BULL TROUT CORE AREA CONSERVATION STATUS ASSESSMENT

Conducted by: U.S. Fish and Wildlife Service
Portland, Oregon
February - April, 2005

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EXECUTIVE SUMMARY

Service scientists assembled and presented a conservation status and risk assessment for each of 121 bull trout core areas, as part of a bull trout five-year review held March 7-9, 2005, in Portland Oregon. The model used for the status ranking exercise was based on a modification of the Natural Heritage Ranking process, using NatureServe Conservation Status Assessment Criteria. The model integrates four separate ranking factors: population abundance, distribution, population trend, and threats (incorporating severity, scope, and immediacy subfactors) to arrive at an overall status ranking. Our original analysis of the 121 bull trout core areas produced categories we referred to as C-Ranks, and were distributed as follows: 43 core areas were ranked C1 = High Risk, 44 core areas were ranked C2 = At Risk, 28 core areas were ranked C3 = Potential Risk, 4 core areas were ranked C4 = Low Risk, and 2 core areas were ranked CU = Unknown.

After presenting this analysis to the review panel, we were asked to conduct additional evaluation of the model and its results. This report describes those additional evaluations in some detail and incorporates extensive GIS-based mapping of core areas to illustrate many of the examples. The Natural Heritage model assigns negative points (P-values) to populations of bull trout in most core areas, due to the relatively low population sizes and limited distribution. Population trend was unknown for most core areas. The three population parameters used in the scoring exhibited a degree of interdependency. We note that the model assigns a relatively positive P-value (0 points) in all categories where population parameters are unknown.

The model is most heavily influenced by the threat rank (particularly the severity of threats subfactor), which is less quantitative and more complex in its standard application. We found that threats were highly core area specific. Considerable familiarity with each core area and application of standard rules and assumptions was needed to apply the threat subfactors (severity, scope and immediacy) with consistency. This was particularly important, given that the model evaluated threat in the context of current conditions and the near-term future. About one-fourth of core areas were considered to have either high severity or low severity of threats, respectively, with the other half exhibiting moderate levels. There was a strong correlation between the eventual C-Rank of a core area and the threat severity ranking for the same core area, with most C1 = High Risk core areas also having high severity of threats. Some threats are quantified and presented in this report in tabular form.

We explored aggregating core areas into larger units, such as Upper Columbia, Coastal, and Snake River evolutionary blocks and examined ranking scenarios treating them as independent blocks. We determined the ranking results would be similar for each block. Another type of analysis, retaining the original scoring but weighting the core areas by the amount of key recovery habitat was more revealing, but needs additional verification. We also present summary exercises to better describe connectivity of bull trout core areas, both internally (among local populations within a core area) and externally (among core areas). We identify life history forms in each core area and discuss relevant aspects of connectivity with Canadian populations.

INTRODUCTION

As part of the technical presentation made to the bull trout 5-year review scientist and manager panels, held March 7-9, 2005 in Portland Oregon, the Service scientists identified as authors of this report assembled and presented a conservation status and risk assessment for bull trout core areas. Our primary objective in using this assessment tool was to conduct a structured evaluation of existing data that had the capability to incorporate and integrate population data and threat information available to us in a variety of nonstandard formats. We wished to spatially evaluate conservation status of the 121 bull trout core areas in order to assess overall patterns of risk and identify any relative strongholds or weak areas for bull trout conservation. We reasoned that a successful process would allow us to maximize use of data collected at the local population and core area level, where the highest degree of specificity occurs and threats are most appropriately characterized. A further goal was to roll the integrated analysis into larger blocks for the panels to use in assessing risk in the ESA context. Our search for a process that was scientifically supported, well documented and widely used led us to the Natural Heritage Ranking (www.NatureServe.org, Master et al. 2003, MNHP 2004). One strength of this process was that it could be applied on multiple scales and would therefore be an appropriate tool for quantifying conservation risk of bull trout.

Andelman et al. (2004) conducted a review of protocols for selecting species at risk in the context of viability assessments for the U.S. Forest Service. They reviewed nine published protocols (including Heritage Ranking, U.S. Fish and Wildlife Service Listing factors, IUCN classification system, and others). They concluded all were useful, but those that explicitly include threats analysis were most useful in determining which species were likely to be adversely affected by proposed management activities. The authors note that the best method for identifying and classifying risk will depend on the management scenarios proposed, the amount of data available, the time frame within which the assessment must be completed, and the scale at which the assessment is to be made (citing Lehmkuhl et al. 2001).

Andelman et al. (2004) discuss common criticisms of multi-attribute point-scoring methods such as the Heritage Ranking (e.g., they are often regarded as ad hoc, arbitrary, pay little attention to biological principles, etc.). However, they concluded the Heritage Ranks may be the most suitable of the nine existing protocols for identifying species at risk on national forests because of the flexibility of scale, potential for use of existing information, and ability to integrate threats analyses. They included a caveat that issues of scale need to be treated appropriately.

There was a close fit between the Heritage Ranking criteria that assess population size, distribution, trends and threats and the data available to us to assess the status of bull trout on the landscape. We felt that applying this process at the core area scale was the most appropriate application of the methodology, primarily because specific threats often act at that level. Bull trout populations, at the core area level, have been shown to largely function independently of other core areas (based on genetic and tracking data – see USFWS 2002, 2004A, 2004B).

For these reasons, we conducted the ranking exercise and presented it to the panels on March 8, 2005. Both the manager and science panels identified this analysis as useful within the overall context of assessing risk to bull trout at multiple spatial scales. However, having not had an opportunity to review the methodology and results beforehand, there were questions raised by the panelists about certain attributes of this relatively complex analysis. Panelists expressed a desire to see additional expansion of some of the information about individual elements of the model. In addition, this gave us an opportunity to provide more descriptive information about how these elements interface in this model. In addition, we were asked to conduct a sensitivity analysis so that panelists could better understand what factors drive the model and what happens to the rankings if certain actions occur or ranking elements are modified. We were asked to develop more quantitative evaluation of certain threats and to better describe the degree of connectivity for bull trout populations, both within core areas and among core areas in the United States. Finally, we were asked to assess the relationship between U.S. bull trout populations and potential for interaction with those in Canada.

There were practical limits on the depth and magnitude of additional evaluations we could conduct. This report does not attempt to fully describe the entire ranking process from start to finish (but see www.NatureServe.org, Master et al. 2003, MNHP 2005). Rather, we have attempted to present enough of the information that was utilized in the original panel discussion to orient readers to the model, but to focus most of our discussion on a continuation of the panel process. For that reason, some of the presentation may not stand alone, or may seem incomplete to readers examining this for the first time without the benefit of participation in the March 7-8 Science Panel review.

METHODS

On February 22-23, 2005, a team of eight Service biologists and the bull trout coordinator, most of whom have regional oversight responsibilities for bull trout activities within a State or portion of a State, gathered in Portland to conduct a ranking exercise of conservation status of bull trout core areas. Using the previously assembled information (listing documents and recovery plans) and relying heavily on the updated bull trout five-year review templates (Fredenberg and Chan 2005), which reflect agency policy on information necessary to conduct five-year reviews under section 4 of the ESA, we adapted a process used by the Montana Natural Heritage Program and Montana Fish, Wildlife and Parks (MNHP 2005) to assess relative status of each of the 121 core areas.

The model used for the ranking exercise was based on a modification of Montana's application of the NatureServe Conservation Status Assessment Criteria (see Master et al. 2003, MNHP 2004). A more complete and detailed description of the methodology is found in the Montana Natural Heritage Program documents: Montana Animal Species of Concern (2004), and State Rank Criteria for Montana Animal Species of Concern (2005). The complete application of the criteria assigns a global rank (G) to the species, indicating overall conservation status, and also assigns a State rank (S), indicating conservation status in a narrower geographic area (State boundaries). The relative rankings are then useful in identifying the conservation status of not only the species, but also a portion of its range. For example, the Montana Natural Heritage Program ranks bull trout as G3/S2. This means the Global status is G3: "Potentially at risk because of limited and/or declining numbers, range, and/or habitat, even though it may be abundant in some areas." The State status in Montana is S2: "At risk because of very limited and/or declining numbers, range, and/or habitat, making it vulnerable to extirpation in the state."

Our review of the Natural Heritage Program (Heritage) criteria indicated that most of the necessary information to conduct the ranking was available from the core area five-year review process templates (Fredenberg and Chan 2005) and other supporting materials and that the categories described in the Heritage criteria were generally consistent with attributes considered importance for bull trout persistence (USFWS 2002, 2004A, 2004B). We pared down the instruction to eliminate unnecessary or redundant categories and incorporated a few assumptions specific to our application to bull trout. The final protocol we used in the ranking process for bull trout core areas is described (Appendix A).

RESULTS SUMMARY

Summary results of the status ranking exercise for bull trout core areas indicated a diverse patchwork of population risk is widely distributed across the Pacific Northwest landscape (see Map A – *C-Rank by Core Area*). Table 1 summarizes the distribution of ranks for each of the four individual elements.

Table 1. Distribution of rank scores across 121 bull trout core areas in each of four ranking categories. Scores A–H represent a continuum of risk categories from lowest to highest; see the following sections and Appendix A for additional detail on the scoring methodology and individual core area scoring.

ALPHABETIC SCORE	**RANKING CATEGORIES**			
	Population Size	Population Distribution	Population Trend	Threats
A	15	1	4	44
B	39	22	6	31
C	27	38	4	3
D	12	45	9	7
E	3	15	18	2
F	1	-	14	19
G	-	-	-	8
H	-	-	-	5
Unknown	24	0	66	2

Table 2 presents the core area status ranking, by the primary States where each core area is located.

Table 2. Final distribution of status ranking of 121 bull trout core areas by state of origin. See the following sections and Appendix A for additional detail on the scoring methodology and individual core area scoring

CORE AREA STATUS	STATE					**TOTAL**
	Idaho	Montana	Oregon	Washington	Nevada	
C1 – High Risk	9	19	7	7	1	**43**
C2 – At Risk	15	14	7	8	0	**44**
C3 – Potential Risk	5	12	3	8	0	**28**
C4 – Low Risk	1	1	0	2	0	**4**
CU - Unknown	2	-	-	-	-	**2**
Total	32	46	17	25	1	**121**

Full results of the scoring exercise are presented in Appendix B. Table 1 (Appendix B) provides the alphabetical rankings assigned to each category for each core area during the scoring process. Table 2 (Appendix B) provides the conversion of those values to numerical rankings. Table 3 (Appendix B) presents the final core area list, in rank order, sorted by point value.

During the science and manager's panel we presented this information at a greater level of detail and analysis. The PowerPoint presentation given at that forum is available for review, but will not be presented again in this report.

SENSITIVITY ANALYSIS

The following discussion is a narrative summary describing certain attributes of the model and its sensitivity to change for each of the four parameters we evaluated (population size, geographic distribution, population trend, threats). Maps, used to illustrate some of the points we discuss, are referenced in the order they are described.

Because the model incorporates scoring from four separate, but somewhat interrelated parameters, we will present them in order and then discuss the synergistic relationships among them in a summary section. It may be very helpful to the reader to review Appendix A and understand the basic attributes of the Heritage Ranking system prior to reading on in this report.

Population Size

Population values input into the model were based on conservative estimates of the number of adults (as the instructions for the Natural Heritage Program require). Where data were available (about half the core areas) we were able to use those data sets to either assess adult numbers directly or extrapolate numbers from redd counts. Where data were generally unavailable, we used best professional judgment where we could justify it as being a relatively accurate characterization of the population size. Where we felt we could not justify an estimate, the population size was ranked as unknown.

The scoring system (see: Population Size – scoring; Appendix A) assigns increasingly broad categories as the adult population values increase. For example, category A is 1-50 individuals (a range of 50), but category E is 2,500-10,000 individuals (a range of 7,500). For the most part, we felt we were able to accurately assign bull trout core areas to categories, even though precise numbers are subject to year-to-year variation and point estimates were typically not available. In some very small or very large core areas, the choice of categories is truncated on either end of the range as a result of the physical extent of the habitat. Therefore, in most cases, the assignment of the proper category was a relatively easy choice between as few as two possible categories.

Map B (*Core Area by Population Size*) visually depicts the array of core area scoring by population size. In general, while we did not attempt to quantify it, there is an apparent relationship between population size and core area size, with smaller core areas tending to have lower population values (depicted in red and orange = 250 adults or fewer). In many cases these are small adfluvial populations with restricted habitat availability. Many of those populations were small even under natural conditions. Their persistence would have been extremely unlikely, however, if populations had not been higher than 50 adults for most of their history. Genetic results generally do not indicate that most of these populations have gone through severe bottlenecks (Spruell et al. 2002). In fifteen core areas, population size is currently ranked A (1-50 adults), which is well below numbers needed to maintain genetic variability and sustain population viability (core areas with A rank are depicted in red) (Rieman and Allendorf 2001, Whitesel et al. 2004).

In general, adfluvial populations have capacity for higher numbers than do fluvial populations existing without lake habitat.

Conversely, Map B (*Core Area by Population Size*) also shows that large adult populations (depicted in green and dark green = 1,000 adults or more) tend to occur in larger core areas where the key recovery habitat is spatially well-connected and well-distributed throughout the core area. All three migratory forms (fluvial, adfluvial, and anadromous) are represented in various portions of the landscape in this category.

It should not be surprising that there is a relationship between core area size and population size. But, the quality and quantity of the habitat, its relative degree of connectivity or, conversely, the degree of patchiness due to either manmade or physical variables, and the relative productivity of the habitat also play a role in determining population size.

Under natural conditions prior to European influence it is likely that many bull trout core areas had populations that supported roughly 1,000 to 10,000 adult individuals. This is admittedly somewhat speculative, but can be supported based in part on the habitat potential and observed amount of genetic variability seen in current populations. Observations of early settlers also indicate bull trout populations in some areas were much higher than current levels. The largest core areas, particularly those with highly productive lake, large river, or anadromous food resources may have exceeded 10,000, or in a few cases even 100,000 individuals. Core areas, under those conditions, would have been fewer in number and in some cases much larger and much better connected than the ones we describe today.

Under the current evaluation we assigned the following ranks to the 121 bull trout core areas for population abundance:

A = 1-50 individuals	n = 15	score = -1.0
B = 50-250 individuals	n = 39	score = -0.75
C = 250-1,000 individuals	n = 27	score = -0.5
D = 1,000-2,500 individuals	n = 12	score = -0.25
E = 2,500-10,000 individuals	n = 3	score = -0.25
F = 10,000-100,000 individuals	n = 1	score = +/- 0
U = Unknown	n = 24	score = +/- 0

These ranks result in an approximate bell-shaped distribution clustered around the mode in categories B and C. If recovery occurs and core area populations increase (or additional documentation indicates the values are higher than those we currently assigned) there is potential for population scores to elevate. In most cases, the elevation would be +0.25 points, since it's unlikely that populations would increase sufficiently to shift two categories. A shift upward through two categories would require, for example, a population that currently has <250 individuals to expand to > 1,000 adults. This is unlikely, at least in the relatively short term of five years (approximating one bull trout generation) that would occur between reviews (under ESA guidelines).

In 24 core areas the population size is currently classified as “unknown”. In the majority of those cases, additional information that would allow us to classify those populations would probably shift the ranking downward (toward the red). There is no positive shift possible (toward the green), since the scoring process assigns “unknown” population size a “0”, which is the same score as for a population that exceeds 10,000 adults. If we assume that populations in those 24 core areas currently classified as “unknown” are similarly distributed as the other 97 core areas we were able to assess, then most of them would receive a deduction of 0.5 points or more for population size.

If, in the future, monitoring data become increasingly unavailable due to decreasing level of effort or other factors, future rerankings could reflect a more positive score for population size even though populations are not actually increasing. Of course, those considerations might be balanced elsewhere in the ranking process (e.g., reduced levels of monitoring may be perceived as a risk, resulting in elevated threat ranking).

Additionally, categories D and E receive the same ranking score. This means that a population of 1,001 adult bull trout and a population of 9,999 individuals receive the same score. From a practical standpoint, the population size ranking is not a very sensitive indicator and should not be judged as stand-alone criteria, though it is a useful category for evaluation as part of a more comprehensive risk assessment.

Geographic Distribution

Distribution values input into the model were based on conservative estimates of currently-occupied high quality bull trout habitat (as described by the FWS overlay of Key Recovery Habitat). The key recovery habitat layer represents the Services’ best current approximation of a mostly continuous stream (and lake) network that we can document as currently occupied and that would necessarily remain occupied in order to fully support bull trout recovery.

Key recovery habitat does not include all habitat that is currently occupied, however. The International Union for the Conservation of Nature (IUCN) explicitly defines area of occupancy to exclude “cases of vagrancy” and notes that portions of the area may be seasonally or temporally unoccupied. Hence, in our key recovery habitat layer we include areas that are typically downstream habitat where adult and subadult bull trout in each core area forage and overwinter as well as the migratory corridor used by those fish to access spawning and rearing areas. We have previously categorized this as foraging, migrating and overwintering (FMO) habitat. For adfluvial and anadromous fish the FMO typically would include the lake of origin, or a portion of marine nearshore waters, respectively.

In addition, the key recovery habitat where each of the 600+ previously-described local populations spawn and rear was also included. The combined FMO and spawning and rearing habitat in each core area are necessarily continuous. Though not necessarily simultaneously occupied, the key recovery habitat that we used in our ranking is all documented as occupied habitat.

We did not include every stream or stream segment where bull trout in a core area might be found. In some cases such occurrence is only poorly documented or occasional (e.g., "vagrancy") and in other cases the population may be sufficiently depressed so that formerly occupied habitat is no longer routinely used. As a consequence, we believe the key recovery habitat represents a network of streams (and lakes or marine nearshore) that provides a healthy support network for the 121 bull trout core areas. If these waters are occupied at or near capacity then additional waters (adjacent headwater streams and perhaps infrequently unoccupied drainages) would continue to see bull trout use at some reduced level.

The Heritage scoring instructions explicitly state: "For migratory species, enter the code that reflects the current length of occupied area at the time of year when occupancy is most restricted. The IUCN criteria state that: "the area of occupancy should be at a scale appropriate to relevant biological aspects of the taxon". We believe the use of key recovery habitat as a surrogate satisfies both those conditions.

Based on the additional level of security and resources as well as expanded habitat provided by high quality lake habitat or marine nearshore habitat for adfluvial and anadromous populations, we developed an additional rule that such populations would be assigned a rank one category higher than the GIS-based output of key recovery habitat would otherwise assign (see Appendix A). Part of our rationale was that in case of natural disasters (e.g., fire, flood, debris flows) or manmade catastrophes (e.g., chemical spills) the stream habitat is much more susceptible to circumstances that could result in complete population annihilation than are lakes. In worst case, several age classes may be lost from an adfluvial population, but there would typically be a source for rapid recolonization provided in the lacustrine habitat. We did not provide that upgrade to the score in cases where the lake habitat was determined to be of poor quality for bull trout, such as in reservoirs where drawdowns or thermal conditions may limit bull trout.

Similar to the population size example cited above, the scoring system for Geographic Distribution (see: Area of Occupancy (Stream length) – scoring; Appendix A) assigns increasingly broad categories as the adult population values increase. For example, category B is 4-40 km (a range of 36), but category D is 200-1,000 km (a range of 800). Again, we felt we were able to accurately assign bull trout core areas within these broad categories. In very small core areas, the choice of categories are truncated on the low end of the range as a result of the limited physical extent of the habitat, but in most of these cases the populations are adfluvial and the rank was automatically advanced one category as described above. The persistence of many such adfluvial core areas within very limited space in the headwaters of the upper Columbia and Saint Mary drainages suggests that their likelihood of persistence is, in part, buffered by the presence of that lake habitat. Therefore, in most cases, the assignment of a category was a relatively easy choice between as few as two possible categories. It is important to acknowledge that the use of the GIS layer implies a level of precision that exceeds our true understanding of the spatial distribution of bull trout on the landscape. The key recovery habitat represented by the GIS layer we used is a conservative representation of actual distribution at any given point in time.

Map C (*Core Area by Distribution*) visually depicts the array of core area scoring by population distribution. Any relationship between population distribution and core area size, where smaller core areas would naturally tend to have lower ranking values (depicted in red and orange = 40 km of occupied key recovery habitat or less), is partially masked by the rank increase we assigned to adfluvial and anadromous populations. In many cases, small adfluvial populations had restricted habitat availability under natural conditions. In some of the smallest core areas, the quality of the habitat available for spawning and rearing is apparently more important than the extent of same. The clustering of core areas with B rankings (orange) in the upper right corner of Map C (*Core Area by Distribution*) is an indicator of the effect of small distribution on the scoring result. Larger core areas do tend to rank out in category D (light green) or E (dark green), in part as an indication of the relative scope of the population distribution on the landscape.

If we were able to look back in time, under natural conditions prior to European influence, the higher degree of connectivity and higher densities of bull trout would have likely depicted a much wider distribution of occupied bull trout habitat on the landscape. We would caution, however, against the assumption that distribution of bull trout ever approached 100% of the watershed for many of the core areas. Bull trout naturally occur in a patchy fashion on the landscape and their distribution was naturally variable by core area, depending on the presence of geologic features, slope, elevation, aspect, water temperatures, etc. (Rieman et al. 1997).

By dividing the total stream network in a core area (1:100,000 hydrography layer) by the GIS-generated values for the length of key recovery habitat, we can obtain a relative idea of the current relative "% saturation" of bull trout key recovery habitat (as a surrogate for distribution) within the core area. This may be another informative measure of current bull trout distribution within core areas (see Appendix B – Table 4). These "saturation" values range from as little as 1% in certain core areas where the watershed is largely blocked to access for bull trout (frequently by natural barriers or other features) to as high as 93% in watersheds that have relatively high quality bull trout habitat throughout. Many of the extremes occur in very small core areas. In 85% of the core areas (103/121) the % saturation of key recovery habitat on the overall stream layer is between 5% and 50%. There is, however, no apparent correlation between percent saturation of key recovery habitat and overall core area rank, with many C1-C4 rankings appearing at both ends of the distribution.

Under the current evaluation we assigned the following ranks to the 121 bull trout core areas for area of occupancy:

A = <4 km (~2.5 miles)	n = 0	score = -1.0
B = 4-40 km (~2.5-25 miles)	n = 22	score = -0.75

C = 40-200 km (~25-125 miles)	n = 39	score = -0.5
D = 200-1,000 km (~125-620 miles)	n = 45	score = -0.25
E = 1,000-5,000 km (~620-3,000 miles)	n = 15	score = +/- 0
U = Unknown	n = 0	score = +/- 0

Because a complete data set was available, there were no core areas where the rank was unknown. In addition, no core area was found to have such a small range of habitat (< 4 km without an adfluvial element) that it achieved an A rank. Thus, the rankings for population distribution fall into four categories (B-E, above).

These ranks result in an approximate normal distribution around a mode between category C and D. Approximately two-thirds (83/121) of the core areas are either category C (n = 39, depicted in yellow) or Category D (n = 45, depicted in light green). A total of 42 core areas had between 100 and 300 miles (~160-480 km) of key recovery habitat. For those core areas, relatively minor additions or subtractions of occupied key habitat (+/_ 100 miles (~160 km) or less) could influence their ranking by 0.25 points either up or down.

