Section III. Assessments of Communities

Chapter 10. Riparian Forests and Shrublands

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Distribution and Ecology

Riparian forests and shrublands (hereafter "riparian areas") are heterogeneous vegetated zones along the banks and floodplains of rivers and streams, which form a transition between aquatic and terrestrial systems (Gregory and others, 1991; Naiman and Decamps, 1997). Typically, riparian areas are defined by the presence of flood-adapted and flood-tolerant plant species, as well as by their topography, such as the presence of active channels and flood-plain morphology. Vegetation composition in woody riparian areas includes forests of primarily plains cottonwood at lower elevations and narrow-leafed cottonwood, aspen, and spruce/fir forests at higher elevations. Additionally there are shrublands of primarily willows, silver sagebrush, silver buffaloberry, redosier dogwood (Knight, 1994) (see Chapter 9—Wetlands for herbaceous riverine wetlands).

Both terrestrial uplands, including floodplains (for example, Dodds and others [2004]), and aquatic systems influence riparian areas. Uplands provide organic matter inputs, and aquatic systems are an important source of disturbance (primarily flooding, but also sediment deposition), and they affect soil moisture regimes. The spatial distribution, vegetation composition, and structure of riparian areas are highly variable and influenced by physical factors, including precipitation, topography, soils, hydrologic regimes, stream gradients, sinuosity, and channel-width-to-depth ratios, as well as hydrologic regimes (see Landscape Structure and Dynamics section in this chapter) (Gregory and others, 1991; Knight, 1994; Naiman and Decamps, 1997). Due to the arid climate, riparian areas in the Wyoming Basin are relatively rare compared to wetter regions of the United States, and the distribution of riparian communities is highly variable in size and structural connectivity.

Landscape Structure and Dynamics

The structure and dynamics of riparian areas reflect histories of both fluvial and nonfluvial disturbance. Fluvial disturbances include cyclic flooding and drought, scouring from ice and other debris, and depositions of sediments. Nonfluvial disturbance regimes of adjacent upland areas include fire, wind, plant disease, insect outbreaks, beaver activities, and ungulate grazing (Gregory and others, 1991; Scott and others, 2003; Glenn and Nagler, 2005; Skagen and others, 2005). Riparian hydrologic regimes are characteristically dynamic, and the amount, timing, and temporal variability of groundwater and surface-water inputs have a major influence on riparian areas. Both seasonal and interannual variability in water flow affect the native plant and animal communities (Baron and others, 2002). Flow regime defines the rates and pathways by which precipitation enters, circulates, and exits the riparian system. Sedimentation affects physical structure and nutrient levels, and chemical characteristics regulate pH, productivity, evapotranspiration, and water quality. Ecosystem process rates and community structure also are governed by the biotic assemblage.

The dynamics of fire in riparian areas are variable due to the temporal variability in moisture regime in these areas. Compared to surrounding uplands, humidity levels and foliar moisture content are generally greater and temperatures are generally lower in riparian areas, which can result in longer fire rotations, lower fire severity, and patchier burns; these contrasts, however, diminish with increasing elevation (Baker, 2009). Because riparian vegetation is generally very productive, fuel loads during dry conditions can lead to greater fire severity. When flooding scours riparian floodplains and deposits sediments in bars, the resulting unvegetated areas can serve as fire breaks, particularly when weather is conducive to low-intensity fire; in extreme fire conditions, however, riparian areas may even funnel fire and wind so that most vegetation burns (Baker, 2009). Overall, historical evidence indicates that fire in riparian areas of the northern and central Rockies was not a major agent in restructuring riparian areas. Postfire vegetation dynamics are variable in riparian areas. Willows and some cottonwood species will resprout postfire, but some cottonwood species do poorly or are killed and may be replaced by grasses or shrubs; in either case the persistence of resprouting trees and shrubs depends on the postfire conditions and flooding regimes (Baker, 2009).

Associated Species of Management Concern

Riparian areas and streams provide many wildlife species with crucial resources, including water, food, cover, and travel routes, which, compared to surrounding uplands, are disproportionately crucial to maintaining regional biodiversity (Gregory and others, 1991; Naiman and others, 1993; Lohman, 2004). In the Intermountain West, at least 140 bird species and 30 mammal species use palustrine wetlands (Gammonley, 2004), and many of these species also occupy nearby riparian areas (Lohman, 2004). Seventy-three of the roughly 250 species of breeding birds found in Wyoming use riparian areas during at least part of their life history (Nicholoff, 2003). The bald eagle, found in both low-elevation and montane riparian areas, is designated as a Level 1 (species requiring conservation action) priority by Wyoming Partners in Flight. Also found in low-elevation riparian areas are yellow-billed cuckoo and Lewis's woodpecker, both of which are designated as Level 2 (species requiring monitoring) priorities by Partners in Flight, and the Bureau of Land Management (BLM) lists them as sensitive species in the Wyoming Basin ecoregion.

Change Agents

Development

Energy and Infrastructure

Water development includes dams, ditches, and wells built for impounding, diverting, transferring, and accessing water and (or) regulating streamflow. Not only can these structures alter streamflow regimes, they may lower water tables, increase sedimentation (above dams) and incision (below dams), and alter riparian communities (Copeland and others, 2010). For example, diversity of plant species in riparian areas has declined with increasing streamflow regulation along the Green River in southwestern Wyoming, but not along the unregulated Yampa River in northwest Colorado (Uowolo and others, 2005). Generally, cottonwood dominance decreases where streamflow is altered (Merritt and Poff, 2010), largely because flooding or other severe disturbances generally required for cottonwood seedling establishment are typically diminished or eliminated by streamflow regulation (Glass, 2002). For example, since the 1960s when Fontenelle Dam was constructed on the Green River in southwestern Wyoming, (1) the timing of peak streamflow downstream of the dam has shifted from early to late summer, which has decoupled the timing between seed dispersal and the flooding needed for cottonwood seed germination; and (2) the amount of winter streamflow has increased (Heitmeyer and others, 2012). By the 1990s, cottonwood stem density was lower below the dam than it was above the reservoir (Gregor Auble and Michael Scott, Research Ecologists, U.S. Geological Survey, Fort Collins Science Center, unpub. data, 1998; Glass, 2002). No new stands have established either above or below the dam after 1940, reflecting the absence of scouring floods over the last 60 years (Glass, 2002). Below the dam, all extant cottonwood stands are situated on terraces beyond the river’s currently active flood plain. Moreover, at Seedskadee National Wildlife Refuge, which is also below the dam, high-density regeneration has been occurring in only a few cottonwood stands, and in cottonwood stands that predate the dam, regeneration is lacking (Fortin and others, 2010).

Agricultural Activities

High levels of grazing by native and domestic ungulates can reduce or eliminate riparian vegetation, leading to erosion and downcutting of streambanks, increased sediment runoff and nutrient loads, and lower water tables (Chaney and others, 1990). For example, at sites in southwestern Wyoming, cottonwood and willow recruitment was greater where livestock grazing had been eliminated (Fortin and others, 2010). When grazing pressure is reduced, however, riparian vegetation may recover if modifications to bank structure and streamflow have been minimal (Chaney and others, 1990; Skagen and others, 2005).

Invasive Species and Altered Fire Regimes

Russian olive and tamarisk (or salt cedar) are invasive nonnative plants that have supplanted native riparian species in many areas of the western United States, altering the structure and function of riparian ecosystems and the species that rely on them (Katz and Shafroth, 2003; Friedman and others, 2005; Nagler and others, 2011). Other nonnative species that invade riparian areas include perennial pepperweed, leafy spurge, and Dyer's woad; these species were not addressed in this Rapid Ecoregional Assessment (REA) because there is little information on their regional distribution in the Wyoming Basin.

Tamarisk is often associated with increases in soil salinity, reduced flows, and channel narrowing. Recent research, however, suggests that salinity increases are due to salt accumulation as a consequence of reduced flooding (Nagler and Glenn, 2013). Although tamarisk invasion often follows anthropogenic modifications of streamflow, such as water removal or upstream dams, subsequent channel narrowing and sedimentation patterns appear to be system dependent, on the basis of climate and actual flows (Auerbach and others, 2013).

The response of biotic communities to the widespread replacement of native riparian vegetation by Russian olive and tamarisk is varied and depends on species and context. Beavers typically browse more on native cottonwood than on Russian olive, which suppresses the cottonwood and gives Russian olive a competitive advantage (Lesica and Miles, 2001). Migrating birds that use riparian corridors as stopover sites typically prefer patches of cottonwood and willow more than tamarisk due to the greater structural diversity associated with the native types (Pocewicz and others, 2013). Although occurrence of Russian olive and tamarisk within stands of cottonwood may provide mid-canopy habitat for some songbirds, these invasives may not provide suitable habitat for cavity nesters (Katz and Shafroth, 2003; van Riper and others, 2008; Fischer and others, 2012). Tamarisk may increase fuel loads of riparian areas, although observed increases in fire frequency in some riparian areas may be due to the absence of scouring floods and resulting fuel accumulations on regulated rivers (Stromberg and Chew, 2002).

