Section IV. Assessments of Species and Species Assemblages

Chapter 22. Spadefoot Assemblage

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Contents

Figures

Tables

Key Ecological Attributes

Distribution and Ecology

The spadefoot assemblage includes the Great Basin spadefoot and the plains spadefoot. The Great Basin spadefoot's range extends from south-central British Columbia south through the Great Basin and from the Pacific Crest piedmont east to southwestern Wyoming and northwestern Colorado (Hammerson, 1999; Stebbins, 2003; Buseck and others, 2005; Lannoo, 2005). The plains spadefoot occurs from the southern Canadian prairies south to northern Mexico, and from the Rocky Mountain piedmont east to the tallgrass prairie (Stebbins, 2003; Lannoo, 2005). The Great Basin spadefoot is listed as threatened in Canada (Committee on the Status of Endangered Wildlife in Canada, 2007), and in Wyoming, both spadefoots are designated as Wyoming Species of Greatest Conservation Need (Wyoming Game and Fish Department, 2010), primarily because little is known about their population dynamics or factors that may threaten their persistence.

The Great Basin spadefoot is found at elevations up to 2,800 meters (m) (9,186.6 feet [ft]), primarily in sagebrush steppe, but they also occur in semidesert shrublands and grasslands, agricultural areas, and conifer systems from pinyon-juniper woodlands to spruce-fir forests (Stebbins, 2003; Lannoo, 2005). The plains spadefoot is found at elevations up to 2,440 m (8,005.3 ft), from semiarid grasslands and shrublands to mixed-grass prairie and agricultural areas of the plains, sandhills, and riparian corridors (Hammerson, 1999; Stebbins, 2003; Lannoo, 2005). For up to 10 months of the year (but generally October to March), both species aestivate in burrows that are typically up to 1 m (3.3 ft) deep (that is, below the frostline, plains spadefoots, however, may burrow as deep as 4.6 m in more arid conditions). During warmer months (generally April to September), both spadefoot species dig shallow burrows for refuge (3–10 centimeters deep [1.2–4 inches]) between nocturnal feeding bouts or periods of inactivity (Hammerson, 1999; Buseck and others, 2005; Lannoo, 2005). Burrow sites must have loose, sandy, loamy, or gravely and well-drained soils (Hammerson, 1999; Buseck and others, 2005; Lannoo, 2005). Spadefoots also use small mammal burrows, such as those of prairie dogs, kangaroo rats, and ground squirrels (Hammerson, 1999; Gerlanc and Kaufman, 2003; Stebbins, 2003; Lomolino, 2004; Lannoo, 2005).

Both spadefoots inhabit semiarid regions characterized by high variability in the timing and amounts of precipitation. Wetlands are required for breeding, and they respond rapidly and synchronously to heavy rains or runoff that create the temporary pools in which they breed and where the young remain until they have undergone metamorphosis (Stebbins, 2003). The breeding cycle from mating through metamorphosis typically lasts 6–10 weeks, depending on species, air and water temperatures, predation pressure, and food availability (Hammerson, 1999; Lannoo, 2005). Breeding onset in the Wyoming Basin occurs in late spring or early summer when snowmelt and spring storms create seasonal pools, but breeding also may be stimulated by inflows of irrigation water (Hammerson, 1999; Stebbins, 2003; Lannoo, 2005). Breeding sites are shallow (up to 1 m [3.3 ft]) and include various types of temporary or seasonal wetlands that hold water long enough to complete a full breeding cycle or permanent wetlands (Hammerson, 1999; Buseck and others, 2005; Lannoo, 2005). Examples of natural breeding sites include floodplains, playas, springs, and sluggish streams; artificial sites include ditches and reservoirs with shallow margins, but often they harbor predators that consume spadefoot larvae (Hammerson, 1999; Gerlanc and Kaufman, 2003; Stebbins, 2003; Lannoo, 2005). In flowing waters, spadefoots anchor themselves and their egg masses to emergent vegetation. Great Basin spadefoots also do not tolerate high salinity levels (total dissolved solids >5,000 milligrams per liter [mg/L] [0.042 pounds per gallon]) in their wetland habitats (salinity tolerances not reported for plains spadefoot) (Hovingh and others, 1985).

Spadefoot foraging sites include wetland margins or open uplands where prey are abundant (Hammerson, 1999; Buseck and others, 2005; Lannoo, 2005). The scant information on spadefoot diets indicates that adults consume a wide variety of arthropods and larvae generally feed on organic detritus (Anderson and others, 1999; Hammerson, 1999; Lannoo, 2005; Zack and Johnson, 2008; Ghioca-Robrecht and others, 2009). Tadpoles may be nonpredaceous or predaceous, depending on aquatic community composition (predators and food resources). Nonpredaceous forms consume detritus and predaceous forms consume small crustaceans and often other spadefoot tadpoles (Ghioca-Robrecht and others, 2009; Lannoo, 2005). Main predators of adult spadefoots include small raptors and mammals, and snakes, and premetamorphic young are consumed by aquatic beetle larvae, crustaceans, wading birds, corvids, and fish.

Landscape Structure and Dynamics

The juxtaposition of terrestrial burrowing and foraging habitats with aquatic breeding habitats is generally thought to be crucial to spadefoot species (Hammerson, 1999; Buseck and others, 2005; Lannoo, 2005), as they are not reported to travel long distances. There is limited information, however, on seasonal and juvenile movements (Buseck and others, 2005). Overall, spadefoot migration patterns and the range of acceptable distances between breeding, foraging, and burrowing habitats are unknown. Spadefoots have been recorded moving 300–1,000 m (984.3–3,280 ft) per night during heavy rains and may move up to a total of 5 kilometers (km) (3.2 miles [mi]) from aestivation to breeding sites, but distances of <0.5 km (0.3 mi) are thought to be more typical (Hammerson, 1999; Buseck and others, 2005; Lannoo, 2005). Information is also lacking on home range size and territoriality.

There has been little research on how fire affects spadefoot populations, either directly through mortality or indirectly through altered habitat and prey base, and the little that is known is based on studies of the eastern spadefoot. Although eastern spadefoots have been found alive among the ashes of still-smoldering brushfires (Badger and Netherton, 1995), this species occurs in relatively mesic regions of North America, where fire effects on spadefoots may differ significantly from those in the Wyoming Basin. It has been hypothesized that spadefoots may escape direct effects of fire because they burrow underground (Fire Sciences Laboratory, 2013), although the Wyoming Basin fire season overlaps the period when spadefoots are on the surface or in very shallow burrows (as opposed to the deeper burrows used during their months of aestivation). The premetamorphic aquatic young may be somewhat protected from direct burning (Buseck and others, 2005), but indirect effects (such as postfire ash flow and sedimentation) can affect their wetland habitats.

Change Agents

Information on how Change Agents affect either spadefoot species is scant. Research on effects of Change Agents have been limited to effects of dewatering, development, and agriculture on the Great Basin spadefoot in British Columbia and a series of studies evaluating agricultural effects on plains spadefoot and other anurans of the Southern Great Plains playas.

Development

Energy and Infrastructure

Potential negative effects of energy development on spadefoot species include habitat loss, degradation, and fragmentation due to surface disturbance and habitat conversion, roads and traffic, soil compaction, noise, and environmental and light pollution (Lovich and Ennen, 2011). Because connectivity between breeding, aestivation, and foraging habitats is crucial to spadefoot ecology (U.S. Fish and Wildlife Service, 2005), disruption or loss of between-habitat movement corridors, especially from roads and traffic, is a major concern for amphibians across the West (Buseck and others, 2005). Low-frequency noises generated by vehicle traffic, seismic exploration, surface scraping, explosions, drilling, and generators can prompt spadefoot emergence from aestivation at inappropriate times (Brattstrom and Bondello, 1983; Lovich and Ennen, 2011). Wetlands adjacent to or downstream from energy-production sites, including ponds developed to hold wastes associated with energy production, can be contaminated with trace elements, high levels of salinity, radiation, and organic compounds (Rowe and others, 1998; Ramirez, 2002). The dewatering, draining, and infilling of wetlands also negatively affects spadefoot species. In British Columbia, lowered water tables due to water extraction for residential and industrial use may have contributed to shorter wetland hydroperiods and disruption of Great Basin spadefoot breeding cycles (Buseck and others, 2005). Artificial wetlands in developed areas may provide alternative breeding sites, but contaminants associated with development may enter these wetlands, and anurans are highly sensitive to environmental toxins (Buseck and others, 2005; U.S. Fish and Wildlife Service, 2005).