Of the 15 core areas that reached Category E status (dark green), only one (Middle Fork Salmon River) contains over 1,000 miles of key recovery habitat (n = 1,011). The other 14 core areas reached the E rank because they contain over 200 miles of key recovery stream as well as suitable lake habitat or marine nearshore habitat (elevating them a rank). The second highest amount of key recovery habitat was 691 miles (in the Upper Salmon River core area) and only five of the 121 core areas exceeded 500 miles. Thus, very large increases in distribution (generally several hundred miles or more) would generally be required to drive ranks of D (light green) toward the E (dark green) category.

In some cases, a less strict interpretation of the distribution criteria (e.g., including all potentially occupied stream habitats) may elevate individual core area ranks by +0.25 point. However, we hasten to add that we already elevated all core areas which contain suitable adfluvial habitat and/or anadromous forms a full rank. We believe the application of key recovery habitat, as we have presented it, is a reasonable application of the ranking criteria based on our understanding of the rule set. In general, broadening the distribution of bull trout (either due to ongoing recovery and/or increased documentation or interpretation) will not result in major changes to the distribution ranking from categories where they are currently placed.

Short-Term Trend

Interpretation of trend in bull trout populations has been widely discussed in the literature, but there has been limited agreement on proper analytical methods and standards for assessing trends in bull trout redd counts or other monitoring data. The Service assembled existing data sets, mostly collected by States and other contributors, and evaluated the complete extent of available information. Based on that overview, we determined that 5 years would be used as the minimum continuous data set for assessing trend information. The longest term data sets extend back about 25 years. These intervals are consistent with the planning horizon used in the Draft Bull Trout Recovery Plan. A period of 5 to 25 years approximates 1 to 5 bull trout generations. Where data sets longer than five years were available, greater emphasis was placed on the most recent 5-year period (latest generation) in assessing the rank.

Because of the extremely variable nature of the data sets, the lack of consistency in methods and protocols (snorkel counts, redd counts, weir counts, etc.), the relatively wide range in the proportion of each core area that was assessed, and previous cautions from the published literature about reliability, repeatability, and observer error in redd counts (see Maxell 1999, Dunham et al. 2000), we were necessarily conservative in our interpretation of bull trout trend information from the indices we assessed. We relied upon local knowledge provided in the five-year review process template narratives for each core area for additional interpretation of observed changes in population levels (e.g., causes, habitat variables, etc.).

The Heritage ranking categories were assigned names that provide a relative continuum (rapidly declining, stable, etc.), but the specific criteria were quantitative (30-50% decline, +/- 10% fluctuation, etc.). From a practical standpoint, due to the variables described in the paragraphs above, we were generally not able to apply the quantitative ranges through any statistical process. Rather, the assignment of ranks was based more upon the general applicability of the descriptive category (e.g., rapidly declining, stable, etc.) and the subjective evaluation of the Service biologist conducting the rankings. A strict quantitative interpretation of trend would result in nearly all bull trout data sets exhibiting unknown trend.

For those reasons, we placed a high level of importance on having each core area ranked by individuals who had strong familiarity with both the core area and the population data set that was being considered. This ranking process is extremely dependent upon having informed and knowledgeable individuals conduct the ranking. By conducting the rankings in a collaborative forum (with 9 individuals each familiar with their own area) we could discuss, contrast, and compare information. We were able to debate and record our assumptions (see Appendix A), develop standardized applications, and achieve a level of overall consistency between regions that would not be possible if rankings were done by individuals working in isolation.

Unlike the previous ranks for population size and distribution, the scoring system in this category (see: Short-term Trend – scoring; Appendix A) assigns equal increments of change across categories. For example, category B (Very Rapidly Declining) is 50-70% decline (a 20% increment) and category E (Stable) is +/- 10% fluctuation (also a 20% range).

Given the numerical nature of population data, it would be tempting to conclude that precise analytical tools could be applied to accurately determine trends. However, for many of the reasons we have already described, that is not the case. In addition, natural variability in populations can exceed 100% from year to year and other factors such as streamflow, weather patterns, and partial barriers (such as beaver dams) may redistribute spawning bull trout. Bull trout are particularly susceptible to these factors due to the fact they spawn in the late fall when spawning streams are typically at or near seasonal low flow volume. In practicality, an approximation of trend, assigned by knowledgeable observers based on the partial count data that is available, is about as good as can be expected. For those reasons, we view the trend ranking process we used as relatively stable and repeatable.

Map D (*Core Area by Population Trend*) visually depicts the array of core area scoring by short-term population trend. As is visually apparent, in over half the core areas (n = 66) we did not feel there was adequate data to make a determination of the short-term population trend. In those cases there was either no monitoring data or data were not collected in a consistent fashion; the data that existed was intermittent or sporadic and did not provide a continuous record (at least five years); or the data were available but highly variable and we could not assess a trend with any degree of confidence.

Some spatial patterns are obvious from evaluation of Map D (*Core Area by Population Trend*). In the majority of Idaho (with the exception of the panhandle) and southwest Montana we were not able to assess population trend. For the most part, the data simply are not adequate to do so. In most of the rest of northwest Montana and the Idaho panhandle population trends have been more adequately monitored and most of the larger core areas reflect trends that are either stable (light green), declining (yellow), or increasing (dark green). In Washington and Oregon the patterns are variable.

Under natural conditions (e.g., prior to European influence) it is likely that the bull trout population trend in most core areas would have fluctuated around a stable mode, but depending on climate, natural events, and other factors there were likely periods when individual core areas would have been increasing or decreasing. The larger and more connected core areas may naturally exhibit less variability in trend, due to the interaction between these variables and the various patches of habitat on the landscape.

Under the current evaluation we assigned the following ranks to the 121 bull trout core areas for population trend:

A = Severely Declining	n = 4	score = -1.0
B = Very Rapidly Declining	n = 6	score = -0.75
C = Rapidly Declining	n = 4	score = -0.5
D = Declining	n = 9	score = -0.25
E = Stable	n = 18	score = +/- 0
F = Increasing	n = 14	score = +0.25
U = Unknown	n = 66	score = +/- 0

Among the 55 core areas we were able to rank for trend (representing 45% of all core areas) approximately equal numbers of core areas were determined to be stable (n = 18), increasing (n = 14) and decreasing at various rates (n = 23). From this analysis we might infer that the overall trend in bull trout populations across their range is neither increasing nor decreasing. However, we also note that 14 of the 55 core areas we ranked (25%) were rapidly, very rapidly, or severely declining and some of those are not expected to recover, at least in the foreseeable future, given the forces that are operating to produce those declines.

As bull trout recovery occurs and core area populations increase (or additional documentation identifies the trend in core areas which we currently have not been able to assess), there is potential for our ranking of short-term trend to change. In most cases where core areas currently indicate a declining trend, improvement would gradually elevate the score (+0.25 points), since the entire recent trend would continue to be taken into account. Increasing trend is logically linked to population abundance and in some cases may be linked to distribution, so that additional ranking points may be simultaneously achieved in those other population categories. We would expect a relatively high degree of concordance between the three population categories, though special cases exist where these variables may not operate in unison.

In the majority of core areas (55%) short-term population trend is currently classified as "unknown". Unknown trend receives a point value of +/-0. In many of those cases, if additional information allows us to classify the trend of those populations, it will ultimately shift the ranking downward (toward the red) because any declining trend is reflected in a decreasing score. There is limited potential for a positive shift (toward the green) of +0.25 points in score for core areas where the trend is currently unknown but would be reclassified as increasing. If we assume that the true population trend in the 66 core areas currently classified as unknown are distributed similarly to the 55 core areas we were able to assess, then more of them would likely receive a deduction in score than an increase and in some cases the deduction would probably shift that core area to a lower C rank classification. In extreme cases, the deduction could be a full -1.0 point, whereas the potential for increase in score as a result of an increasing trend is only +0.25 points. In that regard, an "unknown" ranking of short-term trend reflects more positively in our ranking process than most other possible outcomes.

Threats

The fourth and final category of assessment is the threat category. The other three categories measure various aspects of population status, and are thus strongly interrelated. The threat category measures a somewhat separate variable, accounting for the anthropogenic factors that affect population status to a greater or lesser degree. Most of the population variables have quantitative elements that can be measured, but the threat category is less quantitative. In a separate portion of this report we provide tables that summarize GIS-based quantitative information describing occurrence of nonnative brook trout and lake trout, land ownership, water quality, land use, and road density. However, even those variables require interpretation by someone familiar with the core area. The potential range of threats is large and for each of the 121 core areas a distinct set of variables typically come into play. Each core area has different geographic and spatial dimensions as well as variability in biological complexity that makes the assessment of threats a complicated exercise. In part, the existing status of bull trout in a given core area (population abundance, distribution, and trend) is a direct reflection of the threats that are present and a measure of how those threats are arrayed both spatially and temporally on the landscape.

It is important to note that the threat consideration in this ranking process is meant to be applied to the present and future status of the core area. The effects of past threats (i.e., legacy impacts) are reflected by and accounted for under short-term trend and other population status ranks (see discussion under the heading "Threats (Severity, Scope and Immediacy)" in Appendix A).

The Heritage rank criteria uses the collective assessment of three elements of threat, described as "severity", "scope", and "immediacy" and assigns rank based on the pattern in which those three separate elements are arrayed. Each of the three categories is ranked independently as either "high," "moderate", "low", or "insignificant". With three elements there are 27 possible combinations. Those 27 combinations are combined into seven risk categories (see Table 1 – Appendix A). All core areas where severity is high or moderate end up scored as category A, B, C, D or E, whereas low severity results in a rank of F or G. If scope is high, the ranking category must be A, C, or F. If scope is moderate, the ranking category is B, D, or F. If scope is low, the ranking category is E or G. If threats are of high or moderate immediacy, the ranking category is A, B, E, F, or G. Threats of low immediacy can result in threat rankings of C through G. The following discussion describes the way the three categories were applied for bull trout, in more detail.

Severity

Severity of the threat basically captures the degree to which the threat impacts the population and the degree to which the threat is reversible. High severity indicates the threat is likely to result in extreme losses of bull trout populations or habitat that are essentially irreversible. One example, in the context of bull trout, is the establishment of a reproducing lake trout population in an adfluvial core area. Given what we know about this threat, it is especially severe and likely irreversible in small core areas where habitat is limited (Donald and Alger 1993, Fredenberg 2002). Another example of a high severity threat might be the construction of a dam which is likely to create a warm-water reservoir unsuitable for bull trout and that will also inundate important spawning and rearing habitat.

The Heritage rank criteria describes a moderate severity threat as one likely to result in major reductions in the population or long-term loss of habitat that will require in the neighborhood of 50-100 years for recovery. Examples of moderate severity might be major irrigation withdrawals or watershed impacts due to timber harvest or grazing that could be expected to be minimized over a period of time after the initial impact occurs. Another example might be certain catastrophic natural events. In scoring severity, some judgment must be used to interpret the degree and longevity of the impact and interpret the appropriate rank between categories. If only a portion of a core area is likely to be affected, the threat is more likely to be moderate in severity than high. For example, major urban development or toxic runoff from a mining project may have irreversible impacts, but affect only a portion of a core area. The severity of these impacts would likely be moderate because the threat will not be spread to other portions of the core area.

Low severity threat indicates a reduction in population or habitat could occur, but that the results are likely minor in extent or reversible in as few as 10-50 years. Examples might include minor impacts due to current timber management or roads, overfishing, or poaching activities.

Threats of insignificant severity can only occur in circumstances where no reduction of population or degradation of habitat is foreseeable. In most cases, this is only probable to occur in protected areas such as National Parks or wilderness. However, due to potential human impacts such as nonnative species introductions or other factors, one should not automatically assume that protected areas have threats of insignificant severity. This is particularly true where the core area is only partially in protected status and migratory bull trout use unprotected portions of the core area to complete a portion of their life cycle. Examples of threats of insignificant severity to bull trout might include natural disasters such as fire or floods in a wilderness landscape, or carefully regulated angling in a National Park.

Scope

Scope refers to the proportion of the core area that is affected. If greater than 60%, it is high. If 20-60%, it is moderate and 5-20% is low. If a threat affects <5% of a core area the scope of such a threat is considered insignificant. However, for bull trout we must temper that interpretation to a degree based on the nature and location of the threat. If a high severity threat affects only the spawning and rearing habitat, it may be a minor portion of the entire core area but the effects may devastate the population. For that reason, the scope ranking is subject to modification based on local expertise that can assess the impact of the location of a threat in addition to how widespread it is. Essentially, the analysis and ranking of scope should take into account the most sensitive portion of the ecosystem, which would typically be the spawning and rearing habitat for bull trout. Other sensitive portions of the ecosystem may include key migration corridors through which migratory individuals must pass to complete their life cycle.

Immediacy

The ranking for immediacy of threat is a straightforward analysis of how timely the manifestation of the threat is likely to be. High immediacy means the threat is operational now or within a year. Moderate immediacy is a 2-5 year horizon and low immediacy is a 5-20 year horizon. A threat is only considered insignificant relative to immediacy if it is not operational within 20 years. For specific projects such as mines, timber sales, or similar activities the classification of immediacy is rather straightforward. For threats that are more biological in nature, such as nonnative species introductions or disease considerations, more careful evaluation and some subjectivity is required in order to assess a rank. Often best professional judgment must be employed, based on analysis of similar circumstances, to judge the immediacy of a biological threat.

Synthesis of Severity, Scope and Immediacy

In synthesizing the three threat categories into 8 rank classifications (plus "unknown" – see bottom of this page) the Heritage criteria attaches the greatest significance to the severity of the threat, followed by scope and then immediacy. For bull trout, this rationale seems appropriate as threats of high severity are often likely to be long-lasting. Bull trout have relatively low inherent capacity to rebound from low population levels, in part due to high age of maturity and very specific habitat requirements.

The final threat ranking categories are summarized in narrative format to describe the overall condition of threats operating on the core area for the present and near future (see: Threats –scoring; Appendix A). The categories are alphabetized A through H (and U) and in that order the system assigns point values ranging from -1.0 to +1.0. It is informative to note that categories A through D, which include most of the categories with high threat severity, all produce negative point values in the ranking. Categories E and F, localized or low severity threats, are neutral (0 points). Core areas where threats are considered unknown would also receive neutral scoring (0 points). Only categories G and H, which include low or insignificant threat severity and low or insignificant scope of threats can result in positive points assigned through the ranking process. When two or more of the scoring elements (severity, scope, immediacy) are unknown the final threat ranking is considered unknown.

Map E (*Core Area by Threats*) visually depicts the array of core area scoring by threat category. All threat categories that score negative points (A-D) are displayed in shades of red to orange. Threat categories that score neutral points (E and F) are displayed in shades of yellow. Threat categories G and H (slightly threatened or unthreatened) are displayed in shades of green.

No particular patterning of threat distributions is visually striking (Map E). There are some subtle suggestions that Puget Sound bull trout core areas generally scored somewhat lower threat ratings. In the large contiguous block of bull trout core areas through western Montana and Idaho, the core areas on the east and west edges of the range tend to have somewhat higher rankings for threat than those nearer the center, but there are numerous exceptions.

Under natural conditions (prior to European influence) all core areas could be presumed to have threat rankings of F, G, or H. This would indicate Low or Insignificant severity, but variable scope and immediacy depending on what natural factors were in play at various times in prehistory.

Under the current evaluation we assigned the following ranks to the 121 bull trout core areas for threat. See Appendix A – Table 1 to review how severity, scope and immediacy are combined to produce overall threat rankings.

A = Substantial, imminent threat	n = 44	score = -1.0
B = Moderate, imminent threat	n = 31	score = -0.75
C = Substantial, non-imminent threat	n = 3	score = -0.5

D = Moderate, non-imminent threat	n = 7	score = -0.25
E = Localized, substantial threat	n = 2	score = +/-0
F = Widespread, low-severity threat	n = 19	score = +/-0
G = Slightly threatened	n = 8	score = +0.75
H = Unthreatened	n = 5	score = +1.0
U = Unknown	n = 2	score = +/-0

These ranks for overall threat are heavily clustered around category A (36% of all core areas) and Category B (26%). As we previously noted, severity of threats tends to be the most important of the three subfactors (severity, scope and immediacy) in determining the overall Heritage Rank for threat (see *Synthesis of Severity, Scope and Immediacy*, above).

If one examines the individual threat rankings in the core area scoring (see Appendix A, Table 1), it is apparent that the Service biologists conducting this exercise believed the vast majority of core areas have threats that are currently operating at high or moderate severity. About one-fourth of core areas were scored high for severity (n = 29). They tended to also have high scope (n = 27) and high immediacy values (n = 24), indicating that they were at the highest possible threat status and receiving the maximum deduction of -1.0 points.

Conversely, about the same number of core areas were ranked at the other end of the threat scale and scored low or insignificant for severity (n = 31). These core areas tended to have variable ratings for scope; but mostly insignificant, low or moderate (n = 26) values. They also tended to have low or insignificant immediacy in the threats that were characterized (n = 24).

In about half of all core areas the threat severity was considered moderate (n = 59). Scope and immediacy was mostly moderate or high in these core areas, typically placing them in ranking categories A through D.

In only 2 of 121 core areas (Granite and Sheep Creek) was the overall threat rank considered unknown. No threats were identified in the Draft Recovery Plan or templates, but Service staff felt there was not sufficient information to place these in the unthreatened category.

It is important to understand how the rankings might change if the threat categories were altered, either to the positive (toward the green) as a result of new information or threats are removed or remediated, or to the negative (toward the red) as a result of new threats or increases in their severity, scope, or immediacy. As we have indicated, the primary driver of the threat ranking is the severity.

There is a relatively gray line between high severity and medium severity of threat and that distinction is based upon how much the population or habitat is likely to be impacted (all vs. most) and the estimated potential for recovery (essentially irreversible or >100 years vs. 50-100 years). Certain threats have much higher potential for remediation than others. For example, in core areas that are ranked high severity due to nonnative species threats (such as abundant lake trout populations in the lake that bull trout occupy), those threats are typically considered to be irreversible. Given the current state of knowledge and relatively poor ability to remediate the threat of lake trout by suppression or removal actions, we may be unable to project a scenario where the threat category could be reduced to medium in the foreseeable future. Conversely, in a core area where the legacy of past forestry activities has led to watershed degradation that is so severe that the threat severity was ranked high, it may be possible to implement a watershed restoration program that would move that threat severity into the medium category in a relatively short period of time. On the other side of the ledger, if a core area received a medium threat severity rating due to cumulative watershed impacts and a new project is permitted that is likely to have major impacts to the best remaining spawning and rearing habitat, that may be sufficient to move the threat severity rating to high. These types of shifts have the potential to affect the overall threat score by as much 1.0 point. However, in all cases, the reduction in threat scoring from high to medium severity values would remove negative points from the ranking value.

In the Heritage ranking system, in order to move the threat score from neutral or negative category into the positive category it would be necessary to shift the severity rating from moderate (or high) to low or insignificant. The potential for threat severity that is currently high or moderate to be shifted to low for bull trout core areas, especially in a matter of a few years, would seem to be limited. In managed, human-impacted landscapes (which include most bull trout core areas) there is little likelihood of removing enough of those impacts (and/or their legacy effects) to move the core area to a low threat severity rating. In most cases, because of the nature of the activities causing the threats, the threat rankings for an individual core area are likely to move incrementally within a range of either positive (0 to +1.0) or negative (0 to -1.0) values.

While this is the first time, to our knowledge, the Heritage Ranking process has been applied to bull trout core areas, it is not the first time the status of threats has been evaluated over a period of time. In most of those observations (see USFWS 2002, 2004a, 2004b) the potential for a rapid increase in threats is higher than the potential for a rapid decline. Under this ranking system, threat rankings are not likely to make a major positive jump across the full scale, going from -1.0 (substantial, imminent) to +1.0 (unthreatened), except under very unusual circumstances. Scenarios where the opposite occurs, where core areas that currently have a low threat severity rating rapidly move toward a medium or high rating, would seem to be more plausible. For example, lake trout have invaded and become established in some small adfluvial core areas in protected habitat in Glacier National Park, in essence shifting the threat ranking the full width of the scale (from green to red), in only a few generations.

Summary Rankings

Because bull trout are an apex predator species they tend to exist at naturally low densities. Due to their somewhat narrow habitat tolerance (i.e., cold, clean, complex, and connected) they naturally occur in a patchy fashion within watersheds and are seldom distributed throughout all waters they may have access to (Rieman and McIntyre 1995, Dunham and Rieman 1998). In the Heritage Ranking description for 'environmental specificity", bull trout fit most closely in the general category of a narrow specialist. In the Heritage Ranking for "intrinsic vulnerability", bull trout would be rated moderate to high. Relative to other fish species, they are slow to mature, have inherent reproductive limitations, and exhibit low tendencies for dispersal and recolonization. As a result, impacted bull trout populations are likely to be slow to recover, typically requiring multiple generations (a bull trout generation is roughly the age to maturity – about 5 years).

The four ranking categories operate with varying degrees of interdependence to produce the final core area ranking, or what we term a C-Rank for bull trout (adapted from MNHP 2005).

Points (P)	C RANK
$P \leq 1.5$	C1 –High Risk
$1.5 < P \leq 2.5$	C2 – At Risk
$2.5 < P \leq 3.5$	C3 – Potential Risk
$3.5 < P \leq 4.5$	C4 – Low Risk

Essentially, a core area starts with a score of 3.5, putting it at the upper limit of the C3 (Potential Risk) category, just one increment (0.25 points) away from a C4 (Low Risk). If no other ranking information is available (i.e., if all four ranking categories are unknown), the core area rank stays at the C3 level. Thus, as previously described in our analysis of individual categories, the ranking process treats unknown information rather favorably in the scoring.

If a core area meets three population thresholds: 1) containing at least 10,000 reproductive individuals, 2) occupying at least 1,000 km of habitat (or at least 200 km if anadromous or adfluvial), and 3) having a stable or increasing trend; then that core area remains at the upper end of the C3 category and its' ultimate C-Rank is dependent on the threats assessment. If the core area fails to meet the three population thresholds, then its rank is reduced by the appropriate amount in 0.25 point increments in the category(ies) in which it falls short. For some core areas, especially those that are isolated within limited habitat and thus terminally restricted to small population size, the inherent population parameters will lead to C2 (At Risk) or even C1 (High Risk) status under natural conditions. This is entirely consistent with conservation biology theory which indicates small and isolated populations are inherently at higher relative risk. Factors related to the basic biology of bull trout (described above), further contribute to that inherent potential risk. This is in contrast to a species like whitetail deer or cottontail rabbits which are broad generalists, not intrinsically vulnerable, and have high inherent capability to rebound from declines.

With the three population ranking categories established, the final scoring is dependent upon the overlay of the threat ranking. Ultimately, even core areas that meet the population thresholds would not be ranked higher than C3 (Potential Risk) if there are threats of moderate or high severity. In that regard, the threat ranking may be viewed as the single most significant score in driving the Status Ranking.