Climate Change

The structure and dynamics of riparian areas are strongly tied to climate, and recent climatic variation has affected snowpack and streamflow (Barnett and others, 2008). From the early 1900s to 2005, for example, unregulated rivers north of Wyoming that are fed by snowmelt had increasingly greater winter flows, earlier spring run-off and peak flows, and significant decreases in late summer flows (Rood and others, 2008), possibly as a result of increasing temperatures. Continued warming trends and altered precipitation are of particular concern for riparian communities in arid systems like the Wyoming Basin.

Rapid Ecoregional Assessment Components Evaluated for Riparian Forests and Shrublands

A generalized conceptual model was used to highlight some of the key ecological attributes and Change Agents affecting riparian areas (fig. 10–1). Key ecological attributes addressed by the REA include: (1) the distribution of riparian areas, (2) landscape structure (area of riparian patches), and (3) landscape dynamics (fire occurrence and hydrologic regime) (table 10–1). The Change Agents evaluated were development, invasive species, and climate change (table 10–2). Ecological values and risks used to assess the conservation potential for riparian areas by fifth-level watershed are summarized in table 10–3. Core and Integrated Management Questions and the associated summary maps and graphs are provided in table 10–4.

Methods Overview

Riparian occurrence was mapped using LANDFIRE geospatial data for Existing Vegetation Types classified as riparian, ravine, or floodplain. Cross-validation with revised U.S. Geological Survey National Gap Analysis Program (reGAP) geospatial data and aerial imagery revealed spatial inaccuracies at a 30-meter (m) (98.43-feet [ft]) resolution, as indicated by poor correspondence among datasets for patch locations. Consequently, patch-based metrics could not be used reliably. However, there was general correspondence for the presence of riparian vegetation in watersheds. Therefore, we summarized landscape structure (total area and percent of watershed) for riparian vegetation by sixth-level watershed. To identify large, connected riparian areas, we used an aggregation process to group riparian patches that were in close proximity to one another, which we assumed represented the structural connectivity of riparian patches. We identified riparian areas with a minimum patch size of 10 hectares (ha) (24.71 acres) and a minimum corridor size of 3 ha (7.41 acres), based on the average size of riparian patches that are most useful to many wildlife species (Saab, 1999). Clusters of riparian patches within 760 m were further aggregated into connected patch complexes.

We considered three specific Change Agents to riparian forests and shrublands: (1) development in riparian areas using ADI score, (2) flow disruption based on dams, and (3) potential expansion of invasives due to climatic change. The ADI scores were derived from watersheds coincident with riparian areas. The number of dams within 1 km (3,280 ft) of riparian areas was used as an index of the potential effects of streamflow changes on riparian function. We evaluated the risk of invasive species occurrence currently and for 2030 (covering the period from 2016–2030), 2060 (2046–2060), and 2090 (2076–2090) based on available models developed using BLM field observations (Jarnevich and Reynolds, 2011; Jarnevich and others, 2011). We used BLM field observations collected between 1998 and 2013 to build the invasive-species risk model because distribution maps of invasive plant species derived from LANDFIRE data have a high degree of uncertainty due to the difficulty of using remotely sensed imagery to distinguish native and invasive riparian species. Climate variables used in the model were derived from monthly averages of precipitation, minimum temperature, and maximum temperature using climate scenario II (Geophysical Fluid Dynamics Laboratory's Coupled Climate model 2.1, emissions scenario A2) (Maurer and others, 2007). We trained the model with climate variables for the period 1980–2009 and used projected values for the climate variables for 2030, 2060, and 2090 to examine the potential for expansion of the bioclimatic conditions suitable for tamarisk and Russian olive, summarized by fifth-level watershed. We categorized the relative risk of expansion using equal breakpoints for probability of occurrence (that is, lowest <0.33, medium 0.34–0.66, and highest >0.67).

We compared modeled future distributions to recent distributions of Russian olive and tamarisk derived from BLM field observations and LANDFIRE, because regional surveys of invasive species are limited.

Landscape-level ecological values (amount of riparian area) and risk (ADI score, number of dams, and recent presence of invasives) were compiled into an overall index of conservation potential for each fifth-level watershed (table 10–3). We ranked the size of riparian area within patch clusters as lowest, medium, or highest using equal subsets of the data. The conservation potential for riparian forests and shrublands was summarized by watershed, based on overall landscape-level values and risks (table 10–3). See Chapter 2—Assessment Framework, Chapter 6—Terrestrial Invasive Plant Species, and the Terrestrial Invasive Plant Species section in the Appendix for additional details on the methods.

Landscape-level values and risks, and conservation potential rankings are intended to provide a synthetic overview of the geospatial datasets developed to address Core Management Questions in the REA. Because rankings are very sensitive to the input data used and the criteria used to develop the ranking thresholds, they are not intended as stand-alone maps. Rather, they are best used as an initial screening tool to compare regional rankings in conjunction with the geospatial data for Core Management Questions and information on local conditions that cannot be determined from regional REA maps.

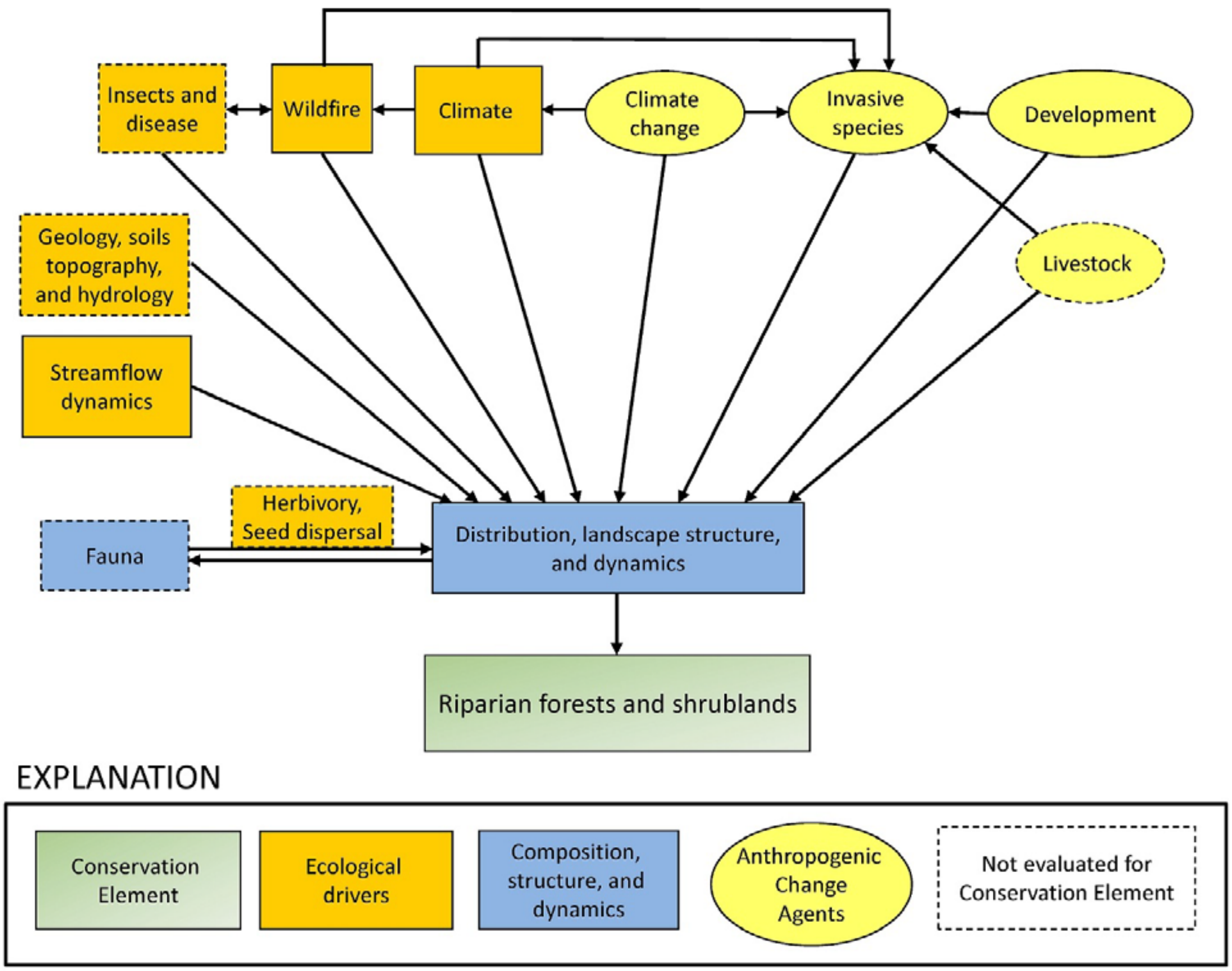

Figure 10–1. Generalized conceptual model of riparian forests and shrublands in the Wyoming Basin Rapid Ecoregional Assessment (REA). Biophysical attributes and ecological processes regulating the occurrence, structure, and dynamics of riparian forests and shrublands are shown in orange rectangles; additional ecological attributes are shown in blue rectangles; and key anthropogenic Change Agents that affect key ecological attributes are shown in yellow ovals. The dashed lines indicate components not addressed by the REA. Livestock is a Change Agent that was not evaluated due to lack of regionwide data.

