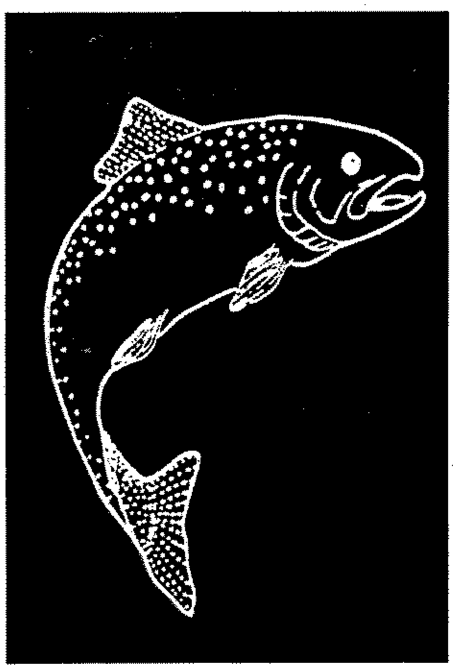
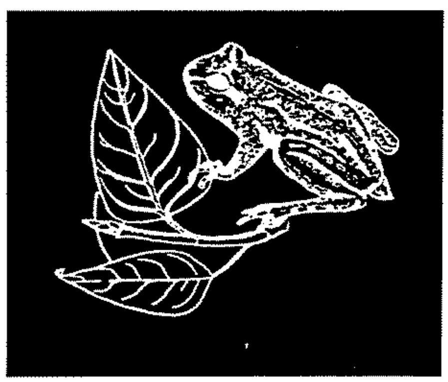
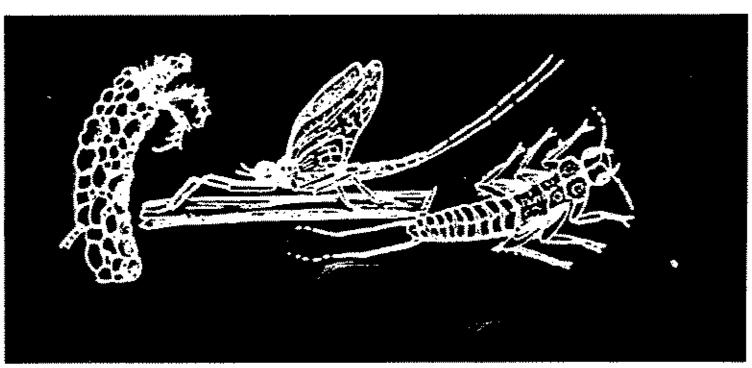
Technical Summary:

EXTINCTION RISK for WESTSLOPE CUTTHROAT TROUT on Federal Lands Within the Upper Missouri River Basin in Eastern Montana



October, 1996





EXECUTIVE SUMMARY

Existing information on the presence and relative abundance of westslope cutthroat trout throughout the upper Missouri River basin documents that their historic distribution has been reduced to a fraction of their original range. Individual populations have recently become extinct. The majority of the remaining populations are confined to small habitat fragments located primarily in headwaters of tributaries. Some existing populations occur in habitats presently degraded by land and/or water management activities. A high percentage of all remaining populations face competition and/or genetic contamination from non-native trout species.

In 1995, the Forest Service, Northern Region and Bureau of Land Management, Montana State Office utilized a questionnaire to collect data on federally-administered lands within the upper Missouri River basin. This questionnaire was designed to provide input to a viability assessment that evaluated the risk of extinction to westslope cutthroat populations. Responses were analyzed in a viability assessment model which provided a consistent framework for assessing the risk of extinction. Interdisciplinary field-level resource teams also estimated adverse effects to aquatic systems from land and/or water management activities within the occupied drainage.

Results from this assessment confirm that most (90%) of the remaining known populations are at a "high" to "very high" risk of becoming extinct over the next 100 years under existing conditions. Results also suggest that livestock grazing and the presence of competing exotic fishes are important existing threats to remaining westslope cutthroat trout populations within the upper Missouri River basin.

CONTRIBUTORS

Primary contributors to this assessment and associated summaries included: Linda Ulmer, Regional Aquatic Ecologist (Project Leader); Brad Shepard, Montana Fish, Wildlife, and Parks, Fisheries Research Ecologist (Lead Technical Support); Brian Sanborn, Forest Fisheries Program Leader (Co-lead Technical Support); Danny Lee and Bruce Rieman, Fisheries Research Ecologists - Intermountain Research Station (Development of Bayesian Belief model and Assessment design support). Many other individuals assisted in the design and completion of the questionnaires. They are identified in the Acknowledgments Section of this report.

FOREWORD

Within the last decade, State and Federal fisheries surveys have documented the decline in the distribution and abundance of westslope cutthroat trout populations within the upper Missouri River basin of eastern Montana. In response, Federal land managers in collaboration with State biologists, have implemented actions on individual populations occupying federally-administered lands to remediate identified problems. Although some individual efforts were successful, known populations have continued to decline. This trend indicated the need for a broader assessment of the status and risks to remaining westslope cutthroat trout populations on National Forest System and Bureau of Land Management lands within the basin.

The goal of this broad-scale assessment was to evaluate the status of remaining known populations, with a genetic purity of at least 90%, and to assess the contribution of management activities to "at risk" populations occupying federally-administered lands within the basin.

Chronology of events and decisions associated with this Assessment are described in Appendix A.

INTRODUCTION

The cutthroat trout has the greatest distribution of any of the species of western trout. Along the Pacific Coast, the "coastal" subspecies occurs from southern Alaska to northern California. The "interior" forms are divided into 14 subspecies which range throughout the intermountain west from Canada to New Mexico.

Westslope cutthroat trout, Oncorhyncus clarki lewisi, are one of the 14 "interior" cutthroat trout subspecies. Their historic range included; western Montana, central and northern Idaho, eastern Oregon and Washington, and southwestern Saskatchewan, southern Alberta and southeastern British Columbia. Currently this subspecies inhabits streams and lakes on both sides of the Continental Divide due to headwater transfers into the South Saskatchewan and Upper Missouri River drainages during the last glaciation period (approx. 7,000 - 10,000 years ago). As post-glacial waters receded, westslope populations east of the Divide became isolated from the Columbia River basin.

Westslope Cutthroat Trout:
Upper Missouri River Basin in Eastern Montana

Historic Range

Hanzel (1959) described the historic range of westslope cutthroat trout within the upper Missouri River basin (UMRB) as the entire Missouri River drainage down to the mouth of the Musselshell River. Behnke (1992) considered the known historic range to include the entire basin down to about Fort Benton, including the headwaters of the Judith, Milk, and Marias rivers.

We now consider westslope cutthroat trout to have historically occupied the entire basin above present-day Fort Peck Reservoir. This includes the entire Mussellshell and Judith River drainages, and the Sun River, from its confluence with the Missouri River to approximately 96 river miles upstream to a natural barrier to fish migration (Figure 1). The lower Mussellshell has now been included based on the presence of 100% genetically pure westslope cutthroat trout in two tributary streams. While we consider the entire Musselshell to be within the historic range, it is possible that pure westslope cuttroat populations, originated from hatchery releases by the Montana Game & Fish Commission. Willock (1969) reported westslope cutthroat trout to be present in the North Fork of the Milk River in Canada. We suspect that the entire upper Milk drainage in Montana historically supported westslope cutthroat.

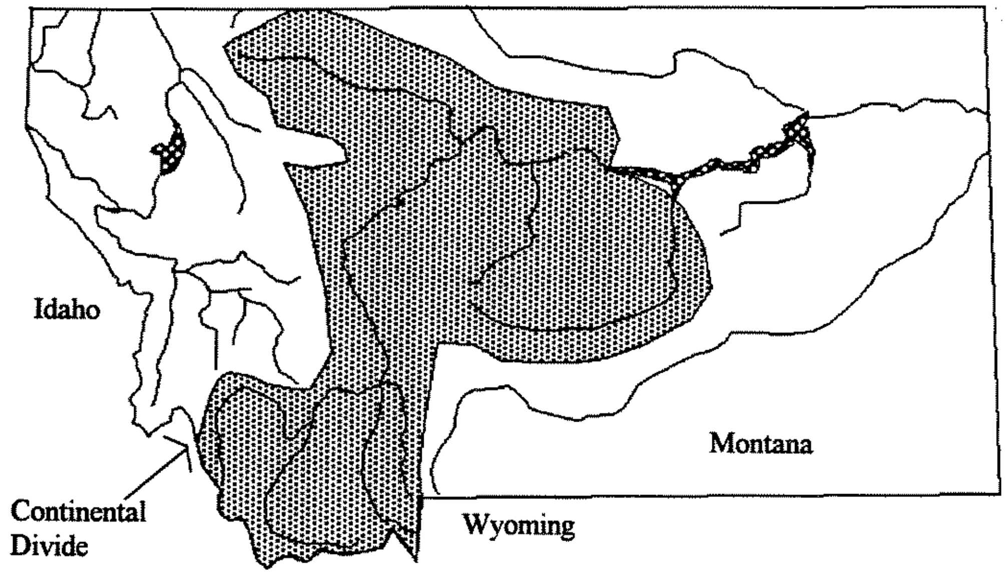


Figure 1. Map of the upper Missouri River basin showing believed historic range of westslope cutthroat trout (Oncorhynchus clarki lewisi) at the time of European man's expansion into this area.

A query of the State's Montana River Information System's (MRIS) database (based on 1:100,000 scale Hydrography Layer information) indicates that the historic range of this subspecies within the UMRB included a total of 56,853 miles of available stream and river habitat at the time of European man's expansion into the basin. This total includes the upper Milk and excludes the upper Sun River basin.

Current Status

Within the UMRB, and throughout their historic range west of the Continental Divide, westslope cutthroat trout have experienced dramatic declines in abundance and distribution (Liknes and Graham 1988; McIntyre and Rieman 1995; Shepard and VanEimeren 1995).

A query of the MRIS fisheries and genetic status databases was used to compare current westslope cutthroat occupancy of UMRB streams with historic. Based on available MRIS information the present distribution of westslope cutthroat within the UMRB is summarized below from Table 1:

100% genetically pure populations of westslope cutthroat trout presently inhabit 545 miles (1.0% of historic range);

98-99.9% genetically pure populations inhabit 169 miles (0.3% of historic range);

90-97.9% genetically pure populations inhabit 333 miles (0.6% of historic range);

<90% genetically pure (known hybridized) populations inhabit 328 miles (0.6% of historic range);

and untested, but suspected, populations inhabit 2,611 miles (4.6%) of total habitat miles within the basin of historic range).

In addition, fish species (presence/absence) records are available from MRIS for 9,468 miles of stream within the UMRB. These records indicate that some level of fish survey information is available for approximately one-sixth of the total number of miles (56,853) believed to have been historically occupied by westslope cutthroat (Table 1). Based on these records current occupancy of westslope cutthroat in surveyed habitats has been calculated:

100% pure populations occupy about 5.8% of surveyed habitats;

98-99.9% pure populations occupy about 1.8% of surveyed habitats; ,

90-97.9% pure populations occupy about 3.5% of surveyed habitats;

known hybridized (<90% pure) occupy about 3.5% of surveyed habitats;

suspected, but untested, populations occupy about 27.6% of surveyed habitats.