Agriculture and Grazing

Crop and livestock production are considered major threats to spadefoot species (Salvador and others, 2004; Lannoo, 2005; Committee on the Status of Endangered Wildlife in Canada, 2007). In general, anurans are sensitive to effects of pesticide and fertilizer contamination in their breeding wetlands, upland habitats, and prey populations, with known effects of pesticides and fertilizers ranging from reduced body mass to direct mortality (Gray and others, 2004; Gray and Smith, 2005; Bishop and others, 2010; Dinehart and others, 2010). Dewatering of wetlands for agricultural irrigation alters hydroperiods and disrupts spadefoot breeding cycles (Buseck and others, 2005). It is unclear whether the many artificial wetlands created for agriculture (ditches, flooded pastures, small reservoirs, and livestock watering ponds) provide the conditions needed for successful spadefoot breeding or whether they are adequately connected to foraging and aestivation sites. To some extent, light grazing that removes wetland vegetation could benefit spadefoots if grazed during the nonbreeding season, as livestock may trample eggs and young, degrade the water quality with excrement, and stir up sediments that suffocate larvae (U.S. Fish and Wildlife Service, 2005; Salvador and others, 2014). In spadefoot breeding pools, livestock trampling can create crater-like depressions that can entrap tadpoles and isolate them from the rest of the pool as it shrinks (Stebbins, 2003).

In semiarid climates, many wetlands are manipulated to increase their water-holding capacity for agricultural and livestock use, which alters their hydroperiods and community structures (Luo and others, 1997; Euliss and Mushet, 2004). In agricultural settings, sediment-laden runoff enters wetlands, which decreases wetland water-holding capacities, and alters overall hydrological processes (Luo and others, 1997). When dry, many seasonal wetland basins in cropland settings are disked or plowed, which alters community compositions and hydrological regimes (Smith and Haukos, 2002). The conversion of upland habitats to cropland and the overall changes to landscape structure in agricultural settings can affect rates of prey capture by spadefoots (Tobias and others, 2001). Dams and diversions also fragment upland habitats and are considered a threat to the Great Basin spadefoot (Lannoo, 2005). Cultivation machinery and trampling by livestock can alter soil structure of burrow sites through compaction, and cultivation activities may cause direct mortality to spadefoots (Sarell, 2004; U.S. Fish and Wildlife Service, 2005).

Altered Fire Regimes

The extent to which altered fire regimes in the Great Basin or prairie systems may affect spadefoot habitat or ecology is unknown. Overall, however, the Great Basin spadefoot apparently adapts to various vegetation structures as long as the prey base is sufficient (Fire Sciences Laboratory, 2013).

Invasive and Introduced Species

Little is known about effects of invasive or introduced species on the spadefoot assemblage, but introduced crayfish, predatory fish (especially sportfish and mosquito fish), and bullfrogs have had negative effects on western spadefoot populations (U.S. Fish and Wildlife Service, 2005). Purple loosestrife, common reed, and other invasive aquatic plants preclude some aquatic species from using affected wetlands. The ephemeral nature of temporary and seasonal breeding sites used by the spadefoot assemblage likely diminishes the possibility of significant invasions at those sites.

Climate Change

Spadefoots depend on shallow, aquatic habitats for successful reproduction and recruitment. Therefore, altered hydroperiods resulting from climate change could have pronounced effects on spadefoot breeding cycles by altering the availability and dynamics of their breeding habitats (Walther and others, 2002). In particular, rains or snowmelt runoff that flood the temporary and seasonal wetlands used by spadefoots for breeding are crucial, and if there are changes that diminish periods of breeding site inundation or pronounced changes in temperature during breeding season, there could be negative consequences for spadefoot breeding success and survivorship of premetamorphic young.

Rapid Ecoregional Assessment Components Evaluated for Great Basin and Plains Spadefoot Assemblage

A generalized, conceptual model was used to highlight some of the key ecological attributes and Change Agents affecting the spadefoot assemblage (fig. 22–1). Key ecological attributes addressed by the REA include (1) the distribution of baseline spadefoot habitat, (2) landscape structure (patch sizes and connectivity of spadefoot habitat), and (3) landscape dynamics (fire occurrence; table 22–1). Only development was evaluated as a Change Agent (table 22–2). Ecological values and risks used to assess the conservation potential for the spadefoot assemblage by township are summarized in table 22–3. Core and Integrated Management Questions and the associated summary maps and graphs are provided in table 22–4.

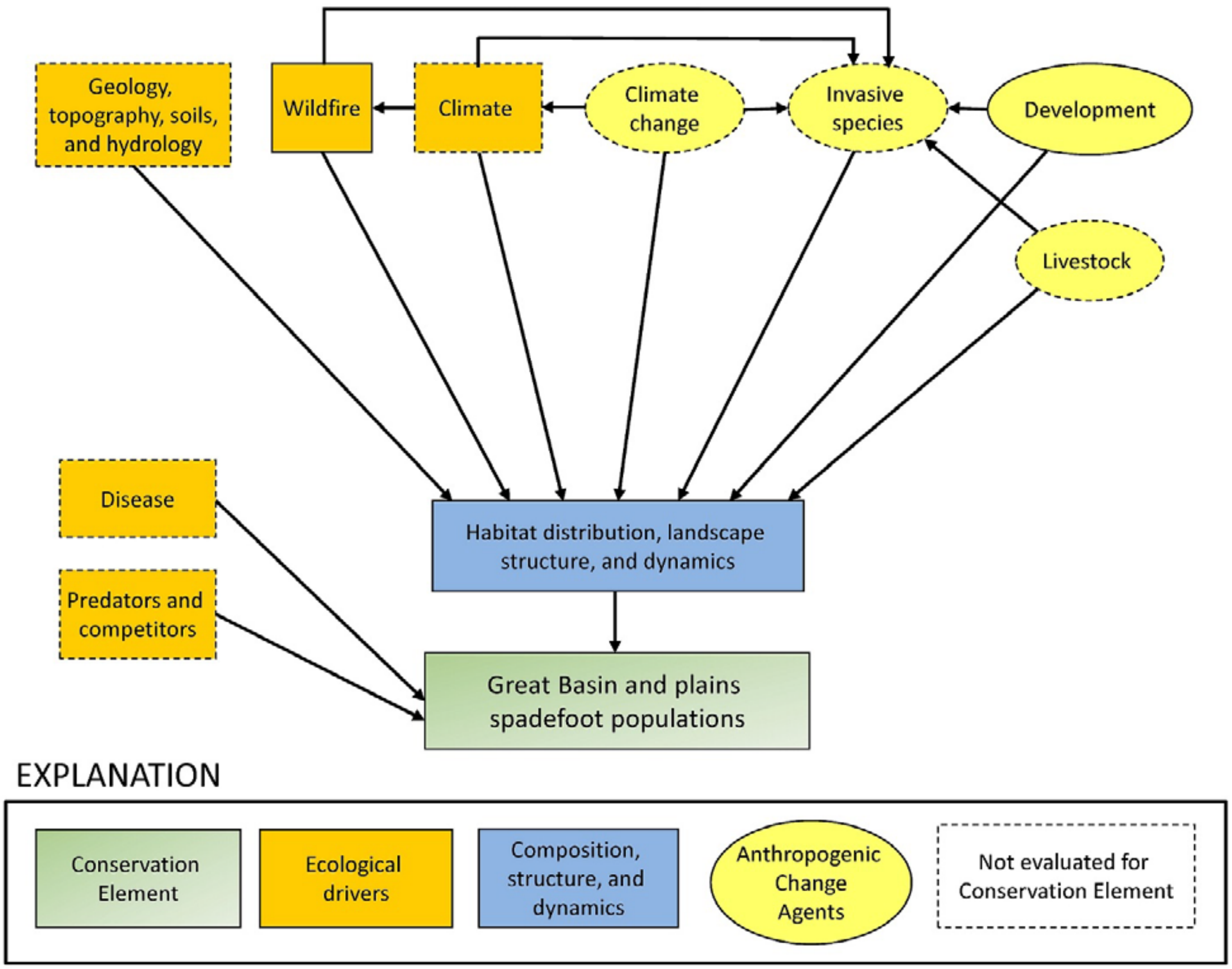

Figure 22–1. Generalized conceptual model of spadefoot assemblage habitat for the Wyoming Basin Rapid Ecoregional Assessment (REA). Biophysical attributes and ecological processes regulating the occurrence, structure, and dynamics of spadefoot assemblage habitat are shown in orange rectangles; additional ecological attributes are shown in blue rectangles; and key anthropogenic Change Agents are shown in yellow ovals. The dashed lines indicate components not addressed by the REA. Livestock and invasive plants are Change Agents that were not evaluated due to the lack of regionwide data.