Table 10–1. Key ecological attributes and associated indicators of baseline riparian forests and shrublands[1] for the Wyoming Basin Rapid Ecoregional Assessment.

Attribute	Variables	Indicators
Amount and distribution	Total area	Distribution map derived from LANDFIRE[2]
Landscape structure	Total area of riparian patches by watershed	Percent of sixth-level watershed occupied by riparian patches[3]
Landscape dynamics	Fire occurrence	See Chapter 8—Streams and Rivers
	Hydrologic regime	See Chapter 8—Streams and Rivers

[1] Baseline conditions are used as a benchmark to evaluate changes in the area and landscape structure of riparian areas due to Change Agents. Baseline conditions are defined as the potential current distribution of riparian area derived from LANDFIRE without explicit inclusion of Change Agents (see Chapter 2—Assessment Framework).

[2] Riparian derived from LANDFIRE Existing Vegetation Types (Appendix).

[3] Total area of riparian patches summarized by sixth-level watershed due to local spatial inaccuracies in riparian patch perimeters precluding the use of patch-based metrics.

Table 10–2. Anthropogenic Change Agents and associated indicators influencing riparian forests and shrublands for the Wyoming Basin Rapid Ecoregional Assessment.

Change Agents	Variables	Indicators
Development	Aquatic Development Index (ADI)[1]	Percent of riparian forests and shrublands in seven development classes
		Percent of sixth-level watershed occupied by relatively undeveloped riparian patches
	Presence of dams	Number of dams per sixth-level watershed[2]
Invasive species	Russian olive and tamarisk occurrence	Invasive species presence in sixth-level watershed
	Potential risk for Russian olive and tamarisk occurrence[3]	Potential risk for 1980–2009 (recent)
Climate change	Potential risk for Russian olive and tamarisk expansion[3]	Projected risk of range expansion derived from the projected distribution of the bioclimatic envelope for 2030[4]
	Hydrologic regime change	See Chapter 8—Streams and Rivers

[1] See Chapter 2—Assessment Framework.

[2] Occurrence information from Bureau of Land Management field offices in Wyoming Basin and LANDFIRE.

[3] Based on models developed by Jarnevich and Reynolds (2011) and Jarnevich and others (2011).

[4] Bioclimatic envelope for invasive species represents the climatic conditions conducive for Russian olive and tamarisk, derived from Jarnevich and Reynolds (2011) Jarnevich and others (2011).

Table 10–3. Landscape-level ecological values and risks for riparian forests and shrublands. Ranks were combined into an index of conservation potential for the Wyoming Basin Rapid Ecoregional Assessment.

[ha/km^2, hectare per square kilometer; >, greater than]

		Relative rank			
	Variables[1]	Lowest	Medium	Highest	Description[2]
Values	Riparian density (ha/km^2)	<6	6.1–6.8	>6.8	Riparian area (ha) per watershed area (km^2)
Risks	Aquatic Development Index (ADI)	<20	20–40	>40	Mean ADI score by watershed
	Number of dams	0	1−3	>3	Number of dams by watershed
	Invasive species risk	<0.33	0.33−0.66	>0.66	Maximum invasive species probability of occurrence by watershed

[1] Fifth-level watershed was used as the analysis unit for conservation potential on the basis of input from Bureau of Land Management (see table A−19 in the Appendix).

[2] See tables 10–1 and 10–2 for description of variables.

Table 10–4. Management Questions evaluated for riparian forest and shrublands in Wyoming Basin Rapid Ecoregional Assessment.

[km, kilometer; mi, mile]

Core Management Questions	Results
Where are baseline riparian forests and shrublands, and what is their total area?	Figure 10–2
Where are the largest areas of riparian forests and shrublands in the Wyoming Basin?	Figure 10–3
Where does development pose the greatest threat to baseline riparian forests and shrublands, and where are the large, relatively undeveloped areas?	Figures 10–4 and 10–5
Where do dams pose an ongoing threat to downstream riparian areas?	Figure 10–6
Where are Russian olive and (or) tamarisk olive present?	Figure 10–7
Where could riparian vegetation be at risk from Russian olive and tamarisk expansion by 2030?	Figure 10–8
Integrated Management Questions	**Results**
How does risk from development vary by land ownership or jurisdiction for riparian forests and shrublands?	Table 10–5, Figure 10–9
Where are the watersheds with the greatest landscape-level ecological values?	Figure 10–10
Where are the watersheds with the greatest landscape-level risks?	Figure 10–11
Where are the watersheds with the greatest conservation potential?	Figure 10–12

Key Findings for Management Questions

Where are baseline riparian forests and shrublands, and what is their total area (fig. 10–2)?

- Riparian areas cover 3,776 square kilometers (km^2) (1,458 square miles [mi^2]), which represents only 2 percent of the Wyoming Basin project area.

Where are the largest areas of riparian vegetation in the Wyoming Basin (fig. 10–3)?

- The total area of riparian vegetation, by sixth-level watershed, varies from 0.001–27.2 km^2 (0.0004–10.5 mi^2), with only 1.4 percent of watersheds (n = 1,629) lacking any riparian vegetation.
- Watersheds in the Green River and central Big Horn drainages encompass the greatest total riparian area.
- Watersheds in the Great Divide Basin (south-central Wyoming Basin), the White-Yampa drainages in Colorado, and just north of Casper have the lowest total area of riparian vegetation.
- In sixth-level watersheds that encompass riparian areas, the total riparian area is between 0.2 percent and 19.3 percent (mean 2.1 percent) of the total watershed area.

Where does development pose the greatest threat to baseline riparian forests and shrublands, and where are the large, relatively undeveloped areas (figs. 10–4 and 10–5)?

- Most of the relatively undeveloped riparian areas occur at higher elevations in the Wind River Mountains and along upper reaches of streams (fig. 10–4).
- Twenty-five percent of the total riparian area is relatively undeveloped (ADI score <20) and 15 percent has an ADI score of >50, indicating high levels of development (fig. 10–5).
- Riparian areas with higher levels of development occur along major rivers, including the Bighorn, lower Wind, Bear, North Platte, and Laramie Rivers.

Where do dams pose an ongoing threat to downstream riparian areas (fig. 10–6)?

- There are 589 dams within the Wyoming Basin, 88.3 percent of which are within 1 km (0.62 mi) upstream of a riparian area. The remaining dams lacked riparian areas in the downstream reach.
- Dams are located in 22 percent of sixth-level watersheds, with up to seven dams are present per watershed (fig. 10–6).