				WCT (Miles)					WCT (Reaches)				
Hydro Unit Name	Total Miles	Surveyed Miles	Surveyed Reaches	100% Pure	98-99% Pure	90-97% Pure	<90% Pure	Untested	100% Pure	98-99% Pure	90-97% Pure	<90% Pure	Untested
10020001 Red Rock	3488.4	1123.7	288	77.0	76.9	109.7	42.1	178.3	11	10	19	9	47
10020002 Beaverhead	1826.2	643.7	130	78.7		25.1	16.4	79.5	13		3	2	21
10020003 Ruby	1284.7	575.8	152	48.6	27.4	39.5	64.5	72.3	9	3	9	10	38
10020004 Big Hole	3953.7	1594.4	431	102.6	33.7	26.3	80.9	378.5	25	7	8	16	122
10020005 Jefferson	2176.2	456.7	86	7.7	12.0		5.8	34.4	2	1		1	8
10020006 Boulder	998.3	322.6	79	1.8				42.7	1				6
10020007 Madison	2517.1	793.9	211	11.8	11.0	17.0	19.2	177.4	2	2	4	5	47
10020008 Gallatin	2401.3	777.8	174	2.3		19.5	23.8	180.0	1		3	6	51
TOTAL - Upper Missouri	18645.9	6288.6	1551	330.5	161.0	237.1	252.7	1143.1	64	23	46	49	340
10030101 Upper Missouri	4763.9	1106.3	301	42.1			29.9	271.4	8			6	58
10030102 Upper Missouri - Dearborn	3538.7	1077.8	151					112.3					20
10030103 Smith	2858.3	986.4	222	36.1		11.9	23.0	412.8	9	3		5	109
10030104 Sun - West	690.0												
10030104 Sun - East	1714.4	708.1	134	2.4		14.2		144.5	1	3			27
10030105 Belt	800.5	370.7	75	26.4		11.6		134.6	5	2			35
10030201 Two Medicine	1422.2	679.6	141	45.5	4.8	28.4	19.8	117.8	12	3	7	7	28
10030202 Cut Bank	1089.2	508.9	61					0.0					0
10030203 Marias	2493.7	1033.7	86					0.0					0
10030204 Willow	708.1	333.7	39					0.0					0
10030205 Teton	1751.4	774.6	102	25.0		12.8		71.9	7		3		15
TOTAL - Forks to Teton	21140.4	7579.8	1312	177.5	4.8	78.9	72.7	1265.3	42	3	18	18	292
10040101 Bullwhacker - Dog	1803.4	682.5	53					0.0					0
10040102 Arrow	1326.3	520.4	68					0.0					0
10040103 Judith	3222.7	1152.3	131	13.7	2.9	16.7	2.4	156.2	5	1	4	1	29
10040201 Upper Musselshell	4676.3	1568.1	146	17.5			0.0	38.8	1			1	3
10040202 Middle Musselshell	2477.2	782.6	60					0.0					0
10040203 Flatwillow	891.0	336.0	29					8.0					1
10040204 Box Elder	1371.8	507.4	35	6.1				0.0	1				0
10040205 Lower Musselshell	1810.0	608.7	41					0.0					0
TOTAL - Teton to Musselshell	17578.7	6158	563	37.3	2.9	16.7	2.4	203	7	1	4	2	33
TOTALS	57365.0	20026.4	3426	545.3	168.7	332.7	327.8	2611.4	113	27	68	69	665
Excluding upper Sun (West)													
		281 reaches had no length measurements											
Percent of Basin without upper Sun													
Percent				0.9622	0.2977	0.5870	0.5784	4.6077					
Cumulative Percent				0.9622	1.2598	1.8468	2.4252	7.0329					
Percent of Surveyed Basin													
Percent				2.7229	0.8424	1.6613	1.6368	13.0398	3.2983	0.7881	1.9848	2.0140	19.4104
Cumulative Percent				2.7229	3.5653	5.226	6.8634	19.9032	3.2983	4.0864	6.0712	8.0852	27.4956

Table 1. Miles and number of reaches westslope cutthroat trout (Oncorhynchus clarki lewisi) presently inhabit in streams and rivers within the upper Missouri River basin. Information obtained from the Montana River Information System last updated on January 1, 1996.

Table 1 also provides information on westslope cutthroat trout occupancy of stream reach units. Of the 3,426 reaches sampled, 113 reaches contained 100% genetically pure populations (3.3%); 27 reaches supported 98-99.9% pure populations (2.0%); 68 reaches had 90-97.9% pure populations (2.1%); known hybridized (<90% pure) populations were found in 69 reaches (2.0%); while suspected, but untested, populations were found in 695 reaches (19.4%).

In summary, MRIS database information indicates that westslope cutthroat trout within the UMRB presently occupy only a fraction of their historic stream habitats. Additional review of fish survey data collected by Montana Fish, Wildlife and Parks (FWP), Forest Service (FS), and Bureau of Land Management (BLM) revealed that several populations have gone extinct within the past ten years and that almost all populations presently occupy isolated habitat fragments, many of which are very small (less than 5 miles in length).

Reasons for Decline - Processes of Extinction

Primary factors associated with recent population extinctions and the fragmentation of habitats within the UMRB, include the presence of non-native salmonids (rainbow trout and brook "trout" or char) and habitat degradation caused by land and/or water management practices. These factors have also been cited as causes for the decline of westslope cutthroat trout by previous investigators (Liknes and Graham 1988; McIntyre and Rieman 1995).

Rieman and McIntyre (1993) reviewed population extinction theory and applied it to bull trout, another native fish species in decline throughout their historic range. They characterized the processes of extinction and placed them into three major categories; deterministic, stochastic, and genetic based on the work of Gilpin (1987), Gilpin and Soule' (1986), Leigh (1981), and Shaffer (1987, 1991):

> **Deterministic** extinction occurs when a permanent or long-term change causes a population to decline to zero (Gilpin and Soule' 1986). Rieman and McIntyre suggest that the importance of mortality related to fishing, predation, or competition with introduced species may increase sharply when habitats have become degraded.

Review of existing information indicates that deterministic factors are now causing extinction of some westslope cutthroat trout populations within the UMRB. The two primary deterministic risk factors underlying the relatively high risk of extinction are introduced trout species and degraded habitat conditions within streams.

> **Stochastic** risks are random demographic and environmental events which lead to a population crash. Demographic stochasticity probably is unimportant unless total

population size becomes very small (ie. 20 adults). Shaffer (1987, 1991) considered environmental stochasticity to include both chronic and catastrophic environmental effects.

All westslope cutthroat trout populations within the UMRB now inhabit isolated headwater streams. As the majority of these headwater streams have been adversely effected by either land/water management activities or invasion by non-native salmonids, or both, the risk of extinction from stochastic environmental effects (chronic and/ or catastrophic) is therefore, believed to be high.

Genetic extinction can also be linked to the loss of genetic diversity within a species. When diversity decreases, the combination of genes that permit a species to survive in a highly variable environment are lost. This decreases a species ability to adapt to changed environmental conditions.

The "risk of extinction" to westslope cutthroat trout in this latter category is associated with the relatively high level of genetic divergence among populations within the UMRB. Therefore, the loss of additional populations will probably result in loss the of genetic diversity within the subspecies. Geneticists have recommended conservation of as many populations throughout their range as necessary to conserve the genetic diversity presently contained within this subspecies (Allendorf and Leary 1988).

ASSESSMENT METHODS

A two-part questionnaire was developed to obtain information on known westslope cutthroat trout populations for this broad-scale assessment. Populations were classified as at least 90% genetically pure based on either genetic analyses or, for recently discovered and untested populations, an evaluation by the local biologist. For this assessment only populations which occupied lands which are administered by the Forest Service or Bureau of Land Management were assessed.

Part A of this questionnaire utilized a viability assessment for all known 90-100% genetically pure populations, and was completed by individuals or teams of State and Federal fisheries biologists (see Appendix B). For Part B, the percentage of effects to aquatic systems within each occupied westslope drainage was estimated for a variety of land and water management activities. These estimates were made by Forest Service and BLM field-level resource Interdisciplinary (ID)

Teams within the basin (Appendix C). Detailed directions and two days of training were provided to fisheries biologists and ID Teams for completion of the questionnaire.

A description of the underlying methodologies used for Parts A and B of the questionnaire follows.

Questionnaire: Part A

Part A of the questionnaire utilized a "Bayesian Belief Viability Assessment Model" (BayVAM) developed for interior trout and char species by D. Lee and B. Rieman at the Forest Service's Intermountain Research Station in Boise, Idaho (Appendix B; Section 1). Viability, in the context of this model, refers to the probability that a population or group of populations will persist within some given area and period of time. Therefore, this viability assessment refers to the quantitative evaluation of risk of extinction for individual westslope cutthroat trout populations.

In general, the BayVAM model utilizes a hybrid approach to viability assessment that blends professional judgement (qualitative assessments) with quantitative data to provide a generalized evaluation of risk and uncertainty. Use of the BayVAM model requires fisheries biologists to judge the relative condition of the important processes or characteristics that influence population dynamics or long-term persistence. Uncertainty associated with professional judgement due to lack of information or experience is incorporated in the model. As model assumptions and parameter estimates are explicit, the analysis is repeatable, and defensible.

The BayVAM model also allows for ranges, associated with individual parameters, to be revised with local or more site-specific information. Revisions to some of the model parameter ranges were made in December, 1994 using data from westslope cutthroat trout populations within the UMRB (Appendix B; Section 2).

Field-level Federal and State agency fisheries biologists (see Acknowledgments Section) were provided a set of directions which included the revised ranges for certain model parameters (nodes) to complete Part A of the questionnaire. Biologists were requested to complete Part A for all known westslope cutthroat trout populations which were, at least, 90% genetically pure based on horizontal starch gel electrophoretic testing (Leary et al. 1987). A few populations were included by the biologists for which electrophoretic testing had not yet been completed but were believed to be genetically pure based on field examination of the physical features of individual trout. Biologists also estimated the length of stream habitat occupied, in miles, for each westslope cutthroat trout population included in the assessment.

Questionnaire: Part B

Information needed to complete Part B of the questionnaire (Appendix C, section 1) was provided by field-level ID Teams (see Acknowledgments Section). Each team was directed to estimate the percent of aquatic systems affected by various land and/or management activities in the subwatershed occupied by a population for which information was provided under Part A. Drainage boundaries had been previously delineated using the US Geological Survey's Hydrologic Unit Coding system. These subwatersheds ranged from 20,000 - 40,000 acres in size and were equivalent to "6th Code Hydrologic Units" or "6th Field" Units.

Estimates of the percentage of aquatic habitat in each subwatershed affected by a management activity was then ranked as either Low (1-10%); Moderate (11-20%); or High (>20%). When the ranking assigned by management activity for the entire 6th field subwatershed was identified as not being applicable to the occupied stream reach, the questionnaire respondent was contacted to provide their estimate of the effect of that activity on the occupied reach.

