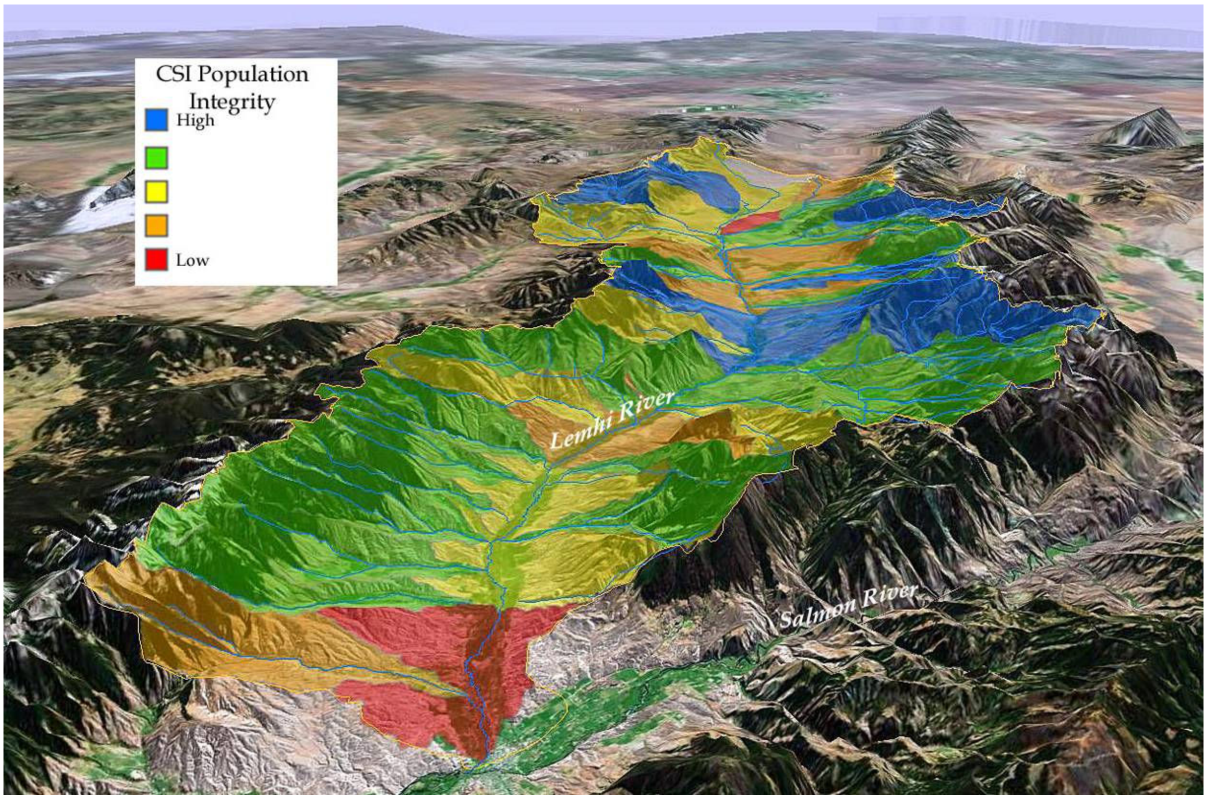
# Trout Unlimited's Conservation Success Index

# User Guide




**Version 4.0**

August 2009

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## 1.0 Introduction to the CSI

*"By the next generation, Trout Unlimited will ensure that robust populations of native and wild coldwater fish once again thrive within their North American range, so that our children can enjoy healthy fisheries in their home waters."*

Trout Unlimited's Vision

"How do we best conserve trout and salmon?" Answering this fundamental question is critical for achieving Trout Unlimited's vision within the next 30 years and is the underlying goal of the Conservation Success Index (CSI). The Conservation Success Index is a landscape-level planning tool developed by Trout Unlimited (TU) to help strategically conserve and restore trout and salmon through characterization of the range-wide status for native salmonids and the status of wild trout populations at the subwatershed scale (typically 10,000 to 30,000 acres). TU's membership as well as interested individuals, non-governmental organizations, and agencies concerned with the conservation of native salmonids can use the CSI to answer the following questions and thereby inform future management and restoration efforts:

- What is the range-wide status of native species?
- Where are the healthiest populations of native and wild trout
- What are the primary existing threats to populations and habitats?
- How secure are populations and habitats from likely future threats?
- Where, from a broad-scale perspective, should we focus our limited conservation resources?
- How does the status of multiple taxa compare and contrast across their respective ranges?

Most strategies for the long-term conservation of native salmonid populations build on the fundamental principles of conservation biology to protect the best remaining habitats and restore degraded areas by reestablishing habitat connectivity and integrity. Figure 1 illustrates the conceptual model of protect-reconnect-restore used by Trout Unlimited. For coldwater fishes, the high quality areas for protection are typically the high elevation headwaters while lower tributary reaches are often fragmented by diversions and dams that prevent access to the mainstem habitats and migratory corridors. These valley bottoms commonly have lower habitat quality due to land conversion and development but also hold the highest restoration potential.

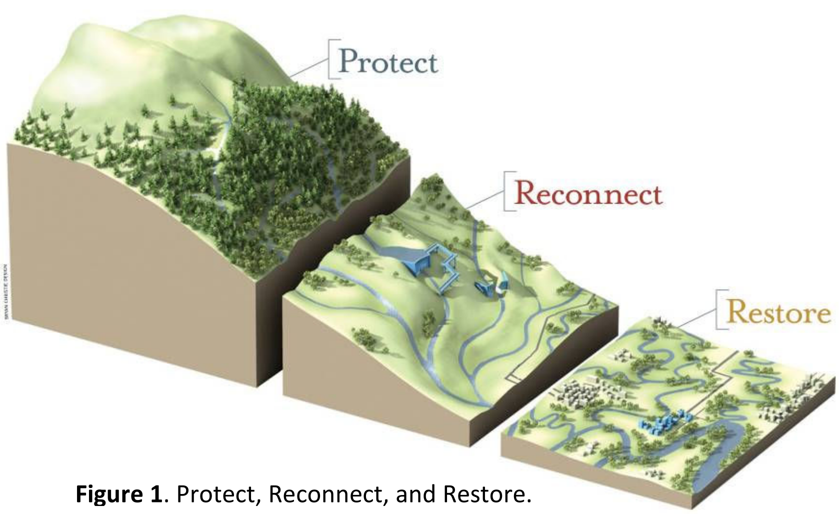



**Figure 1**. Protect, Reconnect, and Restore.

Effective conservation often involves landscape-level planning to ensure that on-the-ground work is meaningful in the context of the target species. The Conservation Success Index has been designed as a landscape-level planning tool to support the application of the protect-reconnect-restore conceptual model to species conservation based on current conditions at the subwatershed scale. The CSI can be thought of as the first tier of a two-tiered approach (Figure 2) to conservation whereby it can help determine current conditions at the subwatershed scale across the landscape and help determine place-based conservation strategies. After the CSI is used to strategically determine conservation needs, the second tier then represents interaction with local land managers, biologists, and grassroots programs. This interaction confirms the CSI results and further defines the existing population and habitat needs and future threats within a subwatershed. The interaction also helps to clarify what conservation opportunities exist and what types of on-the-ground projects can be implemented.

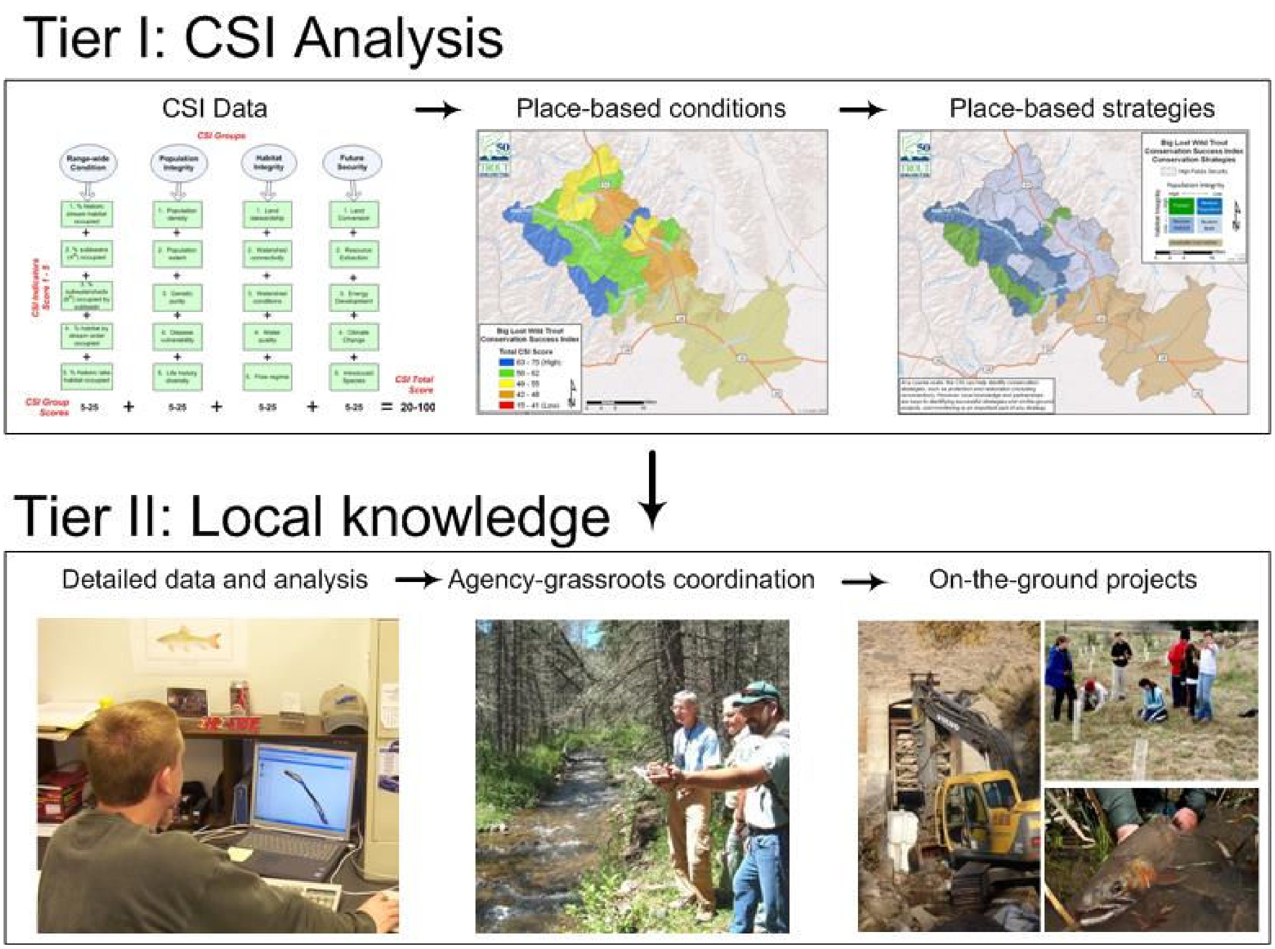



**Figure 2**. Two-tier approach to conservation. Tier I uses a CSI analysis across the range of the target species to help determine place-based conservation strategies. Tier II builds on the CSI analysis by using more detailed analysis and coordination between agencies and TU grassroots and staff.

The CSI is being conducted on a species-by-species basis dependent on completion of range-wide status assessments by state and federal managing agencies and data availability. An update of completed and forthcoming CSI projects is given on the website (Figure 3).

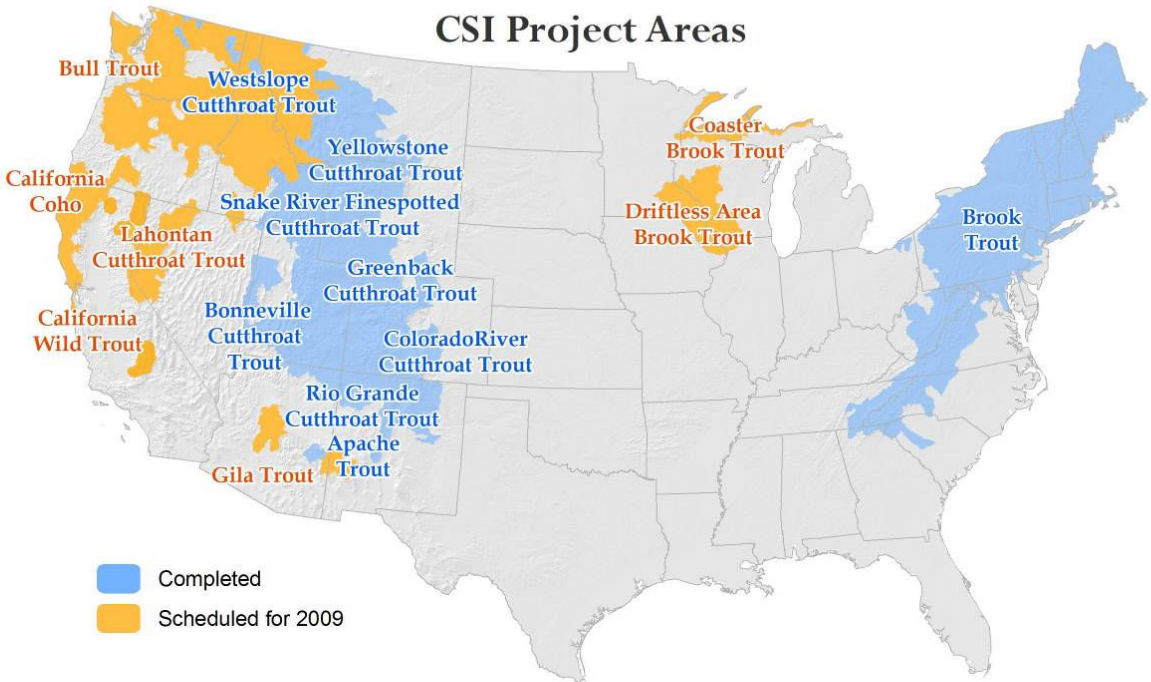



**Figure 3**. Map on the CSI website showing completed and scheduled CSI projects across the United States.

It is our intent to conduct a CSI analysis for all of North America's native coldwater salmonids and select wild trout areas. The CSI will be used to support landscape-scale planning for TU's local and national conservation programs taking into account current conditions as well as future impacts from climate change and energy development.