Table 22–1. Key ecological attributes and associated indicators of baseline spadefoot assemblage habitat[1] for the Wyoming Basin Rapid Ecoregional Assessment.

[km, kilometer; mi, mile]

Attributes	Variables	Indicators
Amount and distribution	Total area	Habitat distribution derived from vegetation and abiotic variables[2]
Landscape Structure	Patch size	Patch-size frequency distribution
	Structural connectivity[3]	Interpatch distances that provide an index of structural connectivity for baseline patches at local (0.09 km; 0.06 mi), landscape (0.18 km; 0.11 mi), and regional (0.18 km; 0.11 mi) levels
Landscape dynamics	Fire occurrence[4]	Locations of fires and annual area burned since 1980

[1] Baseline conditions are used as a benchmark to evaluate changes in the amount and landscape structure of spadefoot habitat due to Change Agents. Baseline conditions are defined as the potential current distribution of spadefoot habitat derived from existing abiotic and biotic variables without explicit inclusion of Change Agents (see Chapter 2—Assessment Framework and the Appendix).

[2] Habitat modeled using MaxEnt; occurrence data from Colorado Natural Heritage Program and the Wyoming Natural Diversity Database; habitat variables derived from SAGEMAP (Hanser and others, 2011) and Homer and others (2012).

[3] Structural connectivity refers to the proximity of patches at local, landscape, and regional levels, but does not reflect species-specific measures of connectivity. See Chapter 2—Assessment Framework.

[4] See Wildland Fire section in the Appendix.

Table 22–2. Anthropogenic Change Agents and associated indicators influencing spadefoot assemblage habitat for the Wyoming Basin Rapid Ecoregional Assessment.

[km^2, square kilometer; mi^2, square mile; km, kilometer; mi, mile]

Change Agents	Variables	Indicators
Development	Terrestrial Development Index[1]	Percent of spadefoot habitat in seven development classes using a 16-km^2 (6.18-mi^2) moving window
		Patch-size frequency distribution for spadefoot habitat that is relatively undeveloped or has low development scores compared to baseline conditions
		Interpatch distances that provide an index of connectedness for relatively undeveloped patches at local (0.27 km; 0.17 mi), landscape (3.51 km; 2.18 mi), and regional (5.67 km; 3.52 mi) levels

[1] See Chapter 2—Assessment Framework.

Table 22–3. Landscape-level ecological values and risks for spadefoot assemblage habitat. Ranks were combined into an index of conservation potential for the Wyoming Basin Rapid Ecoregional Assessment.

		Relative rank			
	Variables[1]	**Lowest**	**Medium**	**Highest**	**Description**[2]
Values	Area	<6	6–22	≥22	Percent of township modeled as Great Basin and plains spadefoot habitat
Risks	Terrestrial Development Index (TDI)	<1	1–3	>3	Mean TDI score by township

[1] Township was used as the analysis unit for conservation potential on the basis of input from the Bureau of Land Management. A minimum area threshold of total area per township was established for each Conservation Element to minimize the effects of extremely small areas and put greater emphasis on large areas (see table A–19 in the Appendix).

[2] See tables 22–1 and 22–2 for description of variables.

Table 22–4. Management Questions addressed for the spadefoot assemblage for the Wyoming Basin Rapid Ecoregional Assessment.

Core Management Questions	**Results**
Where is baseline spadefoot habitat, and what is the total area?	Figure 22–2
Where does development pose the greatest threat to baseline spadefoot habitat, and where are the relatively undeveloped areas?	Figures 22–3 and 22–4
How has development fragmented baseline spadefoot habitat, and where are the large, relatively undeveloped patches?	Figures 22–5 and 22–6
How has development affected connectivity of spadefoot habitat relative to baseline conditions?	Figure 22–7
Where are potential barriers and corridors that may affect animal movements among relatively undeveloped habitat patches?	Figure 22–8
Where have recent fires occurred in baseline spadefoot habitat, and what is the total area burned per year?	Figure 22–9
Integrated Management Questions	**Results**
How does risk from development vary by land ownership or jurisdiction for spadefoot habitat?	Table 22–5, Figure 22–10
Where are the townships with the greatest landscape-level ecological values?	Figure 22–11
Where are the townships with the greatest landscape-level risks?	Figure 22–11
Where are the townships with the greatest conservation potential?	Figure 22–12

Methods Overview

We developed a general habitat model for the spadefoot assemblage using MaxEnt software (Phillips and others, 2006). Values of vegetation and abiotic variables at 110 mapped spadefoot locations were obtained from the Colorado Natural Heritage Program and the Wyoming Natural Diversity Database. Because of limited sample size and overlap in habitat, we modeled both species together. Variables with the greatest weight included the average precipitation of the warmest annual quarter, percent riparian vegetation, percent sand in the soil, and topographic ruggedness. To map potential spadefoot habitat, we used MaxEnt parameter values that included 90 percent of the locations (omission rate of 10 percent). The distribution map was used to quantify attributes of baseline spadefoot habitat within the region.

We assessed development levels in spadefoot habitat using the Terrestrial Development Index (TDI) map and then used the resulting output to calculate patch size and connectivity metrics. We mapped the structural connectivity of relatively undeveloped habitat (TDI score ≤1 percent) at three interpatch distances derived from connectivity analysis: local (0.27 km; 0.2 mi), landscape (3.5 km; 2.2 mi), and regional (5.7 km; 3.5 mi) levels. We used development levels to identify areas that may function as barriers or corridors by overlaying relatively undeveloped habitat patches on the TDI map. The perimeters of fires in desert shrublands since 1980 were compiled from several data sources to assess fire frequency and extent (table 22–1).

Landscape-level ecological values (area of habitat) and risks (TDI score) were compiled into an overall index of conservation potential for each township (table 22–3). Conservation potential for spadefoot habitat was summarized by township based on overall landscape-level values and risks (table 22–3). 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. See Chapter 2—Assessment Framework and the Appendix for additional details on the methods.

Key Findings for Management Questions

Where is baseline spadefoot habitat, and what is the total area (fig. 22–2)?

- The total area of baseline spadefoot habitat is 19,861 square kilometers (km^2) (7,668 square miles [mi^2]) or 11 percent of the Wyoming Basin project area (14 percent of the ecoregion proper).
- Baseline spadefoot habitat is well distributed throughout lower elevations in the Bighorn Basin, sparsely distributed in the Wind and Green River Basins, and rare in the Laramie and Bighorn Basins.

Where does development pose the greatest threat to baseline spadefoot habitat, and where are the relatively undeveloped areas (figs. 22–3 and 22–4)?

- Areas of high development in spadefoot habitat are generally associated with agricultural activities along streams and rivers within the Wyoming Basin (fig. 22–3).
- Approximately 20 percent of spadefoot habitat in the Basin is relatively undeveloped (TDI score ≤1 percent), and 38 percent had high levels of development as indicated by TDI scores >5 percent (fig. 22–4).

How has development fragmented baseline spadefoot habitat, and where are the large, relatively undeveloped patches (figs. 22–5 and 22–6)?

- Development has effectively fragmented spadefoot habitat into smaller patches relative to baseline conditions. All relatively undeveloped habitat occurs in patches <1,000 km^2 (386 mi^2). In contrast, over 39 percent of baseline habitat occurs in patches >1,000 km^2 (fig. 22–5).
- The largest relatively undeveloped habitat patches are located in the Bighorn and Green River Basins (fig. 22–6).

How has development affected connectivity of spadefoot habitat relative to baseline conditions (fig. 22–7)?

- Baseline spadefoot habitat is naturally patchy, and regional-level connectivity occurs at an interpatch distance of 1.53 km (0.95 mi) (fig. 22–7).
- Development has greatly diminished the connectivity of spadefoot habitat. Relatively undeveloped habitat is highly fragmented and local-level connectivity (0.27 km [0.17 mi]) is triple that of baseline conditions. Interpatch distances for landscape- (3.51 km [2.2 mi]) and regional-level connectivity (5.67 km [3.5 mi]) for relatively undeveloped habitat is at least three times greater than baseline conditions.
- Highly connected patches of relatively undeveloped habitat occur in the Bighorn Basin; habitat is not as well connected in the Green River and Great Divide Basins. Areas with high local and landscape connectivity may facilitate dispersal and seasonal movements, whereas habitat with only regional connectivity may have value as stepping stones among isolated areas separated by developed or otherwise unsuitable habitat.
- Landscape and regional connectivity of spadefoot habitat in the Wind River and Laramie Basins and the western portion of the Green River Basin are limited, which could increase vulnerability to habitat loss and fragmentation in these areas.