ANALYSES OF QUESTIONNAIRE DATA

Questionnaire responses from 146 questionnaires were entered into dBase data files. Responses from two streams later determined not to contain westslope cutthroat trout that were at least 90% genetically pure, were removed from further analyses. This left a final sample size of 144 populations. For Part A of the questionnaire (Bay VAM Model), the following steps were used to analyze the data:

1) Data was summarized by conducting frequency analyses for confidence levels (which the fisheries biologists had assigned as low, moderate, and high) at each node in the BayVAM model;

2) Frequencies were then plotted by 10% confidence level increments (0 represented 0; 10 represented >0 to 10, 20 represented >10 to 20, etc);

3) BayVAM model was then run for each westslope cutthroat population;

4) Model outputs were used to calculate the probability that the population would persist for 100 years (Probability of Persistence);

5) Probabilities of Persistence were plotted at 0.10 intervals (probability classes);

6) Intervals were then aggregated into classes of "Very High", "High", and "Moderate" based on above frequency analysis;

7) Each population was assigned to one of these three classes based on its Probability of Persistence and finally;

8) Estimates of genetic purity (based on horizontal starch gel electrophoresis) were segregated into three classes (100%, 98-99.9%, and 90-97.9% pure). This genetic classification was based on preliminary recommendations from the State's Upper Missouri Westslope Cutthroat Trout Technical Committee (Minutes of August 4, 1995). Also included was a class for untested, but suspected pure, populations.

A concern was raised that observer bias might have influenced the results on population status due to reliance on professional judgement of local experts within their management areas. Due to the inability to randomly assign streams to observers or to replicate sampling of streams, observer bias was assessed using a statistical test. In this test, the average Probabilities of Persistence (as predicted from the BayVAM model) were compared across observers and tested for differences using the Kruskal-Wallis nonparametric test (Daniel 1978).

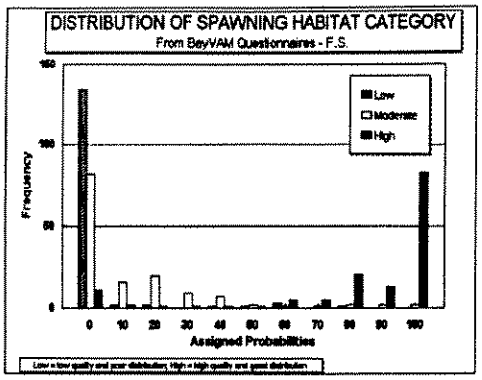
For Part B, ID Team ratings based on effects to aquatic systems from management activities within the occupied 20,00-40,000 acre subwatershed were analyzed with Probabilities of Persistence (Part A) using a MANOVA test (SAS version 6.03, 1988). The first test incorporated the ratings for management activities that were identified as occurring in all 144 occupied watersheds. These included; Roads, Livestock Grazing, Mining (including oil and gas development), Timber Harvest, Water Diversions, Angling, and Presence of Non-Native Fishes. Cumulative Effects was excluded as this variable incorporated effects from the individual management activities listed above.

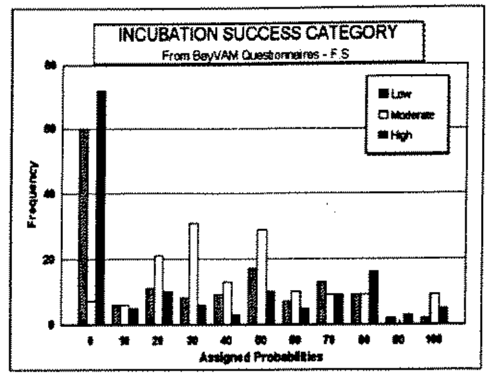
The second test included Cumulative Effects, Forest or Resource Area Plan Allocation, and Risk of Catastrophic Event for which ratings were provided in 134 subwatersheds. Ratings of all of the above effects (except Cumulative Effects) were then classified as "None", "Low", "Moderate" or "High".

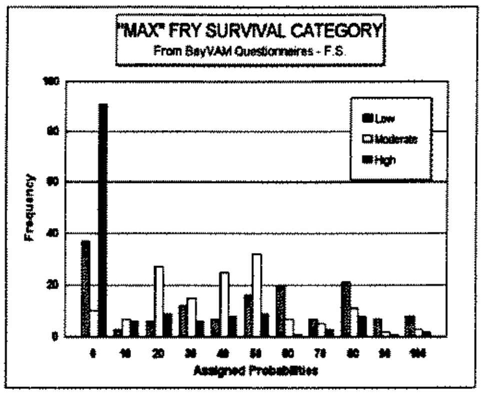
RESULTS

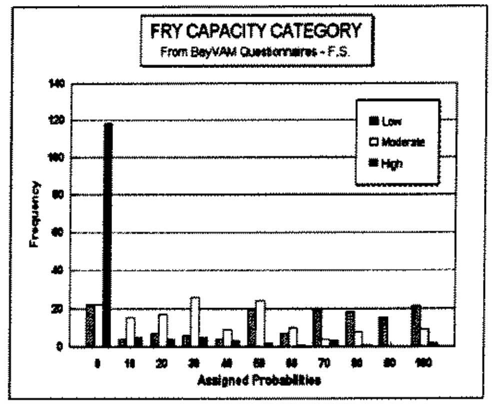
Questionnaire: Part A
Model Life-History and Population Nodes

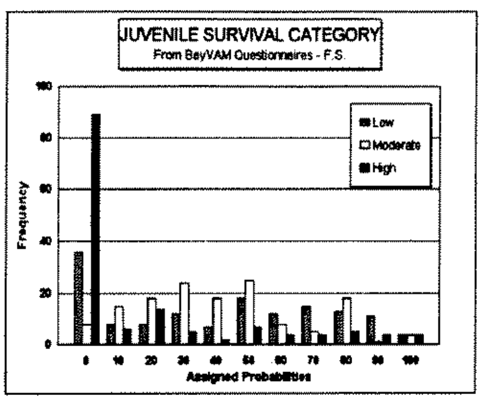
Fisheries biologists did not always enter values for all categories (model nodes), therefore, sample sizes varied by node. All respondents used the default values at the Age at Maturity and Fecundity nodes (Figure 2). Biologists were highly confident that the Distribution and Quantity of Spawning Habitats was "High" for a majority of streams (Figure 2). This was the only category where there was a high level of confidence in the "High" rating. Fisheries biologists were also relatively confident that many streams should be assigned a "Low" rating at the Initial Population Size node. Additional nodes which respondents were fairly confident that most of the stream populations did not fall into the "High" category (but were less certain as to whether it was "Low" or "Moderate") included Fry Capacity (Figure 2), Expected Population Size (Figure 3), and, to a lesser extent, Juvenile/Sub-Adult Survival (Figure 2). Fisheries biologists were less confident in their assessments or populations had a wider range of variability for the remaining model nodes with the "moderate" range most frequently selected.

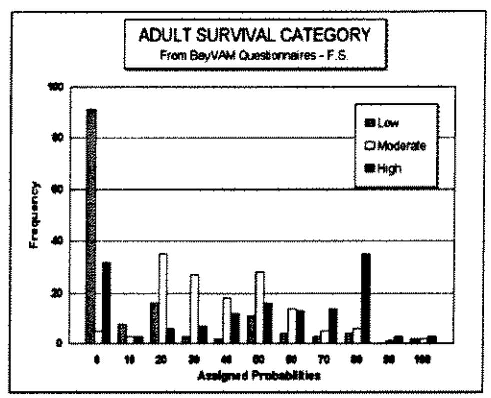












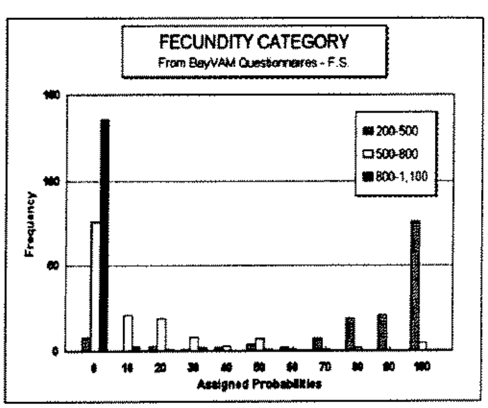


Figure 2. Frequencies of relative confidence (as a percent) biologists placed on their assignment of ranks for life history parameters for westslope cutthroat trout populations inhabiting tributaries within Federal lands in the upper Missouri River basin. Frequencies are assigned to bins of 10% confidences with the upper bound shown (0 = 0, 10 = 1-10, 20 = 11-20, etc.).

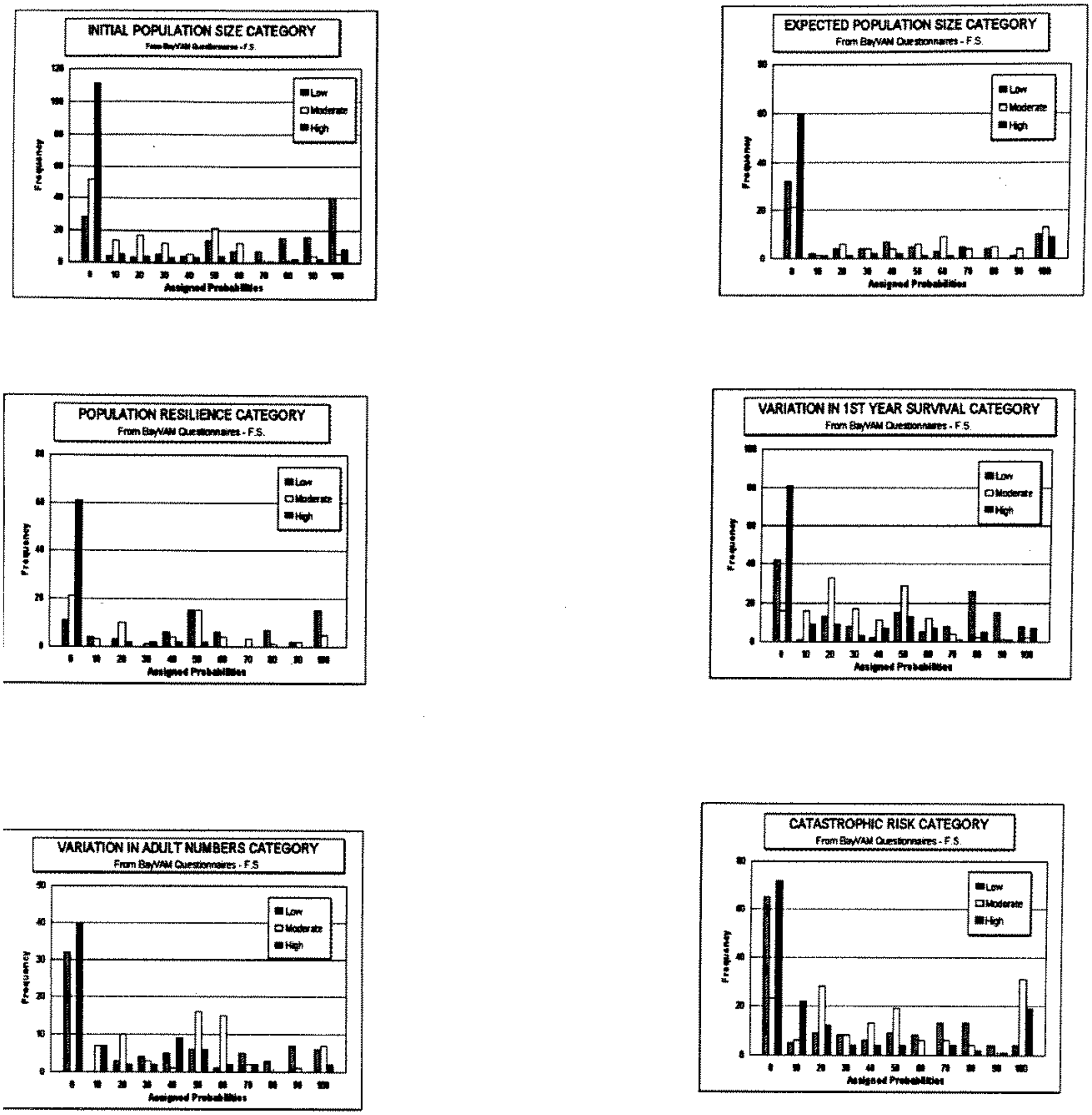


Figure 3. Frequencies of relative confidence (as a percent) biologists placed on their assignment of ranks for population-level categories for westslope cutthroat trout population inhabiting tributaries located within Federal lands in the upper Missouri River basin. Frequencies are assigned to bins of 10% confidence with the upper bound shown (0 = 0, 10 = 1-10, 20 = 11-20, etc.).

