CHAPTER 4 AQUATIC SYSTEMS

4.1 Aquatic Goals and Objectives

The main goal of the aquatic portion of the SDWAP is to maintain the integrity of aquatic communities by conserving the conditions and the processes that sustain them. A key component of this goal was to develop a strategy to focus conservation efforts on key aquatic landscapes called Conservation Opportunity Areas (COAs) to conserve the full array of biodiversity. These primarily riverine aquatic ecosystems adequately represent the full extent of distinct aquatic habitats across South Dakota and focus on SGCN. Emphasis on riverine ecosystems was largely due to habitat preferences of aquatic SGCN.

A function of this analysis was to provide spatial data that could be used by natural resource professionals, non-governmental organizations (NGOs), legislators, and the public to make more informed decisions when prioritizing opportunities to fill information gaps and identify specific areas as high priorities for conservation work.

A large portion of the spatial data used to identify South Dakota's aquatic COAs came from the National Aquatic Gap Analysis Program analysis of the Missouri River basin (MOGAP, Annis et al. 2010). From these data, we used a modified version of the aquatic GAP classification hierarchy to assist in the identification of aquatic COAs.

Specific objectives were to:

1. Classify and map riverine ecosystems into distinct ecological units at multiple levels.
2. Develop statewide distribution maps for all known and probable occurrences for all fish, mussels and aquatic invertebrates listed as SGCN.
3. Generate overall watershed ownership/stewardship statistics for aquatic ecological drainage units.
4. Account for factors that negatively affect or threaten aquatic biodiversity in South Dakota.
5. Identify areas that represent the variety of unique habitats in South Dakota as high priority for future conservation initiatives or protection.
6. Provide information to decision makers to help with conservation planning efforts.

Pallid Sturgeon photo by Sam Stukel, SD GFP

4.2 Aquatic Conservation Strategy

Sam Stukel, SD GFP

Conserving the large variety of aquatic biological diversity in South Dakota is challenging. Detection of long-term changes to freshwater ecosystems and assemblages is often difficult, as historic documentation of range and density is often lacking or incomplete (McCartney 2002). Additionally, conservation and management is difficult due to multiple stressors and disturbances occurring concurrently, making it difficult to determine the exact causes of species and habitat loss and decline (Cushing and Allan 2001, McCartney 2002).

Loss of habitat by land conversion and habitat degradation continues to be a leading cause of species loss and decline in South Dakota, while human and financial resources for conservation remain limited. In the past, conservation efforts to preserve biodiversity were primarily focused on individual species or isolated populations on the brink of extinction or local extirpation (Franklin 1993, Scott et al. 1993). This species-by-species approach to conservation has proved difficult, biased, and not cost effective (Hutto et al. 1987, Scott et al. 1987, 1991, Margules 1989, Noss 1991). Therefore, we must improve the efficiency and effectiveness of conservation efforts by managing biodiversity through a systematic approach. This approach will allow us to identify and prioritize which species, assemblages, habitats, and unique watersheds to focus our conservation efforts on and propose for conservation opportunity areas (COAs).

The US Geological Survey's National Gap Analysis Program (USGS GAP) was initiated in 1988 to provide a coarse-filter approach for identifying conservation needs for biodiversity by identifying gaps in existing conservation efforts (Scott et al. 1993). Within the overall USGS GAP is the Aquatic GAP Program which more specifically evaluates aquatic biodiversity and habitats to enable more efficient and effective conservation prioritization.

The Aquatic portion of the SDWAP incorporates a combined coarse filter and fine filter strategy for conservation of aquatic biodiversity. This filtering strategy along with incorporating data from the National Aquatic GAP allows us to provide a sound scientific foundation for identifying the cumulative effects of threats and land use practices on species and their habitats. Additional explanation about coarse filter and fine filter approaches can be found in Section 3.1.

Application of the Strategy

Biodiversity was assessed at two levels:

1. Ecosystem (Community level), and
2. Species.

The combined filtering strategy provides the mechanism to address different levels of biological organization. The coarse filter addresses the ecosystem or community levels while the fine filter addresses the species level. In the future, when additional information becomes available through survey and research work, we plan to add additional levels of biodiversity, including more detailed links to the landscape and genetic structure.

A Systematic Approach to Conservation

- Identify components of biological diversity on which to focus conservation efforts
  (e.g. SGCN, natural communities, etc.)

- Identify where to focus conservation efforts
  - Select areas based on highest known and probable occurrences of aquatic SGCN and natural communities
    (i.e. highest species diversity; representing all aquatic SGCN; giving special consideration to aquatic SGCN with limited ranges)
  - Select areas with the highest probability for successful conservation of SGCN
    (i.e. lowest known conservation challenges to aquatic ecosystems (i.e. lowest Human Stressor Index (HSI)); highest level of land stewardship and protection from conversion of natural land cover)
  - Select areas from across the state and SGCN ranges that represent unique watershed types to maintain variation
    (i.e. representing all Aquatic Ecological System types (AES-types))

4.3 Aquatic Diversity – Classification of Riverine Ecosystems

It is widely accepted that to conserve biological diversity, one must conserve the ecosystems that support them (Franklin 1993, Grumbine 1994). Ecosystems can be distinct with regard to their structure, function, or composition (Noss 1990). Structural features in riverine ecosystems include factors such as depth, velocity, and substrate. Functional features include flow, thermal regime, and energy sources. Composition can refer to both abiotic and biotic factors such as habitat type or species. Ecological composition is usually closely associated with ecosystem structure and function (Noss 1990).

Taking geographic variation into consideration, our specific objective was to identify and map riverine ecosystems that are distinct at multiple levels with regard to ecosystem structure, function, and evolutionary history. To accomplish this, we used levels four through seven of the eight-level classification system developed by The Nature Conservancy Freshwater Initiative and the National Aquatic GAP of the Missouri River basin (Table 4-1; Figure 4-1; MOGAP, Higgins 2003, Higgins et al. 2005, Annis et al. 2010). Levels within the hierarchy are delineated in a top-down fashion using landscape and stream features (i.e. drainage boundaries, geology, soils, landform, stream size, gradient, etc.).

Table 4-1. Hierarchical framework, with basic descriptions, used for classifying and mapping riverine ecosystems in the Missouri River Gap Analysis Project. Hierarchy is adapted after the classification hierarchies of Frissell et al. 1986, Pflieger 1989, Maxwell et al. 1995, Seelbach et al. 1997, and Higgins et al. 2005. Note: Levels in red account for the levels used in South Dakota's selection process for identifying Conservation Opportunity Areas (COAs).

LEVEL	DESCRIPTION
Zones	Continental boundaries broken into six major zones of the world that resulted from distinct evolutionary histories associated with plate tectonics.
Subzones	Major river networks broken into subcontinental strata with relatively unique aquatic assemblages created by plate tectonics, glaciation, and mountain ranges.
Regions	Major river networks broken into subzone strata created by drainage network patterns that determine dispersal routes and isolation mechanisms that have resulted in different responses to long-term changes in climate.
Subregions	Regional stratification units that have similar climate and physiography that often correspond to broad scale patterns in dominant vegetation.
Ecological Drainage Units (EDUs)	Drainage boundaries broken into subregion strata, a combination of drainages within a distinct physiographic setting that share a common evolutionary history.
Aquatic Ecological System-Types (AES-Types)	Watershed boundaries broken into hydrologic subunits of EDUs with similar physiographic character, basin morphology and position within the larger drainage.
Valley Segment Types (VSTs)	Stream size broken down into hydrologic subunits of AESs, a combination of stream reaches with similar fluvial processes, sediment transport, riparian vegetation, and thermal regime.
Habitat Unit Types	Hydrologic subunits of VSTs, examples include depth, velocity, substrate, riffles, pools, and runs.

