

Section IV. Assessments of Species and Species Assemblages

Chapter 20. Northern Leatherside Chub

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Key Ecological Attributes

Distribution and Ecology

Northern leatherside chub is a small minnow native to streams in the Bonneville Basin in Utah, Idaho, and Wyoming, and portions of the Snake River drainage in far southwestern Wyoming (Zafft and others, 2009). In 2004, taxonomists split northern leatherside chub (or “chub”) from the southern leatherside chub on the basis of genetic, morphological, and ecological differences (Johnson and others, 2004; Belk and others, 2005). Although once common in the Snake River drainage, the chub is now largely restricted to the upper Bear River drainage in the far western portion of the ecoregion (Johnson and others, 2004). This decline in distribution prompted development of a multistate conservation plan by Utah, Wyoming, Nevada, and Idaho State wildlife agencies to protect the chub within its native range (Utah Department of Natural Resources, 2009). The northern leatherside chub was recently a candidate for federal listing on the basis of the Endangered Species Act, although it was not recommended for listing (U.S. Fish and Wildlife Service, 2011).

The Bear River drainage in the Wyoming Basin is a stronghold for the northern leatherside chub, with healthy populations concentrated in the low-gradient portions of streams draining the Uinta Mountains, including the mainstem of the Bear River (Zafft and others, 2009). The chub also occurs in the Green River drainage, although it is currently unknown whether these populations are natural or the result of cross-basin transfer by anglers. Little is known about the chub’s dispersal capabilities, although most populations are believed to be resident, with some fish making occasional long-distance movements (U.S. Fish and Wildlife Service, 2011).

The chub typically occurs in the pool habitats of slow-flowing (<0.5 meters per second (m/sec) [1.64 feet per second (ft/sec)]), mid-elevation (1,800–2,700 m [5,905.5–8,858.3 ft]) streams with golf ball-sized cobble substrates (Zafft and others, 2009; Wesner and Belk, 2012). Aquaculture experiments revealed that northern leatherside chub, which spawn in late spring and early summer, preferred artificial riffles with cobble and gravel substrates (Billman and others, 2008). The chub primarily consume insects and other invertebrates (Zafft and others, 2009). The chub’s temperature tolerances are not well known, although these fish usually inhabit in cool-water streams that average 15–20 degrees Celsius (°C) (59–68 degrees Fahrenheit [°F]) in the summer (Sigler and Sigler, 1996). In a laboratory experiment, the temperature for optimal growth was near 23 °C (73.4 °F) which was higher than the mean temperatures of the chub’s native streams but not higher than the maximum temperatures of those streams (Billman and others, 2008). The chub can live for up to 8 years with a maximum body size of about 15 centimeters (cm) (5.91 inches [in]) (Belk and others, 2005).

Landscape Structure and Dynamics

Although adult chub occur in streams that vary widely in habitat quality, the effect of different stream characteristics on reproductive success is unknown. Chub abundance, however, was positively associated with riffle density and coarse streambed substrates (Wesner and Belk, 2012). This is consistent with laboratory studies on chub preferences for spawning substrates (Billman and others, 2008). The positive relationship between coarse substrates and spawning suggests that population size may depend on availability of suitable spawning substrates.

Isolated chub populations are at greater risk of extirpation, especially the populations inhabiting Dry Fork Creek of the central Bear River subbasin (U.S. Fish and Wildlife Service, 2011). Moreover, the chub does not occur in lakes or reservoirs; thus, the presence of Sulphur Creek Reservoir in the Bear River drainage likely isolated chub populations in reaches of Sulphur Creek above and below the reservoir.

Associated Species of Management Concern

A recent study indicated that the northern leatherside chub may be a potential indicator of biological diversity, because streams where it occurs tend to have greater overall fish diversity than streams where the chub is absent (Wesner and Belk, 2012). This relationship is equivocal, however, as other species in the study also tended to have idiosyncratic habitat requirements that differed from northern leatherside chub (Wesner and Belk, 2012). Commonly co-occurring species include redbside shiner, speckled dace, mountain sucker, and longnose dace (Wesner and Belk, 2012)

Change Agents

Development

Factors limiting northern leatherside chub distribution and possibly productivity include stream siltation, channelization, and water withdrawals associated with energy development and agricultural activities. Energy development throughout the Wyoming Basin is of concern due to the amount of water used for energy extraction; potential pollution from introduced chemicals or waste water; the creation of movement barriers (for example, culverts); and increased sediment runoff due to surface disturbance associated with building and maintaining roads, pipelines, and well pads (Entrekin and others, 2011). Little is known about the chub's pollution tolerance; however, studies of spawning substrate preferences (Billman and others, 2008; Wesner and Belk, 2012) indicate that increased sedimentation could degrade the suitability of their spawning habitats. There is a clear need to understand the link between factors that can increase sedimentation (grazing, agriculture, and energy development) and reproductive output of northern leatherside chub.

Stream fragmentation due to dams and water diversions associated with agricultural irrigation also may limit chub populations. Some known consequences of livestock grazing include substantially altered riparian habitat, water quality, and sediment transport due to livestock trampling of stream banks and riparian vegetation. Extensive livestock grazing also may lead to increased water temperatures, decreased cover, increased bank erosion, and degraded spawning substrate due to siltation (Armour and others, 1991). Another concern is the entrainment of chub in irrigation ditches. On the basis of high mortality rates of other fish in irrigation canals (for example, cutthroat trout), Roberts and Rahel (2008) estimated that a large proportion of northern leatherside chub entrained in irrigation canals do not return to the stream from the canals due to their mortality in the canals following drawdown.

Invasive Species

Predatory brown, rainbow, and brook trout, which are nonnative species widely introduced in the Wyoming Basin, also negatively impact the chub through direct predation or by

potentially forcing them to seek refuge in less-preferred side-channel habitats (Wilson and Belk, 2001). Juvenile trout may also compete directly with adult chub, although relative to predation, little is known about competition between trout and chub (U.S. Fish and Wildlife Service, 2011). Healthy populations of chub appear to be isolated from nonnative trout, particularly brown and rainbow trout. Maintaining isolation from nonnative species likely will help to conserve populations of northern leatherside chub.