Model Outputs

Criteria developed by Shaffer and Sampson (1985) requires **at least** a 95% probability that a population will persist for 100 years to be considered at a "Low" risk of extinction. Predicted Probabilities of Persistence model outputs were used to develop additional classes to rate extinction risk. These three classes included: 0-50% probability of persistence was assigned to the "Very High" class for risk of extinction; >50-80% probability of persistence was assigned to the "High" class for risk of extinction; and >80-95% probability of persistence was assigned to the "Moderate" class for risk of extinction. Based on these criteria, none of the 144 westslope cutthroat trout populations tested had a "Low" risk of extinction.

BayVAM model predictions for Probability of Persistence (% probability that a population will persist for 100 years) was plotted to display the discrete and cumulative frequency distribution (Figure 4). The risk of extinction was then rated and assigned to one of the three categories (Moderate, High, Very High) based on relative changes in the slope of the cumulative distribution line.

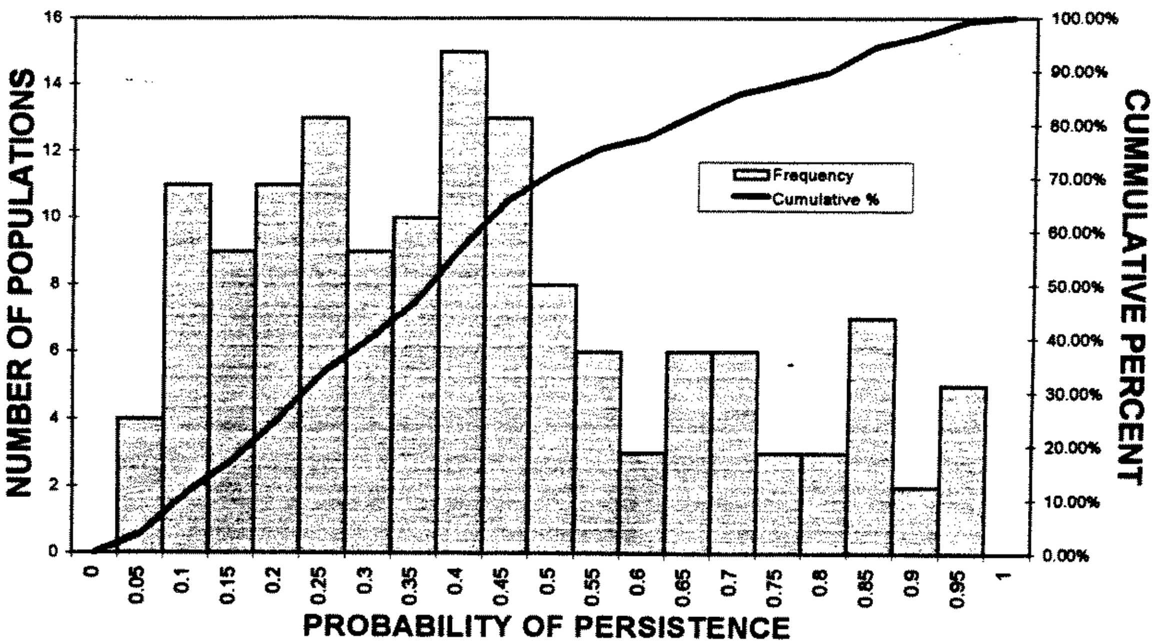


Figure 4. Number of populations by 0.05 predicted probability of persistence and cummulative distribution of populations by probability of persistence from BayVAM model results for 144 westslope cutthroat trout populations in the upper Missouri River basin.

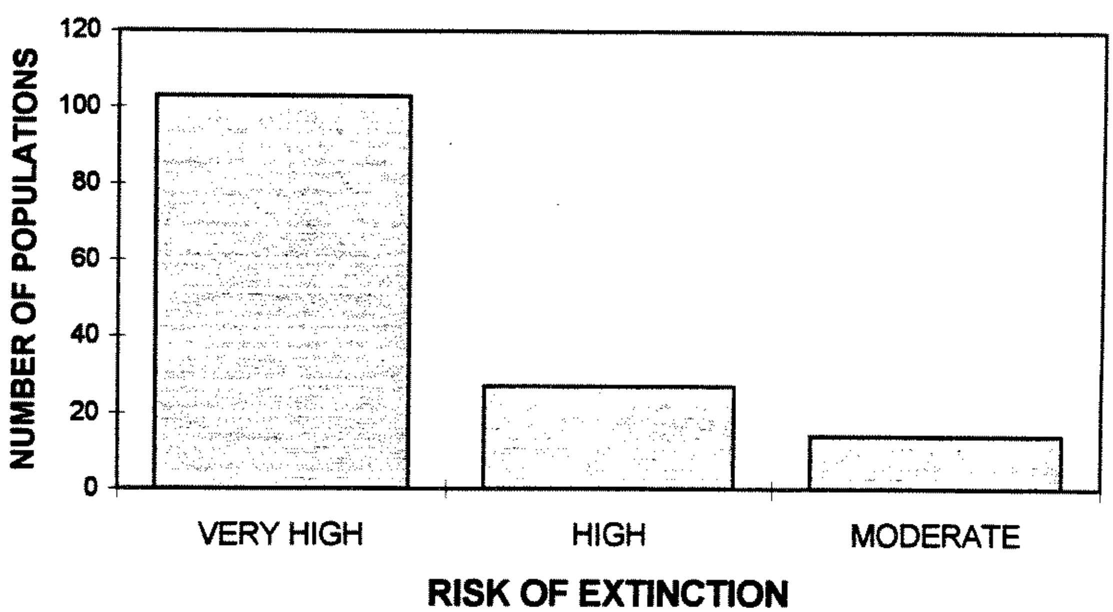


Figure 5. Number of populations by rated risk category from BayVAM model predictions for 144 westslope cutthroat trout populations in the upper Missouri River basin.

The majority, 103 (71%) of the 144 populations, had a "Very High" risk of extinction (<50% probability of persisting for 100 years) (Figure 5). Twenty seven of the populations (18%) had a "High" risk of extinction (50-80% probability of persisting 100 years). Fourteen (10%) of the populations had a "Moderate" risk of extinction (>80-95% probability of persisting 100 years).

There appeared to be no relationship between predicted Probability of Persistence estimated by the model for each population and the estimated length of stream it occupied (Figure 6).

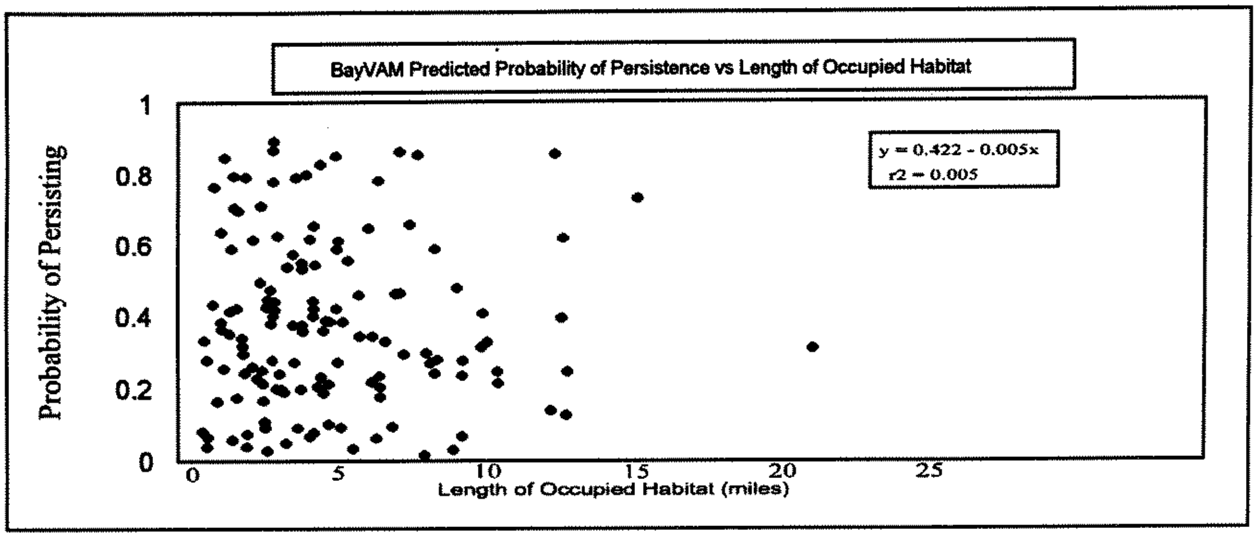


Figure 6. Scatter plot of predicted probabilities of persistence versus length of occupied habitat (miles) for 144 populations of westslope cutthroat trout within Federal lands of Montana.

Average predicted Probabilities of Persistence differed between observers (Figure 7) and these differences were significant ($p < 0.001$; Kruskal-Wallis test). However, these differences could be partially explained by the fact that observer 7 assessed mostly "healthy" westslope cutthroat trout populations and observer 2 assessed primarily populations which were being highly adversely affected by livestock grazing.

