of 300-500 feet; it is the source of many of the ecoregion's streams and rivers. The Osage Plains is characterized by a series of roughly parallel southwest- to northeast-oriented escarpments, separated by gently rolling to level plains. Rivers in this section are generally broad, meandering, and slow-moving.

This difference in landform has had profound impacts on land use patterns in the ecoregion. Like all tallgrass prairie ecoregions, the OPFH is highly impacted by the effects of agricultural conversion. This is especially pronounced in the eastern Osage Plains portion, where over 90% of the original prairie has been tilled and is now in row crop or hay production agriculture. Because of its shallow soils overlying bedrock, the western portion of the ecoregion remains relatively intact, boasting the largest remaining tallgrass landscape remaining in the world - the Flint Hills.

Like ecoregions throughout the Great Plains, population movement in the OPFH over the past decade has been from rural to urban areas. Twenty-six percent of all counties exhibited population declines during this period, all being rural. Seven of nine most sparsely populated counties are located within the Flint Hills region of Kansas, while seven of nine fastest growing counties in the ecoregion are associated with large- and middle-sized metropolitan areas. The overall population of the ecoregion is growing at a rate of just under 1% per year; if this trend continues, 300,000 additional individuals will call the ecoregion home by the year 2020, the vast majority of these living in urban areas.

Four conservation planning teams, each with separate duties, embarked upon the process of fulfilling The Nature Conservancy's conservation goal by following an ecoregional planning process developed and modified in other ecoregions of the Great Plains.[1] Conservation targets (those species and natural communities around which the ecoregional conservation plan was assembled) included 55 terrestrial community types, all aquatic communities (addressed through identification of surrogate stream reaches) and 30 species. Conservation goals (the number and distribution of populations/occurrences required to sustain the targets over time within the ecoregion) were set for each of the conservation targets, followed by the assembly of the ecoregional portfolio of conservation action sites. This assembly process placed an emphasis on viability by favoring the selection of large natural landscapes over small, isolated sites.

The resulting ecoregional conservation portfolio consists of 53 conservation areas, 33 terrestrial and 20 aquatic. Together, these account for nearly 5.4 million acres and 1,444 stream miles, or approximately 27% of the ecoregion's total area. Although all conservation areas in the portfolio are important and mandate conservation action, resource constraints necessitate the setting of priorities. Conservation priorities were set among portfolio conservation areas by assessing four primary factors: complementarity, conservation value, threat/feasibility, and leverage. Twelve sites were identified as the being of highest priority (termed YES action sites), 11 within a second tier (MAYBE), and 30 within a third tier (NO immediate action). Together, sites within the YES and MAYBE categories account for 73% of the species and 86% of the natural community occurrences selected for the ecoregional portfolio.

The vast majority (95%) of the ecoregional portfolio is in private ownership. The U.S. Army Corps of Engineers, state natural resource agencies, and private conservation organizations (principally The Nature Conservancy) are the principle land management agencies/organizations within the selected portfolio. Because of the dominance of private land ownership and an array of conservation partners, the Conservancy and its partners must develop and employ a wide range of innovative strategies.

[1] Conservation goal: the long-term survival of all viable native species and community types through the design and conservation of portfolios of sites within ecoregions.

Three general conservation strategies were identified as a means of effectively implementing the conservation plan: 1) hasten site conservation planning, 2) focus conservation within functional landscapes, and 3) assess and undertake restoration where the option of conserving extant viable examples of conservation targets are no longer possible. Because information gaps pertaining to conservation targets are large, a fourth strategy targeting the strategic filling of biological inventory data gaps was identified.

Although site-by-site conservation is an effective tool, the large total area and number of conservation sites captured by the ecoregion portfolio necessitates an more efficient conservation solution. Two multi-site conservation strategies were identified by the Implementation Team to leverage conservation success across the ecoregion. These are: 1) abating development-based threats by advocating inheritance and capital gains tax reform relative to ranchlands, fostering industry- and producer-driven partner land trusts, and maintaining good communication with state cattleman's associations, and 2) abating agriculture-based threats, by working to infuse conservation values into various farm bill programs, building a battery of incentive programs for biodiversity conservation, and enhancing effective communication between Conservancy government relations and field staff.

Biodiversity Conservation in the Osage Plains/Flint Hills:
An Ecoregional Conservation Blueprint and Action Plan

With the adoption of C*onservation by Design* (The Nature Conservancy 1996), The Nature Conservancy recognized the importance of working at an array of scales (large to small) to achieve its conservation goal, "*the long-term survival of all viable native species and community types through the design and conservation of portfolios of sites within ecoregions*." The Conservancy set forth to design conservation plans within ecoregions by working closely with a full compliment of conservation partners. These plans are intended to provide a framework within which the Conservancy and our partners can make decisions regarding conservation actions to be taken at the local level, confident in the knowledge that site by site activities in ecoregions are not isolated but part of a larger, coherent design.

The current landscape of the Osage Plains/Flint Hills (OPFH) ecoregion presented certain challenges for the Planning Team. Although sharing a common ecological history, the two component sections of the ecoregion (Osage Plains and Flint Hills) have been subjected to widely differing land use practices over the past 150 years. The Osage Plains section is highly converted to rowcrop agriculture, with natural communities represented as relatively small, isolated parcels on the cultivated landscape. The Flint Hills, on the other hand, is dominated by the single largest intact grassland landscape remaining in the North American tallgrass prairie, an area where ranching and large-scale fire regimes are common and accepted practices.

This dichotomy challenged the planning team throughout the development of the plan, from the initial setting of goals for conservation targets to the assembly of the portfolio and the discussion of implementation strategies. Issues pertaining to long-term viability (the high degree of fragmentation and lack of large-scale natural landscapes) dominated the discussion in the Osage Plains, while deliberations with respect to the Flint Hills were more often dominated by programmatic and planning issues.

This ecoregional plan presents a framework for biodiversity conservation in a moderately to highly impacted tallgrass prairie landscape. As a first step toward this ultimate goal, it offers some suggestions as to how best to proceed in the near term toward implementation of biodiversity conservation strategies. We will learn more about how to conduct landscape-scale conservation in the Flint Hills through implementation, while at the same time restoring system functionality to large areas of the Osage Plains. Future iterations of this plan will incorporate this knowledge and move us closer to achieving our conservation mission.

Definitions

Ecoregion: a relatively large unit of land and water defined by the influences of shared climate and geology, the main factors determining the distribution of plants and animals in the area.

Portfolio: the suite of sites within an ecoregion that would collectively conserve the native species and community types found in that ecoregion.

Viability: the ability of a species or community to persist over time.

Natural Heritage Program/ Conservation Data Centers: State, regional, and/or national programs that develop and maintain data sets on location-specific information for imperiled plant and animal species, natural communities, natural areas, and areas under special management. Data are made available to a variety of users for the purposes of environmental review, conservation planning, scientific research, and monitoring of the status of biodiversity within the program's jurisdiction.

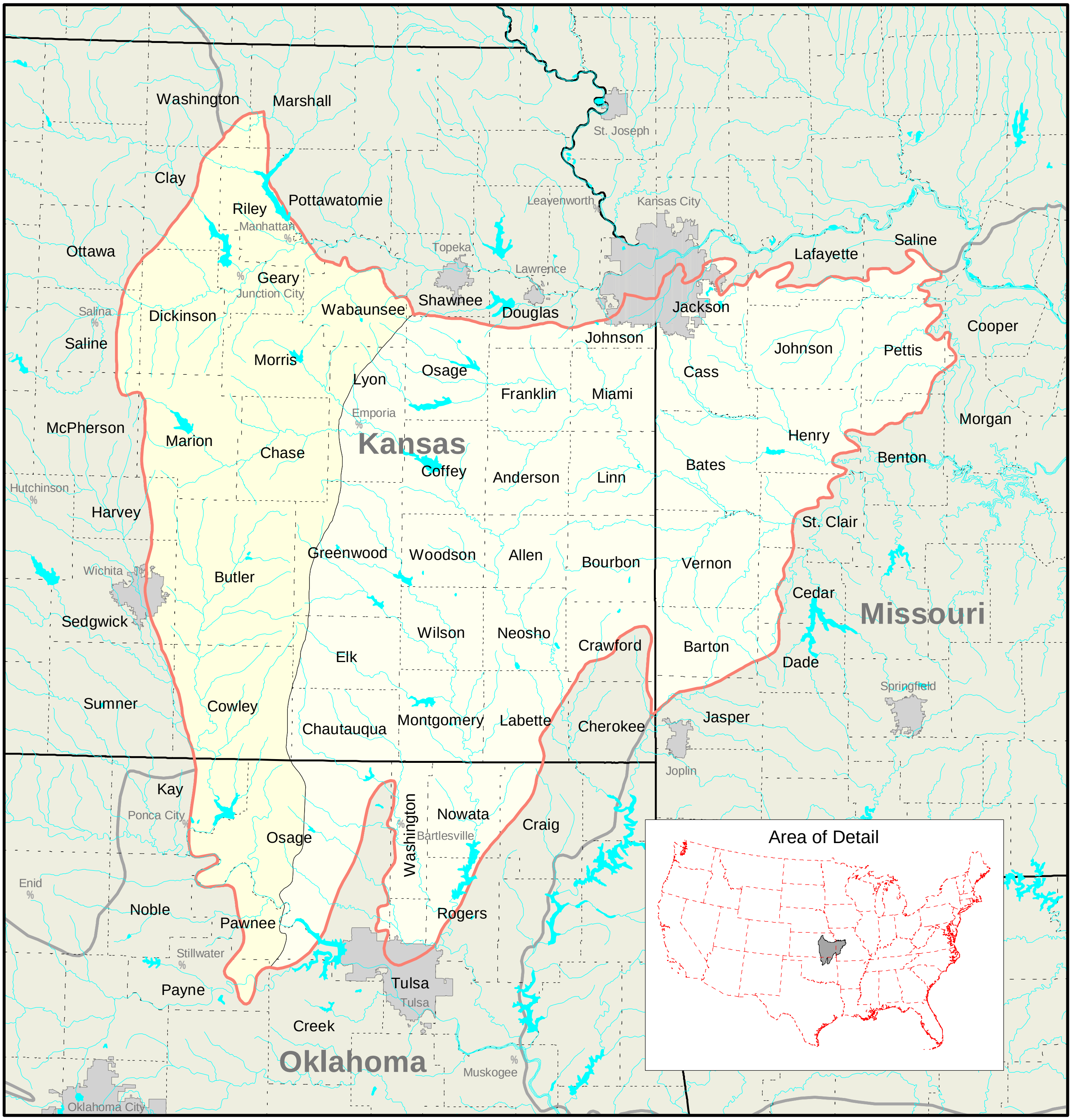
1. The Place and Its People

Like every other ecoregion in the country, the OPFH is unique, with its own geological, biological and climatic character, human history, and challenges to effective conservation action. This section provides a brief overview of the ecoregion – the place, its inhabitants, history, and current socioeconomic characteristics – that shape the area and impact the direction, scope, and scale of conservation work.

1.1 Overview of the Ecoregion

The OPFH ecoregion encompasses 30,916 square miles, extending from west-central Missouri to northeastern Oklahoma and much of eastern Kansas (Figure 1). It encompasses in total, approximately 14% of the total land area of the three-state region. The ecoregion lies south of the farthest maximum advance of glacial ice (with the exception of the far northern portion of the Flint Hills

Figure 1: Osage Plains/Flint Hills Ecoregion Planning Unit



Legend

- Osage Plains / Flint Hills
- Other Ecoregional Boundaries
- Lakes and Rivers

Forest Service Sections
- Flint Hills Section
- Osage Plains Section

- State Lines
- County Lines

- Urban Areas
- Other Cities

0 25 50 Miles

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Section lines from U.S. Forest Service, 1995.

Map created by: The Nature Conservancy, Midwest Conservation Science Center.

section). As the name suggests, the ecoregion is characterized by two distinct landforms, the Flint Hills and Osage Plains. The Flint Hills section is dominated by gently sloping, prairie-dominated hills of limestone and shale, with an elevational relief of 300-500 feet. This landform is the source of many of the ecoregion's streams and rivers (Figure 2). The Osage Plains is characterized by a series of roughly parallel southwest- to northeast-oriented escarpments, separated by gently rolling to level plains. Rivers in this section are generally broad, meandering, and slow-moving.

Climate is influenced by the ecoregion's position within the interior of the continent. Hot continental summer temperatures and cool winters (accentuated by cold arctic blasts) are the norm. A pronounced rain shadow from the Rocky Mountains found throughout the Great Plains is somewhat tempered by periodic to frequent moisture-laden airflow from the Gulf of Mexico (especially during spring, summer and fall months). Annual precipitation varies from 24-41 inches across the ecoregion. The mean annual temperature ranges from 50°-63° F, with a growing season of 160-235 days (McNab and Avers 1994).

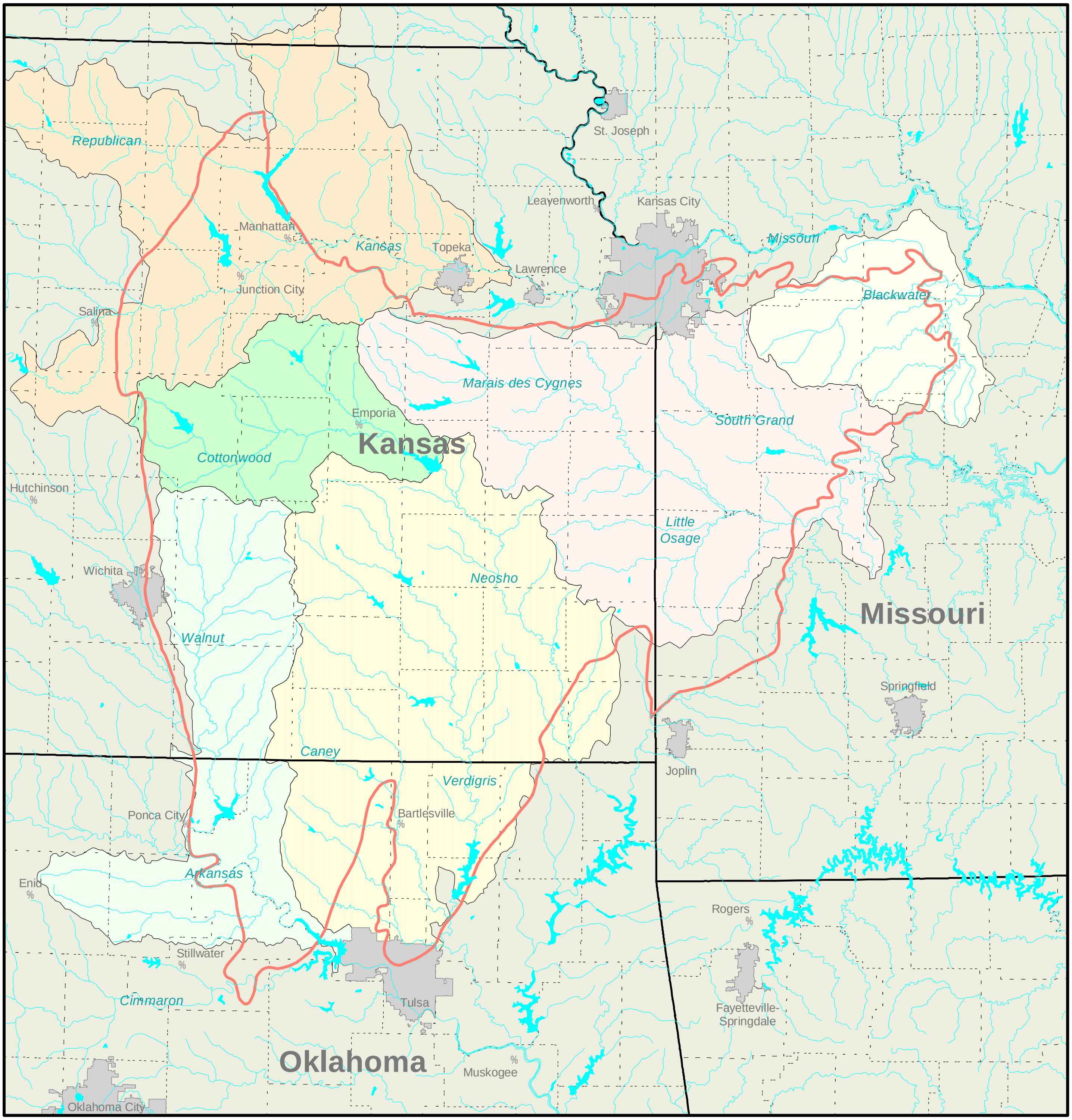
Tallgrass prairie was the dominant vegetation of the ecoregion prior to settlement and subsequent agricultural conversion by Euro-Americans, occupying a range of soils from wet organic-rich soils to dry, thin-soiled uplands at excessively drained sandy and rocky sites (Diamond and Smeins 1988, Kucera 1992). Toward the eastern edge of the ecoregion, oak-hickory forest and crosstimbers were an increasingly important component of the uplands (Bailey 1995). An array of animal life (including bison and elk, now extirpated from the ecoregion) inhabited the ecoregion, having evolved with or adapted to the ecological forces that shaped the region's character and that of the larger Great Plains.

Over the past millennia, prairies occupying wet to moist sites (as was the case throughout much of the Osage Plains section and elsewhere) formed vast accumulations of carbon-rich organic soils, some of the most agriculturally productive sites in the temperate world. That very productivity proved to be the undoing of the prairie landscape, as the intensive agriculture that characterizes the region today became established. In the Flint Hills, however, loam soils thinly mantle the underlying limestone/shale bedrock, making conversion for agricultural purposes difficult. As a result, the historic vegetation of the Flint Hills (i.e., that which dominated the landscape in 1800) is still relatively intact (Figure 3).