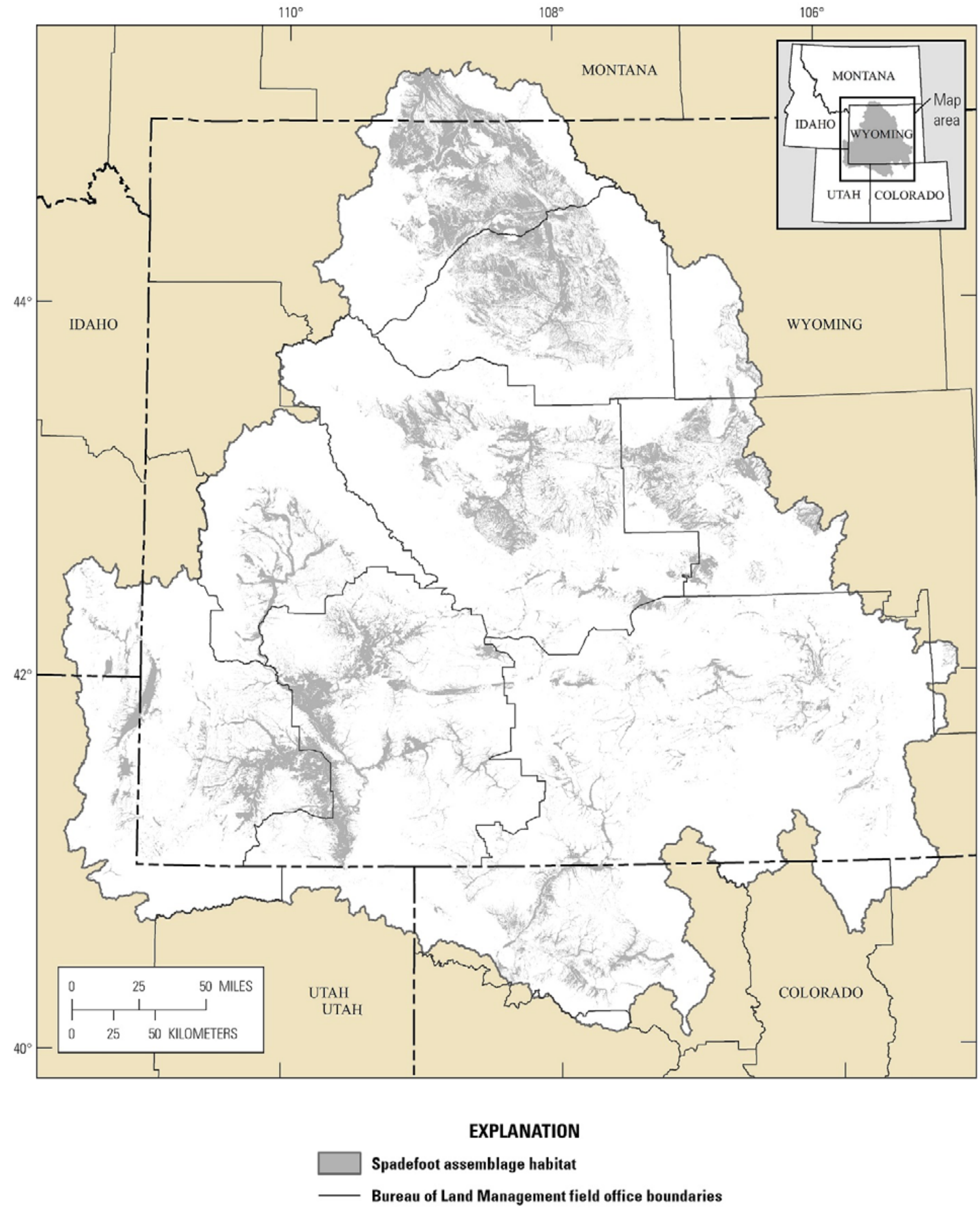

Figure 22–2. Distribution of baseline spadefoot habitat in the Wyoming Basin Rapid Ecoregional Assessment project area.

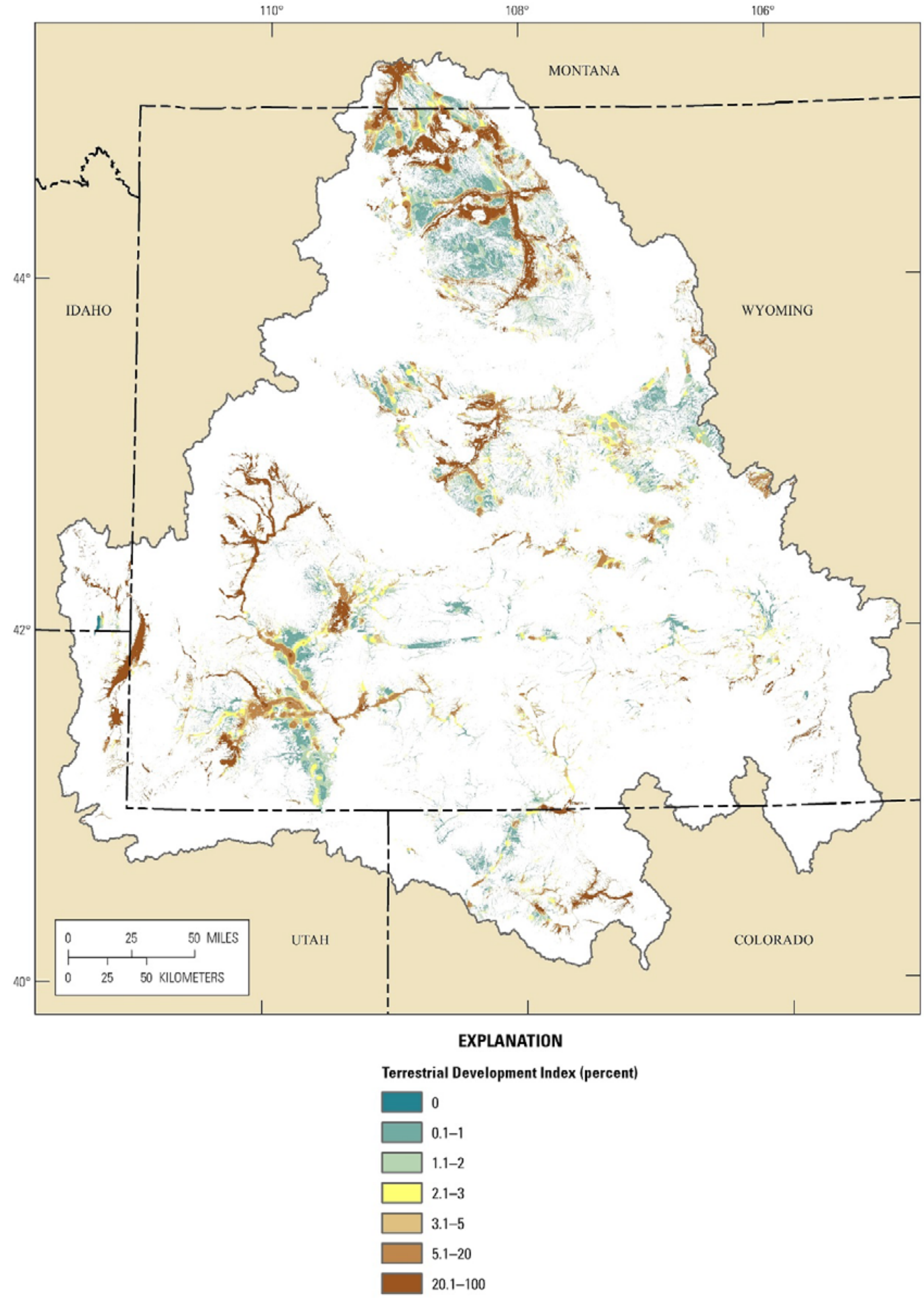

Figure 22–3. Terrestrial Development Index scores for baseline spadefoot habitat in the Wyoming Basin Rapid Ecoregional Assessment project area.