Core areas with low population values will be driven to even lower C-Rank if threats are high. Core areas with low population values may be elevated up to one full C-Rank if threats are low or insignificant. Thus, even in the most extreme case of a very small population with restricted habitat and declining trend, a low or insignificant threat ranking may result in the final C-Rank being C2 (At Risk) or C3 (Potential risk). This, again, is consistent with conservation biology theory that considers small and isolated populations to be at some higher level of risk than are large and connected populations. The most at-risk core areas are those with low population values and high threats.

Core areas with high population values cannot be driven below a C2 (At Risk) ranking by threats, even if the threats are severe in nature and high in scope and immediacy. In fact, a robust population of 10,000 adult bull trout existing with over 1,000 km of habitat (or 200 km if anadromous or adfluvial) and a stable population trend would still be ranked at the upper end of the C2 (At Risk) category. Again, in line with conservation biology theory, strong populations that are well-connected and spatially distributed on the landscape are inherently more stable and resilient to threats. The least at-risk core areas, and the only ones that earn a C4 (Low Risk) ranking are those with relatively robust population parameters and low or insignificant threats.

It is important to understand that this bull trout ranking system does not imply that all core areas can eventually become C4 (Low Risk), or indeed that all core areas naturally existed at that level prior to European influence. Due to natural landscape features (e.g., barrier falls), natural patchiness of suitable habitat, historical fluctuations in climate, fire and flood, and other natural factors, it is logical to assume that bull trout core areas historically ranged from C2 (At Risk) to C4 (Low Risk). It may even be possible to estimate the historical risk ranking of individual core areas in order to determine how much space there is for currently depressed core areas to move upward toward natural condition.

It is logical to assume that over the last 10,000 years bull trout may have existed in watersheds where they were extirpated through natural factors and were not recolonized, or that multiple extirpation and recolonization events may have occurred. However, it is our assumption that under natural conditions very seldom would core areas have been ranked C1 (High Risk). Even the most isolated and small populations would logically be subjected to low threats under natural conditions. It is the added element of threat, directly as a result of human influence, that makes C1 (High Risk) and some C2 (At Risk) core areas most vulnerable to extirpation.

The effect of elevated threat in driving the C-Rankings is evidenced by comparing the individual threat rankings to the eventual C-Rank of each core area. In 22 of 29 core areas (76%) where threat severity was rated high, the eventual C-Rank was C1 (High Risk). The remaining 7 core areas where threat severity was high were ranked C2 (At Risk). In 32 of 43 core areas (74%) ranked as C1 (High Risk), the threat ranking included either high severity of threats, high scope of threats, or both. All 11 of the other C1 (High Risk) core areas had threat rankings that included moderate severity and moderate scope.

Conversely, in 26 of 31 core areas (84%) where the threat severity was rated low or insignificant, the eventual C-Rank was C3 (Potential Risk, n = 23) or C4 (Low Risk, n = 3). The remaining 5 core areas where threat severity was low or insignificant were ranked C2 (At Risk). As well, in 29 of the 32 core areas (91%) ranked as C3 (Potential Risk, n = 30) or C4 (Low Risk, n = 4), the threat ranking included either insignificant or low severity of threats, insignificant or low scope of threats, or both. In the three remaining cases threats were ranked moderate in both severity and scope.

The degree of concordance between threat ranking and C-Rank may also be an indicator that threats largely drive population ranks. The ranking process does not determine the reason that populations are low, fragmented, or in decline, but in some cases where the causes are known those explanations are available in the five-year review template narratives. It is logical to assume that if we have properly identified and focused the ranking on the most significant threats, then those threats that act with greatest impact upon the habitat or the population are the primary drivers of low C-Ranks. In a sense, it's a chicken and egg exercise. We anticipate high threat levels to lead to low populations, and low threat levels to lead to higher populations. The co-occurrence of high threats and high populations or low threats and low populations are less logical outcomes. The ranking results bear this out (Appendix B – Table 1)

P-Value Analysis

Because the C-Ranks are discrete categories, with set boundaries (generally 1.0 points in width except at either end of the spectrum, where they may be even wider), the simplified map displaying C-Ranks (Map A - *C-Rank by Core Area*) has potential to be somewhat misleading. Adjacent core areas that appear as different colors on the map may be as little as 0.25 points apart in the ranking. As an example, the middle reach of the Clark Fork River – Section 2 (western Montana) has a P-value of 1.75 (Appendix B –Table 3) and appears as orange on Map A (*C-Rank by Core Area*). It is sandwiched between two other core areas, Clark Fork River – Section 1 and Clark Fork River – Section 3, that appear as red on the map and they each have a respective P-value of 1.5. Subtle differences in the scoring of distribution and threats account for the differential in this case. Two other core areas can have a P-value as much as P = 1.75 points apart and still be displayed as only one color apart on the map. Similarly, two core areas can both appear as the same color even though their P-value is as much as 1.75 points apart.

In a partial attempt to mitigate the simplification of using discrete categories, we have created a map of actual P-values. Map F (*P-value by Core Area*) displays each P-value as a separate shade of the same general color scheme (red to green). In that way, core areas that are closer in value appear as one or two shades apart as opposed to more extreme differences in scoring that are separate colors. Displaying the point values associated with the core area ranking scheme in this fashion presents a somewhat different perspective on the relationship between core areas.

Unidirectional Scoring Shifts

Because we felt an illustration of the potential changes in core area rank that could occur with unidirectional shifts in the scoring might be informative, we also produced a series of maps that illustrate changes in all core areas, either up or down 0.25 or 0.5 points in P-value. Unidirectional shifts in scoring could occur if the overall scale were adjusted for some reason. As we have described above, it is highly illogical that any particular series of events could lead to all P-values simultaneously shifting up or down in unison, such as addition or removal of major threats, or major adjustments to population parameters. Therefore, this exercise is largely hypothetical. However, it may be illustrative to examine these unidirectional maps as a sort of generic evaluation of how sensitive the model is and how the overall balance amongst C-Ranks might change if the status of bull trout became collectively better or worse over time.

Starting from the original base shown in Map A (*C-Rank by Core Area*), we illustrated these unidirectional changes in sequential fashion. Map G (*P-Value +0.25*) and Map H (*P-Value +0.*5) visually illustrate the changes which would occur if all P-values were simultaneously shifted upward 0.25 or 0.5 points. Map I (*P-Value -0.25*) and Map J (*P-Value -0.*5) visually illustrates the changes which would occur if all P-values were simultaneously shifted downward 0.25 or 0.5 points. The following table shows how the array of C-Ranks would change under those various scenarios.

C-Rank	**-0.5**	**-0.25**	**Existing**	**+0.25**	**+0.5**
C1 (High Risk)	67	55	43	28	22
C2 (At Risk)	40	40	44	49	45
C3 (Potential Risk)	11	22	30	35	40
C4 (Low Risk)	3	4	4	9	14

As shown in this table, moving the P-value up or down has variable effects depending on the C-Rank category one chooses to examine. At one extreme, in the C1 (High Risk) category, about as many core areas are added or subtracted depending on which way the P-value moves and how far. A full half-point move downward results in 24 more core areas being added to C1, whereas a full half-point move upward removes 21 core areas from the C1 category. The existing number of core areas in the C1 category is 43, almost exactly halfway between the other extremes of 67 and 22, respectively. At the other extreme, the C4 (Low Risk) category, the move downward has little effect, but a half-point move upward would more than triple the number of core areas considered to be at low risk. The number of core areas categorized as C2 (At Risk) is remarkably stable.

Regardless of the directional shift there are always between 40 and 49 core areas in this category. The C3 (Potential Risk) category responds similar to the C4 (Low Risk) category, though not as dramatically. For each incremental unidirectional positive move in the scoring, a larger and larger number of core areas go into category C3.

AGGREGATED RANKING BY UNITS LARGER THAN CORE AREAS

One of the considerations we evaluated is whether or not bull trout core areas are the appropriate population units for conducting status rankings using the Natural Heritage protocol. By definition, each bull trout core area is considered to be a functioning, stand-alone population unit (USFWS 2002, 2004a, 2004b). While some threats occur over broad landscape areas (e.g., climate variation, some broad scale forestry impacts), many of the threats we evaluated operate completely independently on individual core areas (e.g., nonnative species, dams and diversions). For the latter category of threats the severity, scope, and immediacy (which lead to the threat ranking) can best be characterized on a core area by core area basis. As a result, we strongly believe that characterizing risk on a core area by core area basis is the most appropriate and most sensitive indicator of the overall health of bull trout across the broader landscape.

Following general guidance given by Spruell et al. (2003) and Whitesel et al. (2004), we divided the bull trout landscape into three general evolutionary units. For sake of brevity, they will be referred to as the Coastal, Snake, and Upper Columbia and are portrayed on the maps previously discussed. If we attempt to characterize bull trout status by evolutionary units (or States or other large blocks) what tends to happen is that individual core area variation is washed out and we end up with a single unified ranking.

As an example, if we score the evolutionary units independently, each would likely receive the following identical ranking values:

PARAMETER	*VALUE*	*ALPHA*	*POINT VALUE*
Population Size	>10,000	F	+/- 0
Distribution	1,000-5,000 km	E	+/_0
Trend	Unknown	U	+/_0
Severity	Moderate		
Scope	High (Moderate?)		
Immediacy	High		
Threat Factor	MHH	A	-1.0

This is largely a theoretical exercise, as we did not have the group that conducted the overall evaluations do a collective scoring by larger units. However, for most of the ranking categories there is little room for ambiguity as to which is the appropriate ranking category. Based on this scoring, with a total P-value of -1.0, each of the evolutionary units would have a score of 3.5 – 1.0 = 2.5, and would receive a C-Rank of C2 (At Risk). The only area of ambiguity would seem to be in the scope of threats. If <60% of a unit was affected by threats, the scope would be moderate (rather than high) and the Threat Factor of MMH would result in an alpha score of B = -0.75 point value. In that case, the score of 3.5 – 0.75 = 2.75 would move the overall unit over the line and into the C3

(Potential Risk) category. G3 was the global ranking assigned to bull trout under the Heritage Ranking system (MNHP 2004).

If we had not truncated the upper limits of the Heritage scoring system to make it more closely resemble the spread of values seen in bull trout core areas, then one could logically argue that positive point values for bull trout population size, distribution, and trend would be possible in sufficiently large landscape type units (or for the species rangewide). However, in order to receive a G value for population size (+0.25 point value), it would be necessary to exceed 100,000 adult bull trout. It is doubtful that many can be documented in the entire U.S. portion of the range. An H value (+0.5 point value) must exceed 1,000,000 adults.

Similarly, an F value for distribution would require 5,000-20,000 km of habitat, a G value 20,000-200,000 km, and an H value >200,000 km. Some larger units could achieve an F value. However, the scoring system does not assign positive points for distribution until the H category is reached (H = +0.25). Since there are about 18,000 miles (approx. 29,000 km) of key recovery habitat in the entire U.S. portion of the range, we would need to expand that by a factor of seven times to reach the lower threshold of the H category; a very unlikely scenario.

Given the high state of uncertainty in the data sets that express population trend, we would anticipate that any larger aggregation of core areas would demonstrate even higher uncertainty than do individual core areas. In addition, pooling of bull trout trend data sets is difficult, due to the generally nonstandardized approach for how the data have been collected and summarized. As a result, any aggregation of core areas would logically receive an Unknown trend value, with a score of +/-0. Similarly, as we noted earlier, the threats would tend to become somewhat similar as we amalgamate core areas into larger units, with moderate severity, high or moderate scope, and high immediacy the most logical pattern, resulting in a score of -1.0 or -0.75. Aggregating threats across a larger landscape would not seem to logically move threats in any fashion toward low severity, which is what is required in the scoring matrix to achieve positive point values.

Finally, what this demonstrates is that aggregating bull trout core areas for collective ranking in large blocks under the Heritage scoring process tends to reduce individual variation and result in a highly standard score, such as we presented in the analysis for the three evolutionary units (above). Assessment of threats at the aggregated level is particularly problematic, given the wide range of core area conditions and the way that certain threats tend to individually impact populations (e.g. non-native species, mining, dams, etc.).

There is another way to approach this problem. It is possible to establish a weighted average of the individual core area scores based on some factor that accurately reflects the contribution that each core area makes to the range of bull trout. The most appropriate weighting factor would be to use the amount of key recovery habitat in each core area, as it provides a surrogate measure of the amount of occupied bull trout habitat. This approach is a bit problematic, because there is a mixture of stream and lake habitat.

However, because all adfluvial and anadromous populations require streams for spawning and rearing, we chose to simplify this exercise and use only the key recovery stream habitat layer.

For each core area, we multiplied the point value (P) from the original status ranking by the amount of key recovery habitat. For example, the P-value for the Hood River core area was 1.5. The amount of key recovery habitat in the Hood River core area was 69.0 miles. The product of the two was 1.5 X 69.0 = 103.5. We did this for each of the 121 core areas, establishing a Rank Product value.

We then aggregated the core areas into various groupings. By summing the Rank Product for each aggregation and dividing by the total amount of key recovery habitat within that aggregation of core areas, we obtained a weighted average of the P-value for that aggregation. This weighted value may represent our best approximation of the overall status of core areas within each of the aggregate blocks. It should be noted that this weighted value does not incorporate extirpated bull trout watersheds (shaded black) within the aggregate blocks. These watersheds cannot be individually ranked under this process, so must be viewed in conjunction with the regional rankings.

This exercise provides some interesting output. Given that the Heritage Ranking Process is not normally applied in this fashion, further analysis is needed to assess the assumptions and validate or repudiate this approach. We would caution against using this analysis for anything more than an interpretive exercise for discussion purposes at this point in time. By the very nature of what we've done the method discounts known important habitat in lakes (and the ocean) and weights the results toward large core areas with a lot of connected habitat, even if much of the habitat may be a migration corridor that has low or intermittent occupancy. With those caveats, we present the following results.

The overall P-value for the 121 core areas, with weighting for 18,062 miles of key recovery habitat is 2.30. This would equate to a C-Rank of C2 (At Risk). If we divide the core areas up into three evolutionary units (Coastal, Snake, Upper Columbia - see Maps A-E), the 23 core areas in the Coastal Evolutionary Unit (including Klamath) have the highest weighted aggregate P-value of 2.81. This would equate to a C3 (Potential Risk) ranking. The relative strength of the weighted aggregate P-value of the Coastal Evolutionary Unit is largely provided by the relatively high ranking values and large amounts of key recovery habitat in the Skagit, Snohomish and Skykomish, Queets, and Lower Deschutes core areas. The weighted aggregate P-value would be even higher were it not for relatively low ranking values and substantial amounts of key recovery habitat in the Upper Willamette, Hood, Upper Sprague, and Hoh core areas. It should be noted that seven of the nine areas where bull trout are considered extirpated are in the Coastal Evolutionary Unit. Because they contain no currently occupied habitat, those do not factor into this analysis and do not contribute to the score.

The 44 core areas in the Snake Evolutionary Unit have an intermediate aggregate weighted P-value of 2.39. This equates to a C2 Rank (At Risk). The weighted aggregate

P-value of the Snake Evolutionary Unit is largely supported on the upper end by relatively high ranking values and large amounts of key recovery habitat in the Middle Fork Salmon, Selway, and Middle Salmon-Chamberlain core areas. On the other end of the scale are low ranking values combined with substantial amounts of key recovery habitat in the Pine Indian Wildhorse, Powder, Malheur, and Little-Lower Salmon core areas. None of the extirpated areas fall in the Snake Evolutionary Unit.

The remaining 54 core areas grouped as the Upper Columbia Evolutionary Unit have the lowest weighted aggregate P-value of 1.87. This also equates to a C2 Rank (At Risk), but is approaching the C1 (High Risk) threshold. Major factors in this relatively low aggregate ranking are the combination of high amounts of key recovery habitat and low ranking values in the Priest, Yakima, Pend Oreille River, Upper Clark Fork, Methow, and Coeur d'Alene core areas. At the other end of the scale, relatively high ranking values and large amounts of key recovery habitat occur in Hungry Horse, Blackfoot, Wenatchee, and Lake Pend Oreille core areas. Two of the nine extirpated areas are in the UPPER Columbia Evolutionary Unit. A quirk in this analysis is that the strongest core area by rank (Lake Koocanusa) receives limited weighting because most of the key recovery habitat is in Canada and is not quantified. Similar situations occur for the Chilliwack and Upper Skagit core areas in the Coastal region. The small adfluvial core areas in this evolutionary unit grouping have little weight, but are about evenly arrayed with concentrations at both ends of the scale.

A similar analysis can be done by grouping the core areas by states. Though this type of grouping has less biological significance than the evolutionary grouping, it is nonetheless informative. The same strong and weak core areas drive the results. Idaho core areas (n = 33, including Jarbidge River in Nevada) had the most key recovery habitat (7,644 miles) and the highest weighted aggregate P-Value of 2.46. Washington core areas (n = 25) had a very similar weighted aggregate P-Value of 2.43. The weighted aggregate P-Values of core areas in Montana (n = 46) and Oregon (n =25) were somewhat lower and those two units exhibited similar scores of 2.05 and 2.01, respectively. The weighted aggregate P-Value of the four states would each equate to a C2 Rank (At Risk), although Idaho and Washington would approach the upper end of that rank category (P>2.5 = C3).

CORE AREA LIFE HISTORY AND CONNECTIVITY ASSESSMENT

The maintenance of migratory forms of bull trout and the related connectivity requirements to support these forms are important factors in evaluating persistence of the species within core areas, as well as within regional or larger units. To compile this information in a consistent manner across the range, a system was developed to characterize the life history composition within each core area, the level of connectivity within each core area, and the level of potential connectivity among core areas. Definitions and guidance (rule set) were developed for each of the characterization fields to help ensure consistency (see Appendix C - Rule Set for Life History and Connectivity Characterization Definitions). As we did with the Heritage ranking process, we sent this exercise out to Service biologists whom have regional oversight responsibilities for bull trout activities within a State or portion of a State. Individual reviewers most familiar with each core area assigned the characterization for each field. Where additional explanation was judged necessary for particular entries, a comment was inserted for that entry in the spreadsheet. The final core area characterizations were analyzed across the range and by region, and mapped for evaluation of patterns. The complete results of this exercise for the 121 core areas are summarized in Appendix C. Maps, used to illustrate some of the points that are discussed, are referenced in the order they are described.

Life History Forms

Migratory Forms

There are three migratory life history forms which may be present within a core area (fluvial, adfluvial, anadromous). In core areas where more than one migratory form was present, the dominant and secondary form(s) were identified. It is important to note that the characterization of life history types as fluvial, adfluvial or anadromous is not absolute and may not be mutually exclusive. In reality, migratory fish often exhibit complex movement patterns and individual fish may utilize more than one strategy during their lifetime (e.g., adfluvial one year but fluvial the next). Map K (*Dominant Life History by Core Area*) visually depicts the array of core areas by the dominant migratory life history type that occurs in each.

Under this characterization we determined which migratory form is dominant in each of the 121 bull trout core areas:

Adfluvial	n = 58
Fluvial	n = 49
Anadromous	n = 6
*No Longer Present	n = 7
Non-migratory	n = 1
Total	**n = 121**

*No Longer Present - refers to a core area where the migratory form was historically present but only resident fish now remain.

The adfluvial form (light blue) is the dominant migratory life history found within 48% of the 121 core areas, closely followed by the fluvial form at 40% (purple). The anadromous life history form (dark blue) is found in only 5% of the core areas (6/121), and these are located solely within the Coastal-Puget Sound population segment.

In some core areas several different migratory life history strategies may overlap. Map L (*Migratory Forms by Core Area*) shows the number of migratory life history forms present in each core area.

Single migratory form	n = 83
Multiple migratory forms	n = 30
Resident form only	n = 7
None identified	n = 1
Total	**n = 121**

In 69% of the core areas (83/121), only a single migratory form is present, while 25% (30/121) contain multiple migratory forms. Only one core area, the Lower Skagit, is known to contain all three migratory forms.

Seven core areas (6% of the total) formerly had migratory fish but no longer support them (yellow - Map K – *Dominant Life History by Core Area*). Additionally, one core area is not known to have ever supported migratory bull trout (uncolored). What this analysis does not indicate is where substantial losses of the migratory form have occurred in core areas where the migratory form was once dominant but is no longer the primary life history form (i.e., remnant).

<u>Resident Form</u>

Some core areas include resident bull trout in portions of the watershed(s), often in addition to a migratory form(s). In a few cases the resident form may be the only one still present. Historically, where resident and migratory forms coexisted within the same core area, the migratory form was typically dominant. The evolutionary history of bull trout indicates that as an apex predator species the migratory life form was a highly successful strategy (Whitesel et al. 2004).

With fragmentation, loss, and/or degradation of habitats within a core area (particularly key migration corridors between foraging and overwintering habitats), the migratory form may no longer be dominant. The resident form is inherently at greater risk of loss to stochastic events than the migratory life history form (Rieman and McIntyre 1993, 1995; Rieman et al. 1997; USFWS 2002). If dominant within a core area, residency reduces the likelihood of persistence when compared to core areas supporting migratory forms. Map K (*Dominant Life history by Core Area*) visually depicts where the resident form is dominant (orange hashed areas) within a core area, present but not dominant (green hashed areas), or absent (grey hashed areas). There are also core areas where the resident form's presence is currently unknown (no hashing).

Under the current characterization we assigned the following resident categories to the 121 bull trout core areas:

Resident Dominant	n = 19
Resident Present	n = 34
Resident Absent	n = 34
Unknown	n = 34
Total	**n = 121**

The resident form is currently known to be dominant or present in 44% of the core areas (53/121). In the 19 core areas (16%) where the resident form is dominant, 13 contain a remnant migratory component and five have lost the migratory component. The remaining core area, Little Minam River, is a natural resident population isolated in a headwater drainage, which is not the result of the loss of the migratory form through habitat degradation or fragmentation. The resident form is known to be absent in 28% of the core areas (34/121). In one of these core areas, North Fork Payette River, the historic fluvial form is also no longer present and this core area is most likely at or near extirpation. The presence or absence of the resident form has not been determined in the remaining 28% of the core areas (34/121). In some cases, this is likely the result of the limited survey efforts within core areas, and the difficulty in distinguishing younger life stages of migratory forms from the resident form. In other cases, the diversity of habitat may be insufficient to support the resident form (e.g., small isolated mountain lakes), or harsh climatic conditions or low productivity may preclude resident fish from being able to exist without access to more productive lakes or rivers downstream.

Core Area Extent and Connectivity

Connectivity, especially hydrologic connectivity, is essential to the ecological integrity of the landscape (Pringle 2003). Connectivity of habitats within core areas, and in some cases with habitats outside of core areas, is critical for migratory bull trout to successfully complete their life history (Rieman and McIntyre 1993; MBTSG 1998; Brenkman and Corbett *in press*). Connectivity among local populations is also important to provide the opportunity for genetic exchange within core areas and for refounding after local extinction events (Rieman and McIntyre 1993; Rieman et al. 1997). Multiple local populations distributed throughout a watershed provide a mechanism for spreading risk because the simultaneous loss of all local populations is unlikely; and if well connected, provide for the resiliency of the core area through potential refounding. In some cases, connectivity among adjacent core areas is important for maintaining/restoring the original population structure that existed prior to fragmentation by artificial barriers. Connectivity among core areas also provides for the opportunity of genetic exchange (one or two-way) to maintain diversity and allows the potential for refounding.