1.1.1 Home, Home on the Range
The primary ecological processes that shaped the natural character of the ecoregion were climate, grazing and fire, each operating at multiple scales, frequencies and intensities (Weaver and Albertson 1956, Axelrod 1985, Risser 1985, Anderson 1990). Fire, interacting with the effects of grazing and climate, promoted the development of a diverse vegetation mosaic across the prairie landscape. Seasonal precipitation and temperature patterns influenced the growth of vegetation, and consequently the availability of fuels for burning and forage for grazing. Fires created a mosaic of burned and unburned areas. Bison and elk, the principal large grazers in the ecoregion, grazed preferentially on vegetation in burned areas because of greater productivity and nutritive quality of forage following fire (Risser 1985, Risser 1990, Collins and Gibson 1990, Ostlie et al. 1996). Their transitory grazing patterns allowed the vegetation to recover from intermittent and sometimes intensive grazing events. These grazing patterns further impacted the availability of fuel for fire and, in turn, impacted and helped maintain the vegetation mosaic. People living on the landscape influenced these patterns (by hunting, setting fires, etc.) and thus played a large role in shaping the historic landscape prior to Euro-American settlement.

1.1.2 Corn as High as an Elephant's Eye
Euro-American settlement during the late 19^{th} Century had a major impact on the landscape of the ecoregion. In fact, few places in the world have experienced the recent anthropogenic alteration to the extent documented in the prairie regions of the central United States (Noss et al. 1995). While urban development has significantly impacted natural communities in the region, these effects pale in comparison to the wholesale conversion of the rich prairie landscape into the vast agricultural fields of corn, soybeans and tame grass pastures that now characterize the Osage Plains section of the ecoregion. Even though the region is one of the most agriculturally productive areas in the world, this productivity has been gained at the expense of its natural heritage. For example, in the Osage Plains section, remnant natural communities cover less than 10 percent of the total area. Much of this remaining natural habitat is relegated to small, highly isolated tracts that are degraded by soil erosion, invasive species (and a host of additional threats), and devoid of many of the species requiring larger-sized areas.

Figure 2: Osage Plains/Flint Hills Ecological Drainage Units



Legend

Osage Plains / Flint Hills
State Lines
County Lines

Lakes and Rivers
Urban Areas
Other Cities

Ecological Drainage Units
Flint Hills - Mid to South
Flint Hills - Neosho Headwaters
Lower Missouri
Missouri River Tributaries
Osage Plains - Osage River
Osage Plains - Verdigris River

0 25 50 Miles

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Map created by: The Nature Conservancy, Midwest Conservation Science Center.

Figure 3: Untilled Landscapes Relative to Ecoregional Subdivisions

Agriculture and urban development have also negatively impacted the quality of remaining natural communities through effects associated with habitat fragmentation and manipulation of the historic grazing and fire regimes. In the Osage Plains, the remaining uncultivated lands are widely scattered and isolated from one another, concentrated on the least agriculturally productive sites, and less diverse than in historic times. The disproportionate loss of community types has resulted in species once common becoming rare. For example, the western prairie fringed orchid was a historically widespread and locally common species of prairies and sedge meadows, ranging from southern Manitoba to northern Oklahoma. The wholesale conversion of its habitat to agriculture has caused the species to be placed on the U.S. Threatened Species list (Ostlie et al. 1996). In the Flint Hills, intensive grazing operations have had a deleterious effect on the condition of many of the prairie tracts. Grazing management in the Flint Hills often involves intensive early-season grazing combined with annual spring burning and herbicide application. These altered grazing and fire regimes (with different scales, frequencies and intensities than under which the prairie system evolved) may be negatively impacting many of the native species of the Flint Hills, although their effects are not well understood.

The water quality and natural flow of the region's streams and rivers have been significantly impacted by extensive agricultural conversion and land use practices. Aquatic systems throughout the ecoregion have been impacted significantly through siltation (and its associated effects) from cultivated lands, construction of dams and floodplain levees, and stream channelization.

1.2 Human Context

Socioeconomic data were collected at the state and county level for the three states that compose the ecoregion. Data were obtained from the United States Bureau of the Census and ESRI data files and maps representing 1990 values unless otherwise noted.

1.2.1 Population

The population of the ecoregion in 1990 (1.56 million) represents about 15% of the total population of the three OPFH states. No large cities exist entirely within the ecoregion, but three major metropolitan areas are partially contained (Kansas City, Wichita, and Tulsa). Counties with elevated population levels relative to the rest of the ecoregion generally occur in proximity to medium- and large-sized cities. Of the 9 counties with lowest population density in the ecoregion, 7 are located in the Flint Hills of Kansas.

Like most regions of the Great Plains, the trend in population movement in the OPFH is from rural to metropolitan areas (Figure 4). During the last decade (1990-1999), 18 of 69 counties (26%) within the ecoregion lost population, all of these being rural counties. Conversely, 7 of 9 fastest growing counties are in close proximity to large and middle-sized urban areas. If present trends continue, the overall population of the ecoregion is expected to grow by roughly 300,000 (0.95% annual increase) over the next 20 years, this increase largely attributed to growth in urban areas.

1.2.2 Land Use/Ownership

Agriculture is the predominant land use in the ecoregion. Agricultural land uses in the Osage Plains portion of the ecoregion are dominated by row crops, particularly corn and soybeans, which account for up to 95% of land use in some counties. In the Flint Hills section, row crop farming is overshadowed by the more dominant agriculture practice of cattle ranching. The vast majority of land in the ecoregion is owned by private landowners, although sizeable federal-, state- and privately-owned managed areas (including those of The Nature Conservancy) are found scattered throughout the OPFH.

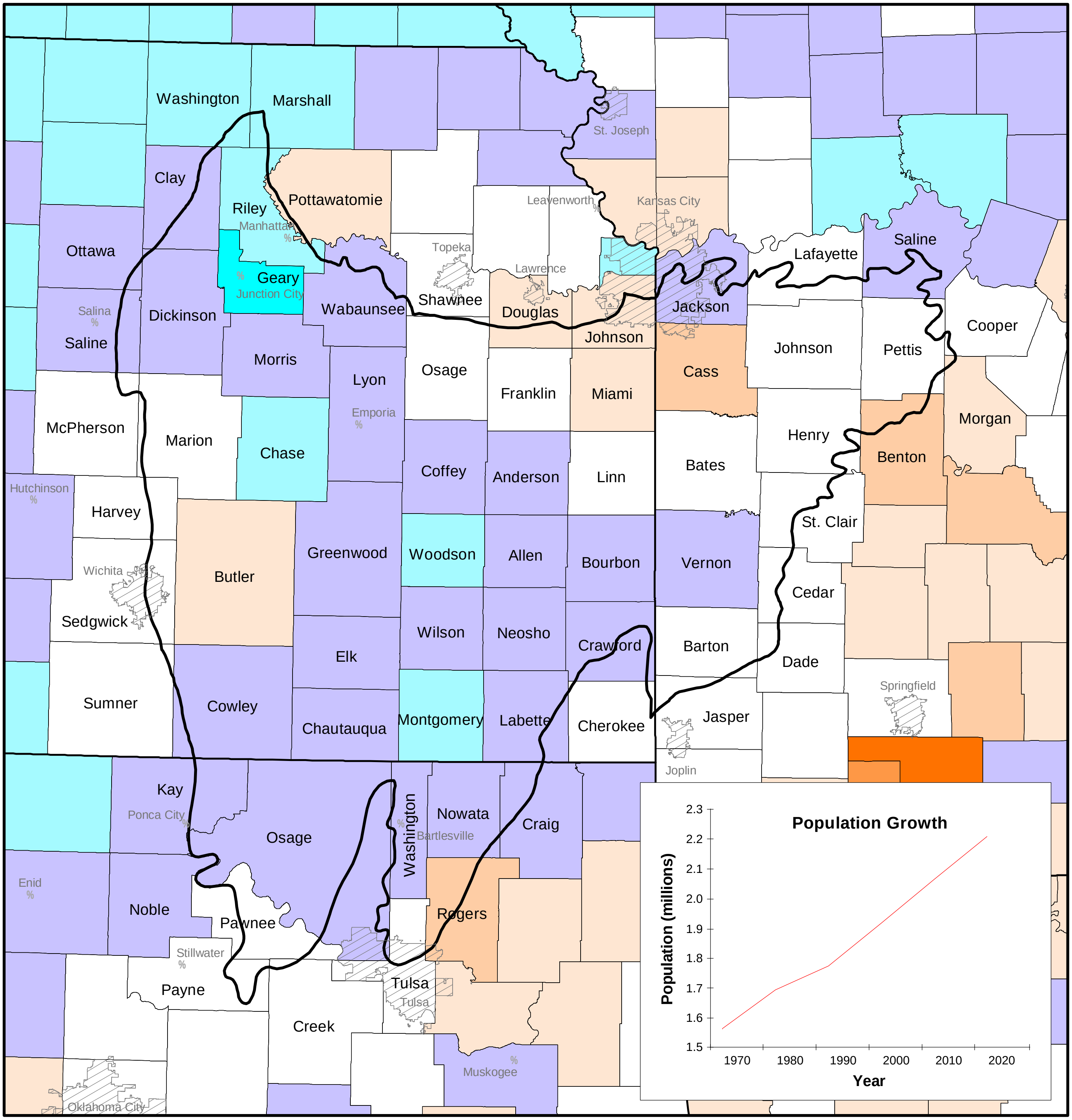
1.2.3 Employment

In 1990, the principle means of employment among OPFH residents was technical/sales/administration (32%), managerial/professional (26%), operation/fabrication/laborers (14%), and service (13%). This breakdown closely mirrors that of the combined three-state region. Less than 3% of the population of the OPFH was employed in farming and ranching.

1.2.4 Education

Adults living within the OPFH ecoregion, on average, are more likely to have a high school diploma (80.4% in OPFH to 76.2% in the three states) and a bachelor's degree (19.3% in OPFH to 17.0% in the three states) than those within the three state region.

Figure 4: Osage Plains/Flint Hills Ecoregion Population Growth



Legend

1990 - 2020 Projected Percent Population Change per Year:

- < -4
- -4 - -3
- -3 - -2
- -2 - -1
- -1 - 0
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4

Osage Plains / Flint Hills Ecoregion Boundary

Urban Areas

% Other Cities

0 25 50 Miles

Population projections prepared by The Nature Conservancy, based on rate of change 1990-1999.

Map created by: The Nature Conservancy, Midwest Conservation Science Center.

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1.2.5 Income and Poverty

OPFH residents have a lower median household income than the general populations of the three states that the ecoregion in part encompasses: $23,016 in OPFH versus the statewide averages in Kansas ($27,291), Missouri ($26,362) and Oklahoma ($23,577), and the average across the three states as a whole ($25,743). The poverty rate in the OPFH (12.3%) is less than the combined average of the three states (13.9%). State poverty rates are: Kansas (11.5%), Oklahoma (16.7%), and Missouri (13.3%).

2. <u>Building a Foundation for Conservation Design</u>

Prior to entering into full-scale ecoregional planning, a group of individuals including state directors and science staff from each of the three Conservancy state field offices, along with participants from some of the state Heritage Programs, met to discuss the scope, direction, team structure, timeline and budget for the planning exercise. This meeting cemented a close working relationship between the newly established Steering Committee, Core Team, and Assessment and Design Team. A brief summary of the process developed for ecoregional planning, an overview of the planning guidelines, and a summary of the key conservation design issues considered are provided below.

2.1 Planning Teams

Planning teams comprised largely of Conservancy and state Heritage Program staff were critical to the overall compilation of the OPFH ecoregional plan. Because of the small size of program staff in the ecoregion, there was a great deal of overlap in team memberships (see Section 7: Acknowledgements). There were four primary teams of individuals who worked together to complete the plan:

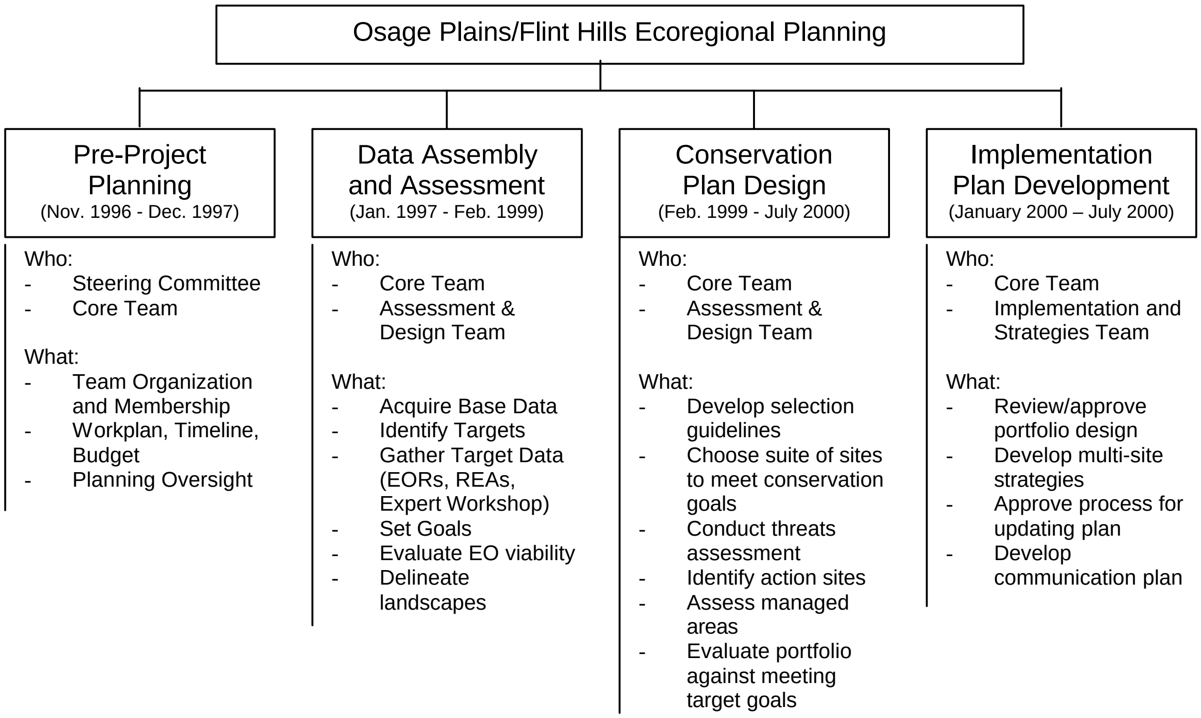
1. Steering Committee: *Led by Alan Pollom and composed of state directors from each state and members of the core team, the steering committee approved the budget and work plan, discussed strategic planning and implementation issues, and oversaw the ecoregional planning process.*

2. Core Team: *A small team of staff from the three Conservancy state programs, Midwest Conservation Science and the Great Plains Program (led first by Fred Fox and ultimately Bob Hamilton) worked together throughout the planning process to identify and recruit experts, compile information needed for all stages of the planning process, assemble the portfolio, complete site threats and biodiversity ranking analyses, and write the plan.*

3. Assessment and Design Team*: This group of technical experts composed of Heritage, Conservancy, and Missouri Resource Assessment Partnership (MoRAP) staff, worked with the Core Team to develop the targets list, set conservation goals, collect and evaluate target occurrence data, assess occurrence viability, design the portfolio, and provide threats data.*

4. Implementation and Strategies Team: *Composed of Conservancy state directors and other key staff from each state in the ecoregion, this team worked with the Core Team to review and approve the portfolio design and final report, develop multi-site threat abatement strategies, identify a timetable for implementation, create a process for amending the portfolio over time, develop a communication plan, and make recommendations regarding process and content changes for the second iteration of the plan.*

Figure 5: Process and Timeline for OPFH Plan Development



2.2 The Planning Process

The process adopted for use in the OPFH was comparable to that followed by other ecoregional planning teams across the country, and therefore will not be described in detail here. Those interested may refer to Ostlie and Haferman (1999) for a general assessment of the ecoregion planning process in the Great Plains, may consult the Northern Tallgrass Prairie or Central Shortgrass Prairie ecoregional plans for specific details (The Nature Conservancy 1998a and 1998b, respectively). Figure 5 illustrates the major phases of the project, the approximate timeframe for each, and the relationship and responsibilities of the teams in developing the ecoregional plan.

2.3 Planning Data and Guidelines

The Assessment and Design Team in conjunction with the Core Team completed the following critical assessment products prior to selection of sites. A few of these are further summarized below.

- ✓ List of ecoregional conservation targets (species and natural communities);
- ✓ Data base of ecoregional target occurrences, compiled from state heritage programs, expert workshops and Rapid Ecological Assessments (REAs);
- ✓ Viability guidelines for target occurrences;
- ✓ Ecoregional conservation goals for each target;
- ✓ Untilled landscape identification;
- ✓ Data gap documentation.

2.3.1 Conservation Targets

The conservation targets identified for use in the planning exercise included all natural community types (both terrestrial and aquatic), all G1-G3 ranked species, and several imperiled subspecies ranked T1-T3 (see sidebar) with occurrences in the ecoregion. This resulted in a total of 85 principle (or primary) targets - 55 terrestrial communities (Appendix A) and 30 species (Appendix B). Another set of species, here termed secondary targets for their secondary role in building the ecoregional portfolio, was developed as a means to test the adequacy of the portfolio in capturing the full array of biodiversity (see Appendix C and Section 4.3.5). This list included globally common species (ranked G4 or G5) that were: (1) endemic or had limited distributions relative to the ecoregion, (2) had large area habitat needs, or (3) were in significant long-term decline.

The terrestrial community classification used in this planning effort followed that of The Nature Conservancy (Grossman et al.1998). Because an aquatic community classification had not been completed for the ecoregion and an alternative process for addressing them had yet to be developed, we used the advice of experts to identify the best stretches of streams and rivers in the ecoregion (see discussion below). Specific information about the species and terrestrial community targets, and their pattern and distribution, is included in Appendices D (terrestrial communities) and E (species).

