



Conservation Success Index: Greenback Cutthroat Trout

ONCORHYNCHUS CLARKII STOMIAS

Rev. 2.0 - 9/2009

SPECIES SUMMARY

Greenback cutthroat trout (GCT) are the most easterly **Historic Range Relief Map** of all cutthroats, evolving from ancestral steelhead and coastal cutthroat trout that migrated up with Columbia and Snake River drainages to the Yellowstone and Green/Colorado systems. Robert Behnke believes that the Colorado River cutthroat, which likely invaded the South Platte basin by headwater stream capture, are the closest relatives to the GCT.



Greenback cutthroat trout (GCT) once were abundant in the South Platte and Arkansas river drainages in central Colorado and a small portion of adjacent Wyoming. By the early 1900s, however, GCT had been extirpated from most of this native range because of habitat destruction and the introduction of non-native trouts. GCT appear to be perhaps the most susceptible native trout to displacement by non-native trout introductions.

Genetically pure greenbacks were thought to be extinct by the 1930s due to over harvest and introductions of non-native fishes. Nonetheless, a few populations persisted in remote, high-country drainages to be rediscovered in the 1960s and 1970s.



In 1973, GCT from the few remaining populations were reintroduced into historic habitats. By 1998, the recovery plan noted that GCT occurred in 62 sites. Recovery efforts continue for this subspecies, which is listed as “threatened” pursuant to the Endangered Species Act.

Our CSI analysis shows that GCT are still found in only a small portion of their native range, with 30 of 455 subwatersheds (6.6%) of the historic range currently occupied. Even within occupied subwatersheds, GCT often occur in restricted habitat areas such as a small lake or single stream segment. CSI scores for population extent were very low with only 3 subwatersheds (10%) scoring 3 or higher, indicating that most stream populations are 10-20 km of habitat or less. Most remaining populations are found at higher elevations, with a relatively high proportion of strongholds in Rocky Mountain National Park.

Total CSI scores vary widely, with only 10% of subwatersheds scoring in the highest category (81-90). Population density and genetic purity information were lacking for some populations (“starred” subwatersheds in Total CSI map).

Restoration actions should focus on 3 problem areas identified by the CSI: expanding and reconnecting small populations currently at risk of extinction, restoring migratory life histories, and controlling non-native trout in key subwatersheds. Interconnected genetically pure stream populations are needed as many existing populations are at risk of extinction because of their small size. Genetically, there are concerns from introgression of non-native cutthroat genes and rainbow trout genes as well as bottlenecks associated with small populations.

Key CSI Findings

- Less than 7% of historic range is occupied as measured by subwatersheds
- Most remaining populations are small and vulnerable to extirpation
- Primary strongholds exist in Rocky Mountain National Park
- Restoration and reintroduction efforts must address poor water quality and the presence of non-native trouts

In the management priorities map, most subwatersheds show high priority for reintroduction. Improvement in water quality, flows and control of non-native trouts are a prerequisite to reintroduction in many of these areas.

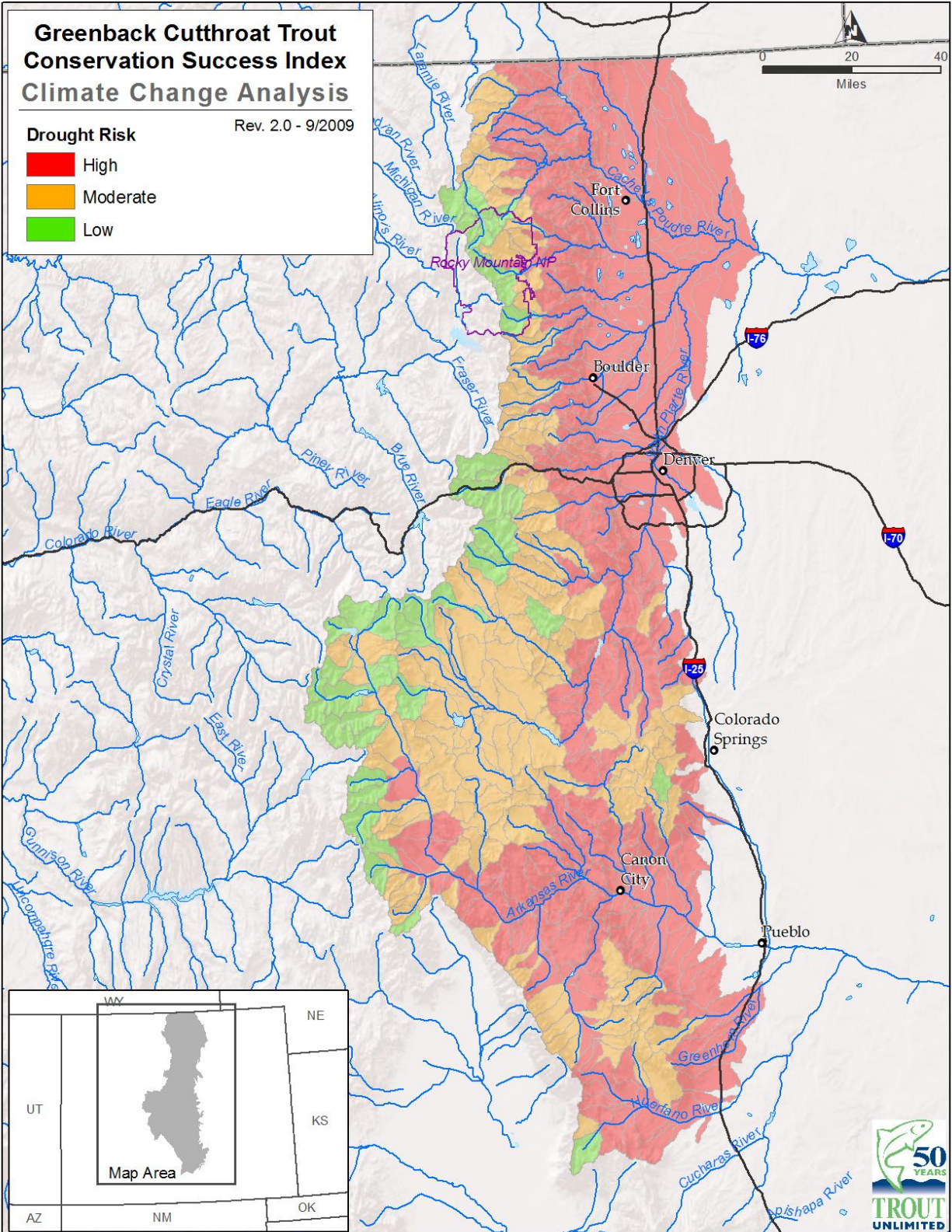
Prepared by Jack E. Williams, TU, 11/28/2006