To a certain extent, the distinction between connectivity "within" core areas and connectivity "among" core areas is a temporal distinction. By definition, a core area represents a largely self-contained biologically functioning unit for bull trout (USFWS

2002, 2004A, 2004B). Over the short term (several generations) connectivity within a core area is critical to a bull trout population maximizing its potential (abundance, distribution, trend), and perhaps even to its persistence. However, over a longer time frame, perhaps even evolutionary time, core areas necessarily share (or once shared) some degree of connectivity (Whitesel et al. 2004).

Thus, if a core area is completely isolated today (e.g., natural barriers), the lack of connectivity to other core areas in the future may not be a factor in its chances of persistence. That is not to suggest connectivity to other core areas (at least over multigenerational time periods) might not be beneficial, but rather, that from a practical standpoint future connectivity is extremely unlikely to occur. Conversely, a core area that currently maintains connectivity with other core areas both upstream and downstream (e.g., a portion of a mainstem river basin) may be considered more secure, simply because the potential for recolonization (however slight) still exists.

Core Area Extent

All core areas have a lower and upper bound which delineates the extent of the core area. These may include 1) a watershed boundary [typically the lower bound of core areas that are directly associated with the mainstem Columbia or Snake Rivers, or marine waters (i.e., Pacific Ocean, Strait of Juan de Fuca, Hood Canal, and Puget Sound)]; a dam or other artificial barrier; a natural barrier such as a waterfall or other longstanding natural habitat condition that precludes migration; or headwaters (only applicable as an upper bound to a core area). For some core areas, the upper bound may actually be the result of multiple features given the complexity of the most upstream portions of a river system. In these cases, multiple features may have been identified as upper bound(s) of the core area (e.g., headwaters/artificial barrier). We developed and applied a set of rules for use in assessing connectivity and assigning categories (Appendix C – Rule Set for Life History and Connectivity Characterization Definitions). The results of this exercise for the 121 core areas are detailed in Appendix C.

Under the current characterization we assigned the following upper and lower bound categories to the 121 bull trout core areas:

Upper Bound	
Headwaters	n = 81
Watershed Boundary	n = 9
Dam/Artificial Barrier	n = 7
Natural Barrier	n = 6
(Multiple Bounds)	n = 18
Total	**n = 121**

Lower Bound	
Watershed Boundary	n = 78
Dam/Artificial Barrier	n = 27
Natural Barrier	n = 16
Total	**n = 121**

As might be expected, “headwaters” were identified as the upper bound of most core areas (67%). This makes sense, given that core areas generally coincide with watersheds. An additional 5% had a natural barrier (e.g., major waterfall or other impassible feature) defined as its upper bound. Only 6% of the core areas (7/121) had a dam/artificial barrier identified as an upper bound. Fifteen percent of the core areas (18/121) had identified more than one bound type as an upper bound, due to the complexity of the upper watershed. This complexity is usually the result of a core area having multiple river forks with different boundary types. It should be noted that in all these cases either “headwaters” and/or “natural barrier” were identified as one of these multiple bounds.

The majority of core areas (64%) identified “watershed boundary” as the lower bound. Given that core areas generally extend to the bottom of a major watershed, often to major hydrologic areas such as the mainstem Columbia and Snake Rivers, Puget Sound and the Pacific Ocean, this is not unexpected. Generally, core areas with a “watershed boundary” as the lower delineation are not completely isolated from downstream core areas. However, 22% of the core areas (27/121) have a dam or other artificial barrier that was identified as a lower bound, fully isolating them from other core areas. Finally, 13% of the core areas (16/121) are naturally isolated from other core areas by a natural barrier.

Degree of External Connectivity Among Core Areas

Directly related to the boundary delineations above is the effect that these bounds have on the degree of connectivity to adjacent upstream and downstream core areas. There are generally three levels of connectivity at the upstream and downstream boundaries of core areas (No Passage, Restricted Passage, and Unrestricted Passage – see Rule Set in Appendix C). “No Passage" applies to longstanding natural habitat conditions that preclude downstream migration (e.g., Jarbidge) or dams/diversion that prevent any passage; "Restricted Passage” applies to dams/diversions with one- or two-way passage, or anthropogenic habitat conditions that significantly impair downstream migration (e.g., Yakima); and "Unrestricted Passage" applies to intact migratory corridors. This characterization only applies to the ability for fish to migrate from a core area to other downstream or upstream core areas. Note that connectivity “within” the boundaries of each core area is a separate topic dealt with in a later section of this report (see Degree of Internal Connectivity Within Core Areas below).

It is assumed that adfluvial populations typically do not migrate downstream of their lake (in part a behavior, but also because water downstream of lakes is typically warmer than bull trout prefer in the summer). Thus, for adfluvial populations, downstream passage is considered “Restricted Passage” by default, unless demonstrated otherwise.

We acknowledge that in evaluating anthropogenic habitat conditions, there is sometimes a level of interpretation in deciding when those conditions “significantly impair” downstream migration. The results of this passage exercise should therefore not be interpreted as strictly black or white, but rather as shades of gray. Information from radio telemetry and fish passage studies has often led to surprising conclusions about the migratory movements of these highly mobile fish.

Under the current characterization we described the following level of connectivity at the upper and lower bounds of the 121 bull trout core areas:

Upper Bound

No Passage	n = 110
Restricted Passage	n = 6
Unrestricted Passage	n = 5
Total	**n = 121**

Lower Bound

No Passage	n = 16
Restricted Passage	n = 66
Unrestricted Passage	n = 39
Total	**n = 121**

In order to describe the overall degree of connectivity between adjacent core areas a simple scoring system was developed. Each level of connectivity was given a point value (No Passage = -1; Restricted Passage = 0; Unrestricted Passage = +1), and then the two resulting point values for downstream and upstream connectivity were added together. A value of "-1" is still applied to core areas having headwaters or a natural barrier as an upper bound, even though the lack of upstream connectivity to other core areas is the natural prevailing condition. This is appropriate, since we are trying to assess the overall degree of connectivity relative to other core areas, whether natural or altered.

A range of five "connectivity" scores are possible (+2, +1, 0, -1, -2). The final point value for each core area indicates its overall degree of connectivity with other core areas, with +2 being highest and -2 being lowest. This overall "connectivity score" may also be considered to provide a relative indicator of the potential for refounding if bull trout were extirpated in a core area. Map M (*External Connectivity Among Core Areas*) visually depicts the array of "connectivity" scores for each core area. The low connectivity categories (-2 or -1) are displayed in red and orange, respectively. The moderate connectivity category (0) is displayed in yellow. The high connectivity categories (+1 or +2) are displayed in shades of green.

Under the current scoring we assigned the following degrees of connectivity among each of the 121 bull trout core areas:

Low Connectivity	n = 73	score = ≤ -1
Moderate Connectivity	n = 43	score = 0
High Connectivity	n = 5	score = ≥ 1
Total	**n = 121**	

The majority (60%) scored as having "low" connectivity with other core areas. In order to achieve this score, a core area must have no passage at one of the core area's bounds and restricted passage at the other. A total of 16 core areas scored "-2", meaning that there was complete isolation with no passage at either bound. Thirty-six percent of the core areas (43/121) scored as having "moderate" connectivity with other core areas, meaning either "restricted passage" at both bounds, or "unrestricted passage" at one bound and "no passage" at the other. Only 4% of the core areas (5/121) scored as having "high" connectivity with other core areas, and only one core area scored "2", meaning "unrestricted passage at both bounds". These scoring results would suggest that current connectivity among core areas is low across the range overall. This current lack of connectivity among core areas significantly reduces the probability of refounding events should a core area become extirpated. It also illustrates why we consider core areas to be important biological units and why threats should be evaluated primarily at the core area level.

It is important to note some core areas are isolated primarily by natural conditions. Certain headwater core areas that are also isolated by natural barrier falls downstream would score -2 in this evaluation. However, in other cases, the natural degree of isolation is enhanced by artificial means, which contributes to the loss of external connectivity. The isolating mechanisms that lead to the individual core area scores are detailed in Appendix C – Table 1.

Degree of Internal Connectivity Within Core Areas

As described earlier, connectivity of habitats within core areas is also critical for migratory bull trout to successfully complete their life history. Within core area connections provide interaction among local populations to allow for genetic exchange and refounding. Similar to describing connectivity "among" core areas, the degree of connectivity "within" each core area was characterized as either low, moderate, or high. However, no scoring was used in this exercise. Categorization of each core area was rated based on the following definitions.

"Low" internal connectivity applies to core areas where the majority of local populations are artificially separated from one another, or migratory or resident forms (if dominant) have impaired access (year round or seasonally) to a majority of the habitat within the core area. Access may be impaired by degraded habitat conditions or by artificial barriers (e.g., diversions, culverts, etc.).

"Moderate" internal connectivity applies to core areas where some portion (but not the majority) of local populations are artificially separated from the others, or migratory or resident forms (if dominant) have impaired access to smaller portions of habitat within the core area. In this category connectivity issues are still considered significant.

"High" internal connectivity applies to core areas where connectivity between local populations is generally unimpaired, or where only minor or insignificant portions of usable habitat are currently inaccessible. Map N (*Internal Connectivity Within Core Areas*) visually depicts the array of core areas by "internal" connectivity category. The low connectivity category is displayed in red, the moderate connectivity category is displayed in yellow, and the high connectivity category is displayed in green.

Under the current characterization we assigned the following degrees of connectivity within each of the 121 bull trout core areas:

Low Connectivity	n = 30
Moderate Connectivity	n = 39
High Connectivity	n = 52
Total	**n = 121**

Over half of the core areas (57%) were characterized as having "low" or "moderate" connectivity "within" the core area. This means that at least some local populations (i.e., spawning groups) were artificially separated from other local populations within the core area, and/or significant portions of usable habitat within the core area were currently inaccessible. Forty-three percent of the core areas (52/121) were characterized as having "high" connectivity within the core area.

Maintaining internal connectivity may be even more critical to the persistence of those core areas that scored "low" or "moderate" with respect to external connectivity. At the very least, core areas with low connectivity at both the internal and external level would seem to be highly vulnerable to extirpation. Twenty-five core areas (21%) characterized as having low internal connectivity also scored as having low external connectivity with other core areas. Another 17 core areas (14%) characterized as having moderate internal connectivity also scored as having low external connectivity.

CONNECTIVITY WITH CANADA

As with the assessment of connectivity within and among core areas in the United States, there are a number of watersheds where connectivity of core areas in the United States with habitat in Canada is vitally important to bull trout. In part because bull trout are not listed in Canada, and also because core area population structure has not been described north of the border, we have not extended the previous analysis of core area connectivity to Canadian waters. However, the identification of portions of the watersheds in British Columbia and Alberta, Canada that routinely interact with core areas in the United States. is relatively straightforward. Those watersheds are highlighted in Map O (*Core Area Interaction With Canada*). We will describe these in the following paragraphs, moving from west to east across the landscape.

Chilliwack River

The Chilliwack core area is delineated around those portions of the Chilliwack River and its major tributaries (Silesia Creek, Tomyhoi Creek, and Sumas River) contained within the United States. However, a significant portion of the Chilliwack River drainage lies within Canada and is functionally part of this core area. It is a transboundary system that flows from the United States northwest into British Columbia where it discharges into the lower Fraser River.

Those reaches of the Chilliwack River and Silesia Creek (spelled "Slesse" in Canada) within the United States are contained within North Cascades National Park and the Mount Baker Wilderness, respectively. The short section of the mainstem river (extending from the international border) and Chilliwack Lake, comprise Chilliwack Lake Provincial Park in British Columbia. Although Chilliwack Lake is now entirely within the Provincial Park, two of its major tributaries, Paleface and Depot Creeks, are extensively outside of the park boundary with the exception of their lower reaches. The headwater reaches of Depot Creek initiate within North Cascades National Park in the United States. Silesia Creek and Tomyhoi Creek (spelled "Tamihi" in Canada), initiate from the Mount Baker Wilderness in the United States, eventually crossing the international border and entering the Chilliwack River downstream of Chilliwack Lake. The Chilliwack River flows west out of Chilliwack Lake, eventually becoming the Vedder River, where it is then joined by the Sumas River (at Vedder Canal) before discharging into the lower Fraser River. There are at least five other tributaries on British Columbia side that appear to support spawning (Airplane, Borden, Centre, Foley, and Nesakwatch Creeks).

The bull trout within the Chilliwack system are believed to express fluvial, adfluvial, and potentially resident and anadromous life histories. Adfluvial, fluvial, and any anadromous forms spawning in the United States must migrate to British Columbia waters to complete their life histories. Adfluvial forms need to migrate only to Chilliwack Lake, while fluvial forms may migrate as far as the lower Fraser River, and any anadromous forms would have to migrate as far as the Strait of Georgia downstream though the lower Fraser River.

The other major subwatersheds within the lower Fraser system below Hells Gate (Fraser Canyon, Lillooet, Harrison River, Lower Fraser, and Squamish) are all accessible to migratory salmonids. Lillooet-Harrison River and Squamish, which enter on the north side of the Fraser River, would probably be considered separate core areas based on the definitions applied to bull trout populations within the United States. Those subwatersheds that are primarily reaches of the mainstem Fraser River (i.e., Fraser Canyon and Lower Fraser) would be considered primarily foraging, migration, and overwintering habitat. The use of these areas by bull trout from the Chilliwack River system is currently undetermined. Given the migratory patterns that have been observed for several populations within Puget Sound and the Columbia River system, it is conceivable that some bull trout from the Chilliwack system could occasionally (Lillooet-Harrison River and Squamish) or frequently (Fraser Canyon and Lower Fraser) migrate through portions of these areas. The status of bull trout in the Lillooet, Harrison River and Squamish subwatersheds likely has no direct influence on the status within the Chilliwack system, whereas portions of the Fraser Canyon and Lower Fraser subwatersheds could be important for supporting some migratory forms that spawn in the Chilliwack core area.

Upper Skagit River

A significant portion of the upper Skagit River drainage lies within British Columbia, Canada. It is a transboundary system that flows south from British Columbia into the upper end of Ross Lake, a reservoir formed by the construction of Ross Dam on the mainstem Skagit River in the United States. Ross Lake extends partially into British Columbia, but is substantially within the United States. The upper mainstem Skagit River enters Ross Lake less than 0.75 mile from the international border. Much of the bull trout habitat within the Canadian portion of the watershed is relatively undisturbed, since most lies within Skagit Valley and Manning Provincial Parks, and the Cascade Recreation Area (backcountry wilderness), which compliments protection within North Cascades National Park and the Pasayten Wilderness in the United States. The Upper Skagit core area supports populations of both bull trout and Dolly Varden. Adfluvial, fluvial, and resident life history forms of bull trout are present in the upper Skagit drainage. Adfluvial bull trout are present in many of the tributaries to Ross Lake including the upper Skagit River, while fluvial forms are found primarily in the upper Skagit River within British Columbia. Resident bull trout are also found in several British Columbia tributaries to the upper Skagit River including Nepopekum and Snass Creeks, and the Klesilkwa, Sumallo, and Skaist Rivers. The portion of the upper Skagit River drainage the lies within British Columbia should be considered functionally part of the Upper Skagit core area. It should be noted that in contrast to the Chilliwack core area, local populations (spawning groups) within the United States portion of the upper Skagit generally don't require migration into Canadian waters (with perhaps the exception of a small portion of Ross Lake) to complete their life history. However, the local populations of adfluvial bull trout in British Columbia do require access to Ross Lake in United States to complete their life history.

Columbia River Headwaters
The Columbia River heads in British Columbia at Canal Flats, adjacent to (west of) the Kootenai River, and it flows north for over 100 miles before abruptly looping south and flowing back toward the United States. On the south-flowing reaches of the upper Columbia River in British Columbia a series of reservoirs exist behind major dams (in downstream order Mica, Revelstoke, and Keenleyside). Keenleyside Dam near Castlegar, about 20 miles north of the international border, impounds Lower Arrow Lake. While there are relatively robust populations of bull trout throughout portions of the upper Columbia River system and its reservoirs in British Columbia, the Columbia River downstream from the international border (in northeast Washington) is not considered part of the existing range of bull trout. No bull trout core area was designated in the upper Columbia River after it flows into the United States and bull trout are found there only rarely. Consequently, bull trout in the entire upper Columbia River drainage in Canada should be considered disconnected from the U.S. portion of the range.

Lower Kootenay River/Lower Pend Oreille River
Similarly, the lower portions of the Kootenai River, after it leaves Kootenay Lake in British Columbia, flow into the upper Columbia River near Castlegar, about 20 miles north of the international border. Bonnington Falls is an historic natural fish passage barrier on the lower Kootenay, near the confluence of the Columbia. Additionally, the lower Pend Oreille River after leaving Lake Pend Oreille and flowing through Albeni Falls Dam in the United States, flows over Metaline Falls (a historic barrier) and then into British Columbia to enter the upper portion of the Columbia River. The area of the upper Columbia River just north of the international border, where the Kootenay and Pend Oreille Rivers join the Columbia, is heavily influenced by relatively warm summer surface water discharge from the major lakes (Arrow, Pend Oreille, and Kootenay) and is not regularly inhabited by bull trout.

Kootenai River
The Kootenai River core area in the United States. (bounded by Libby Dam with no fish passage on the upper end and the international border on the lower end) has the capability to exchange bull trout from its headwater spawning and rearing streams with downstream waters in Kootenay Lake in British Columbia. Kootenay Lake is a large natural lake, with several large tributaries entirely in Canada, including the Duncan River and Lardeau River. Kootenay Lake is a productive bull trout system, but the available evidence indicates most of the bull trout in Kootenay Lake spawn in tributaries in Canadian portions of the Kootenai River. It may be that the historic conditions of the Kootenai River upstream of Kootenay Lake prior to Libby Dam were less suitable for bull trout, or there were limited opportunities to navigate Kootenai Falls to access the best spawning and rearing habitat in the U.S. portions of the Kootenai River system. Regardless, there is limited evidence that bull trout from Kootenay Lake routinely migrate to United States portions of the Kootenai River system, or vice versa, either currently or historically. While the connectivity that does occur may be important, it is not a major migratory route.

Lake Koocanusa
Lake Koocanusa, behind Libby Dam (completed in 1972), floods into British Columbia at full pool. Only one tributary to the system (Grave Creek) on the United States side of the border supports bull trout spawning and rearing. The entire headwaters of the Kootenay River in British Columbia are largely unobstructed for fish passage, and radio telemetry studies have shown extensive migrations of bull trout from Lake Koocanusa in the U.S. to numerous watersheds in British Columbia for spawning and rearing. The White River, Skookumchuck Creek, St. Mary River, Elk River, Wigwam River, and Bull River are just some of the very important tributaries identified for this thriving population of bull trout. The maintenance of connectivity and continuing transboundary interchange of bull trout in this system are vital to the status of the species in this watershed.

Upper Flathead River
Most of the watershed of the upper Flathead River (known as the North Fork Flathead River on the United States side) is in Montana. However, adfluvial bull trout from Flathead Lake, and likely some fluvial fish from the Flathead River system routinely migrate as far as 150 miles upstream to spawn in the upper Flathead River in British Columbia. or in its tributaries (including Howell, Cabin, and Kishinehn Creeks). In recent years, as Flathead Lake bull trout populations have declined due to negative interaction with lake trout, the British Columbia. headwaters appear to have supported an increasingly larger share of the systemwide spawning. Maintenance of this historic connectivity may be key to the long-term protection of bull trout in the Flathead Lake core area.

Belly River
Both the Belly River and the Saint Mary River originate in the United States within Glacier National Park on the east slopes of the continental divide. Both rivers flow south into Alberta, Canada. Eventually, they unite into the headwaters of the Oldman River and flow to the South Saskatchewan River system on into Hudson Bay. The very small portion of the North Fork Belly River headwaters that are in the United States is disproportionately important to bull trout in the Alberta portion of the watershed. They form the only known spawning area for this population. These waters are protected in the backcountry of Glacier National Park.

Saint Mary River
Bull trout within the headwaters of the Belly and Saint Mary Rivers are isolated populations today. Irrigation diversions, dams, and rapidly degrading habitat occur in Alberta as the rivers flow northeastward onto the Great Plains. Neither population is large and both are dependent upon habitat in the United States and Alberta, Canada. Continued opportunities for connectivity and interchange of bull trout in these systems across the international border are vital to the long-term maintenance of both populations.

GIS-BASED THREATS ANALYSIS

Threats to bull trout conservation have been identified in the scientific literature (e.g., Rieman and McIntyre 1993; MBTSG 1998; Quigley and Arbelbide 1997), and summarized in several FWS listing rules (e.g., 63 FR31647). In this section we summarize three specific categories of threats (presence of two species of non-native competitors, road density, and water quality); as they are portrayed in GIS data layers, relative to the core areas identified in the FWS draft Bull Trout Recovery Plan (USFWS 2002, 2004A, 2004B).

The three categories described are not necessarily the most important or significant threats that occur in any particular core area. Rather, they are categories that were presented visually through GIS-based mapping exercises, or discussed during the March 7 and 8, 2005 Bull Trout Science Panel. We are responding to a request to provide a more quantitative summary of those results.

Also included are core area-specific information on land ownership and land use patterns (see Appendix D) which are useful in informing an overall perspective of the distribution of these and other threats (e.g., effects of forest management, development, agricultural activities) across the range of bull trout. The Core Area Connectivity Assessment section of this document discusses an additional aspect of threats.

The threats analysis summary was prepared primarily utilizing GIS data layers available from State and Federal agencies. Some of the information was available for all states within the range of bull trout in the coterminous United States, but other information was only available for portions of the five states.

GIS road densities are visually displayed in Map P (*Road Density by Core Area*). This information appears to be based on different sets of assumptions, depending on the State and agency source. For instance, a little used forest road may be included in one State's GIS layer and a comparable road not included in another State's GIS layer. For this reason we believe the best use of this particular combination of data sets is for relative comparisons of road density within two different geographic areas: coastal states of Oregon and Washington forming one block where a uniform approach to mapping occurred and interior states of Montana, Idaho, and Nevada forming a separate and distinct block. Any comparison between the two blocks would be less meaningful. If no quantitative information was available, we attempted to provide a qualitative indication of threat presence and/or severity. In these cases the primary source of information was the draft bull trout Recovery Plan (as informed by public comment and peer review). Where no information was available, it is clearly indicated.

It should also be noted that in addition to the quantitative summaries for roads, the summaries for brook trout co-occupation presented in the tables should be considered estimates. In some core areas, these numbers underestimate of the total amount of key recovery habitat actually co-occupied by brook trout, based on more recent information that we could not summarize in a GIS layer.

Some GIS layers created by different State and Federal agencies do not match up precisely, such that there is often an area of irregularity where the layers intersect (e.g., State boundaries). Because bull trout core areas or other units based primarily on biology most often do not correspond with administrative boundaries, we used our best professional judgment to make slight adjustments to "fit" the different layers. While we have made our best effort to minimize irregularities, for these reasons quantitative values should be considered as close approximations. Additionally, indications of land ownership should also be viewed as approximations if only due to the fact that land ownership is dynamic.