Definition of G-ranks and T-ranks

Global ranks, shortened to "G-ranks," indicate the relative abundance and stability of species and natural communities globally. For example, a rank of "G1" indicates that a particular species or community is critically imperiled, represented by no more than five occurrences (or 1,000 or fewer individuals) worldwide. A rank of "G5" is given to those species and communities that are stable and abundant globally.

"T-ranks" follow the same basic logic as G-ranks, but are used to describe the relative abundance of animal subspecies or plant varieties, and are always listed with the G-rank for the species (as in G5T1, which would indicate a rare subspecies of a common species).

Discussion: Selecting Aquatic Targets

Aquatic systems provide habitat for a significant portion of the biodiversity in the OPFH ecoregion. To address this biodiversity, a team of experts was asked to participate in an Experts Workshop to assist in identifying priority aquatic conservation sites as conservation targets. The experts provided locational and quality information pertaining to occurrences of target taxa and stream/river reaches that still retained relatively natural flow regimes and high-quality assemblages of aquatic species. Species-specific information augmented the ecoregional target occurrence data set and provided the basis for aquatic site selection based on species. High-quality concentrations of aquatic species and stream/river reaches were used as surrogates for aquatic communities (which predated specifications for target identification outlined in the Conservancy's *Geography of Hope Update #6* [Higgins et al. 1999]). Site nominations were placed within the context of ecological drainage units (EDUs)—aggregates of watersheds that share ecological and biological characteristics—to spatially stratify the OPFH according to environmental variables (see Figure 2 for a depiction of OPFH EDUs).

The Assessment and Design Team sifted through this information and recommended the inclusion of 20 aquatic sites as the top priorities for aquatic conservation in the plan. Five of these were selected for target species only, 10 as high-quality stream reaches for aquatic assemblages, and 5 for a combination of both. A summary of the expert information provided for each aquatic site is found in Appendix F.

2.3.2 Data Base of Ecoregional Target Occurrences

The backbone of the OPFH ecoregional plan was data pertaining to the location and viability of conservation targets in the ecoregion. Data assembled for this planning exercise came from three separate sources: 1) state Heritage Program target occurrence data sets, 2) regional experts who supplied locational and quality information via an experts workshop, and 3) REAs of intact landscapes through contract ecologists. All of these data were combined into a single ecoregional target data set from which the eventual portfolio was assembled. This data set was not assembled via a comprehensive inventory of the ecoregion, but rather represented the information readily available at the time. This data set will change as additional inventory work is completed in the ecoregion; conversely, this new data will inform decision-makers and suggest modifications in the coming years to the existing ecoregional plan.

2.3.3 Viability Guidelines

In the context of ecoregional conservation, viability is the likelihood that a conservation target or its component occurrences (e.g., a specific population) will be maintained over a given period of time. This concept is of prime importance if ecoregional plans are to be assembled in such a way that the Conservancy will meet its conservation goals in a given ecoregion.

Viability is a function of an occurrence's condition, size and landscape context. Consequently, in order to compare the quality of occurrences for a given conservation target across the ecoregion, each of these factors had to be applied evenly to all occurrences (whether the source was Heritage databases, expert workshops or rapid ecological assessments). Target-specific ranking criteria (EORANK Specs, when available) were applied to each target occurrence throughout the ecoregion as a way of quantifying viability. The resulting element occurrence ranks (EORANKS, see side bar) determined whether or not a given occurrence was sufficiently viable for inclusion into the ecoregional portfolio. Occurrences with ranks of A-C were maintained for further consideration during the portfolio assembly meeting (see Section 4.1).

Assessing Occurrence Viability

Element Occurrence Ranks (sometimes called EORANKS) provide a succinct assessment of predicted viability based on three factors: occurrence size, condition, and the landscape context within which the occurrence exists. EORANKS, based on standardized criteria (EORANK Specs), allow for a meaningful comparison of all occurrences of a given target across its range. The following predicted viability scale is used:

Excellent = A
Good = B
Fair = C
Poor = D

2.3.4 Conservation Goals

Conservation goals set the number and geographic stratification of occurrences required to sustain a conservation target in the ecoregion and across its range. As such, they provide guidance as to how much is enough, molding the numerous and widespread target occurrences into an efficient ecoregional portfolio. While it is clear that viability is ensured by protecting multiple, geographically dispersed, viable or recoverable occurrences of each conservation target, it is not possible to say with certainty the exact number or distribution of any species or community type that will be necessary for persistence in perpetuity. However, it is possible to develop sound, generalized goals based on the related principles of extinction, colonization, and viability drawn from the field of conservation biology.

Distribution Definitions

Endemic targets occur exclusively in the ecoregion

Limited targets typically occur within the ecoregion but also occur within a few adjacent ecoregions

Widespread targets occur within the ecoregion and are common in many other ecoregions

Peripheral targets occur rarely within the ecoregion – the core of their range is in other ecoregions

2.3.4.1 Species

Conservation goals for species were based on a species' distribution relative to the ecoregion, stepped down from a maximum of 10 occurrences for those endemic to the ecoregion to 1-2 for those with peripheral distributions. Species with limited and widespread distributions received conservation goals of 7 and 4, respectively (see sidebar for distribution definitions). The rangewide goal of 10 was based on viability estimates using large vertebrates, in which 10 occurrences of at least 200 individuals were deemed necessary for long-term viability of species (Cox et al. 1994). This 10-7-4-2 conservation goal template was modified for several species where special circumstances called for a departure from goals based strictly upon distribution. Further modification of this rule is perhaps necessary, but lack of better information made species-specific revision impossible at this time. Where possible, federal recovery plans for endangered and threatened species were utilized to enhance the quality of some goals to reflect the current thinking of species experts. Ecoregion section and subsection units were used as a means of stratifying species occurrence selections.

Spatial Pattern Definitions

Matrix Communities:
Matrix communities were the characteristic vegetation types of the ecoregion, occurring in patches of greater than 10,000 acres. They are dependent upon large-scale processes now perhaps found only at the largest sites in the ecoregion. As a result, viable sites selected for these targets tend to be among the largest.

Large Patch Communities:
Large patch communities typically formed blocks of 200-10,000 acres within the above matrix. Viable sites for large patch communities are typically large enough to also support small patch community types and many species.

Small Patch and Linear Communities:
Small patch and linear communities tended to be less than 200 acres in size and were sustained by localized processes such as microclimatic variability. Thus, small patch and linear community viability requirements may be met at sites too small for large patch and matrix types.

2.3.4.2 Natural Communities

Conservation goals for communities were based on spatial pattern and distribution relative to the ecoregion (see sidebars). Each target was placed into one of four distribution categories (endemic, limited, widespread, and peripheral) and one of four spatial patterns (matrix, large patch, small patch and linear). Specific conservation goals were determined for each unique combination of distribution category and spatial pattern. Specific conservation goals ranged from a low of 2 occurrences for large patch types with peripheral distributions to a high of 20 for endemic small patch and linear types (Table 1). These goals represent a minor numerical deviation from the Conservancy's recommendations (The Nature Conservancy 2000b, Anderson et al. 1999), but nevertheless follow the rationale and approximate preliminary numbers put forward in those reports and elsewhere. As with species, ecoregion section and subsection units were used as a means of stratifying terrestrial community occurrence selections, while aquatic selections were stratified relative to Ecological Drainage Units.

Table 1: Target Conservation Goals for Terrestrial Vegetation Communities In the Osage Plains/Flint Hills Ecoregion

Distribution Relative to Ecoregion	Conservation goals for *large patch, small patch,* and *linear* vegetation community types (expressed as number of sites) and for *matrix* vegetation communities (expressed as a percentage of historic extent).[1]			
	Spatial Pattern in Ecoregion			
	Large Patch	*Small Patch*	*Linear*	*Matrix*
Endemic	14	20	20	40%[2]
Limited	7	10	10	
Widespread	4	5	5	
Peripheral	2	5	5	

[1] Examples for a given patch type should be distributed among ecoregion subsections in which the type naturally occurs (e.g., Cherokee Plains, Scarped Osage Plains, Glaciated Flint Hills).

[2] Relative to historic extent circa 1800, within intact systems large enough to meeting minimum dynamic area estimates, as assessed for each type (see section 3.3).

An exception to this practice was the development of goals for matrix communities. Unlike smaller-scale patch and linear communities, matrix types play a significant role in maintaining large-scale ecosystem function, and as a result, goals were developed as percent of total historic distribution within the ecoregion (see The Nature Conservancy et al. 2000). Matrix-forming communities were overwhelmingly dominant on the landscapes of the ecoregion, and served an important function in the long-term viability of most conservation targets, both in terms of habitat and maintaining the numerous functional networks between the species and processes operating within them. Splitting this interconnected network into discrete occurrences in order to assess progress toward meeting numeric conservation goals fails to recognize the importance of these factors.

Measures of area (i.e., percent of historic distribution) have been commonly applied to reserve design criteria at national scales utilizing concepts derived from island biogeography theory (Wilcox 1992). Because large relative to small areas support more species over time, criteria expressed in terms of area are a more robust hedge against species loss in an increasingly fragmented landscape. Using inferences from island biogeography, coupled with an assessment of current extent and likely future loss of the matrix backdrop in the ecoregion, we selected an initial goal for matrix-forming communities as 40% of historical extent, stratified by ecoregion subsection.

Historical extent for each matrix community type in the ecoregion was estimated through the utilization of existing natural community data coupled with expert knowledge. Estimates of historical area covered by each of the 7 matrix types within each ecoregion subsection was obtained from these sources, then used as a guide to assess where examples should be conserved in order to satisfactorily meet conservation goals (see Appendix F).

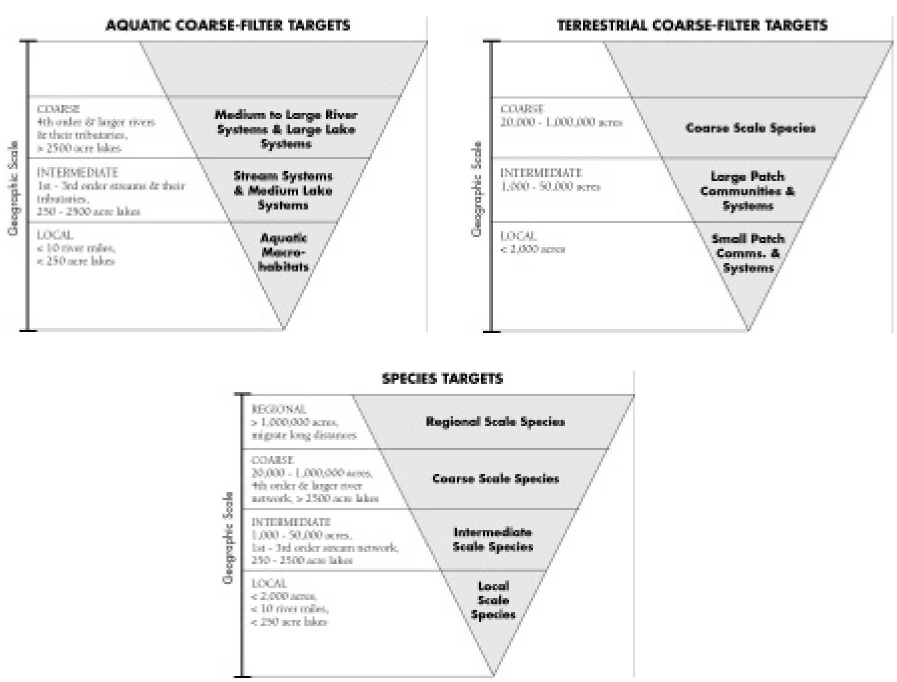
3. <u>Designing an Ecoregional Plan at Multiple Spatial Scales</u>

It is generally acknowledged that to effectively conserve biological diversity, it is necessary to work at multiple spatial scales, from the very large to small (e.g., Schwartz 1999). This concept played an integral role in the development of this ecoregional plan. The role of differing spatial scales in ecoregional planning, the concept of functional systems, and the application of this concept to the design of an ecoregional plan that explicitly addresses the need for multiple spatial scales are discussed in detail below. Although concepts relating to spatial scale are inherently complex, their inclusion within this report is essential to the full understanding of its role in developing the OPFH ecoregional plan.

3.1 A Brief History of Spatial Scale Concepts in Ecoregional Planning

Early in the ecoregional planning process, Conservancy ecologists pioneered the concept of spatial scale in characterizing terrestrial community patch size (i.e., matrix, large patch, small patch and linear). This concept helped ecologists set occurrence viability guidelines for community types based on the scale at which they historically occurred within the ecoregion. Using this approach, the Northern Appalachians (The Nature Conservancy 1998c) and Northern Tallgrass Prairie (The Nature Conservancy 1998a) ecoregional planning teams developed different methodologies (i.e., large roadless area and untilled landscape delineation, respectively) to identify areas where matrix communities were intact and viable, and large-scale natural processes were still likely to occur (or could be restored). Subsequently, the Northern Great Plains Steppe ecoregional team (The Nature Conservancy 1999) first utilized the concept of an *ecological backdrop* by identifying and incorporating the full compliment of untilled landscapes into the plan prior to actually selecting ecoregional portfolio sites. As such, it was the first plan to pay explicit attention to intact areas throughout an ecoregion (both within and outside the portfolio proper) and the role these areas might play in the long-term viability of all selected sites and associated conservation targets. Poiani et al. (1999) summarized and expanded upon many of these and other concepts as a means to help planners and ecologists address the issues of viability and functionality in biodiversity conservation.

Figure 6: Spatial Scales and Levels of Biological Organization



3.2 The Concept of Functional Systems

Species, natural communities and ecological systems (ecosystems) have been characterized as occurring at four spatial scales in nature: local, intermediate, coarse and regional (Figure 6: Poiani et al. 1999). Different ecosystems and species occur at each of these geographic scales. At the smallest scale (local), small patch ecosystems and local-scale species operate in areas of up to 2000 acres, while at the largest (regional), regional-scale species generally require in excess of 1 million acres (1563 square miles).

Recognition of these different scales, and the species and ecosystems occurring at each of them, is critical for successful conservation planning and implementation. However, conservation of biodiversity at multiple levels of biological organization and geographic scale also requires an adequate understanding of the associated multi-scale ecological processes that support and sustain these ecosystems and species (Poiani et al. 1999). Specific conservation areas generally contain ecosystems and species at multiple geographic scales that nest together in complex ways. Such nesting and co-occurrence contribute greatly to an area's ecological complexity and integrity (Poiani et al. 1999). Sites that meet these requirements have been termed ***functional conservation areas*** - *geographic domains that maintain functional ecosystems, species, and supporting ecological processes within their natural ranges of variability.* Three types of functional conservation areas were identified for use in the OPFH planning exercise: functional networks, functional landscapes, and functional sites (see sidebar).

Functional Conservation Area Definitions

Functional Networks: An integrated set of functional sites and landscapes designed to conserve regional species. Portfolios of sites in regions of the country (multiple ecoregions) that still support wide-ranging species like migratory birds should be based upon functional networks of sites.

Functional Landscapes: Large-scale sites that seek to conserve a large number of ecological systems, communities, and species at all scales below regional. The conservation targets are intended to represent many other ecological systems, communities, and species (i.e., "all" biodiversity).

Functional Sites: Functional sites aim to conserve a small number of ecological systems, communities, or species at one or two scales below regional. Targets tend to be relatively few and often share similar ecological processes.

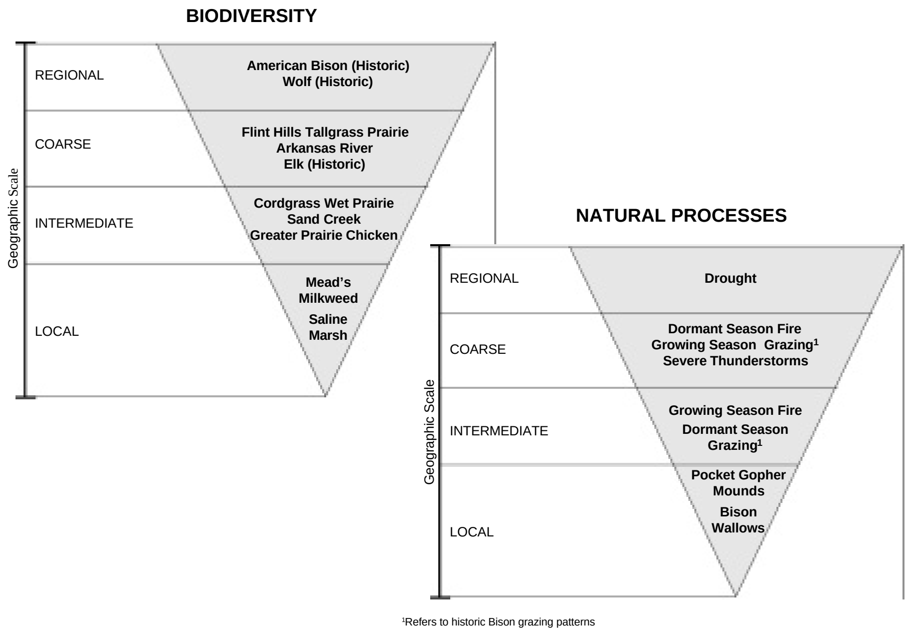
The OPFH Assessment and Design Team utilized and further built upon many of these concepts to produce a conservation plan that explicitly identified conservation areas of differing spatial scales, incorporating the concepts of target viability and site functionality. This proved to be a challenging undertaking, especially in the Osage Plains section, as the vast majority of natural vegetation has been converted to agricultural or other uses, and severe habitat fragmentation has resulted in the isolation of many small, remnant communities that hold significant portions of the region's biodiversity. The intense fragmentation of the Osage Plains section has resulted in the general elimination of exceptionally large, relatively undisturbed areas where regional- (e.g., the American bison) and most coarse-scale species (e.g., bobcat, elk) could exist. Site boundaries were delineated to satisfactorily encompass the needs of the targets captured therein, although Site Conservation Planning will refine these boundaries.