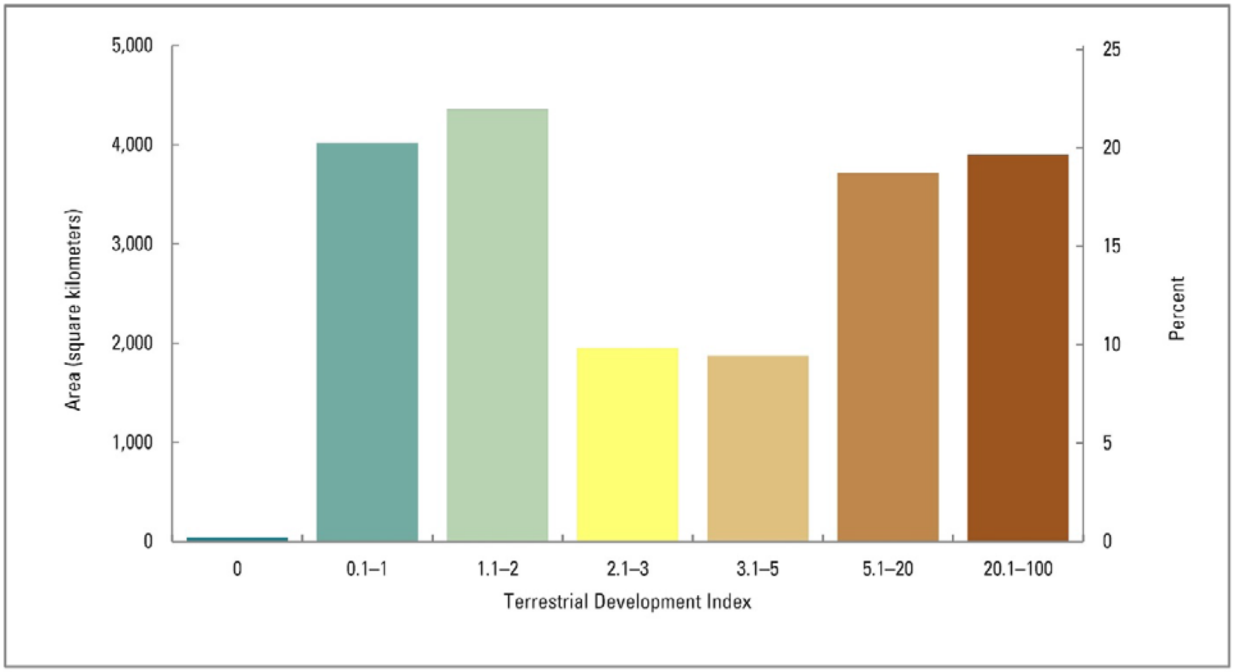

Figure 22–4. Area and percent of baseline spadefoot habitat as a function the Terrestrial Development Index in the Wyoming Basin Rapid Ecoregional Assessment project area.

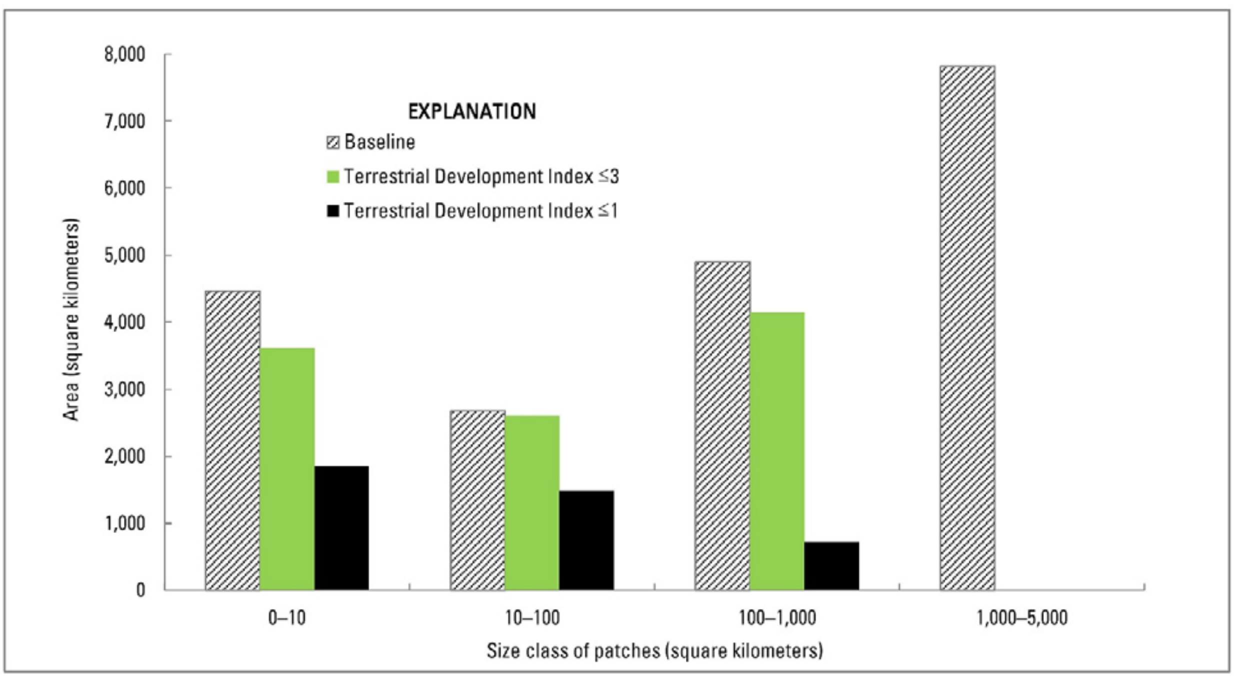

Figure 22–5. Area of spadefoot habitat as a function of patch size for baseline conditions and two development levels: (1) Terrestrial Development Index (TDI) score ≤3 percent and (2) TDI score ≤1 percent (relatively undeveloped areas) in the Wyoming Basin Rapid Ecoregional Assessment project area.

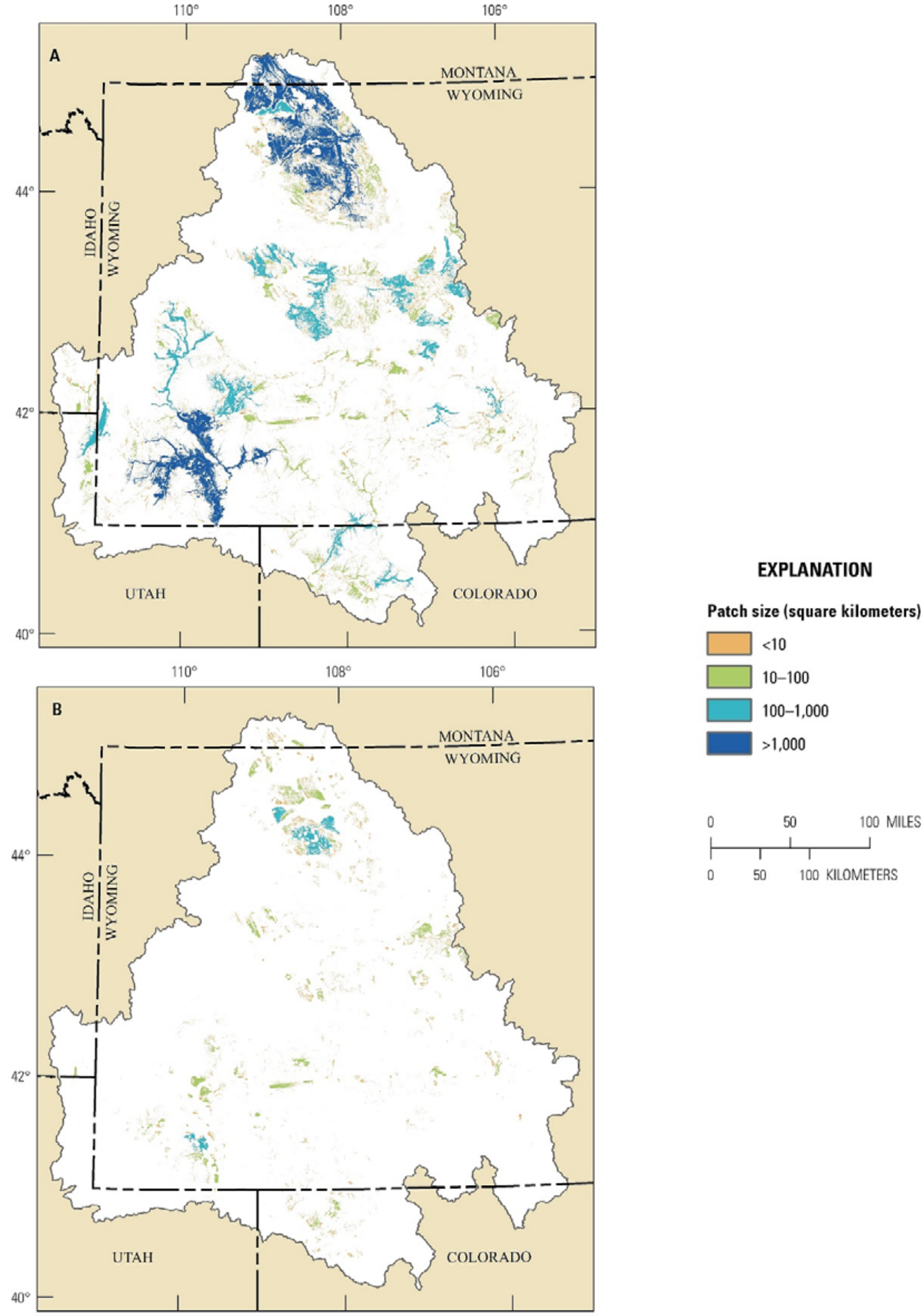

Figure 22–6. Patch sizes of spadefoot habitat in the Wyoming Basin Rapid Ecoregional Assessment project area for (*A*) baseline conditions and (*B*) relatively undeveloped areas (Terrestrial Development Index score ≤1 percent).