Climate Change

Climate change is a growing concern due to projected (1) increased summer temperatures, (2) increased winter flooding, (3) increased risk of wildfire, and (4) protracted drought (Haak and others, 2010). The upper incipient lethal water temperature for adult chub is estimated to be between 26.5–30.2 °C (79.7–86.4 °F) (Billman and others, 2008); thus, water temperatures between 23–26 °C (73.4–78.8 °F) may have moderate but sublethal effects on northern leatherside chub, whereas prolonged summer water temperatures above 26 °C (78.8 °F) may be lethal. Eggs may be more vulnerable and egg survival may decline if stream temperatures exceed 23 °C (73.4 °F) (Bartley and others, 2012). Spring temperatures exceeding 23 °C (73.4 °F) also may reduce offspring survival.

Rapid Ecoregional Assessment Components Evaluated for Northern Leatherside Chub

A generalized conceptual model was used to highlight some of the key ecological attributes and Change Agents affecting northern leatherside chub (fig. 20–1). Key ecological attributes addressed by the REA include (1) the distribution of northern leatherside chub within the Wyoming Basin and (2) landscape dynamics (fire occurrence and hydrologic regime, table 20–1). Occurrence information was insufficient data to address landscape structure for this species. The Change Agents evaluated include development, competition, predation, and climate change (table 20–2). Ecological values and risks used to assess the conservation potential for northern leatherside chub by fifth-level watershed are summarized in table 20–3. Core and Integrated Management Questions and the associated summary maps and graphs are provided in table 20–4.

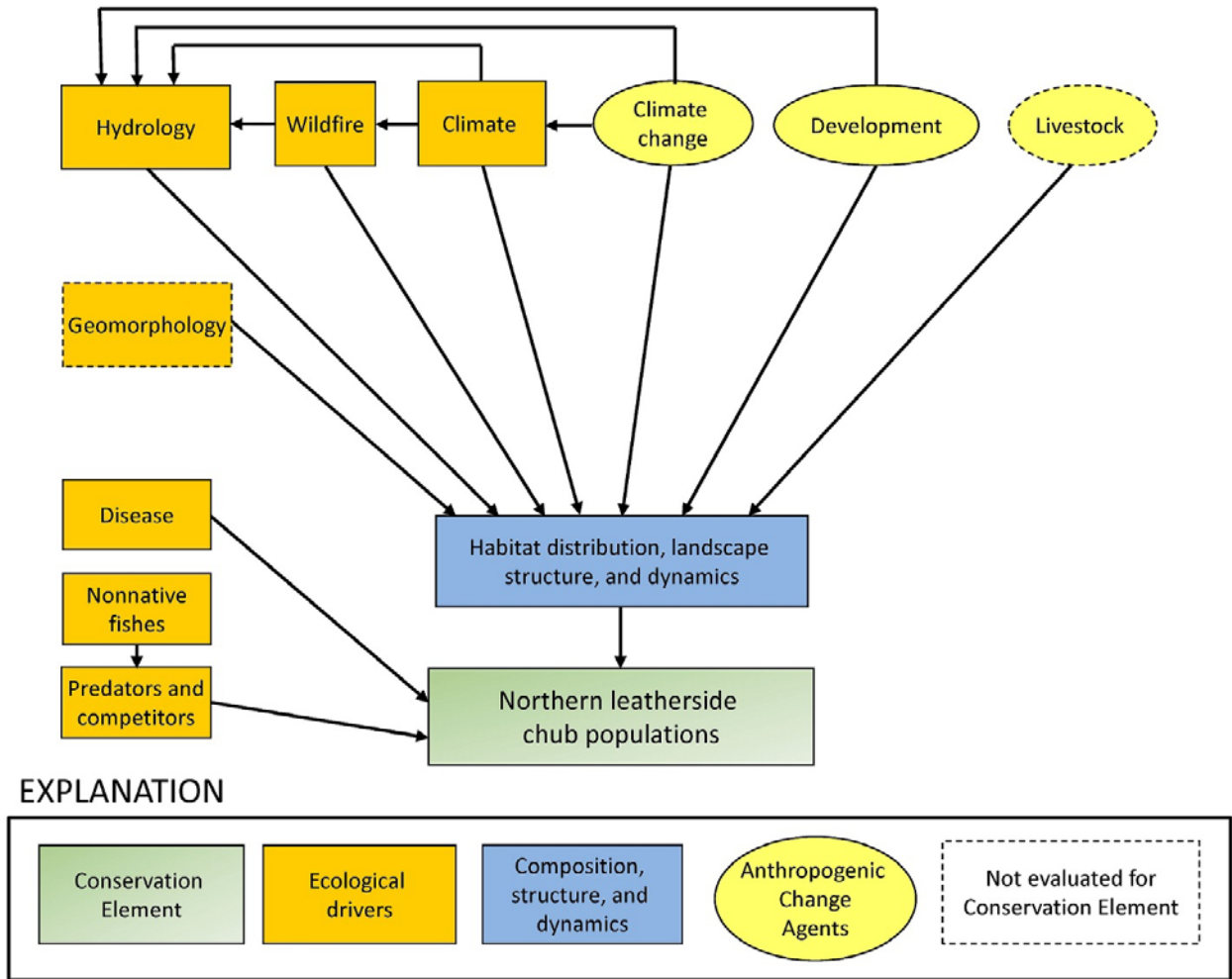


Figure 20–1. Generalized conceptual model of northern leatherside chub habitat for the Wyoming Basin Rapid Ecoregional Assessment (REA). Biophysical attributes and ecological processes regulating the occurrence, structure, and dynamics of northern leatherside chub populations and habitat are shown in 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 20–1. Key ecological attributes and associated indicators of baseline northern leatherside chub habitat¹ for the Wyoming Basin Rapid Ecoregional Assessment.

Attributes	Variables	Indicators
Distribution	Occupied sixth-level watersheds	Habitat distribution derived from occurrence data ²
Landscape structure	Patch size	Not addressed because data were not sufficient for evaluating stream-segment length distribution
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 amount and landscape structure of occupied catchments due to Change Agents. Baseline conditions are defined as the current distribution of streams and rivers in occupied catchments derived from data obtained from National Hydrography Dataset <http://nhd.usgs.gov/index.html>. However, dams have already altered conditions and increased isolation of populations. See Chapter 2—Assessment Framework.

² Data provided by Wyoming Game and Fish Department, Utah Department of Wildlife Resources (2009), Wesner and Belk (2012).

Table 20–2. Anthropogenic Change Agents and associated indicators influencing northern leatherside chub habitat for the Wyoming Basin Rapid Ecoregional Assessment.