3.3 Applying Concepts of Functionality to Ecoregional Portfolio Design

The long-term viability of all elements of biodiversity (species as well as natural communities) is tied to the natural processes with which they evolved. These processes, as with conservation targets themselves, can occur at multiple geographic scales. An understanding of the relationship between target viability and geographic scale is essential to the adequate design of an ecoregional plan.

In general, elements of biodiversity (species or natural communities) are principally maintained by natural processes operating at or near the geographic scale at which they themselves occur (Figure 7). For example, in historic times, regional-scale climatic patterns and course-scale fire events shaped and drove the migration patterns of the American bison, a regional-scale species (Roe 1951). Conversely, local scale disturbances had little effect on the viability or distribution of this species. Local-scale species or communities are likely to be maintained principally by local- to intermediate-scale processes, rather than by regional events (although course- and regional-scale events may have significant impacts on the viability of these species and systems). As such, conservation sites designed to meet the requirements of targets must account for the scale at which both they and the associated disturbance events that maintain them operate.

Figure 7: Spatial Scales of Biodiversity and Natural Processes in the Osage Plains/Flint Hills Ecoregion



To better understand the inter-relationship between scale, system functionality, and biota in the OPFH, we assessed the area habitat needs of the ecoregion's characteristic native species (both extant and historic) relative to the primary natural processes (fire, grazing and climate) that shaped the character of the ecoregion during historic times (Figure 8). Although natural processes are numerous, occur at various scales and all are possibly important to one or more conservation targets, it is these large-scale processes that play a dominant role in the long-term viability of most if not all biodiversity in the ecoregion. It is likely that the viability of all conservation targets is tied (at some level) to both the historic scale and frequency of such processes. The geographic area needed to ensure survival or re-colonization following these stochastic events has been termed the ***minimum dynamic area*** (Pickett and Thompson 1978). Determining the minimum dynamic area was critical to adequately planning for the long-term viability of the ecoregion's ecological systems.

In our assessment of minimum dynamic area in the OPFH ecoregion, we focused primary attention on the matrix community types. It is these systems that provide the backbone within which the ecological character of the ecoregion rests. Two primary factors were used to assess minimum dynamic area: 1) scale and frequency with which the primary natural processes of the ecoregion historically occurred, and 2) diversity of the systems with respect to biodiversity. The dominant natural process events typically covered large geographic areas (e.g., 50,000 acres for dormant-season fire and growing season bison grazing) and occurred with a historic frequency approximating 3-5 years. Additionally, the OPFH (like most other regions of the Great Plains) can be characterized as having low diversity in its ecological systems (Ostlie et al. 1996). Using this information, a minimum dynamic area five times larger than the historic disturbance patch size was estimated[2]. This estimate (250,000 acres or 391 square miles) represents the area required for the continuation of natural processes at the scale they occurred historically, while maintaining a mosaic of habitat in all structure classes for the full array of species in the ecoregion (Figure 8).

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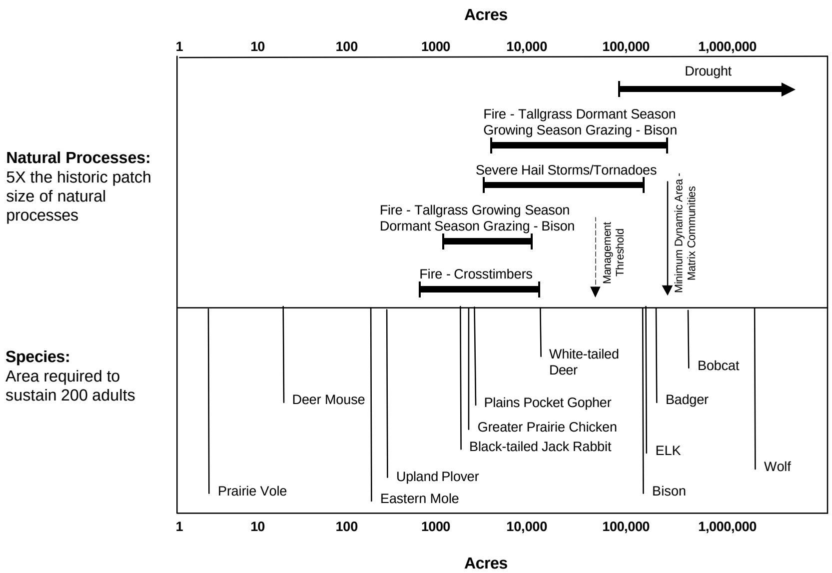
[2] A 50,000 acre estimate of historic patch size created by natural processes (principally dormant season fire and growing season grazing) was used for assessing minimum dynamic area in OPFH matrix communities. It represents the upper end of normal, non-catastrophic events as they occurred on the OPFH landscape roughly 150-200 years ago.

Figure 8: Patch Size of Natural Processes Relative to Species Area Requirements



A review of the 250,000 acre minimum dynamic area estimate relative to the area habitat needs of characteristic species of the ecoregion (based on populations of 200 individuals or 100 breeding pairs) found this size to sufficiently encompass all but some of the historic mammalian species now extirpated from the ecoregion (e.g., migratory bison and gray wolves). Smaller-scale sites may be sufficiently large to support viable populations of important characteristic species (e.g., greater prairie chickens, pocket gophers and black-tailed jackrabbits), but would be susceptible to large-scale disturbance events (Figure 8).

Although the 250,000 acre benchmark is a preferred minimum for functional landscapes, it may be possible to significantly reduce the required acreage to roughly 70,000 acres and still retain a moderately high level of system functionality. It is fortunate that aside from weather events, the primary natural processes in the ecoregion (fire and grazing) are manageable at scales smaller than what occurred historically. Additionally, many of the mammals in the ecoregion with large-area requirements (bison, elk, white-tailed deer and badger) are also manageable at smaller scales or effectively utilize non-native habitat. In a livestock-dominated landscape, the conservation challenge will be how to best utilize range management practices in a manner that approximates the scope and frequency of historic processes and benefits biodiversity.

Further confounding the conservation picture is a very real concern over regional-scale processes (e.g., drought, climate change) and the impact these may have on the biodiversity of the OPFH ecoregion. The natural vegetation of the region is highly fragmented, with even the largest landscapes (e.g., Flint Hills) isolated from other neighboring landscape areas. This isolation has eliminated or seriously reduced the capacity of most biodiversity targets to move large distances in response to these regional-scale processes. This fact may prove to be a serious impediment to future conservation success, unless strategic steps are taken to address the need for functional networks of sites, thereby allowing movement in response to these regional processes.

4. <u>Osage Plains/Flint Hills Conservation Design</u>

Utilizing the information gathered during the data assembly and assessment phase of the project, along with the in-house expertise of team members, the Assessment and Design Team met in February 1999 to identify the best, most viable target occurrences in the ecoregion and assemble the portfolio.

4.1 Site Selection

To ensure that target occurrences selected to meet conservation goals were likely to remain viable over the long term, and because long-term viability of these occurrences is often tied to large-scale processes (e.g., fire, grazing, and climate), a site selection process with a weighted focus on *ecological context* was adapted from portfolio assembly guidelines used in other Great Plains ecoregional planning efforts (e.g., Northern Tallgrass Prairie, Central Shortgrass Prairie, Central Tallgrass Prairie). Ecological context was factored into this assembly process in two ways:

1. Target occurrences with excellent and good predicted viability (EORANKS A or B) were selected before less-viable examples. Because a primary factor in ranking occurrences is landscape context, target occurrences within a good landscape context were likely to be incorporated before those in poorer settings.

2. The site selection sequence placed emphasis on natural communities (selecting occurrences of communities before species), and within natural communities on types that dominated the landscape (selecting occurrences of matrix before those of large patch or small patch types).

Inherent within this assembly process were two assumptions related to the viability of target occurrences:

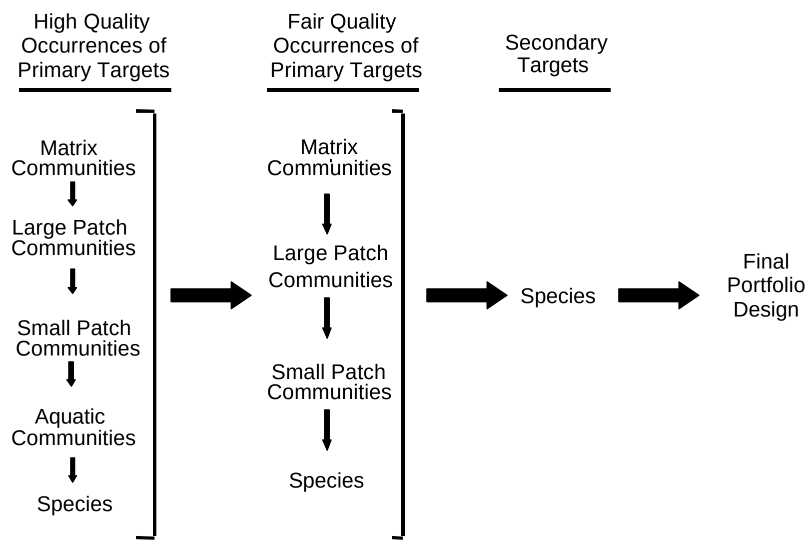
1. Long-term viability potential for a given target occurrence increases with the size of the natural area within which it is imbedded.

2. In general, long-term benefits continue to accrue at progressively larger sites even after minimum viability requirements have been met for a given target occurrence. These "added benefits" beyond the minimum thresholds are realized by further reducing risk of extinction, or by extending the time period over which the target is considered "viable."

Figure 9 depicts the site selection process. Initial site selections were made for the high viability examples of matrix community types that once dominated the landscapes in the ecoregion, followed by large patch, and then small patch types. Site selections were then added to incorporate aquatic communities and to meet species' goals. A second round of site selection incorporated those examples of only fair viability (EORANK = C).

The Assessment and Design Team completed the first two phases of site selection – identifying and selecting high and fair quality target occurrences. An assessment of secondary targets did not occur at this time but will be used in future iterations to evaluate the plan's adequacy in conserving the full suite of biodiversity in the ecoregion. Future changes to correct any deficiencies with regard to conservation of the secondary targets will be addressed in successive iterations.

Figure 9: Portfolio Assembly Sequence



4.2 The Ecoregional Portfolio

After the sites were selected and refined, an ecoregional portfolio of 33 terrestrial and 20 aquatic Conservation Areas emerged (Figure 10). Site descriptions with associated target, threat, and biodiversity information are included in Appendix G. Together, the terrestrial sites encompass nearly 5.4 million acres (8,385 square miles), or nearly 27% of the OPFH ecoregion. Aquatic sites add another 1,444 stream miles to this total.

The vast majority of area encompassed by the ecoregion portfolio is found within the 5 functional landscapes which account for 82% of the portfolio total, compared to 18% for functional sites. Functional networks are not represented within the plan to date. All aquatic sites are considered to be functional sites, although the majority are large rather than small.

4.3 Evaluating the Design

Several assessments were conducted to critically evaluate the conservation implications of the portfolio. The analyses performed included an assessment relative to site functionality in the portfolio, an imperiled communities evaluation, a threats assessment, and an evaluation of managed areas. These are summarized below.

4.3.1 Site Functionality in the OPFH Portfolio

As stated earlier (Section 3.2), nesting and co-occurrence of species and ecosystems at multiple spatial scales contribute greatly to a site's ecological complexity and integrity. Sites that meet these requirements have been termed functional conservation areas. As a means of better understanding the level of functionality within the array of portfolio sites, an assessment of the full portfolio was conducted (Table 2).

Table 2: Contribution of Terrestrial and Aquatic Conservation Sites by Level of Functionality[1]

	Number of Sites	Total Size[2]	Average Size[2]	Size Range[2]
Total Conservation Areas	33	6,176,479	187,166	6 - 3,802,055
	20	1,536	77	16 - 230
Functional Networks	0	0	0	0
	0	0	0	0
Functional Landscapes	5	5,073,589	1,014,718	37,658 - 3,802,055
	0	0	0	0
Functional Sites	28	1,102,890	39,388	6 - 322,779
	20	1,536	77	16 - 230
Large Functional Sites	7	1,044,823	149,260	66,139 - 322,779
	17	1,469	86	19 - 230
Small Functional Sites	21	58,067	2,765	6 - 36,488
	3	67	22	16 - 30

[1] Summaries of terrestrial sites appear in white rows, aquatic sites in shaded rows.
[2] Numbers expressed as acres for terrestrial sites, stream miles for aquatic sites.

4.3.1.1 Functional Networks

No functional networks were identified for species in the OPFH ecoregion, although this is likely to change in future iterations through an in-depth look at birds and perhaps aquatics. Planning for targets operating at scales larger than the ecoregion is inherently difficult and will likely entail a concerted regional approach along the lines of that currently taking place for Great Plains birds (see Elphick 2000).

4.3.1.2 Functional Landscapes

Functional landscapes in the OPFH are large sites (generally > 75,000 acres), designed with the intent to capture the full array of biodiversity (terrestrial and aquatic) at all geographic scales (regional to local). These areas were first identified via Landsat Thematic Mapper (TM) satellite imagery and later confirmed as suitable natural habitat based on REAs and expert knowledge. Five functional landscapes were selected, together representing 9% of all conservation areas and 82% of the total terrestrial area in the portfolio. Functional landscapes capture half of the natural community occurrences selected for the portfolio (65% of all matrix occurrences), but less than 10% of all species occurrences. This low level of species target occurrences within landscapes is due to several primary factors - 1) species diversity (at least in terms of the number of rare targets) is significantly greater in the Osage Plains section of the ecoregion, where landscapes are inherently absent, 2) greater inventory effort in highly modified portions of the ecoregion relative to landscapes, and 3) pending taxonomic issues relating to several potential target species (all of which had occurrences in landscapes) that prompted the team to not select any occurrences for the portfolio at this time.

The two largest functional landscapes, the Flint Hills and Elk Prairie, are actually part of the same untilled landscape area. However, they are treated as two separate portfolio sites due to differing matrix vegetation types (Flint Hills tallgrass prairie and crosstimbers woodlands, respectively) resulting from distinct surficial geology characteristics. The Flint Hills is generally underlain with limestone and the Elk Prairie with sandstone.

4.3.1.3 Functional Sites

Functional terrestrial sites generally include a small number of representative matrix, large patch, small patch or linear communities and/or species as targets (i.e., not the full array of biodiversity as in functional landscapes). We have divided functional sites into two size classes (large and small) as a means of addressing the large scale differences between those sites designed for matrix communities versus those for smaller-scale communities and species (see sidebar). Together, functional sites account for 91% of the sites in the plan and 18% of the total terrestrial area selected. Functional sites also capture half of the natural community occurrences selected for the portfolio (100% of small patch types) and over 90% of all species occurrences.

This result might suggest that functional landscapes do not do a good job in capturing biodiversity occurring at small scales (many species, small patch community types, etc.). In the discussion of functional landscapes above (4.3.1.2), the low level of species targets was deemed an artifact of the inverse distribution of species and landscapes in the ecoregion. However, in the case of natural communities, additional inventory effort likely would serve to significantly balance the number of small patch types between functional landscapes and sites (perhaps even shifting the balance toward functional landscapes).

Functional aquatic sites include component habitats or species from one or two geographic scales. Because aquatic sites were predominantly selected for reaches of rivers, and not complete drainages, they were not considered to be landscapes by themselves.

Functional Site Definitions

Large Functional Sites: The large functional site category pertains to moderately large to landscape-scale sites that conserve targets at coarse (e.g., matrix prairie community types), and possibly other scales. In the OPFH, we have included sites identified for large-scale restoration (*Landscape Restoration Sites*) in this category. Landscape Restoration Sites were identified with the intent of connecting concentrations of small matrix community remnants and their associated species, or significant clusters of smaller-scale community targets. The focus of these sites is to enhance the long-term viability of coarse-scale conservation targets. Large functional sites account for 45% of the portfolio sites and 17% of the total portfolio area selected.

Small Functional Sites: Small functional sites are relatively small sites that conserve local- and intermediate-scale targets. This category captures the largest percent of portfolio sites (46% of the whole), but the smallest percent of total portfolio area (< 1%).

4.3.2 Success at Meeting Conservation Goals

An assessment of the ecoregional plan revealed that conservation goals were met for very few species or community targets. In fact, the sites selected fully encompass the needs of a mere 23% of the species targets (Table 3) and 9% of community (Table 4). This failure in achieving conservation goals was spread across all pattern and distribution categories, communities as well as species.

Table 3: Success at Meeting Conservation Goals: Species Targets

Species Distribution	Total Species	Total Selections Possible	Total Selections Made	Progress Towards Meeting Goals by Species				
				0-25%	25-50%	50-75%	75-100%	Goals Fully Met
Endemic	3	30	0	3	0	0	0	0
Limited	10	70	24	6	1	0	0	3
Widespread	9	38	14	6	0	0	1	2
Peripheral	8	15	6	4	2	0	0	2
TOTAL	*30*	*153*	*44*	*19*	*3*	*0*	*1*	*7*

Table 4: Success at Meeting Conservation Goals: Community Targets

Community Pattern and Distribution	Total Community Types	Total Selections Possible	Total Selections Made	Progress Towards Meeting Goals by Type				
				0-25%	25-50%	50-75%	75-100%	Goals Fully Met
Pattern								
Matrix	7	na[1]	na[1]	5	0	0	1	1
Large Patch	4	20	9	2	1	0	0	1
Small Patch	30	200	10	28	2	0	0	0
Linear	14	100	14	12	0	0	0	2
Distribution								
Endemic	0	0	0	0	0	0	0	0
Limited	25	174[2]	17[2]	21	1	0	1	2
Widespread	18	89	10	15	2	0	0	1
Peripheral	12	57	6	11	0	0	0	1
TOTAL	*55*	*320*	*33*	*47*	*3*	*0*	*1*	*4*

[1] Matrix conservation goals were based on percent of historic distribution rather than being numerical
[2] These numbers do not include selections made for matrix community types, all of which have limited distributions relative to the ecoregion.