The CSI website, accessible from the Trout Unlimited homepage (www.tu.org/csi), contains extensive information on methods, data sources and results for each species analyzed as well as internet-based mapping applications and downloadable maps. There also is a brief summary of CSI results for each of the completed species.

This user guide has been prepared by Trout Unlimited to facilitate use of the website and interpretation and application of CSI results. The guide includes the following materials:

1. An overview of the CSI conceptual model and how Trout Unlimited is integrating it programmatically (Chapter 2).

2. A description of the types of information located on the CSI website, how to find what you need, instructions on how to use the internet mapping tools, and some 'walk-you-through' examples (Chapter 3).

3. Examples of CSI applications to Trout Unlimited's work on energy development and climate change (Chapter 4).

## 2.0 Methodology

The Conservation Success Index assesses the status of coldwater fishes based on current distribution, population, and habitat conditions, and security from future threats at various geographic scales from the local subwatershed to the broader historic range. It uses a Geographic Information System (GIS) to integrate existing biological data gathered by state and federal agencies with spatial information about natural and anthropogenic landscape features. Results identify subwatersheds where populations remain strong, have become weakened, or have been extirpated, where the integrity of habitats is intact or has been compromised, and where there are future threats to populations and habitats. The CSI integrates these pieces of information to help determine whether protection, population restoration, habitat restoration, and/or species reintroduction is likely to be the best conservation strategy.

The CSI was originally developed for native salmonids but has recently been adapted to wild trout. The CSI as applied to native salmonids evaluates 20 population and environmental indicators that influence salmonid persistence. These are grouped into four categories: Range-wide Condition, Population Integrity, Habitat Integrity, and Future Security (Figure 4). Each indicator is scored from 1 to 5 based on a species-specific quantitative ruleset resulting in total CSI scores for each subwatershed that range from 20 – 100; higher scores indicate better conditions for each indicator. The rulesets are based on relevant scientific research and, when available, follow categories defined in range-wide assessments.

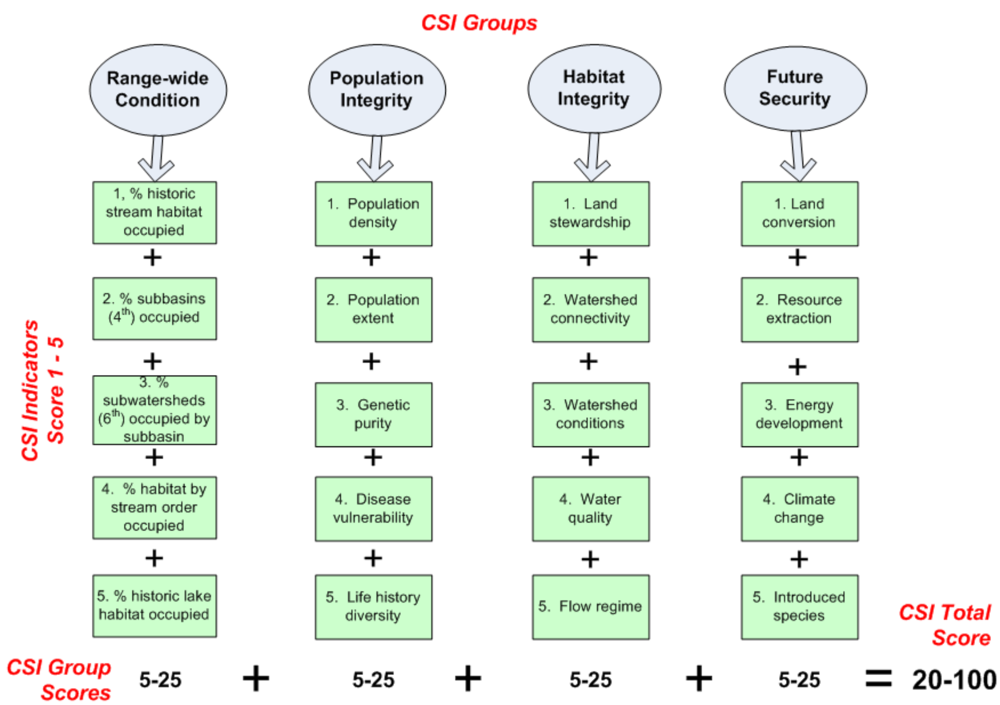



**Figure 4**. Status of native salmonids is examined by a suite of 20 CSI indicators, which are divided into four categories of range-wide condition, population integrity, habitat integrity and future security. Each indicator is scored from 1-5 for every subwatershed in which the target fish occurs, resulting in 100 possible points.

The Range-wide Condition indicators measure changes between historical (pre-colonial) and current (1990-Present) distribution. The Population Integrity indicators are based primarily on population data collected and compiled in federal, state, and tribal status assessments and recovery plans. Habitat Integrity indicators use publicly available spatial data sets to characterize in-stream and watershed conditions. When data for a specific indicator, such as flow, are not available, appropriate surrogates, such as dams and diversions, are used. Future Security indicators evaluate potential threats to both population and habitat and are critical to prioritizing subwatersheds, watersheds, and subbasins for conservation strategies.

Since wild trout, by definition, are not native, the Range-wide Condition indicators are not applicable and, thus, are excluded from a wild trout CSI (Figure 5). As a result, the wild trout total CSI scores range only from 15 to 75. However, the Population Integrity, Habitat Integrity, and Future Security group scores still range from 5 to 25. One major difference from a native trout CSI is that Population Integrity for wild trout can accommodate multiple species.

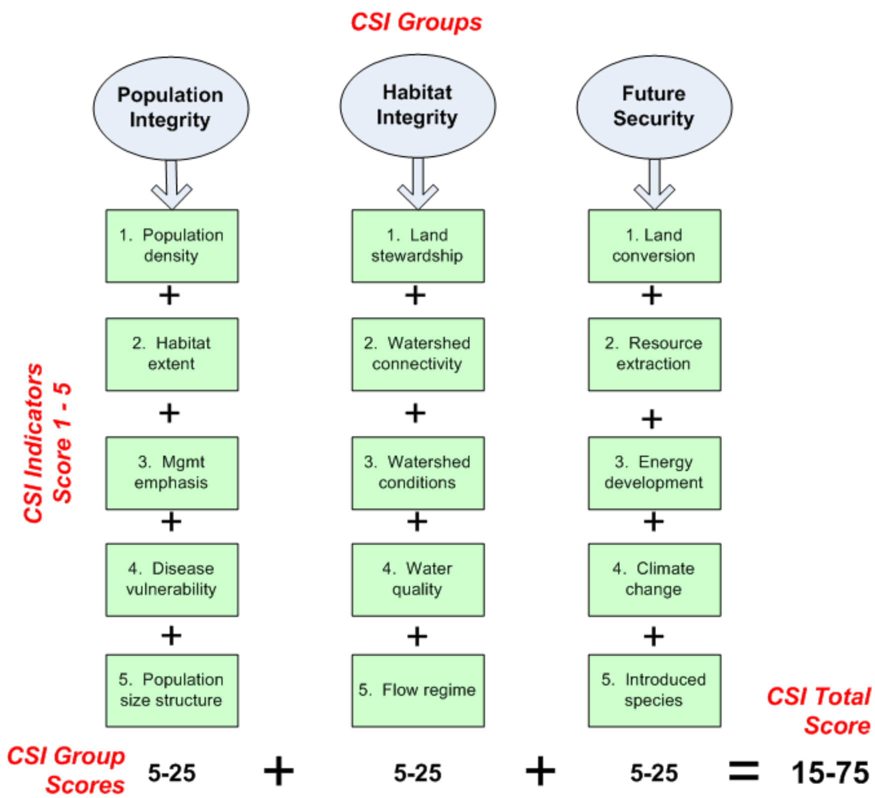



**Figure 5**. Status of wild trout populations is examined using a modified CSI with only 15 indicators. The Rangewide Conditions indicators are no longer used, and the remaining indicators are divided into three categories of population integrity, habitat integrity and future security. Each indicator is scored from 1-5 for every subwatershed in which wild trout occur, resulting in 75 possible points.

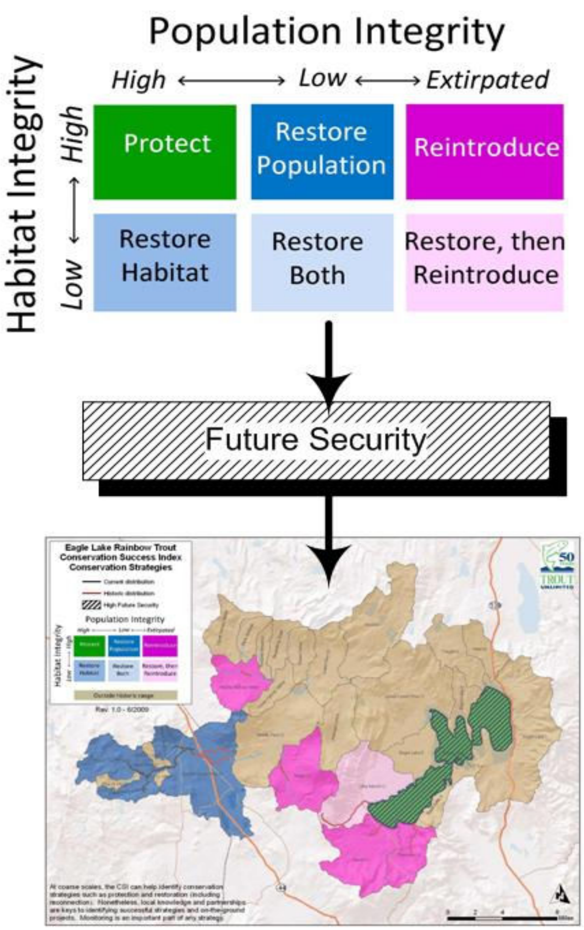



**Figure 6**. CSI group scores can be used to form subwatershed strategies for protection, habitat and population restoration, and reintroductions

The cumulative indicator group scores (5-25 possible) are used to identify conservation strategies for protection, population and habitat restoration, and reintroduction (Figure 6). These strategies are based on the conservation biology principles of protecting subwatersheds with the highest population and habitat integrity, especially if they have low future security due to projected environmental changes such as global warming and land conversion. Subwatersheds with high future security but low habitat integrity or population integrity, or both, have high restoration potential. Subwatersheds where populations have been extirpated but habitat integrity and future security both remain high, may provide opportunities for reintroduction. Monitoring should be an inherent part of all significant protection, restoration, and reintroduction efforts and is therefore considered an integral part any strategy.

Trout Unlimited's goal is to apply the CSI methodology to all native salmonid species and selected wild trout fisheries across the U.S. and report the findings in a variety of formats suitable for Trout Unlimited programs and grassroots efforts, as well as diverse agency and public audiences with a broad range of technological expertise and biological knowledge. However, completion of the CSI for a species is dependant upon availability of a comprehensive range-wide assessment that provides biological data on existing populations.

## 3.0 Using the CSI Website

This section of the User Guide provides information on how to navigate the website and find information about both the CSI conceptual model as well as information on a specific species and/or a geographic area of interest. There is a considerable amount of data that is accessible from the website for downloading or viewing interactively. Therefore, it is highly recommended that a new user read the following sections while accessing the website and before attempting to conduct his/her own research.

Figure 7 shows the linkages between the web pages beginning with the home page. The user can follow these links to access information on the web site, the CSI methods, species-specific results and, for the more advanced users, interactive mapping applications. Each of these elements is discussed in more detail below.

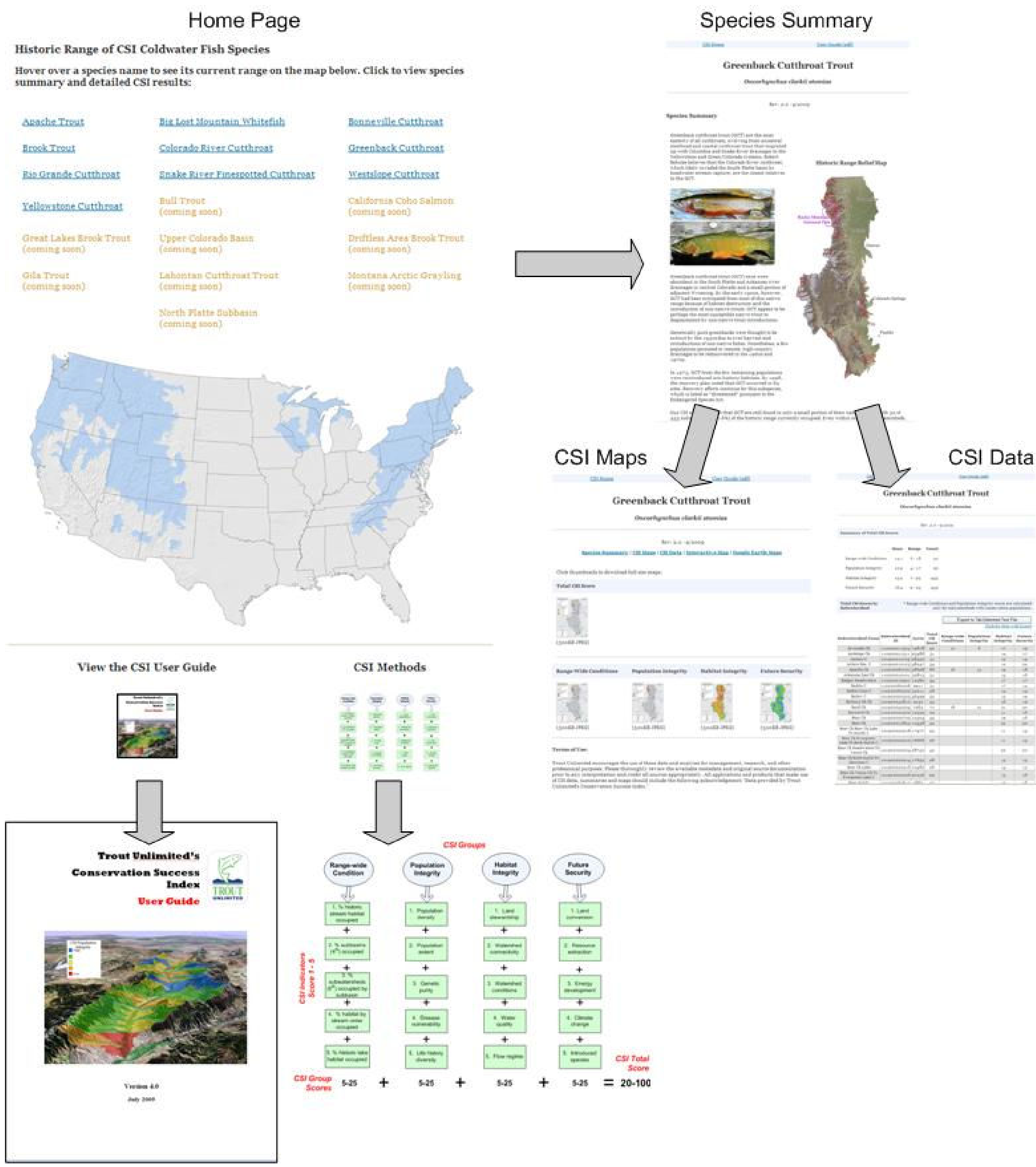



**Figure 7**. CSI website linkages from the Home page.

## 3.1 Home Page and Methods

The **Home** page contains information on the CSI and links to species-specific CSI information, the User Guide, and a cursory introduction on CSI methods. The **View the CSI Users Guide** link opens the user's guide as a .pdf. The **CSI Methods** link opens a new page that includes an overview of the CSI and links for some additional downloadable information on CSI methods. When reviewing these documents it is important to keep in mind that they represent the ***conceptual*** model for the CSI and may be modified for species-specific analyses in accordance with data availability and local circumstances. Analytical details for a specific species can be found with the other data on that species as described in the Ruleset and Scoring Indicators Framework document associated with each species.