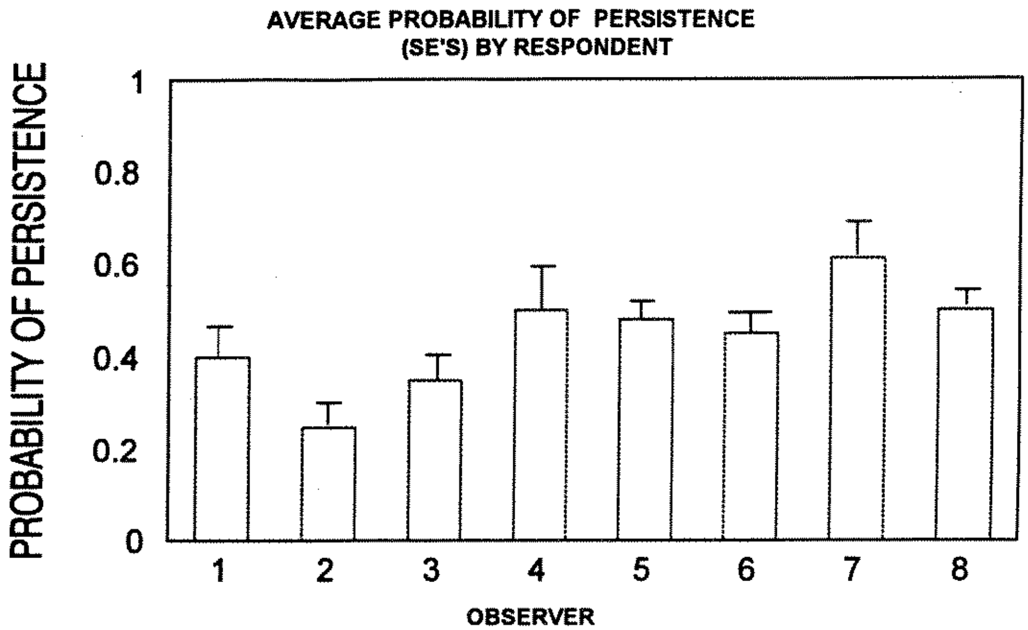


Figure 7. Means (bars) and SE's (vertical lines) of predicted probabilities of persistence for westslope cutthroat populations inhabiting Federal lands within the UMRB by observer.

Predicted Probabilities of Persistence followed a trend with higher average persistence probabilities usually predicted for those populations inhabiting watersheds with lower rated adverse impacts from management activities (Table 2). For analyses of individual management activity types, impacts from Livestock Grazing and Non-Native Fish were significantly related to predicted Probabilities of Persistence ($P<0.01$; Table 2). For analysis of Cumulative Effects and Catastrophic Risk, rated impacts of both were significantly related to predicted Probabilities of Persistence ($P<0.01$; Table 2). When a MANOVA test was conducted for those 134 populations which had information on rated impacts from Forest Plan Allocation and Catastrophic Risk, with Cumulative Effects replacing impacts from individual management activity classes, the relationship between Cumulative Effects and predicted Probabilities of Persistence were significant ($P<0.01$). Adverse effects from Forest Plan Allocations were not significant ($P>0.01$).

	GRAZING	NON-NATIVE FISH	ROADS	MINERALS	TIMBER	WATER WITHDRAWAL	ANGLING	MAJOR EVENT	CUMMUL EFFECTS	FOREST PLAN
NONE	0.701 (7)	0.592 (27)	0.481 (18)	0.402 (84)	0.407 (68)	0.454 (61)	0.378 (21)	0.255 (12)	N/A	0.414 (2)
LOW	0.456 (42)	0.357 (14)	0.407 (73)	0.412 (39)	0.393 (55)	0.366 (47)	0.42 (104)	0.339 (86)	0.573 (26)	0.491 (49)
MODERATE	0.412 (40)	0.4 (30)	0.374 (32)	0.328 (12)	0.345 (13)	0.314 (15)	0.343 (11)	0.519 (32)	0.405 (58)	0.321 (30)
HIGH	0.297 (55)	0.328 (73)	0.313 (21)	0.341 (9)	0.39 (8)	0.348 (21)	1.192 (8)	4.481 (6)	0.309 (60)	0.308 (53)
MANOVA test results: Model F value = 3.91; p < 0.001 (includes only 134 populations which had Forest Plan, Cumulative, and Catastrophic Risk assessments)										
Type I Sum of Squares										
F VALUE	14.14	11.23	2.42	0.13	0.83	2.25	0.65	1.94	4.87	0.96
P	<0.001	<0.0001	0.0704	0.9399	0.4781	0.0871	0.5837	0.1275	0.0095	0.414
Type III Sum of Squares										
F VALUE	1.61	5.14	1.37	0.71	1.44	1.67	0.5	2.91	4.87	0.35
P	0.1926	0.0023	0.2554	0.5608	0.235	0.1777	0.6853	0.0382	0.0095	0.7918

N/A INDICATES NO DATA

Table 2. Means (sample size) of probabilities of westslope cutthroat trout persisting from the BayVAM model by "None", "Low", "Moderate", and "High" ratings assigned by biologist from effects of land management or human related disturbances on 144 westslope cutthroat trout populations within the upper Missouri River basin along with results from MANOVA tests.

Spatial Distribution of Populations

There are 27 subbasins within the historic range of westslope cutthroat trout in the UMRB above Fort Peck Dam (Table 3). Seventeen of these subbasins currently contain at least one population of westslope cutthroat. This analysis included at least one population from 16 of these subbasins. Additional populations have been verified in one additional subbasin (Lower Musselshell) since the time of this analysis. The majority of the 144 populations included in this analysis are located in the southwest portion of the UMRB (Figure 8), with the density of populations decreasing in the northern and eastern portions of the basin.

The remaining populations occupy high elevation stream fragments associated with mountain ranges. The location of remaining populations follows two distinct patterns within subbasins (Figure 9). In the high elevation southwest subbasins, populations tend to be distributed in tributary streams throughout the subbasin (e.g. Bighole River subbasin). These subbasins lie within high elevation areas surrounded by mountains. In the subbasins associated with the east front of the Rocky Mountains and the isolated mountain ranges in the eastern portion of the UMRB, remaining populations tend to be located in headwater areas (e.g. Two Medicine River subbasin). In these subbasins, the headwater areas are associated with island mountain ranges (e.g. Belt Range, Judith Range, Snowy Range) or the east front of the Rocky Mountains, and the lower portions of the subbasins drain lower elevation prairie areas.

	Moderate Risk				High Risk				Very High Risk				
Sub-basin	100%	98-99.9%	90-97.9%	UNTESTED	100%	98-99.9%	90-97.9%	UNTESTED	100%	98-99.9%	90-97.9%	UNTESTED	TOTAL
Red Rock	1	1	0	1	1	2	1	9	9	2	9	0	27
Beaverhead	1	1	1	0	1	0	1	0	6	0	0	0	11
Big Hole	0	1	1	0	2	1	1	2	17	3	2	2	32
Ruby	0	0	1	0	0	0	0	0	6	2	7	0	16
Jefferson	0	0	0	0	1	0	1	0	0	0	0	1	3
Boulder	0	0	0	0	0	0	0	0	1	0	0	2	3
Madison	2	0	0	0	0	1	0	0	0	0	1	1	5
Gallatin	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Missouri	0	0	0	0	3	0	0	0	7	0	0	0	10
Upper Missouri (D)	0	0	0	0	0	0	0	0	0	0	0	0	0
Smith	1	0	0	0	0	0	2	0	7	0	0	0	10
Sun	0	0	0	0	0	0	0	0	0	0	2	0	2
Belt	0	0	0	0	1	0	0	0	3	0	1	0	5
Two Medicine	1	0	0	0	2	0	0	0	1	0	4	0	8
Cut Bank	0	0	0	0	0	0	0	0	0	0	0	0	0
Marias	0	0	0	0	0	0	0	0	0	0	0	0	0
Willow	0	0	0	0	0	0	0	0	0	0	0	0	0
Teton	0	0	0	0	1	0	0	0	1	0	2	0	4
Judith	1	0	0	0	1	0	0	0	2	1	1	0	6
Bullwacker-Dog	0	0	0	0	0	0	0	0	0	0	0	0	0
Arrow	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Musselshell	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Musselshell	0	0	0	0	0	0	0	0	0	0	0	0	0
Flatwillow	1	0	0	0	0	0	0	0	0	0	0	0	1
Box Elder	0	0	0	0	1	0	0	0	0	0	0	0	1
Lower Musselshell	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	7	3	4	0	14	3	7	3	60	8	29	6	144

Table 3. Number of westslope cutthroat trout populations by extinction risk and genetic classes in each major sub-basin believed to be within their range in the upper Missouri River basin.

Figure 8. Distribution of westlope cutthroat trout populations (by 6th code hydrologic unit) within the Upper Missouri River Basin.