Levels 1-3: Zone, Subzone, and Region

The upper three levels of the hierarchy are largely zoogeographic strata representing geographic variation in taxonomic composition of aquatic assemblages across the landscape resulting from distinct evolutionary histories. The first three levels (Zones, Subzones, Regions) provide little ecological content as these are more specifically related to continental, subcontinental, and subzone zoogeographical boundaries and were not included in our selection process for defining COAs, although they are important for research and conservation at a global scale (Matthews 1998).

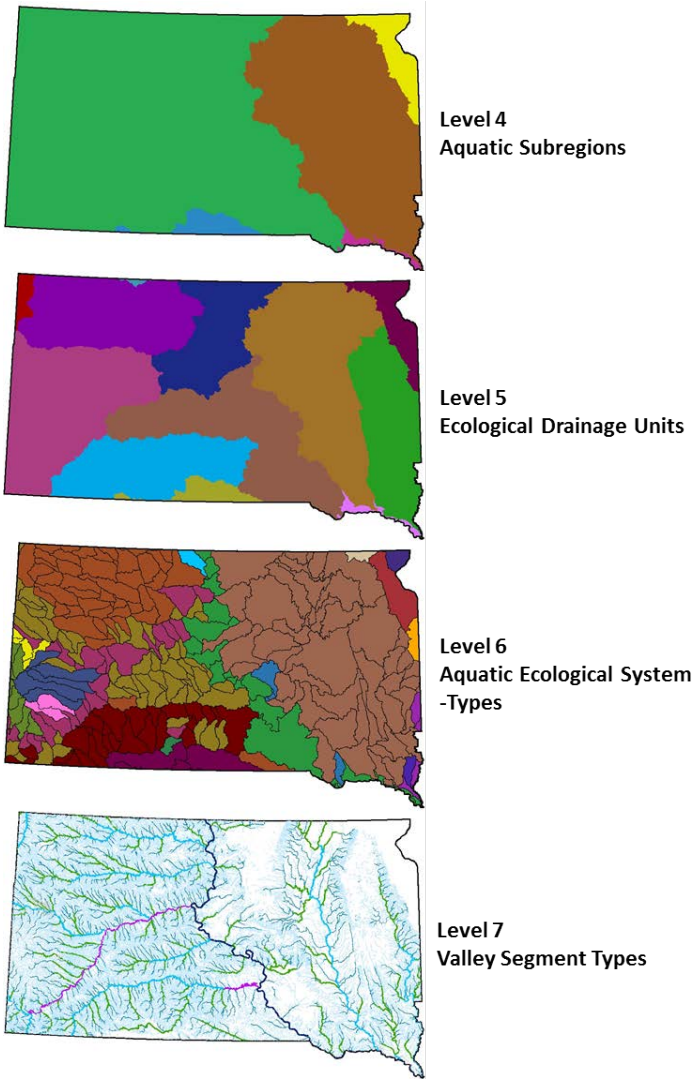

Figure 4-1. Map showing Levels 4-7 of the Missouri River Gap Analysis Project Aquatic Ecological Classification hierarchy in South Dakota (Annis et al. 2010).

Level 4: Aquatic Subregions

The Aquatic Subregions of South Dakota are separated along major drainages that generally correspond with abrupt transitions in geology, landform, soils, climate, land cover, etc. There are five Aquatic Subregions in South Dakota including the Sandhills and Plains, Middle Missouri Plains, Central Dissected Till Plains, Northern Glaciated Plains, and Upper Minnesota River (Figure 4-2). The Upper Minnesota River Basin is part of the Mississippi River drainage system and therefore was not a part of the MOGAP dataset. This area is found in northeastern South Dakota and encompasses the Upper Minnesota River drainage. Limited data were available for this watershed.

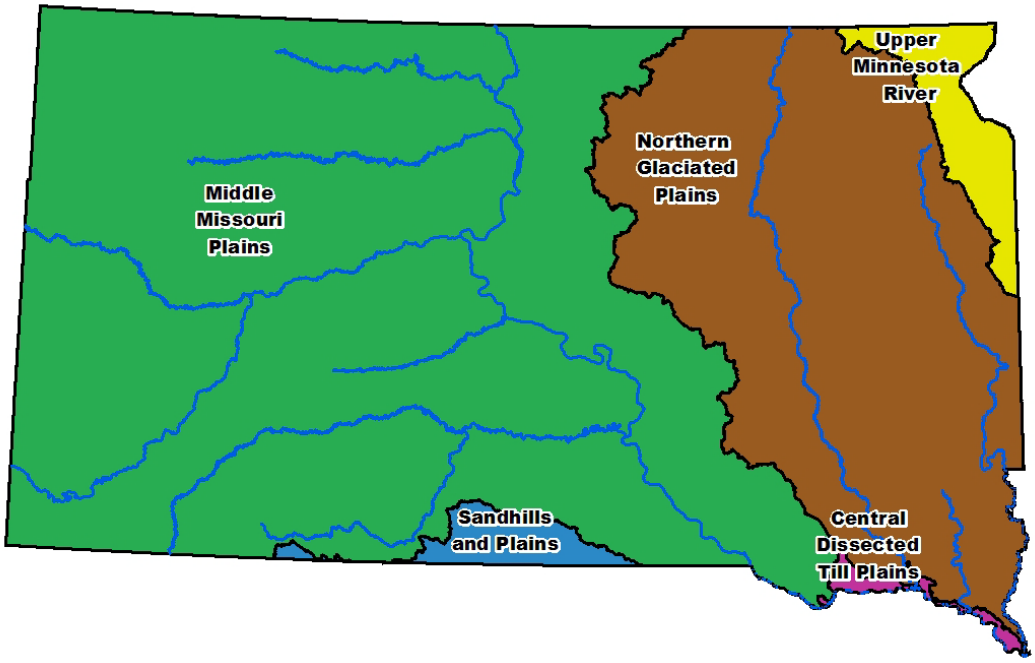

Figure 4-2. Map showing the boundaries of the five aquatic subregions of South Dakota, including the Upper Minnesota River basin, which lies outside of the Missouri River drainage.

Sandhills and Plains

The Sandhills and Plains Aquatic Subregion is primarily within the northern half of Nebraska, with only a small portion reaching into southcentral South Dakota. This subregion contains two Ecological Drainage Units (EDUs): the Middle Platte and the Niobrara, however the only EDU within South Dakota is the Niobrara River drainage. The Sandhills and Plains Aquatic Subregion consists of low hills, dissected plains, sand dunes, and wetlands; however, the majority of this subregion is composed of smooth plains.

Middle Missouri Plains

The largest Aquatic Subregion within South Dakota is the Middle Missouri Plains, which encompasses the western half of the state. This subregion contains seven EDUs: the Bad/Choteau, Cheyenne, Grand/Moreau, Heart, Little Missouri, Middle Missouri, and White drainage units. Major rivers include

the Bad, Belle Fourche, Cheyenne, Grand, Little Missouri, Little White, Missouri, Moreau, and White rivers. The Middle Missouri Plains Aquatic Subregion consists of level to dissected uplands, hills, and mountainous regions near the Badlands formations; however, the majority of this subregion is composed of smooth plains.

Central Dissected Till Plains

The Central Dissected Till Plains Aquatic Subregion primarily lies within Nebraska and Iowa, with only a small portion in southeastern South Dakota. This subregion contains four EDUs: the Blackwater/Lamine, Grand/Chariton, Kansas, and Little Sioux/Nemaha drainage units, however only the Little Sioux/Nemaha drainage unit lies within South Dakota. This Aquatic Subregion consists mostly of flat to gently undulating plains and hills; however, the majority of this subregion is composed of smooth plains.

Northern Glaciated Plains

The Northern Glaciated Plains Aquatic Subregion is primarily located within North and South Dakota and encompasses the eastern half of South Dakota. This subregion contains two EDUs: the Big Sioux/Vermillion and James River drainages. This Aquatic Subregion is generally flat with some rolling plains areas; however, it is primarily composed of flat plains.