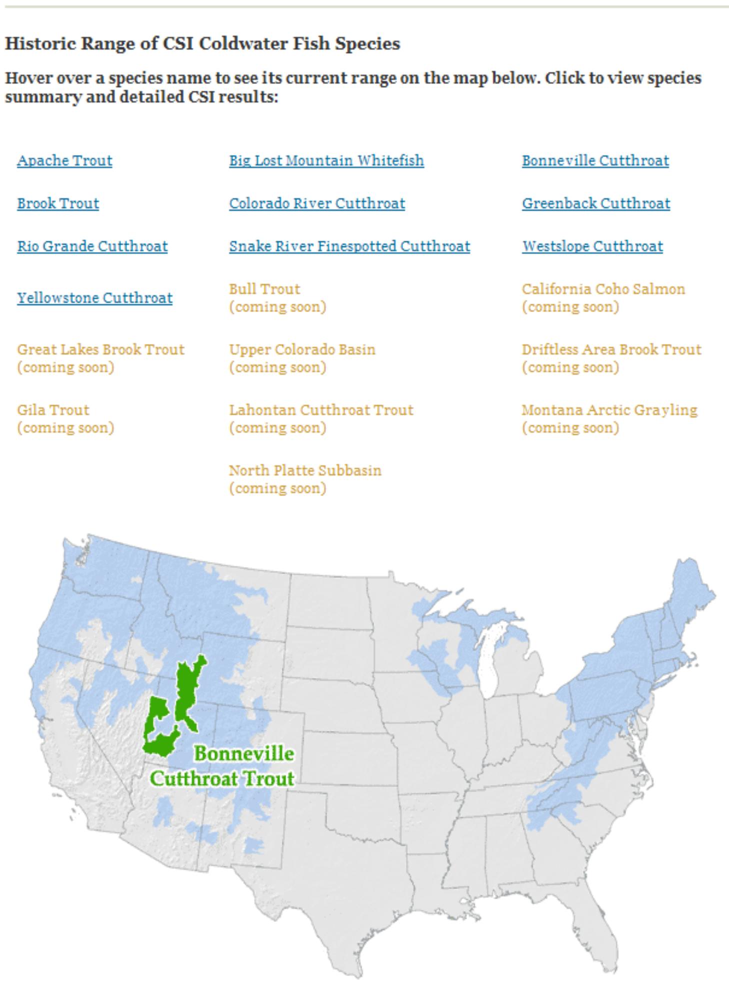



**Figure 8**: Link from **Home** page to **Species Summary**

Finally, the **Drainage Hierarchy Diagram,** also available for download on this page, places the subwatershed CSI analysis unit within the context of larger hydrologic units to provide the user with a sense of scale. The Drainage Hierarchy is based on the Hydrologic Unit Codes, which are hierarchical planning units for the United States developed by the U.S. Geological Survey.

Once familiar with the concepts behind the CSI, users can access results for specific species or wild trout areas via the map of the United States located in the center of the home page. The map shows the geographic extent for the completed CSI species and the species to be completed in the near future. The species are listed above the map, completed ones in green text and to be completed in orange. If the user hovers over a species name, the current range will appear on the map in green as shown for Bonneville cutthroat in Figure 8 below. Clicking on the name of a completed species will link to the **Species Summary** page for the selected species.

## 3.2 Results and Species Summaries

Figure 9 shows the **Species Summary** page for Bonneville cutthroat trout. As the name implies, this page provides a narrative summary of the species, a bulleted summary of CSI results (also available in a printable format), and a map of conservation strategies suggested by the CSI results that can be enlarged for viewing and printing. All of the CSI data, maps, and internet mapping applications can be accessed from the table of links at the bottom of this page (Figure 10).

CSI Home | User Guide (pdf)

# Bonneville Cutthroat Trout

***Oncorhynchus clarkii utah***

Rev. 1.5 - 4/2008

**Species Summary**

Once thought to be extinct, Bonneville cutthroat trout (BCT) were rediscovered in recent decades and relatively pure populations continue to persist along the periphery of the Bonneville Basin in Utah, Idaho, Wyoming, and Nevada. BCT evolved in ancient Lake Bonneville and its tributaries during the Pleistocene period, after the Bear River was diverted from the Snake River drainage into the Great Basin by a massive lava flow. The subspecies now occupies only a portion of its historic range and was unsuccessfully petitioned for listing under the ESA in 1998. BCT is currently considered a species of special management concern in all of the states where it is found.

Like Lahontan cutthroat trout, BCT have adapted to survive in relatively warm water and marginal habitats, and migratory life forms historically grew to be quite large in lakes and large rivers. Some populations within the Bear River drainage in southern Idaho and northern Utah continue to exhibit the species' impressive range of life history strategies and habitat requirements, migrating seasonally between turbid, lower elevation mainstem rivers and cold, clear, high elevation tributary streams. These adaptations, along with their unique ability to persist in the presence of non-native salmonids, make the conservation and restoration of this species a priority.

Key CSI Findings

- Only 36% of occupied habitats are in larger stream systems (≥ 2nd order)
- Life history diversity and habitat and population connectivity are greatest in the upper Bear and Weber River drainages
- BCT populations are vulnerable to future climate change
- General conservation priorities are protection in higher elevation northern subwatersheds, restoration in lower elevation northern subwatersheds, and reintroduction in southern subwatersheds

**Historic Range Relief Map**

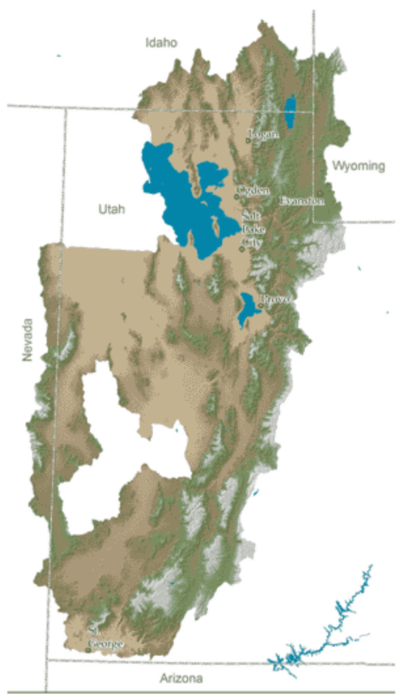



**Figure 9**: Top portion of the Species Summary page for Bonneville Cutthroat Trout

## Advanced users can find detailed CSI results below:

| | |
|---|---|
| CSI Maps<br>Download maps of CSI scores for this species. | CSI Data<br>View CSI scores and raw data for the entire species range, or for a specific subwatershed. |
| Interactive Map<br>View a zoomable Google Map of all subwatersheds, color-coded by CSI scores. | Google Earth Maps<br>Access a map of subwatersheds, color-coded by CSI score and viewable in the Google Earth program. |
| Rule Sets and Data Sources (Word Document)<br>View detailed scoring rules and data sources used in the CSI analysis. | |

**Figure 10:** Table of links for detailed CSI results for Bonneville Cutthroat Trout.

The CSI Maps link provides the mapped results of the CSI analysis for each of the indicator groups as well as the total CSI score and conservation strategies (Figure 11). The maps typically are of the entire historic range of native salmonids, but species with large historic ranges or wild trout may have a more limited geographic extent. Clicking any of the thumbnails will open an 8½ x 11" printable jpeg map in a new window.

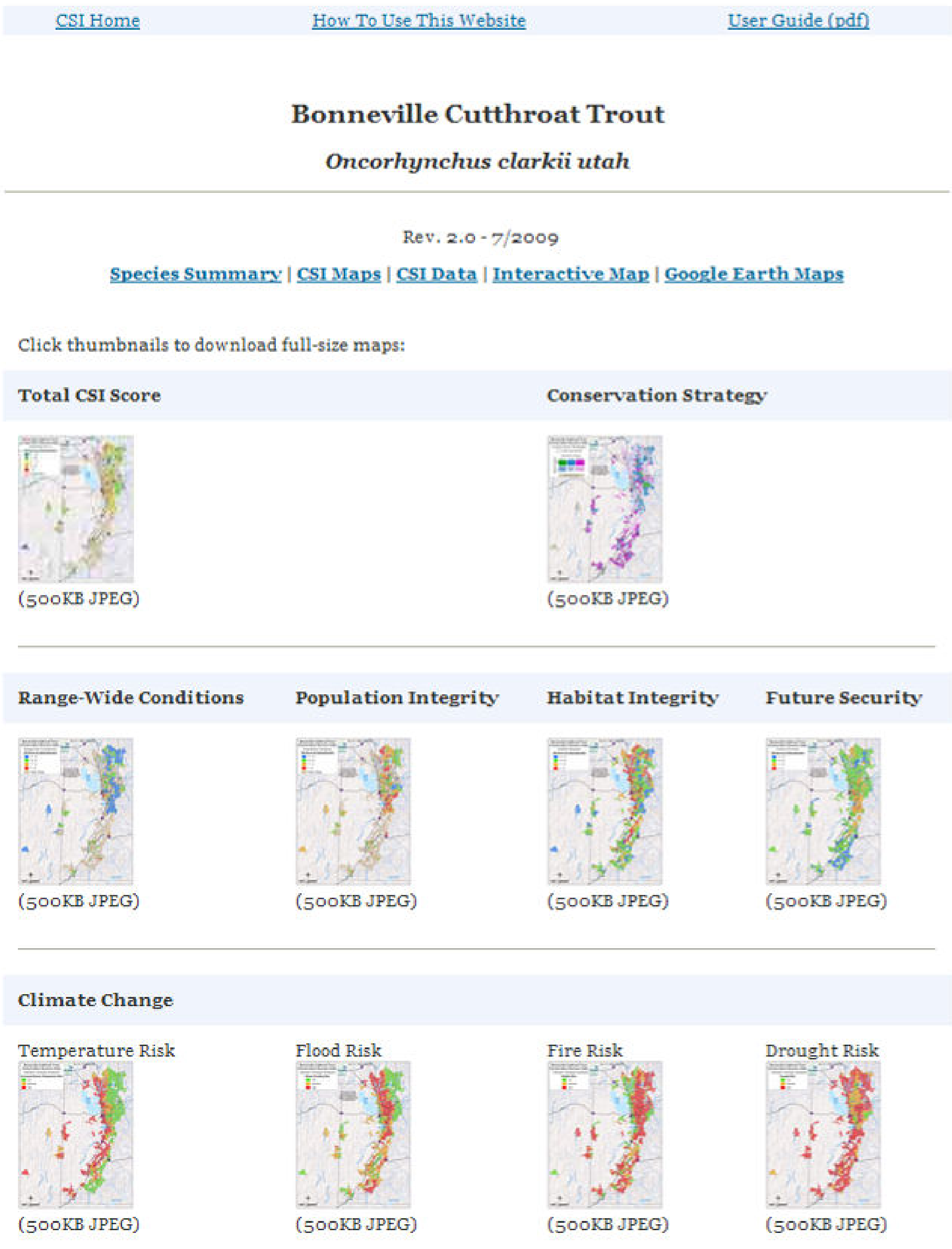



**Figure 11:** CSI Maps page for Bonneville Cutthroat Trout.

The CSI Data link provides the results of the CSI analysis in a tabular format for each of the four indicator groups (Figure 12).