Because matrix community goals were set as a percent of historic distribution, a two-step assessment was required to adequately determine the degree to which conservation goals were or were not met. As a first step, the amount of each matrix type captured within the ecoregional portfolio was ascertained, then assessed relative to historic context (see Appendix F). Second, matrix community selections within the portfolio were judged relative to minimum dynamic area estimates established for their respective types. This second step assessed the degree to which examples of these community types may be considered viable over the long term. These assessments illustrated that 1 of 7 (14%) matrix types fully met established conservation goals, capturing over 40% of historic distribution in the ecoregion within sites larger than 250,000 acres. This type has its dominant distribution within the relatively intact Flint Hills landscape.

This result, although not optimal, has been the norm for ecoregional plans completed by the Conservancy to date throughout the Great Plains (e.g., Northern Tallgrass Prairie, Central Tallgrass Prairie, Central Shortgrass Prairie, Northern Great Plains Steppe). This outcome can be attributed to two primary factors - the lack of a comprehensive biological inventory, and the wholesale loss of natural areas from large parts of the ecoregion, principally within the Osage Plains section.

The strategy to combat these inherent problems is quite different for the two primary causes. Where inventory has been lacking, a strategic approach to further document extant occurrences of target species and natural communities is needed. Where wholesale destruction is suspected of being the cause, restoration might be the answer. Before a decision can be made as to which strategy to invoke, an assessment of targets relative to their conservation goals and the likelihood of locating additional viable occurrences is required. This assessment would yield important data pertaining to the gap between desired condition (fully meeting all conservation goals) and the current situation within the ecoregion.

To this end, an ecoregional imperilment assessment for natural communities was completed, recognizing that communities form the coarse-filter within which the ecoregion's species are found. The intent of this exercise was to more accurately portray the condition of the ecoregion and quantify the conservation task ahead. In order to assign imperilment ranks to community types, we married data from the existing ecoregional plan (a picture of what is documented in the ecoregion) with speculation from biologists as to what is likely to occur but has not been documented (Table 5). Only highly viable occurrences (A- and B-ranked) were considered for this assessment. Because aquatic communities had not been delineated for the OPFH, a similar assessment for aquatic communities was not conducted, but should be conducted prior to or during the next iteration.

Table 5: Estimates of Terrestrial Community Imperilment

Community Pattern and Distribution	Total Community Types	Community Types Relative to Projected Potential for Meeting Conservation Goals					
		Functionally extirpated (0%)	0-25%	25-50%	50-75%	75-100%	Goals Fully Met
Pattern							
Matrix	7	3	2	0	0	1	1
Large Patch	4	1	0	0	0	2	1
Small Patch	30	5	2	2	3	18	0
Linear	14	2	0	4	3	3	2
Distribution							
Endemic	0	0	0	0	0	0	0
Limited	25	7	3	4	5	4	2
Widespread	18	2	0	1	1	13	1
Peripheral	12	2	1	1	0	7	1
TOTAL	*55*	*11 (20)* [1]	*4 (7)*	*6 (11)*	*6 (11)*	*24 (44)*	*4 (7)*

[1] The percent of total communities in each category is indicated in parentheses ().

The results of the imperilment assessment for terrestrial natural communities indicated that conservation goals will not be met for over 90% of all community types, regardless of additional inventory intensity. Of the 55 community types documented as occurring in the ecoregion, only 4 (7% of all types) will likely have their conservation goals met. Twenty percent of the total terrestrial community types in the ecoregion are considered to be functionally extirpated, having no viable examples remaining. Matrix communities are the most imperiled of the four pattern groups, with 3 of 7 functionally extirpated; two additional types have the potential of meeting less than 25% of their established conservation goals.

Additional inventory work would reap the greatest benefits for community types with large patch, small patch and linear patterns. Significant gains in numbers of viable occurrences toward meeting conservation goals would be anticipated in each of these community groups. This assessment illustrated that matrix community types would not benefit significantly from additional inventory. In terms of distribution categories, all categories (with the exception of endemic types, as there are none in the ecoregion) would show significant gains, with the most pronounced occurring in types with widespread and peripheral distributions. The magnitude of the change in status portrayed by this community imperilment assessment illustrates the dramatic need for more inventory work to accurately assess the condition of terrestrial vegetation communities (compare tables 3 and 5, specifically the 75-100% category).

Where additional inventory cannot fill the void in terms of meeting conservation goals, restoration must play a prominent role. Over 90% of all community types would benefit directly from this action (Table 5), with special emphasis given to matrix types that form the backbone of the biological character of the ecoregion.

4.3.3 Threats Assessment

The primary purpose of a threats assessment at the ecoregional scale is to assist in setting priorities for action among all the potential conservation sites, identifying the critical, pervasive threats to biodiversity across the ecoregion and at each specific site, and developing strategies to abate those threats. Data pertaining to threats acting against the health of conservation targets at each of the portfolio sites were collected by polling Conservancy and Heritage staff and other individuals knowledgeable about these sites. These data were gathered through a standardized electronic form in the following areas: type of stress, source of stress, severity, scope, probability, immediacy, and irreversibility. The most frequently occurring stresses and sources of stress were used for development of multi-site threat abatement strategies (Table 6).

Table 6: Highest Frequency Threats

Terrestrial sites	***Aquatic sites***
Agriculture (25/33 sites), especially: Altered fire regime (17/33) Conversion to and invasion from tame grass pasture (15/33) Intensive seasonal haying programs (12/33 sites) Development (15/33 sites), especially: Urban sprawl/growth (13/33)	Agriculture (18/20 sites), especially: Sedimentation (5/20) In-Stream/Floodplain Alteration (14/20 sites), especially: Dams (10/20)

4.3.4 Managed Areas Status

A managed area coverage for the ecoregion was compiled from the Kansas GAP Program, Missouri Resource Assessment Partnership (MoRAP), and Oklahoma Biological Survey. The Managed Areas Assessment focused on the following specific objectives:

- ✓ Identify potential partners and stakeholders across the ecoregion and at specific conservation areas, and determine who might lead coordination of conservation actions for specific conservation areas;
- ✓ Provide stakeholder information important to site conservation planning; and
- ✓ Determine the level of current conservation action at each conservation area and identify unprotected areas as priorities for action.

The OPFH portfolio is dominated heavily by privately-owned lands. The 53 portfolio sites include all or part of 135 managed areas, which encompass a mere 5% of the total portfolio land area (Figure 11). The Army Corps of Engineers manages the largest portion of lands designated as managed areas in the ecoregion, with nearly 140,000 acres under management along its many reservoir systems (Table 7). Other major land management entities include state natural resource agencies and private conservation organizations (principally The Nature Conservancy and the National Park Trust[3]), with over 67,000 and 65,000 acres under management, respectively.

Table 7: Conservation Areas and Area Under Management by Management Agency

Management Agency or Organization	Conservation Areas	Total Area (Acres)
Federal - Army Corps of Engineers	3	137025
Federal - Fish and Wildlife Service	1	9622
Local - City or County	1	22
Private – Organization - Conservation	9	65344
Private - Organization - Other	1	202
State/Province - Natural Resources	14	67729
State/Province - Other	2	27808
State/Province - University	1	222
TOTAL	32	307974

[3] The Tallgrass Prairie National Preserve, KS, is owned by the National Park Trust, but managed by the National Park Service.

Protection status information was collected for all managed areas occurring within all portfolio sites (see sidebar). A mere 2 percent of the acreage identified for the portfolio is currently protected at the highest levels (Status 1 or 2).

Finally, current Conservancy land holdings were assessed to identify the degree to which past Conservancy protection efforts were directed toward areas included in the ecoregional conservation plan. Of the 14 preserves owned by the Conservancy in the ecoregion, 13 are part of the current portfolio, the exception being Pawhuska Prairie Natural Area. It will be incumbent upon the Missouri Field Office to assess the strategic implications of maintaining this preserve within its future collection of preserves. A full synopsis of the managed areas assessment for the OPFH ecoregion is found in Appendix H.

Definitions: Managed Areas Protection Status

The following classification of protected areas (modified from Caicco et al. 1995) was used to measure the long-term commitment to management of these areas for their biodiversity value.

Status 1: An area having permanent protection from conversion, maintained in its natural state with a mandated management plan. Natural disturbance events are allowed to proceed without interference or are mimicked through management.

Status 2: An area having permanent protection from conversion and a mandated management plan to maintain a primarily natural state, but that may receive uses or management that degrades the quality of natural communities, including suppression of natural disturbance.

Status 3: An area having permanent protection from conversion for the majority of the area, but may be managed for consumptive uses (e.g., logging, mining) or recreational values. Confers protection to federally endangered or threatened species present.

Status 4: All land in public or private ownership with no known easement or management agreement that maintains native species and natural communities. The area could be subject to conversion.

4.3.5 Secondary Target Assessment

The mission of The Nature Conservancy is to protect all species and natural communities, whether common or rare. Because the OPFH ecoregional plan was assembled using natural community and rare species data, a further evaluation of the plan to see how effective it is at capturing non-target species is preferred.

To this end, the Assessment and Design Team assembled a list of additional species, here termed secondary targets, as a means of testing the adequacy of the current portfolio in capturing the full array of biodiversity (Appendix C). This list included globally common species (ranked G4 or G5) with one or more of the following characteristics: (1) endemic or had limited distributions relative to the ecoregion, (2) large area habitat needs, and (3) significant long-term population declines.

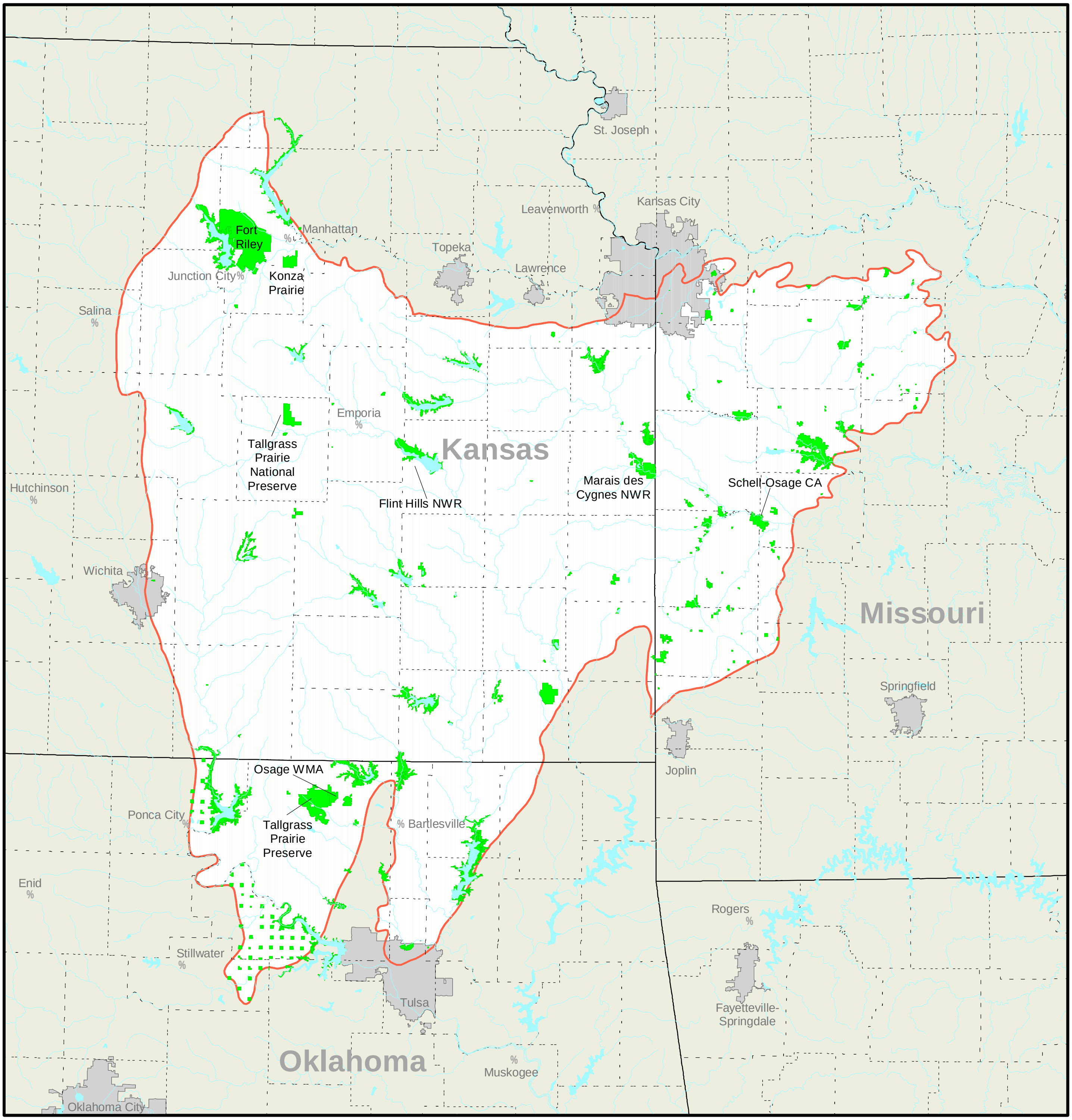
If further review indicates that some species are not being adequately addressed within the current portfolio, the inclusion of additional sites may be warranted. However, given the large number of data gaps and the high percentage of primary targets for which conservation goals were not met, this assessment was not attempted at this time. In the future, progress towards this end might be achieved by working closely with partner agencies and organizations that are actively pursuing conservation of many of these species. Comprehensive use of secondary targets to assess the adequacy of the portfolio, however, will likely have to wait until the second iteration of the plan is undertaken.

4.4 Identifying Conservation Priorities

All sites occurring within the ecoregion portfolio warrant conservation action - they are all important to the long-term viability of biodiversity in the ecoregion. However, with limited resources, decisions must be made as to where first to start. To that end, the OPFH Implementation and Strategies Team tested an evolving standard developed by the Conservancy's Greg Low to set priorities for conservation action among an ecoregion's conservation portfolio. The highest priority of these are called Action Sites. The model, available as an MS Excel spreadsheet, considered equally the four principles of complementarity, conservation value, threat/feasibility, and leverage in delineating Conservancy Action Sites (see The Nature Conservancy 2000b). These four principles are defined below:

> *Complementarity:* The principle of selecting action sites that complement or are "most different" from sites that are already conserved.

Figure 11: Osage Plains/Flint Hills Ecoregion Managed Areas



Legend

- Managed Areas
- Lakes and Rivers
- State Lines
- County Lines
- Ecoregion Boundary
- Urban Areas
- Other Cities

0 25 50 Miles

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Managed area polygons from Kansas GAP Program, Missouri Resource Assessment Partnership (MoRAP), and Oklahoma Biological Survey.
Map created by: The Nature Conservancy, Midwest Conservation Science Center.

Conservation Value: A criterion based on two sub-factors: 1) the number and diversity (i.e., regional to local scales, aquatic/terrestrial) of conservation targets, and 2) the health of conservation targets located within the site.

Threat/Feasibility: A criterion based on two sub-factors: 1) the urgency and immediacy required to abate threats, and 2) feasibility of achieving conservation success (i.e., the staff capacity of the Conservancy and its partners to abate threats, the probability of success, and the financial costs of implementation).

Leverage: The ability, by undertaking conservation action at one site, to affect conservation at other sites.

The draft Excel spreadsheet utilized in the action site delineation process weighted each of these four categories equally (each 25% of the whole). This weighting, however, did not fit well with the characteristics of the ecoregion and the portfolio assembly process adopted for use. Therefore, these modifications to the weighting were made:

1) Two components of the *Conservation Value* score (biodiversity health and diversity) were originally weighted equally (each 50% of the overall score). Because biodiversity health was already considered as a primary factor in selecting sites for the portfolio, we felt that an equal scoring here amounted to a double-weighting of the factor. To reduce this inherent problem, the weighting was shifted to a ratio of 75% diversity to 25% health. The conservation value rankings for portfolio sites are visually illustrated in Figure 12.

2) Complementarity was eliminated as a major factor in the overall weighting, as no sites in the ecoregion could meet the strict definition of being conserved at the present time. Consequently, all portfolio sites were given the same score within the Excel matrix.

Based on the above prioritization scheme, 12 YES Action Sites were identified, together representing 94% of the total terrestrial area and 31% of total aquatic stream miles proposed for conservation in the ecoregion (Table 8, Figure 13). An additional 11 sites (5% of the total terrestrial area and 39% of total aquatic stream miles) were characterized as MAYBE action sites, while 30 sites were characterized as NO action sites. All YES action sites are slated to have site conservation plans completed in the next five years, with significant conservation action accomplished within 10 years. Aside from these, states are encouraged to pursue conservation opportunities at all ecoregional sites. A list of sites by Action Site category is provided in Appendix I.