Greenback Cutthroat Trout Conservation Success Index Climate Change Analysis

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Drought Risk

- High
- Moderate
- Low

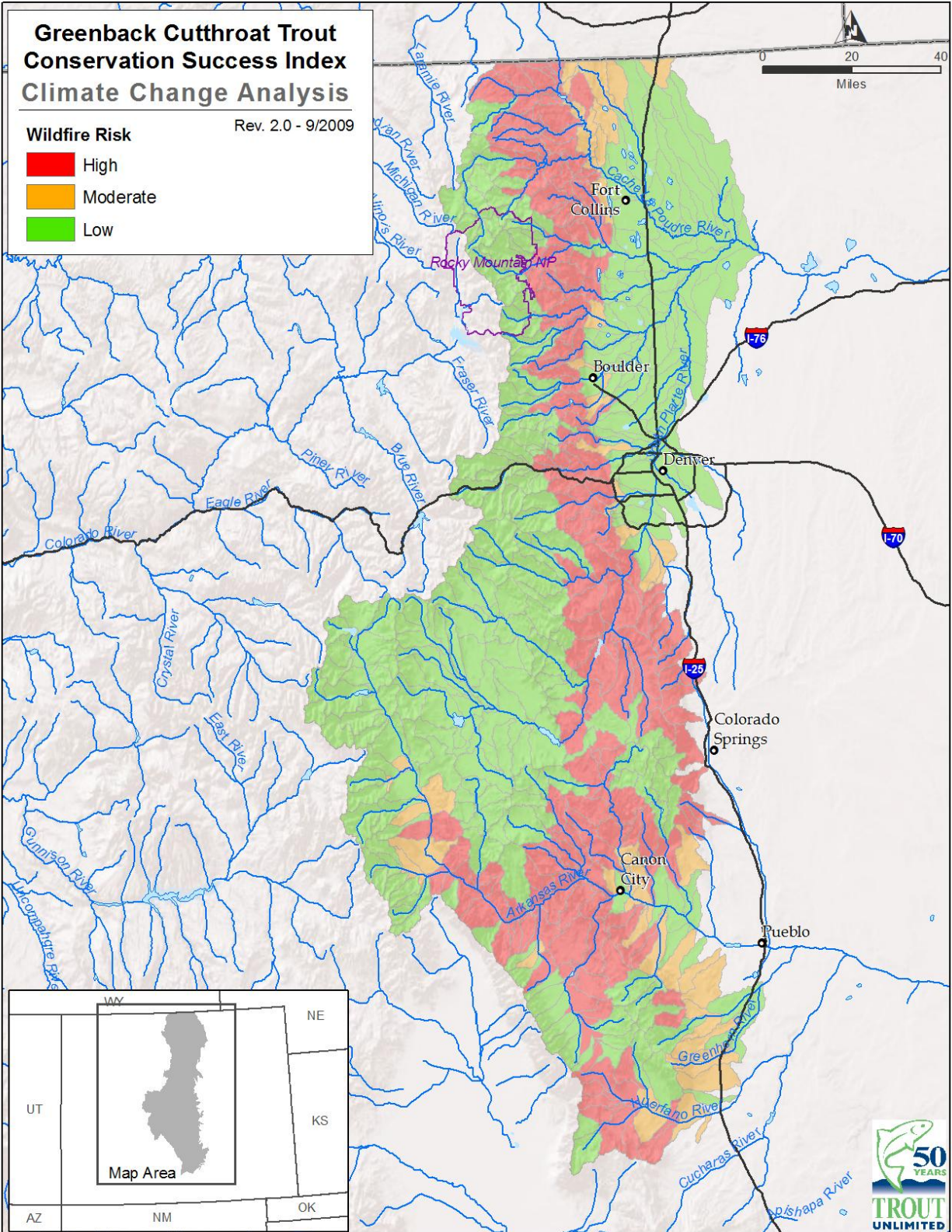


Greenback Cutthroat Trout Conservation Success Index Climate Change Analysis

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Wildfire Risk

- High
- Moderate
- Low