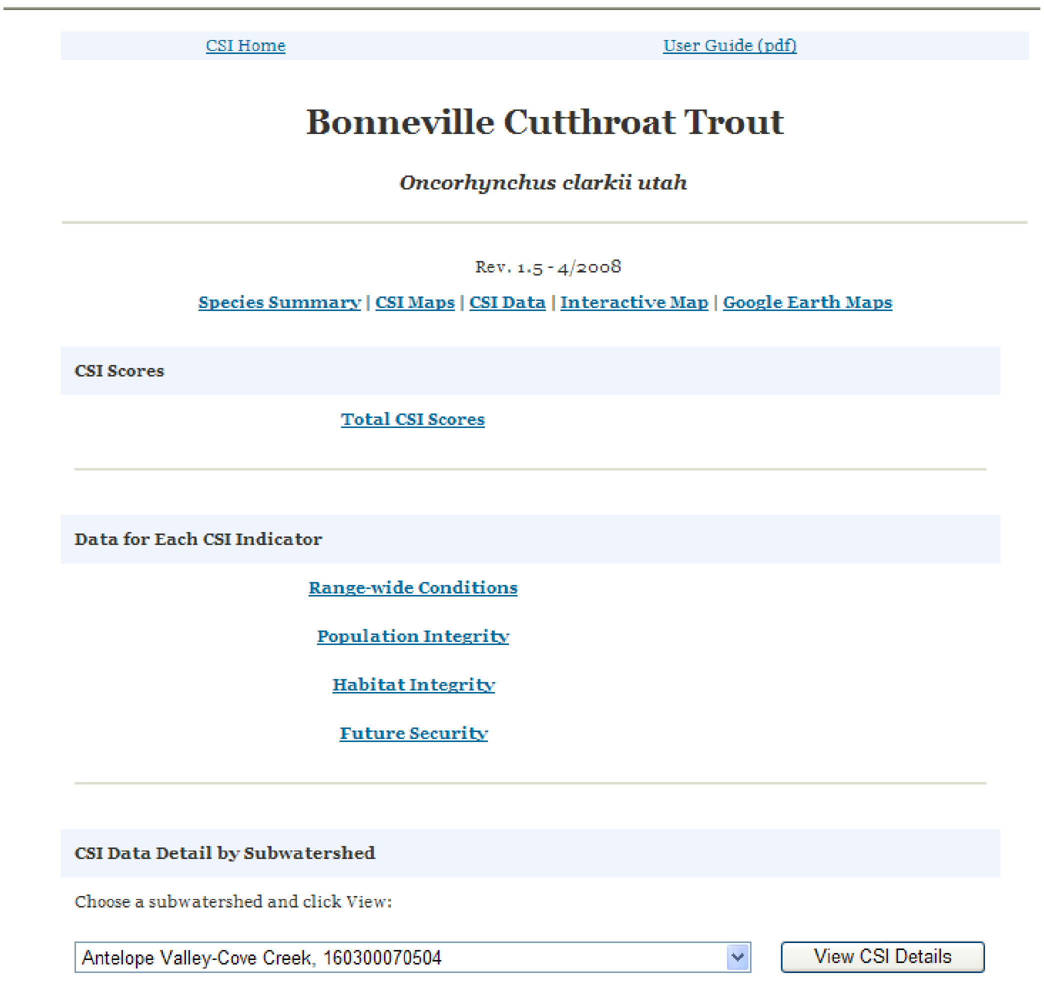



**Figure 12:** CSI Data page for Bonneville Cutthroat Trout.

The database containing scores for each of the indicators and the underlying data can be accessed for each indicator group by clicking on the appropriate link such as Range-Wide Condition Data. This takes the user to the CSI database which lists scores for each of the five indicators within the group by subwatershed (Figure 13). If more information is needed, additional links are available to "drill-down" through the indicators into the raw data. In the example below in Figure 13, the Bear River-Hayden Fork subwatershed has a score of 3 for the first indicator in the Range-Wide Conditions group which is CSI 1: Percent historic stream habitat occupied. After clicking on the link, a new table opens that shows the underlying spatial data that went into calculating that particular CSI score. The raw data can be viewed in conjunction with the rule set for the indicator to show exactly how the CSI score was derived. This particular subwatershed historically had 21.02 miles of available habitat and currently only 5.05 miles are occupied, or just 24%, resulting in a CSI score of 3.

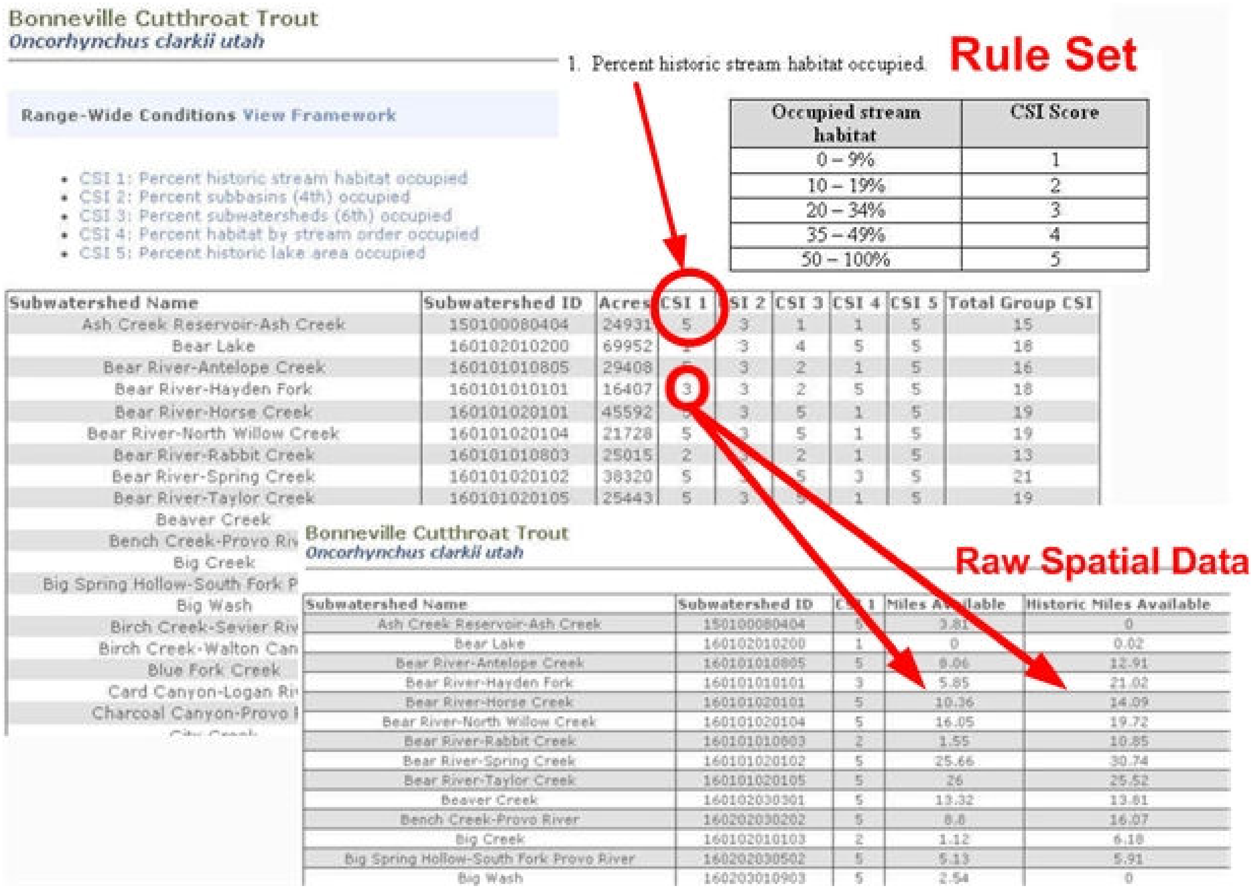



**Figure 13:** Range-Wide Condition Data link to database and raw spatial data used to calculate the Range-Wide Condition scores for Bonneville Cutthroat Trout.

The user can also locate detailed CSI data for a specific subwatershed if he/she knows the name and/or the 12 digit Hydrologic Unit Code for the subwatershed of interest. He/she can then use the scroll down menu located at the bottom of the CSI Data page under the heading **CSI Data Detail by Subwatershed**. Once the appropriate watershed has been selected, the user can then click on the **View CSI Details** button and a window will open that provides CSI scores for each of the indicator groups with links to the individual indicators and raw data.

The **Rulesets and Datasources** link from the **Species Summary** page downloads a document that describes in detail the scoring rules and data sources for each indicator used in the CSI analyses for that species.

## 3.3 Interactive Mapping Applications for Advanced Users

The CSI website provides two internet mapping applications for viewing CSI results for a specific subwatershed or region of interest to the user. One is based on Google Earth™ and the other has been integrated with Google Maps™. Before selecting a method, the user should go to the Google Earth Maps link and review system requirements to determine whether he/she has adequate computer resources to support Google Earth software. If not, a second method that is less CPU intensive is available based on a customized Google Maps application. Both of these applications can be accessed for each species from the **Species Summary** page.

*Finding Your Watershed with* **Interactive Map**

Clicking on the **Interactive Map** application link will open up the Google Maps application containing CSI data (Figure 14). The initial view is of the historic range for native species or geographic extent defined for wild trout. This view includes data on major highways, towns and the subwatersheds used in the analysis. The subwatersheds are also listed to the left so the user can zoom to a specific subwatershed if the name is known. Otherwise the pan and zoom tool can be used to navigate to the general area of interest.

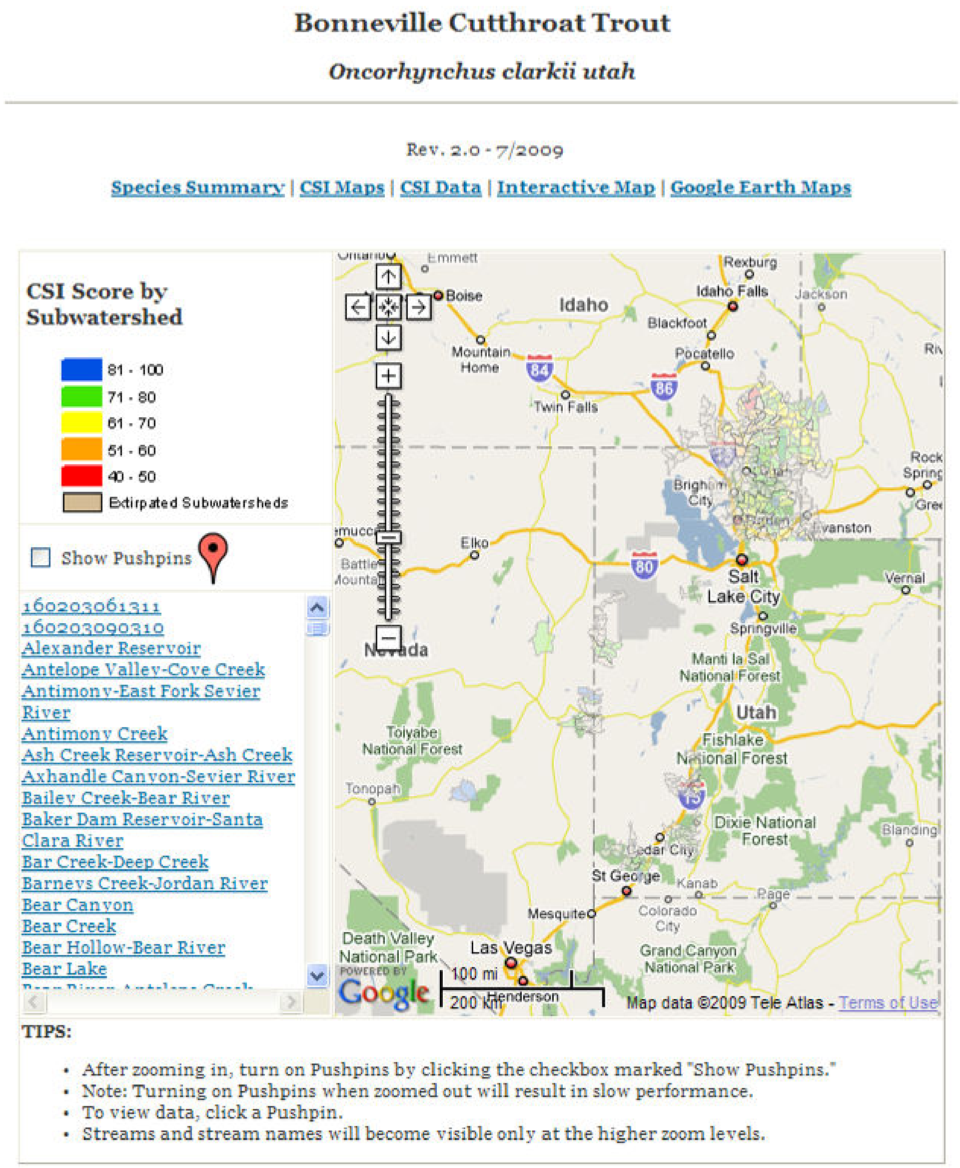



**Figure 14:** Interactive Map opening window for Bonneville Cutthroat Trout.

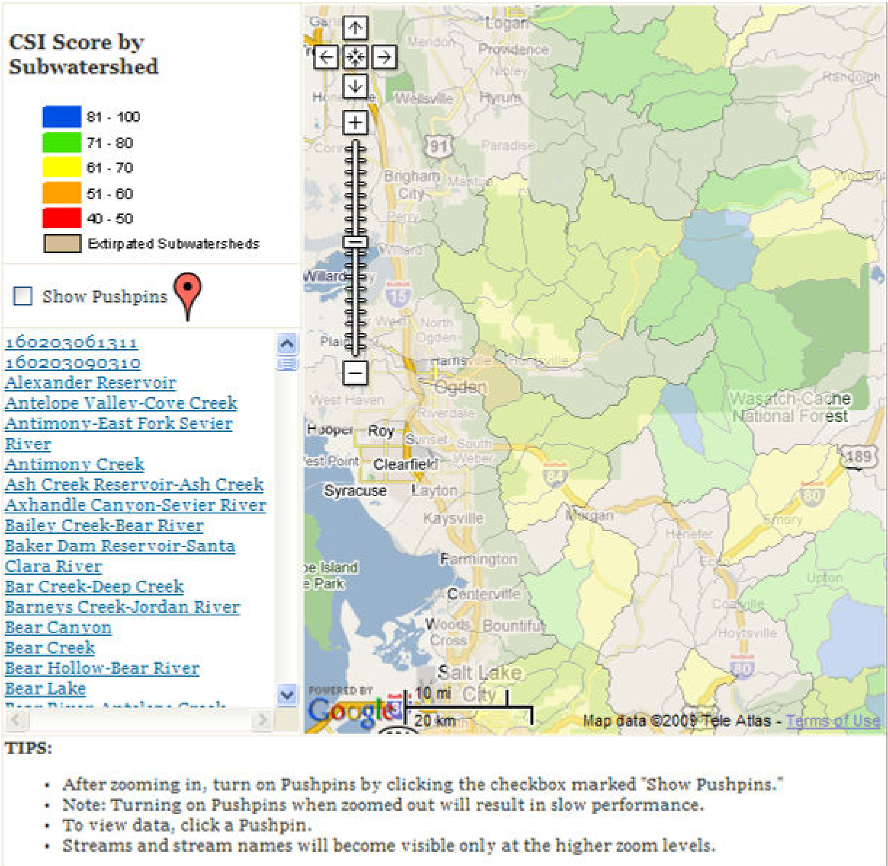



**Figure 15:** Spatial zoom using Interactive Map application.

Figure 15 shows the result of zooming. As the user zooms in to an area, additional data layers appear to facilitate navigation. At this scale, more towns appear in the view.