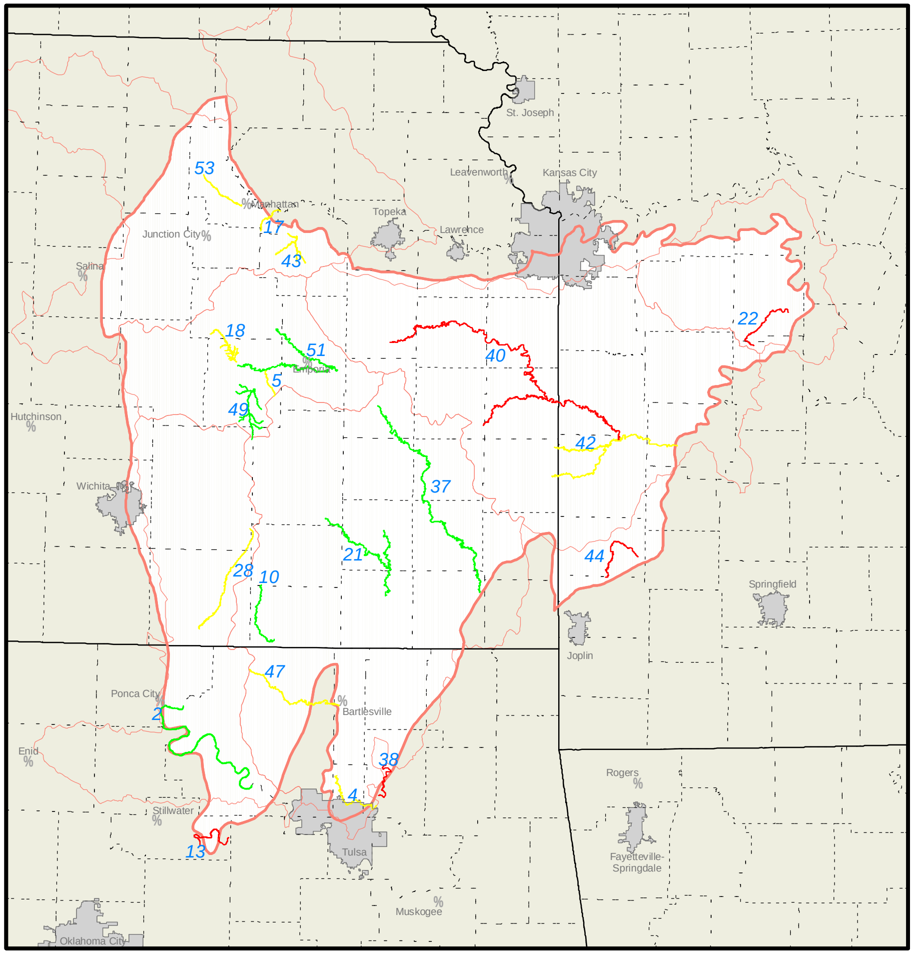
Table 8: Action Site Distribution by Functional Scale

	Portfolio Action Designation		
	Yes	Maybe	No
Functional Network	0	0	0
Functional Landscapes	3	2	0
Large Functional Sites	9	7	8
Small Functional Sites	0	2	22

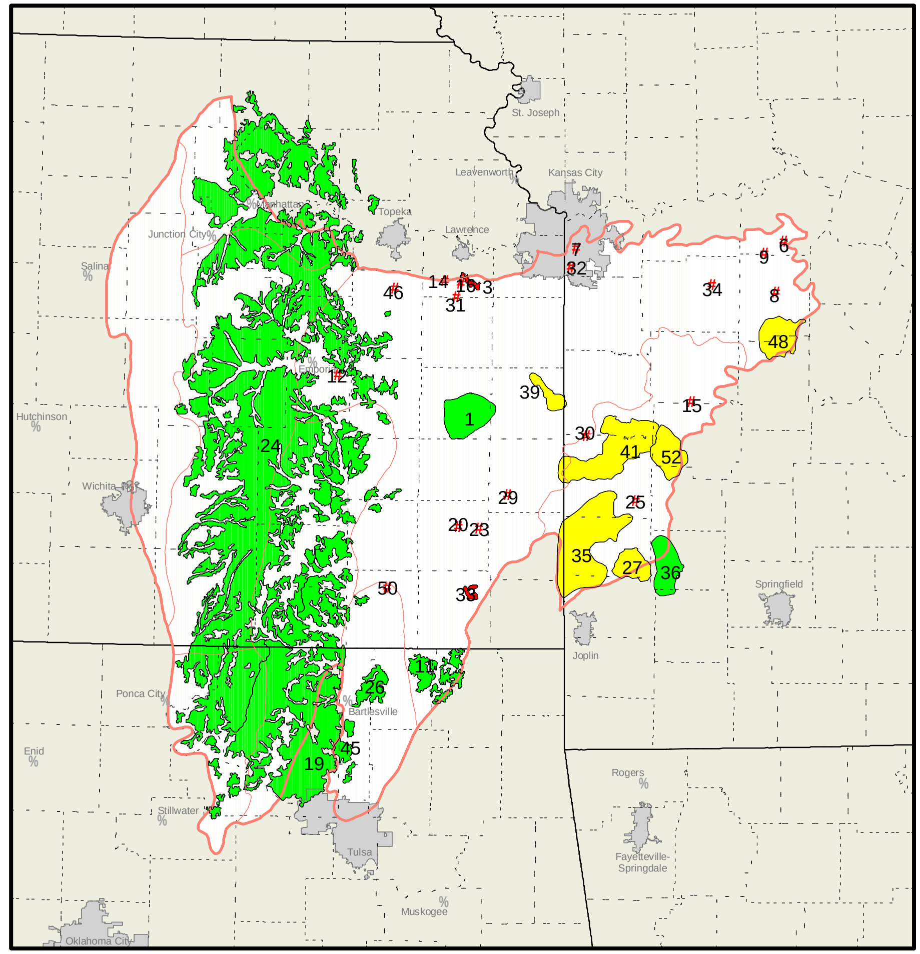
An analysis of Action Sites relative to the biodiversity captured in the portfolio (as known at the present time) was conducted to determine whether this prioritization process was indeed focusing attention at areas of high biodiversity significance. The analysis showed that YES action sites captured 64% of the high quality (A- and B-ranked) terrestrial community occurrences, distributed as a majority across all patterns and distribution categories represented in the portfolio (Table 9). In fact, this assessment did a better job of capturing biodiversity than simply focusing on functional landscapes alone (which captured 50% of the high-quality occurrences). The degree to which this result is influenced by the low level of inventory effort within the landscapes of the ecoregion, however, is not well understood.

Figure 12: Biodiversity Value of Conservation Areas

Aquatic Sites



Terrestrial Sites



Legend

Aquatic Sites	Terrestrial Sites	
Highest	Highest	Ecoregion Boundary
Medium	Medium	Stratification Units
Lower	Lower	State Lines
		County Lines
		Urban Areas
		Other Cities

0 25 50 Miles

Map created by: The Nature Conservancy, Midwest Conservation Science Center. Produced in cooperation with Kansas Applied Remote Sensing Program and Kansas Biological Survey.

Table 9: High Quality (A- and B-ranked) Community Occurrences Relative to "YES," "MAYBE," and "NO" Action Sites, and Functional Landscapes and Sites.

Community Pattern and distribution	Total number of high quality community occurrences	Community occurrences in YES ActionSites	Community occurrences in MAYBE Action Sites	Community occurrences in NO Action Sites	Community occurrences in Functional Landscapes	Community occurrences in Functional Sites
Pattern						
Matrix	17	12 (71) [1]	5 (29)	0 (0)	11 (65)	6 (35)
Large Patch	9	6 (67)	2 (22)	1 (11)	5 (56)	4 (44)
Small Patch	10	6 (60)	1 (10)	3 (30)	0 (0)	10 (100)
Linear	14	8 (57)	3 (21)	3 (21)	9 (64)	5 (36)
TOTAL	*50*	*32 (64)*	*11 (22)*	*7 (14)*	*25 (50)*	*25 (50)*
Distribution						
Endemic	0	na	na	na	na	na
Limited	34	21 (62)	8 (23)	5 (15)	16 (47)	18 (53)
Widespread	10	7 (70)	1 (10)	2 (20)	4 (40)	6 (60)
Peripheral	6	4 (67)	2 (33)	0 (0)	5 (83)	1 (17)
TOTAL	*50*	*32 (64)*	*11 (22)*	*7 (14)*	*25 (50)*	*25 (50)*

[1] The percent of total number is indicated in parentheses ().

YES action sites also did a good job of capturing high-quality species occurrences, with 55% of all high quality species occurrences falling within these sites. Although less pronounced than in communities, half of all species occurrences fell within YES action sites (Table 10). In comparison to functional landscapes, YES action sites did a better job in capturing the array of biodiversity than focusing on functional landscapes alone, which captured a mere 9% of the total high-quality species occurrences in the ecoregion. The large majority of rare species in the ecoregion are concentrated within the Osage Plains section, a portion of the ecoregion that is highly fragmented and where few landscapes occur.

This analysis suggested that the portfolio action site delineation process was relatively efficient in capturing the majority of community and species occurrences over a broad range of patterns and distributions. Of course, these results may be somewhat skewed by inventory effort. More intensive inventory efforts have been undertaken in the highly fragmented portions of the ecoregion, while the large landscape areas (e.g., Flint Hills) have had little. Despite this, prudent attention to both functional landscapes and other sites of high biodiversity value will provide the best means for allocating scarce monetary and staff resources.

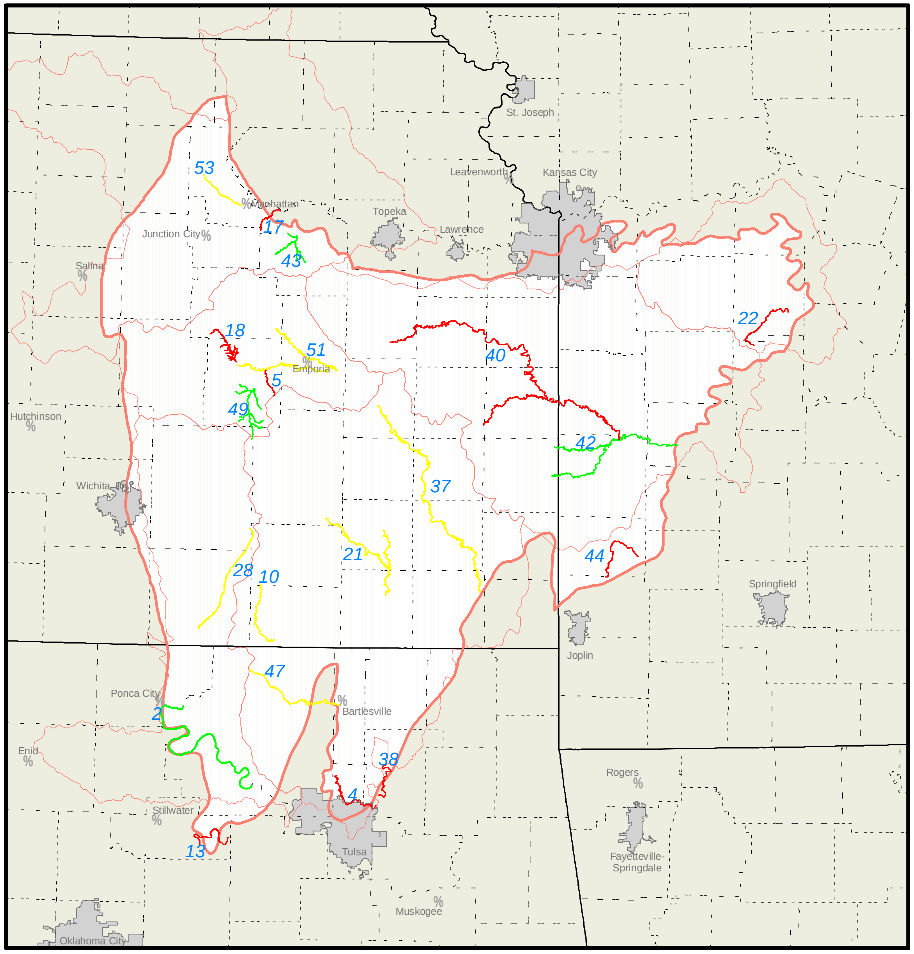
Table 10: High Quality (A- and B-ranked) Species Occurrences Relative to "YES," "MAYBE," and "NO" Action Sites, and Functional Landscapes and Sites.

Species distribution	Total number of high quality species occurrences	Species occurrences in YES ActionSites	Species occurrences in MAYBE Action Sites	Species occurrences in NO Action Sites	Species occurrences in Functional Landscapes	Species occurrences in Functional Sites
Distribution						
Endemic	0	na	na	na	na	na
Limited	24	11 (46) [1]	7 (29)	6 (25)	1 (4)	23 (96)
Widespread	14	8 (57)	1 (7)	5 (36)	2 (14)	12 (86)
Peripheral	6	5 (83)	0 (0)	1 (17)	1 (17)	5 (83)
TOTAL	*44*	*24 (55)*	*8 (18)*	*12 (27)*	*4 (9)*	*40 (91)*

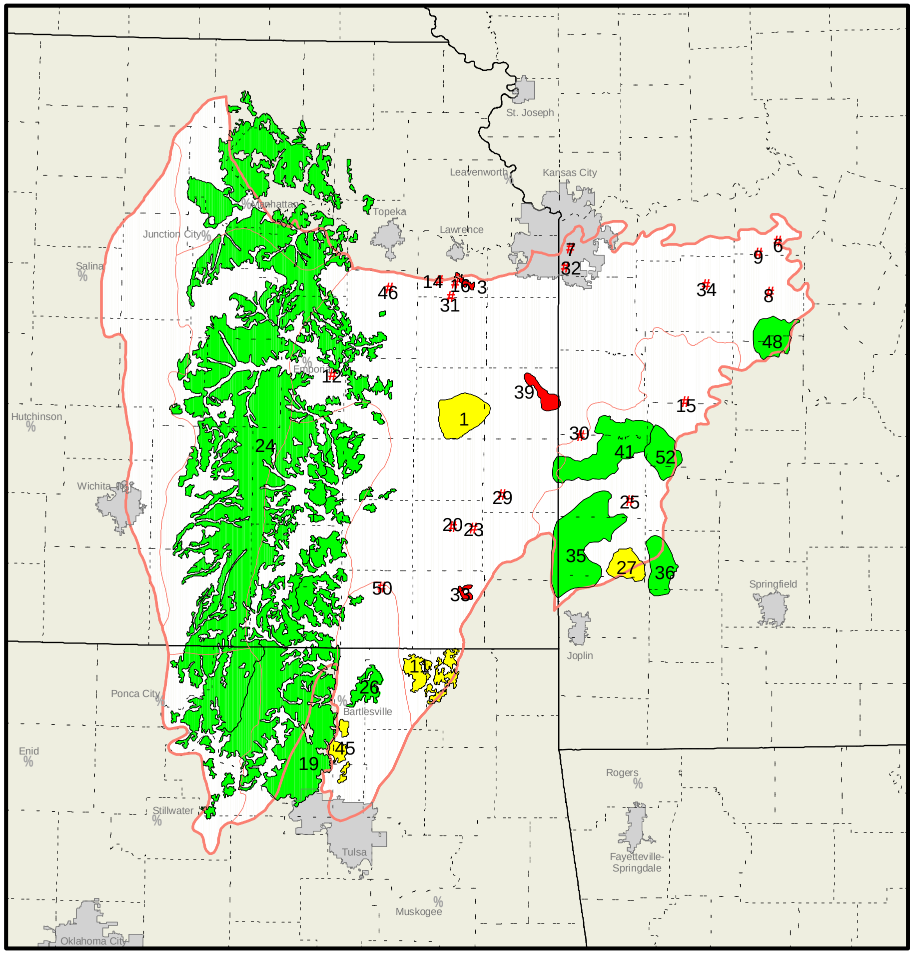
[1] The number of occurrences is indicated in parentheses ().

Figure 13: Osage Plains/Flint Hills Action Sites

Aquatic Sites



Terrestrial Sites



Legend

Aquatic Sites
- Yes
- Maybe
- No

Terrestrial Sites
- Yes
- Maybe
- No

- Ecoregion Boundary
- Stratification Units
- State Lines
- County Lines
- Urban Areas
- Other Cities

0 25 50 Miles

KARS Kansas Applied Remote Sensing Program

KANSAS BIOLOGICAL SURVEY

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Map created by: The Nature Conservancy, Midwest Conservation Science Center. Produced in cooperation with Kansas Applied Remote Sensing Program and Kansas Biological Survey. © August 2000, The Nature Conservancy.

5. Taking Conservation Action

The OPFH Implementation and Strategies Team reviewed the ecoregional plan and information pertaining to threats to biodiversity at portfolio sites. This information was used to set conservation priorities for each of the sites (see Section 4.4). With site priorities set, the team discussed and agreed upon strategies to enhance implementation of the ecoregional plan. These strategies are discussed in detail within this section.

5.1 Overall Implementation Strategies

The following key strategies were identified to effectively implement the plan:

1. Conservation Planning

- ✓ Complete Site Conservation Plans for YES Action Sites within the next five years.
- ✓ Assess strategies and conservation leadership for MAYBE and NO action sites.
- ✓ Implement recommendations for maintaining the ecoregional plan prior to second iteration.

2. Conservation within Functional Landscapes

- ✓ Undertake conservation action at YES Action Sites, principally those within functional landscapes.
- ✓ Pursue priority multi-site threat abatement strategies as a means of leveraging conservation success regionally and across the ecoregion.

3. Restoration

- ✓ Assess the long-term role of restoration activities at all portfolio sites, particularly those identified as YES action sites.
- ✓ Prioritize large-scale restoration activities on those imperiled community types that are most characteristic and distinctive of the ecoregion (i.e., matrix, endemic, limited) in order to improve the status of the coarse filter.

4. Inventory

- ✓ Set priorities for biological inventory within the ecoregion based upon data gap information collected during this planning exercise.
- ✓ Develop a work plan, timeline and budget; secure funding for priority biological inventory prior to second iteration.