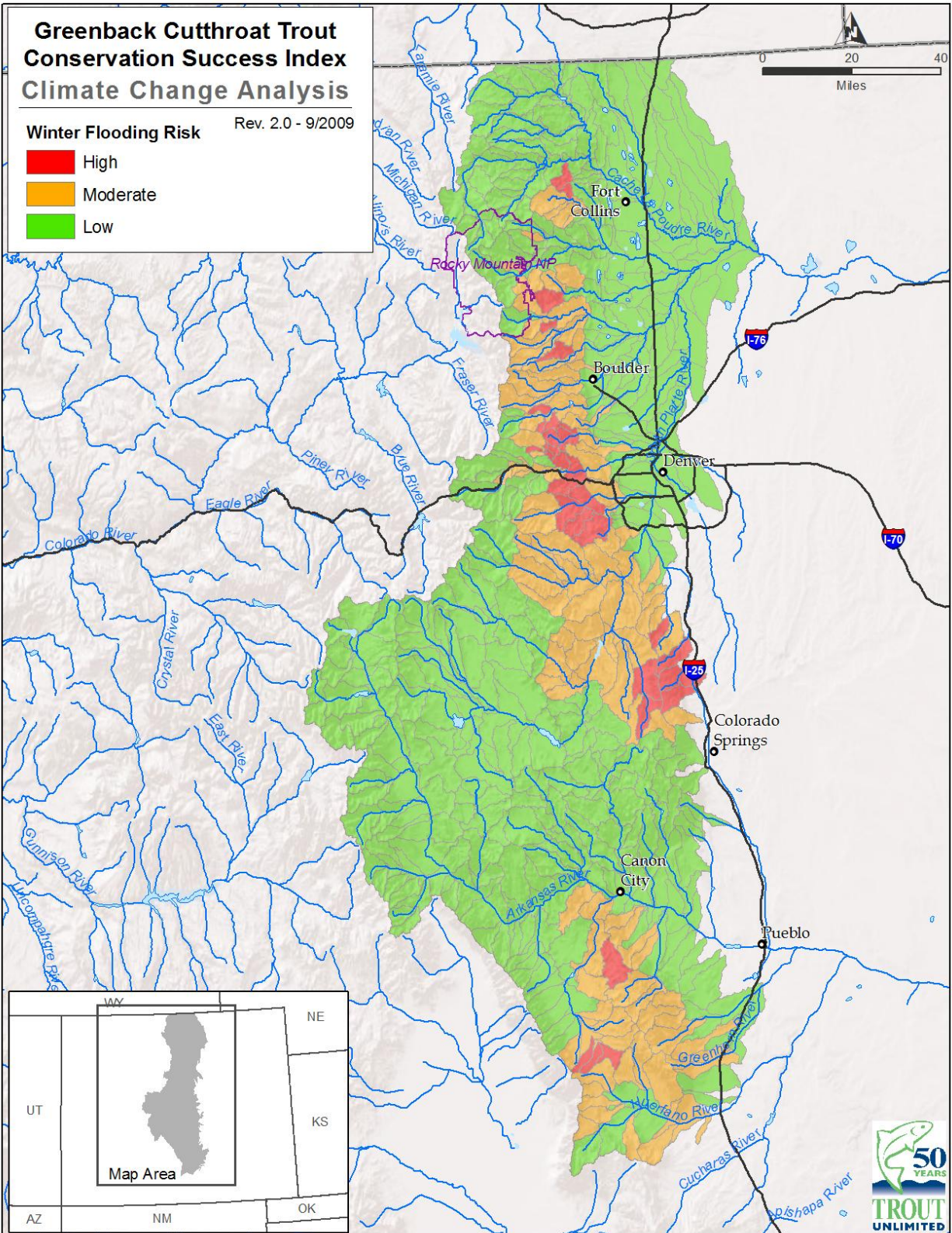


Greenback Cutthroat Trout Conservation Success Index Climate Change Analysis

Winter Flooding Risk

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- High
- Moderate
- Low

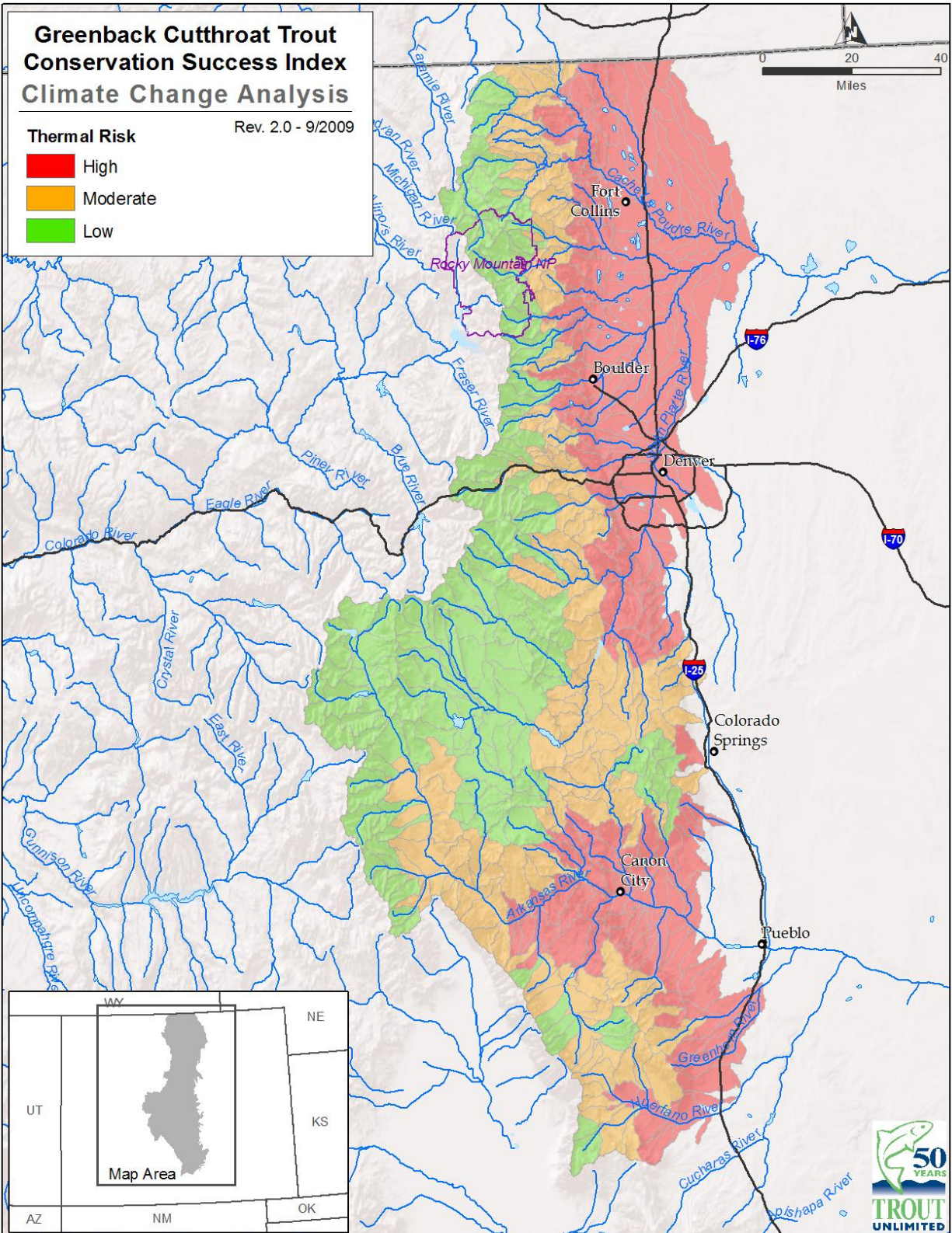


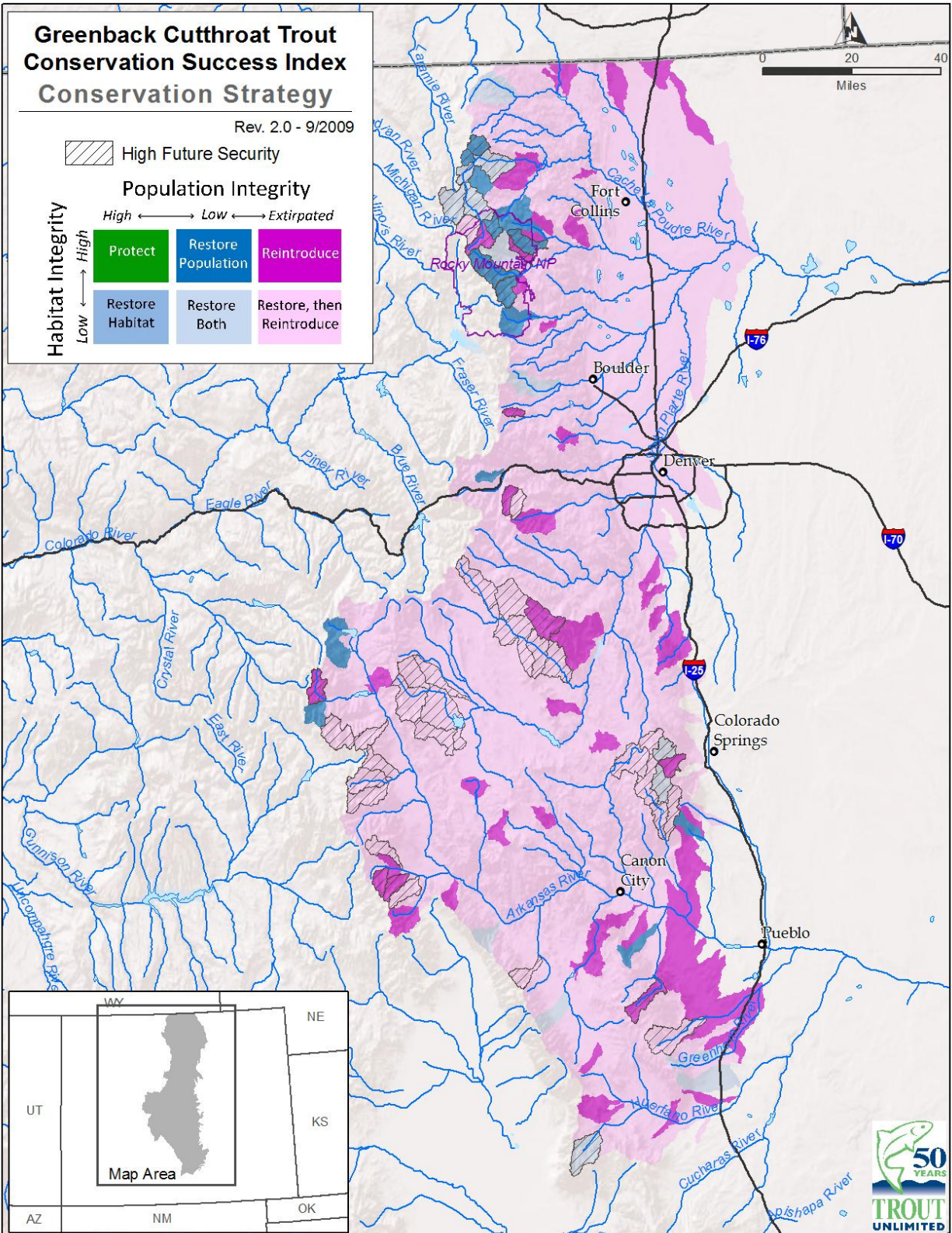
Greenback Cutthroat Trout Conservation Success Index Climate Change Analysis