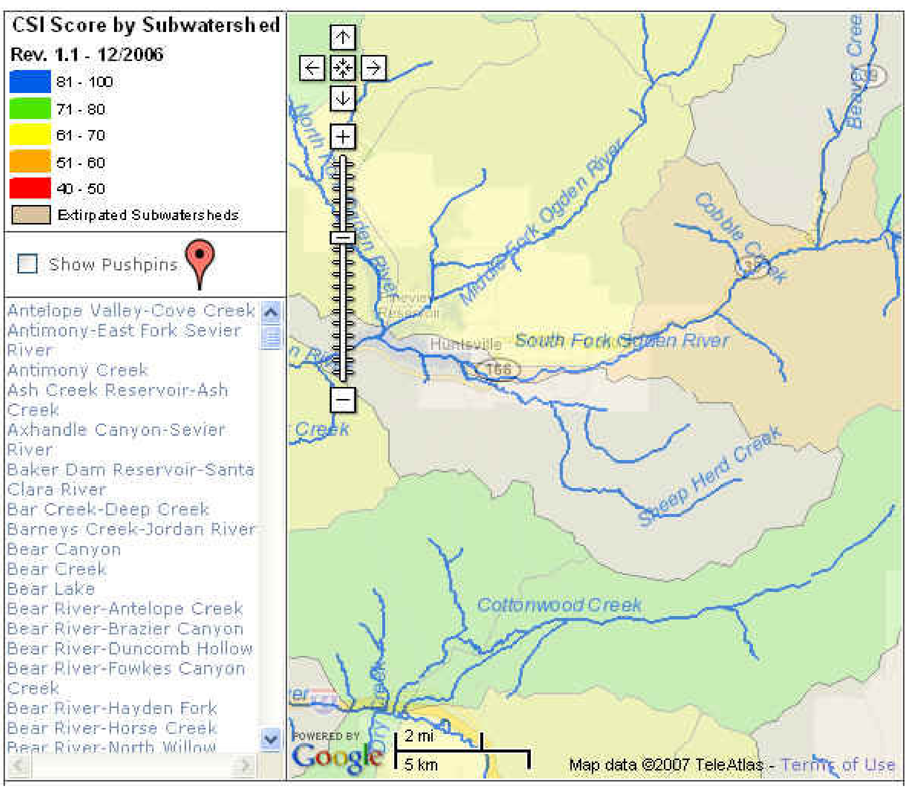



**Figure 16**: The stream layer with stream names shows when zoomed to a specific map scale.

Figure 16 shows the results of another zoom that brings in the local hydrology and stream names.

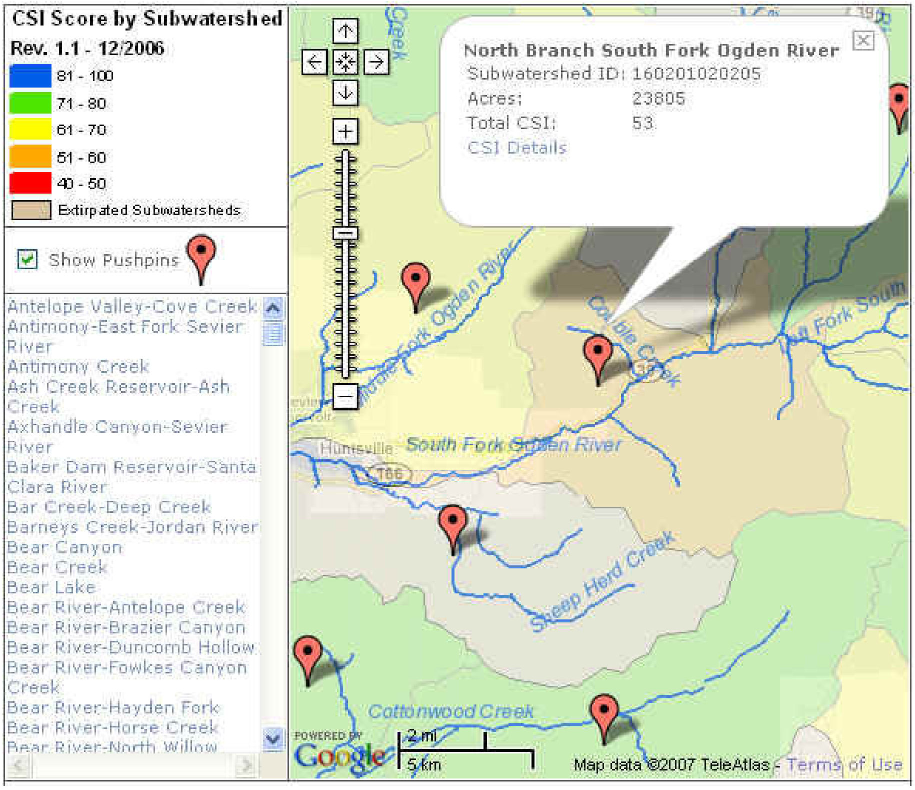



**Figure 17**: Clicking on the pushpin shows CSI information for the subwatershed with an additional link to the database.

Figure 17 illustrates how the user can access the CSI data. Once he/she has zoomed to the desired location, the pushpins can then be activated.

The pushpins identify the label point for each of the subwatersheds and contains a link to the CSI database. By clicking on the appropriate pushpin, the user will then find a pop-up on the map that includes basic subwatershed information such as name, subwatershed ID, and total CSI score. There will also be a CSI Details link that displays data from the CSI database. After clicking on the link, a new window will open showing the CSI data for that subwatershed and providing links to the underlying spatial data as described in the previous section. The user can also print a map of the screen view.

*Finding Your Watershed with* Google Earth Maps

The Google Earth application can be used to visualize CSI scores in conjunction with aerial imagery. However, before using the Google Earth application, the user must first have the Google Earth software installed on his/her computer. Refer to Google Earth Information found under the **Google Earth Maps** page to review the recommended system configuration. If you have the appropriate computer configuration, load the software onto the computer. Then on the **Google Earth Maps** page click on the View subwatersheds in Google Earth link. The following example uses Eastern Brook Trout which has been broken into regions due to the size of the species range. For this example, the Mass / Conn / RI region is used.

Figure 18 shows the image as it first appears with the subwatershed boundaries colored according to the total CSI score. Features such as the watershed and basin boundaries and the label points can be toggled off and on in the legend box. The control bars in the upper right hand corner can be used to zoom, pan, rotate, and tilt the image. (If the user is not familiar with the use of Google Earth, he/she should consult the Google Earth website for more detailed instructions on its use.)

Enter the name of a town in or near to your watershed here.

Subwatershed and basin boundaries and label points can be turned off and on by clicking on the checked boxes, here.

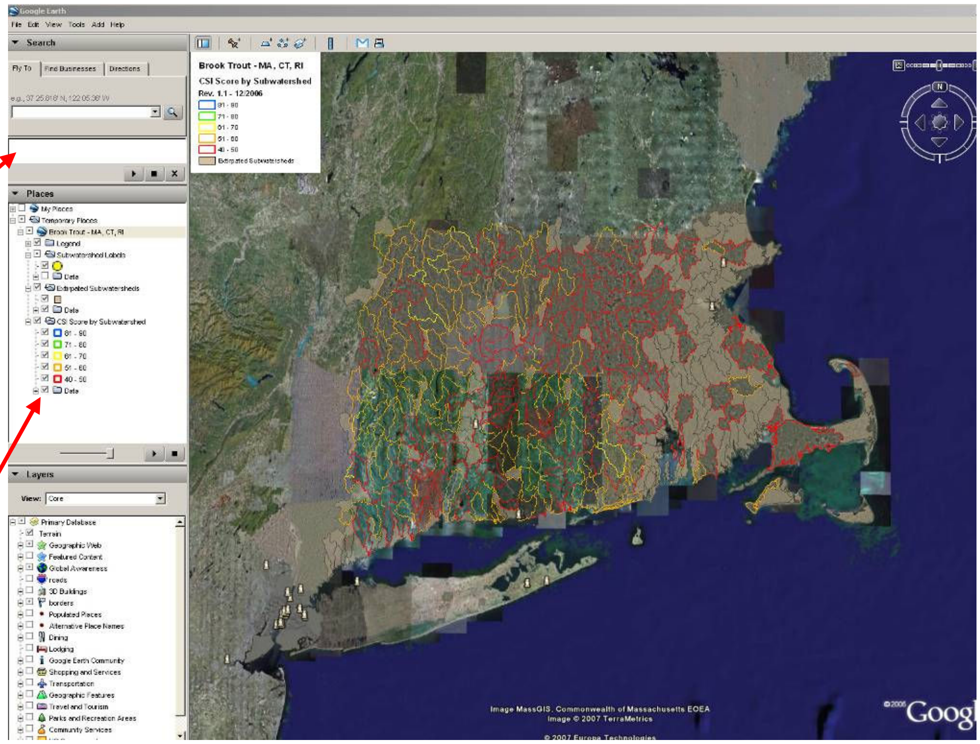
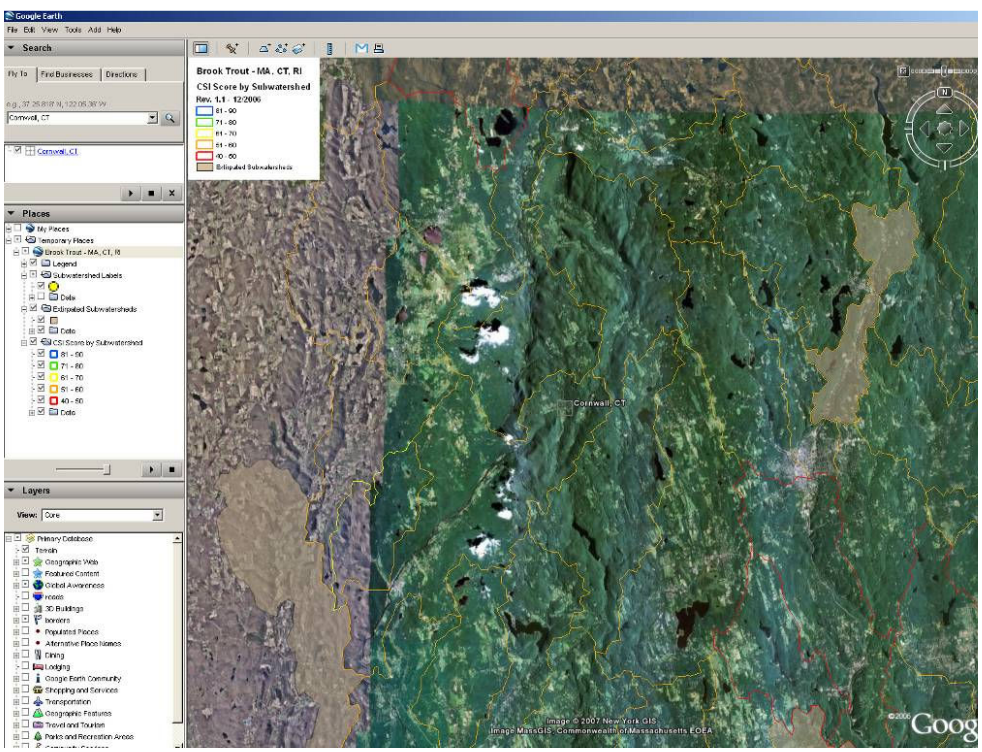



**Figure 18:** Initial Google Earth view Eastern Brook Trout in MA, CT, and RI.




For the purposes of this example, the town of **Cornwall, CT** was entered and Google Earth automatically zooms to it (Figure 19). Clicking in the image view at any time will stop the zooming process.

**Figure 19**: Google Earth zoom to Cornwall, CT.

Figure 20 shows the integration of several additional layers into the view. The roads data layer provided by Google Earth has been turned on to facilitate navigation and the label points from the CSI menu have also been turned on so that the database can be accessed. After clicking on a label point, a pop-up window appears with a link to the database accessible by clicking on **CSI Details** in the pop-up. This is the same procedure as was previously described for the Interactive Map application.

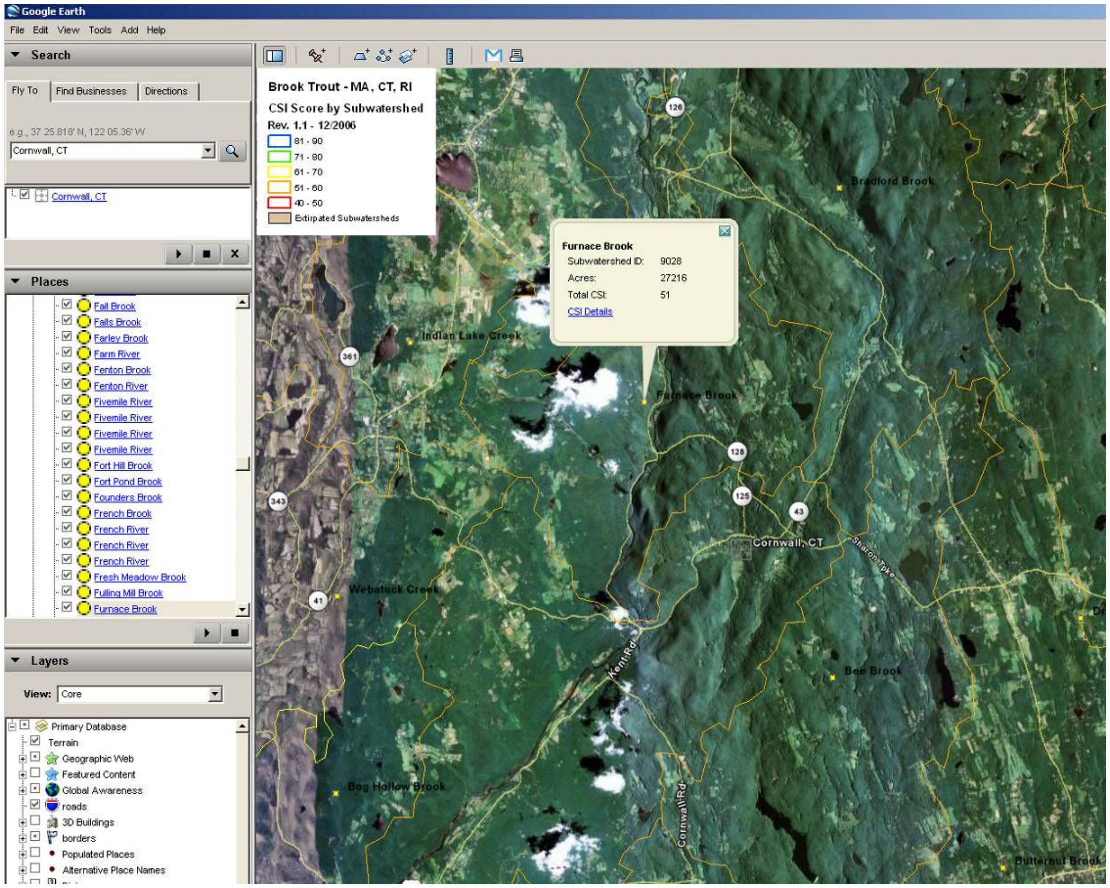



**Figure 20**: Link to the CSI database from the label point of a user selected subwatershed.

Clicking on a label point expands the list of subwatersheds with the selected one highlighted at the bottom of the menu view. If the user knows the name of the subwatershed they wish to access, he/she can expand the label point list and scroll to that subwatershed. It should be noted that the officially accepted name of the subwatershed does not always correspond to the largest or most well-known stream or river in that subwatershed. Once it has been highlighted in the list, double-clicking will cause Google Earth to automatically zoom to that area and bring up the pop-up.