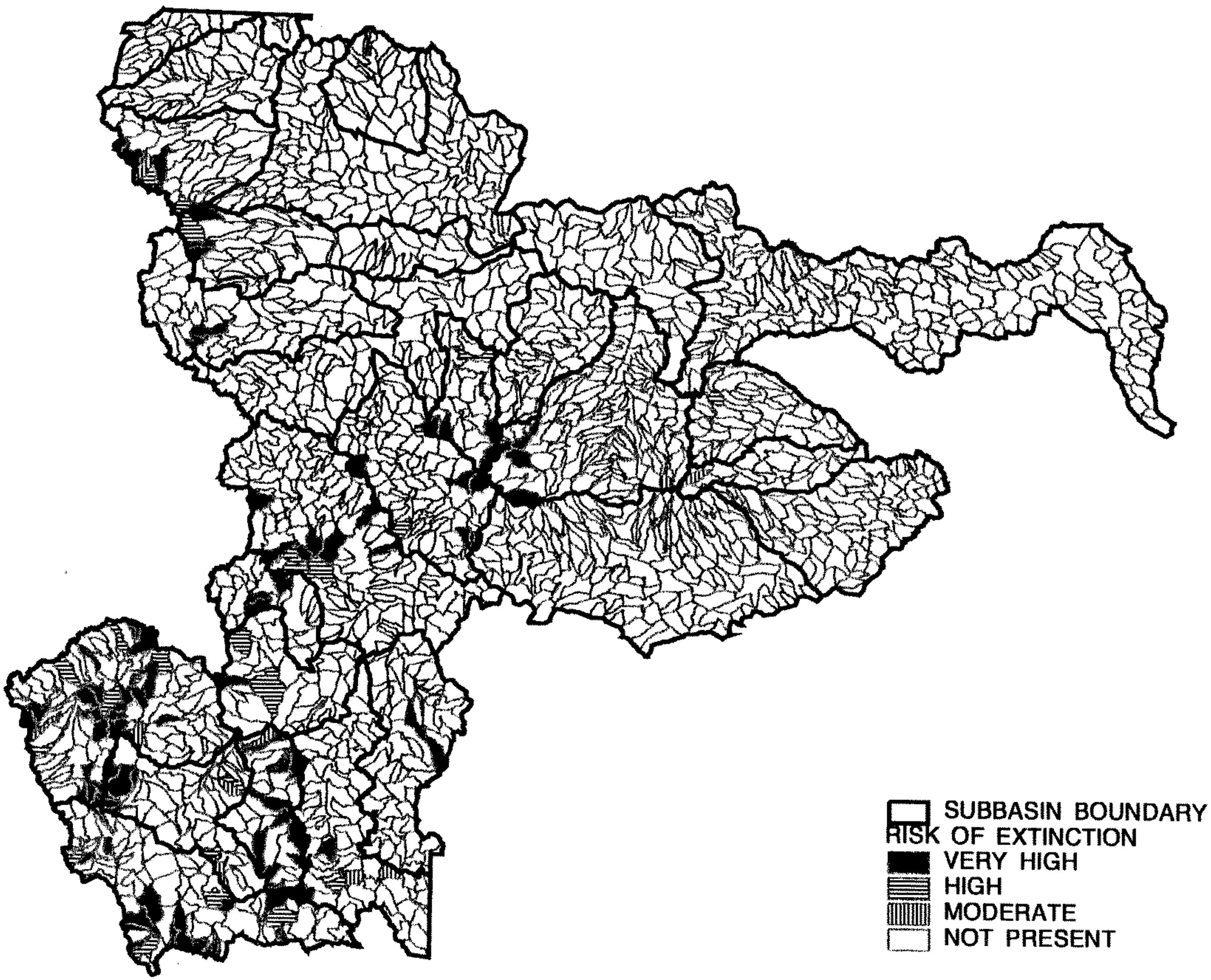
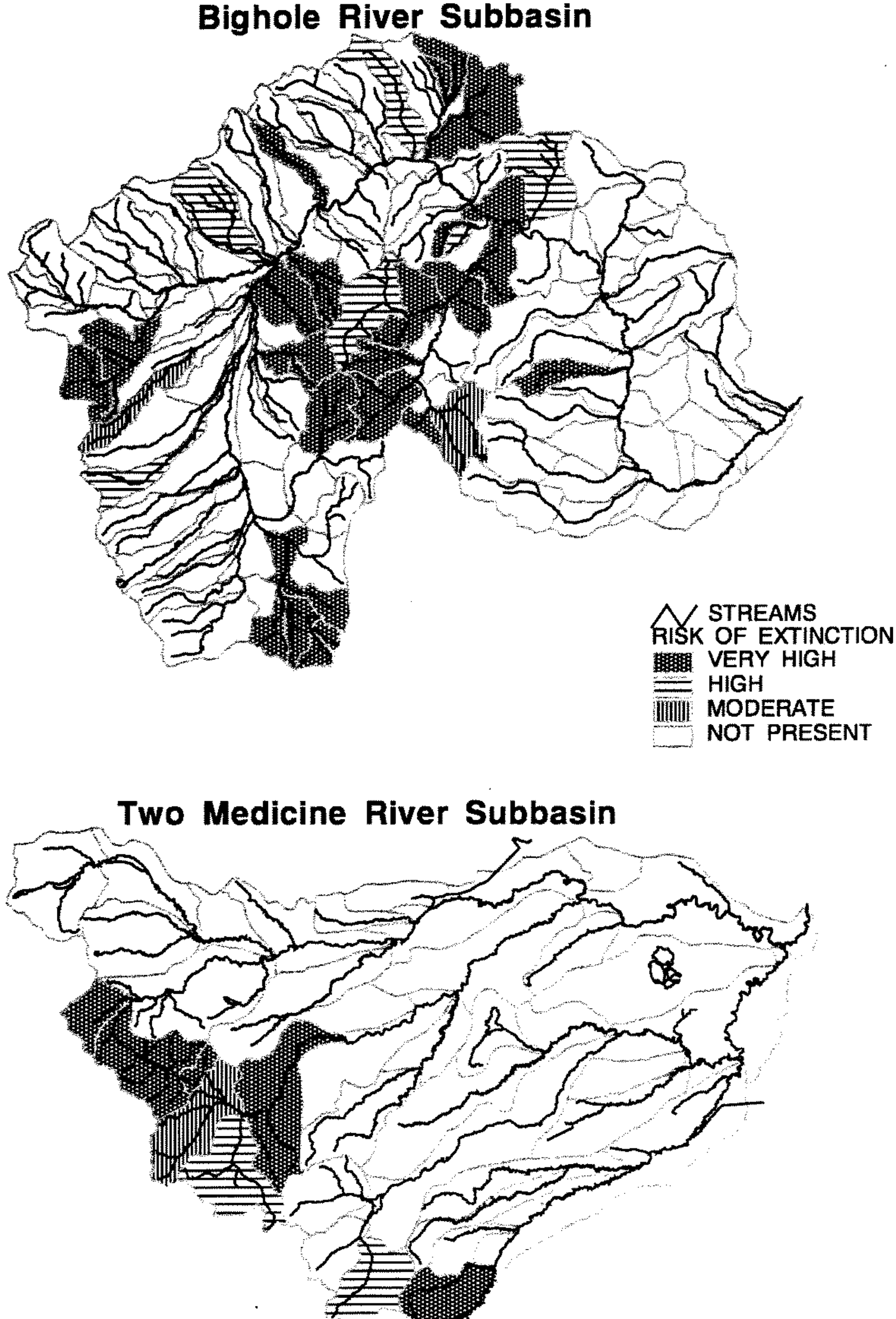


Figure 9. Distribution of westslope cutthroat trout populations in two subbasins of the Upper Missouri River Basin.



MANAGEMENT CONSIDERATIONS

One of the primary factors leading to the decline of westslope cutthroat trout in the upper Missouri River basin has been trout hybridization with, and replacement by, other *Onchoryncus* species. Westslope cutthroat readily hybridize with rainbow trout and yellowstone cutthroat trout. These two species have been widely introduced in streams and lakes in the UMRB. An important component of determining the status of westslope cutthroat populations has been genetic analysis of potential populations using horizontal starch-gel electrophoresis. Genetic status is an important consideration in management of westslope cutthroat populations due to potential contamination of genetically pure populations by adjacent hybrid populations, human assisted re-founding of new populations, and potential development of a broodstock for re-establishing populations in streams and lakes. The Montana Upper Missouri Westslope Cuttroat Technical Committee (UMWCTTC) provided preliminary recommendations on genetic classification. In 1955 this committee recommended three genetic classes of westslope cutthroat trout (100% pure, 98.0-99.9% pure, and 90-97.9% pure) and provided recommendations for management of each class. An additional class includes populations which have not been genetically analyzed, but are suspected to be westslope cutthroat trout. Of the 144 populations used in this analysis over half (81) were 100% genetically pure (Table 4). However, only 7 of the genetically pure populations were considered to be at "Moderate" risk of extinction.

	GENETIC	PURITY			
RISK OF EXTINCTION	100%	98-99.9%	90-97.9%	UNTESTED	TOTAL
VERY HIGH	60	8	29	6	103
HIGH	14	3	7	3	27
MODERATE	7	3	4	0	14
TOTAL	81	14	40	9	144

Table 4. Number of westslope cutthroat trout populations by genetic status which the BayVAM model predicted had a "Very High", "High", or "Moderate" risk of going extinct.

This analysis indicates that the majority of westslope cutthroat trout populations occupying Federal lands within the UMRB are at a "high" or "very high" risk of becoming extinct within the next 100 years under existing conditions. This risk rating does not include additional stresses placed on these populations from new land or water management activities, or concerted conservation efforts focused on preservation and restoration. The small habitat fragments which these populations now occupy, indicated by stream length occupied and lack of connectivity between these populations, are also believed to be leading to their tenuous status (Rieman and

McIntyre 1993). Negative effects from management activities and presence of naturally reproducing non-native trout (primarily brook and rainbow trout) populations were significant and inversely related to the predicted probability that remaining populations of westslope cutthroat trout will persist.

Short-term Needs

With respect to the findings of this Assessment, the (UMWCTTC) through FWP, recommended that the following interim strategies be adopted by the Forest Service and Bureau of Land Management. The following is excerpted from their letter of April 10, 1996:

> 1. Aquatic habitats in all drainages which support populations ≥ 90% genetically pure (presently 144 populations) should be protected from existing and future land management impacts. The level of protection should be further specified and related to genetic purity of individual populations. We want to make it clear that the 144 presently identified populations will likely be a somewhat dynamic number as some populations are going extinct while other new populations are being documented. The important point is that any habitats which can support westslope cutthroat trout populations which are at least 90% pure should be maintained in as high a quality as possible to allow for recovery this subspecies in the basin.
>
> 2. As an interim priority, until a basin-wide conservation strategy presently being developed by the (UMWCTTC) is adopted, management emphasis should be focused in the tributaries which support genetically pure populations which have a "Moderate" or "High" probability of extinction.* The 100% pure populations should first be secured and populations which are 98-99% pure (which the Committee has designated as "pure" for management purposes) should then be secured. At the present time, 21 populations meet the "Moderate" or "High" risk criteria and are 100% genetically pure, while 6 populations are 98-99% pure.
>
> * The rationale for recommending that healthier populations be secured first is based on the level of effort needed to secure this type versus what would be needed to sustain populations which were in the "very high" risk of extinction class.

The FWP letter concluded with the recommendation that local information and existing conservation/restoration efforts should be used, in addition to the above recommendations, to prioritize those populations selected for further consideration.

A commitment to implement these recommendations, prior to the adoption of a State directed conservation strategy for the basin, was made by Hal Salwasser-Regional Forester and Larry Hamilton-State BLM Director in March 1996. Subsequent to this agreement, a UMRB "Steering Committee" comprised of Federal and State Agency line officers was convened to oversee development of a "short-term" implementation strategy.

This “Short Term Strategy” was completed in mid-June, 1996 and was based on the results of this broad-scale assessment. Primary objectives of this strategy are to prevent further habitat degradation and begin restoration efforts on Forest Service and Bureau of Land Management-administered lands until a long-term strategy can be developed and implemented. This strategy calls for avoiding or deferring new activities in all streams occupied by westslope cutthroat trout populations covered under this assessment unless no further habitat degradation or an improvement over existing conditions can be demonstrated. In addition, specific timeframes are identified for evaluating effects of ongoing activities and development of remedial action plans in occupied watersheds where problems are found to exist. Finally, a list of Agency programs are identified that will require additional emphasis and funding to support restoration efforts for westslope cutthroat trout populations.

Long-term Needs

To address long-term conservation and restoration needs, the state of Montana through FWP will develop a conservation and restoration plan for westslope cutthroat trout based on scientific recommendations provided by the UMWCTTC and input from the public. It is anticipated that this broad-based management plan will be implemented through collaborative conservation agreements and strategies which will detail management actions and schedules for completing identified actions.