Rev. 2.0 - 9/2009

Thermal Risk

- High
- Moderate
- Low





Greenback Cutthroat Trout Conservation Success Index Future Security

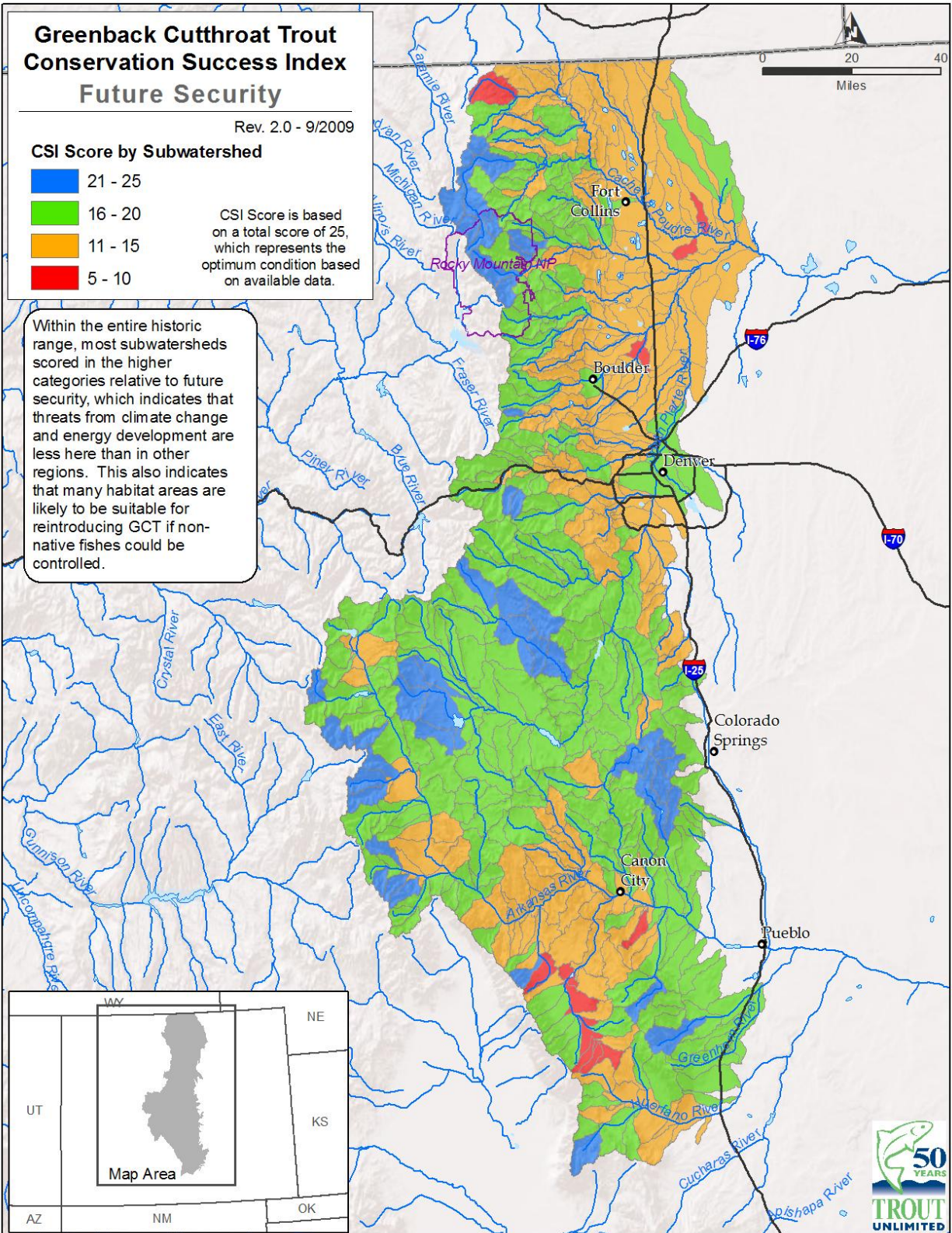
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CSI Score by Subwatershed

- 21 - 25
- 16 - 20
- 11 - 15
- 5 - 10

CSI Score is based on a total score of 25, which represents the optimum condition based on available data.

Within the entire historic range, most subwatersheds scored in the higher categories relative to future security, which indicates that threats from climate change and energy development are less here than in other regions. This also indicates that many habitat areas are likely to be suitable for reintroducing GCT if non-native fishes could be controlled.