The user can also print an image from Google Earth by going to File menu on the Google Earth menu bar, selecting Save and then Save Image and navigating to a location for saving the file. The image will be saved as a jpeg and will only include the image window. The scroll bars and menus to the left will not appear in the saved image.

## 3.4 Detailed Examples

*What are the Conservation Needs for a Watershed?*

TU Programs and grassroots efforts can sometimes be focused in one or a few watersheds, and the CSI can help determine the conservation needs within those watersheds. For example, several state and federal agencies and California Trout have been active in Paiute cutthroat trout restoration in northern California whereby they are removing non-native fish in Silver King Creek. To evaluate conservation needs within the Silver King Creek, go to the CSI website and click on the link to California Trout and Paiute Cutthroat Trout. After reading the Species Summary information, scroll down to Table 1. Table 1 shows the number of subwatersheds that received different CSI scores for each of the 20 indicators. The table shows that 5 subwatersheds scored a 1 for Introduced Species within Future Security, thus highlighting the problem of introduced species for Paiute cutthroat trout in some watersheds. Next, click on the **CSI Data** link at the bottom of the Species Summary page, then select the Lower Silver King Creek subwatershed in the "CSI Data Detail by Subwatershed" portion of the page, and finally click the "View CSI Details" button. This leads you to a page that displays CSI results only for the Lower Silver King subwatershed and shows that the status of Paiute cutthroat in the subwatershed is "Extirpated." Scores for Habitat Integrity are as high as they can possibly be – 25 out of 25 – indicating that habitat conditions are good, as would be expected for habitat found within a formally protected area, the Carson-Iceberg Wilderness. However, clicking on the **Future Security** link shows again that Introduced Species result in low Future Security scores (Introduced Species score = 1), indicating that introduced species represent a future threat to any Paiute cutthroat restoration in the Lower Silver King Creek subwatershed. This is the exact reason why partners working on Paiute cutthroat restoration are undertaking non-native fish removal efforts in this watershed.

While the CSI accurately reflects the Introduced Species problem that has already been identified by partners working on Paiute cutthroat restoration, looking at other Future Security scores for the Lower Silver King Creek subwatershed shows that Climate Change

CSI Home | How To Use This Website | User Guide (pdf)

**Paiute Cutthroat Trout**

*Oncorhynchus clarki seleniris*

Rev. 1.0 - 6/2009

| | |
|---|---|
| **Subwatershed Name:** | Lower Silver King Cr |
| **Subwatershed ID:** | 16050201_LSK |

**Future Security**

**CSI 4: Climate change = 1**

| | |
|---|---|
| Winter flooding risk | High |
| Uncharacteristic wildfire risk | High |
| Increased temperature risk | Low |
| Drought risk | Moderate |

**Figure 21**: Climate Change page for Paiute cutthroat trout.

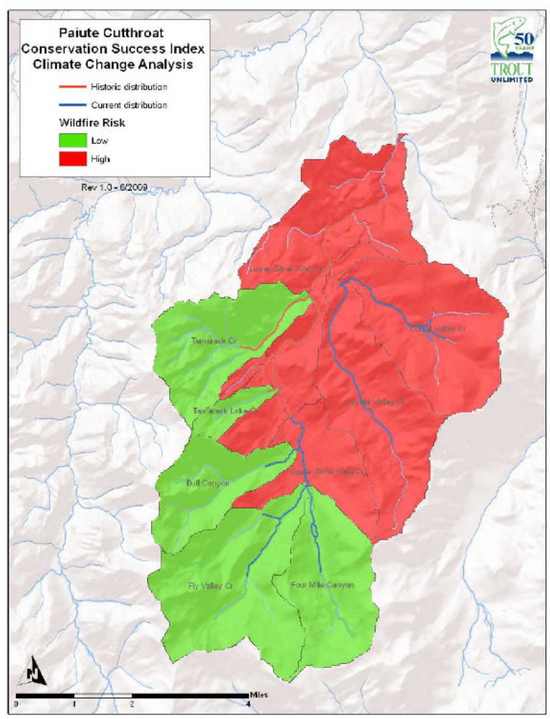



**Figure 22**: Wildfire Risk due to Climate Change for Paiute cutthroat trout

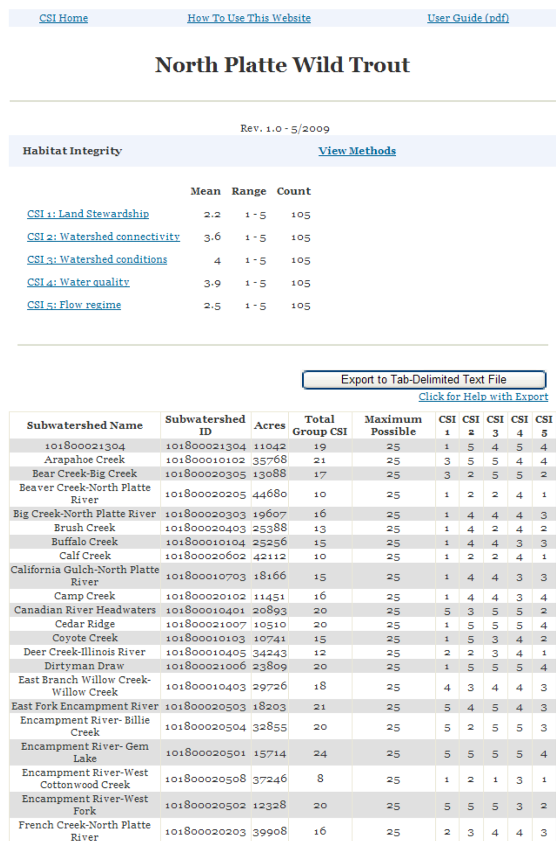
also scores low and poses a future risk to Paiute cutthroat restoration. Clicking on the **CSI 4: Climate Change** link shows that there is high risk for winter flooding and uncharacteristic wildfire risk (Figure 21); if you navigate back and click on the **CSI Maps** link, this is also shown on the **Fire Risk** map; click on the thumbnail to open the map (Figure 22).

As you can see, the CSI also suggests that proactive management should be undertaken to combat impacts to Paiute cutthroat trout due to future climate change. This often involves habitat restoration to ensure adequate stream shading and reconnecting large expanses of habitat. Since Lower Silver King Creek, and the entire Silver King Creek watershed, already has high Habitat Integrity - due to a lack of man-made barriers and good watershed conditions, water quality, and flow regimes - there isn't much that can be done except monitor for changes in habitat and restored Paiute cutthroat populations with a changing climate and undertake necessary management at that time. Consequently, the CSI can highlight additional factors, such as Climate Change, that threaten native salmonids in addition to those that are already being acted upon by partners working towards native trout restoration.

*Where do Opportunities Exist for Habitat Restoration?*

Many Trout Unlimited chapters encounter project opportunities that center on a specific issue. For example, in the North Platte River Basin a local nursery has hypothetically donated hundreds of riparian saplings for riparian restoration and a local heavy machinery business wants to donate equipment and time for streambank stabilization work. In both examples these donations represent opportunities to conduct habitat restoration in the North Platter River Basin. The CSI can help to determine where good opportunities for habitat restoration exist in the basin.

A good starting point is the **Species Summary** page for the North Platte River Basin on the CSI website. It offers background on some of the issues in the Basin, including some habitat problems. The CSI Scores for Habitat Integrity can help determine where current habitat conditions are likely to be poor and where habitat restoration is needed. To evaluate Habitat Integrity across the basin, begin by clicking on the **CSI Data** link at the bottom of the Summary page. Next, click on the **Habitat Integrity** link. Here you will find Habitat Integrity scores for all subwatersheds in the North Platte River Basin (Figure 23). By scrolling through the Habitat Integrity Total Group CSI scores you can see that the Encampment River –West Cottonwood Creek, Lower Michigan River, Middle Michigan River, North Platte River – Saratoga Lake, North Platte River – Elk Hollow Creek, and Pass Creek – Hat Creek subwatersheds all have Habitat Integrity group scores less than 10, indicating poor habitat conditions.


CSI Home How To Use This Website User Guide (pdf)

North Platte Wild Trout

Rev. 1.0 - 5/2009

Habitat Integrity View Methods

| | Mean | Range | Count |
|---|---|---|---|
| CSI 1: Land Stewardship | 2.2 | 1 - 5 | 105 |
| CSI 2: Watershed connectivity | 3.6 | 1 - 5 | 105 |
| CSI 3: Watershed conditions | 4 | 1 - 5 | 105 |
| CSI 4: Water quality | 3.9 | 1 - 5 | 105 |
| CSI 5: Flow regime | 2.5 | 1 - 5 | 105 |

Export to Tab-Delimited Text File
Click for Help with Export

| Subwatershed Name | Subwatershed ID | Acres | Total Group CSI | Maximum Possible | CSI 1 | CSI 2 | CSI 3 | CSI 4 | CSI 5 |
|---|---|---|---|---|---|---|---|---|---|
| 101800021304 | 101800021304 | 11042 | 19 | 25 | 1 | 5 | 4 | 5 | 4 |
| Arapahoe Creek | 101800010102 | 35768 | 21 | 25 | 3 | 5 | 5 | 4 | 4 |
| Bear Creek-Big Creek | 101800020305 | 13088 | 17 | 25 | 3 | 2 | 5 | 5 | 2 |
| Beaver Creek-North Platte River | 101800020205 | 44680 | 10 | 25 | 1 | 2 | 2 | 4 | 1 |
| Big Creek-North Platte River | 101800020303 | 19607 | 16 | 25 | 1 | 4 | 4 | 4 | 3 |
| Brush Creek | 101800020403 | 25388 | 13 | 25 | 1 | 4 | 2 | 4 | 2 |
| Buffalo Creek | 101800010104 | 25256 | 15 | 25 | 1 | 4 | 4 | 3 | 3 |
| Calf Creek | 101800020602 | 42112 | 10 | 25 | 1 | 2 | 2 | 4 | 1 |
| California Gulch-North Platte River | 101800010703 | 18166 | 15 | 25 | 1 | 4 | 4 | 3 | 3 |
| Camp Creek | 101800020102 | 11451 | 16 | 25 | 1 | 4 | 4 | 3 | 4 |
| Canadian River Headwaters | 101800010401 | 20893 | 20 | 25 | 5 | 3 | 5 | 5 | 2 |
| Cedar Ridge | 101800021007 | 10510 | 20 | 25 | 1 | 5 | 5 | 5 | 4 |
| Coyote Creek | 101800010103 | 10741 | 15 | 25 | 1 | 5 | 3 | 4 | 2 |
| Deer Creek-Illinois River | 101800010405 | 34243 | 12 | 25 | 2 | 2 | 3 | 4 | 1 |
| Dirtyman Draw | 101800021006 | 23809 | 20 | 25 | 1 | 5 | 5 | 5 | 4 |
| East Branch Willow Creek-Willow Creek | 101800010403 | 29726 | 18 | 25 | 4 | 3 | 4 | 4 | 3 |
| East Fork Encampment River | 101800020503 | 18203 | 21 | 25 | 5 | 4 | 5 | 4 | 3 |
| Encampment River- Billie Creek | 101800020504 | 32855 | 20 | 25 | 5 | 2 | 5 | 5 | 3 |
| Encampment River- Gem Lake | 101800020501 | 15714 | 24 | 25 | 5 | 5 | 5 | 5 | 4 |
| Encampment River-West Cottonwood Creek | 101800020508 | 37246 | 8 | 25 | 1 | 2 | 1 | 3 | 1 |
| Encampment River-West Fork | 101800020502 | 12328 | 20 | 25 | 5 | 5 | 5 | 3 | 2 |
| French Creek-North Platte River | 101800020203 | 39908 | 16 | 25 | 2 | 3 | 4 | 4 | 3 |

**Figure 23**. CSI webpage for Habitat Integrity scores.

Since we're looking for opportunities for riparian and streambank restoration, the Land Stewardship, Watershed Condition, and Water Quality scores can all indicate areas where riparian vegetation has been cleared and streambanks may be eroding.  While we could explore subwatershed scores for all three indicators, by clicking on the **CSI 4: Water Quality** link we can see that one of the previously mentioned subwatersheds, the North Platte River – Saratoga Lake, has the lowest Water Quality CSI score (CSI Score = 1) because of numerous miles of roads along streams, 303(d) listed stream miles, and acres of agricultural land.  Hence, this watershed is a good candidate for a habitat restoration project.