Table 3, "Summary of Three Threat Categories and Federal Land Ownership by Core Area" indicates (1) the percentage of key bull trout recovery habitat in core area streams co-occupied by brook trout; (2) the percentage of key bull trout recovery habitat in core area lakes and reservoirs co-occupied by lake trout; (3) core area road density; (4) water quality as indicated by the proportion of State-listed 303(d) streams relative to key bull trout recovery habitat by core area; and (5) Primary Federal or Tribal land ownership percentage by core area. Categories #1, 2, and 4 analyze only those stream or lake layers considered key recovery habitat, whereas categories #3 and 5 are inclusive of all habitat within the core area.

Table 3. Summary of three threat categories and Federal land ownership by core area. Core areas presented in order of P-Value (most at risk to least at risk).

Core Area˜	**Brook Trout (% of key streams occupied)***	**Lake Trout (% of key lakes occupied)^**	**Road Density (mi/mi^2) ****	**Water Quality Key habitat on State 303(d) lists^^**	**Primary Federal or Tribal land ownership*****
Kintla Lake	0%	100%	0	none	NP = 100%
Lake McDonald	100%	100%	0.35	none	NP = 100%
Bowman Lake	0%	100%	0.02	none	NP = 100%
Logging Lake	0%	100%	0	none	NP = 100%
North Fork Payette	2%	0%	1.6	low	NF = 50%
Sycan River	present	absent	3	none	NF = 77%
Cyclone Lake	0%	0%	0.9	high	NF = 100%
Priest Lakes	48%	95%	1.7	low	NF = 53%
Sophie Lake	0%	0%	2.2	none	NA
Odell Lake	present	present	2.8	moderate	NF = 81%
Holland Lake	100%	0%	0.5	none	NF = 97%
Lower Quartz Lake	0%	100%	0	none	NP = 100%
Upper Whitefish L.	0%	0%	1.2	high	NF = 72%
Whitefish Lake	100%	100%	2.2	high	NF = 15%

Core Area˜	Brook Trout (% of key streams occupied)*	Lake Trout (% of key lakes occupied)^	Road Density (mi/mi^2) **	Water Quality Key habitat on State 303(d) lists^^	Primary Federal or Tribal land ownership***
Pine, Indian & Wildhorse Creeks	present	absent	1.8	moderate	NF = 57%
Powder River	present	?	3	moderate	NF = 31%
Lucky Peak Res.	present	absent	1.8	?	NF = 90%
Weiser River	52%	0%	1.4	none	NF = 53%
Yakima River	39%	28%	2.6	moderate	TR = 24% NF = 18%
Pend Oreille River	38%	0%	2.2	elevated	NF = 48%
Skokomish River	55%	0%	2.8	low	NF = 50%
Lee Creek	0%	0%	0.5	none	TR = 63% NP = 37%
Lincoln Lake	100%	0%	0.8	none	NP = 100%
Upper Stillwater L.	100%	100%	1.5	none	NF = 63%
Malheur River	0%	0%	1.9	moderate	BLM = 41%
Fish Lake (N. Fork Clearwater River)	0%	0%	0.2	none	NF = 100%
Asotin Creek	0%	0%	1.7	low	NF = 27%
Dungeness River	0%	0%	2.1	low	W = 56%
Cabinet Gorge Res.	100%	0%	1.1	elevated	NF = 77%
Clark Fork River (Section 1)	100%	0%	1.3	high	NF = 38%
Clark Fork River (Section 3)	84%	94%	1.4	elevated	NF = 65%
Harrison Lake	100%	0%	0	none	NP = 100%
Lower Flathead R.	17%	0%	1.6	low	TR = 87%
Noxon Rapids Res.	100%	100%	1	high	NF = 81%
Upper Willamette	present	absent	3.1	moderate	NF = 56%
Hood River	present	absent	3.5	none	NF = 50%
Touchet River	0%	0%	1.6	low	NF = 7%
Coeur d'Alene Lake	20%	0%	1.9	moderate	NF = 55%
Little-Lower Salmon River	70%	0%	1.6	moderate	NF = 46%
Deadwood River	0%	0%	0.5	low	NF = 96%
Squaw Creek	19%	0%	1.4	low	NF = 42%
Methow River	91%	0%	1.3	low	NF = 50%
Jarbidge River	42%	0%	0.9	none	BLM = 61%
Bitterroot River	82%	0%	1.7	moderate	NF = 51%
Clark Fork River	94%	0%	1.7	elevated	NF = 80%

Core Area˜	**Brook Trout** **(% of key streams occupied)***	**Lake Trout** **(% of key lakes occupied)^**	**Road Density** **(mi/mi^2) ****	**Water Quality** **Key habitat on State 303(d) lists^^**	**Primary Federal or Tribal land ownership*****
(Section 2)					
Clearwater R. & L.	94%	0%	1.9	moderate	NF = 82%
Lindbergh Lake	92%	100%	0.3	none	W = 71%
Umatilla River	absent	absent	1.9	low	NF = 11%
Fish Lake (Lochsa)	0%	0%	0.5	none	W = 100%
Lochsa River	0%	0%	0.7	moderate	NF = 69%
No. Fk. Clearwater	18%	0%	1.4	low	NF = 66%
Lemhi River	41%	0%	0.8	moderate	NF = 40%
Anderson Ranch	26%	0%	0.8	low	NF = 97%
Entiat River	56%	0%	3.4	low	NF = 72%
Saint Mary River	45%	0%	0.7	low	NP = 57%
Upper Sprague R.	absent	absent	3.4	none	NF = 81%
Quartz Lakes	0%	0%	0	none	NP = 100%
Flathead Lake	6%	100%	1.4	moderate	NF = 38%
W. Fork Bitterroot	95%	0%	1	moderate	NF = 85%
Kootenai River	87%	0%	2	moderate	NF = 75%
Walla Walla River	absent	absent	2	moderate	NF = 12%
South Fork Clearwater River	62%	0%	1.4	elevated	NF = 62%
Middle Fork Payette River	35%	0%	1.3	low	NF = 88%
Little Lost River	84%	0%	0.4	low	NF = 44%
Elwha River	20%	0%	0.9	low	W = 88%
Hoh River	0%	0%	1.6	moderate	W = 58%
Red Eagle Lake	0%	0%	0	none	NP = 100%
Big Salmon Lake	0%	0%	0	none	W = 100%
Rock Creek	75%	0%	0.7	moderate	NF = 60%
Bull Lake	100%	0%	1.2	elevated	NF = 75%
Upper Mainstem John Day River	present	absent	2.2	elevated	NF = 33%
Middle-Lower Clearwater River	25%	0%	1.9	moderate	TR = 41%
Lake Creek	0%	0%	1	none	NF = 98%
Pahsimeroi River	12%	0%	0.7	low	NF = 46%
Arrowrock Res.	13%	0%	0.9	low	NF = 88%
Klickitat River	100%	0%	2.4	none	TR = 54%
Stillaguamish River	65%	0%	2.4	moderate	NF = 25%
Upper Klamath L.	present	absent	2.8	none	NF = 41%

Core Area˜	**Brook Trout (% of key streams occupied)***	**Lake Trout (% of key lakes occupied)^**	**Road Density (mi/mi^2) ****	**Water Quality Key habitat on State 303(d) lists^^**	**Primary Federal or Tribal land ownership*****
Swan Lake	100%	99%	1.3	elevated	NF = 68%
Middle Fork John Day River	absent	absent	3.8	elevated	NF = 56%
North Fork John Day River	absent	absent	3	moderate	NF = 52%
Grrande Ronde R.	absent	absent	2.8	low	NF = 30%
Middle Salmon River-Panther	26%	0%	0.7	low	NF = 68%
South Fork Salmon River	51%	0%	0.5	low	NF = 92%
Upper South Fork Payette River	12%	0%	0.6	low	NF = 83%
Puyallup River	0%	0%	4.2	low	W = 24%
Quinault River	0%	0%	1.2	none	W = 49%
Granite Creek	0%	0%	0	none	W = 99%
Imnaha River	0%	0%	1.9	low	NF = 67%
Sheep Creek	0%	0%	0.5	none	W = 99%
Opal Lake	0%	0%	0	none	NF = 100%
Upper Salmon R.	51%	0%	0.5	low	NF = 53%
Chilliwack River	0%	0%	1	none	W = 60%
Nooksack River	23%	0%	2.4	low	W = 12%
Belly River	0%	0%	0.1	none	NP = 100%
Akokala Lake	0%	0%	0	none	NP = 100%
Arrow Lake	0%	0%	0	none	NP = 100%
Blackfoot River	90%	0%	1	moderate	NF = 35%
Doctor Lake	0%	0%	0	none	W = 100%
Frozen Lake	0%	0%	1.3	none	NF = 100%
Lake Pend Oreille	84%	100%	2.1	low	NF = 39%
Trout Lake	0%	0%	0.1	none	NP = 100%
Little Minam River	0%	0%	1.2	none	W = 99%
Wenatchee River	71%	0%	2.3	low	NF = 54%
Tucannon River	0%	0%	1.6	low	NF = 20%
Chester Morse L.	0%	0%	3.4	none	NF = 100%
Slide Lake	0%	0%	0	none	NP = 100%
Isabel Lakes	0%	0%	0	none	NP = 100%
Lower Deschutes River	present	absent	2.6	moderate	TR = 24%
Selway River	32%	0%	0.2	none	W = 73%

Core Area~	**Brook Trout (% of key streams occupied)***	**Lake Trout (% of key lakes occupied)^**	**Road Density (mi/mi^2) ****	**Water Quality Key habitat on State 303(d) lists^^**	**Primary Federal or Tribal land ownership*****
Middle Salmon River-Chamberlain	28%	0%	0.3	moderate	W = 65%
Lewis River	0%	0%	3.4	none	NF = 56%
Hungry Horse Res.	0%	0%	0.4	moderate	W = 61%
Upper Kintla Lake	0%	0%	0	none	NP = 100%
Snohomish & Skykomish Rivers	27%	0%	2.5	low	NF = 29%
Queets River	0%	0%	2.2	none	W = 30%
Cracker Lake	0%	0%	0	none	NP = 100%
Lake Koocanusa	69%	0%	1.9	moderate	NF = 78%
Middle Fork Salmon River	32%	0%	0.2	low	W = 77%
Lower Skagit River	29%	0%	1.5	low	W = 41%
Upper Skagit River	28%	0%	0.4	none	W = 81%

~Does not include areas of the mainstem Snake and Columbia Rivers supporting bull trout.

*Estimates based on GIS data comparing key stream recovery habitat occupied by brook trout as a percentage of total core area key recovery habitat occupied by bull trout; GIS data not available for Oregon and isolated areas of other states. In these areas only presence or absence is indicated.

^Estimates based on GIS data comparing key lake and reservoir recovery habitat occupied by lake trout as a percentage of total core area key lake and reservoir recovery habitat occupied by bull trout; GIS data not available for Oregon and isolated areas of other states. In these areas only presence or absence is indicated.

**Based on entire core area. State GIS data layers are not precisely comparable (e.g., a little used forest road may be included in one State's GIS layer and a comparable road not included in another State's GIS layer) and should be used with caution.

^^Based on proportion of key stream recovery habitat for bull trout within a core area that is 303-d listed: low = 0-25%; moderate = 26-50%; elevated = 51-75%; high = 76-100%. Some States have not completed the process of identifying water quality impaired streams.

***Only the primary Federal (or Tribal) land ownership status is indicated. NF = National Forest; W = wilderness (includes NF and NP); TR = Tribal; BLM = Bureau of Land Management; NP = National Park; NA = not applicable. See tables in Appendix D for complete land ownership by core area.

Appendix D - Table 1, "Distribution of Federal Land by Core Area" indicates a more comprehensive breakdown of Federal land allocation by core area than that presented in Table 3 (above).

Appendix D - Table 2, "Land Use by Core Area" indicates a comprehensive breakdown of land use (e.g., developed, forested, cultivated) by core area.

The Tables are fully self-explanatory and the diversity seen in these layers helps to inform certain aspects of the threats analysis. We repeat our caution against using the values in these tables as absolutes due to mismatches in the GIS layers, inconsistencies between States, and our general inability to proof all data sets. We are, however, confident that the general patterns indicated are useful and informative. We will not attempt to explain or analyze those patterns, as the complexity of that is beyond the scope of this report.

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Appendix A

CORE AREA RANK CRITERIA FOR BULL TROUT

The ranking criteria described below were used in developing state ranks for vertebrate animal species in Montana. Detailed definitions and guidance for use are provided individually for each criterion. As a precursor to the exercise, the bull trout ranking team of nine individuals stepped through the criterion and customized them according to the following format. Only minor modifications were necessary from the standard. Individual reviewers most familiar with each core area assigned a rank for each criterion. The final core area ranks were then compiled, displayed on a spreadsheet, and mapped for evaluation of outliers. A group consensus on the final rankings was achieved using the process described in Appendix A, with input and review from five-year review staff and other experts.

This methodology used for bull trout has been adapted from Montana Natural Heritage Program from a process developed and proposed by scientists at NatureServe (the international affiliate for natural heritage programs), as documented in:

Master, L. L., L. E. Morse, A. S. Weakley, G. A. Hammerson, and D. Faber-Langendoen. 2003. NatureServe Conservation Status Assessment Criteria. NatureServe, Arlington, Virginia, U.S.A.

CONSERVATION CRITERIA

Population Size

Enter the code for the estimated current naturally occurring wild total population of the species within each bull trout core area. Count or estimate ONLY the number of individuals of reproductive age (ADULTS), including mature but currently non-reproducing individuals.

Guidance, consider the following points (from IUCN 2000) when estimating population numbers:

? *In the case of populations with biased adult or breeding sex ratios it is appropriate to use lower estimates for the number of mature individuals, which take this into account (e.g., the estimated effective population size).*

? *Where the population size fluctuates use a lower estimate. In most cases this will be much less than the mean.*

Assumptions:

1) For bull trout core areas we assumed categories A-F were appropriate, based on available population data across the range and on work by Rieman and Allendorf (2001).

2) In core areas where only redd counts were available, a standard conversion of two adults per redd was used to roughly estimate adult population size.

3) Population size estimates may underestimate the resident life history component where migratory and resident life forms coexist. However, the migratory form has been the predominant life history throughout the range and is the most sensitive to disruption.

Population Size – Scoring

Select from the following values:

A = 1-50 individuals
B = 50-250 individuals
C = 250-1,000 individuals
D = 1,000-2,500 individuals
E = 2,500-10,000 individuals
F = 10,000-100,000 individuals
U = Unknown

Area of Occupancy

Area of occupancy is described by IUCN (2001) for taxa as:

> *Area of occupancy is defined as the area within its 'extent of occurrence' (see definition), which is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats. In some cases (e.g., colonial nesting sites, feeding sites for migratory taxa) the area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon. The size of the area of occupancy will be a function of the scale at which it is measured, and should be at a scale appropriate to relevant biological aspects of the taxon, the nature of threats and the available data.*

Determine the code for the estimated current area of occupancy of bull trout in the core area. For species in linear habitats (e.g., riverine shoreline), enter the code for the total length of all currently occupied habitat segments. If information on both occupied area and occupied length is available, use the one that results in the more restrictive value, but provide information on both in the comments field.

For migratory species, enter the code (area or length) that reflects the current area of occupancy (or length of occupied area) at the time of the year when occupancy is most restricted.

Assumptions:

1) For bull trout core areas we had previously conducted an exercise to identify ‘key recovery habitat”. That GIS layer includes the linear (and lake) extent of habitat that was included in the proposed (not the final) critical habitat rule. As such, we determined that this layer and the values generated were an appropriate surrogate for identifying the minimum distribution of bull trout within a core area. Those “key recovery habitat” values were used in assigning the rankings for area of occupancy.

2) Additionally, we determined that adfluvial and anadromous populations of bull trout likely have an extra security level built in by virtue of the habitat provided by the lake or ocean where part of the population resides. In case of natural disasters (e.g., fire, flood, debris flows) or manmade catastrophes (e.g., chemical spills) the stream habitat is much more susceptible to circumstances that could result in complete population annihilation than are lakes. In worst case, several age classes may be lost from an adfluvial population, but there would typically be a source for rapid recolonization provided in the lacustrine habitat. Because of that level of redundancy, we reasoned that adfluvial or anadromous populations, where the standing water continues to provide high quality cold water habitat suitable to support bull trout, should be elevated one level on the risk category beyond what the extent of occupancy would indicate. Thus, a lake population of bull trout with only 10 km of habitat would normally receive a B rank, but due to the lake presence we elevated that rank to a C. We did not apply this factor in a few cases where lakes were either a minor part of the core area or where the lake (or more typically reservoir) habitat was generally unsuitable for bull trout due to extreme drawdowns, thermal conditions, or other factors.

Area of Occupancy (Stream Length) Scoring:

Select from the following values:

A = <4 km (less than about 2.5 miles)
B = 4-40 km (about 2.5-25 miles)
C = 40-200 km (about 25-125 miles)
D = 200-1,000 km (about 125-620 miles)
E = 1,000-5,000 km (about 620-3,000 miles)
U = Unknown

Short-term Trend

Enter the code that best describes the observed, estimated, inferred, suspected, or projected short-term trend in population size and/or area of occupancy, whichever most significantly affects the rank. Consider short-term historical trend within 25 years or 5 bull trout generations (consistent with the oldest data sets and with timeframes identified in the Draft bull trout recovery plan). Place the greatest emphasis in the ranking on trend information since the time of listing (1999 or later).

The trend may be recent, current, or projected (based on recent past), and the trend may or may not be known to be continuing. Trends may be smooth, irregular or sporadic. Fluctuations will not normally count as trends, but an observed change should not be considered as merely a fluctuation rather than a trend unless there is evidence for this. Specifics known about various pertinent trends, including trend information for particular factors, more precise information, regional trends, etc. are typically described in the accompanying template for the core area. Also, comments on whether the causes of decline, if any, are understood, reversible, and/or ceased will be found in the templates. If the trend is known not to be continuing, that is specified in template comments as well.

Assumptions:

1) Trend was estimated over the whole short-term time period when data were available. For example, recent population increases or decreases were put in context with past population abundances within the time period to determine final scoring.

Short-term Trend –Scoring

Select from the following values:

A = Severely Declining. Decline of >70% in population, range, area occupied, and/or number or condition of occurrences

B = Very Rapidly Declining. Decline of 50-70% in population, range, area occupied, and/or number or condition of occurrences

C = Rapidly Declining. Decline of 30-50% in population, range, area occupied, and/or number or condition of occurrences

D = Declining. Decline of 10-30% in population, range, area occupied, and/or number or condition of occurrences

E = Stable. Population, range, area occupied, and/or number or condition of occurrences unchanged or remaining within +/-10% fluctuation

F = Increasing. Increase of >10% in population, range, area occupied, and/or number or condition of occurrences

U = Unknown. Short-term trend in population, range, area occupied, and number and condition of occurrences are unknown.

Threats (Severity, Scope, and Immediacy)

Indicate the degree to which bull trout in this core area are observed, inferred, or suspected to be directly or indirectly threatened. Use this field to evaluate the impact of extrinsic threats, which typically are anthropogenic but may be natural. The impact of human activity may be direct (e.g., destruction of habitat) or indirect (e.g., invasive species introduction). Effects of natural phenomena (e.g., fire, hurricane, flooding) may be especially important when the species is concentrated in few locations.

Threats considerations apply to the present and the future. Effects of past threats (whether or not continuing) should be addressed instead under the short-term trend factors. Threats may be observed, inferred, or projected to occur in the near term. They should be characterized in terms of severity (how badly and irreversibly the species population is affected), scope (what proportion of it is affected), and degree of imminence (how likely the threat is and when it will occur). "Magnitude" is sometimes used to refer to scope and severity collectively.

Consider threats collectively, and for the foreseeable threat(s) with the greatest magnitude (severity and scope combined), individually rate the severity, scope, and immediacy as High, Moderate, Low, Insignificant, or Unknown, as briefly defined below. The threat(s) to which severity, scope, and immediacy pertains should be identified in the draft recovery plans and/or more recent template exercise. Additional threats will also be identified in recovery plans or templates, or interactions among threats discussed, including any high-magnitude threats considered insignificant in immediacy. For each core area, categorization of severity, scope and immediacy of threats will be documented so that we may determine now and in the future how the ultimate scoring category was determined.

Severity

High: Loss of species population (all individuals) or destruction of species habitat in area affected, with effects essentially irreversible or requiring long-term recovery (>100 years).

Moderate: Major reduction of species population or long-term degradation or reduction of habitat in the core area, requiring 50-100 years for recovery.

Low: Low but nontrivial reduction of species population or reversible degradation or reduction of habitat in area affected, with recovery expected in 10-50 years.

Insignificant: Essentially no reduction of population or degradation of habitat or ecological community due to threats, or populations, habitats, able to recover quickly (within10 years) from minor temporary loss. Note that effects of locally sustainable levels of hunting, fishing, logging, collecting, or other harvest from wild populations are generally considered Insignificant as defined here.

Scope

High: > 60% of total population or area affected

Moderate: 20-60% of total population or area affected

Low: 5-20% of total population or area affected

Insignificant: < 5% of total population or area affected

Immediacy

High: Threat is operational (happening now) or imminent (within a year).

Moderate: Threat is likely to be operational within 2-5 years.

Low: Threat is likely to be operational within 5-20 years.

Insignificant: Threat not likely to be operational within 20 years.

The system will calculate a rank factor value of A, B, C, D, E, F, or G, as shown in Table 2 below. If two of the three parameters are known, the rank factor value will be calculated by treating the unknown (or not assessed [null]) parameter as "Low." If only one of the rank factors is rated (as High, Moderate, or Low), the resulting rank factor value will be "U" (unknown). If any of the three factors are considered "Insignificant," the resulting rank factor will be "H" (unthreatened)."

Threats – Scoring Threat values, calculated from scope, severity, and immediacy, or unknown, may be considered as follows.

A = Substantial, imminent threat. Threat is moderate to severe and imminent for most (> 60%) of the population or area.

B = Moderate and imminent threat. Threat is moderate to severe and imminent for a significant proportion (20-60%) of the population or area.

C = Substantial, non-imminent threat. Threat is moderate to severe but not imminent (> 10 years) for most of the population or area.

D = Moderate, non-imminent threat. Threat is moderate to severe but not imminent for a significant portion of the population or area.

E = Localized substantial threat. Threat is moderate to severe for a small but significant proportion of the population or area.

F = Widespread, low-severity threat. Threat is of low severity but affects (or would affect) most or a significant portion of the population or area.

G = Slightly threatened. Threats, while recognizable, are of low severity, or affecting only a small portion of the population or area.

H = Unthreatened. Threats if any, when considered in comparison with natural fluctuation and change, are minimal or very localized, not leading to significant loss or degradation of populations or area even over a few decades' time. (Severity, scope, and/or immediacy of threat considered Insignificant.)

U = Unknown. The available information is not sufficient to assign degree of threat as above. (Severity, scope, and immediacy are all unknown, or mostly [two of three] unknown or not assessed [null].)

Table 1. Calculation of Threats factor values from values for Severity, Scope, and Immediacy subfactors.