Level 5: Ecological Drainage Units (EDUs)

Embedded within the aquatic subregions are Ecological Drainage Units (EDUs), which are also referred to as "islands" on the landscape (Sowa et al. 2005). Ecological Drainage Units group watersheds that share common taxonomic composition (species and genetic integrity), which is the result of similar evolutionary histories within the major drainages within each Aquatic Subregion.

Ecological Drainage Units provide ecologically meaningful units within which conservation areas can be selected to ensure that conservation elements (i.e. species and community units) are represented across the landscape. This type of regional stratification is critical in conservation planning and includes genetic and ecological variability among species, communities, and ecosystems across their spatial and environmental ranges. Twelve EDUs are embedded within South Dakota, eleven within the Missouri River basin including the Bad/Choteau, Big Sioux/Vermillion, Cheyenne, Grand/Moreau, Heart, James, Little Missouri, Little Sioux/Nemaha, Middle Missouri, Niobrara, and White drainage units and an additional EDU that lies within the Mississippi River basin, the Upper Minnesota River (Figure 4-3; Table 4-2). The Upper Minnesota River EDU is part of the Mississippi River drainage system. Because it was not part of the MOGAP dataset, limited data were available for this EDU.

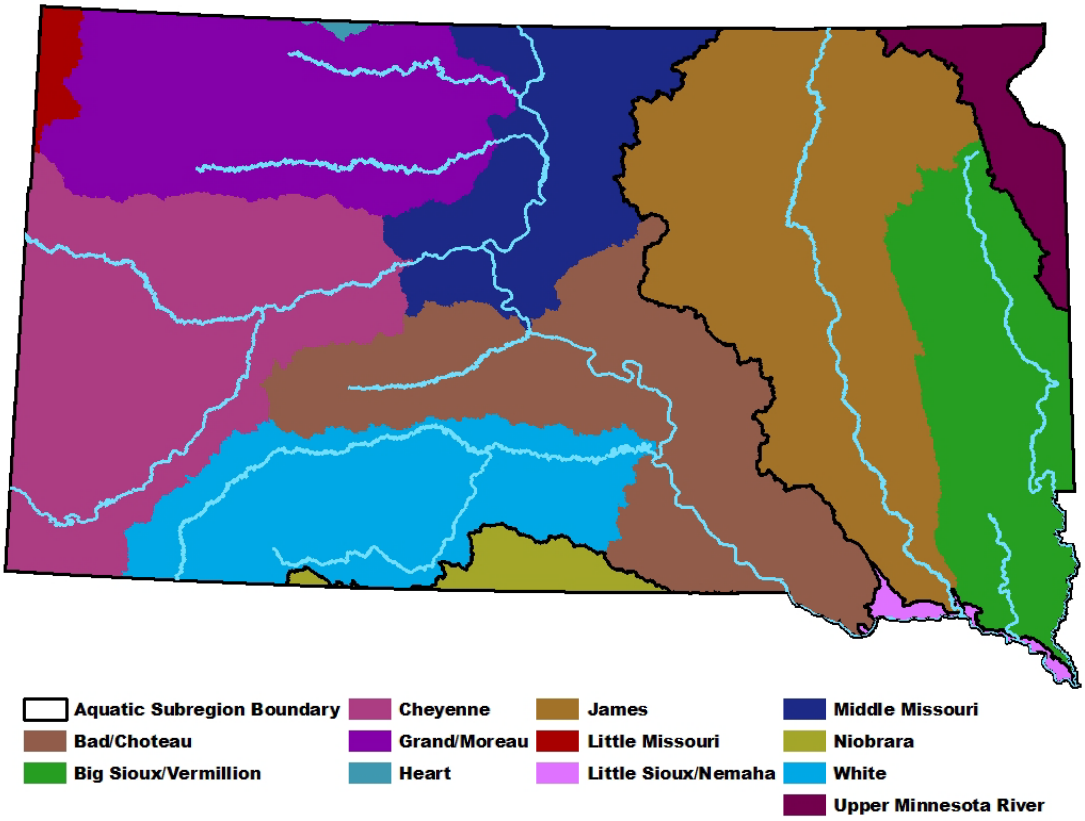

Figure 4-3. Map showing the boundaries of the twelve ecological drainage units (EDUs) of South Dakota, including the Upper Minnesota River drainage from the Mississippi River basin.

Table 4-2. Descriptions of Ecological Drainage Units (EDUs) in the Missouri River Basin of South Dakota.

Bad/Choteau EDU	Within the Middle Missouri Plains Aquatic Subregion lies the Bad/Choteau EDU. This EDU can be found within southcentral South Dakota, extending into northeastern Nebraska. In addition to the Bad and Choteau Rivers, the only other major river within this EDU is the Missouri. This area has been glaciated and has a landscape of level to rolling uplands and plains with some dissected hills and canyons. Pothole wetlands can also be found throughout this region. In South Dakota, 10 aquatic SGCN are known to inhabit this EDU. The fish community can generally be classified as minnow/sunfish/sucker.
Big Sioux/Vermillion EDU	Within the Northern Glaciated Plains Aquatic Subregion lies the Big Sioux/Vermillion EDU. This EDU can be found within eastern South Dakota and extends into the corners of Minnesota, Iowa, and Nebraska. In addition to the Big Sioux and Vermillion Rivers, the only other major river within the EDU is the Rock River. The landscape of this area changes from floodplains near the Missouri River to low rolling hills and plains with some bluffs and glaciations. The northern half of this EDU has many lakes and wetlands throughout. In South Dakota, 18 aquatic SGCN are known to inhabit this EDU. The fish community can generally be classified as minnow/sucker/sunfish.
Cheyenne EDU	Within the Middle Missouri Plains Aquatic Subregion lies the Cheyenne EDU. This EDU can be found within western South Dakota, Wyoming, and the extreme northwestern corner of Nebraska. In addition to the Cheyenne River, major streams within the EDU include the Belle Fourche River, Beaver Creek, Cottonwood Creek, Hat Creek, Indian Creek, Lance Creek, Mixes Food Creek, and Cherry Creek. The landscape of this area has not been glaciated and is composed of dissected hills, rolling plains, isolated buttes, badland formations, and salt pans. This area has many intermittent streams. In South Dakota, 8 aquatic SGCN are known to inhabit this EDU. The fish community can generally be classified as minnow/sunfish/sucker.
Grand/Moreau EDU	Within the Middle Missouri Plains Aquatic Subregion lies the Grand/Moreau EDU. This EDU is found in the northwestern corner of South Dakota and the southwestern corner of North Dakota. In addition to the Grand and Moreau Rivers, major streams within this EDU include the Missouri River, Handboy Creek, the North and South Forks of the Grand River, and the South Fork of the Moreau River. The landscape has not been glaciated and is composed of dissected hills, rolling plains, forested buttes, badland formations, and salt pans. This area has some headwater areas derived from springs, as well as intermittent streams in shallow valleys. In South Dakota, four aquatic SGCN are known to inhabit this EDU. The fish community can generally be classified as minnow/sunfish/perch.

Table 4-2 (continued). Descriptions of Ecological Drainage Units (EDUs) in the Missouri River Basin of South Dakota.