To explore the North Platte River – Saratoga Lake subwatershed even further, navigate back to the **Species Summary** page and click on the **Google Earth Maps** link a the bottom.  Next, click on the link **View subwatersheds for this species in Google Earth**.  When Google Earth is installed on your computer, this link will open Google Earth with the subwatersheds for the North Platte River Basin. Find the North Platte River – Saratoga Lake subwatershed by viewing the labels (make sure the "**Data**"

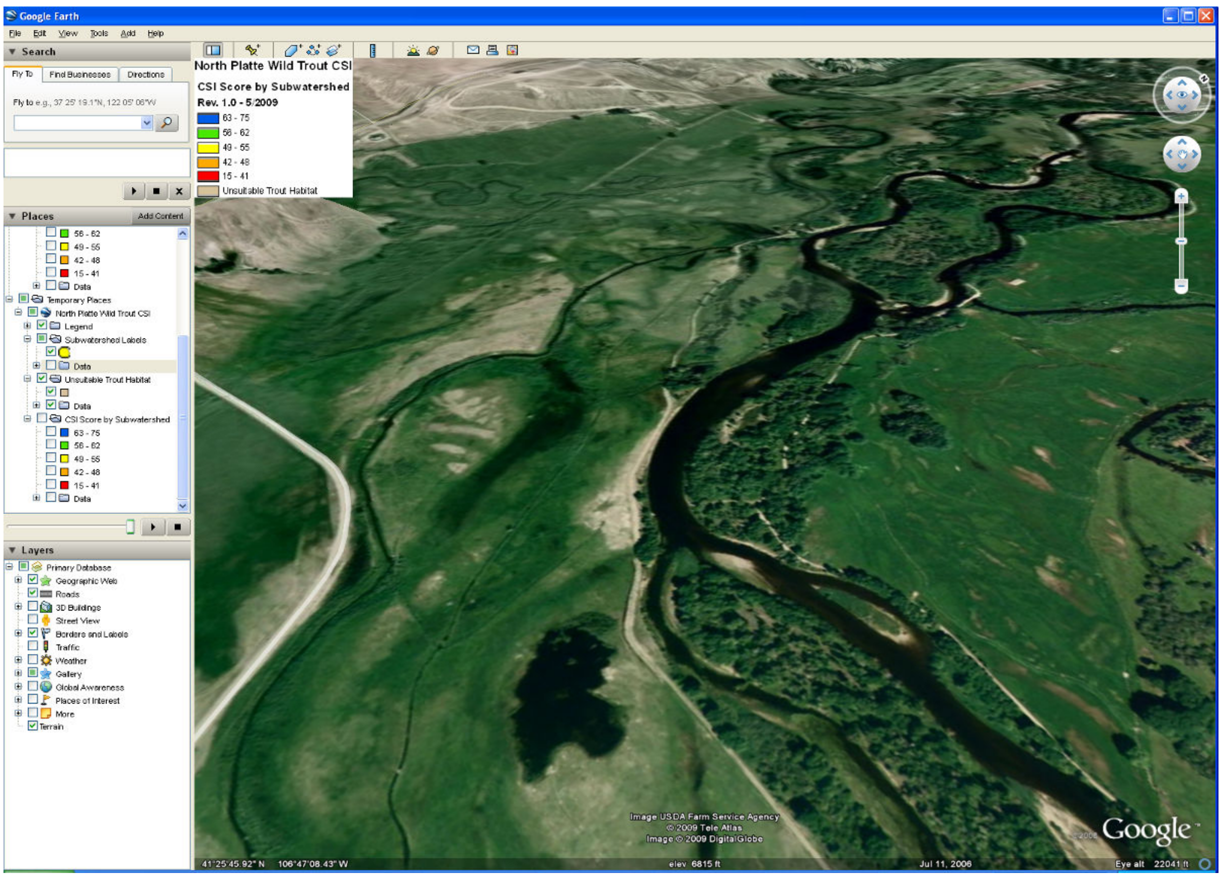



**Figure 24**.  Google Earth view of the North Platte River – Saratoga Lake subwatershed, showing hayfields and roads along the North Platte River where there are potential habitat restoration opportunities.

box in the "**Places**" frame on the left hand side of the screen is checked), panning around, or searching "Saratoga Lake."  Notice that the subwatershed is colored red, indicating that it has a low Total CSI score. When the labels are turned on, click on the **North Platte River – Saratoga Lake** label.  This will open a pop-up window that shows the Total CSI score to be 38.  Zoom in to take a closer look at the North Platte River in this subwatershed, and then turn off the subwatershed scores by unchecking the "**CSI Score by Subwatershed**" box to the left.  Pan along the river.  Note that there are numerous hayfields in the valley, some road crossings, and roads along the river (Figure 24). Note where hayfields and roads are adjacent to the river and there are no riparian trees. These are good candidate areas to evaluate on the ground for their potential need for riparian and streambank restoration. This would conclude Tier I of the analysis - using the CSI to strategically identify subwatersheds with likely habitat restoration needs and exploring areas within the subwatershed for potential opportunities.

The next step (Tier II) is to incorporate local knowledge by interacting with land managers, agency biologists and conservationists, and landowners to identify potential project sites in the subwatershed identified using the CSI. This local knowledge will further define where a potential restoration project can be implemented. And while this example was focused on habitat restoration, the CSI can likewise be used to determine where efforts should be focused to: combat climate change impacts by evaluating Climate Change CSI scores across subwatersheds; provide fish passage by evaluating Population Extent scores and Watershed Connectivity scores across subwatersheds; remove non-native fishes by evaluating Genetic Integrity scores and Introduced Species scores; and engage in habitat protection efforts using Land Stewardship scores, Land Conversion scores, Energy Development scores, and Resource Extraction scores. As you can see, the CSI can be a useful first step in strategically identifying areas where different conservation actions are needed.

## 4.0 Advanced CSI Applications

Trout Unlimited is using CSI results in a number of different advanced ways in order to improve our organizational effectiveness and restore native coldwater fish. Two of the most fundamental applications are assisting in the determination of on-the-ground conservation priorities and informing members and the interested public about the health of our native trout and their habitats. We also describe recent applications involving climate change and impacts from broad-scale energy development. Working with Trout Unlimited's Science and Technology Team is critical for these advanced applications.

### 4.1 Determining Conservation Priorities

Bonneville cutthroat trout (BCT), found primarily in Idaho and Utah, provide a good example of how the CSI can be used to define organizational priorities and direct future management actions to maximize conservation benefits to BCT. All subwatersheds and streams have inherent value, but the CSI helps decision-makers and scientists develop conservation strategies for subwatersheds across the historic range of a species. Different components of the CSI can be used to suggest an appropriate strategy, thus ensuring the most effective use of conservation dollars and time.

Figure 25 provides a side-by-side comparison of the Total CSI score and the resulting conservation priorities for BCT. Subwatersheds with high CSI scores remain largely

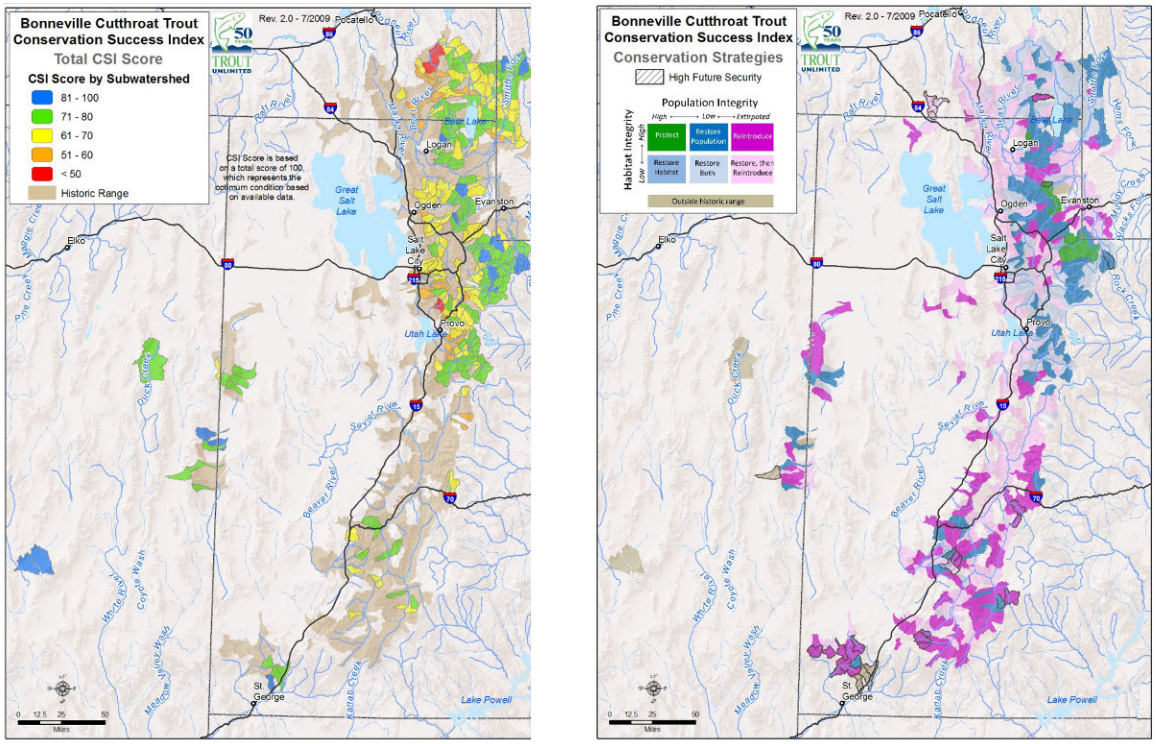



**Figure 25**. (On left) Map of the total CSI score for Bonneville cutthroat trout by subwatershed. These scores were used to determine the Conservation Strategies shown in the map on the right.

intact in terms of populations and habitats, and therefore have a conservation strategy based on protection. Subwatersheds with high population integrity scores but low habitat integrity scores have a conservation strategy based on habitat restoration. Subwatersheds with high habitat integrity but low population integrity have a strategy based on population restoration. In some instances, BCT have been extirpated from subwatersheds with high habitat integrity, which suggests that BCT could potentially be reintroduced into these high quality habitats. Looking at Conservation Strategies across the range of BCT show that higher elevations in the northeast portion of their range have high quality habitats that need protection or population restoration, whereas rivers lower in the watersheds, which usually are located on privately owned lands, require habitat restoration. In the southern range, BCT conservation strategies should focus on population restoration and reintroductions where they have been extirpated in portions of their historic range. The Conservation Strategies suggested by the CSI should also be weighed against the Future Security of subwatersheds. Strategies implemented in subwatersheds with high future security are more likely to be successful in perpetuity than subwatersheds with low future security.

While the CSI can help to identify conservation strategies for subwatersheds at a coarse scale, local knowledge and partnerships are keys to identifying successful strategies and on-the-ground projects. Likewise, monitoring is a critical to determine the success of any strategy and detect changes from threats that manifest themselves in the future.

## 3.2 Public Education

One of the primary goals of the CSI is to communicate complex assessment data and conservation opportunities to both the TU membership and broader public. Through the synthesis and display of salmonid assessment data, we hope to increase knowledge among TU membership to 1) foster a better understanding of the health of rivers and watersheds that support native salmonids, 2) increase awareness of threats facing these systems, and 3) encourage support for and participation in needed management efforts.

Grassroots participation in habitat protection, restoration, species reintroduction, and monitoring is critical to successful long-term management of coldwater resources. Each year, local TU chapters and partner organizations participate in hundreds of on-the-ground restoration activities while our state council and national office staffs team up with agencies and other non-governmental organizations to improve water, energy and land use policies. In addition, members have been successfully organized in policy debates on protecting National Forest roadless areas, curtailing oil and gas development on sensitive public lands, and overturning unnecessary bans on the use of piscicides. For TU, the CSI is another valuable tool in our efforts to educate our members and assist our partner organizations with their conservation missions.

Results of the CSI can be used in a variety of ways to communicate information to the public about the health and future of our native trout populations. One of the most effective communication tools is the integration of the CSI data with Google Earth ™ imagery. The imagery helps to explain visually the analytical results of the CSI for a specific subwatershed. Figure 26 shows an example of that interface for the Oneida Narrows Reservoir subwatershed on the lower Bear River in southeastern Idaho. This subwatershed received a relatively low CSI score of 10 points out of 25 for population integrity. Someone investigating CSI scores for BCT in this subwatershed might immediately speculate that the low scores result in part from the presence of the Oneida Narrows Dam that is visible near the bottom of the image (in the upper part of the watershed). In fact, this subwatershed received low individual scores for population density and extent, genetic stability, and life history diversity, all of which can be at least partially attributed to the presence of the dam. Dams serve as barriers that isolate above- and below-dam populations from each other, truncating accessible habitat for each group and preventing the dispersal that is so important for maintaining both genetic diversity and a migratory life history form. Additionally, in this case, non-native competitors like brown trout and rainbow trout may compete with or interbreed with native populations below the dam, jeopardizing the native gene pool. In the case of the Oneida Narrows Reservoir subwatershed, migratory Bonneville cutthroat trout historically occupied the mainstem Bear River, but have been nearly extirpated from these habitats and now thrive only in isolated tributaries with resident life histories.

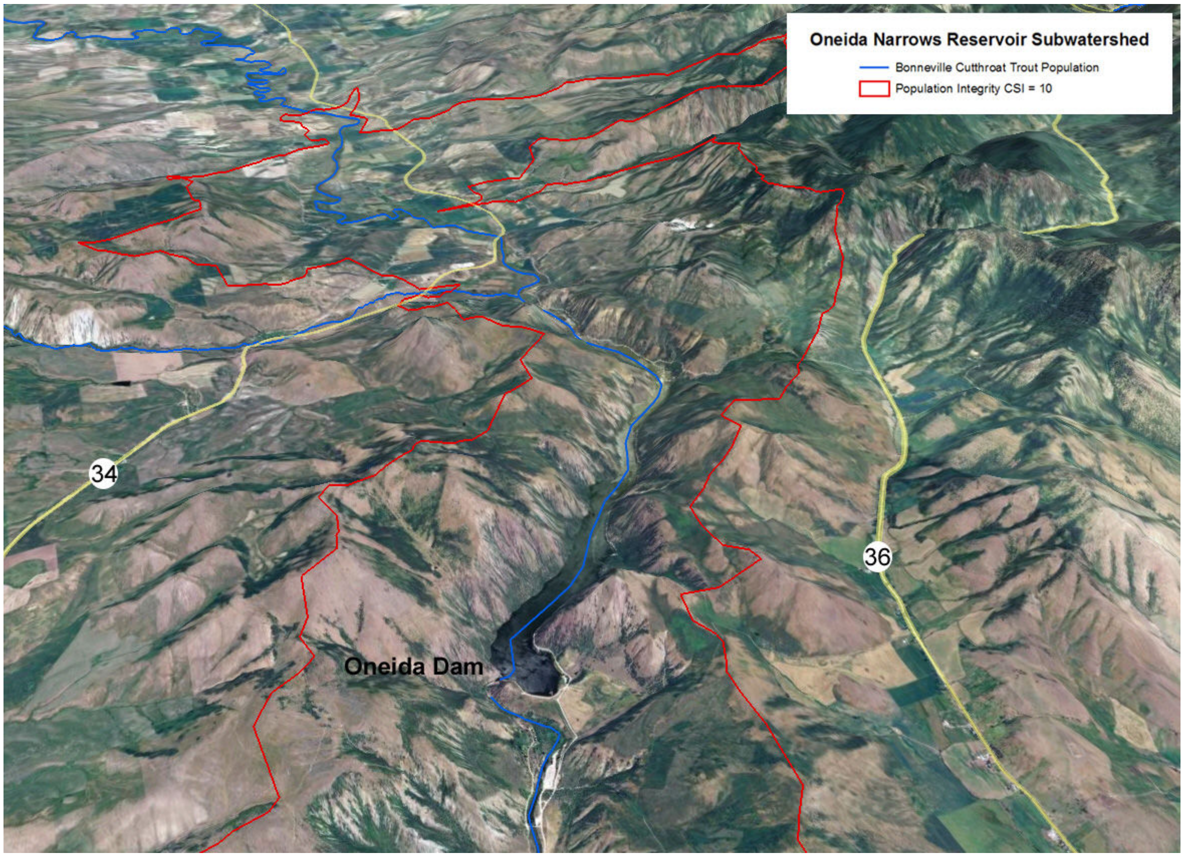



**Figure 26**. CSI Google Earth ™ image of Oneida Narrows Reservoir subwatershed on the Bear River in southeastern Idaho. Subwatershed boundaries are delineated by red lines, streams and rivers by blue lines, and roads by yellow lines. Note the Oneida Narrows Dam near the bottom of the image.