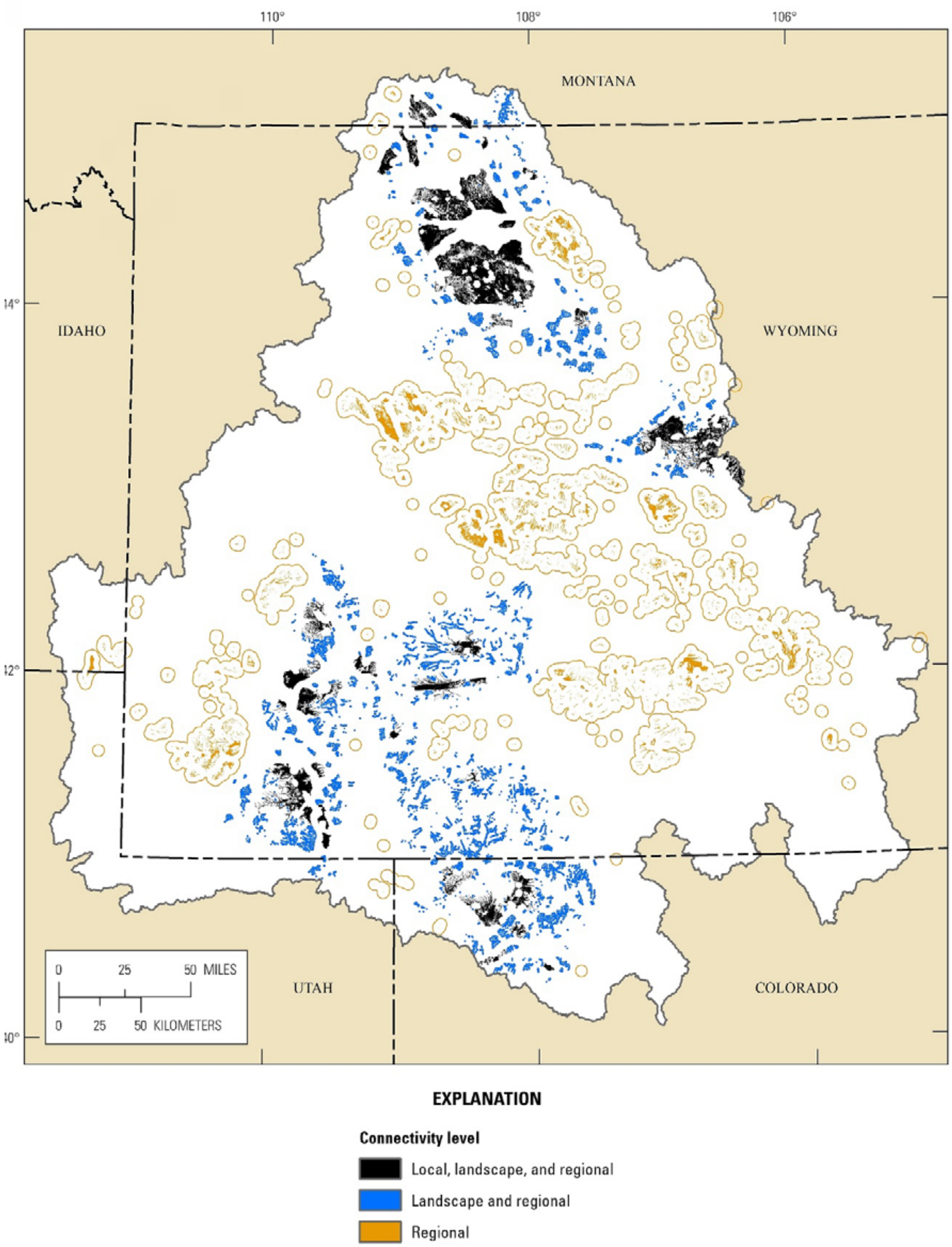

Figure 22–7. Structural connectivity of relatively undeveloped spadefoot habitat in the Wyoming Basin Rapid Ecoregional Assessment project area. Black polygons include large and highly connected habitat patches. Blue polygons include habitat patches that contribute to both landscape and regional connectivity. Orange polygons represent isolated clusters of patches surrounded by developed areas or other cover types.

Where are potential barriers and corridors that may affect animal movements among relatively undeveloped habitat patches (fig. 22–8)?

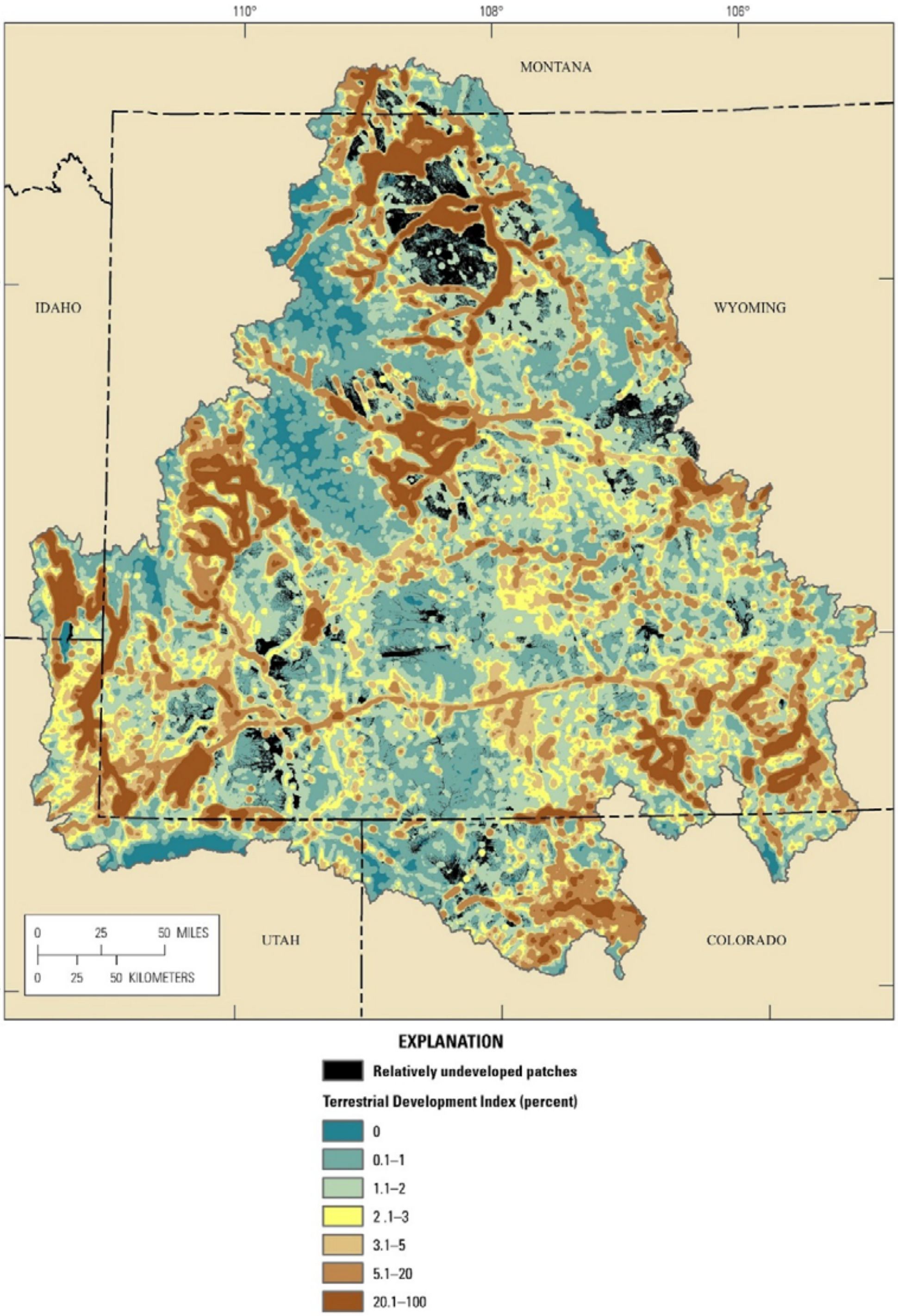

Figure 22–8. Potential barriers and corridors as a function of Terrestrial Development Index (TDI) score for lands surrounding relatively undeveloped spadefoot habitat. Higher TDI scores (for example, >5 percent) represent potential barriers to movement among relatively undeveloped habitat patches. Lower TDI scores (for example, <2 percent) represent potential corridors for movements among patches.