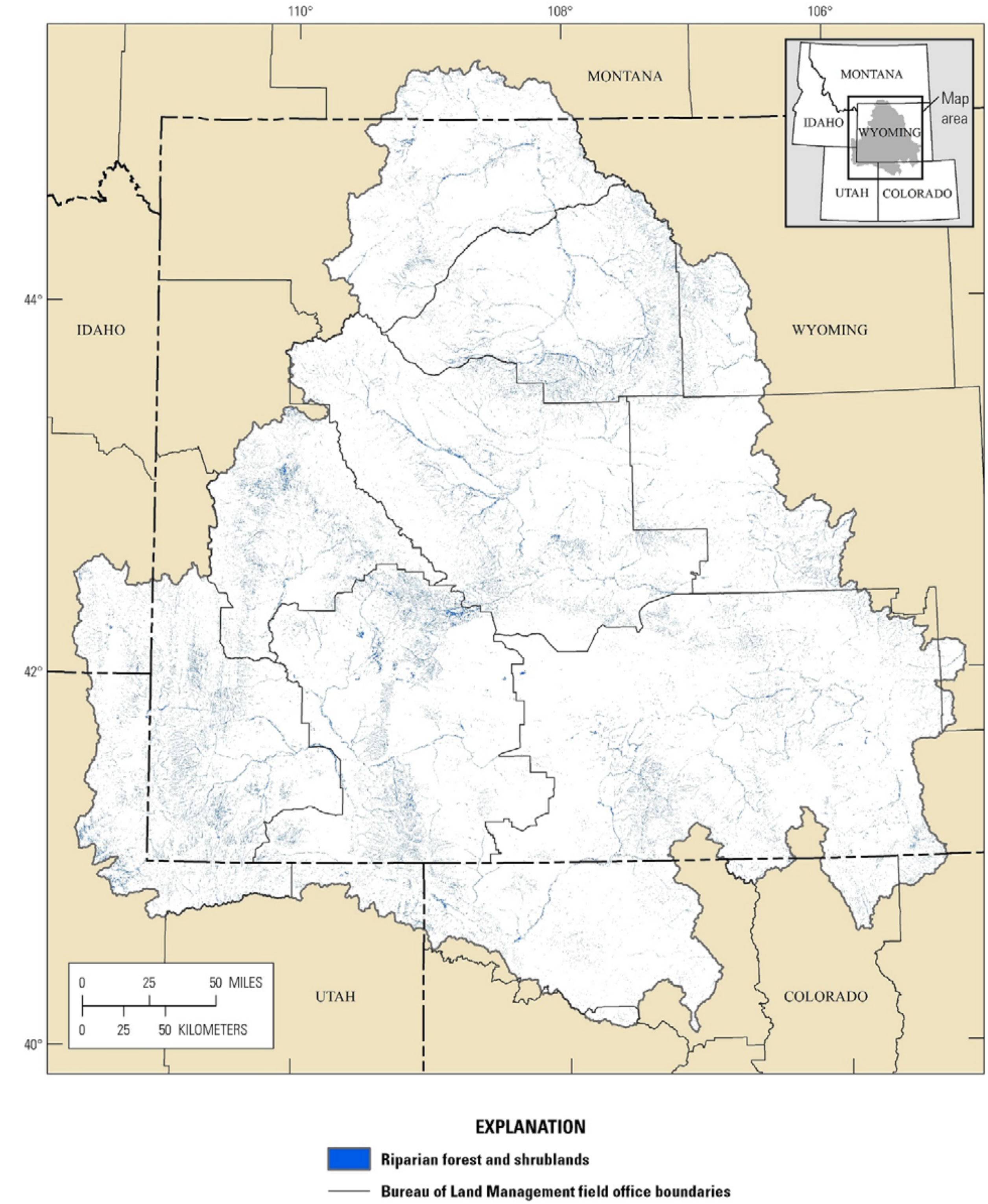

Figure 10–2. Distribution of baseline riparian forests and shrublands in the Wyoming Basin Rapid Ecoregional Assessment project area.

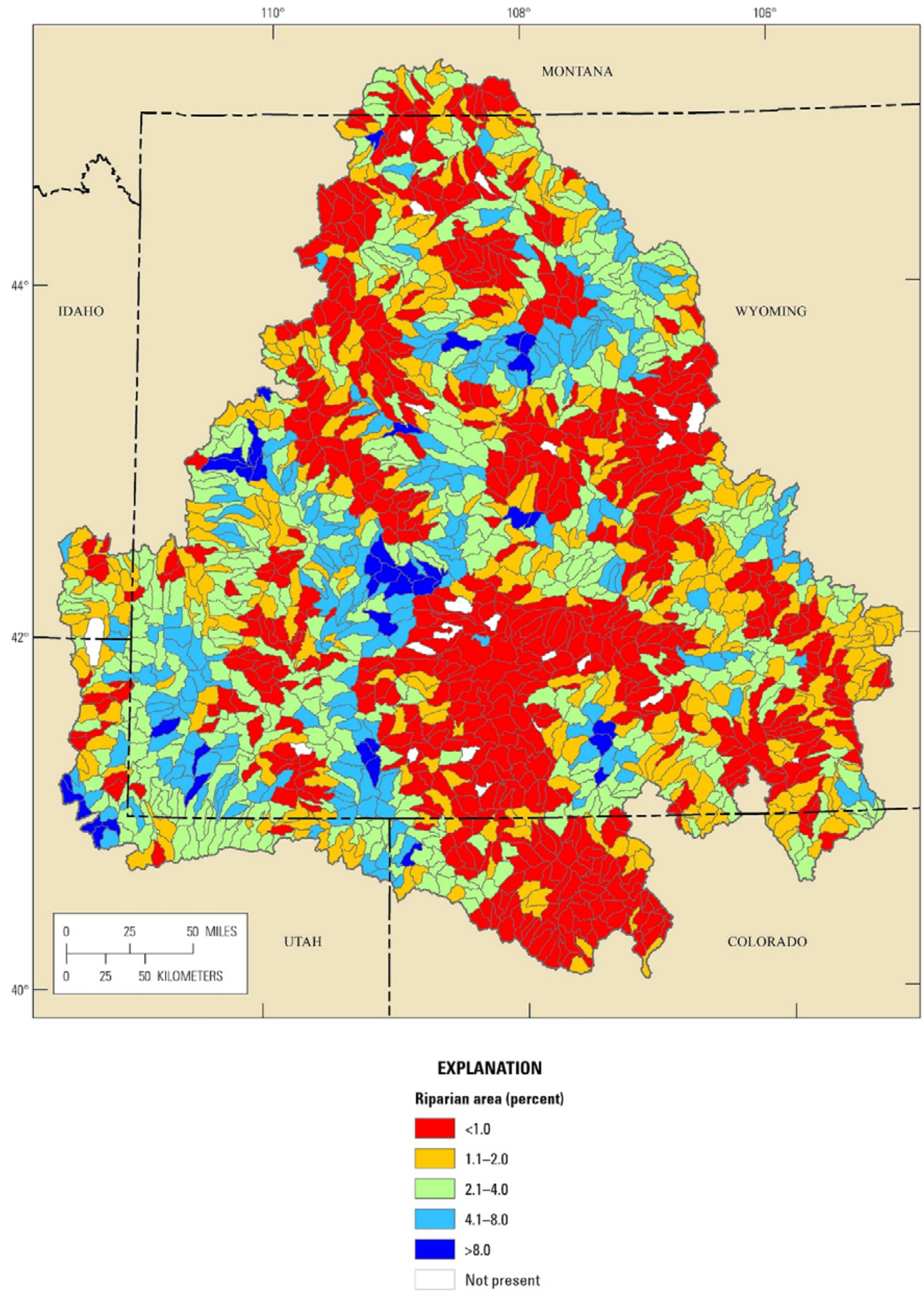

Figure 10–3. Total riparian area by percent of sixth-level watershed in the Wyoming Basin Rapid Ecoregional Assessment project area.

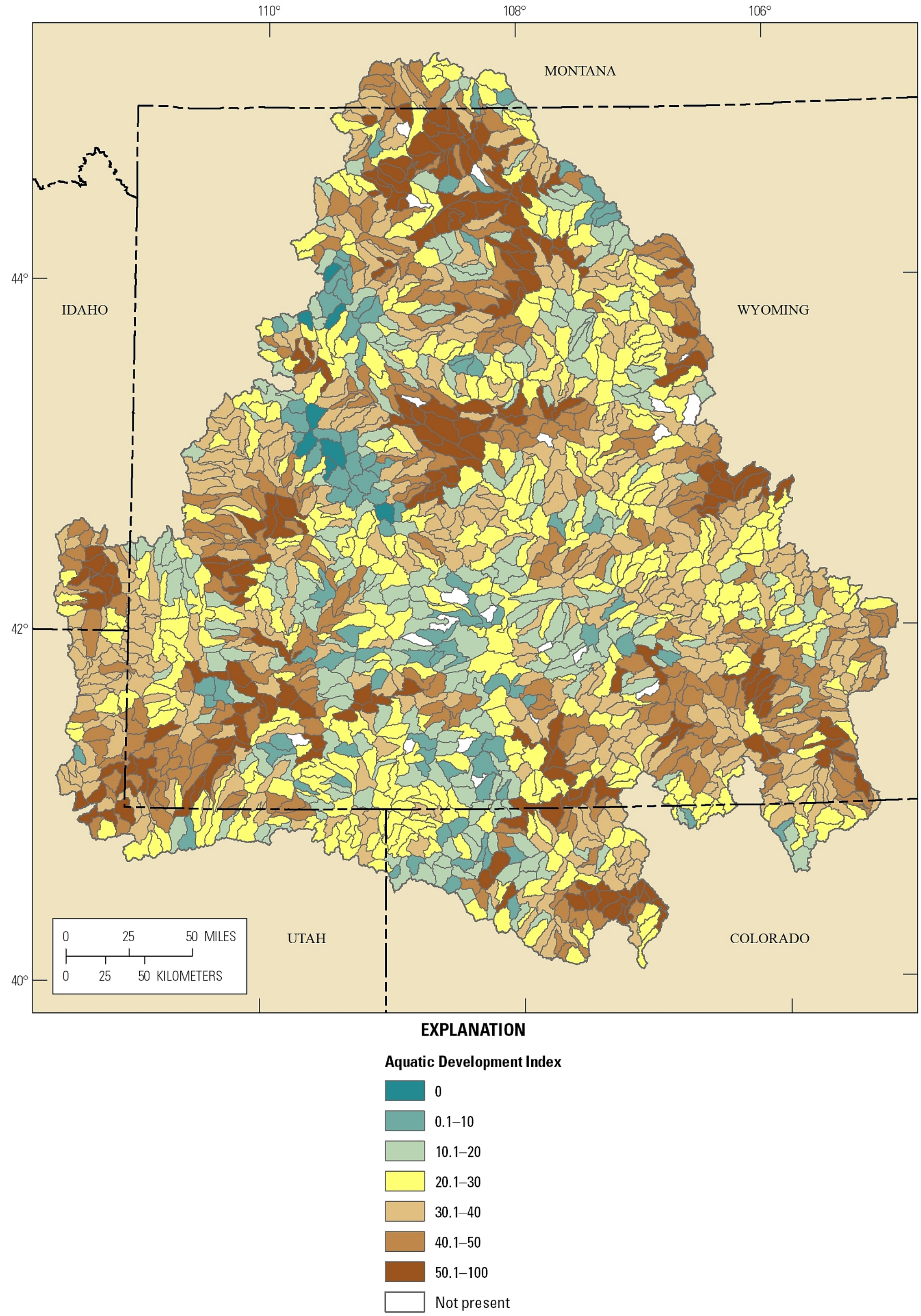

Figure 10–4. Aquatic Development Index scores for riparian forests and shrublands, summarized by sixth-level watershed, in the Wyoming Basin Rapid Ecoregional Assessment project area.