Change Agents	Variables	Indicators
Development	Aquatic Development Index (ADI)	Percent of northern leatherside chub habitat in seven development classes ¹
	Barriers to movement and flow alteration	Number of potential barriers (dams, points of diversion, and stream-road crossings) in occupied sixth-level watersheds ¹
Nonnatives	Competition and predation with nonnative trout species	Co-occurrence of northern leatherside chub with nonnative trout ²
Climate change	Hydrologic regime change	See Chapter 8—Streams and Rivers

¹ See Chapter 2—Assessment Framework and Appendix

² Data on nonnative salmonids from Wyoming Game and Fish Department and Trout Unlimited.

Table 20-3. Landscape-level ecological values and risks for northern leatherside chub habitat. Ranks were combined into an index of conservation potential for the Wyoming Basin Rapid Ecoregional Assessment.

	Variables ¹	Relative rank			Description ²
		Lowest	Medium	Highest	
Values	Amount of habitat	<1.95	1.95–8.61	>8.61	Percent of catchments, by watershed
Risks	Aquatic Development Index (ADI)	<20	20–40	>40	Mean ADI score by watershed

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

² See tables 20-1 and 20-2 for description of variables.

Table 20-4. Management questions evaluated for northern leatherside chub for Wyoming Basin Rapid Ecoregional Assessment.

Core Management Questions	Results
Where is occupied baseline northern leatherside chub habitat?	Figure 20-2
Where does development pose the greatest threat to northern leatherside chub habitat?	Figures 20-3 and 20-4
Where do dams, diversions, and stream-road crossings pose potential barriers to northern leatherside chub movements, and where are watersheds with the highest structural connectivity?	Figure 20-5
Where are northern leatherside chub populations at risk of competition and predation by nonnative salmonid species?	Figure 20-6
Integrated Management Questions	Results
How does risk from development vary by land ownership or jurisdiction for northern leatherside chub habitat?	Table 20-5, Figure 20-7
Where are the watersheds with the greatest landscape-level ecological values?	Figure 20-8
Where are the watersheds with the greatest landscape-level risks?	Figure 20-8
Where are the watersheds with the greatest conservation potential?	Figure 20-9

Methods Overview

To map the distribution of northern leatherside chub, we compiled location data (see table 20–1 for data sources) and mapped presence by catchments and for sixth-level watersheds. The occurrence by sixth-level watershed was used to quantify baseline conditions for northern leatherside chub. Dams and reservoirs have already significantly altered baseline conditions and isolated several chub populations. Key ecological attributes were evaluated for baseline conditions and compared with overlays of Change Agents. The ADI scores were averaged by sixth-level watershed. To incorporate additional potential barriers, we summarized the number of dams, points of diversion, and stream-road crossings of occupied sixth-level watersheds.

Potential competition and predation risk were derived from occurrence data for brown, rainbow, and brook trout (see table 20–1 for data sources). Competition and predation risk were derived from the watershed-level co-occurrence of northern leatherside chub and at least one species of nonnative trout in sixth-level watersheds. Whereas trout are the primary nonnative species of concern for northern leatherside chub (Wilson and Belk, 2001), other nonnative fish are also sparsely distributed throughout the range of northern leatherside chub, primarily fathead minnow, smallmouth bass, and walleye. We did not include these species because they have sparse distributions in the chub’s range (especially smallmouth bass and walleye) and are not surveyed as intensively as trout.

Landscape-level ecological values (amount of northern leatherside chub habitat) and risk (ADI score) were compiled into an overall index of conservation potential for each fifth-level watershed (table 20–3). 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 occupied baseline northern leatherside chub habitat (fig. 20–2)?

- Northern leatherside chub are narrowly distributed and are known to occupy a total of 97 catchments, all of which are located in the western portion of the Wyoming Basin REA project area (fig. 20–2).
- With the exception of one population (possibly introduced) in the Green River drainage, all chub populations in the Wyoming Basin are restricted to the Bear River drainage.
- Within the Bear River drainage, northern leatherside chub occur in three distinct regions: a northern region that includes the Smith’s Fork River and its tributaries; a central region that includes Twin Creek and its tributaries; and a southern region that includes the mainstem of the upper Bear River and its tributaries.

Where does development pose the greatest threat to northern leatherside chub habitat (figs. 20– 3 and 20–4)?

- Only 8.6 percent of sixth-level watersheds occupied by the chub are classified as relatively undeveloped (ADI score <20) (figs. 20–3 and 20–4).
- Approximately 21 percent of watersheds occupied by the chub has ADI scores >50, indicating high levels of development (fig. 20-3).
- The southwestern watersheds where the chub is present have the greatest levels of development (fig. 20–3).

Where do dams, diversions, and stream-road crossings pose potential barriers to northern leatherside chub movements, and where are watersheds with the highest structural connectivity (fig. 20–5)?

- The southwestern watersheds occupied by the chub have the greatest number of dams and potential barriers
- The fewest number of potential barriers occur primarily in the northern most watersheds occupied by the chub.

Where are northern leatherside chub populations at risk of competition and predation by nonnative salmonid species (fig. 20–6)?

- Nonnative trout are present in 48 percent of sixth-level watersheds in which the chub occurs.
- The distribution of nonnative trout is spread relatively evenly across the range of northern leatherside chub.