Heart EDU	Within the Middle Missouri Plains Aquatic Subregion lies the Heart EDU. This EDU lies primarily in southwestern North Dakota with only a small portion extending into north central South Dakota. In addition to the Heart River, major streams within the EDU include the Cannonball and Knife rivers. The landscape of this area has not been glaciated and is composed of dissected, level to rolling plains and hills, with an occasional sandstone butte. In South Dakota, no aquatic SGCN are known to inhabit this EDU. The fish community can generally be classified as minnow/sunfish/sucker.
James EDU	Within the Northern Glaciated Plains Aquatic Subregion lies the James EDU. This EDU is located in central North Dakota and extends south through eastern South Dakota to the Nebraska border. The only major stream or river within this EDU is the James River. The landscape of this area has been glaciated and is composed of rolling plains, moraines, and some sand dunes. This area has many lakes, wetlands, and is cut by steep perennial streams. In South Dakota, 15 aquatic SGCN are known to inhabit this EDU. The fish community can generally be classified as minnow/sunfish/sucker.
Little Missouri EDU	Within the Middle Missouri Plains Aquatic Subregion lies the Little Missouri EDU. This EDU is located in eastern Montana, western North Dakota and the northwestern corner of South Dakota. In addition to the Little Missouri River the only other major river is the Missouri River. These areas are unglaciated with landscapes of dissected hills, level to rolling plains, isolated buttes, badland formations, salt pans, and mounds. In South Dakota, 2 aquatic SGCN are known to inhabit this EDU. The fish community can generally be classified as minnow/yellow perch/sucker.
Little Sioux/Nemaha EDU	Within the Central Dissected Till Plains Aquatic Subregion lies the Little Sioux/Nemaha EDU. This EDU borders Iowa, Kansas, Missouri, Nebraska, and extends into the extreme southeastern corner of South Dakota. In addition to the Little Sioux and Big Nemaha River, other major streams include Boyer River, Nishnabotna River, Missouri River, Nodaway River, Olive River Branch, One Hundred River, and Two River, Platte River, Rattlesnake Creek, and Wahoo Creek. The landscape is primarily rolling low hills, with some dissected hills, bluffs, and irregular plains. In South Dakota, 9 aquatic SGCN are known to inhabit this EDU. The fish community can generally be classified as minnow/sunfish/sucker.
Middle Missouri EDU	Within the Middle Missouri Plains Aquatic Subregion lies the Middle Missouri EDU. This EDU runs from the northwestern corner of North Dakota to the north central portion of South Dakota. In addition to the Missouri River, major streams in the EDU include the Cannonball River, Cheyenne River, and Handboy Creek. These areas have been glaciated, and the landscape consists of level to hilly plains, rolling moraines, and scattered wetlands and lakes. In South Dakota, 5 aquatic SGCN are known to inhabit this EDU. The fish community can generally be classified as minnow/sunfish/sucker.

Table 4-2 (continued). Descriptions of Ecological Drainage Units (EDUs) in the Missouri River Basin of South Dakota.

Niobrara EDU	Within the Sandhills and Plains Aquatic Subregion lies the Niobrara EDU. This EDU is mainly in northern Nebraska, but also extends into the edges of south central South Dakota. The only major river within this EDU is the Niobrara River. This area has a landscape of flat and rolling hills, ridges and valleys, areas of sand dunes and canyons along streams. Most of the streams are intermittent, with a few large perennial streams. In South Dakota, 4 aquatic SGCN are known to inhabit this EDU. The fish community can generally be classified as minnow/sunfish/yellow perch.
White EDU	Within the Middle Missouri Plains Aquatic Subregion lies the White EDU. This EDU is located in southwestern South Dakota and the northwest corner of Nebraska. In addition to the White River, major streams in this EDU include Cain Creek, Little White River, and the Missouri River. This area has not been glaciated, and the landscape is composed of dissected hills, level to rolling plains, isolated buttes, badland formations, mounds, and salt pans. In South Dakota, 5 aquatic SGCN are known to inhabit this EDU. The fish community can generally be classified as minnow/sunfish/sucker.

Level 6: Aquatic Ecological System Types (AES-Types)

Embedded within EDUs are Aquatic Ecological Systems (AESs), which account for finer resolution variation in ecological composition of local assemblages. Aquatic Ecological System-Types (AES-Types) group small and large river hydrologic units into distinct "habitat types", which combine areas of similar geology, soils, landform, groundwater influence, thermal regime, and physical habitats.

These AES-Types are similar to the habitat classifications of lakes and other wetlands, with multiple instances of the same habitat type within a classification system, except that this classification applies specifically to riverine systems. For example, within riverine classification systems, riffles may be one example of an individual habitat type. Millions of individual riffles may occur across the landscape; however they are grouped together based on a similar habitat type. AES-Types are classified similarly. Each AES is broken down into individual spatially distinct macrohabitats. However, all individual AESs that are structurally and functionally similar are grouped together within the same AES-Type. Across the Missouri River basin there are 32 different AES-Types. Within South Dakota, 16 different AES-Types occur within the Missouri River basin (Table 4-3) and an additional 5 AES-Types lie within the Mississippi River basin (Figure 4-4). The AES-Types that lie within the Mississippi River basin are not part of the MOGAP dataset, therefore limited data exist (Annis et al. 2010). These AES-Types are the Big Slough, Lake Tewaukon, Upper Little Minnesota River, Upper West Branch Lac Qui Parle River, and Upper Yellow Medicine River.

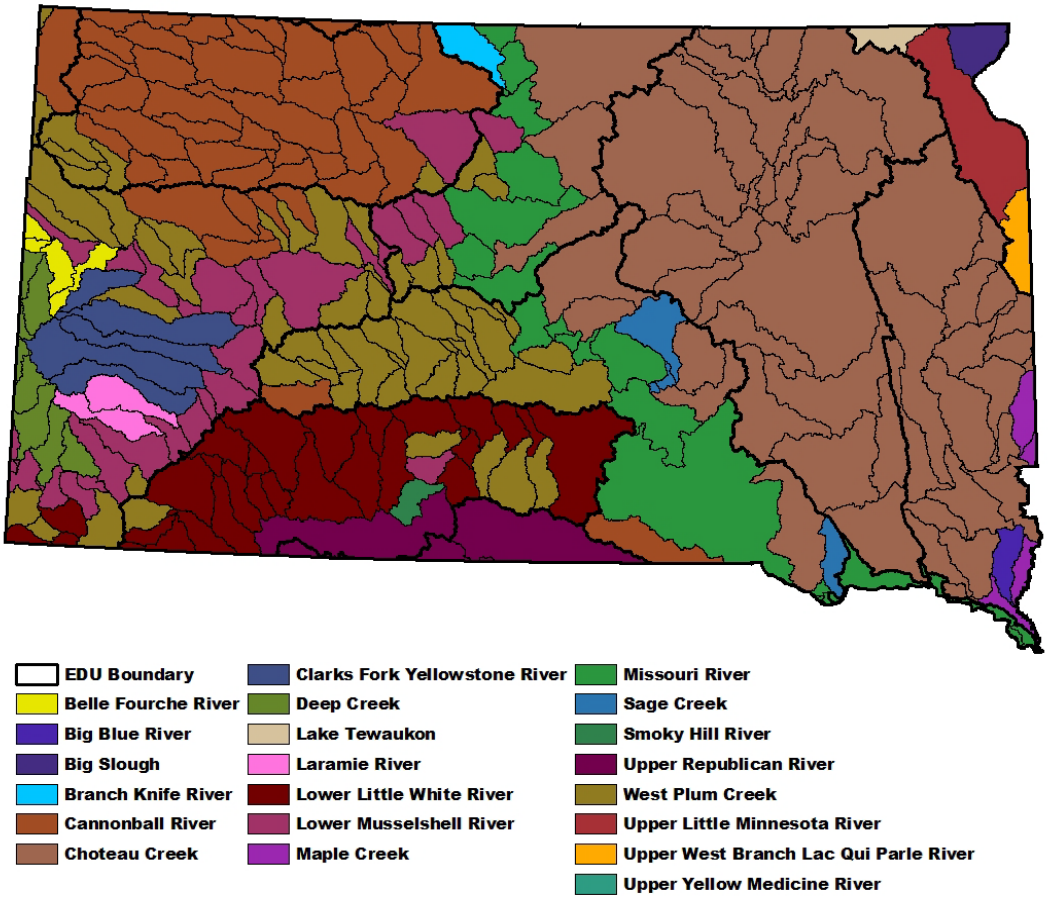

Figure 4-4. Boundaries of the 21 aquatic ecological system types (AES-Types) delineated for South Dakota.