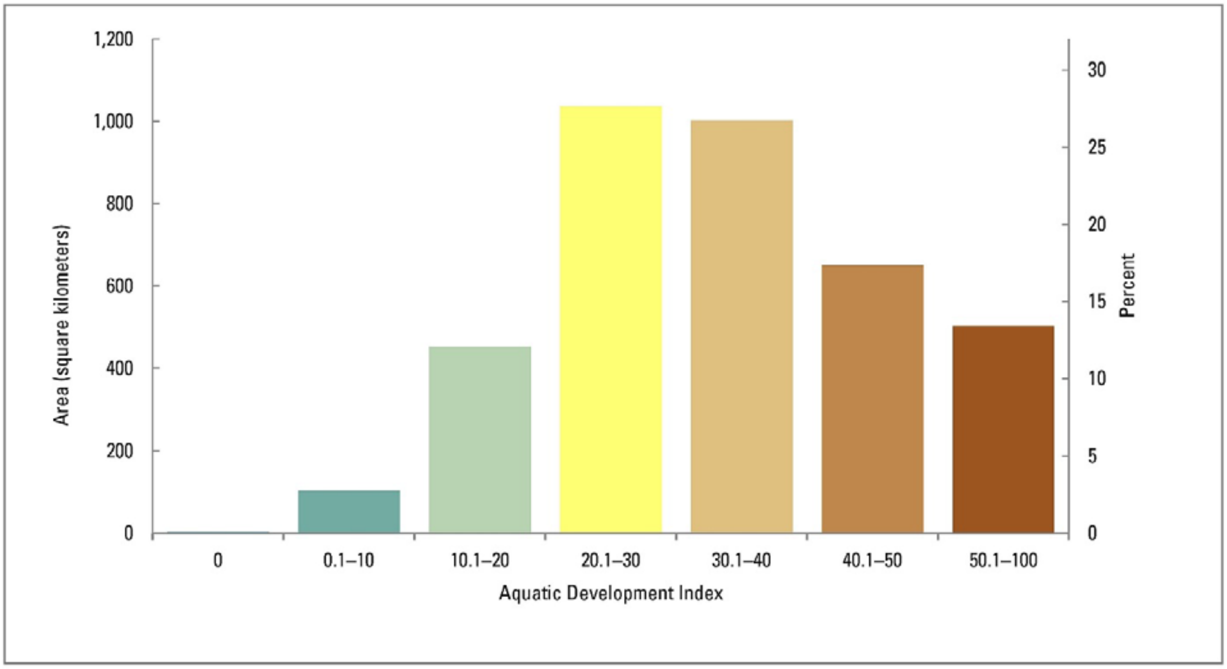

Figure 10–5. Area and percent of baseline riparian forests and shrublands as a function of the Aquatic Development Index score in the Wyoming Basin Rapid Ecoregional Assessment project area.

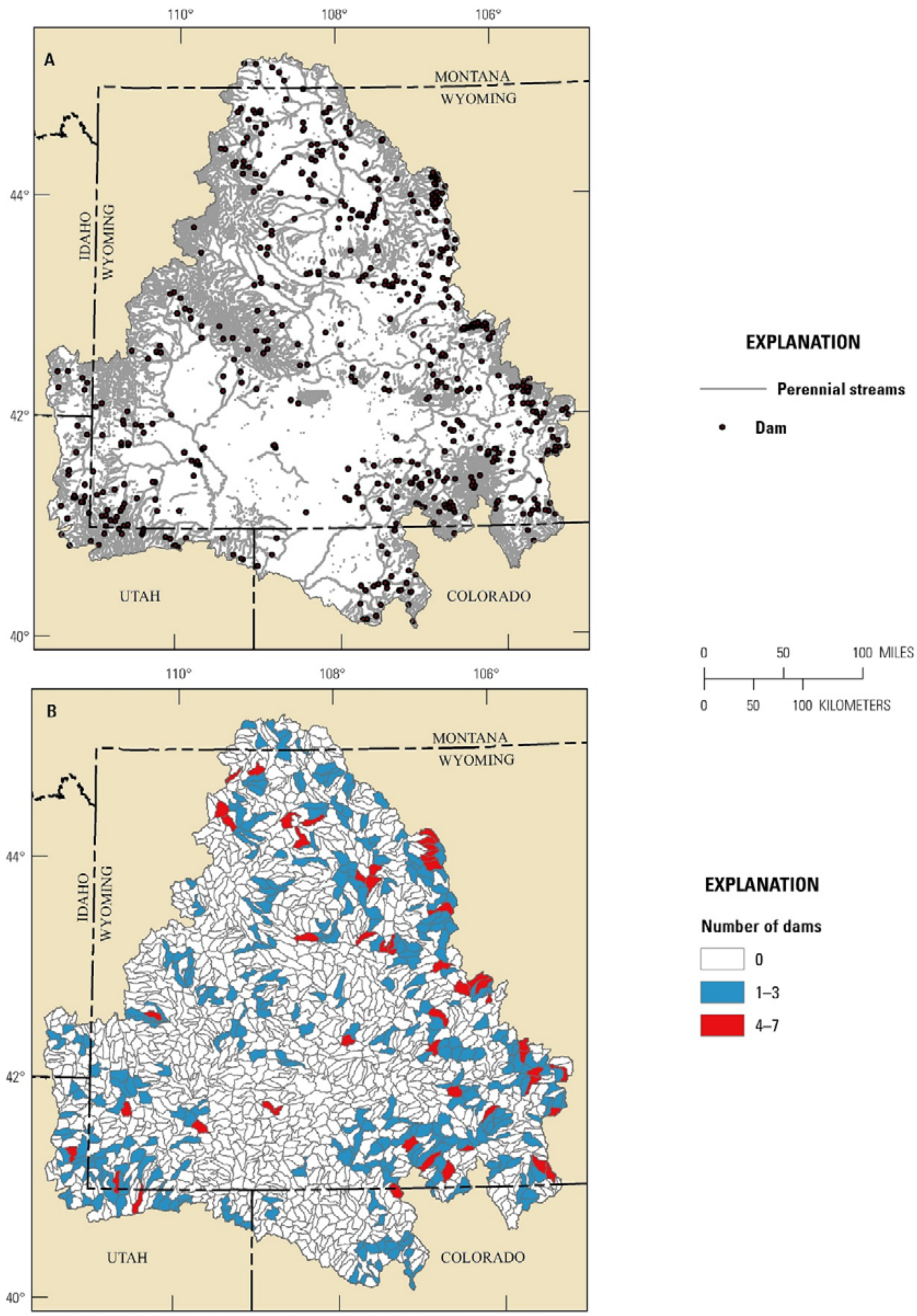

Figure 10–6. (*A*) Dam locations and perennial streams and (*B*) and number of dams by sixth-level watershed in the Wyoming Basin Rapid Ecoregional Assessment project area.

Where are Russian olive and (or) tamarisk present (fig. 10–7)?

- There are mapped occurrences of invasive species in riparian areas throughout the Bighorn Basin and in the southern areas of the Wyoming Basin.
- Russian olive and tamarisk often co-occur within watersheds, especially in the Bighorn Basin.
- Information on invasive species occurrence in the Wyoming Basin is extremely limited and represents a critical information gap.

Where could riparian vegetation be at risk from Russian olive and tamarisk expansion by 2030 (fig. 10–8)?

- Currently, the risk of Russian olive expansion is relatively low in most watersheds of the Wyoming Basin.
- The highest risk for Russian olive expansion is in the Bighorn Basin, where it is widely distributed (fig. 10–8*A*).
- In contrast, most watersheds in the Wyoming Basin are at a relatively high risk of tamarisk expansion, especially at lower elevations (fig. 10–8*B*).
- By 2030, conditions conducive to Russian olive (using climate scenario II) are projected to expand in many watersheds, especially in the Bighorn Basin. The potential risk of expansion is relatively low throughout higher elevations and in the southeastern portion of the basin (fig. 10–8*C*).
- In contrast, conditions conducive to tamarisk are projected to expand throughout the entire Wyoming Basin by 2030, indicating the potential for expansion into higher elevations where current conditions are not conducive to tamarisk (fig. 10–8*D*).