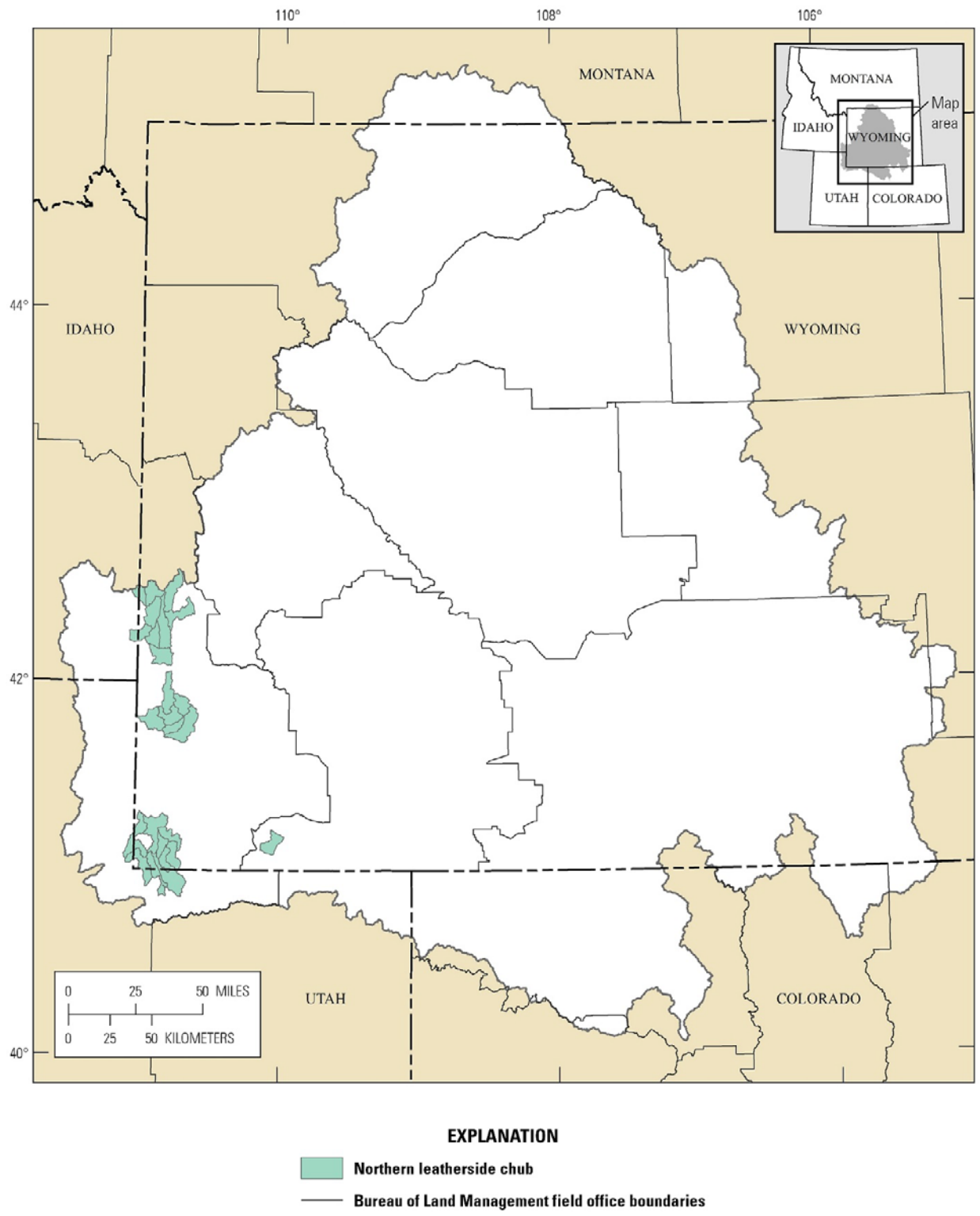


Figure 20–2. Distribution of baseline northern leatherside chub by sixth-level watershed in the Wyoming Basin Rapid Ecoregional Assessment project area.

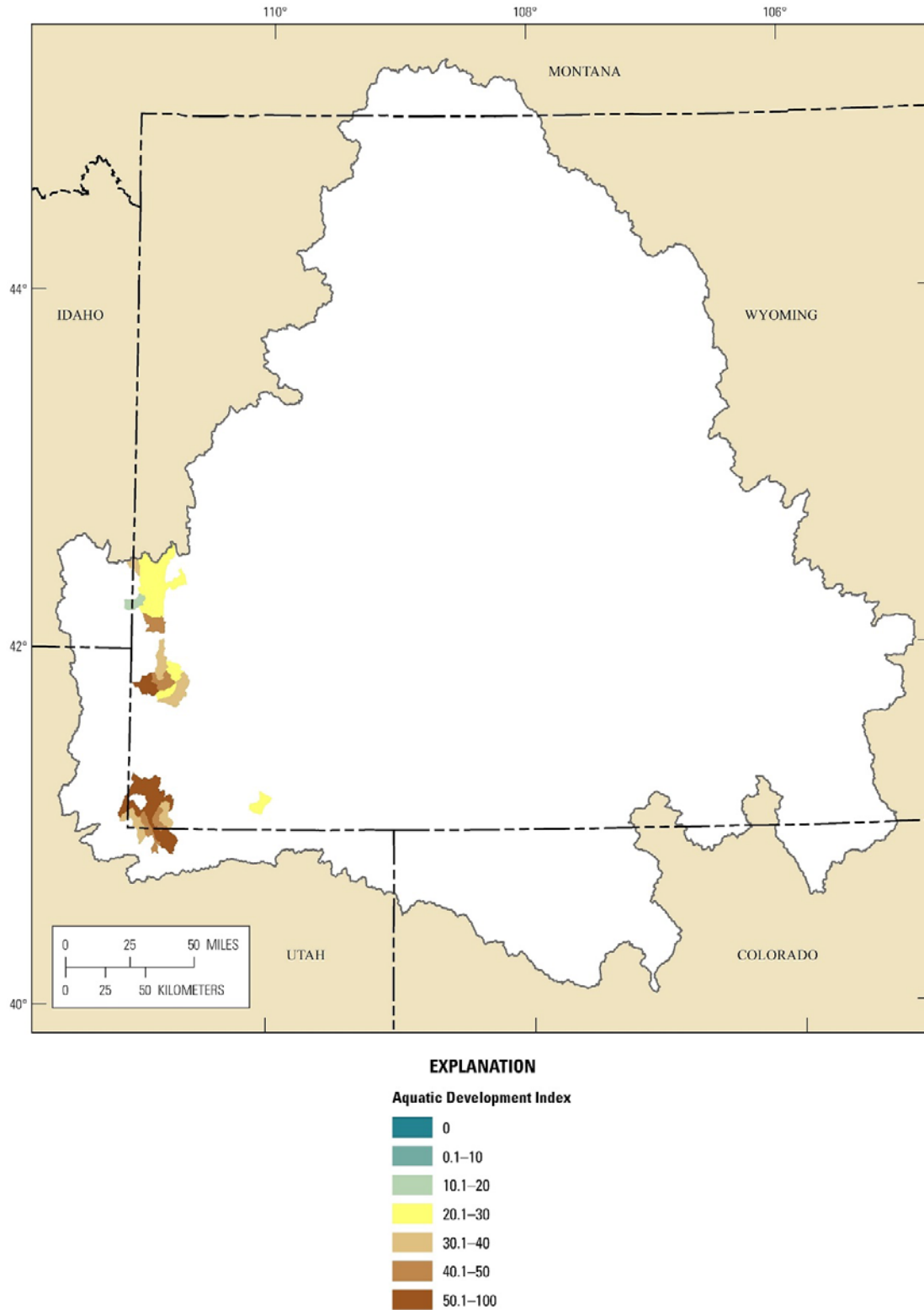


Figure 20–3. Aquatic Development Index scores for sixth-level watersheds that have known occurrences of northern leatherside chub in the Wyoming Basin Rapid Ecoregional Assessment project area.