SEVERITY	SCOPE	IMMEDIACY	VALUE	DESCRIPTION
High High Moderate Moderate	High High High High	High Moderate High Moderate	= A	Moderate to severe, imminent threat for most (>60%) of population, occurrences, or area
High High Moderate Moderate	Moderate Moderate Moderate Moderate	High Moderate High Moderate	= B	Moderate to severe imminent threat for a significant proportion (20-60%) of population, occurrences, or area
High Moderate	High High	Low Low	= C	Moderate to severe, non-imminent threat for significant proportion of population, occurrences, or area
High Moderate	Moderate Moderate	Low Low	= D	Moderate to severe, non-imminent threat for a significant proportion of population, occurrences, or area
High High High Moderate Moderate Moderate	Low Low Low Low Low Low	High Moderate Low High Moderate Low	= E	Moderate to severe threat for small proportion of population, occurrences, or area
Low Low Low Low Low Low	High High High Moderate Moderate Moderate	High Moderate Low High Moderate Low	= F	Low severity threat for most or significant proportion of population, occurrences, or area
Low Low Low	Low Low Low	High Moderate Low	= G	Low severity threat for a small proportion of population, occurrences, or area

Intrinsic Vulnerability

Enter the appropriate letter code for the observed, inferred, or suspected degree to which intrinsic or inherent factors of the species (such as life history or behavior characteristics of species) make bull trout vulnerable or resilient to natural or anthropogenic stresses or catastrophes. Examples of such factors include reproductive rates and requirements, time to maturity, dormancy requirements, and dispersal patterns.

Since geographically or ecologically disjunct or peripheral populations may show additional vulnerabilities not generally characteristic of the species, these factors are to be assessed for the species throughout the area of interest, or at least for its better populations. Do not consider here such topics as population size, number of occurrences, area of occupancy, extent of occurrence, or environmental specificity; these are addressed as other ranking factors.

Note that the intrinsic vulnerability factors exist independent of human influence, but may make the species more susceptible to disturbance by human activities. The extent and effects of current or projected extrinsic influences themselves should be addressed in the Threat comments field.

Assumptions: The reasons for our selection of the Intrinsic Vulnerability Factor for bull trout are well described in the Draft recovery plan, Chapter 1. Although some aspects of bull trout biology would support an A ranking, we have determined that the rangewide ranking of bull trout under the category of intrinsic vulnerability is B = Moderately Vulnerable. This B ranking is due mainly to the relatively high potential reproductive rate and fecundity. Admittedly, rates of recolonization and reestablishment of bull trout are speculative, given the infrequency with which they have been documented to occur.

For comparative purposes, here are the categories from which we selected:

A = Highly Vulnerable. Species is slow to mature, reproduces infrequently, and/or has low fecundity such that populations are very slow (> 20 years or 5 generations) to recover from decreases in abundance; or species has low dispersal capability such that extirpated populations are unlikely to become reestablished through natural recolonization (unaided by humans).

B = Moderately Vulnerable. Species exhibits moderate age of maturity, frequency of reproduction, and/or fecundity such that populations generally tend to recover from decreases in abundance over a period of several years (on the order of 5-20 years or 2-5 generations); or species has moderate dispersal capability such that extirpated populations generally become reestablished through natural recolonization (unaided by humans).

C = Not Intrinsically Vulnerable. Species matures quickly, reproduces frequently, and/or has high fecundity such that populations recover quickly « 5 years or 2 generations) from decreases in abundance; or species has high dispersal capability such that extirpated populations soon become reestablished through natural recolonization (unaided by humans).

Environmental Specificity
Enter the appropriate letter code for the observed, inferred, or suspected vulnerability or resilience of bull trout due to habitat preferences or restrictions or other environmental specificity or generality. The reasons for the selection in the Environmental Specificity field are well documented in the Draft recovery plan and templates. This factor is most important when the number of populations and the range extent or area of occupancy is largely unknown.

Assumptions: The reasons for our selection of the Environmental Specificity Factor for bull trout are well-described in the Draft recovery plan, Chapter 1. Although some aspects of bull trout biology would again support an A ranking, we have determined that the rangewide ranking of bull trout under the category of Environmental Specificity is B = Narrow. This B ranking is due mainly to the widespread historical range of the species, and the generally common occurrence of many bull trout habitat parameters within the remaining distribution.

For comparative purposes, here are the categories from which we selected:

A = Very Narrow. Specialist. Specific habitat(s), substrate(s), food type(s), hosts, breeding/non breeding microhabitats, or other abiotic and/or biotic factor(s) are used or required by the Element in the area of interest, with these habitat(s) and/or other requirements furthermore being scarce within the generalized range of the species within the area of interest, and, the population (or the number of breeding attempts) expected to decline significantly if any of these key requirements become unavailable.

B = Narrow. Specialist. Specific habitat(s) or other abiotic and/or biotic factors (see above) are used or required by the Element, but these key requirements are common and within the generalized range of the species within the area of interest.

C = Moderate. Generalist. Broad-scale or diverse (general) habitat(s) or other abiotic and/or biotic factors are used or required by the species but some key requirements are scarce in the generalized range of the species within the area of interest.

D = Broad. Generalist. Broad-scale or diverse (general) habitat(s) or abiotic and/or biotic factors are used or required by the species, with all key requirements common in the generalized range of the species in the area of interest. If the preferred food(s) or breeding/nonbreeding microhabitat(s) become unavailable, the species switches to an alternative with no resulting decline in numbers of individuals or number of breeding attempts.

CONSERVATION STATUS FOR SPECIES:
A RULE- AND POINT -BASED PROCESS FOR RANK ASSIGNMENT

Adopted for bull trout from Montana Natural Heritage Program - 2004

A Quantitative approximation to assigning Heritage Ranks

The method for determining a C rank is a hybrid of rule based approaches and point scoring techniques. The method incorporates unknown data. To determine a C rank, we first determined what information was available for each core area. Using the following rationale, along with the Status Assessment Factors presented in this document and the method for point allocation for each of the factors presented below, we determined the classification.

? *Population size.* If the number of mature individuals is small, it may be appropriate to raise the priority by one-half rank or more. If there are many mature individuals, the priority may be lowered. [A = -l, B = -0.75, C = -0.5, D and E = -0.25, F = 0, U = 0]

? *Geographic distribution.* If the area of occupancy within the core area is relatively small, it is more vulnerable to negative effects from localized events. It may be appropriate to raise priority by one-quarter rank or more for narrow distribution and lower it by one-quarter to one-half rank for widespread distribution. Lower the score one rank if the population is adfluvial or anadromous and lentic habitat is sufficiently supportive. [A = -l, B = -0.75, C = -0.5, D = -.25, E = 0, U = 0]

? *Environmental specificity.* If a species requires highly specific habitat(s) or other abiotic or biotic factor(s), and if the number of populations and distribution is unknown, the rank may be raised or lowered. [A = -0.5, B and C = 0, D = +0.5, U = 0].

? *Short-term trends in population size, area of occupancy, extent of occurrence, or number or condition of occurrences.* A significant short term and non-cyclic negative trend may be reason to raise priority by one-quarter rank or more, or a significant positive trend may indicate that priority should be lowered by one-half rank. [A = -l, B = -0.75, C = -0.5, D = -0.25, E = 0, F = +0.25, U = O] In the absence of short-term trend data, the rank may be raised or lowered for *long-term trends.* [A = -0.5, B = -0.25, C and D and E = 0, F = +0.25, U = 0]

? *Threats.* Threats include habitat destruction or degradation, introduction of exotic species, overexploitation and direct human-caused mortality, and elimination of natural disturbance regimes, such as fire or flooding. Depending on the severity, scope, and immediacy of threats, the priority may be raised or lowered by one-half to one rank. [A = -l, B = -0.75, C = - 0.5, D = -0.25, E and F = 0, G = +0.75, H = + 1.0, U=O]

? *Intrinsic vulnerability*. If a species is intrinsically vulnerable because it is slow to mature, reproduces infrequently, and/or has low fecundity such that populations are very slow to recover from decreases in abundance, or if a species has low dispersal capability such that extirpated populations are unlikely to become reestablished through natural colonization, it may be appropriate to raise its priority. [A = -0.5, B = -0.25, C and U =0]

***Step* 1**: Determine the available data for the species. The following subheadings are indicative *of* the types *of* data useful for classification (Refer to Heritage Conservation Status Assessment Factors for definitions *of* the following factors as noted in this document.

Assumption: For bull trout core areas, in most cases, all categories were well represented in Draft bull trout recovery plan, templates, or both.

Population size
Geographic Distribution (Extent *of* Occurrence [EOO] or Area *of* Occupancy [AOO])
Environmental Specificity
Trends (short-term and long-term trends)
Threats (scope, severity, immediacy)
Management / Protection
Intrinsic Vulnerability

Step2*:* Determine which *of* the following combinations *of* the first five data requirements suits the available data (only choose one combination and the first to apply).

Assumption: For bull trout core areas the first category applies.

Pop size + Geographic Distribution (greatest value from EOO or *AOO)*
Pop size + Environmental Specificity
Population size
Geographic Distribution (EOO only; *AOO* unknown) and Environmental Specificity
Geographic Distribution (greatest value from EOO or *AOO)*
Environmental Specificity

***Step* 3**: Start point allocation at 3.5. Using the point allocation document below, determine a value for the combination you choose and add or subtract if appropriate. If all six factors are unknown: points = 3.5

***Step* 4**: Once a value has been determined for the first five data requirements, incorporate remaining data.

P = points (total from step 3) + trends (short term trend otherwise use Long term trend) + threats

The following Ranks correspond to the final point total.

Points (P)	C RANK
$P \leq 1.5$	C1
$1.5 < P \leq 2.5$	C2
$2.5 < P \leq 3.5$	C3
$3.5 < P \leq 4.5$	C4

FINAL BULL TROUT RANKING CATEGORIES

The following narrative descriptions are provided for each of the final bull trout ranking categories:

C1 – HIGH RISK - Core area at high risk because of extremely limited and/or rapidly declining numbers, range, and/or habitat, making the bull trout in this core area highly vulnerable to extirpation. (Map Color – Red)

C2 – AT RISK -Core area at risk because of very limited and/or declining numbers, range, and/or habitat, making the bull trout in this core area vulnerable to extirpation. (Map Color – Orange)

C3 – POTENTIAL RISK - Core area potentially at risk because of limited and/or declining numbers, range, and/or habitat even though bull trout may be locally abundant in some portions of the core area. (Map Color – Yellow)

C4 – LOW RISK - Bull trout common or uncommon, but not rare, and usually widespread through the core area. Apparently not vulnerable at this time, but may be cause for long-term concern. (Map Color – Green)

CU – UNRANKED - Core area currently unranked due to lack of information or due to substantially conflicting information about status and trends. (Map Color – Blue)

CX – EXTIRPATED - Core population extirpated; not a viable core area. (Map Color – Black)

Appendix B - Bull Trout Core Area Ranking Results

Table 1. Alphabetic scores assigned in each category by core area.

CORE AREA ALPHABETIC SCORING (FINAL - 3/1/05)									
Core Area	**Environmental Specificity**	**Intrinsic Vulnerability**	**Population Size**	**Distribution**	**Trend**	**Threats**	**Severity**	**Scope**	**Immediacy**
Sycan River	B	B	B	C	A	B	M	M	H
Upper Klamath Lake	B	B	B	D	F	D	M	H	M
Upper Sprague River	B	B	D	C	U	B	H	H	H
Akokala Lake	B	B	B	B	U	H	I	I	I
Arrow Lake	B	B	B	C	U	G	L	L	L
Big Salmon Lake	B	B	C	C	D	F	L	M	H
Bitterroot River	B	B	C	D	U	A	M	H	H
Blackfoot River	B	B	C	D	F	E	M	L	H
Bowman Lake	B	B	A	B	B	A	H	H	H
Cabinet Gorge Reservoir	B	B	B	C	E	B	M	M	H
Quartz Lake(s)	B	B	C	C	E	C	M	H	L
Clark Fork River (Section 1)	B	B	B	D	U	A	H	H	H
Clark Fork River (Section 2)	B	B	B	D	U	B	M	M	H
Clark Fork River (Section 3)	B	B	B	C	U	B	M	M	H
Clearwater River & Lakes	B	B	C	D	D	B	M	M	H
Cyclone Lake	B	B	A	B	B	D	M	M	L
Doctor Lake	B	B	B	C	U	G	L	L	L

CORE AREA ALPHABETIC SCORING (FINAL - 3/1/05)									
Core Area	Environmental Specificity	Intrinsic Vulnerability	Population Size	Distribution	Trend	Threats	Severity	Scope	Immediacy
Flathead Lake	B	B	D	E	D	A	M	H	H
Frozen Lake	B	B	B	C	U	G	L	L	L
Harrison Lake	B	B	A	D	U	B	M	M	H
Holland Lake	B	B	B	B	C	C	H	H	L
Hungry Horse Reservoir	B	B	E	E	F	F	L	M	L
Isabel Lakes	B	B	C	B	U	H	I	I	I
Kintla Lake	B	B	A	B	A	A	H	H	H
Lake McDonald	B	B	A	B	A	A	H	H	H
Lake Pend Oreille	B	B	E	E	E	D	M	M	L
Lincoln Lake	B	B	B	B	U	B	M	M	M
Lindbergh Lake	B	B	B	C	U	C	H	H	L
Logging Lake	B	B	B	B	A	A	M	H	M
Lower Flathead River	B	B	B	C	U	B	M	M	H
Lower Quartz Lake	B	B	B	B	U	A	M	H	H
Noxon Rapids Reservoir	B	B	B	C	U	B	M	M	H
Priest Lakes	B	B	B	C	C	A	H	H	H
Rock Creek	B	B	C	D	D	D	M	M	L
Swan Lake	B	B	D	E	E	B	M	M	H
Trout Lake	B	B	C	B	U	G	L	L	L
Upper Kintla Lake	B	B	C	C	U	H	I	I	I
Upper Stillwater Lake	B	B	B	C	U	A	M	H	H
Upper Whitefish Lake	B	B	A	C	U	A	H	H	M

CORE AREA ALPHABETIC SCORING (FINAL - 3/1/05)									
Core Area	**Environmental Specificity**	**Intrinsic Vulnerability**	**Population Size**	**Distribution**	**Trend**	**Threats**	**Severity**	**Scope**	**Immediacy**
West Fork Bitterroot River	B	B	B	C	U	D	M	M	L
Whitefish Lake	B	B	A	C	U	A	H	H	H
Bull Lake	B	B	C	C	E	D	M	M	L
Kootenai River	B	B	C	D	E	B	M	M	M
Lake Koocanusa	B	B	F	E	F	F	L	M	L
Sophie Lake	B	B	A	B	U	A	H	H	H
Upper Willamette River	B	B	B	D	E	A	H	H	H
Hood River	B	B	B	C	U	B	M	M	M
Lower Deschutes River	B	B	D	D	F	E	M	L	H
Odell Lake	B	B	A	B	U	A	H	H	H
Middle Fork John Day River	B	B	U	D	F	A	H	H	M
North Fork John Day River	B	B	U	D	F	A	M	H	M
Upper Mainstem John Day River	B	B	A	D	F	D	M	M	L
Touchet River	B	B	B	C	E	B	M	M	M
Umatilla River	B	B	B	D	U	B	M	M	M
Walla Walla River	B	B	D	C	E	B	H	M	M
Grande Ronde River	B	B	B	D	E	F	L	M	M
Little Minam River	B	B	C	B	E	G	L	L	L
Granite Creek	B	B	U	B	U	U	U	U	U
Imnaha River	B	B	C	D	E	F	L	M	L

CORE AREA ALPHABETIC SCORING (FINAL - 3/1/05)									
Core Area	**Environmental Specificity**	**Intrinsic Vulnerability**	**Population Size**	**Distribution**	**Trend**	**Threats**	**Severity**	**Scope**	**Immediacy**
Sheep Creek	B	B	U	B	U	U	U	U	U
Pine, Indian & Wildhorse Creeks	B	B	C	D	B	A	H	H	H
Powder River	B	B	C	D	B	A	H	H	H
Malheur River	B	B	B	D	D	A	H	H	H
Coeur d'Alene Lake	B	B	B	D	E	A	M	H	H
Fish Lake (Lochsa River)	B	B	A	B	U	F	L	H	L
Fish Lake (No. Fork Clearwater River)	B	B	A	D	D	B	H	M	H
Lochsa River	B	B	B	D	E	B	M	M	H
Middle-Lower Clearwater River	B	B	U	D	U	A	M	H	H
North Fork Clearwater River	B	B	C	D	D	B	M	M	M
Selway River	B	B	U	D	U	F	L	M	L
South Fork Clearwater River	B	B	D	D	U	A	M	H	H
Lake Creek	B	B	B	C	U	F	U	H	L
Lemhi River	B	B	C	D	U	A	M	H	H
Little-Lower Salmon River	B	B	B	D	U	A	M	H	H
Middle Fork Salmon River	B	B	D	E	U	G	L	L	L
Middle Salmon River-Chamberlain	B	B	U	D	U	F	L	M	M

CORE AREA ALPHABETIC SCORING (FINAL - 3/1/05)									
Core Area	**Environmental Specificity**	**Intrinsic Vulnerability**	**Population Size**	**Distribution**	**Trend**	**Threats**	**Severity**	**Scope**	**Immediacy**
Middle Salmon River-Panther	B	B	U	D	U	B	M	M	H
Opal Lake	B	B	U	B	U	F	L	H	L
Pahsimeroi River	B	B	U	D	U	A	H	H	H
South Fork Salmon River	B	B	U	D	U	B	M	M	H
Upper Salmon River	B	B	U	E	U	B	M	M	H
Anderson Ranch Reservoir	B	B	C	D	U	A	M	H	H
Arrowrock Reservoir	B	B	U	D	D	B	M	M	H
Deadwood River	B	B	C	C	U	A	M	H	H
Lucky Peak Reservoir	B	B	A	C	U	A	H	H	H
Middle Fork Payette River	B	B	U	C	U	A	M	H	H
North Fork Payette River	B	B	A	B	B	A	H	H	H
Squaw Creek	B	B	C	C	U	A	H	H	H
Upper South Fork Payette River	B	B	U	D	U	B	M	M	H
Weiser River	B	B	U	C	C	A	H	H	H
Little Lost River	B	B	U	C	U	A	M	H	H
Klickitat River	B	B	U	C	U	B	M	M	H
Lewis River	B	B	D	D	F	F	L	M	M
Yakima River	B	B	C	D	B	A	H	H	H
Entiat River	B	B	B	D	E	B	M	M	H

CORE AREA ALPHABETIC SCORING (FINAL - 3/1/05)									
Core Area	**Environmental Specificity**	**Intrinsic Vulnerability**	**Population Size**	**Distribution**	**Trend**	**Threats**	**Severity**	**Scope**	**Immediacy**
Methow River	B	B	B	D	D	B	M	M	H
Wenatchee River	B	B	C	E	E	F	L	M	H
Pend Oreille River	B	B	A	C	U	A	H	H	H
Asotin Creek	B	B	B	C	U	A	M	H	H
Tucannon River	B	B	D	D	E	F	L	M	M
Jarbidge River	B	B	B	D	U	A	H	H	H
Chester Morse Lake	B	B	D	C	F	F	L	H	L
Chilliwack River	B	B	D	C	U	F	L	M	H
Lower Skagit River	B	B	E	E	F	G	L	L	H
Nooksack River	B	B	U	E	U	B	M	M	H
Puyallup River	B	B	U	E	U	A	M	H	H
Snohomish & Skykomish Rivers	B	B	D	E	F	F	L	M	H
Stillaguamish River	B	B	C	E	U	B	M	M	H
Upper Skagit River	B	B	U	E	U	G	L	I	H
Dungeness River	B	B	B	C	U	A	M	H	H
Elwha River	B	B	U	C	U	A	H	H	H
Hoh River	B	B	C	D	F	A	H	H	H
Queets River	B	B	U	E	U	F	L	H	H
Quinault River	B	B	U	D	U	B	M	M	H
Skokomish River	B	B	B	D	C	A	M	H	H
Belly River	B	B	C	C	F	F	L	M	L
Cracker Lake	B	B	C	C	U	H	I	I	I
Lee Creek	B	B	B	B	U	A	M	H	M
Red Eagle Lake	B	B	B	B	U	F	L	H	L
Saint Mary River	B	B	C	C	E	B	M	M	M
Slide Lake	B	B	B	B	U	H	I	I	I

Appendix B - Bull Trout Core Area Ranking Results

Table 2. Numeric scores assigned in each category by core area.