The Oneida watershed illustrates the complexity that often characterizes on-the-ground conservation decisions: despite the negative impacts of the dam described above, the dam may serve as a barrier to upstream movement of non-native trout. Therefore, while the CSI helps shape conservation strategies across various spatial scales, local knowledge of individual streams and stream reaches is absolutely critical to developing effective on-the-ground strategies for improving subwatershed conditions and restoring trout populations and habitat. State or federal agencies, watershed councils and local coalitions are excellent sources of local information on stream condition. As with any project, effective partnerships and leadership are key ingredients for long-term success.

## 3.3 Climate Change

Rapid global warming and associated climate change are likely to cause unprecedented environmental challenges for coldwater fish, including trout, char and salmon. As ectotherms they are directly regulated by the temperature of their environment, and their specific habitat requirements for various life stages also make them particularly vulnerable to the many changes predicted to occur in aquatic habitats. Many of these species are already struggling in the face of wide-scale habitat degradation, fragmentation, and the introduction of non-native species, all of which will compound the effects of climate change.

The most pervasive environmental change associated with climate change is a warming of the Earth's surface. Temperatures have already risen on average more than 1º F (0.6°C) over the last century and are projected by the Climate Impacts Group to increase anywhere from 2 to 10ºF (1.1 to 5.6°C) over the next 100 years. Warming air temperatures will cause numerous fundamental changes to aquatic systems including reduced snow pack, earlier peak run-off, and lower base flows. Longer, hotter summers projected for the Rocky Mountains in conjunction with low flows will stress native salmonids.

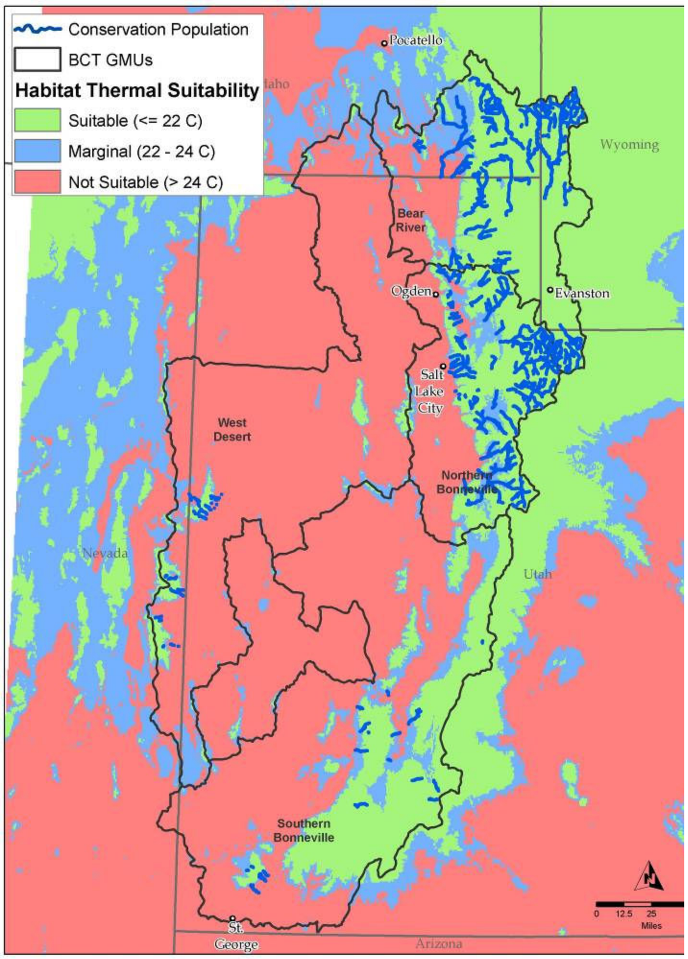



**Figure 27:** Predicted habitat thermally suitable for Bonneville cutthroat trout given a 3°C increase in summer temperatures.

Trout Unlimited is using the CSI in conjunction with a model of 3°C (5.4°F) mean July temperature increase to evaluate the effects of global warming on local populations of native trout. The results of these analyses are used to develop place-based management strategies that will mitigate the impacts of global warming.

Figure 27 shows the distribution of Bonneville cutthroat trout under a global warming scenario. Thermal thresholds for BCT were found to be optimal for an air temperature of 22°C and thermally unsuitable at temperatures greater than 24°C.

Many of the populations have been isolated in higher elevations and cooler habitats and may not be directly affected by warmer temperatures.

However, these populations are often highly fragmented and do not currently occupy habitat patches large enough for long-term persistence. This problem is particularly evident in the West Desert and Southern Bonneville geographic management units where the small populations are already in thermally marginal or unsuitable habitat and opportunities to reconnect tributaries to main stems are limited.

When developing strategies to mitigate changes in the availability of thermally suitable habitat, it is important to take into account the inherent advantages and disadvantages that a population may have for adapting to environmental change based on local conditions. Population and habitat integrity indicators from the CSI provide important information for the development and implementation of strategies to build resistance and resilience to climate change in a manner that will ensure future persistence of local populations as well as the species.

Figure 28 shows the relative risk to local populations of Bonneville cutthroats from rising temperatures (left) and the Habitat Integrity scores (right) from the CSI. The high habitat integrity areas are important places to protect, particularly for those subwatersheds at moderate or high risk of exceeding thermal limits where habitat degradation will accentuate the risk. An example of this is found in the West Desert along the Utah-Nevada border where a number of small, isolated populations are located in high quality habitat. However, they are at risk from increased temperatures and their extremely small habitat patch size makes them particularly vulnerable to local extirpation. Here, minimizing outside stressors is essential to the persistence of these populations which have unique genetic characteristics important to the overall survival of the species.

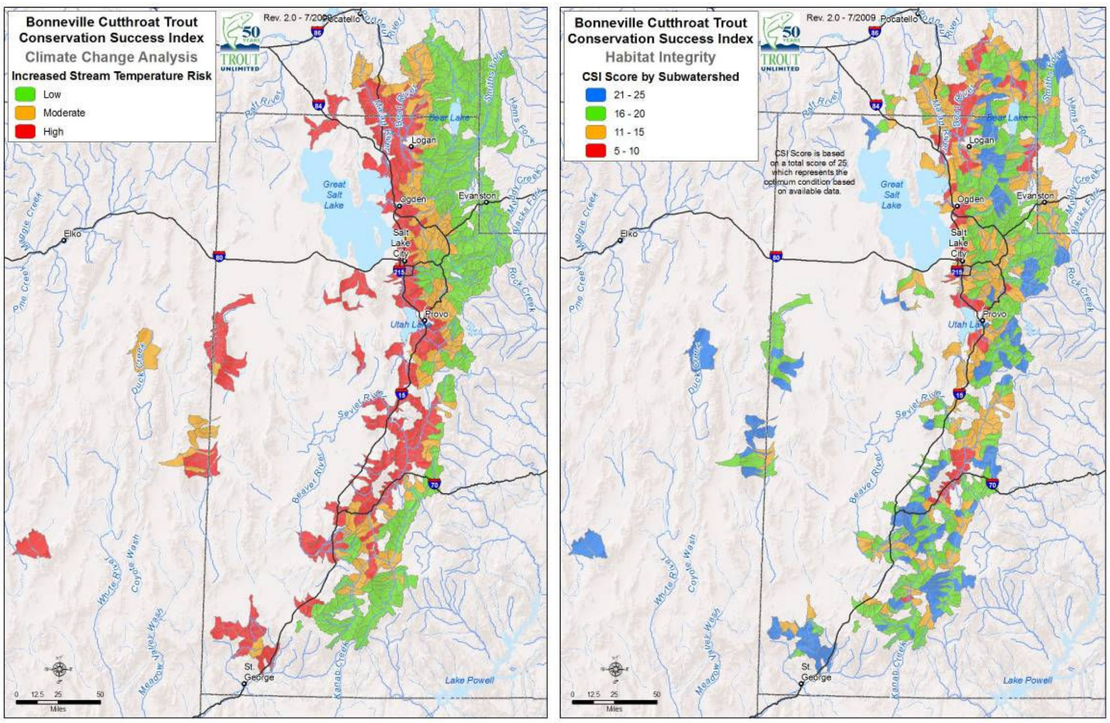



**Figure 28**: Risk to local populations of Bonneville cutthroat trout from increased summer temperature (left) and CSI habitat integrity scores (right).

Areas of moderate to high risk with low habitat integrity scores are high priority sites for active restoration. This situation is found in the lower reaches of the Bear River GMU where some of the important corridors for maintaining the migratory life history form of BCT are located. It is important that the restoration strategy include management actions that directly address the issue of thermal suitability such as increased riparian shading and/or flow augmentation. Watersheds where the local population has been extirpated that are well within the thermal tolerances of Bonneville cutthroat and still support high quality habitat may be good sites for reintroductions as other subwatersheds within the basin become unsuitable.

## 3.4 Energy Development

Trout Unlimited is working to ensure that oil and gas and renewable energy development in the West is done in a responsible manner that takes into account the inherent impacts of development on fish and wildlife habitat. The intent of TU's Responsible Energy Development (RED) program is to keep energy development out of the most sensitive and critical fish and wildlife areas and ensuring that appropriate stipulations and mitigation measures are applied when development does occur. Making these types of place-based decisions requires a spatially accurate understanding of the resources at risk and the vulnerability of local populations to development. The CSI provides information to help TU in its decision-making process so that native coldwater fisheries are protected.

A significant part of TU's energy program is organizing hunters and anglers to become involved in local policies surrounding energy development on lands administered by the U.S. Forest Service and Bureau of Land Management. The CSI, and particularly the Google Earth interface, provide an important tool for communicating the science and resource values at stake in a highly effective manner. Figure 29 shows a development scenario within the Strawberry Reservoir Management Area on the Uinta National Forest and CSI scores for Bonneville cutthroat trout. Using the CSI, TU can show that projected energy development in this region has the potential to impact high quality Bonneville cutthroat populations and habitat.

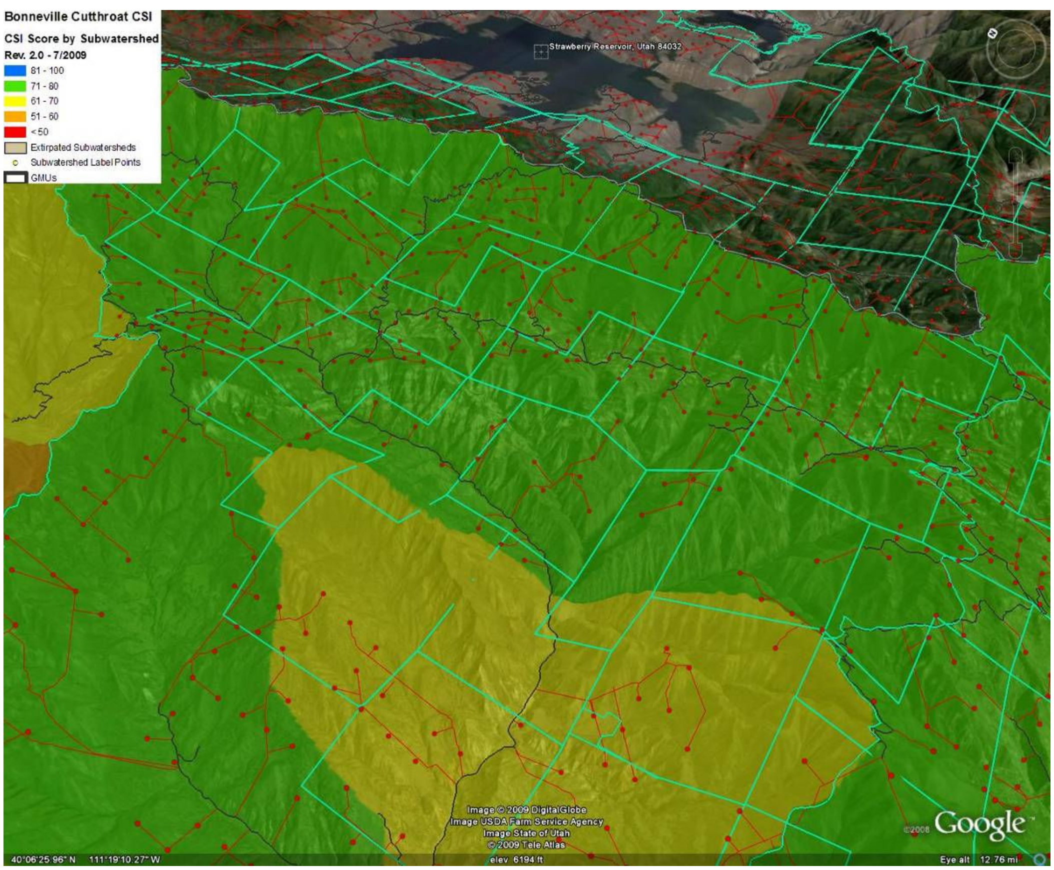



**Figure 29:** Energy development scenario and Bonneville cutthroat trout CSI scores on the Uinta National Forest, Utah. Grey lines depict existing roads, red lines planned roads, red dots indicate well pads and drilling sites, and blue lines represent leases. High CSI Scores across much of the area show that energy development could impact high quality Bonneville cutthroat populations and habitats.