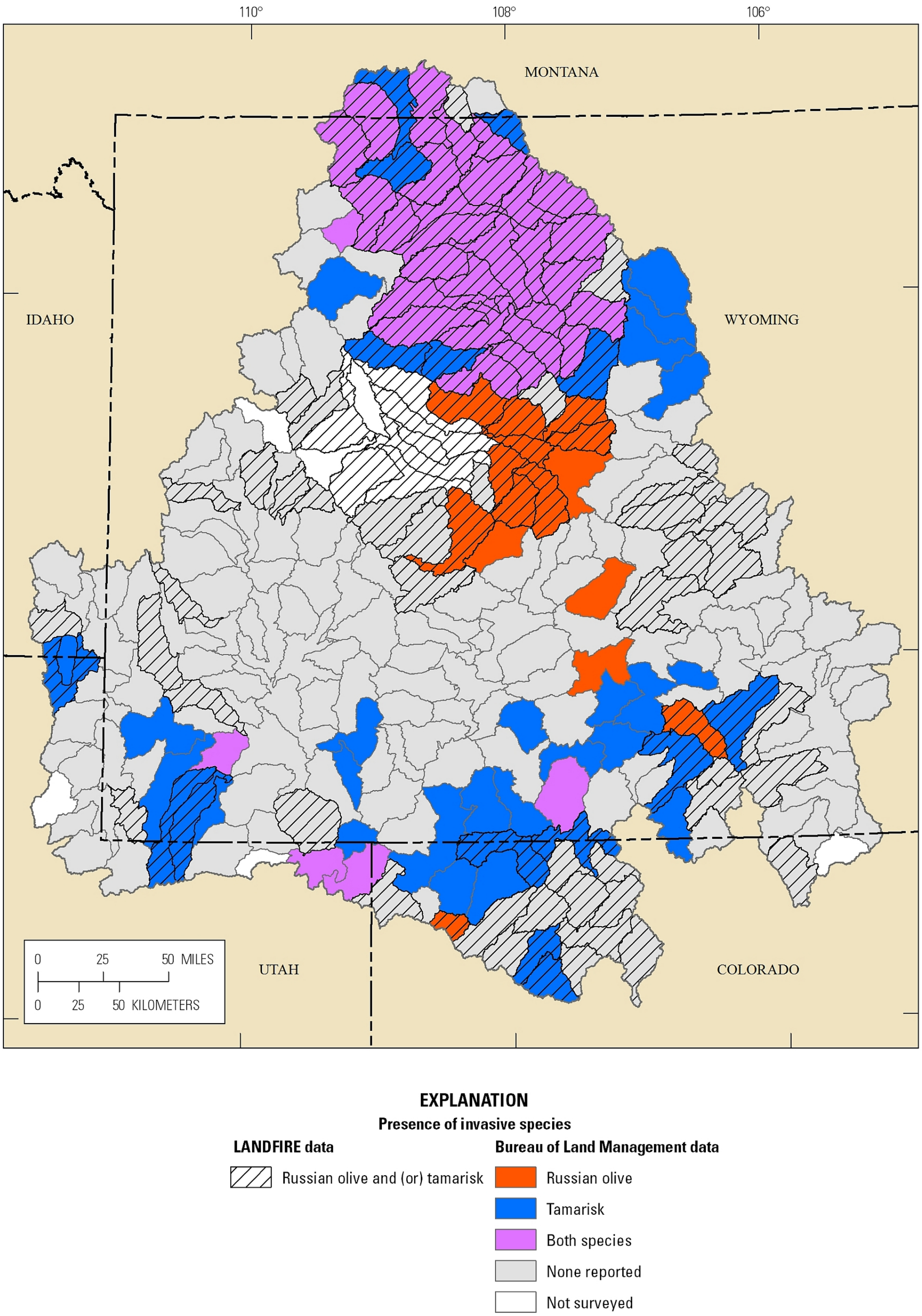

Figure 10–7. Presence of Russian olive and tamarisk, derived from Bureau of Land Management field office data and LANDFIRE data in the Wyoming Basin Rapid Ecoregional Assessment project area, summarized by fifth-level watershed.

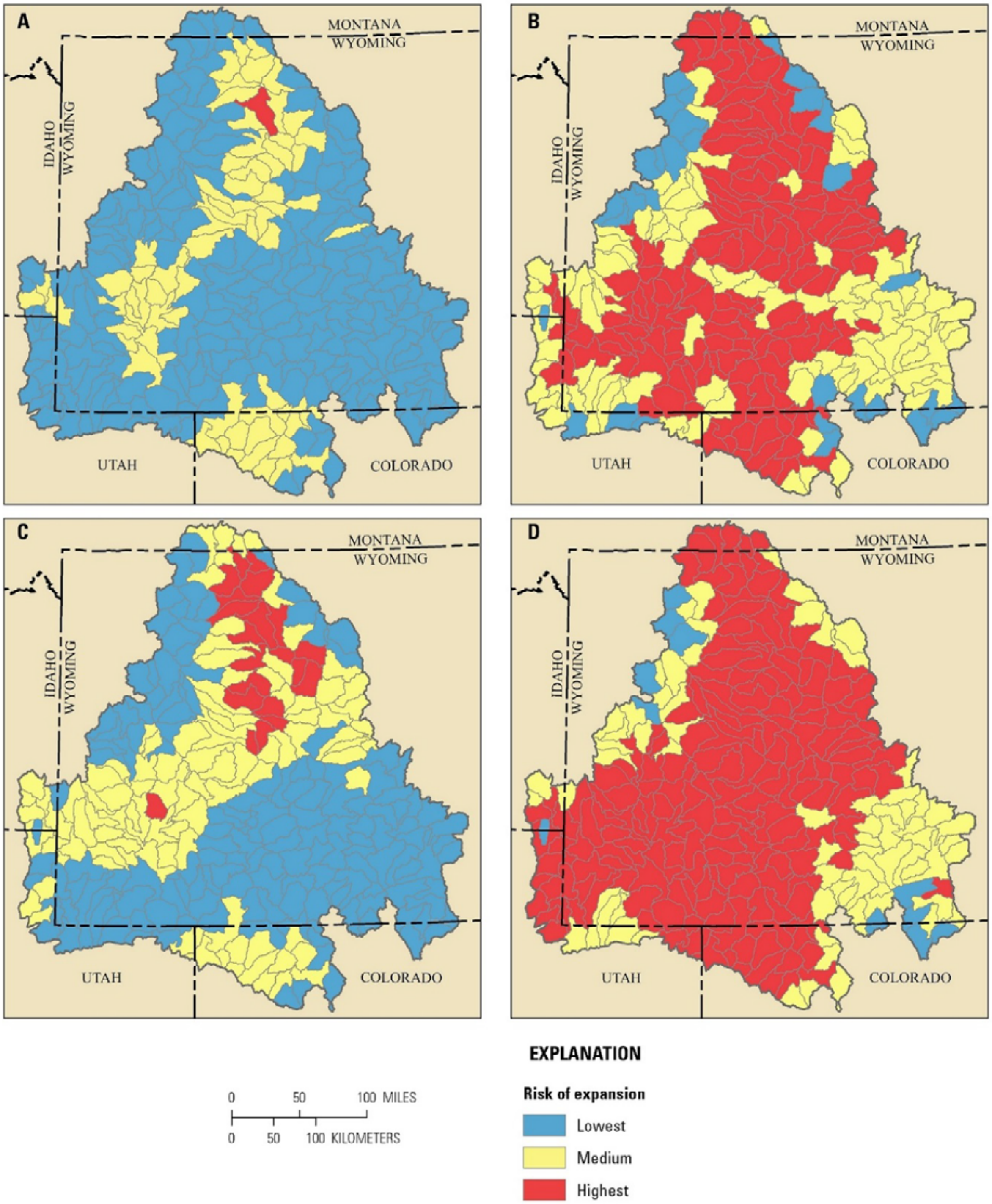

Figure 10–8. Relative risk of invasive species expansion, summarized by fifth-level watersheds for the Wyoming Basin Rapid Ecoregional Assessment project area. Current risk of expansion is derived from suitability models for (*A*) Russian olive and (*B*) tamarisk for recent climatic conditions (1980−2009). Future risk of expansion for (*C*) Russian olive and (*D*) tamarisk for projected climate scenario II (2016−2030). Expansion risk is lowest (probabilities <0.33), medium (probabilities from 0.34−0.66), and highest (probabilities >0.67). Probabilities derived from occurrence models developed by Jarnevich and Reynolds (2011) and Jarnevich and others (2011).