Where have recent fires occurred in baseline spadefoot habitat, and what is the total area burned per year (fig. 22–9)?

- Less than 1 percent (157 km^2 [60.2 mi^2]) of the spadefoot habitat has burned since 1980 (fig. 22–9).
- In most years since 1980, fires have been small and burned only a small portion of spadefoot habitat, with most of the area burned by fires occurring in 1996. This pattern is consistent with the historical size and occurrence of fires (fig. 22–9) (see Chapter 5—Wildland Fire for a more comprehensive discussion of fire).

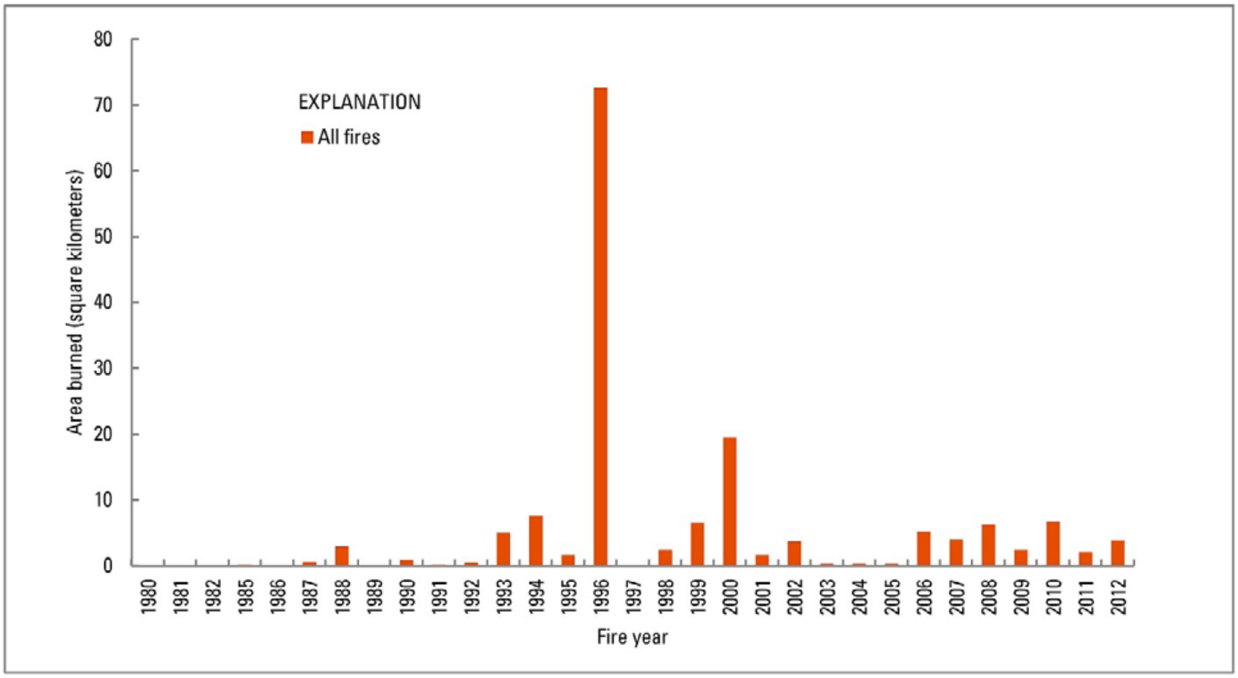

Figure 22–9. Annual area burned by fires in baseline spadefoot habitat since 1980 in the Wyoming Basin Rapid Ecoregional Assessment project area.

How does risk from development vary by land ownership or jurisdiction for spadefoot habitat (table 22–5, fig. 22–10)?

- Approximately 40 percent of baseline spadefoot habitat is found on BLM lands, and another 37 percent is in private ownership (table 22–5).
- Development levels are lowest on BLM lands; other Federal, State/County, and Tribal lands have intermediate levels of development; and private conservation lands are highly developed (fig. 22–10).

Table 22–5. Area and percent of Great Basin and plains spadefoot habitat by land ownership or jurisdiction in the Wyoming Basin Rapid Ecoregional Assessment project area.

[km^2, square kilometers]

Ownership or jurisdiction	Area (km^2)	Percent
Bureau of Land Management	7,925	39.9
Private	7,417	37.3
Other Federal[1]	1,883	9.5
State/County	1,322	6.7
Tribal	1,181	5.9
Private conservation	117	0.6

[1] National Park Service, Department of Defense, Department of Energy, Bureau of Reclamation, U.S. Department of Agriculture Forest Service, and U.S. Fish and Wildlife Service.

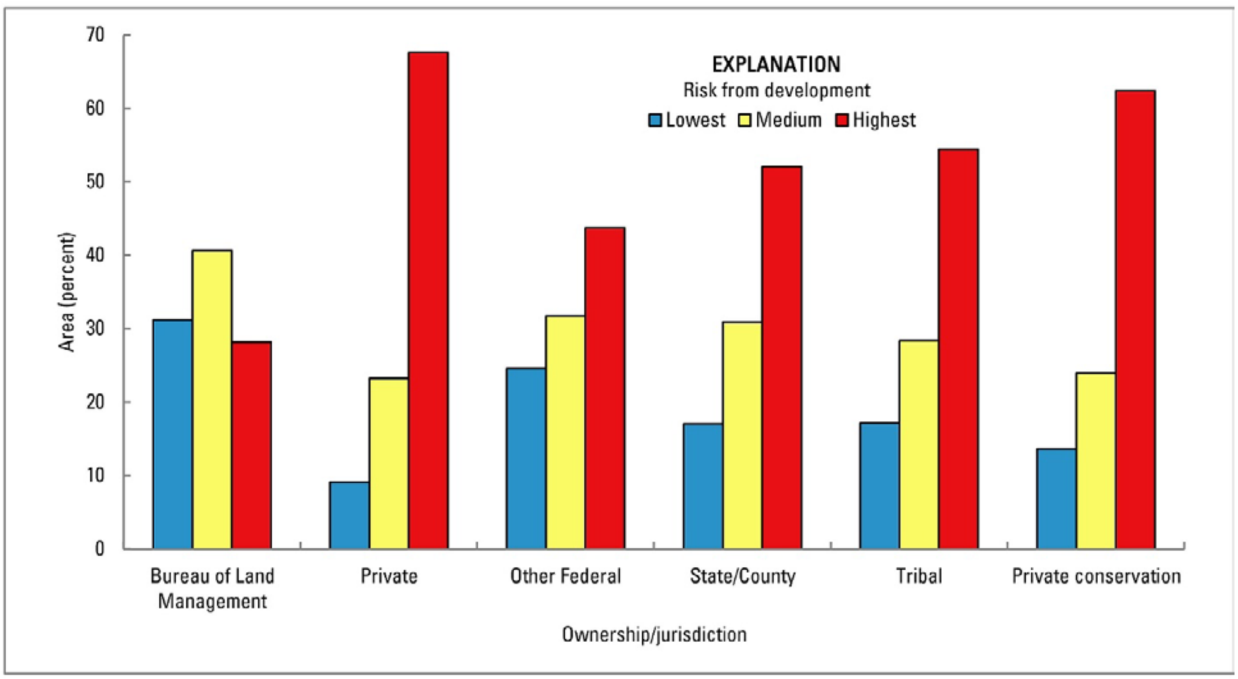

Figure 22–10. Relative ranks of risk from development by land ownership or jurisdiction for spadefoot habitat in the Wyoming Basin Rapid Ecoregional Assessment project area. Rankings are lowest (Terrestrial Development Index [TDI] score <1 percent), medium (TDI score 1−3 percent), and highest (TDI score >3 percent).

Where are the townships with the greatest landscape-level ecological values, and where are the townships with the greatest landscape-level risks (fig. 22−11)?