CORE AREA NUMERIC SCORING (FINAL - 3/1/05)

Core Area	Environmental Specificity	Intrinsic Vulnerability	Population Size	Distribution	Trend	Threats	SUM 4	C RANK
Sycan River	0	-0.25	-0.75	-0.5	-1	-0.75	-3	1
Upper Klamath Lake	0	-0.25	-0.75	-0.25	0.25	-0.25	-1	2
Upper Sprague River	0	-0.25	-0.25	-0.5	0	-0.75	-1.5	2
Akokala Lake	0	-0.25	-0.75	-0.75	0	1	-0.5	3
Arrow Lake	0	-0.25	-0.75	-0.5	0	0.75	-0.5	3
Big Salmon Lake	0	-0.25	-0.5	-0.5	-0.25	0	-1.25	2
Bitterroot River	0	-0.25	-0.5	-0.25	0	-1	-1.75	2
Blackfoot River	0	-0.25	-0.5	-0.25	0.25	0	-0.5	3
Bowman Lake	0	-0.25	-1	-0.75	-0.75	-1	-3.5	1
Cabinet Gorge Reservoir	0	-0.25	-0.75	-0.5	0	-0.75	-2	1
Quartz Lake(s)	0	-0.25	-0.5	-0.5	0	-0.5	-1.5	2
Clark Fork River (Section 1)	0	-0.25	-0.75	-0.25	0	-1	-2	1
Clark Fork River (Section 2)	0	-0.25	-0.75	-0.25	0	-0.75	-1.75	2
Clark Fork River (Section 3)	0	-0.25	-0.75	-0.5	0	-0.75	-2	1
Clearwater River & Lakes	0	-0.25	-0.5	-0.25	-0.25	-0.75	-1.75	2
Cyclone Lake	0	-0.25	-1	-0.75	-0.75	-0.25	-2.75	1
Doctor Lake	0	-0.25	-0.75	-0.5	0	0.75	-0.5	3
Flathead Lake	0	-0.25	-0.25	0	-0.25	-1	-1.5	2
Frozen Lake	0	-0.25	-0.75	-0.5	0	0.75	-0.5	3
Harrison Lake	0	-0.25	-1	-0.25	0	-0.75	-2	1
Holland Lake	0	-0.25	-0.75	-0.75	-0.5	-0.5	-2.5	1
Hungry Horse Reservoir	0	-0.25	-0.25	0	0.25	0	0	3
Isabel Lakes	0	-0.25	-0.5	-0.75	0	1	-0.25	3
Kintla Lake	0	-0.25	-1	-0.75	-1	-1	-3.75	1
Lake McDonald	0	-0.25	-1	-0.75	-1	-1	-3.75	1
Lake Pend Oreille	0	-0.25	-0.25	0	0	-0.25	-0.5	3
Lincoln Lake	0	-0.25	-0.75	-0.75	0	-0.75	-2.25	1

CORE AREA NUMERIC SCORING (FINAL - 3/1/05)

Core Area	Environmental Specificity	Intrinsic Vulnerability	Population Size	Distribution	Trend	Threats	SUM 4	C RANK
Lindbergh Lake	0	-0.25	-0.75	-0.5	0	-0.5	-1.75	2
Logging Lake	0	-0.25	-0.75	-0.75	-1	-1	-3.5	1
Lower Flathead River	0	-0.25	-0.75	-0.5	0	-0.75	-2	1
Lower Quartz Lake	0	-0.25	-0.75	-0.75	0	-1	-2.5	1
Noxon Rapids Reservoir	0	-0.25	-0.75	-0.5	0	-0.75	-2	1
Priest Lakes	0	-0.25	-0.75	-0.5	-0.5	-1	-2.75	1
Rock Creek	0	-0.25	-0.5	-0.25	-0.25	-0.25	-1.25	2
Swan Lake	0	-0.25	-0.25	0	0	-0.75	-1	2
Trout Lake	0	-0.25	-0.5	-0.75	0	0.75	-0.5	3
Upper Kintla Lake	0	-0.25	-0.5	-0.5	0	1	0	3
Upper Stillwater Lake	0	-0.25	-0.75	-0.5	0	-1	-2.25	1
Upper Whitefish Lake	0	-0.25	-1	-0.5	0	-1	-2.5	1
West Fork Bitterroot River	0	-0.25	-0.75	-0.5	0	-0.25	-1.5	2
Whitefish Lake	0	-0.25	-1	-0.5	0	-1	-2.5	1
Bull Lake	0	-0.25	-0.5	-0.5	0	-0.25	-1.25	2
Kootenai River	0	-0.25	-0.5	-0.25	0	-0.75	-1.5	2
Lake Koocanusa	0	-0.25	0	0	0.25	0	0.25	4
Sophie Lake	0	-0.25	-1	-0.75	0	-1	-2.75	1
Upper Willamette River	0	-0.25	-0.75	-0.25	0	-1	-2	1
Hood River	0	-0.25	-0.75	-0.5	0	-0.75	-2	1
Lower Deschutes River	0	-0.25	-0.25	-0.25	0.25	0	-0.25	3
Odell Lake	0	-0.25	-1	-0.75	0	-1	-2.75	1
Middle Fork John Day River	0	-0.25	0	-0.25	0.25	-1	-1	2
North Fork John Day River	0	-0.25	0	-0.25	0.25	-1	-1	2
Upper Mainstem John Day River	0	-0.25	-1	-0.25	0.25	-0.25	-1.25	2
Touchet River	0	-0.25	-0.75	-0.5	0	-0.75	-2	1
Umatilla River	0	-0.25	-0.75	-0.25	0	-0.75	-1.75	2
Walla Walla River	0	-0.25	-0.25	-0.5	0	-0.75	-1.5	2
Grande Ronde River	0	-0.25	-0.75	-0.25	0	0	-1	2
Little Minam River	0	-0.25	-0.5	-0.75	0	0.75	-0.5	3
Granite Creek	0	-0.25	0	-0.75	0	0	-0.75	U
Imnaha River	0	-0.25	-0.5	-0.25	0	0	-0.75	3

CORE AREA NUMERIC SCORING (FINAL - 3/1/05)

Core Area	Environmental Specificity	Intrinsic Vulnerability	Population Size	Distribution	Trend	Threats	SUM 4	C RANK
Sheep Creek	0	-0.25	0	-0.75	0	0	-0.75	U
Pine, Indian & Wildhorse Creeks	0	-0.25	-0.5	-0.25	-0.75	-1	-2.5	1
Powder River	0	-0.25	-0.5	-0.25	-0.75	-1	-2.5	1
Malheur River	0	-0.25	-0.75	-0.25	-0.25	-1	-2.25	1
Coeur d'Alene Lake	0	-0.25	-0.75	-0.25	0	-1	-2	1
Fish Lake (Lochsa River)	0	-0.25	-1	-0.75	0	0	-1.75	2
Fish Lake (No. Fork Clearwater River)	0	-0.25	-1	-0.25	-0.25	-0.75	-2.25	1
Lochsa River	0	-0.25	-0.75	-0.25	0	-0.75	-1.75	2
Middle-Lower Clearwater River	0	-0.25	0	-0.25	0	-1	-1.25	2
North Fork Clearwater River	0	-0.25	-0.5	-0.25	-0.25	-0.75	-1.75	2
Selway River	0	-0.25	0	-0.25	0	0	-0.25	3
South Fork Clearwater River	0	-0.25	-0.25	-0.25	0	-1	-1.5	2
Lake Creek	0	-0.25	-0.75	-0.5	0	0	-1.25	2
Lemhi River	0	-0.25	-0.5	-0.25	0	-1	-1.75	2
Little-Lower Salmon River	0	-0.25	-0.75	-0.25	0	-1	-2	1
Middle Fork Salmon River	0	-0.25	-0.25	0	0	0.75	0.5	4
Middle Salmon River-Chamberlain	0	-0.25	0	-0.25	0	0	-0.25	3
Middle Salmon River-Panther	0	-0.25	0	-0.25	0	-0.75	-1	2
Opal Lake	0	-0.25	0	-0.75	0	0	-0.75	3
Pahsimeroi River	0	-0.25	0	-0.25	0	-1	-1.25	2
South Fork Salmon River	0	-0.25	0	-0.25	0	-0.75	-1	2
Upper Salmon River	0	-0.25	0	0	0	-0.75	-0.75	3
Anderson Ranch Reservoir	0	-0.25	-0.5	-0.25	0	-1	-1.75	2
Arrowrock Reservoir	0	-0.25	0	-0.25	-0.25	-0.75	-1.25	2
Deadwood River	0	-0.25	-0.5	-0.5	0	-1	-2	1
Lucky Peak Reservoir	0	-0.25	-1	-0.5	0	-1	-2.5	1

CORE AREA NUMERIC SCORING (FINAL - 3/1/05)

Core Area	Environmental Specificity	Intrinsic Vulnerability	Population Size	Distribution	Trend	Threats	SUM 4	C RANK
Middle Fork Payette River	0	-0.25	0	-0.5	0	-1	-1.5	2
North Fork Payette River	0	-0.25	-1	-0.75	-0.75	-1	-3.5	1
Squaw Creek	0	-0.25	-0.5	-0.5	0	-1	-2	1
Upper South Fork Payette River	0	-0.25	0	-0.25	0	-0.75	-1	2
Weiser River	0	-0.25	0	-1	-0.5	-1	-2.5	1
Little Lost River	0	-0.25	0	-0.5	0	-1	-1.5	2
Klickitat River	0	-0.25	0	-0.5	0	-0.75	-1.25	2
Lewis River	0	-0.25	-0.25	-0.25	0.25	0	-0.25	3
Yakima River	0	-0.25	-0.5	-0.25	-0.75	-1	-2.5	1
Entiat River	0	-0.25	-0.75	-0.25	0	-0.75	-1.75	2
Methow River	0	-0.25	-0.75	-0.25	-0.25	-0.75	-2	1
Wenatchee River	0	-0.25	-0.5	0	0	0	-0.5	3
Pend Oreille River	0	-0.25	-1	-0.5	0	-1	-2.5	1
Asotin Creek	0	-0.25	-0.75	-0.5	0	-1	-2.25	1
Tucannon River	0	-0.25	-0.25	-0.25	0	0	-0.5	3
Jarbidge River	0	-0.25	-0.75	-0.25	0	-1	-2	1
Chester Morse Lake	0	-0.25	-0.25	-0.5	0.25	0	-0.5	3
Chilliwack River	0	-0.25	-0.25	-0.5	0	0	-0.75	3
Lower Skagit River	0	-0.25	-0.25	0	0.25	0.75	0.75	4
Nooksack River	0	-0.25	0	0	0	-0.75	-0.75	3
Puyallup River	0	-0.25	0	0	0	-1	-1	2
Snohomish & Skykomish Rivers	0	-0.25	-0.25	0	0.25	0	0	3
Stillaguamish River	0	-0.25	-0.5	0	0	-0.75	-1.25	2
Upper Skagit River	0	-0.25	0	0	0	0.75	0.75	4
Dungeness River	0	-0.25	-0.75	-0.5	0	-1	-2.25	1
Elwha River	0	-0.25	0	-0.5	0	-1	-1.5	2
Hoh River	0	-0.25	-0.5	-0.25	0.25	-1	-1.5	2
Queets River	0	-0.25	0	0	0	0	0	3
Quinault River	0	-0.25	0	-0.25	0	-0.75	-1	2
Skokomish River	0	-0.25	-0.75	-0.25	-0.5	-1	-2.5	1
Belly River	0	-0.25	-0.5	-0.5	0.25	0	-0.75	3
Cracker Lake	0	-0.25	-0.5	-0.5	0	1	0	3
Lee Creek	0	-0.25	-0.75	-0.75	0	-1	-2.5	1
Red Eagle Lake	0	-0.25	-0.75	-0.75	0	0	-1.5	2
Saint Mary River	0	-0.25	-0.5	-0.5	0	-0.75	-1.75	2
Slide Lake	0	-0.25	-0.75	-0.75	0	1	-0.5	3

Appendix B - Bull Trout Core Area Ranking Results

Table 3. Final core area C-Ranking, sorted by point value (P).

CORE AREA RANKINGS (FINAL - 3/1/05)								
Core Area	**Population Size**	**Distribution**	**Trend**	**Threats**	**SUM**		**C-RANK**	**P**
Kintla Lake	-1	-0.75	-1	-1	-3.75		1	-0.25
Lake McDonald	-1	-0.75	-1	-1	-3.75		1	-0.25
Bowman Lake	-1	-0.75	-0.75	-1	-3.5		1	0
Logging Lake	-0.75	-0.75	-1	-1	-3.5		1	0
North Fork Payette River	-1	-0.75	-0.75	-1	-3.5		1	0
Sycan River	-0.75	-0.5	-1	-0.75	-3		1	0.5
Cyclone Lake	-1	-0.75	-0.75	-0.25	-2.75		1	0.75
Priest Lakes	-0.75	-0.5	-0.5	-1	-2.75		1	0.75
Sophie Lake	-1	-0.75	0	-1	-2.75		1	0.75
Odell Lake	-1	-0.75	0	-1	-2.75		1	0.75
Holland Lake	-0.75	-0.75	-0.5	-0.5	-2.5		1	1
Lower Quartz Lake	-0.75	-0.75	0	-1	-2.5		1	1
Upper Whitefish Lake	-1	-0.5	0	-1	-2.5		1	1
Whitefish Lake	-1	-0.5	0	-1	-2.5		1	1
Pine, Indian & Wildhorse Creeks	-0.5	-0.25	-0.75	-1	-2.5		1	1
Powder River	-0.5	-0.25	-0.75	-1	-2.5		1	1
Lucky Peak Reservoir	-1	-0.5	0	-1	-2.5		1	1
Weiser River	0	-1	-0.5	-1	-2.5		1	1
Yakima River	-0.5	-0.25	-0.75	-1	-2.5		1	1
Pend Oreille River	-1	-0.5	0	-1	-2.5		1	1
Skokomish River	-0.75	-0.25	-0.5	-1	-2.5		1	1
Lee Creek	-0.75	-0.75	0	-1	-2.5		1	1
Lincoln Lake	-0.75	-0.75	0	-0.75	-2.25		1	1.25
Upper Stillwater Lake	-0.75	-0.5	0	-1	-2.25		1	1.25
Malheur River	-0.75	-0.25	-0.25	-1	-2.25		1	1.25
Fish Lake (No. Fork Clearwater River)	-1	-0.25	-0.25	-0.75	-2.25		1	1.25
Asotin Creek	-0.75	-0.5	0	-1	-2.25		1	1.25
Dungeness River	-0.75	-0.5	0	-1	-2.25		1	1.25
Upper Willamette River	-0.75	-0.25	0	-1	-2		1	1.5
Cabinet Gorge Reservoir	-0.75	-0.5	0	-0.75	-2		1	1.5
Clark Fork River (Section 1)	-0.75	-0.25	0	-1	-2		1	1.5
Clark Fork River (Section 3)	-0.75	-0.5	0	-0.75	-2		1	1.5
Harrison Lake	-1	-0.25	0	-0.75	-2		1	1.5
Lower Flathead River	-0.75	-0.5	0	-0.75	-2		1	1.5
Noxon Rapids Reservoir	-0.75	-0.5	0	-0.75	-2		1	1.5
Hood River	-0.75	-0.5	0	-0.75	-2		1	1.5
Touchet River	-0.75	-0.5	0	-0.75	-2		1	1.5

CORE AREA RANKINGS (FINAL - 3/1/05)								
Core Area	**Population Size**	**Distribution**	**Trend**	**Threats**	**SUM**		**C-RANK**	**P**
Little-Lower Salmon River	-0.75	-0.25	0	-1	-2		1	1.5
Deadwood River	-0.5	-0.5	0	-1	-2		1	1.5
Jarbidge River	-0.75	-0.25	0	-1	-2		1	1.5
Methow River	-0.75	-0.25	-0.25	-0.75	-2		1	1.5
Coeur d'Alene Lake	-0.75	-0.25	0	-1	-2		1	1.5
Squaw Creek	-0.5	-0.5	0	-1	-2		1	1.5
Bitterroot River	-0.5	-0.25	0	-1	-1.75		2	1.75
Clark Fork River (Section 2)	-0.75	-0.25	0	-0.75	-1.75		2	1.75
Clearwater River & Lakes	-0.5	-0.25	-0.25	-0.75	-1.75		2	1.75
Lindbergh Lake	-0.75	-0.5	0	-0.5	-1.75		2	1.75
Umatilla River	-0.75	-0.25	0	-0.75	-1.75		2	1.75
Fish Lake (Lochsa River)	-1	-0.75	0	0	-1.75		2	1.75
Lochsa River	-0.75	-0.25	0	-0.75	-1.75		2	1.75
North Fork Clearwater River	-0.5	-0.25	-0.25	-0.75	-1.75		2	1.75
Lemhi River	-0.5	-0.25	0	-1	-1.75		2	1.75
Anderson Ranch Reservoir	-0.5	-0.25	0	-1	-1.75		2	1.75
Entiat River	-0.75	-0.25	0	-0.75	-1.75		2	1.75
Saint Mary River	-0.5	-0.5	0	-0.75	-1.75		2	1.75
Flathead Lake	-0.25	0	-0.25	-1	-1.5		2	2
Upper Sprague River	-0.25	-0.5	0	-0.75	-1.5		2	2
Quartz Lake(s)	-0.5	-0.5	0	-0.5	-1.5		2	2
West Fork Bitterroot River	-0.75	-0.5	0	-0.25	-1.5		2	2
Kootenai River	-0.5	-0.25	0	-0.75	-1.5		2	2
Walla Walla River	-0.25	-0.5	0	-0.75	-1.5		2	2
South Fork Clearwater River	-0.25	-0.25	0	-1	-1.5		2	2
Middle Fork Payette River	0	-0.5	0	-1	-1.5		2	2
Little Lost River	0	-0.5	0	-1	-1.5		2	2
Elwha River	0	-0.5	0	-1	-1.5		2	2
Hoh River	-0.5	-0.25	0.25	-1	-1.5		2	2
Red Eagle Lake	-0.75	-0.75	0	0	-1.5		2	2
Stillaguamish River	-0.5	0	0	-0.75	-1.25		2	2.25
Big Salmon Lake	-0.5	-0.5	-0.25	0	-1.25		2	2.25
Rock Creek	-0.5	-0.25	-0.25	-0.25	-1.25		2	2.25
Bull Lake	-0.5	-0.5	0	-0.25	-1.25		2	2.25
Upper Mainstem John Day River	-1	-0.25	0.25	-0.25	-1.25		2	2.25
Middle-Lower Clearwater River	0	-0.25	0	-1	-1.25		2	2.25
Lake Creek	-0.75	-0.5	0	0	-1.25		2	2.25
Pahsimeroi River	0	-0.25	0	-1	-1.25		2	2.25
Arrowrock Reservoir	0	-0.25	-0.25	-0.75	-1.25		2	2.25

CORE AREA RANKINGS (FINAL - 3/1/05)								
Core Area	**Population Size**	**Distribution**	**Trend**	**Threats**	**SUM**		**C-RANK**	**P**
Klickitat River	0	-0.5	0	-0.75	-1.25		2	2.25
Swan Lake	-0.25	0	0	-0.75	-1		2	2.5
Puyallup River	0	0	0	-1	-1		2	2.5
Upper Klamath Lake	-0.75	-0.25	0.25	-0.25	-1		2	2.5
Middle Fork John Day River	0	-0.25	0.25	-1	-1		2	2.5
North Fork John Day River	0	-0.25	0.25	-1	-1		2	2.5
Grande Ronde River	-0.75	-0.25	0	0	-1		2	2.5
Granite Creek	0	-0.75	0	-0.25	-1		U	2.5
Sheep Creek	0	-0.75	0	-0.25	-1		U	2.5
Middle Salmon River-Panther	0	-0.25	0	-0.75	-1		2	2.5
South Fork Salmon River	0	-0.25	0	-0.75	-1		2	2.5
Upper South Fork Payette River	0	-0.25	0	-0.75	-1		2	2.5
Quinault River	0	-0.25	0	-0.75	-1		2	2.5
Upper Salmon River	0	0	0	-0.75	-0.75		3	2.75
Nooksack River	0	0	0	-0.75	-0.75		3	2.75
Imnaha River	-0.5	-0.25	0	0	-0.75		3	2.75
Opal Lake	0	-0.75	0	0	-0.75		3	2.75
Chilliwack River	-0.25	-0.5	0	0	-0.75		3	2.75
Belly River	-0.5	-0.5	0.25	0	-0.75		3	2.75
Lake Pend Oreille	-0.25	0	0	-0.25	-0.5		3	3
Little Minam River	-0.5	-0.75	0	0.75	-0.5		3	3
Wenatchee River	-0.5	0	0	0	-0.5		3	3
Akokala Lake	-0.75	-0.75	0	1	-0.5		3	3
Arrow Lake	-0.75	-0.5	0	0.75	-0.5		3	3
Blackfoot River	-0.5	-0.25	0.25	0	-0.5		3	3
Doctor Lake	-0.75	-0.5	0	0.75	-0.5		3	3
Frozen Lake	-0.75	-0.5	0	0.75	-0.5		3	3
Trout Lake	-0.5	-0.75	0	0.75	-0.5		3	3
Tucannon River	-0.25	-0.25	0	0	-0.5		3	3
Chester Morse Lake	-0.25	-0.5	0.25	0	-0.5		3	3
Slide Lake	-0.75	-0.75	0	1	-0.5		3	3
Middle Salmon River-Chamberlain	0	-0.25	0	0	-0.25		3	3.25
Isabel Lakes	-0.5	-0.75	0	1	-0.25		3	3.25
Lower Deschutes River	-0.25	-0.25	0.25	0	-0.25		3	3.25
Selway River	0	-0.25	0	0	-0.25		3	3.25
Lewis River	-0.25	-0.25	0.25	0	-0.25		3	3.25
Hungry Horse Reservoir	-0.25	0	0.25	0	0		3	3.5
Snohomish & Skykomish Rivers	-0.25	0	0.25	0	0		3	3.5
Queets River	0	0	0	0	0		3	3.5

CORE AREA RANKINGS (FINAL - 3/1/05)								
Core Area	**Population Size**	**Distribution**	**Trend**	**Threats**	**SUM**		**C-RANK**	**P**
Upper Kintla Lake	-0.5	-0.5	0	1	0		3	3.5
Cracker Lake	-0.5	-0.5	0	1	0		3	3.5
Lake Koocanusa	0	0	0.25	0	0.25		4	3.75
Middle Fork Salmon River	-0.25	0	0	0.75	0.5		4	4
Lower Skagit River	-0.25	0	0.25	0.75	0.75		4	4.25
Upper Skagit River	0	0	0	0.75	0.75		4	4.25

Appendix B - Bull Trout Core Area Ranking Results

Table 4. Saturation of key recovery habitat as a proportion of total stream habitat in bull trout core areas (sorted from lowest to highest).