Table 4-3. Descriptions of Missouri River Basin AES-Types in South Dakota.

Belle Fourche River	The Belle Fourche River AES-Type is located in Montana, Wyoming and South Dakota. Major perennial streams within this AES-type include the Belle Fourche River, Nowood River, and Smith River. Several landform types share dominance including irregular plains, breaks, and low hills.
Big Blue River	The Big Blue River AES-Type is located in Missouri, Kansas, Nebraska, Iowa and South Dakota. Major perennial streams within this AES-type include the Kansas River, Republican River, and Big Blue River. Several landform types share dominance, including smooth, flat, and irregular plains.
Branch Knife River	The Branch Knife River AES-Type is located in Montana, North Dakota and South Dakota. Major perennial streams within this AES-type include the Knife River, Heart River, and Big Dry Creek. Two main landform types found within this AES-type include irregular and smooth plains.
Cannonball River	The Cannonball River AES-Type is located in Montana, North Dakota, South Dakota, Wyoming and Nebraska. Major perennial streams within this AES-type include the Moreau, Cannonball, Grand, and Heart Rivers. Several landform types include smooth, irregular, and flat plains.
Choteau Creek	The Choteau Creek AES-Type is located in Montana, North Dakota, South Dakota, Iowa and Canada. Major perennial streams within this AES-type include the James, Big Sioux, and Poplar Rivers. This AES-type has the highest amount of flat plains landforms in the entire Missouri River basin.
Clarks Fork Yellowstone River	The Clark's Fork Yellowstone River AES-Type is located in Montana, Wyoming, Colorado, and South Dakota. Major perennial streams within this AES-type include the South Platte River, Wind River, and Bighorn River. There are no dominant landform types within the AES-type.
Deep Creek	The Deep Creek AES-Type is located in Montana, Wyoming, South Dakota and Colorado. Major perennial streams within this AES-type include the headwaters of the North Platte River, Smith River, and Sage Creek. Several landform types, including hills, low hills, irregular plains, and breaks share dominance within this AES-type.
Laramie River	The Laramie River AES-Type is located in Montana, Wyoming, Colorado, and South Dakota. Major perennial streams within this AES-type include the North Platte River, Laramie River, and Medicine Bow River. Several landforms share dominance including irregular plains, low hills, smooth plains, and breaks.
Lower Little White River	The Lower Little White River AES-Type is located in South Dakota, Nebraska, and Wyoming. Major perennial streams within this AES-type include the White River, and Hat Creek. Landform types include irregular plains, smooth plains, and breaks.

Table 4.3 (continued). Descriptions of Missouri River Basin AES-Types in South Dakota.

Lower Musselshell River	The Lower Musselshell River AES-Type is located in Montana, North Dakota, South Dakota, and Wyoming. Major perennial streams within this AES-type include the Little Missouri River, Musselshell River, Cheyenne River, and Belle Fourche River. Landform types include irregular plains, smooth plains, and breaks.
Maple Creek	The Maple Creek AES-Type is located in Missouri, Iowa, Minnesota, South Dakota, Nebraska, and Kansas. Major perennial streams within this AES-type include the Little Sioux River, Nodaway River, and Rock River. Landform types include smooth, irregular, and flat plains.
Missouri River	The Missouri River AES-Type is located in Missouri, Kansas, Nebraska, Iowa, South Dakota, North Dakota, and Montana. This AES-type follows the mainstem of the Missouri River. Landform types include flat, irregular, and smooth plains and breaks.
Sage Creek	The Sage Creek AES-Type is located in Montana, South Dakota, and Canada. Major perennial streams within this AES-type include the Milk River, Marias River, and Frenchman Creek. The most common landform types are flat, smooth, and irregular plains.
Smoky Hill River	The Smoky Hill River AES-Type is located in Kansas, Nebraska, Colorado, Wyoming, and South Dakota. Major perennial streams within this AES-type include the Republican River, Solomon River, Smoky Hill River, and Lodgepole Creek. The two main landform types are flat and smooth plains.
Upper Republican River	The Upper Republican River AES-Type is located mostly in Nebraska and Colorado, with some overlap in Kansas, South Dakota, and Wyoming. Major perennial streams within this AES-type include the Republican River, Elkhorn River, and Niobrara River. Two main landforms include flat and smooth plains.
West Plum Creek	The West Plum Creek AES-Type is located in Montana, South Dakota, Nebraska, and Wyoming. Major perennial streams within this AES-type include the Bad River, Little Missouri River, and West Plum Creek. Landform types include smooth plains, irregular plains, and breaks.

Level 7: Valley Segment Types (VSTs)

The smallest level of the hierarchical classification of riverine ecosystems is Valley Segment Types (VSTs). Valley Segment Types define and map longitudinal and other linear variations in ecosystem structure and function. Stream segments were selected within the 1:100,000 USGS/EPA National Hydrography Dataset (NHD) and were classified into VSTs according to stream size class (headwater, creek, small river, medium river, large river, and great river), flow, gradient, temperature, and geology (Figure 4-5).

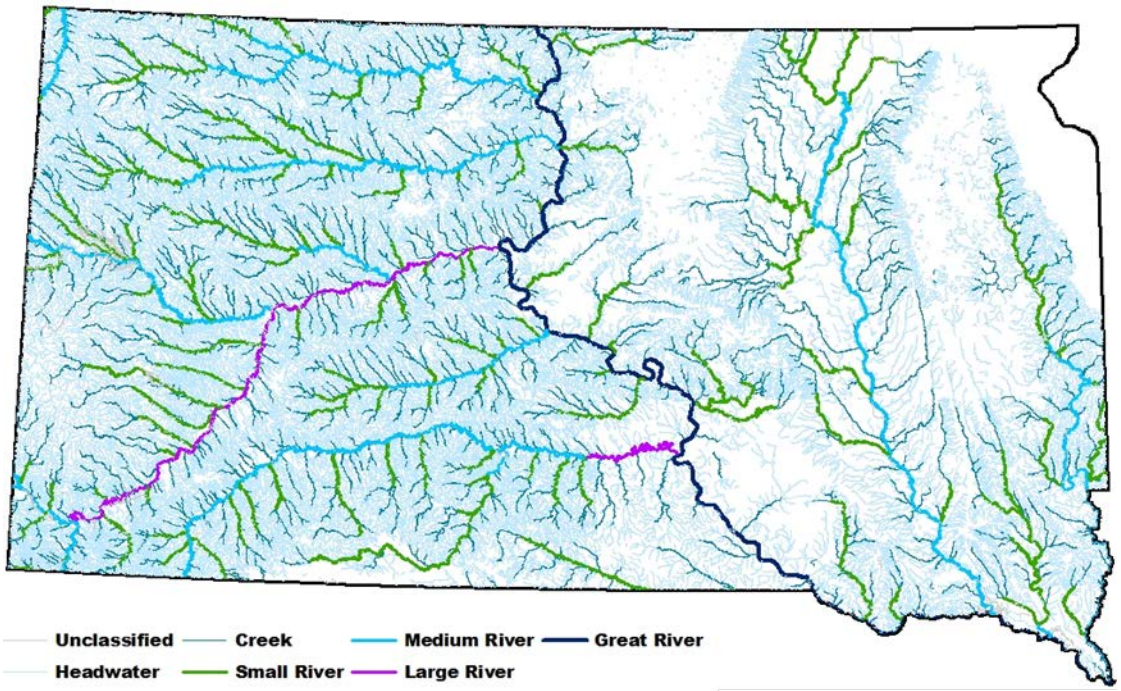

Figure 4-5. Map showing the six stream size classes used in the classification of valley segment types (VSTs) for South Dakota.