How does risk from development vary by land ownership or jurisdiction for riparian forests and shrublands (table 10–5, fig. 10–9)?

- The majority of riparian areas is in private ownership or under Bureau of Land Management jurisdiction (table 10–5).
- Private lands have relatively high risk from development whereas BLM and Forest Service lands have a much lower risk from development (fig. 10–9).

Table 10–5. Area and percent of riparian areas by land ownership or jurisdiction in the Wyoming Basin Rapid Ecoregional Assessment project area.

[km^2, square kilometer]

Ownership or jurisdiction	Area (km^2)	Percent of riparian
Private	1,602	42.44
Bureau of Land Management	1,188	31.45
State/County	336	8.91
Forest Service[1]	315	8.35
Tribal	189	5.01
Other Federal[2]	91	2.42
Private conservation	45	1.18

[1] U.S. Department of Agriculture Forest Service.

[2] Department of Defense, Bureau of Reclamation, and U.S. Fish and Wildlife Service.

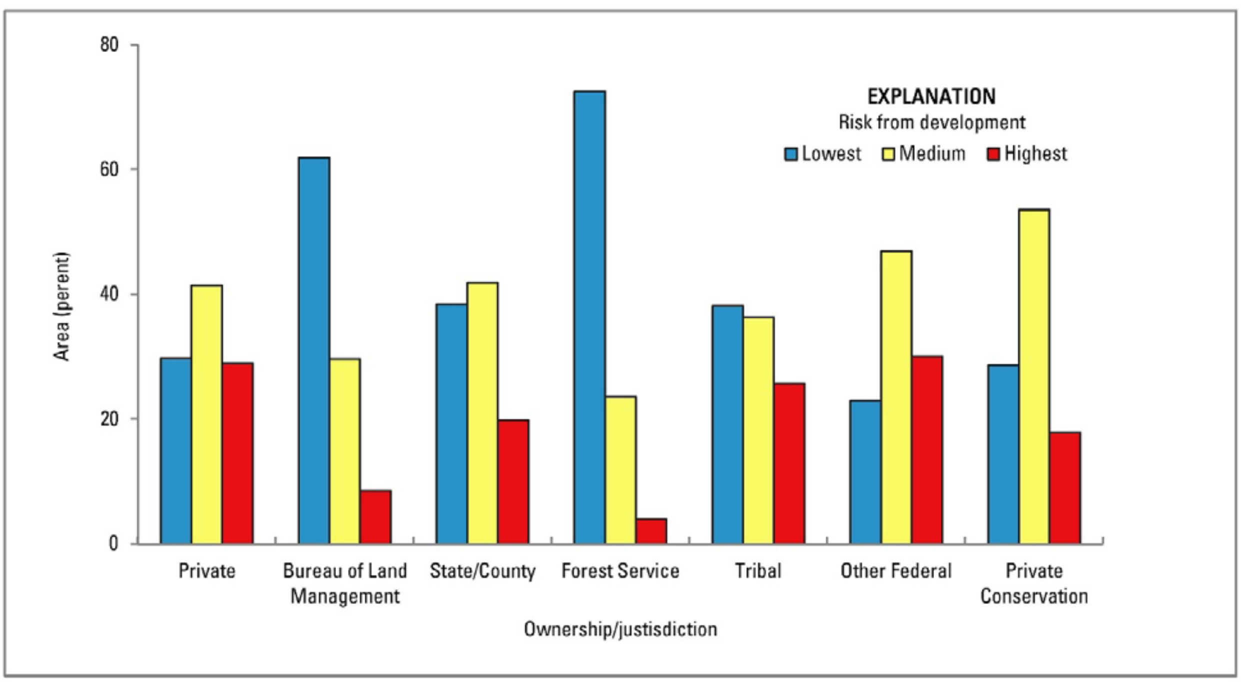

Figure 10–9. Relative ranks of risk from development, by land ownership or jurisdiction, for riparian areas in the Wyoming Basin Rapid Ecoregional Assessment project area. Rankings are lowest (Aquatic Development Index [ADI] score <20), medium (ADI score 20−40), and highest (ADI score >40).

Where are the watersheds with the greatest landscape-level ecological values (fig. 10–10)?

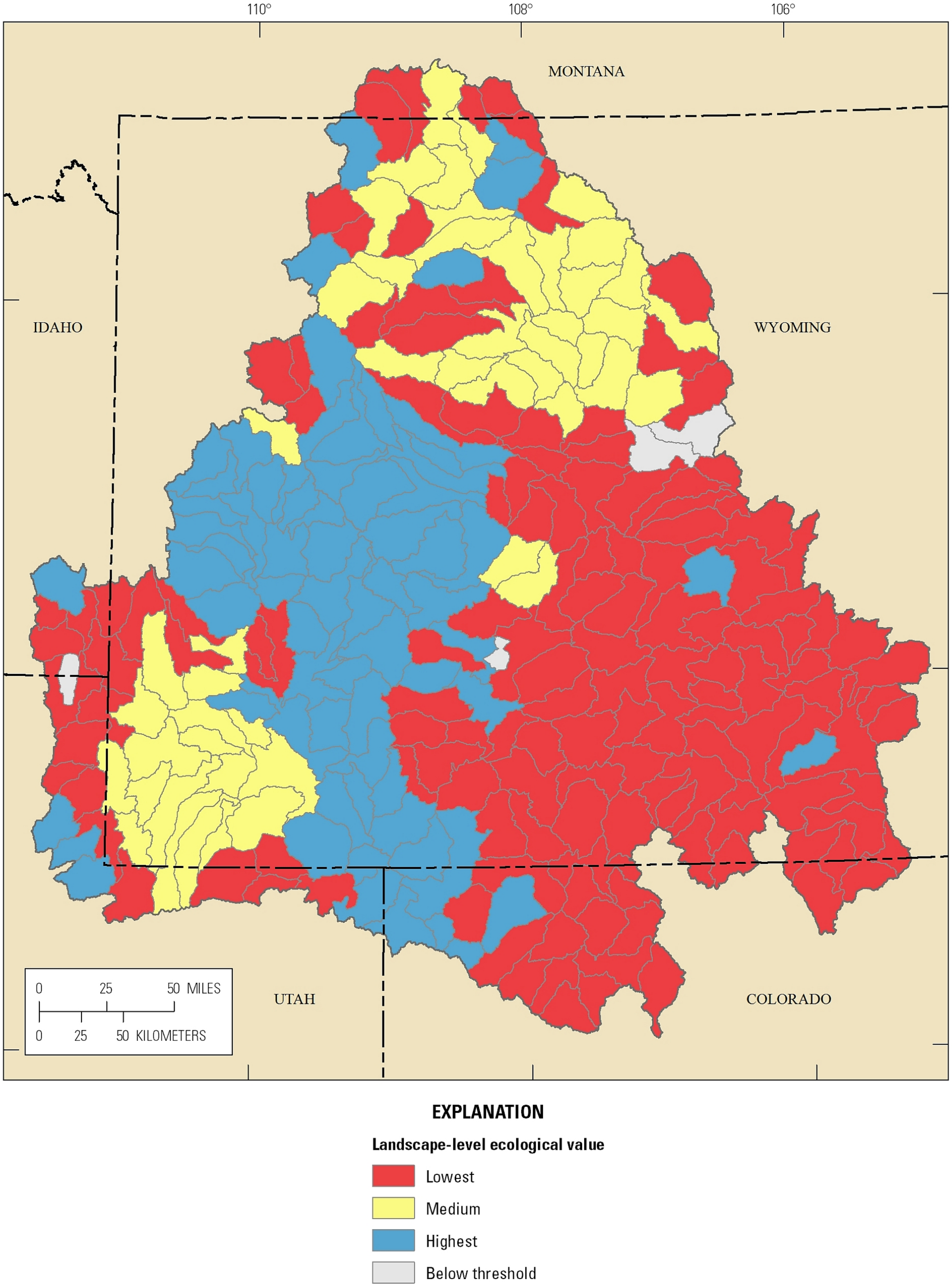

Figure 10–10. Ranks of landscape-level ecological values for riparian forests and shrublands, summarized by fifth-level watershed, in the Wyoming Basin Rapid Ecoregional Assessment project area. Values based on structural connectivity are summarized by fifth-level watershed (see table 10–3 for overview of methods).

Where are the watersheds with the greatest landscape-level risks (fig.10–11)?