Greenback Cutthroat Trout Conservation Success Index Habitat Integrity

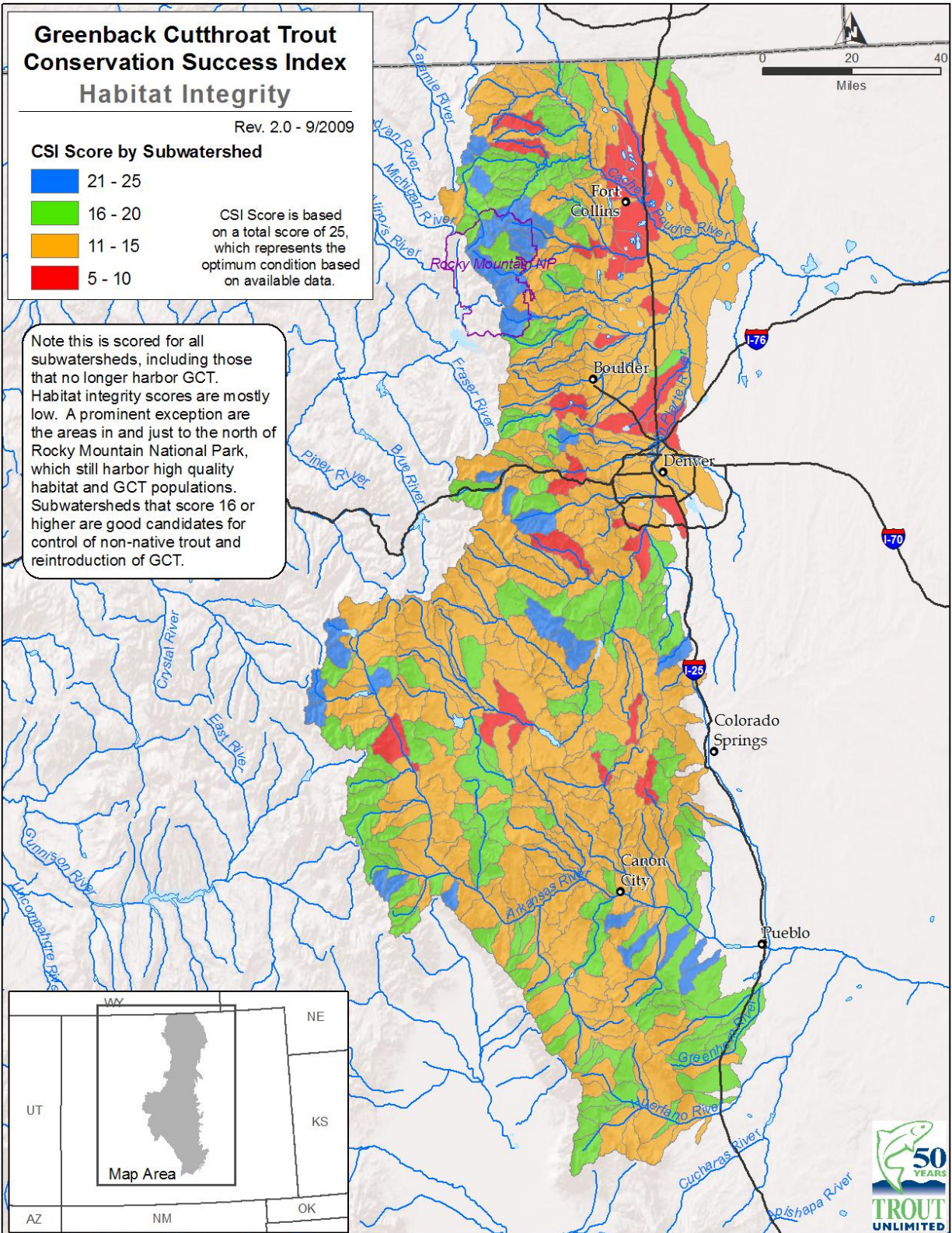
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CSI Score by Subwatershed



CSI Score is based on a total score of 25, which represents the optimum condition based on available data.

Note this is scored for all subwatersheds, including those that no longer harbor GCT. Habitat integrity scores are mostly low. A prominent exception are the areas in and just to the north of Rocky Mountain National Park, which still harbor high quality habitat and GCT populations. Subwatersheds that score 16 or higher are good candidates for control of non-native trout and reintroduction of GCT.



Greenback Cutthroat Trout Conservation Success Index Population Integrity

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 Greenback Historic Range

CSI Score by Subwatershed

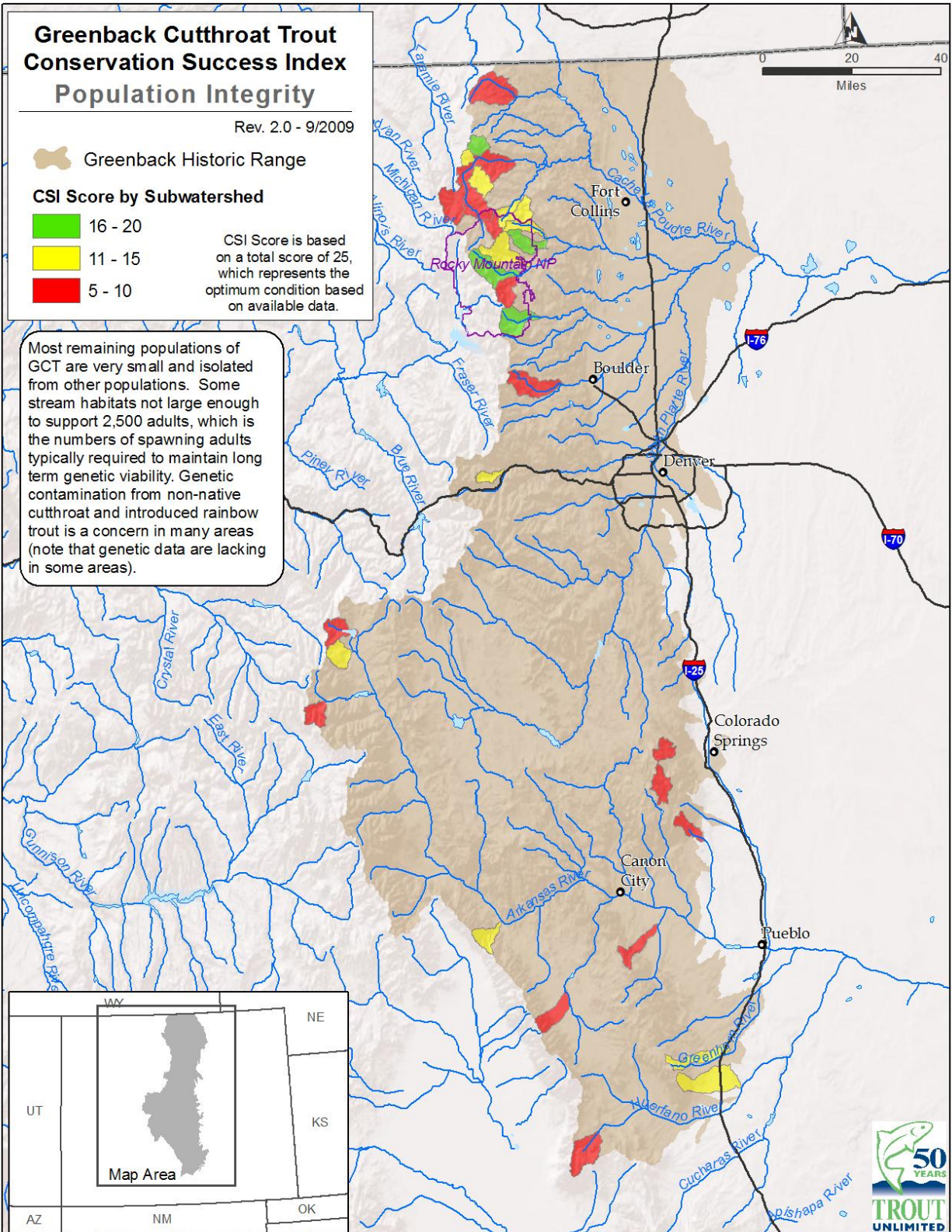
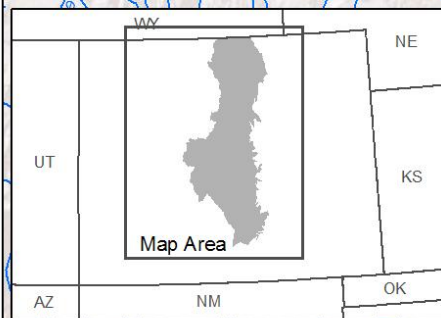
 16 - 20

 11 - 15

 5 - 10

CSI Score is based on a total score of 25, which represents the optimum condition based on available data.