Data Limitations

Due to data gaps and a lack of consistent basin-wide information at the VST level, the MOGAP dataset only fully classified and mapped the primary channels of interconnected stream networks. Streams in any given size class may have very different flow volumes and water temperatures in different parts of the Missouri River basin. Within South Dakota, the stream networks are braided and consist of many channels and intermittent streams with limited data.

Due to large information gaps at the VST level, AES-Types were the chosen level for prioritizing areas for conservation. These medium sized watersheds represent various “habitat types” and are the smallest hierarchical classification of riverine ecosystem level for which we have the most information at the statewide level.

4.4 Aquatic Species of Greatest Conservation Need

A complete listing of SGCN is found in Table 2-1, which includes 36 aquatic SGCN (Table 4-4).

Table 4-4. List of aquatic species of greatest conservation need (SGCN) developed for the South Dakota Wildlife Action Plan.

Common Name	Scientific Name	Federal Status[a]	State Status[b]	Selection Code
FRESHWATER MUSSELS				
Creek Heelsplitter	*Lasmigona compressa*			3
Elktoe	*Alasmidonta marginata*			3
Hickorynut	*Obovaria olivaria*			3
Higgins Eye	*Lampsilis higginsii*	E		1
Mapleleaf	*Quadrula quadrula*			3
Pimpleback	*Quadrula pustulosa*			3
Rock Pocketbook	*Arcidens confragosus*			3
Scaleshell	*Leptodea leptodon*	E		1
Yellow Sandshell	*Lampsilis teres*			3
AQUATIC INSECTS				
A Mayfly	*Analetris eximia*			3
Dakota Stonefly	*Perlesta dakota*			2a; 3
Dot-winged Baskettail - A Dragonfly	*Epitheca petechialis*			3
Elusive Clubtail - A Dragonfly	*Stylurus notatus*			3
FISHES				
Banded Killifish	*Fundulus diaphanus*		E	1
Blacknose Shiner	*Notropis heterolepis*		E	1
Blackside Darter	*Percina maculata*			3
Blue Sucker	*Cycleptus elongatus*			3
Carmine Shiner	*Notropis percobromus*			3
Central Mudminnow	*Umbra limi*			3
Finescale Dace	*Chrosomus neogaeus*		E	1
Hornyhead Chub	*Nocomis biguttatus*			3
Lake Chub	*Couesius plumbeus*			3
Logperch	*Percina caprodes*			3
Longnose Sucker	*Catostomus catostomus*		T	1
Mountain Sucker	*Catostomus platyrhynchus*			3
Northern Pearl Dace	*Margariscus nachtriebi*		T	1
Northern Redbelly Dace	*Chrosomus eos*		T	1
Pallid Sturgeon	*Scaphirhynchus albus*	E	E	1
Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	T		1
Sicklefin Chub	*Macrhybopsis meeki*		E	1
Southern Redbelly Dace	*Chrosomus erythrogaster*			3

Table 4-4. (continued). List of aquatic species of greatest conservation need (SGCN) developed for the South Dakota Wildlife Action Plan.

Common Name	Scientific Name	Federal Status[a]	State Status[b]	Selection Code
FISHES(continued)				
Sturgeon Chub	*Macrhybopsis gelida*		T	1
Topeka Shiner	*Notropis topeka*	E		1
Trout-perch	*Percopsis omiscomaycus*			3
TURTLES				
False Map Turtle	*Graptemys pseudogeographica*		T	1
Smooth Softshell	*Apalone mutica*			3

[a] Federal Status - E= Endangered, a species in danger of extinction throughout all or a significant portion of its range; T = Threatened, a species likely to become endangered in the foreseeable future

[b] State Status - E= Endangered, a species in danger of extinction throughout all or a significant portion of its range in South Dakota; T = Threatened, a species likely to become endangered in the foreseeable future in South Dakota

Selection Codes and criteria used to select SGCN are listed in Table 2-1.

Species distributions can be displayed in a variety of ways, including:

1. *Actual distribution* – based on long-term surveys that are infrequent, time consuming, and not cost effective;
2. *Known distribution* – based on current knowledge of where the species distribution can be found; however, this may have data gaps; and
3. *Predicted (probable) distribution* – combines known distribution and knowledge of habitat associations of a species to develop a probable or expected species distribution.

Despite a scarcity of information, species distribution maps are an important part of our COA selection process as a large portion of the focus is on the presence of federally and state endangered, threatened, or rare aquatic species, listed as SGCN. The South Dakota Natural Heritage Database (SDNHD) represents the most comprehensive, statewide data on at-risk species and natural communities in the state; however, its data are far from complete. Therefore, our species distribution maps use a combination of both known and predicted distributions. With these maps we can better estimate where the best management options are for conserving individual species and aquatic communities.

Known species distributional data are primarily point records dating as far back as 1879 (SDNHD). Historical records were defined as records dating prior to 1985. These were not used in our current species distributional maps or in the COA selection process. Current records were those from January 1, 1985 through December 31, 2013. For the COA selection process both confirmed and probable species richness distributional information at the AES level was used. A confirmed species status was defined as an Aquatic Ecological System (AES) unit for which a current collection point was reported within the SDNHD (Figure 4-6). A probable species status was defined as the area outside an AES boundary without current collection point records, while still contained within the 8-digit Hydrologic unit code

(HUC_8) boundary (Figure 4-6). Both confirmed and probable species richness records were used in the COA selection process.

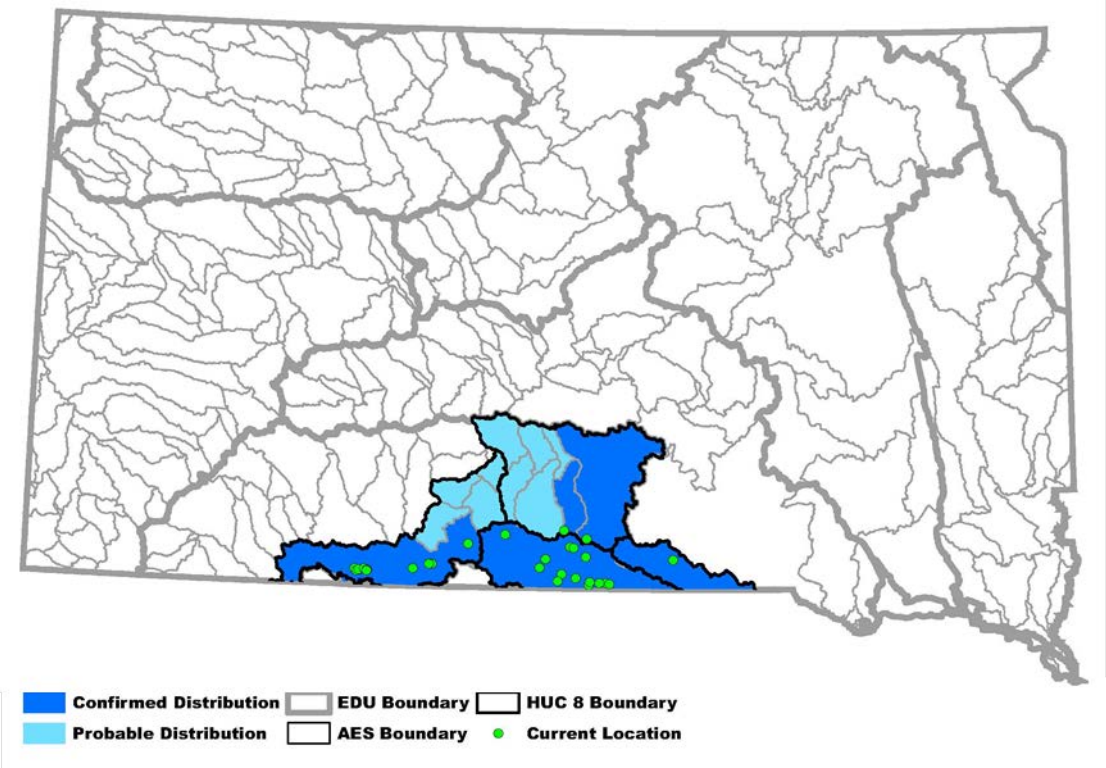

Figure 4-6. Sample map defining confirmed and probable distributional records at the aquatic ecological system (AES) and hydrologic unit code (HUC_8) boundary levels, respectively.