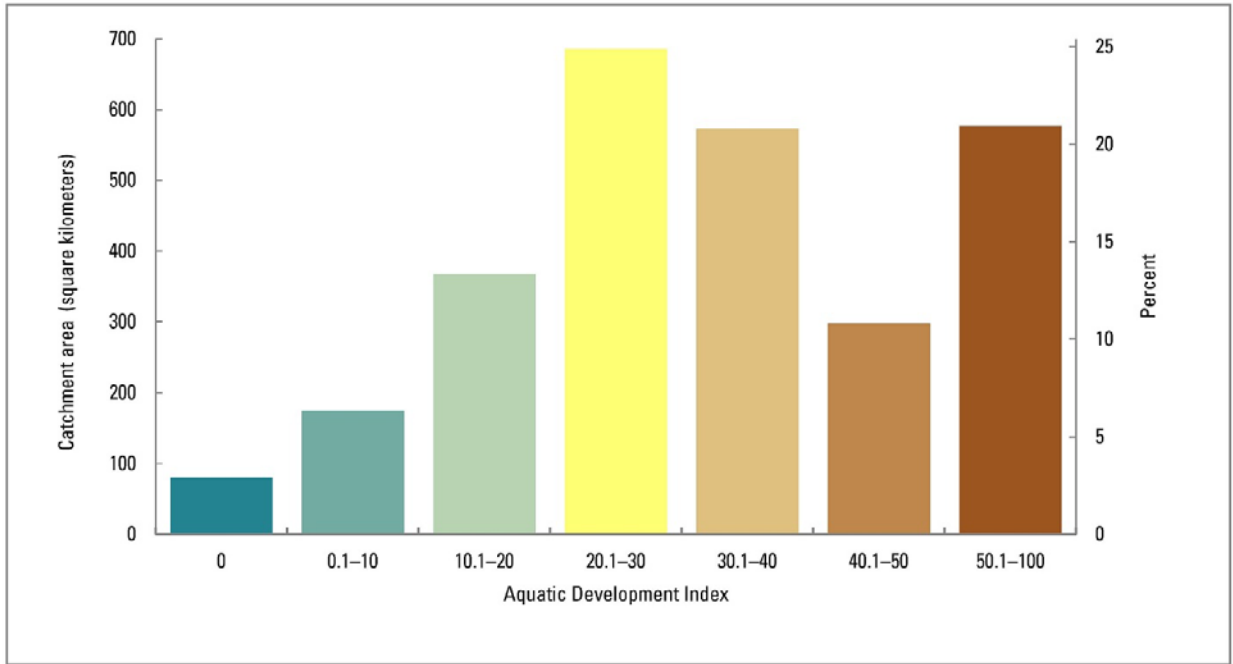


Figure 20-4. Area and percent of catchments within sixth-level watersheds occupied by northern leatherside chub as a function of the Aquatic Development Index in the Wyoming Basin Rapid Ecoregional Assessment project area.

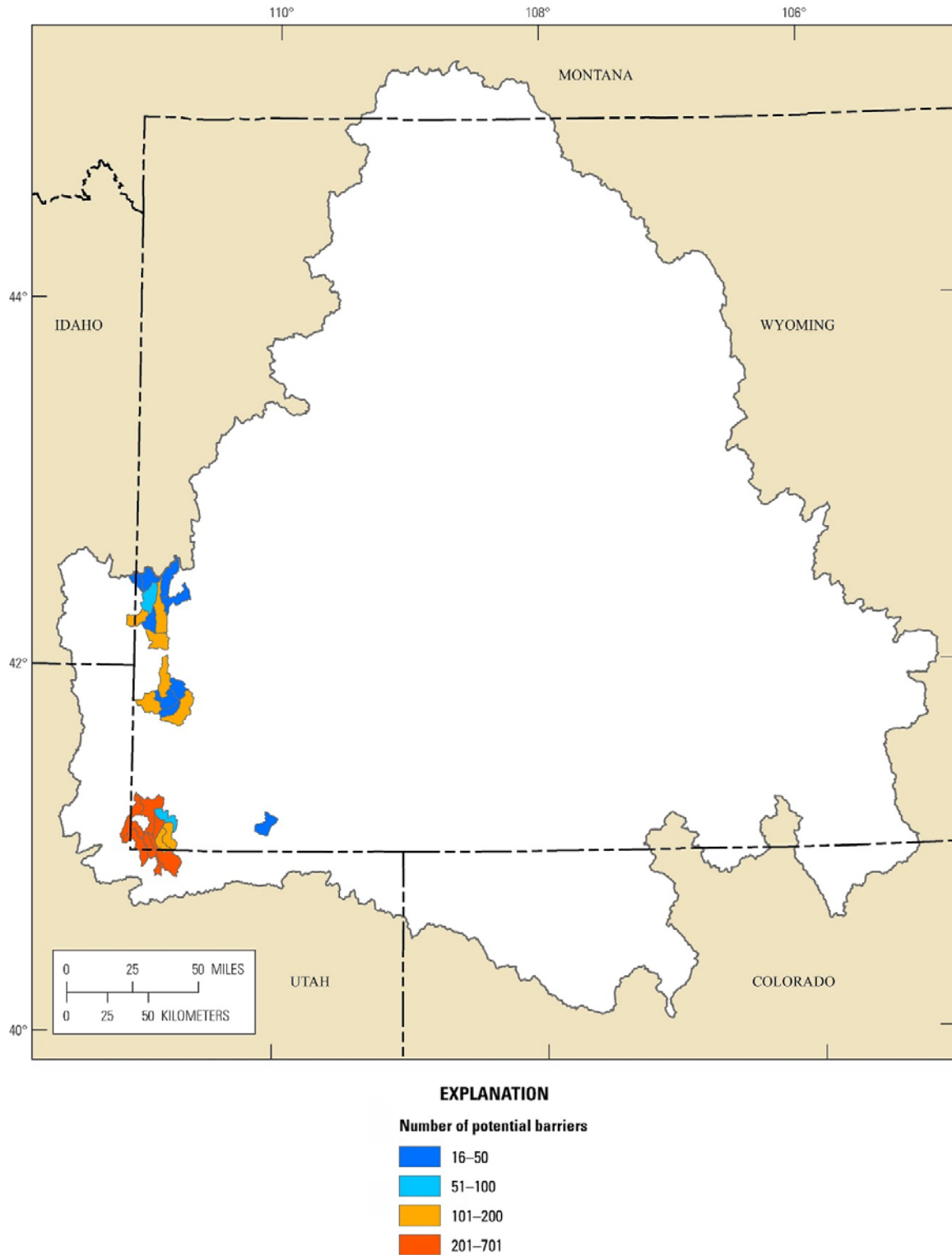


Figure 20–5. Potential barriers to northern leatherside chub movements summarized by sixth-level watershed in the Wyoming Basin Ecoregional Assessment project area. Number of potential barriers includes dams, points of diversion, and stream-road crossings within occupied sixth-level watersheds.