Most remaining populations of GCT are very small and isolated from other populations. Some stream habitats not large enough to support 2,500 adults, which is the numbers of spawning adults typically required to maintain long term genetic viability. Genetic contamination from non-native cutthroat and introduced rainbow trout is a concern in many areas (note that genetic data are lacking in some areas).



Greenback Cutthroat Trout Conservation Success Index Rangewide Conditions

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 Greenback Historic Range

CSI Score by Subwatershed

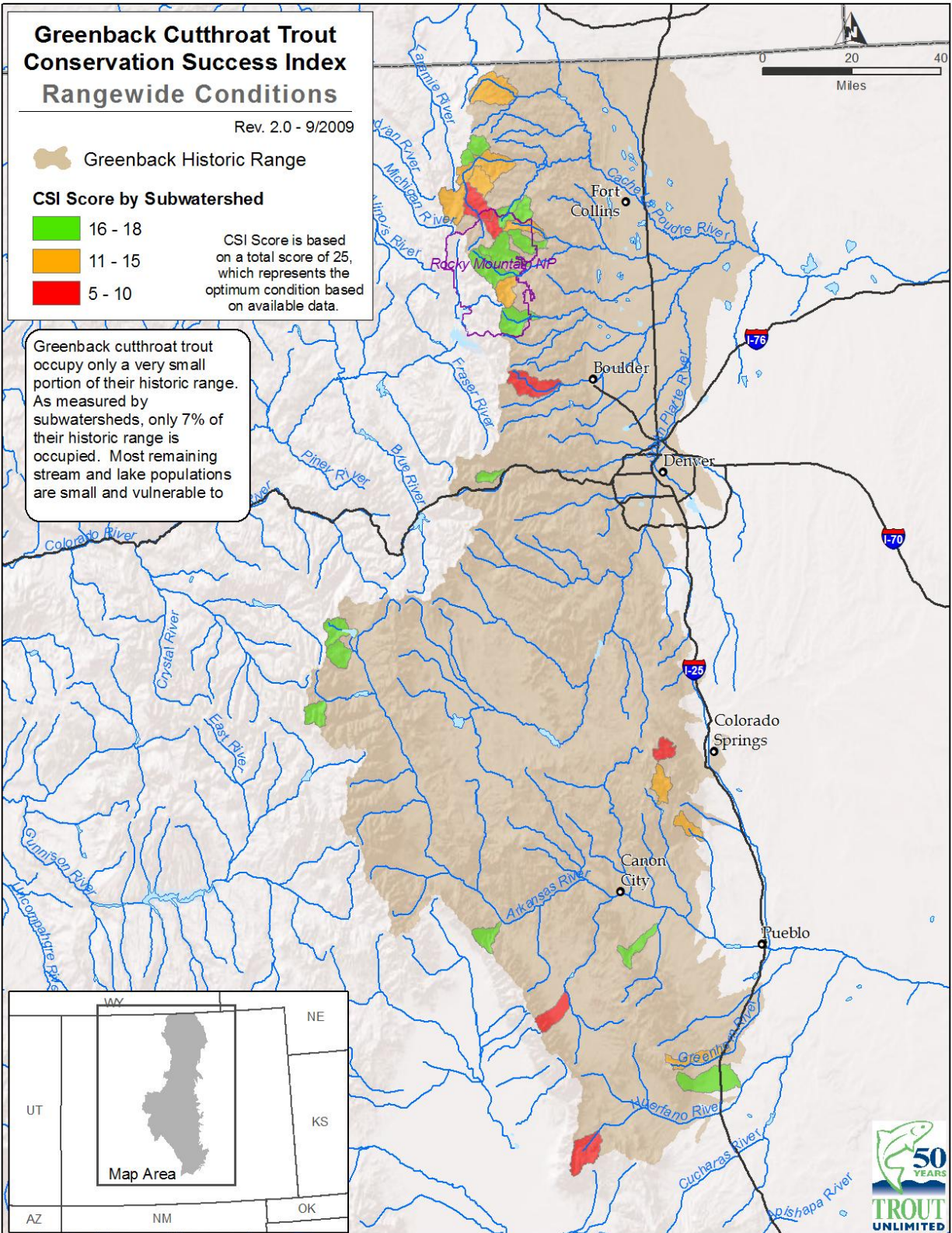
 16 - 18

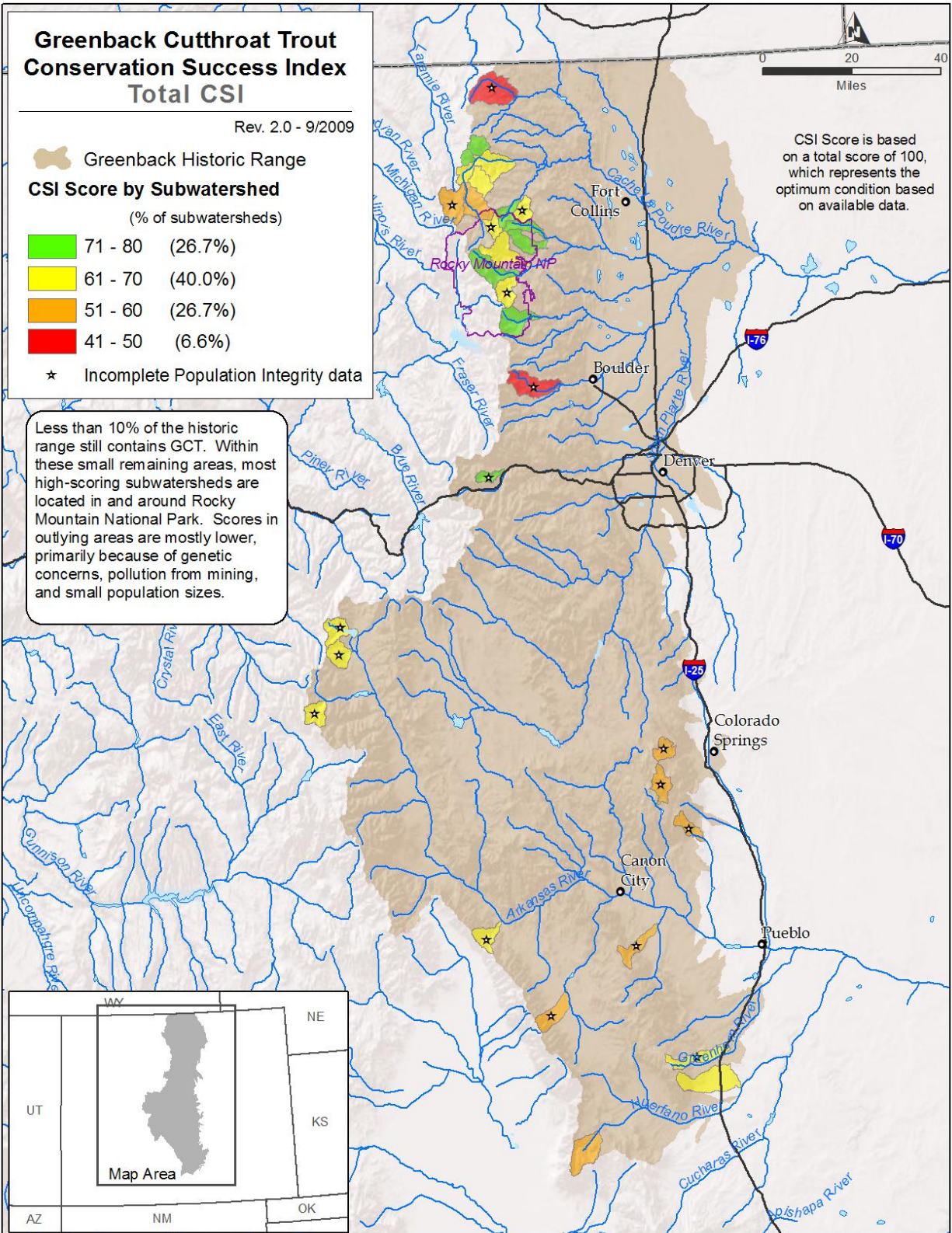
 11 - 15

 5 - 10

CSI Score is based on a total score of 25, which represents the optimum condition based on available data.

Greenback cutthroat trout occupy only a very small portion of their historic range. As measured by subwatersheds, only 7% of their historic range is occupied. Most remaining stream and lake populations are small and vulnerable to





Conservation Success Index
Greenback Cutthroat Trout Rule Set

August 2007

Range-wide Conditions

Scored for all currently occupied and available streams and lakes.

Currently available habitat is calculated as perennial streams connected to known occupied reaches.

Historic habitat is all perennial streams and connected, natural lakes across historic range.

Lakes less than 2 hectares that are connected to streams are considered stream habitat while lakes greater than 2 hectares or isolated lakes are calculated as lake habitat.

1. Percent historic stream habitat occupied.

Occupied stream habitat	CSI Score
0 – 9%	1
10 – 19%	2
20 – 34%	3
35 – 49%	4
50 – 100%	5

Source: Greenback Cutthroat Trout Recovery Team. 1998. Greenback cutthroat trout recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.

Young et al. 2002.

Colorado Division of Wildlife. Hydrography of Colorado, 1:24,000

2. Percent subbasins occupied.

Percent subbasins occupied	CSI Score
1-49%	1
50-69%	2
70-79%	3
80-89%	4
90-100%	5

Source: Greenback Cutthroat Trout Recovery Team. 1998. Greenback cutthroat trout recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.

Young et al. 2002.

U.S. Geologic Survey. Subbasins (4th order HUCs), 1:2,000,000, July 2005

3. Subwatersheds occupied within subbasin.

Percent subwatersheds occupied by subbasin	CSI Score
1 – 20%	1
21-40%	2
41-60%	3
61-80%	4
81-100%	5

Source: Greenback Cutthroat Trout Recovery Team. 1998. Greenback cutthroat trout recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.

Young et al. 2002.

U.S. Department of Agriculture, Forest Service. Sub-watersheds, 6th order HUCs

4. Habitat by stream order occupied.

Occupied 2nd order streams and higher	CSI Score
0 – 9%	1
10 – 14%	2
15 – 19%	3
20 – 24%	4
25 – 100%	5

Source: Greenback Cutthroat Trout Recovery Team. 1998. Greenback cutthroat trout recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.

Young et al. 2002.

Colorado Division of Wildlife. Hydrography of Colorado, 1:24,000