CORE AREA NAME	CORE AREA (Acres)	ALL STREAMS (Stream Miles)	KEY HABITAT (Stream Miles)	% SATURATION (Key H / Total)
Lake McDonald	105,004	172	2	0.9%
Belly River	57,233	98	1	1.5%
Lake Koocanusa	781,200	1,373	45	3.2%
Logging Lake	19,908	34	1	3.3%
Red Eagle Lake	22,324	36	1	3.3%
Lower Deschutes River	2,577,637	4,974	173	3.5%
Lower Flathead River	1,276,896	3,150	128	4.1%
Holland Lake	7,228	9	0.4	4.1%
Umatilla River	1,606,383	3,062	149	4.9%
Lewis River	530,692	905	44	4.9%
Weiser River	604,885	1,076	54	5.0%
Klickitat River	862,151	1,636	84	5.1%
Middle-Lower Clearwater River	1,636,927	3,446	181	5.2%
Yakima River	3,923,888	9,467	519	5.5%
Big Salmon Lake	49,950	82	5	5.6%
North Fork Payette River	394,080	740	42	5.7%
Lucky Peak Reservoir	301,318	626	38	6.1%
Noxon Rapids Reservoir	372,451	476	32	6.6%
Malheur River	1,569,670	3,210	214	6.7%
Entiat River	336,980	698	52	7.4%
Touchet River	483,086	1,058	82	7.8%
Upper Willamette River	1,701,994	2,530	200	7.9%
Clark Fork River (Section 1)	1,789,937	3,778	301	8.0%
Clark Fork River (Section 3)	760,512	1,272	105	8.2%
Blackfoot River	1,269,541	3,244	270	8.3%
Walla Walla River	640,210	1,354	117	8.6%
Upper Mainstem John Day River	1,096,433	2,143	189	8.8%
Coeur d'Alene Lake	2,533,688	4,497	403	9.0%
Little Lost River	608,846	1,224	110	9.0%
Kootenai River	1,759,878	3,276	297	9.1%
Lincoln Lake	1,658	5	0.5	9.1%
Bull Lake	126,544	232	23	9.9%
North Fork John Day River	1,179,652	2,378	239	10.0%
Lake Pend Oreille	1,138,674	1,757	177	10.1%
Powder River	1,089,957	2,626	266	10.1%
Methow River	1,374,174	2,749	299	10.9%
Flathead Lake	2,195,814	3,817	424	11.1%

Little-Lower Salmon River	1,121,342	2,365	265	11.2%
Bitterroot River	1,624,046	3,348	379	11.3%
Cabinet Gorge Reservoir	233,275	371	43	11.5%
Hungry Horse Reservoir	1,000,768	1,701	201	11.8%
Upper Skagit River	464,089	694	84	12.1%
Chilliwack River	152,819	231	29	12.5%
Hood River	217,297	528	69	13.1%
Wenatchee River	877,172	1,692	227	13.4%
Anderson Ranch Reservoir	636,139	1,490	201	13.5%
Middle Fork John Day River	505,543	997	135	13.6%
Harrison Lake	13,794	31	4	14.0%
Sheep Creek	25,867	42	6	14.0%
Snohomish & Skykomish Rivers	1,171,243	1,986	281	14.2%
Grande Ronde River	2,240,402	4,223	612	14.5%
Swan Lake	435,854	867	126	14.6%
Sycan River	202,046	391	58	14.8%
Middle Fork Payette River	217,958	450	68	15.0%
Dungeness River	130,823	209	32	15.1%
Asotin Creek	249,504	557	85	15.3%
Saint Mary River	229,913	441	68	15.4%
Tucannon River	321,286	674	104	15.4%
Lindbergh Lake	25,761	33	5	15.5%
Whitefish Lake	81,477	160	25	15.6%
Upper Stillwater Lake	82,085	176	28	15.8%
Selway River	1,280,732	2,533	407	16.1%
North Fork Clearwater River	1,556,190	2,837	465	16.4%
Clark Fork River (Section 2)	1,265,458	2,305	386	16.8%
Trout Lake	5,285	8	1	17.1%
South Fork Clearwater River	753,739	1,668	288	17.3%
Lee Creek	17,700	54	10	17.8%
Middle Salmon -Chamberlain	864,399	1,637	293	17.9%
Bowman Lake	27,746	36	7	18.3%
Kintla Lake	15,471	9	2	18.4%
Pend Oreille River	674,638	1,250	232	18.6%
Imnaha River	543,015	958	178	18.6%
Lemhi River	806,932	1,391	267	19.2%
Chester Morse Lake	52,308	82	17	20.2%
Elwha River	205,548	285	60	21.0%
Upper Salmon River	1,551,743	3,273	691	21.1%
Pahsimeroi River	535,757	968	205	21.2%
Squaw Creek	217,640	428	91	21.3%
Slide Lake	5,190	8	2	21.4%
Upper Sprague River	206,801	420	90	21.5%
Doctor Lake	9,388	15	3	22.4%
Lochsa River	749,991	1,364	306	22.4%
Lower Skagit River	1,377,327	2,110	493	23.3%
Quinault River	279,477	435	102	23.5%
Arrowrock Reservoir	779,063	1,551	366	23.6%

Stillaguamish River	450,856	793	192	24.2%
Granite Creek	21,364	28	7	24.4%
Clearwater River & Lakes	211,102	390	97	25.0%
Rock Creek	568,290	1,196	302	25.3%
Nooksack River	499,300	908	231	25.4%
Jarbidge River	308,399	519	132	25.4%
Skokomish River	152,816	242	62	25.4%
Upper Klamath Lake	420,665	508	131	25.8%
Middle Salmon River-Panther	1,374,368	2,335	609	26.1%
Upper South Fork Payette River	428,330	856	225	26.3%
Priest Lakes	376,561	621	166	26.7%
Puyallup River	663,537	1,050	286	27.2%
Middle Fork Salmon River	1,835,118	3,548	1,011	28.5%
Upper Kintla Lake	15,606	20	6	28.8%
Quartz Lake(s)	15,089	21	6	29.2%
South Fork Salmon River	833,448	1,626	488	30.0%
Upper Whitefish Lake	10,045	19	6	30.3%
Queets River	288,115	460	147	31.9%
West Fork Bitterroot River	201,288	368	117	31.9%
Pine, Indian & Wildhorse Cr.	423,330	731	242	33.1%
Isabel Lakes	1,273	1	0.5	33.9%
Akokala Lake	1,424	3	1	34.2%
Odell Lake	59,431	38	13	34.5%
Lake Creek	11,221	15	5	35.7%
Lower Quartz Lake	3,163	2	1	37.0%
Arrow Lake	5,092	6	3	39.7%
Hoh River	190,938	272	108	39.7%
Cyclone Lake	6,619	13	5	42.5%
Little Minam River	18,990	26	13	50.8%
Deadwood River	70,067	119	67	55.7%
Frozen Lake	1,911	4	3	63.1%
Fish Lake (Lochsa River)	5,093	8	5	64.8%
Sophie Lake	5,231	5	3	68.2%
Fish Lake (No. Fk. Clearwater)	3,581	5	4	70.0%
Cracker Lake	5,224	7	5	71.3%
Opal Lake	1,275	2	2	92.6%

Appendix C - Core Area Life History & Connectivity Rule Set & Tables

Rule Set for Life History and Connectivity Characterization Definitions
March 22, 2005 (Bull Trout 5-Year Review)

NOTE: Where additional explanation is necessary for any entry in the excel spreadsheet, right click and use "insert comment" to attach additional explanation to the specific cell where the code is provided.

Life History Form(s) Present

(1)

Dominant Migratory Form Fluvial = F Adfluvial = AD Anadromous = AN No Longer Present = NP

Enter code for the current dominant migratory form within the core area ("F", "AD", or "AN"). If all historic migratory forms have been lost within the core area, enter "NP" and proceed to (3). Note, even if there is a very small remnant migratory component within the core area, still enter a form type. Their remnant status will be addressed under (3), the Resident Form column. If migratory forms never existed within the core area, leave blank.

(2)

Secondary Migratory Form(s) (if present) Fluvial = F Adfluvial = AD Anadromous = AN No Longer Present = NP

Enter code for a secondary migratory form within the core area if one exists ("F", "AD", or "AN"). If the secondary migratory form has been lost within the core area, enter "NP". If migratory forms never existed within the core area, leave blank. In rare cases, where all three migratory forms maybe present, enter both secondary forms.

(3)

Resident Form Dominant = D Present = P Absent = A Unknown = U

Enter the status of the resident form within the core area. "D" indicates that it is historically the only life history form, or currently the primary life history form within the core area. "P" indicates that although it exists within the core area, it is not the dominant life history. "A" indicates that the resident life history form is absent within the core area. "U" indicates that it is unknown whether the resident form exists within the core area.

Core Area Extent / Connectivity

(4)

Upper Bound

Headwaters = HW
Watershed boundary = WB
Dam/Artificial Barrier = AB
Natural Barrier = NB

Enter the delineation of the current "upstream" extent (upper bound) of the core area where it abuts a watershed divide or another core area. For core areas situated furthest upstream within a basin, only "HW" or "NB" should apply. Note that although core areas are typically defined around watershed boundaries, "NB" should be used in cases where a natural barrier actually precludes migratory access to the majority of headwater habitat within the core area. For core areas where the upstream boundaries of major portions of the watershed are complex and defined by multiple aspects, such as both a dam (or dams) on one major fork of the drainage and headwaters on another, use multiple codes in their relative order of importance (e.g., "WB/AB" would indicate the boundaries are mostly headwaters but a bull trout core area also exists above a dam upstream).

Degree of Connectivity To Upstream Cores

No Passage = NP
Restricted Passage = RP
Unrestricted Passage = UP

Enter the level of upstream connectivity to other core areas relative to the upper bound selected above. Note that connectivity within the boundaries of the core area is dealt with in a separate column entry (see #6). This column only addresses the ability for fish to migrate from this core area to other upstream core areas. "NP" applies to natural waterfalls and dams/diversions without upstream passage facilities; "RP" applies to dams/diversions with upstream passage facilities; and "UP" applies to intact migratory corridors. For core areas situated most upstream within a basin (i.e., upper bound coded as "HW" or "NB" in some cases), leave this column blank, as passage to other upstream core areas is not applicable.

(5)

Lower Bound

Watershed boundary = WB
Dam/Artificial Barrier = AB
Natural Barrier = NB

Enter the delineation of the current "downstream" extent (lower bound) of the core area. Where a core area extends to the mainstem Columbia River or marine waters, enter "WB", unless this happens to be coincident with a dam/artificial barrier.

Degree of Connectivity to Downstream Cores

No Passage = NP
Restricted Passage = RP
Unrestricted Passage = UP

Enter the level of downstream connectivity to other core areas relative to the lower bound selected above. "NP" applies to longstanding natural habitat conditions that preclude downstream migration (e.g., Jarbidge) or dams/diversion that prevent any passage; "RP" applies to dams/diversions with one- or two-way passage, or anthropogenic habitat conditions that significantly impair downstream migration (e.g., Yakima); and "UP" applies to intact migratory corridors. Note that connectivity within the boundaries of the core area is dealt with in the next entry (see #6) – this entry only applies to ability for fish to migrate from this core area to other downstream core areas. It is assumed that adfluvial populations typically do not migrate downstream (in part a behavior, but also because water downstream of lakes is typically warmer than bull trout preference in the summer). Thus, for adfluvial populations downstream passage is considered "RP" by default, unless demonstrated otherwise.

(6)

Degree of Connectivity within Core Area
Low (significantly impaired) = L Moderate (partially impaired) = M High (unimpaired) = H

Enter the level of connectivity within the core area (i.e., between local populations, within local populations, between local populations and FMO habitats, and within FMO habitats). "L" (Low) applies to core areas where the majority of local populations are artificially separated from one another, or migratory or resident forms (if dominant) have impaired access (year round or seasonally) to a majority of the habitat within the core area. Access may be impaired by degraded habitat conditions or by artificial barriers (e.g., diversions, culverts, etc.). "M" (Moderate) applies to core areas where a minority of local populations are artificially separated from the others, or migratory or resident forms (if dominant) have impaired access to smaller portions of habitat within the core area, but are still considered significant. "H" (High) applies to core areas where connectivity between local populations is generally unimpaired, or where only minor or insignificant portions of usable habitat are currently inaccessible. Where "M" or "L" applies attach descriptive comments, if appropriate.

Appendix C - Core Area Life History and Connectivity Tables

Table 1. Life history form(s) and internal and external connectivity status by core area.

ID #	Core Area	Life History Form(s) Present			Core Area Extent / Connectivity					"External Connectivity" Scoring		
		Dominant Migratory Form	Secondary Migratory Form(s) (if present)	Resident Form	Upper Bound	Degree of Connectivity to Upstream Cores	Lower Bound	Degree of Connectivity to Downstream Cores	Degree of Connectivity within Core Area	UP-STREAM SCORE	DOWN-STREAM SCORE	TOTAL SCORE
		Fluvial = F Adfluvial = AD Anadromous = AN No Longer Present = NP	Fluvial = F Adfluvial = AD Anadromous = AN No Longer Present = NP	Dominant = D Present = P Absent = A Unknown = U	Headwaters = HW Watershed boundary = WB Dam/Artificial Barrier = AB Natural Barrier = NB	No Passage = NP Restricted Passage = RP Unrestricted Passage = UP	Watershed boundary = WB Dam/Artificial Barrier = AB Natural Barrier = NB	No Passage = NP Restricted Passage = RP Unrestricted Passage = UP	Low (significantly impaired) = L Moderate (partially impaired) = M High (unimpaired) = H			
1	Chester Morse Lake	AD		A	HW		NB	RP	H	-1	0	-1
2	Chilliwack River	F	AD, AN?	U	HW		WB	UP	H	-1	+1	0
3	Dungeness River	F	AN	U	NB		WB	UP	H	-1	+1	0
4	Elwha River	F	AD, AN?	U	HW		WB	RP	L	-1	0	-1
5	Hoh River	AN	F	U	HW		WB	UP	H	-1	+1	0
6	Lower Skagit River	AN	F, AD	P	AB	NP	WB	UP	M	-1	+1	0
7	Nooksack River	AN	F	U	HW/NB		WB	UP	M	-1	+1	0
8	Puyallup River	F	AN	P	HW		WB	UP	M	-1	+1	0
9	Queets River	AN	F	U	HW		WB	UP	H	-1	+1	0
10	Quinault River	AD	F	U	HW		WB	UP	H	-1	+1	0
11	Skokomish River	AD	F	U	NB		WB	UP	L	-1	+1	0

ID #	Core Area	Life History Form(s) Present			Core Area Extent / Connectivity					"External Connectivity" Scoring		
		Dominant Migratory Form	Secondary Migratory Form(s) (if present)	Resident Form	Upper Bound	Degree of Connectivity to Upstream Cores	Lower Bound	Degree of Connectivity to Downstream Cores	Degree of Connectivity within Core Area	UP-STREAM SCORE	DOWN-STREAM SCORE	TOTAL SCORE
12	Snohomish & Skykomish R.	AN	F	P	HW		WB	UP	H	-1	+1	0
13	Stillaguamish River	AN	F	P	HW		WB	UP	H	-1	+1	0
14	Upper Skagit River	AD	F	U	HW		AB	RP	M	-1	0	-1
15	Akokala Lake	AD		A	HW		WB	RP	H	-1	0	-1
16	Anderson Ranch Res.	AD		P	HW		AB	NP	M	-1	-1	-2
17	Arrow Lake	AD		A	HW		WB	RP	H	-1	0	-1
18	Arrowrock Reservoir	AD	F	P	HW		AB	RP	L	-1	0	-1
19	Asotin Creek	F		D	HW		WB	RP	L	-1	0	-1
20	Big Salmon Lake	AD		A	HW		WB	RP	H	-1	0	-1
21	Bitterroot River	F		D	HW/AB	NP	WB	UP	L	-1	+1	0
22	Blackfoot River	F		U	HW		AB	RP	M	-1	0	-1
23	Bowman Lake	AD		A	HW		WB	RP	M	-1	0	-1
24	Bull Lake	AD		A	HW		AB	RP	H	-1	0	-1
25	Cabinet Gorge Reservoir	AD		U	AB	RP	AB	RP	L	0	0	0
26	Quartz Lake(s)	AD		A	HW		WB	RP	H	-1	0	-1
27	Clark Fork River (Sec. 1)	F	AD	U	HW		AB	RP	L	-1	0	-1
28	Clark Fork River (Sec. 2)	F	AD	U	AB	NP	WB	UP	M	-1	+1	0

ID #	Core Area	Life History Form(s) Present			Core Area Extent / Connectivity					"External Connectivity" Scoring		
		Dominant Migratory Form	Secondary Migratory Form(s) (if present)	Resident Form	Upper Bound	Degree of Connectivity to Upstream Cores	Lower Bound	Degree of Connectivity to Downstream Cores	Degree of Connectivity within Core Area	UP-STREAM SCORE	DOWN-STREAM SCORE	TOTAL SCORE
29	Clark Fork River (Sec. 3)	F	AD	U	WB	UP	WB	UP	M	+1	+1	+2
30	Clearwater River & Lakes	AD		U	HW		WB	RP	L	-1	0	-1
31	Coeur d'Alene Lake	AD	F	P	HW		NB/AB	NP	M	-1	-1	-2
32	Cyclone Lake	AD		A	HW		WB	RP	H	-1	0	-1
33	Deadwood River	AD		D	HW		AB	NP	H	-1	-1	-2
34	Doctor Lake	AD		A	HW		NB	RP	H	-1	0	-1
35	Entiat River	F		U	NB/HW		WB	RP	H	-1	0	-1
36	Fish Lake (Lochsa River)	AD		U	HW		NB	RP	H	-1	0	-1
37	Fish Lake (NF Clearwater)	AD		U	HW		NB	RP	H	-1	0	-1
38	Flathead Lake	AD	F	A	AB/WB	NP/RP	AB	RP	H	-1	0	-1
39	Frozen Lake	AD			HW		WB	RP	H	-1	0	-1
40	Grande Ronde River	F	NP	D	HW		WB	RP	L	-1	0	-1
41	Granite Creek	F		P	AB/HW		WB	UP	H	-1	+1	0
42	Harrison Lake	AD		A	HW		WB	RP	H	-1	0	-1
43	Holland Lake	AD		A	HW		WB	RP	M	-1	0	-1
44	Hood River	AD	F	U	AB/HW		WB	RP	L	-1	0	-1
45	Hungry Horse Reservoir	AD		A	WB	RP	AB	RP	H	0	0	0
46	Imnaha River	F		P	HW/AB		WB	UP	M	-1	+1	0
47	Isabel Lakes	AD		A	HW		NB	RP	H	-1	0	-1
48	Kintla Lake	AD		A	NB	NP	WB	RP	M	-1	0	-1
49	Klickitat River	F		D	HW		WB	UP	M	-1	+1	0

ID #	Core Area	Life History Form(s) Present			Core Area Extent / Connectivity					"External Connectivity" Scoring		
		Dominant Migratory Form	Secondary Migratory Form(s) (if present)	Resident Form	Upper Bound	Degree of Connectivity to Upstream Cores	Lower Bound	Degree of Connectivity to Downstream Cores	Degree of Connectivity within Core Area	UP-STREAM SCORE	DOWN-STREAM SCORE	TOTAL SCORE
50	Kootenai River	F	AD	A	AB/NB	NP	WB	UP	M	-1	+1	0
51	Lake Creek	AD		U	HW		NB	NP	H	-1	-1	-2
52	Lake Koocanusa	AD		A	HW		AB	RP	H	-1	0	-1
53	Lake McDonald	AD		A	NB	NP	WB	RP	L	-1	0	-1
54	Lake Pend Oreille	AD		P	AB	RP	AB	RP	M	0	0	0
55	Lemhi River	F		D	HW		WB	RP	L	-1	0	-1
56	Lewis River	AD		A	HW		AB/WB	RP	L	-1	0	-1
57	Lincoln Lake	AD		A	HW		WB	RP	H	-1	0	-1
58	Lindbergh Lake	AD		U	HW		WB	RP	H	-1	0	-1
59	Little Lost River	F		P	HW	NP	NB	NP	M	-1	-1	-2
60	Little Minam River			D	HW		NB	RP	H	-1	0	-1
61	Little-Lower Salmon River	F		P	NB	NP	WB	UP	M	-1	+1	0
62	Lochsa River	F		P	HW		WB	UP	H	-1	+1	0
63	Logging Lake	AD		A	HW		WB	RP	H	-1	0	-1
64	Lower Deschutes R.	AD	F	U	HW/NB/AB		WB	RP	L	-1	0	-1
65	Lower Flathead River	F	AD	U	HW		WB	RP	M	-1	0	-1
66	Lower Quartz Lake	AD		A	WB	RP	WB	RP	H	0	0	0

ID #	Core Area	Life History Form(s) Present			Core Area Extent / Connectivity					"External Connectivity" Scoring		
		Dominant Migratory Form	Secondary Migratory Form(s) (if present)	Resident Form	Upper Bound	Degree of Connectivity to Upstream Cores	Lower Bound	Degree of Connectivity to Downstream Cores	Degree of Connectivity within Core Area	UP-STREAM SCORE	DOWN-STREAM SCORE	TOTAL SCORE
67	Lucky Peak Reservoir	NP		U	AB	NP	AB	NP	L	-1	-1	-2
68	Malheur River	F	NP	P	WB		AB	NP	L	-1	-1	-2
69	Methow River	F	AD	P	NB/HW		WB	RP	M	-1	0	-1
70	Middle Fork John Day R.	F		D	HW		WB	UP	M	-1	+1	0
71	Middle Fork Payette River	NP		D	HW/WB	UP	WB	RP	M	+1	0	+1
72	Middle Fork Salmon River	F		P	HW		WB	UP	H	-1	+1	0
73	Middle Salmon River-Chamberlain	F		P	WB		WB	UP	H	-1	+1	0
74	Middle Salmon River-Panther	F		P	WB		WB	UP	M	-1	+1	0
75	Middle-Lower Clearwater R.	F		P	WB/AB	NP	WB	RP	M	-1	0	-1
76	North Fork Clearwater R.	AD		P	HW		AB	NP	H	-1	-1	-2
77	North Fork John Day R.	F		D	HW		WB	UP	M	-1	+1	0
78	North Fork Payette River	NP		A	HW		AB	NP	L	-1	-1	-2
79	Noxon Rapids Reservoir	AD		U	AB	RP	AB	RP	M	0	0	0
80	Odell Lake	AD		U	NB/HW		NB	NP	M	-1	-1	-2
81	Opal Lake	AD		U	HW		NB	NP	H	-1	-1	-2

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82	Pahsimeroi River	F		P	HW		WB	UP	L	-1	+1	0
83	Pend Oreille River	AD	F	U	AB	NP	NB/AB	NP	L	-1	-1	-2
84	Pine, Indian & Wildhorse Cr.	AD		D	HW		WB	UP	M	-1	+1	0
85	Powder River	NP		D	HW		AB	NP	L	-1	-1	-2
86	Priest Lakes	AD		U	HW		AB/WB	RP	M	-1	0	-1
87	Rock Creek	F		P	HW		WB	UP	H	-1	+1	0
88	Selway River	F		P	HW		WB	UP	H	-1	+1	0
89	Sheep Creek	F		P	AB/HW		WB	UP	H	-1	+1	0
90	Sophie Lake	AD		A	HW		NB	NP	L	-1	-1	-2
91	South Fork Clearwater R.	F		P	HW		WB	UP	M	-1	+1	0
92	South Fork Salmon River	F		P	HW		WB	UP	H	-1	+1	0
93	Squaw Creek	NP		D	HW		WB	NP	L	-1	-1	-2
94	Swan Lake	AD		A	WB	UP	AB	RP	H	+1	0	+1
95	Touchet River	F		P	HW		WB	RP	M	-1	0	-1
96	Trout Lake	AD		A	WB	UP	WB	RP	H	+1	0	+1
97	Tucannon River	F		P	HW		WB	UP	H	-1	+1	0
98	Umatilla River	F		P	HW/NB		WB	RP	L	-1	0	-1
99	Upper Kintla Lake	AD		A	HW		NB	RP	H	-1	0	-1
100	Upper Mainstem John Day R.	F		P	HW		WB	UP	M	-1	+1	0

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101	Upper Salmon River	F		P	HW		WB	UP	M	-1	+1	0
102	Upper South Fork Payette River	F		D	HW		WB	RP	H	-1	0	-1
103	Upper Stillwater Lake	AD		U	HW		WB	RP	H	-1	0	-1
104	Upper Whitefish Lk.	AD		A	HW		WB	RP	L	-1	0	-1
105	Upper Willamette R.	F	AD	A	AB/NB/HW		WB	UP	L	-1	+1	0
106	Walla Walla River	F		P	HW		AB/WB	RP	L	-1	0	-1
107	Weiser River	NP		D	HW		WB	RP	L	-1	0	-1
108	Wenatchee River	AD	F	P	NB/HW		WB	RP	H	-1	0	-1
109	West Fork Bitterroot R.	AD		U	HW		AB	RP	M	-1	0	-1
110	Whitefish Lake	AD		A	WB	UP	WB	RP	H	+1	0	+1
111	Yakima River	AD	F	P	AB/NB/HW		AB/WB	RP/NP	L	-1	0	-1
112	Sycan River	F		D	HW		AB	RP	L	-1	0	-1
113	Upper Klamath Lake	NP		D	HW		AB	RP	L	-1	0	-1
114	Upper Sprague River	F		D	HW		NB	RP	M	-1	0	-1
115	Belly River	F		U	NB		WB	UP	M	-1	+1	0
116	Cracker Lake	AD		A	HW		AB	RP	H	-1	0	-1
117	Lee Creek	F	AD	U	HW		WB	UP	M	-1	+1	0

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118	Red Eagle Lake	AD		A	HW		WB	RP	H	-1	0	-1
119	Saint Mary River	F	AD	U	HW		WB	UP	M	-1	+1	0
120	Slide Lake	AD		A	HW		NB	RP	H	-1	0	-1
121	Jarbidge River	F		D	HW		WB	NP	M	-1	-1	-2

Appendix D – Supplemental Threats Information

Table 1. Federal and Tribal Land Ownership by Core Area.

This information is displayed in a separate attachment.

Appendix D – Supplemental Threats Information

Table 2. Land Use by Core Area.

This information is displayed in a separate attachment.