Individual species statewide distribution maps were developed for 21 fish, 9 mussels, 2 aquatic invertebrates and two aquatic turtle species listed as SGCN. Two aquatic invertebrates lack distribution maps, due to a lack of information on distribution. Individual distribution maps contain point data from the SDNHD, confirmed records at the AES level, and probable records from the HUC_8 boundary level. Individual distribution maps for SGCN can be found within the species profiles section (Appendix C).

Species Richness

Species richness is one of many measures of biodiversity and one way of assessing the representation of species and all unique riverine ecosystems across South Dakota. Considering the 36 aquatic SGCN, we used a combination of confirmed and probable species distributional data to collectively determine the richest AESs across South Dakota (Figure 4-7). This information was later used in the COA selection process.

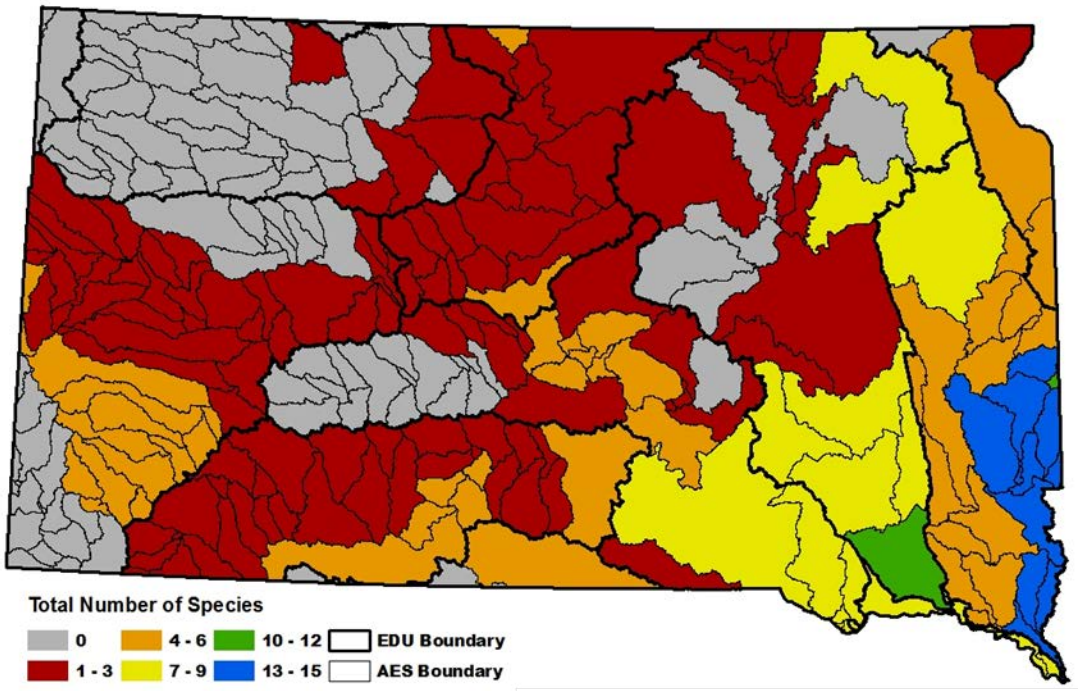

Figure 4-7. Map of overall species richness (fish, mussels, aquatic invertebrates, and aquatic turtles) for species of greatest conservation need for aquatic ecological system (AES) units.

The highest species richness (13-15 species) across all aquatic taxonomic groups occurs within the Northern Glaciated Plains aquatic subregion, and more specifically within the Big Sioux/Vermillion Ecological Drainage Unit (EDU), just before it empties into the Missouri River. This same stretch of river contains the highest species richness values for both fish (7 species; Figure 4-8 and mussels (4-6 species; Figure 4-9). In addition, the Upper Minnesota River, upper James River, and White River EDUs contain high species richness values for fish, and the lower James River EDU contains high species richness values for mussels (Figures 4-8 and 4-9).

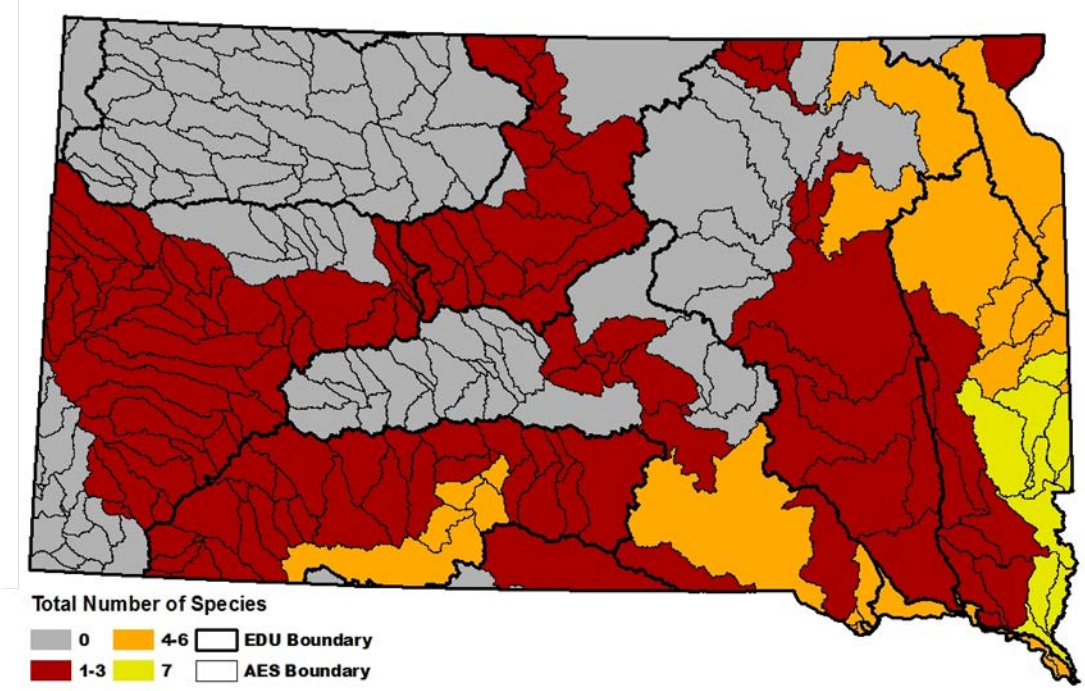

Figure 4-8. Map of fish species richness for species of greatest conservation need by aquatic ecological system (AES) units.