5. Historic lake habitat occupied.

Historic lake populations only considered natural lakes while current populations have been identified in reservoirs thus leading to an increase in lake habitat for some subwatersheds.

Occupied lake habitat	CSI Score
0 – 9%	1
10 – 19%	2
20 – 34%	3
35 – 49%	4
50 – 100%	5

Source: Greenback Cutthroat Trout Recovery Team. 1998. Greenback cutthroat trout recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.

Young et al. 2002.

Colorado Division of Wildlife. Hydrography of Colorado, 1:24,000

Population Integrity

Scored for all current stream or lake populations based on data in GTR. Lake populations were incorporated as a linear distance.

1. Density – where multiple populations exist within a subwatershed, density was calculated as stream length weighted average.

Fish per mile	Total Population	CSI Score
1 - 50	LT 500	1
1 - 50	GE 500	2
51 - 150	GE 1	3
151 - 400	GE 1	4
GT 400	GE 1	5

Source: Greenback Cutthroat Trout Recovery Team. 1998. Greenback cutthroat trout recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.

Young et al. 2002.

2. Population Extent – based on maximum cumulative length of connected and occupied stream habitat. Lake centerlines are used.

Connected miles of habitat	CSI Score
LT 6 mi	1
6 – 11.9 mi	2
12 – 19.9 mi	3
20 – 29.9 mi	4
GE 30 mi	5

Source: Colorado Division of Wildlife. Hydrography of Colorado, 1:24,000

Trout Unlimited Colorado Water Project. Dewatered stream segments

U.S. Army Corps of Engineers. Dams, March 22, 2006

U.S. Geological Survey. Geographic Names Information System. Waterfalls. 2005

3. Genetic Purity – based on GTR and other sources.

Genetic test results	CSI Score
Hybridized > 20%	1
Hybridized unknown or hybridized 11 – 20%	2
Hybridized 5 – 10%	3
Suspected pure or <5%	4
Known Pure	5

Source: Hybridized scores are based on combination of GTR analysis and Martin, Mitton, and Metcalf study of populations in Rocky Mountain National Park. When results were found for a population in both studies, the Martin study was used.

4. Disease Vulnerability - All scored as 2 based on presence of whirling disease through-out Colorado.

5. Life History Diversity – assume only 1 stream and 1 lake life history form remains.

Current population	CSI Score
Lake or stream population	1
	2
Lake and stream population	3
	4
	5

Source: Greenback Cutthroat Trout Recovery Team. 1998. Greenback cutthroat trout recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado.

Young et al. 2002.

Colorado Division of Wildlife. Hydrography of Colorado, 1:24,000

Habitat Integrity

Scored for all subwatersheds in historic range.

1. Land Stewardship – score using AND/OR between two indicators

Protected occupied habitat	Subwatershed protection	CSI Score
none	any	1
1 – 9%	LT 25%	1
1 – 9%	GE 25%	2
10 – 19%	LT 25%	2
10 – 19%	GE 25%	3
20 – 29%	LT 50%	4
20 – 29%	GE 50%	5
GE 30%	any	5

Source: Colorado State University Natural Resource Ecology Lab. COMaP v4. June 30, 2005.
Land ownership/stewardship.