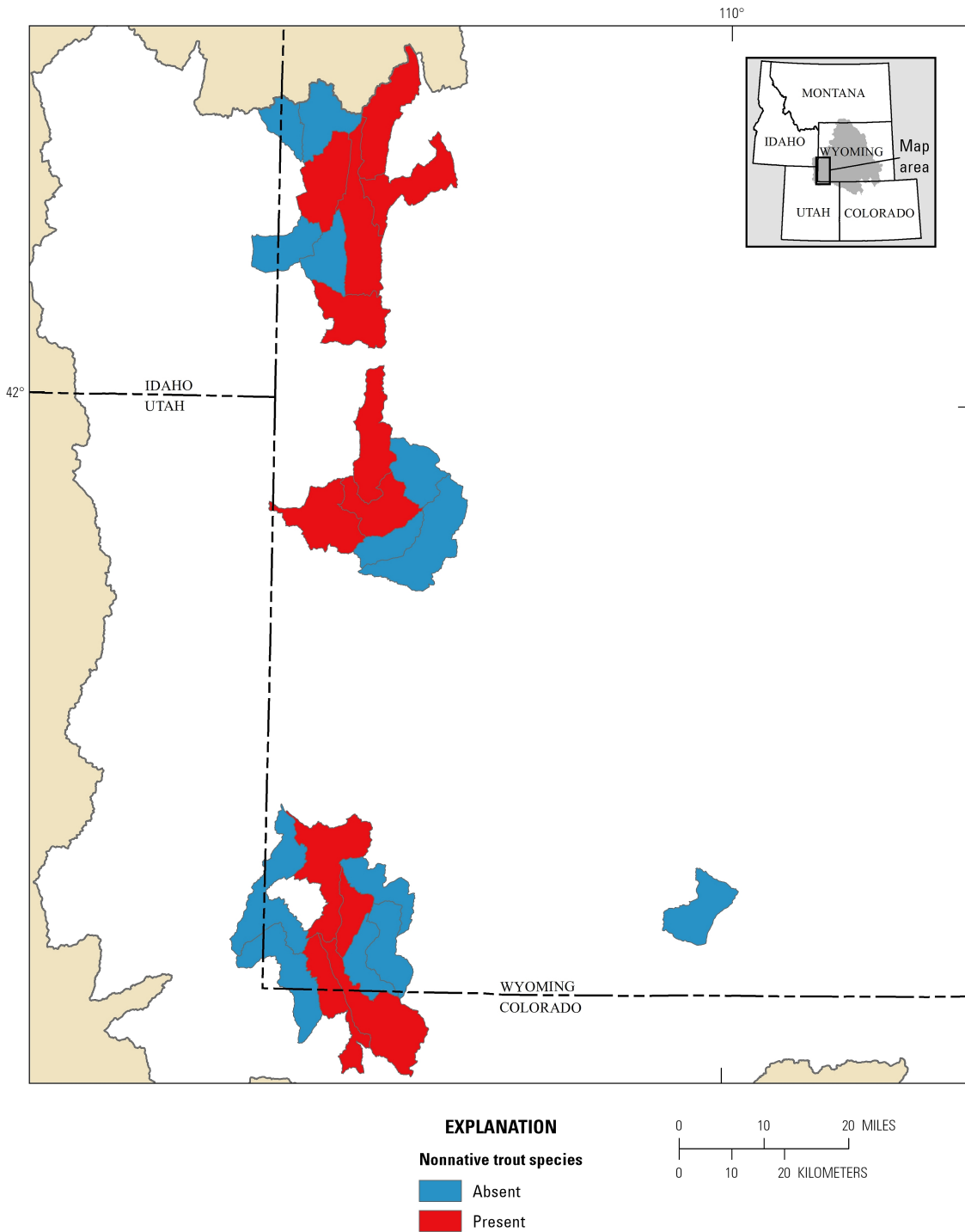


Figure 20–6. Potential risk of competition and predation risk to northern leatherside chub in the Wyoming Basin Rapid Ecoregional Assessment project area. Risk is derived from the presence of nonnative trout species including brown trout, rainbow trout, and brook trout in sixth-level watersheds.

How does risk from development vary by land ownership or jurisdiction for northern leatherside chub habitat (table 20–5, fig. 20–7)?

- The two major types of land ownership or jurisdiction associated with the chub’s distribution are BLM (42 percent) and private (35 percent) (table 20–5).
- Lands managed by the BLM primarily have moderate risk from development, whereas private lands have a nearly equal mix of moderate and high risk from development (fig. 20–7).

Table 20–5. Area and percent of watersheds occupied by northern leatherside chub, by land ownership or jurisdiction, in the Wyoming Basin Rapid Ecoregional Assessment project area. [km², square kilometer]

Ownership or jurisdiction	Watershed area (km ²)	Percent
Bureau of Land Management	278	41.8
Private	231	34.6
Forest Service ¹	89	13.3
State/County	64	9.6
National Park Service	3	0.5

¹U.S. Department of Agriculture Forest Service.