5.2 Multi-Site Threat Abatement Strategies

Threats to biodiversity occur at multiple scales and frequencies. Some single threats may occur at large geographic scales and others may occur at a local scale, yet be pervasive across a large number of conservation sites. In the former, site-specific threat abatement activities will not be successful; coordinated regional or national activities are a necessity. In the latter, site-specific activities may be successful, but a regional approach may prove more efficient. Each of these are examples where multi-site strategies for the abatement of threats might be effective.

To identify possible multi-site strategies in the OPFH, the Implementation and Strategies Team utilized threats data gathered for each of the portfolio sites in the ecoregion by the Assessment and Design Team. Several primary threats were identified that might lend themselves to multi-site abatement strategies. These included:

- ✓ Exotic/Invasive Species
- ✓ Haying Regimes
- ✓ Row Crop Farming/Conversion
- ✓ Grazing Regimes
- ✓ Pesticide Application
- ✓ Fragmentation From Development
- ✓ Resource Extraction
- ✓ Fire Regimes
- ✓ Sedimentation of Streams/Rivers
- ✓ Dams

From these, two overarching strategy statements were developed as priorities to achieve many of the threat-specific strategies identified:

1. *Abating Development-based Threats:* Current and future reduction in the ranching industry within the Flint Hills (and elsewhere in the ecoregion) is a likely scenario given the increase in populations in counties bordering urban centers and the corresponding increases in land values, smoke- and fire-related sensitivities (and the likely push to restrict burning within rangelands), and subdivision of ranches into small ranchettes. The Implementation and Strategies Team recommended a number of strategies to maintain the current extent of rangeland in the ecoregion:

   - ✓ Advocate inheritance and capital gains tax reform relating to ranchlands;
   - ✓ Foster development of a new livestock industry-/producer-driven partner land trust[4];
   - ✓ Initiate and maintain dialogue with KS and OK livestock associations to create support of concepts;
   - ✓ Garner the support of prominent ranchers to validate the viability of developed concepts and strategies.

2. *Abating Agriculture-based Threats:* Many of the critical threats to biodiversity in the ecoregion (and across much of the Great Plains and Midwest) can be lessened or completely alleviated through successful passage of biodiversity-friendly agriculture legislation. By influencing Farm Program legislation, the Conservancy's Government Relations staff have the ability to achieve a major positive impact on biodiversity conservation at scales that would be difficult to match through a site-by-site approach. However, the Conservancy's Home Office Government Relations staff have been underutilized in terms of their potential impact on conserving biodiversity across the country. The Implementation and Strategies Team recommended a number of strategies to maintain the current extent of rangeland in the ecoregion:

   - ✓ The Conservancy's conservation practitioners at the state, divisional, and national levels should formally discuss and determine how best to approach agriculture issues as an institution.
   - ✓ The Conservancy's Government Relations department's involvement in agriculture policy-making is considered crucial to successful implementation of ecoregional plans. Enhanced communication between conservation implementers and Government Relations staff is essential;
   - ✓ Infuse conservation values into Farm Bill programs, including the Conservation Reserve Program, Environmental Quality Incentives Program, Wildlife Habitat Incentives Program, Sodbuster provisions, and Natural Resources Conservation Service technical assistance delivery programs;
   - ✓ Build a battery of incentive programs specifically for biodiversity conservation;
   - ✓ Advocate for proactive exotic species control programs at national, state and local levels; build institutional capability for addressing these concerns.

In summary, working with agricultural interests, which affect the vast majority of the ecoregion, will be critical to achieving conservation success in the OPFH. There are rich opportunities to create partnerships to address issues that are of concern to both agriculture and conservation interests.

5.3 Conservation of Functional Landscapes as a Key Conservation Strategy for the OPFH Ecoregion

Functional landscapes are a dominant feature of the OPFH portfolio, representing 82% of the total terrestrial portfolio area and capturing a large proportion of the ecoregion's biodiversity. Furthermore, they offer conservation targets the best opportunity for long-term viability. As such, conservation

[4] This effort would contribute to building institutional capacity to develop local and regional land trust organizations in the Great Plains

implementation strategies designed to focus on these areas must be a priority (see section 4.3.1.2). Because it harbors a large proportion of remaining tallgrass prairie on the continent, the OPFH holds great promise for conserving expansive landscapes that provide for the conservation of a diverse array of prairie-dependant or associated biodiversity.

The predominance of these sites in private, ranching ownership dictates that conservation strategies be designed to fully engage the livestock and agricultural industries. The Implementation and Strategies Team recognized that site conservation planning for these sites must involve these key stakeholders, early on and throughout the planning process. Developing and implementing tools that both maintain conservation targets over the long term and ensure the economic viability of the ranching industry will be an essential prerequisite to conservation success.

Key conservation strategies identified for landscape-scale sites include the creation of a producer-driven conservation easement program in the Flint Hills, and efforts to ensure that future federal Farm Program and other government initiatives include a strong focus on both rangeland and biodiversity conservation issues. To that end, the Conservancy and other key partners are already collaborating with a Kansas-based coalition of producer and conservation interests (called The Tallgrass Legacy Alliance), to identify common resource concerns and develop conservation strategies for an area that encompasses much of the OPFH in Kansas. This group could play a significant role in informing site conservation planning for functional landscapes in the ecoregion and in catalyzing conservation action.

5.4 Restoration as a Key Conservation Strategy in the OPFH Ecoregion

The widespread loss and degradation of natural communities in the OPFH ecoregion (especially in the Osage Plains section) resulted in a preliminary set of sites that fell well short of meeting the Conservancy's conservation goals. An assessment described previously (Section 4.3.2) found that additional inventory would provide a partial solution to this problem, but would not be the entire answer. Twenty percent of the coarse filter community types in the ecoregion may be considered functionally extirpated, and an additional 29% imperiled (with less than 75% of their conservation goal achievable through additional inventory). In order to enhance and improve biological diversity in this, and in any, ecoregion in the Great Plains, restoration must play an integral role in the development and design of the ecoregional plan.

We have defined restoration as: *Any enhancement of the viability of a conservation target or target occurrence by modifying its size, condition or landscape context*. Although restoration can include simply letting nature takes its course (natural restoration), realities within the OPFH mandate a more hands-on course of action. As such, the discussion here will focus on proactive strategies designed to expand the size of an occurrence (for natural communities, sometimes referred to as reconstruction), reintroduce natural process back into a system (or remove unnatural damaging ones), or link isolated, frequently degraded, occurrences together via reconstruction or other means.

Restoration in the context of the OPFH was viewed as a necessary effort to maintain and enhance the wide array of biodiversity targets found in the ecoregion. The OPFH plan recognizes that without long-term restoration occurring at multiple scales, the conservation goals for the ecoregion cannot be achieved and many conservation targets will be lost. While conservation efforts must start with the suite of sites identified as critical for conservation, substantial restoration efforts over the past 50 years provide experience that allow us to look ahead, and work towards not only conserving, but enhancing our natural resources. Perhaps most daunting of these potential undertakings is the role restoration might be able to play in the realm of maintaining (or in this case, resurrecting) functional networks between functional areas within and among ecoregions.

5.4.1 Identifying Restoration Sites

The Assessment and Design Team examined the role of restoration in the development of the OPFH ecoregional plan. It was apparent to the team that restoration activities at the site level would be important at all conservation areas in the plan to abate pervasive threats. Although restoration is a discussion topic of merit for each ecoregional conservation target, the primary emphasis within this iteration will be placed on communities, focusing principally on matrix types. It is these types that form the predominant natural character of the ecoregion, providing habitat for an array of species which would not otherwise be able to survive. Furthermore, discussion will be centered on the identification of potential restoration areas where no viable occurrences are extant.

The most obvious outcome of this work can be seen in the explicit designation of ***Landscape Restoration Areas*** within the portfolio. These are areas where restoration efforts will be focused on improving the functionality of isolated matrix community remnants by linking them through restoration of connecting lands. This concept was independently pioneered and first applied towards prairie conservation in the OPFH by The Nature Conservancy and the Missouri Department of Conservation with the designation of Landscape Conservation Areas. In ecoregional planning, this concept was first tested in the Central Tallgrass Prairie (The Nature Conservancy 2000a). Through increased connectivity, improved landscape context, and greater management flexibility to restore natural disturbance processes like fire at or near the scale the historically occurred, it is assumed that these areas will be more functional, and consequently, target occurrences within them will be more viable over the long term.

Landscape Restoration Areas were identified in the ecoregion principally via Heritage Program occurrence data and expert knowledge. The objective of this exercise was the identification of concentrations of matrix community remnants in areas where matrix communities had been largely destroyed. Missouri, as stated above, had already independently delineated a number of Landscape Restoration Areas, while Kansas has delineated one. Further inventory in Kansas and perhaps in Oklahoma may identify additional areas to consider for landscape-scale restoration.

A second assessment using Thematic Mapper satellite imagery (Landsat) was conducted to identify dense concentrations of large-sized matrix remnants, typically in close association with relatively intact untilled landscape areas. This approach allowed the creation of a two-zone map for the ecoregion, illustrating both areas of unfragmented, landscape-scale vegetation, and concentrations of community remnants (Figure 14). This tool proved useful in delineating restoration priorities that would enhance the functionality and viability of existing landscape systems, and was in stark contrast to the conditions under which the Landscape Restoration Areas of Missouri and eastern Kansas was utilized (i.e., relatively small, isolated remnants which would serve as cores from which to build a functional landscape).

5.4.2 The Contribution of Restoration to the Osage Plains/Flint Hills Plan

Designating restoration areas was an essential first step in identifying the role of restoration in this ecoregional plan. As stated above, these fell into two primary types: 1) building landscapes from concentrations of small, isolated examples (Landscape Restoration Areas), and 2) enhancing the functionality and viability of untilled, relatively intact landscapes through the connection of remnants to the main core area. The contribution of each type to the long-term maintenance of biodiversity in the ecoregion is discussed here.

5.4.2.1 Landscape Restoration Areas

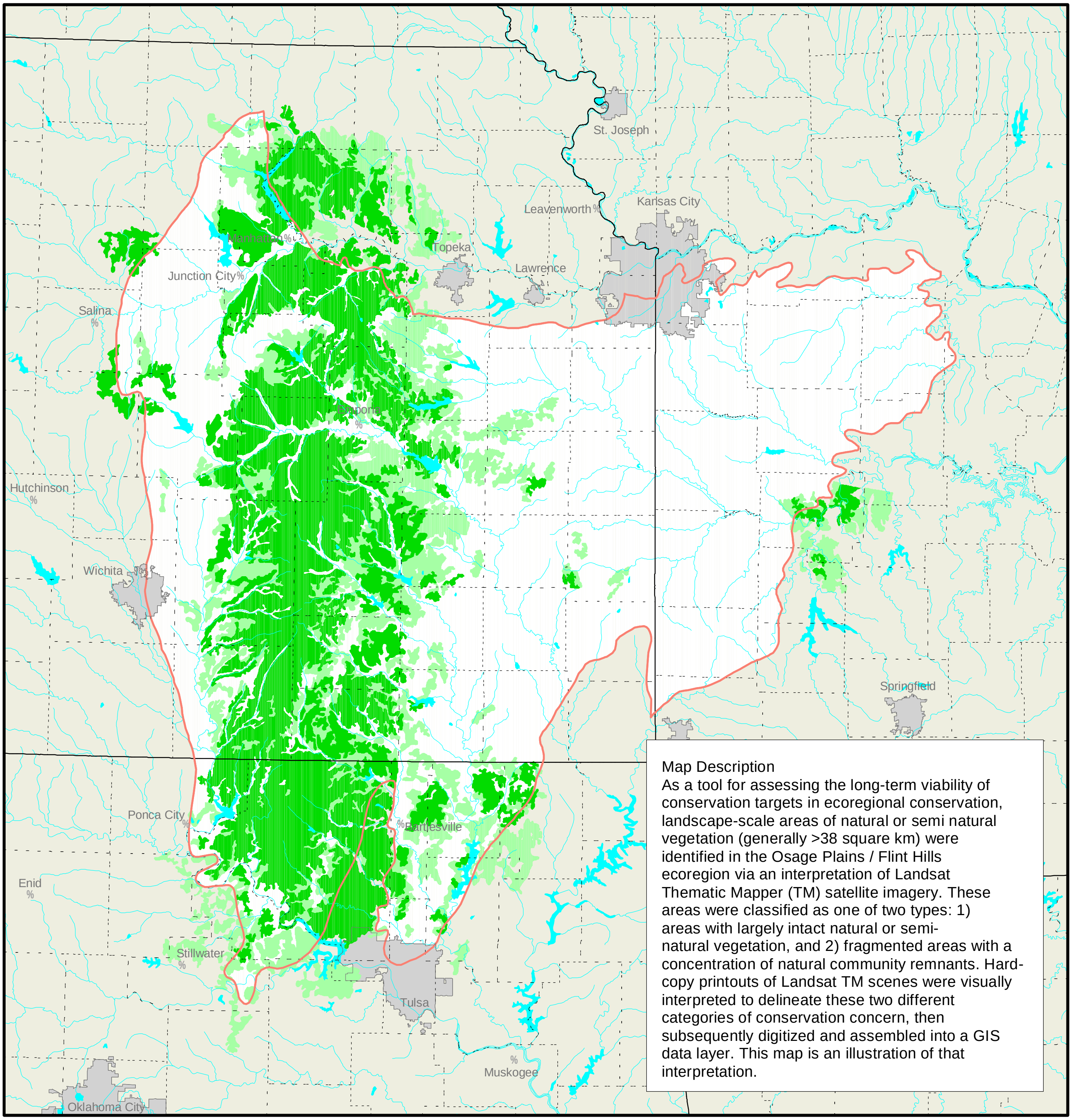
As a whole, seven Landscape Restoration Areas (LRAs) were identified in the OPFH ecoregion, each approximately or significantly larger than the 70,000 acre minimum benchmark established through the minimum dynamic area assessment. Together, these account for 13% of all terrestrial portfolio sites in the plan, and represent 17% of the total area identified for conservation (see Table 2)[5]. Despite the small area encompassed by these LRAs, they capture 36% of the A- and B-ranked community occurrences and 50% of the target species occurrences selected for the portfolio.

5.4.2.2 Restoration Around Untilled Landscapes

As a means of better illustrating the degree to which matrix types within portfolio landscapes might be considered viable, landscape polygons were assessed and plotted relative to the 250,000 and 70,000 acre minimum dynamic area benchmarks identified in Section 3.3 (Figure 15). This assessment revealed that 73% of total landscape area is captured within polygons exceeding 250,000 acres, meeting the stringent minimum dynamic area requirements for long-term viability. Another 7% fell within sites of 70,000-250,000 acres; twenty percent occurred within landscape units under 70,000 acres.

[5] In the OPFH, all terrestrial large functional sites are also landscape restoration areas.

Figure 14: Untilled Landscapes and Concentrations of Matrix Remnants



Map Description
As a tool for assessing the long-term viability of conservation targets in ecoregional conservation, landscape-scale areas of natural or semi natural vegetation (generally >38 square km) were identified in the Osage Plains / Flint Hills ecoregion via an interpretation of Landsat Thematic Mapper (TM) satellite imagery. These areas were classified as one of two types: 1) areas with largely intact natural or semi-natural vegetation, and 2) fragmented areas with a concentration of natural community remnants. Hard-copy printouts of Landsat TM scenes were visually interpreted to delineate these two different categories of conservation concern, then subsequently digitized and assembled into a GIS data layer. This map is an illustration of that interpretation.

Legend

- Untilled Landscapes
- Concentration of Fragments
- Lakes and Rivers
- Ecoregion Boundary
- State Lines
- County Lines
- Urban Areas
- % Other Cities

0 25 50 Miles

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Yet, there is room for significant improvement. A look at the Flint Hills landscape, for example, clearly illustrates that despite the fact that much remains, a moderate-pronounced degree of fragmentation has occurred. Most river valleys have been tilled, and landscape units have become separated from the main Flint Hills core through conversion to agriculture. This action has also occurred at all other untilled landscapes in the ecoregion.

Using the two-zone interpretation from satellite imagery discussed in section 5.4.2 above, polygons identified for capturing concentrations of fragments were married with those of untilled landscapes to illustrate the benefit to long-term viability that restoration around landscape cores could achieve (Figure 15). Restoration focusing on concentrations of fragments as delineated in Figure 14 would enhance to 81% the total landscape area captured within polygons exceeding 250,000 acres. Eight percent would fall within landscapes of 70,000-250,000 acres, and 11 percent would occur in landscape units under 70,000 acres. Furthermore, this approach would further meet the conservation goal set for the Flint Hills Tallgrass Prairie. Beyond merely increasing size, this approach to restoration would effectively reduce the impacts of fragmentation by reducing perimeter edge at landscape sites and the associated negative impacts of edge effect on biodiversity. It must be noted that the conservation plan of the OPFH fully endorses this approach despite the fact that it is not visually displayed within the context of the ecoregional portfolio map.