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ACKNOWLEDGMENTS

The agencies would like to thank the many people who assisted in the completion of this assessment. These include:

Development of "Ecological Assessment Process for Sensitive Species (FSM 2670)"

Forest Service - Northern Regional Office

Linda Ulmer, Regional Aquatic Ecologist (co-lead)
Leslie Vaculik, Leasable Minerals Specialist (co-lead)
Martin Prather, Wildlife Ecologist
Larry Blocker, Landscape Architect
John Haber, Planner/Legal Analyst
Don Foth, Forester
Fred Bower, Transportation Engineer

BLM - Montana State Office

Dan Lechefsky - Environmental Planner

Questionnaire Development

Northern Region - Forest Service

(see above list of names) including;

Brian Sanborn, Fisheries Biologist (Beaverhead-Deerlodge NF)
Bo Stuart, Hydrologist (Helena NF)
Wayne Phillips, Ecologist (Lewis & Clark NF)
Dan Svoboda, Forest Soil Scientist/Sensitive Plants (Beaverhead-Deerlodge NF)

Questionnaire Completion

Forest Service - Northern Region

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Mark Story, Forest Hydrologist

Beaverhead-Deerlodge National Forest

Brian Sanborn, Forest Fisheries Biologist
Dave Browning, Zone Fisheries Biologist (Dillon RD)
Pete Bengeyfield, Forest Hydrologist
Dan Svoboda - Forest Soil Scientist/Sensitive Plants
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Gil Gale, Resource Assistant (Wisdom RD)
Bruce Roberts, Zone Fisheries Biologist (Wise River/Wisdom RDs)
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Eric Tolf - Resource Assistant (Jefferson Ranger District)
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Bo Stuart, Forest Hydrologist
Dwight Chambers, Forest Planner
Dennis Heffner, ID Team Leader
Lois Olsen, Forest Ecologist
Larry Laing, Forest Soil Scientist
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Lewis & Clark National Forest

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Wayne Phillips, Forest Ecologist
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APPENDIX A

Chronology of efforts and decisions associated with the broad-scale assessment of westslope cutthroat trout populations on Forest Service (FS) and Bureau of Land Management (BLM) lands within the upper Missouri River basin (UMRB):

February, 1994 - Environmental analyses related to Oil and Gas Leasing Alternatives were being conducted on three National Forests (Beaverhead, Helena, Lewis & Clark) within UMRB. A resource issue consistently identified by the respective Forest Interdisciplinary (ID) Teams was potential adverse effects to westslope cutthroat trout populations and their habitats. As Leasing decisions would allow for various levels of watershed disturbance associated with exploration and development of oil and gas resources on National Forest System (NFS) lands, site-specific environmental analyses were needed.

April, 1994 A team of FS and Montana Fish, Wildlife and Parks (FWP) fisheries biologists was convened to develop a strategy to consistently identify known adverse effects from oil and gas exploration and development activities, and to recommend legally permissible mitigation measures. This collaborative effort surfaced concerns related to documented declines in distribution and abundance of westslope cutthroat trout populations within the UMRB and uncertainty related to long-term persistence of remaining populations.

May, 1994 - Status report on westslope cutthroat trout populations within UMRB completed by FWP and FS biologists and presented to Forest Service's Northern Region - Leadership Team. Direction provided by Regional Forester to convene a Regional-level Interdisciplinary (ID) Team. Purpose of this ID Team was to develop a strategy to assess current status of known westslope cutthroat trout populations inhabiting National Forest System lands and to identify linkages between existing conditions and land and/or water management activities.

July, 1994 - BLM's Montana State Office formally enters into partnership with Forest Service's Northern Region. This expanded the assessment area to include westslope populations occupying BLM-administered lands within the UMRB.

July-September, 1994 - Assessment strategy alternatives developed by Regional/State level FS/BLM ID Team. Due to urgency of westslope cutthroat trout in UMRB as documented in the May, 1994 status report, Regional Forester and BLM State Director select an alternative which relies on existing information and professional judgement for completion of a questionnaire.

September-November, 1994 - Interagency ID Team expanded to include field-level resource staff in design of the questionnaire. Questionnaire designed to incorporate a population viability model for assessing extinction risk to westslope cutthroat trout (Part A) using quantitative data and professional judgement of field-level fisheries biologists. Part B of the questionnaire used agency staff expertise (see Acknowledgment Section of this report) and existing information to estimate the degree of adverse effects to aquatic systems within the occupied watershed based on the contribution of natural and human-related disturbance.

December, 1994 - Regional Forester and BLM State Director direct Agency line officers to have their staff complete questionnaires on all known westslope cutthroat populations with greater than 90% genetic purity occupying federally-administered lands within the basin.

January through July, 1995 - FS/BLM/FWP fisheries biologists collaborate to complete Part A (viability model) of questionnaire (Appendix B). Interdisciplinary resource specialists from four National Forests and two BLM Resource Areas complete Part B of the questionnaire (See Appendix C).

January, 1995 - FWP convenes the "Upper Missouri Westslope Cutthroat Trout Technical Committee" (UMWCTTC) to develop science-based recommendations for the conservation and restoration of westslope cutthroat trout within the UMRB.

March, 1995 - First meeting of FWP's UMWCTTC. Goal of this interagency team of fisheries biologists (US Fish and Wildlife Service, FS, BLM, FWP, Univ. of Montana geneticist) was "Develop biologically feasible management strategies to conserve westslope cutthroat trout in the upper Missouri River basin, including their habitats and associated native species."

July through December, 1995 - Questionnaire data entered into Forest Service database. Statistical analyses completed on questionnaires by B. Shepard (FWP); B.Sanborn (FS); and Dr. Danny Lee (FS-Research).

February and March, 1996 - Results of assessment presented to UMWCTTC; FS - Regional Leadership Team; and BLM State Office's Leadership Team. The UMWCTTC provided interim recommendations for conserving and restoring westslope cutthroat trout populations on FS/BLM-administered lands within UMRB. Regional Forester and BLM State Director assign Agency line officers to develop strategy to implement UMWCTTC interim recommendations.

March through June, 1996 - Interagency (FS/BLM/FWP) line officer Steering Committee convened. Sub-group to Steering Committee chartered to develop short-term strategy for implementation of UMWCTTC recommendations by June 15, 1996. Implementation sub-group comprised of FS/BLM/FWP line officers, fisheries biologists, and representatives from Public Affairs staff. Steering Committee agrees on need for collaborative process to support FWP's efforts at developing a long-term conservation and restoration strategy westslope cutthroat trout in UMRB.

April, 1996 - Chair of the UMWCTTC formally transmits through FWP to Regional Forester interim strategies (see Management Considerations "Short-term" section) for conserving westslope cutthroat trout on FS and BLM-administered lands within the UMRB. FWP recommends that these interim strategies be adopted by the FS and BLM.

June, 1996 - Steering committee approves "short-term strategy" for implementation of UMWCTTC interim recommendations on federally administered lands within UMRB. Short-term strategy identifies a process for evaluating effects of new and on-going land management activities in drainages occupied by westslope cutthroat trout.

APPENDIX B

Section 1: QUESTIONNAIRE - PART A (BayVAM model):
And
Section 2: Directions for inputs into BayVAM Model

Section 1

A score or rating was generated by the local fisheries biologist(s) at each model "node" using directions provided in Section 2 of this Appendix. In addition, a narrative was required to be completed at each node identifying citations of available data and other rationale used to support the score or rating given.

The following information was also provided at each "node":

1. **"Data Quality Rating" (DQR)** - system used when data is entered into the State of Montana's River Information System (MRIS) database. A DQR is used to judge the quality of the information/data from "1" (poorest) to "9" (best).

To provide consistency, the DQR rating system was used to identify the quality of information or data at each model "node". Selection of one number from each of the following categories was required:

1-3: Data is based on judgement estimates

4-6: Data is based on limited measurements

7-10: Data is based on extensive measurements

2. Rating based on the following **"Relative Contribution Class" (RCC)** for the categories of "Natural" and "Human-related"

	Natural/	/	**Human-related**
A=	**0%**	/	**100%**
B=	**Less than 50%**	/	**Greater than 50%**
C=	**Greater than 50%**	/	**Less than 50%**
D=	**100%**	/	**0%**

3. For each "RCC" rating identified under #2, the applicable contributing factors (Mining, grazing, etc.) were circled.

Part A - Form

WCT Population - Occupancy (Use EPA Reach Code #'s):____________
Miles of Stream Occupied (meters)____________________
Location of WCT Population - 6th code HUC#______________
Genetic Purity of Population:________________________
[(If "100%" pure, circle appropriate threat from hybridization:
S (secure, barrier), NS (not secure, no barrier), UK (Security Unknown)].
Land Ownership of Occupied Drainage (% Estimated): FS______BLM______
Private______State______
Contact Person:_________Forest:_________

ASSESSMENT AT INDIVIDUAL LIFE STAGE SCALE

Characteristic	**Scores (each row must sum to 100)**

1.**Quality and Distribution of Spawning Habitat** DQR_____

60-80%__________________	85-95%________________	100%___________________
(Low)	**(Moderate)**	**(High)**

Narrative:____

Natural/Human-caused	**RCC**______
Geology	Grazing
Landform	Mining
Precipitation (type/rate)	Roads
Subsurface Flows	Dewatering
Sediment (natural)	Timber
Other (list)	Other (list)
____________________________	____________________

2. Incubation success DQR_____

5-20%_________________	**20-35%**_________________	**35-50%**______________
(Low)	**(Moderate)**	**(High)**

Narrative:____

Natural/Human-caused	**RCC**______
Geology	Grazing
Landform	Mining
Precipitation (type/rate)	Roads
Subsurface Flows	Dewatering
Sediment (natural)	Timber
	Potential Hybridization
Other (list)	Other (list)
____________________________	____________________

3. "Max Fry survival"/Density-Independent early rearing and overwinter survival

DQR____

10-20%__________________ **(Low)** **20-30%**__________________ **(Moderate)** **30-40%**__________________ **(High)**

Narrative:____

Natural/Human-caused	**RCC______**
Geology	Grazing
Landform	Mining
Precipitation (type/rate)	Roads
Subsurface Flows	Dewatering
Sediment (natural)	Timber
Riparian Community	Competing Species
	Riparian Community
Other (list)	Other (list)
________________	______________________________

4. "Fry Capacity"/Habitat capacity early rearing

DQR____

1,000-4,000____ **4,000-7,000____** **7,000-20,000____**

Narrative:____

Natural/Human-caused	**RCC______**
Geology	Grazing
Landform	Mining
Precipitation (type/rate)	Roads
Subsurface Flows	Dewatering
Sediment (natural)	Timber
Riparian Community	Competing Species
Consider Water temp.	Riparian Community
Other (list)	Other (list)
______________________________	______________________________

5. **"Juvenile Survival"/Sub-adult survival** **DQR______**

14-26%______________	**26-38%______________**	**38-50%______________**
(Low)	**(Moderate)**	**(High)**

Narrative:____

Natural/Human-caused	**RCC______**
Geology	Grazing
Landform	Mining
Precipitation (type/rate)	Roads
Subsurface Flows	Dewatering
Sediment (natural)	Timber
Riparian Community	Competing Species
Consider Water Temp.	Angling Pressure
Consider Macroinvert	Angler Harvest
Production	Other (list)
Other (list)	__________
__________	__________
__________	

6. **Adult Survival** **DQR______**

10-30%______________	**30-50%______________**	**50-70%______________**
(Low)	**(Moderate)**	**(High)**

Narrative:____

Natural/Human-caused	**RCC______**
Geology	Grazing
Landform	Mining
Precipitation (type/rate)	Roads
Subsurface Flows	Dewatering
Sediment (natural)	Timber
Riparian Community	Competing Species
Consider Water Temp.	Angling Pressure
Consider Macroinvert	Angler Harvest
Production	
Other (list)	Other (list)
__________	__________

7. **Age of first maturity** DQR____

Age 3(30%)____ **Age 4(40%)____** **Age 5(20%)____** **Age 6(10%)____**

Narrative:______________________________

8. **Fecundity** DQR____

200-500____ **500-800____** **800-1100____** ***1100-1500____ (*do not use in UMRB)**

Narrative:______________________________

ASSESSMENT AT LOCAL POPULATION SCALE

Characteristic **Scores(each row must sum to 100)**

1. **Initial population size** DQR____

50-450____ (Low) **450-850____ (Moderate)** **850-1250____ (High)**

Narrative:______________________________

2. **Expected population size** DQR____

0-250____ (Low) **250-750____ (Moderate)** **Greater than 750____ (750+)**

Narrative:______________________________

3. **Population Resilience** DQR____

None____ **Low____** **Moderate____**

Narrative:______________________________

4. **Variation in 1st year Survival** DQR____

Low____ **Moderate____** **High____**

Narrative:______________________________

5. **<u>Variation in adult numbers</u>** **DQR____**

Low____ **Moderate_ ___** **High___** **Very High____**

Narrative:____

6. **<u>Catastrophic risk</u>** **DQR____**

120-170 year interval(YI)_________ (Low) **70-120 YI___________ (Moderate)** **20-70 YI______________ (High)**

Narrative:____

Natural/Human-caused	RCC____
Flood	Flood
Fire	Fire
Mass-wasting	Mass-wasting
Drought	chemical Spills
Earthquake	Other
Volcanoes	
Other	
__________	__________
__________	__________
__________	__________

II.1. SCALE OF ANALYSIS

Part II. ASSESSMENT SURVEY

The first step in a population viability analysis is defining the population. Watershed boundaries form the logical boundaries populations. However, because the scales of administrative interest and population processes may not always coincide, it is important to define local and regional populations clearly. Boundaries placed on local populations may vary widely by species and life-history type. In general, local populations are defined by watersheds or stream systems that support self-sustaining, reproductively isolated populations. In most cases, local populations will be recognized on the basis of isolation or fragmentation of suitable habitats.