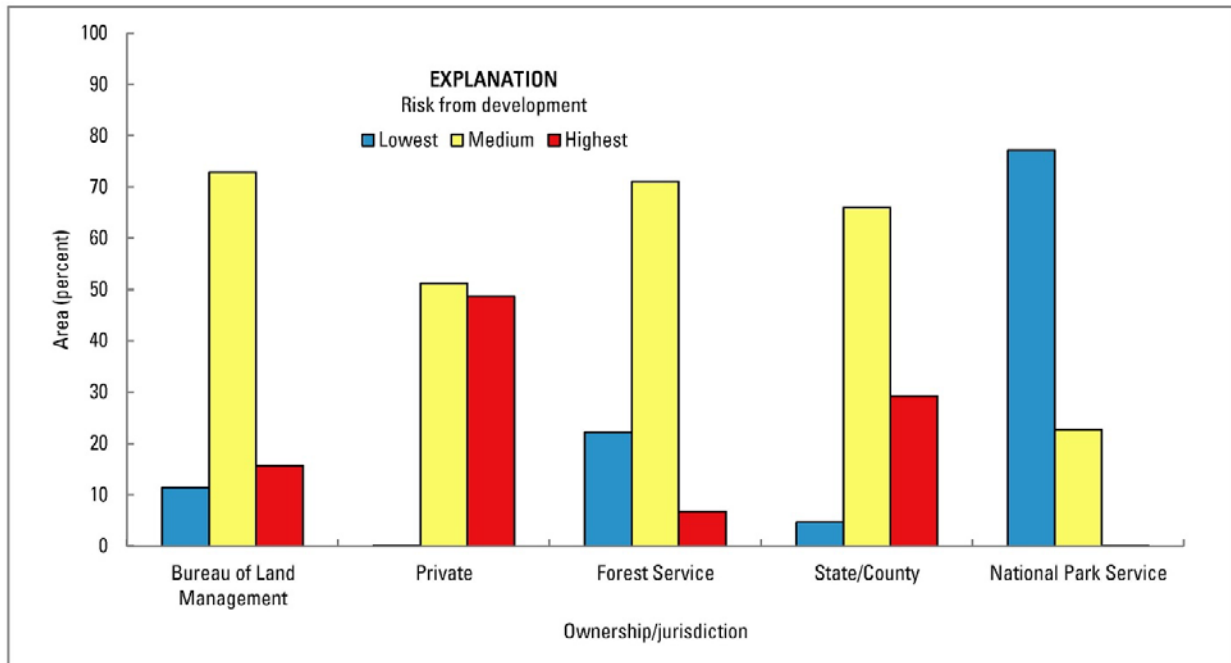


Figure 20–7. Relative ranks of risk from development, by land ownership or jurisdiction, for watersheds occupied by northern leatherside chub in the Wyoming Basin Rapid Ecoregional Assessment project area. Rankings are lowest (Aquatic Development Index [ADI] score <20), medium (ADI score 20–40), and highest (ADI score >40). [Forest Service, U.S. Department of Agriculture Forest Service]

Where are the watersheds with the greatest landscape-level ecological values and risks (fig. 20–8)?

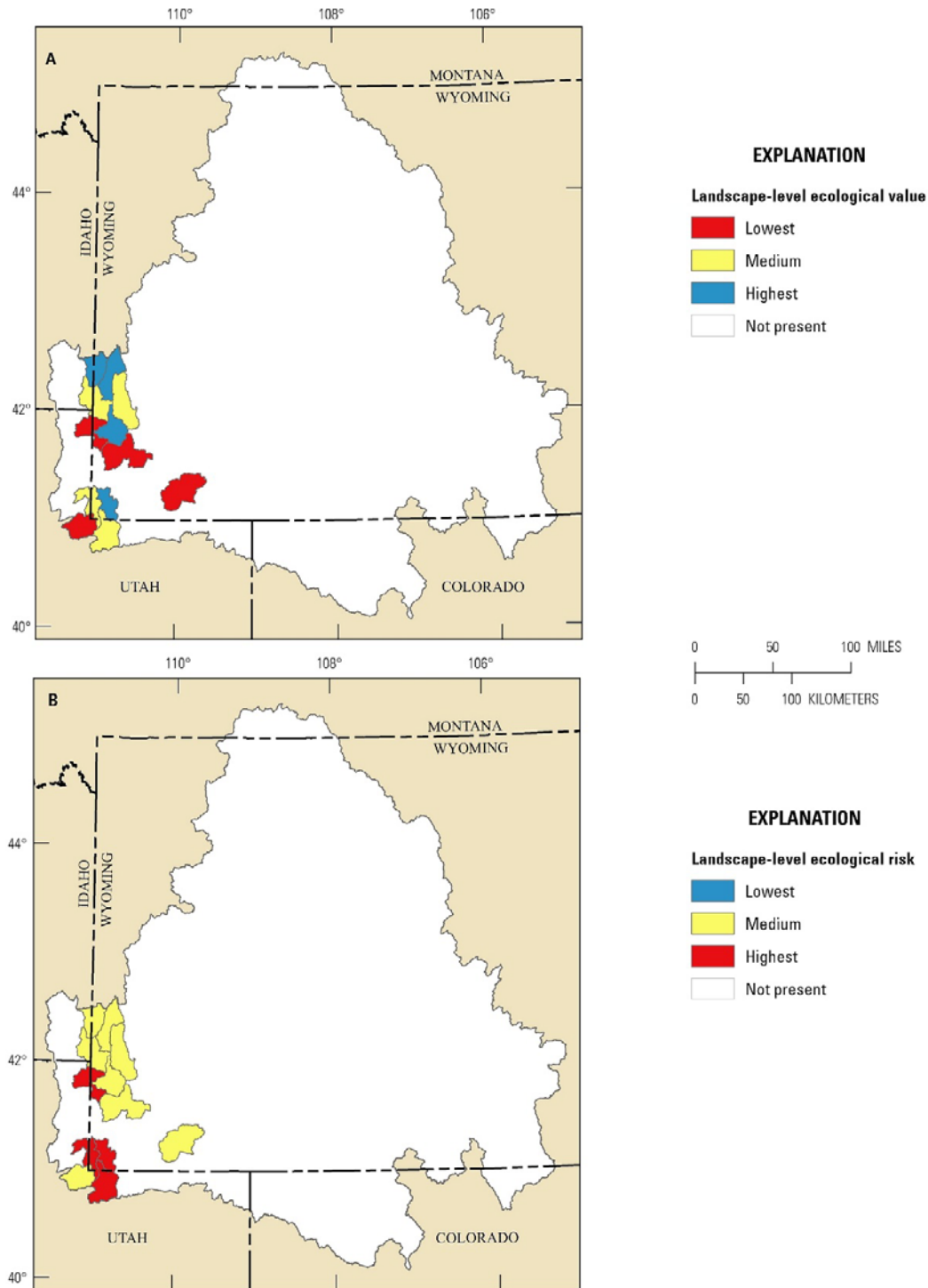


Figure 20–8. Ranks of landscape-level ecological values and risks for northern leatherside chub habitat, summarized by fifth-level watershed, in the Wyoming Basin Rapid Ecoregional Assessment project area. (A) Landscape-level values based on percent of occupied catchments per watershed and (B) landscape-level risks based on Aquatic Development Index (see table 20–3 for overview of methods).