5.4.3 Establishing Ecoregional Priorities for Restoration

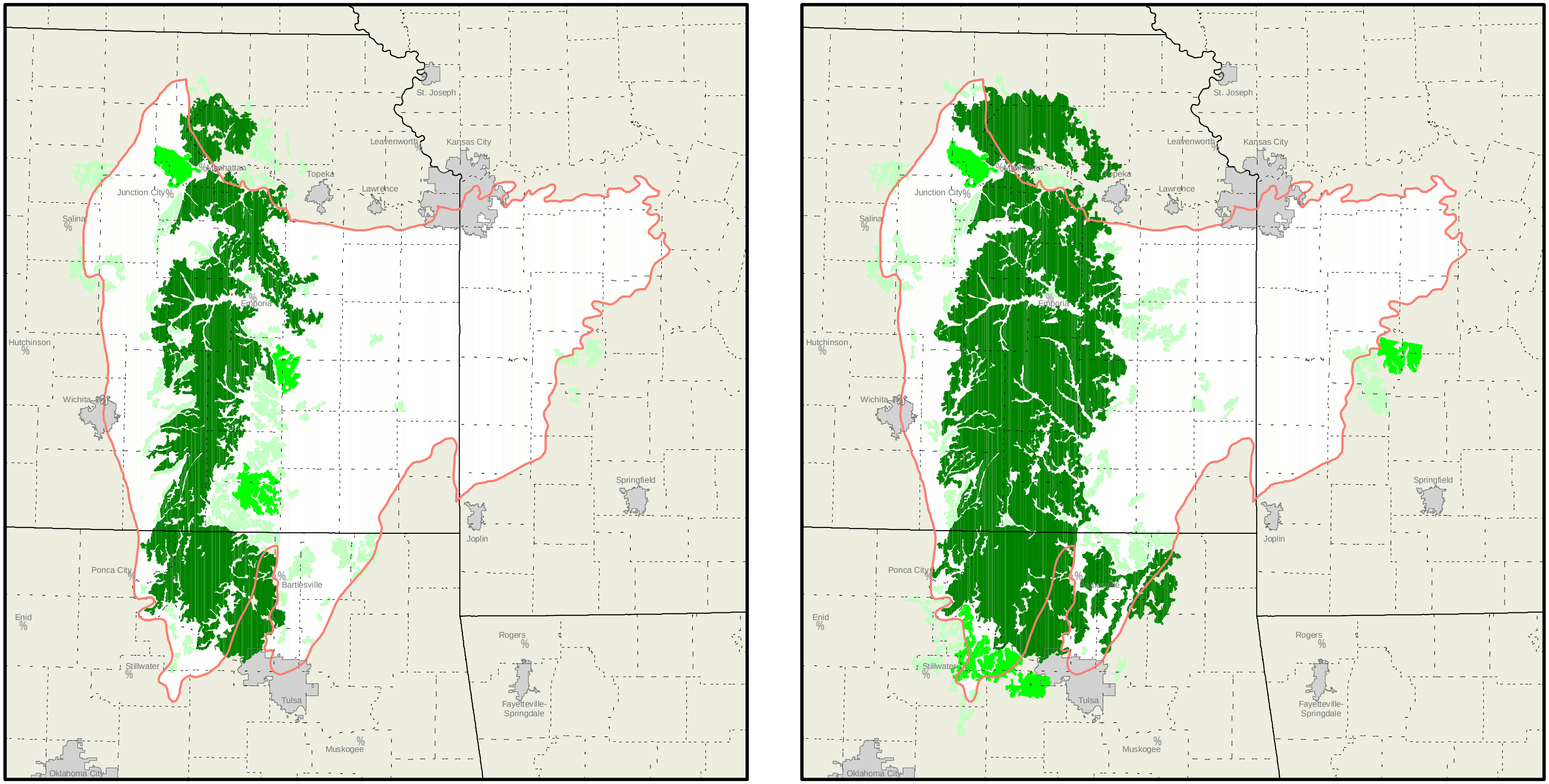
One of the overriding messages from this ecoregional plan is that comprehensive conservation of all portfolio sites would still leave us far short of meeting our conservation goals for biodiversity in the OPFH. Even with additional inventory in the ecoregion and follow-up conservation action, we would likely be able to fully address the conservation needs of approximately 7% of the known plant communities in the ecoregion. This fact is of great concern to conservationists in the ecoregion.

The current contribution of restoration, while significant, would have to be dramatically increased to have a substantial impact on reaching the conservation goals outlined in this plan. However, restoration activities are expensive, an estimated 2-5 times more so than conserving intact and viable examples of natural communities outright. The task at hand is how to prioritize restoration efforts, given the scarcity of resources in the ecoregion for conservation action. A primary ecoregional conservation strategy adopted for this ecoregion was to prioritize conservation action toward the natural communities in the ecoregion, focusing those efforts at restoring the matrix community types that historically characterized the ecoregion. To this end, two approaches were pursued to address the needs of matrix communities (as discussed in Section 5.4.2).

Taking this step, however, mandates that sizeable amounts of resources are generated in support of these activities. Viable examples of matrix communities are inherently large and the expense to undertake these efforts enormous. There are numerous unanswered questions that must be addressed by the Implementation and Strategies Team before action can take place. What additional resources could be found to undertake the level of restoration needed to fully achieve the conservation goals? Does the will exist among natural resource agencies, organizations and private landowners to work cooperatively to carry out large-scale, long-term, and expensive restoration efforts necessary to improve the condition of the region’s impoverished natural heritage? Conversely, what if we are not capable of carrying out this level of work? What implications does this have on the future of biological diversity for the ecoregion? Are we willing to lose the imperiled communities and the associated populations of species that rely on them?

By specifically quantifying the current contribution of restoration to this plan, and identifying the scope of the work needed to move towards the goal of biodiversity conservation in the ecoregion, more informed decisions can be made. There is a dire need for the Conservancy and other organizations to effectively tackle head-on the issue of restoration and its role in conservation. We have begun to chart a future, and have learned that in highly fragmented landscapes, to fully achieve our goals will require restoration efforts of a magnitude we have only begun to consider.

Figure 15: Segments of Landscapes Meeting Minimum Dynamic Area Thresholds



Legend

Landscapes
- < 70,000 acres
- 70,000 - 249,999 acres
- > 250,000 acres

- Ecoregion Boundary
- State Lines
- County Lines
- Urban Areas
- Other Cities

0 25 50 Miles

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6. <u>Planning for the Next Iteration</u>

In order for ecoregional plans to remain pertinent to the day-to-day actions of The Nature Conservancy and its conservation partners, it is imperative that they become living documents and are updated regularly over time as new information and data are obtained. This section of the report details the procedures and time frame under which modifications to the existing plan will be made.

6.1 On-going Maintenance of the Ecoregional Conservation Plan

To ensure that the ecoregional conservation plan is a living document, the Implementation and Strategies Team recommended two means of updating the ecoregional portfolio between successive iterations. First, a Site Selection Advisory Team (SSAT) should be created to review recommended modifications to the portfolio (additions and deletions) on an on-going basis. Guidelines and protocols for modifying the existing ecoregional portfolio were adopted (Appendix J). Second, the Assessment and Design Team will meet periodically to review the interim changes and to consider others.

6.1.1 Site Selection Advisory Team

From time to time, situations will arise when it will be desirable to make modifications to the original suite of selected sites: species global ranks may change, resulting in a loss or addition to the targets list; future inventory may alter the relative ranking of sites for specific targets; or other new information may come to light. If changes are made on an on-going basis, and that information is well documented, the plan will become a living document, one that is utilized on an on-going basis rather than one that stagnates and becomes stale over time. Additionally, the second iteration planning process will be able to use this updated first iteration as the benchmark from which to build.

A Site Selection Advisory Team was created and includes a data manager, and one science representative from each state. At present, this team consists of team leader Bob Hamilton (Tallgrass Prairie Preserve), Greg Wingfield (Kansas Field Office), and Doug Ladd (Missouri Field Office). Those advocating changes to the Conservation Design will contact the Team Leader and are responsible for providing the information needed by the Advisory Team to review and make a decision about their proposal. The Advisory Team will utilize the agreed upon rationale for reviewing and approving changes to the sites selected. Conference call meetings of the Advisory Team will be held on an as-needed basis, as determined by the Team Leader. As the Advisory Team makes decisions, these will be tracked and documented by the data manager. Also, the Divisional Directors will be notified of any changes.

6.1.2 Assessment and Design Team - Meeting Timeframe and Purpose

Every 18 months, the Assessment and Design Team will meet to review the changes made by the SSAT, and to consider portfolio modifications based on changing species Global (G) or Type (T) ranks, results of additional inventory, additions to or deletions from the target lists, or to rectify deficiencies in the original design (e.g. gaps in secondary target conservation). These changes will be tracked and documented by the data manager, and the Divisional Directors will be notified of the changes.

In addition to this, the Implementation and Strategies Team will meet biannually with semi-annual conference calls to discuss matters of importance, including on-going conservation efforts and progress towards meeting established site conservation planning deadlines, cooperative conservation ventures, modifications to the existing communication plan (see Appendix K), and multi-site threat abatement strategies.

6.2 Data Management

Initial management of tabular and spatial data for this project was handled on a contract basis with the Kansas Biological Survey in Lawrence, Kansas. This responsibility ultimately moved to the Conservancy's Midwest Conservation Science Division at its Midwestern Resource Office in Minneapolis, Minnesota. Management of all tabular and spatial data for this project was accomplished using Microsoft Access in conjunction with ESRI ArcInfo and ArcView products. All data and information, except Natural Heritage Program element occurrence records, will be archived in a manner consistent with the Conservancy's recently published guidelines for ecoregional information management by the end of FY2001 (see The Nature Conservancy 2000c).

6.3 Second Iteration of the Plan

Within ten years of completing this plan, a second iteration ecoregional planning process should be initiated to integrate all new information in a comprehensive manner. The above-mentioned on-going maintenance should significantly simplify this task. It is expected that new information about the species and communities of the ecoregion as well as advances in conservation science and planning will be integrated into the Conservation Design at that time. For example, an aquatic macrohabitat classification and ecological groups analysis should be incorporated into the second iteration, as should a more extensive evaluation of important bird areas in the ecoregion. A similar undertaking addressing the needs of birds in the Great Plains is being finalized and recommendations will be available for use in Summer 2000.

6.4 Data Gaps

The lack of comprehensive data will always be an obstacle toward reaching the ultimate goal of developing an ecoregional conservation design that ensures the long-term viability of all native species and natural communities. Compiling information on data gaps and research needs will benefit the Conservation Design process as well as help set priorities for inventory within each state to inform the second iteration of the Ecoregional Plan.

These data can be placed into one of three different categories: geographic data gaps, conservation target data gaps, and gaps related to the ecoregional planning process.

6.4.1 Geographical Data Gaps

Although portions of the OPFH ecoregion are well inventoried (particularly in Missouri), many areas remain poorly assessed.

Kansas and Oklahoma. Because there were limited existing biological data on natural plant communities in the western part of the ecoregion, the team decided to conduct REAs to gather information on terrestrial plant communities in areas identified as untilled landscapes, principally within the Flint Hills. Inventory work within identified untilled landscapes was conducted during the spring and summer of 1998. Potential inventory sites were identified with the aid of recent satellite imagery, color infrared air photography, driving county roads, and existing knowledge of large ranch ownership. Large ranch properties were used as the unit of inventory. The overall quality of natural plant communities on the ranches was rated a grade “B” (Loring et al. 1999). Significant additional survey work is recommended for these areas.

Missouri. County level natural feature inventories have been completed for all of the Missouri counties in the OPFH ecoregion. These inventories focused on existing high quality element occurrences, and little information is available about restorable examples in much of the region.

6.4.2 Conservation Target Data Gaps

Numerous data gaps for the ecoregional conservation targets were identified throughout the planning process, for both communities and species. Areas of foremost concern include primary conservation targets, secondary targets, birds, and aquatic communities.

Primary Targets. Primary targets include all natural communities (both terrestrial and aquatic) and globally imperiled species with occurrences in the ecoregion (Appendices A and B). Although significant inventory has been completed in parts of the ecoregion, large areas remain unsurveyed; as such, data gaps relating to primary targets are large. Additionally, resurveys of historic target occurrences need to be undertaken, and taxonomic issues pertaining to target species resolved. Serious efforts to fill priority data gaps should be undertaken prior to the second iteration of the OPFH ecoregional plan.

Secondary Targets. Secondary targets were identified as a means to evaluate the effectiveness of the portfolio in conserving the full array of biodiversity in the ecoregion, including those species that are globally common. Because of the magnitude of data gaps pertaining to primary targets, an assessment of the portfolio relative to secondary targets was not perceived as a useful tool at this time. The secondary target assessment should be withheld until the second iteration, after serious and intensive inventory efforts have addressed the large data gaps prevalent in the ecoregion.

Birds. Few bird species were included as conservation targets due to a lack of information at the time targets were being selected. Bird conservation should be addressed as part of a second iteration or as an add-on to the first. Recommendations for incorporating birds into ecoregional plans, specific to the ecoregions of the Great Plains, will be forthcoming in 2000, a project funded by the Conservancy's Wings of the America's and Ecoregional Conservation programs. These recommendations will further assist planning teams in this venture.

Aquatic communities. While the expert nomination process for identifying portfolio aquatic sites was adequate, it will be necessary to complete an aquatic community classification for the ecoregion prior to the second iteration. This will enable the Conservancy to describe the aquatic communities in a manner consistent with the national standard, now in use in other ecoregions. Because resources are limited in the Plain's ecoregions, neighboring ecoregional teams should look for ways to share expenses and otherwise cooperate between themselves and partner agencies/organizations in this effort.

6.4.3 Ecoregional Planning Process Gaps

From a process standpoint, information gaps also plagued the planning effort. These occurred primarily in the areas of viability assessment and restoration.

Viability assessment issues. The general lack of target occurrence viability data made it difficult to set meaningful conservation goals and build the ecoregional plan from viable examples. General guidelines for natural communities were not readily available to the OPFH teams, and as such, general specs derived from an adjacent ecoregion were used. Further refinement of viability guidelines are needed prior to undertaking the second iteration.

Restoration. Few other ecoregional planning efforts have explicitly taken on the role of restoration in ecoregional conservation; thus, the restoration team had the difficult task of charting new territory and expanding upon earlier efforts. This entailed a certain amount of time spent testing different hypotheses, some of which were not fruitful in and of themselves. While the incorporation of restoration goals did prolong the amount of time it took to complete this ecoregional plan, it is hoped that planning efforts in other ecoregions will benefit from the work of this restoration team.

7. Acknowledgements

As noted at the beginning of this document, there were five teams that worked together to complete this ecoregional plan. Participants were Conservancy staff unless noted otherwise.

Core Team
Fred Fox, formerly Kansas Field Office
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In addition to those individuals listed as members of ecoregional planning teams (above), we would like to acknowledge the efforts of the following individuals who provided important information and assistance during critical portions of the planning exercise. These include:

Bill Busby, Kansas Natural Heritage Inventory
Steve Chaplin, Midwestern Resource Office
Beth Churchwell, Missouri Field Office
Ron Dent, Missouri Department of Conservation
David Diamond, Missouri Resource Assessment Partnership
Frederick Drummond, Pawhuska, OK
Holly Farris Erwin, Oklahoma Field Office
Don Faber-Langendoen, formerly Midwestern Resource Office
Dennis Figg, Missouri Dept. of Conservation
Craig Freeman, Kansas Natural Heritage Inventory
Suzanne Greenlee, formerly Missouri Field Office
Jonathan Higgins, Freshwater Initiative
Dana Hurlburt, Kansas Natural Heritage Inventory
Paul Kores, Oklahoma Biological Survey
Kay Krebbs, Tallgrass Prairie Preserve
Chris Lauver, Kansas Natural Heritage Inventory
Hillary Loring, Kansas Natural Heritage Inventory
Jim Minnerath, US Fish and Wildlife Service
Norman Murray, Missouri Dept. of Conservation
Michelle Northcutt, Western Resource Office
Ruth Palmer, Kansas Field Office
Brian Schreurs, Midwestern Resource Office
Jan Slaats, Midwestern Resource Office
Aimee Stewart, Kansas Natural Heritage Inventory
F. Victor Sullivan, Pittsburg State University
Caryn Vaughn, Oklahoma Biological Survey
Jue Wang, Kansas Natural Heritage Inventory

Finally, we would like to thank the following individuals who provided valuable expert information at the OPFH Experts Workshop in Pittsburg, Kansas and throughout the duration of the project.

Joe Arruda, Pittsburg State University
Bill Busby, Kansas Natural Heritage Inventory
Ralph Charlton, Kansas State University
Bryan Clark, Southeastern Oklahoma State University
Chuck Conaway, Tulsa, OK
Anne Fernald Cross, Oklahoma State University
Cyndi Evans, Missouri Dept. Natural Resources
Elmer Finck, Emporia State University
Pat Folley, Noble, OK
Craig Freeman, Kansas Natural Heritage Inventory
Bruce Hoagland, Oklahoma Natural Heritage Inventory
Jerry Horak, Kansas Dept. Wildlife & Parks
Kelly Kindscher, Kansas Natural Heritage Inventory
Chris Lauver, Kansas Natural Heritage Inventory
Larry Magrath, University of Science and Arts of Oklahoma
Paul Mackenzie, U.S. Fish & Wildlife Service
Charles Mather, University of Science and Arts of Oklahoma
Edie Marsh-Matthews, Oklahoma Biological Survey
Mike McFadden, Kansas Dept. Wildlife & Parks
Ed Miller, Kansas Dept. Wildlife & Parks
Norman Murray, Missouri Dept. Conservation
Brian Obermeyer, Eureka, KS
George Oviatt, National Park Service
Jimmy Pigg, Oklahoma Dept. Environmental Quality
Daren Riedle, Independence, KS
Dan Reinking, George Miksch Sutton Avian Research Center
Christiane Roy, Kansas Dept. Wildlife & Parks
Gregory Sievert, Emporia State University
Lynette Sievert, Emporia State University
Mike Skinner, Missouri Dept. Conservation
Emily Stanley, Oklahoma State University
Tom Swan, Kansas Dept. Wildlife & Parks
Vernon Tabor, U.S. Fish & Wildlife Service
Connie Taylor, Southeastern Oklahoma State University
Rick Thom, Missouri Dept. Conservation
Steve Timme, Pittsburg State University
Matt Whiles, Kansas State University
David Wiedenfeld, George Miksch Sutton Avian Research Center
Gene Young, Southwestern College

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