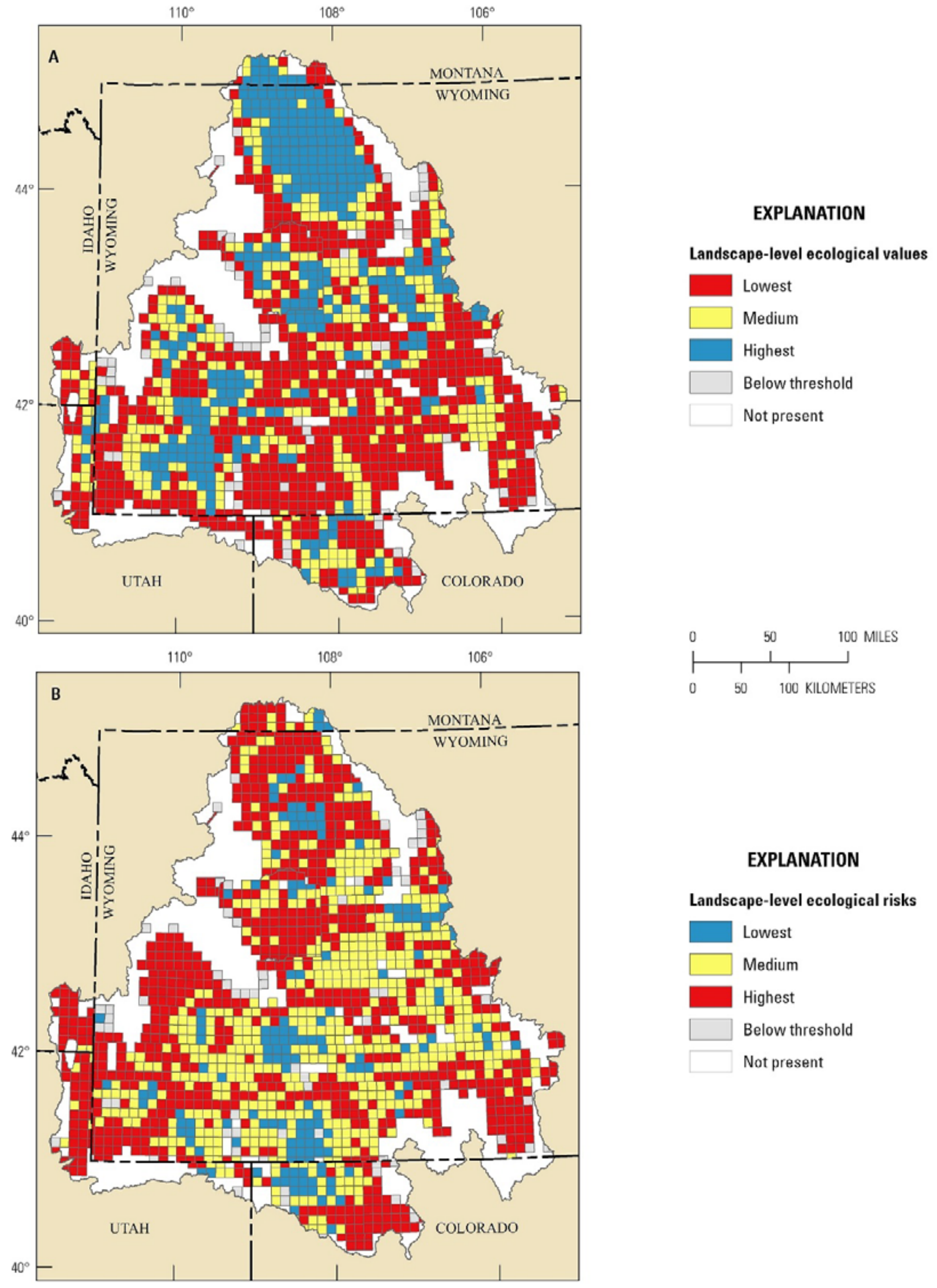

Figure 22–11. Ranks of landscape-level ecological values and risks for spadefoot habitat, summarized by township, in the Wyoming Basin Rapid Ecoregional Assessment project area. (*A*) Landscape-level values based on habitat area and (*B*) landscape-level risks based on Terrestrial Development Index (see table 22–3 for overview of methods).

Where are the townships with the greatest conservation potential (fig. 22−12)?

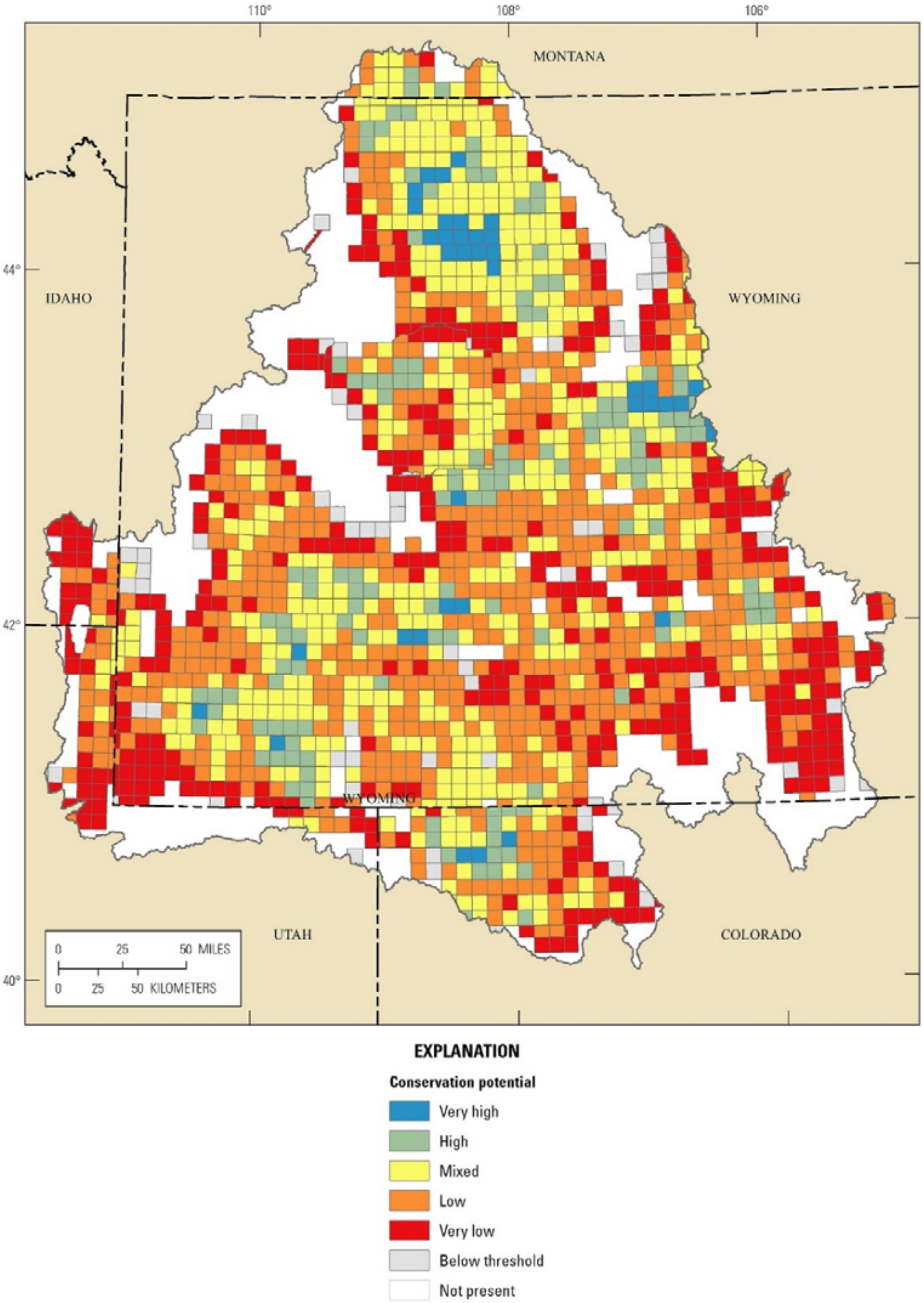

Figure 22–12. Conservation potential of spadefoot habitat, summarized by township, in the Wyoming Basin Rapid Ecoregional Assessment project area. Highest conservation potential identifies areas that have the highest landscape-level values and the lowest risks. Lowest conservation potential identifies 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

The spadefoot habitat model indicates that their habitats are widely distributed in the Bighorn Basin but patchily distributed elsewhere in the Wyoming Basin. The results indicate that agricultural conversion, roads, and energy development in spadefoot habitat have the potential to increase fragmentation and decrease connectivity of Great Basin and plains spadefoot habitat. Spadefoots require connectivity between breeding and wintering areas; thus, development (roads and agriculture) that could disrupt dispersal and seasonal movements is a potential concern. In addition, Great Basin and plains spadefoots, like many other anurans, may be sensitive to pesticides, herbicides, and other toxins associated with agricultural and energy development in their breeding wetlands. A large proportion of the modeled spadefoot habitat in the Wyoming Basin is managed by the Bureau of Land Management (BLM), and spadefoot habitat on BLM lands has much lower development values than on other lands, indicating the potential conservation value of BLM lands for spadefoots.

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