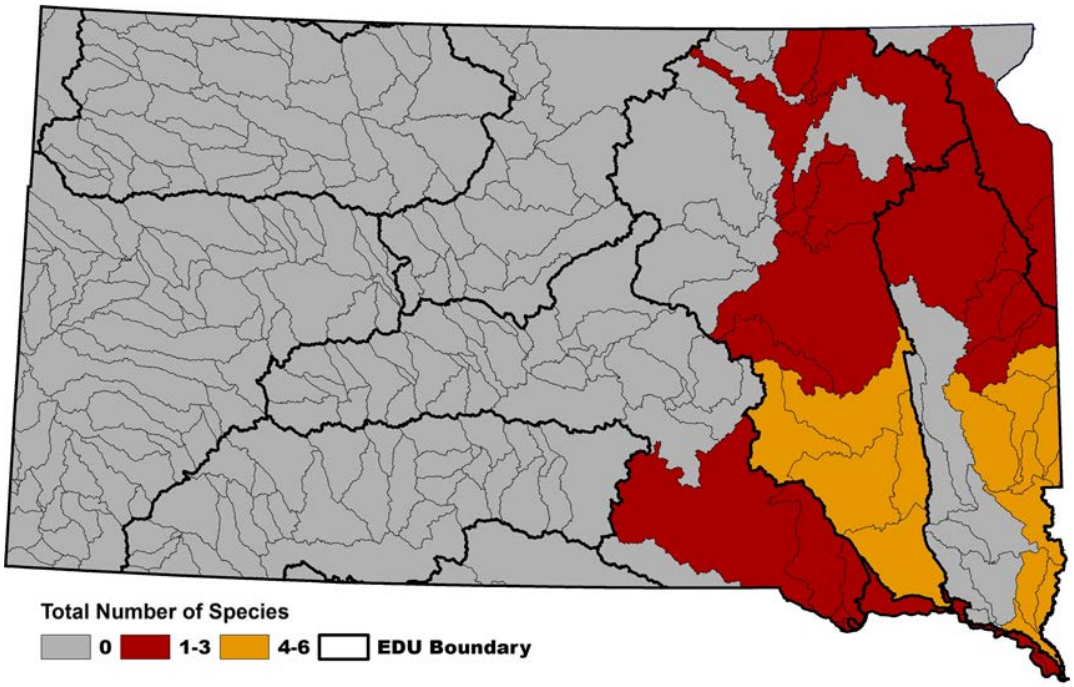

Figure 4-9. Map of mussel species richness for species of greatest conservation need by aquatic ecological system (AES) units.

Limitations of Species Distributional Data

All species distribution maps are a combination of known and predicted occurrences across South Dakota and reflect general ranges. Some data limitations exist for aquatic SGCN, as large information gaps exist. Consistent long-term monitoring and surveys are rare and many areas of the state have never been sampled or sampled only for a specific species or taxonomic group. There is also a need for the spatial integration of biological survey data among individuals and agencies. The SDNHD is part of a nationally standardized geospatial database that would benefit from increased coordination related to species and habitat research and monitoring.

4.5 Watershed Ownership/Stewardship Status

Land ownership/stewardship management can help provide information to decision makers in the selection of new conservation opportunity areas (COAs) and/or identify changes in management of existing public land holdings. Digital coverage of public land boundaries was obtained from various agencies (Table 4-5). Thirteen land ownership/stewardship categories were identified and mapped, including but not limited to, lands owned by the U.S. Fish and Wildlife Service (USFWS), the U.S. Forest Service (USFS), South Dakota Game, Fish and Parks (SDGFP), the Bureau of Land Management (BLM), Bureau of Reclamation, the National Park Service (NPS), tribal, and privately owned lands (Figure 4-10). Ownership/stewardship layers did not include Conservation Reserve Program (CRP) lands, Conservation Reserve Enhancement Program (CREP) lands, or wetland and grassland easements. Additionally, CRP and CREP lands were not included due to their management status. These lands lack permanent protection status and have relatively short enrollment periods.

Table 4-5. List of the geographic information system (GIS) coverages, their sources, and percent coverage obtained or created to account for local and watershed ownership/stewardship in South Dakota.

Ownership/Stewardship Data Layer	Source	Percent Cover
Game Production Areas	SDGFP	<1%
Parks and Recreation Areas	SDGFP	<1%
School and Public Lands	State of South Dakota	1.5%
Tribal Lands	Bureau of Indian Affairs (2005)	10.2%
United States National Forest	USFS	2.3%
United States National Grasslands	USFS	1.7%
Bureau of Land Management	BLM	<1%
Bureau of Reclamation	Bureau of Reclamation	<1%
United States Army Corps of Engineers	USACE	<1%
National Park Service	NPS	<1%
National Wildlife Refuge	USFWS	<1%
Waterfowl Production Areas	USFWS	<1%
The Nature Conservancy	The Nature Conservancy	<1%

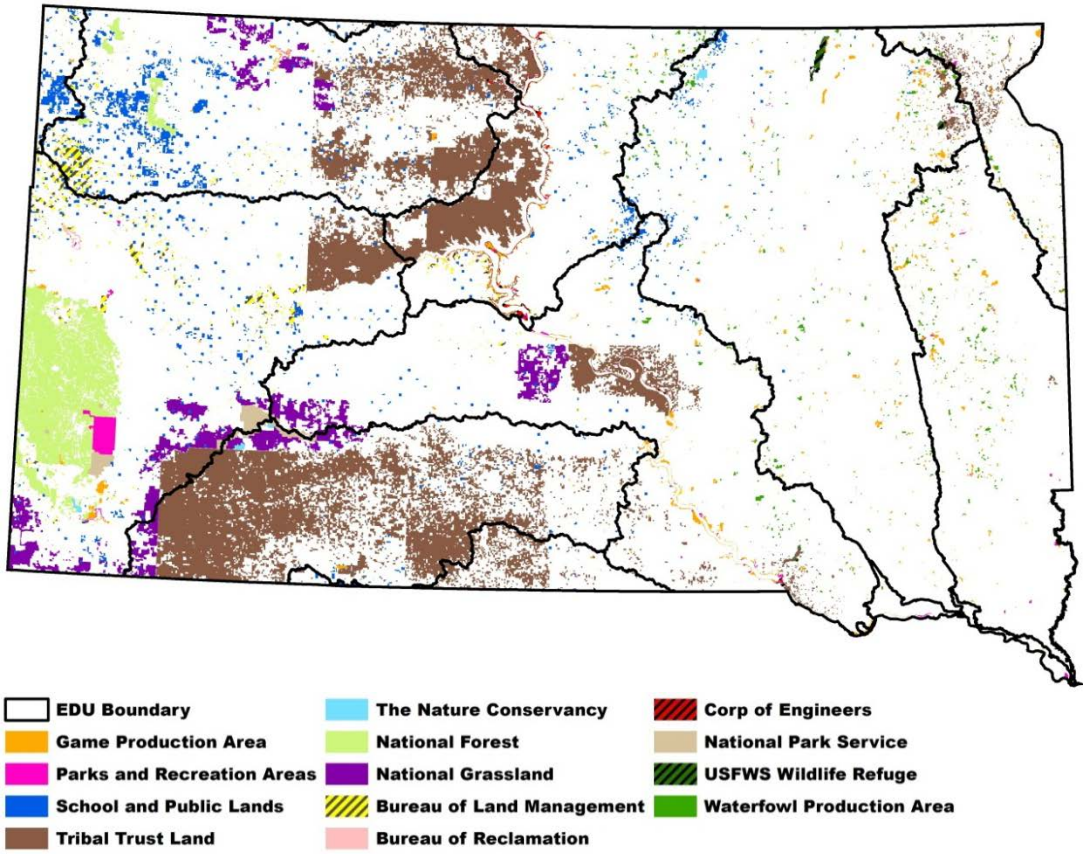

Figure 4-10. South Dakota land ownership/stewardship map with ecological drainage units (EDUs) overlaid.

Over 80% of the land area in South Dakota is privately owned and managed. Federal and state agencies own approximately 5.7% and 2.3% of the land area in South Dakota, respectively. Additionally, tribal lands account for approximately 10.2% of the land area in South Dakota (Table 4-5). Most of the public lands in South Dakota are located west of the Missouri River in the Cheyenne River EDU (Figure 4-10).

Limitations of Ownership/Stewardship Data

The land ownership/stewardship map represents a collection of stewardship maps provided by a variety of sources, however by no means does it represent the full array of conservation initiatives across South Dakota. These maps were created solely for the purpose of the final selection criteria in the selection of COAs when similarities existed among other metrics examined.

Land ownership/stewardship changes as parcels of land are bought, sold, or traded. The land stewardship map provides a “snapshot” of the land ownership in South Dakota.