U.S. Department of Agriculture, Forest Service, Geospatial Service and Technology Center.
Inventoried Roadless Areas.

2. Watershed Connectivity – use worst case?

Current/historic connectivity 5th	Current/historic connectivity 6th	CSI Score
any	LT 50%	1
40 – 49%	50 – 74%	2
50 – 74%	75 – 89%	3
75 – 89%	90 – 94%	4
90 – 100%	95 – 100%	5

Source: Colorado Division of Wildlife. Hydrography of Colorado, 1:24,000

Trout Unlimited Colorado Water Project. Dewatered stream segments

U.S. Army Corps of Engineers. Dams, March 22, 2006

U.S. Geological Survey. Geographic Names Information System. Waterfalls. 2005

3. Watershed Conditions

Land conversion	CSI Score
GE 30%	1
20 – 29%	2
10 – 19%	3
5 – 9%	4
0 - 4%	5

CSI score is downgraded 1 point if road density is GE 1.7 and LT 4.7 mi/square mile.
If road density is GE 4.7 mi/square mile it is downgraded 2 points.

Source: Colorado Division of Wildlife: Colorado GAP Analysis Project (100 meter). Land cover/land use by subwatershed

U.S. Census Bureau. 2004 2nd Edition TIGER/Line Files. Roads.

4. Water Quality

Miles 303(d) Streams	Percent Agricultural Land	Number Active Mines	Rd mi/ Str mi	CSI Score
GT 0	58-100%	GT 9	0.5 – 1.0	1
	28-57%	7 – 9	0.25 – 0.49	2
	16-27%	4 – 6	0.24 - 0.10	3
	6-15%	1 – 3	0.05 – 0.09	4
	0-5%	0	0 – 0.04	5

Final score is the lowest value.

Source: Colorado Division of Wildlife: Colorado GAP Analysis Project (100 meter). Land cover/land use by subwatershed

U.S. Census Bureau. 2004 2nd Edition TIGER/Line Files. Roads.

U.S. Environmental Protection Agency. 303(d) streams, 1:24,000; 2002.

U.S. Geological Survey, Mineral Resources Data System: U.S. Geological Survey, Reston, Virginia. Active Mines. 2005.

US Geological Survey, National Hydrography Dataset Plus, 1:100,000.

5. Flow Regime

Score for worst case.

Number of dams	Number of diversions	Storage (acre- ft)/stream mile	CSI Score
GE 5	GE 30	GE 2,500	1
3 – 4	20 – 29	1,000 – 2,499	2
2	10 – 19	250 – 999	3
1	5 – 9	1- 249	4
0	LT 5	0	5

Source: U.S. Army Corps of Engineers. Dams, March 22, 2006

Colorado Division of Water Resources. Colorado's Decision Support System. CDSS Diversion Structures, Colorado, Database Version. Stream diversions. 2004.

Colorado Division of Wildlife. Hydrography of Colorado, 1:24,000

Future Security

Scored for all subwatersheds in historic range.

1. Land Conversion – modeled based on slope, land ownership, roads, and existing urban areas.

Land Vulnerable to Conversion	CSI Score
81 – 100%	1
61 – 80%	2
41 - 60%	3
21 - 40%	4
0 – 20%	5

Source: Colorado Division of Wildlife: Colorado GAP Analysis Project (100 meter). Land cover/land use by subwatershed

U.S. Census Bureau. 2004 2nd Edition TIGER/Line files. Census Blocks, Roads.

U.S. Geological Survey. Digital Elevation Model. 30 meter.

2. Resource extraction –

Forest management	Hard Metal Mine Claims	CSI Score
51-100%	51 -100%	1
26 – 50%	26-50%	2
11 – 25%	11-25%	3
1 – 10%	1 – 10%	4
0%	0%	5

Score for worst case.

Source: Timber management potential identifies productive forest types using the existing vegetation type in the Landfire dataset. The number of mining claims was determined using Bureau of Land Management data, and each claim was assumed to potentially impact 20 acres. Protected areas data were compiled from the ESRI, Tele Atlas North American / Geographic Data Technology dataset on protected areas and the U.S. Department of Agriculture, Forest Service's National Inventoried Roadless Areas dataset.

3. Energy Development

Leases or reserves	New Dams 4 th	New Dams 6 th	CSI Score
51-100%	≥0	≥1	1
26 – 50%	3		2
11 – 25%	2		3
1 – 10%	1		4
0%	0		5

Score for worst case.

Source: Wind resources (“Good” and better) from Wind Powering America/National Renewable Energy Lab (NREL). Coal leases are mineable types from the Coal Fields of the United States dataset. Geothermal known and closed lease areas and oil and gas leases and agreements from BLM Geocommunicator.* Potential dam sites are based on Idaho National Laboratory (INL) hydropower potential data. Protected areas data were compiled from the ESRI, Tele Atlas North American / Geographic Data Technology dataset on protected areas and the U.S. Department of Agriculture, Forest Service’s National Inventoried Roadless Areas dataset.

4. Climate Change

TU Climate Change Analysis	
Climate Risk Factors	CSI Score
High, High, Any., Any	1
High, Any, Any, Any	2
Mod., Mod., Mod, (Mod or Low)	3
Mod, Mod, Low, Low	4
Low, Low, Low, (Mod or Low)	5

* Several geospatial data types are available from Geocommunicator, and they have the following definitions:

Lease: Parcel leased for oil and gas production.

Agreement: An ‘agreement’ between operator and host (private or public) to evaluate geological, logistic, geophysical, etc issues involving a concession. The agreement essentially allows a technical evaluation of lease feasibility.

Unit Agreements: Multiple entities go in collectively on an agreement. Implied: there are limits to the number of agreements that one individual entity can have outstanding, and a unit agreement allows them to get around the limit.

Communitization: Combining smaller federal tracts to meet the necessary minimum acreage required by the BLM (for spacing purposes).

Authorized: Bid on and sold lease or authorization, ready for production.

Lease Sale Parcel: Parcel slated for auction but not yet sold.

Closed: Not retired, just expired and may become available and open to resubmittal.

Other Agreements: Catch-all for other agreement types.

Source: Temperature and precipitation data were obtained from the PRISM Group. Elevation data was obtained from the National Elevation Dataset, and LANDFIRE data for the Anderson Fire Behavior Fuel Model 13 was used as input for wildfire risk. The Palmer Drought Severity Index was used for drought risk, but was adjusted for elevation (elevations above 2690 have lower risk) and the deviation from mean annual precipitation (areas with more precipitation on average have lower risk).

Source: U.S. Geological Survey. Digital Elevation Model. 30 meter.

5. Introduced Species

Present in 5th	Present in 6th	Road Density	CSI Score
Yes	Yes	any	1
Yes	No	GT 4.7	2
Yes	No	1.7 - 4.7	3
Yes	No	LT 1.7	4
No	No	any	5

Source: U.S. Census Bureau. 2004 2nd Edition TIGER/Line files. Roads.

Young et al., Exotic species presence. 2002.