Where are the watersheds with the greatest conservation potential (fig. 20–9)?

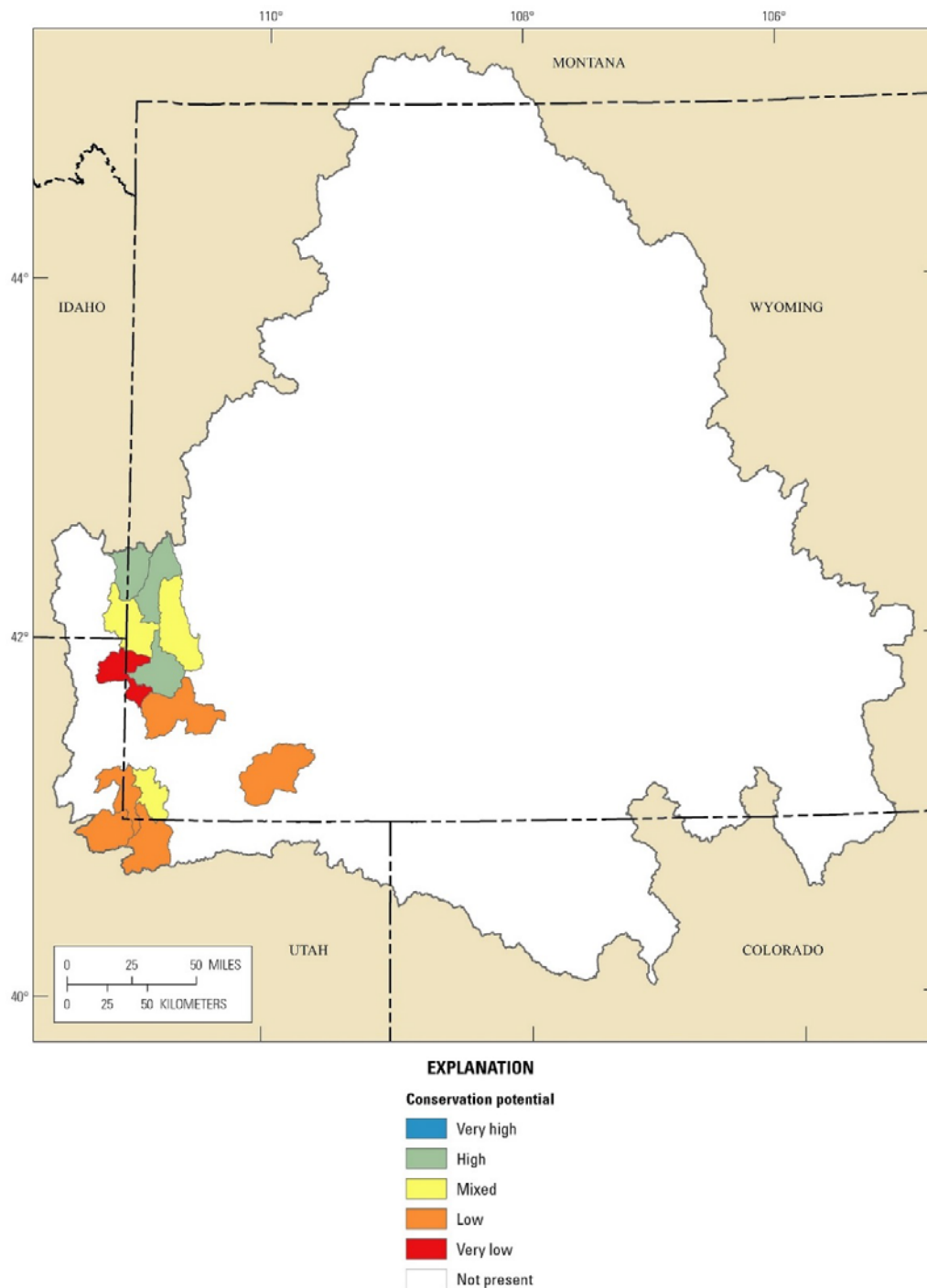


Figure 20–9. Conservation potential of northern leatherside chub habitat, summarized by fifth-level watershed, in the Wyoming Basin Rapid Ecoregional Assessment project area. Highest conservation potential identifies watersheds that have the highest landscape-level values and the lowest risks. Lowest conservation potential identifies watersheds 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 Wyoming Basin includes a majority of the extant populations of northern leatherside chub. These populations are limited to the far southwestern portion of the Wyoming Basin. With the exception of a potentially introduced population in the Green River drainage (Utah Department of Natural Resources, 2009), all chub populations inhabit the Bear River drainage, including the mainstem Bear River and its major tributaries.

The watersheds occupied by northern leatherside chub are heavily developed for agricultural use, particularly in the southwestern part of their range, where there are more than 200 potential barriers (dams, diversions, and road crossings) per watershed. Effects of these barriers likely vary; reservoirs are typically impassible to chub, whereas the permeability of culverts (road crossings that allow streams to pass under roads) varies with culvert design. Diversions pose a risk to chub, which can become entrained in canals once water flow is shut off (Roberts and Rahel, 2008).

Overall, most northern leatherside chub habitat in the Wyoming Basin has high levels of development. The areas with the highest conservation potential are in the northern part of the chub's range. This includes the healthy populations in Dry Fork Creek, which has low levels of development and occurs largely on public land (Schultz and Cavalli, 2012). Although the southern range has higher levels of development, it also contains some of the largest chub populations. These areas, however, present significant management challenges due to their higher levels of development, apparently low structural connectivity, and private land ownership (Schultz and Cavalli, 2012).

Landscape-level analysis at the fifth-level watershed scale does not identify variation in habitat values and risks to populations within catchments. Nevertheless, our results are consistent with a recent report indicating that northern populations of northern leatherside chub contain excellent habitat and high conservation potential. The Wyoming Game and Fish Department recently classified these northern sites as "Goal 1" sites, defined as "crucial to conserving and maintaining populations of terrestrial and aquatic wildlife for the present and future." They also classified the southern sites as Goal 2 sites, defined as "habitats where enhancement activities can be opportunistically performed" (Schultz and Cavalli, 2012).

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