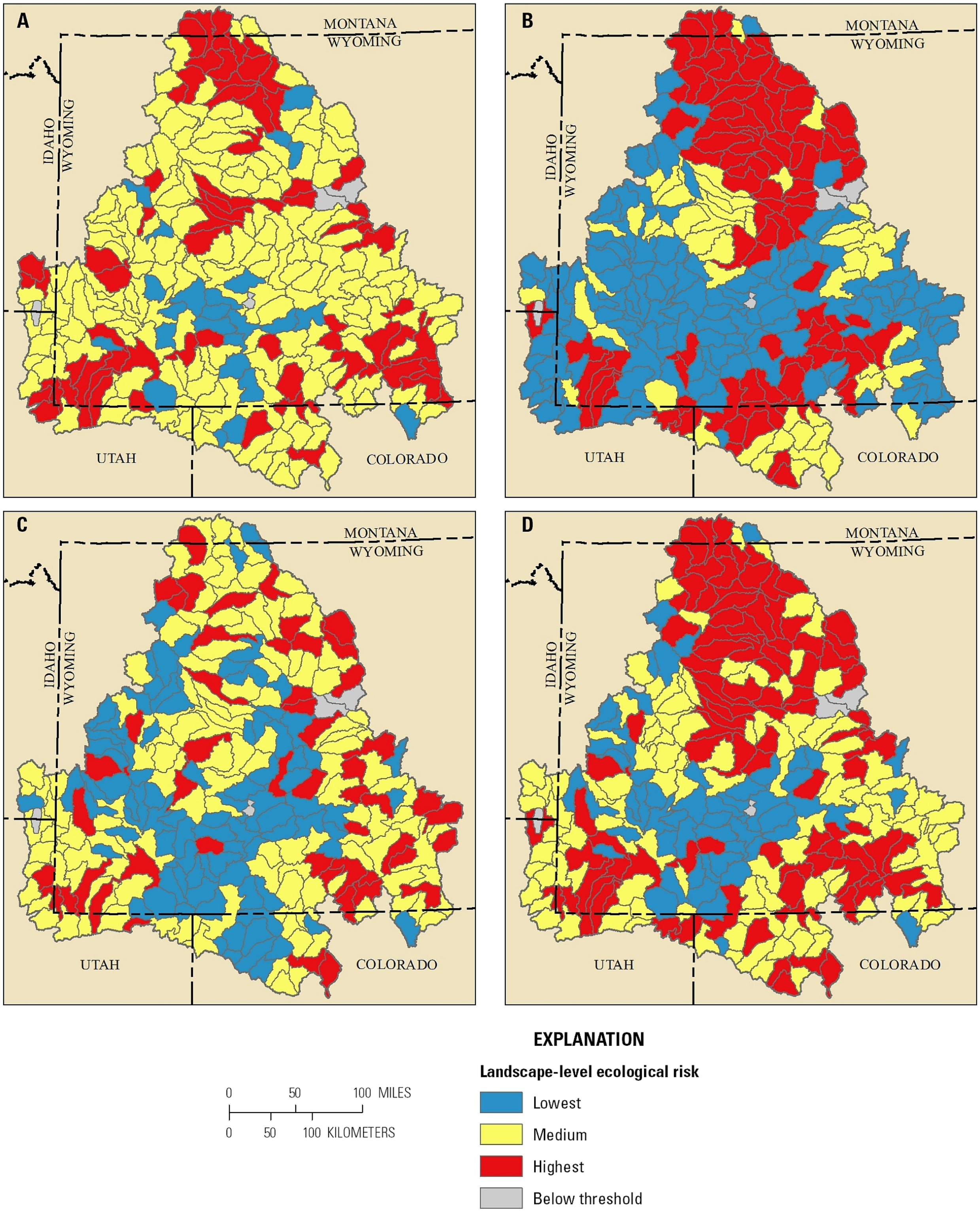

Figure 10–11. Ranks of landscape-level ecological risks for riparian areas, summarized by fifth-level watershed, in the Wyoming Basin Ecoregional Assessment project area: (*A*) Aquatic Development Index, (*B*) presence of invasive species expansion, (*C*) number of dams, and (*D*) overall risks

Where are the watersheds with the greatest conservation potential (fig. 10–12)?

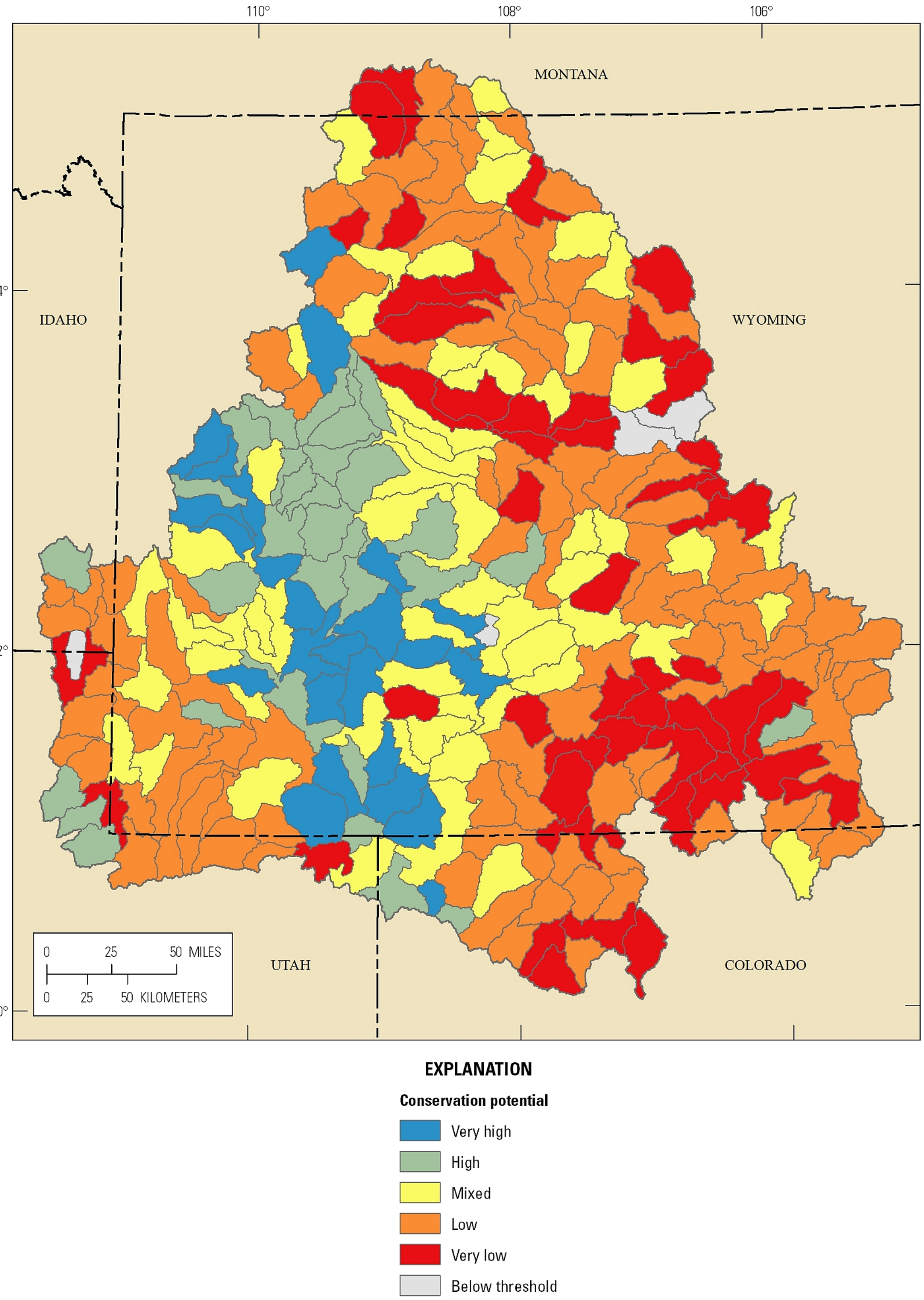

Figure 10–12. Conservation potential of riparian areas, summarized by fifth-level watershed, for the Wyoming Basin Rapid Ecoregional Assessment project area. Highest conservation potential identifies areas that have the highest landscape-level values and the lowest risks. Lowest conservation potential identifies areas with the lowest landscape-level values and the highest risks. Ranks of conservation potential are not intended as stand-alone summaries and are best interpreted in conjunction with the geospatial datasets used to address Core Management Questions.

Summary

Riparian forests and shrublands are sparsely and unevenly distributed throughout the Wyoming Basin and represent only 2 percent of the total project area. Except for portions of the Great Divide Basin, most watersheds have some riparian vegetation present. Most watersheds, particularly at lower elevations, have been affected negatively by development, most commonly by agriculture, energy, and dams. Private lands account for almost half of the total riparian area, with higher development pressure from the presence of roads, dams, industry, energy, and agriculture. Invasive species, specifically Russian olive and tamarisk, are present in many northern and some southern watersheds, but data on invasive species are quite limited regionwide. Surveys of invasive species may be useful in watersheds lacking Bureau of Land Management occurrence data and where risk of invasive species occurrence is high (LANDFIRE indicates that invasive species and the conditions conducive to invasive species occurrence are present; in other words, where watersheds have high risk of invasives expansion) (fig. 10–6). Moderately sized and extensively connected and large but isolated high-density riparian areas in the Wyoming Basin may provide important refugia and stopover habitat for animals dispersing or migrating across expanses of sagebrush and desert shrubland.

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