II.2. SURVEY OF LOCAL POPULATION CHARACTERISTICS

Completing the survey of population characteristics or processes is the next critical step in applying the BayVAM module. Module users must consider each of the important characteristics or processes listed in Table 2, and assess the current or expected state of each. For convenience, each characteristic as a system **node**. There are three or four mutually exclusive values associated with each node. **Nodal values are expressed as ranges**, for example, incubation success would have three possible ranges: 5-20%; 21-35%; and 36 to 50%.

It is important to remember, that in reality the true value for the population being analyzed is contained within no more than one of the possible ranges for each node and that all others are false (e.g. incubation success is within the range 35-50%, rather than 5-20% or 21-35%). The range which contains this true value might not be known with absolute certainty. Within the BayVAM module, this uncertainty is captured by assigning a degree of belief (i.e., Bayesian probability) to each value within each node. Each node then has an array of values associated with it, called a belief vector. These vectors are constrained such that the sum of all values within each vector sums to 100%. The allocation of beliefs within a node is used to quantify strength or quality of the available information. The value attached to each range represents the degree to which we believe this range contains the true population's rate or characteristic. For example, if several years of data provide estimates of incubation success that range between 40 and 50% (based on hollow core sampling of spawning sites), the belief vector for incubation success might be: a 90% belief that the true value lies within the 36-50% range; 10% that the true value lies within the 21-35% range; and 0% that the true value lies within the 5-20% range. If there is no information available to judge initial survival, the uncertainty could be represented as a uniform probability distribution (33.3% in each class), or as a worst case analysis with a high probability in the worst class. In reality, a biologist with some knowledge of the watershed, the species and its life-history, and the relevant fish habitat relations will be able to make classifications that fall somewhere between the extremes.

The discussion below provides background information and references intended to aid in specifying belief vectors at each node. **It is important that module users document their rationale for each survey response**. Ultimately, the credibility of the analysis depends on the strength of the biological justifications for each response. The survey is structured to consider sources of information available from different scales within the biological system. For example, population characteristics and processes at the life-stage level ultimately define population size, resilience, and temporal variability of the population. Information at the life-stage level thus can be used to draw inferences about population-level features. A biologist might also draw inferences about the size, resilience, or temporal variability of a population through direct observation of the whole population rather than study of the underlying mechanisms. The BayVAM module allows users to incorporate information from both levels, and assign differential weights to that information. Information from multiple levels is used either to support or modify the model predictions that would be generated from a single level of analysis.

Good data on population trends or characteristics may be limited or unavailable. In such cases biologists can draw inferences from supporting information on habitat and watershed condition or other biological characteristics. The following materials are provided as background and examples of information or observations that might be associated with population characteristics. The examples are not complete, exhaustive, or exclusive, but are provided to aid a competent biologist in making a judgement. If available information is too limited to support any judgment, then conservative management would dictate a score consistent with the highest risk until better data are available.

II.3. INDIVIDUAL LIFE STAGES

Quantity and Distribution of Spawning Habitat

Availability of spawning habitat (quantity and distribution) may determine whether available rearing habitat is fully seeded. Three classes of availability of spawning habitat (gravels) have been defined. When spawning gravels are readily available throughout the watershed, spawning habitat would not be considered limiting to the local population. In these cases spawning success would be 100%. Unless there is clear evidence that spawning habitat is likely limiting the population, the upper range (i.e."Spawning habitat not limiting") should be used. Where the quantity or distribution of spawning gravels severely limits the potential for egg deposition, resulting in underseeding of rearing habitat, the user should classify spawning habitat as severely limited. For these populations spawning success would rate between 60-80%. The intermediate class would include situations where spawning habitat is limited in either quantity or distribution, corresponding to spawning success of 85-95%. The user should note that resident westslope cutthroat trout populations where females mature at relatively small sizes (lengths of 150 to 200 mm) suitable spawning habitat may consist of small isolated patches (0.2 m^2) of pea-sized gravel behind water velocity breaks.

Rationale: For resident westslope cutthroat trout (WCT), spawning habitat rarely limits egg deposition enough to limit fry production to a level below that needed to fully seed fry and juvenile rearing habitats. For that reason, Shepard and Sanborn suggest using a prior belief that places a high (90-100%) likelihood on having a high spawning success rate (greater than 90%). They also believe that ranges for the two other classes of spawning success should be increased to 70-80% and 80-90%. They could not conceive of a resident population which does not have enough spawning habitat to seed at least 70% of the rearing habitat. For situations where fry production is insufficient to fully seed rearing habitats, low incubation success is usually the reason. Note: Danny Lee modified these recommendations to even out the range of the classes to Low (60-80%); Moderate (85-95%); and High (100%).

Incubation Success

Survival at this critical life stage may strongly influence the population growth rate and resilience or the ability of the population to absorb or recover from disturbance. Where incubation and survival to emergence are not reduced due to natural or human caused habitat disruption, incubation survival would be expected to be similar to survivals documented in the field within the best spawning habitats for cutthroat trout (35% to 50%). For this level to be selected: fine sediments or sediment loading should not differ from natural conditions; channel and watershed conditions should be well within sediment/discharge equilibrium; and high water quality and favorable stream flows are maintained throughout the incubation period.

Selection of the 5-20% range (Low) would be characteristic of watersheds where substrate is moderately to heavily embedded with fine sediments or where water quality has otherwise been degraded within the incubation environment. Fluctuations in water quality or streamflow during incubation may substantially reduce survival (e.g., through dewatering or scouring of redds). The above factors would result in estimates of survival from egg to emergent fry being less than half of that expected in high quality habitats.

No recommendations to revise this node were made by Shepard and Sanborn. Therefore, the ranges remain as Low (5-20%); Moderate (20-35%); and High (35-50%).

"Maximum Fry Survival" (i.e. Density Independent, Early Rearing and Overwinter Survival)

The quality of initial rearing and overwinter habitats for young-of-the-year salmonids is an important determinant of population resiliency, thus influencing temporal variability in population size. High mortality (survivals rates under 20%) during this period may restrict the capability of the population to recover from disturbance. Precise estimates of early survival are generally possible only with intensive studies. Relative survival ranges, however, can be inferred from habitat condition.

Superior habitat conditions produce high survival rates (> 30%). Extensive off channel and stream margin habitats and high levels of instream cover are important for cutthroat fry. Instream cover should create low water velocity microhabitats and visually isolate fry occupying these microhabitat sites from other instream terrestrial, and avian habitats (i.e. woody debris and substrate). Unembedded, cobble substrates should be widely available for age 0 cutthroat to use during winter. Non-native fish species, especially brook trout, are believed to have an important influence on cutthroat trout and might be particularly important in disrupted habitats. Non-native fish species should not be present, or have limited potential of introduction through natural dispersal, for an estimated survival rate of >30% to be assigned.

Where early rearing habitats are not widely distributed, where wood debris or other cover is very low, and where off channel habitats are either lacking because of channel geomorphology, or seriously degraded because of channel instability, maximum fry survival should be rated under 20%. Moderately to highly embedded substrates where alternative cover is lacking also suggest a low survival. In addition, low survival would be consistent where one or more species of non-native occur within the watershed and either are, or could be, widely distributed throughout. The influence of non-native fish species could be considered moderate only if it can be shown that the influence of that non-native species has little impact on cutthroat trout.

Rationale: Original rating categories were not changed. A change was made in the narrative which increased the importance of non-native fish species on early survival. Shepard and Sanborn maintain that a single, non-native species (such as brook trout) adversely affect WCT fry capacity through two mechanisms:

1. Non-natives (e.g. brook trout) directly increase mortality through predation and competition.
2. Non-natives (e.g. brook trout) may limit habitat capacity by occupying habitats that could be occupied by cutthroat trout in allopatry (allopatric species are those that occur in different geographical areas).

Therefore, they integrated adverse effects from the presence of brook trout at four levels within the model. At this level, they suggest that when brook trout occur with WCT there needs to be good evidence to select a survival range rating higher than 25% (moderate rate). In addition, streams where non-natives , especially brook trout, occur **with** WCT they recommend that **"Fry Habitat Capacity"** be rated as "Low" and **"Sub-Adult Survival"** as "Low" or "Moderate". They also suggest that the presence of non-native fish species be considered in the **"Adult Survival"** assessment. Note: Danny Lee modified these ranges in the final model to even out the ranges for the classes into 10-20% (Low); 20-30% (Moderate); and 30-40% (High).

"Fry Capacity"- Habitat Capacity Early Rearing

The availability of habitat critical to early rearing and overwinter survival can limit the ultimate size of a population. Habitats described above may be restricted in availability or in distribution such that habitat for juvenile rearing becomes limiting to the population. Recognizing such limitations will often not be possible without detailed studies of population dynamics and habitat utilization. Such limitations might be inferred, however, where habitat requirements or preferences are documented and habitat inventories are available to determine the relative capacities for different life stages throughout the watershed.

Habitats capable of supporting more than 7,000 age 1 cutthroat trout would indicate that juvenile rearing habitat is widely distributed throughout the watershed, particularly in relation to spawning sites. For this habitat capacity to be selected, no non-native trout species would occupy, or have easy access to, the portion of habitat where this level of age 1 fish could be supported and the length of stream occupied by cutthroat trout should be at least 4 km. Low habitat capacity would indicate watersheds where juvenile rearing habitat is in short supply, and is not widely distributed in relation to spawning sites. A low habitat capacity would indicate the habitat is capable of supporting fewer than 4,000 age 1 fish. The presence of non-native fish species, particularly brook trout, should indicate a low fry habitat capacity.

Rationale: Shepard and Sanborn modified the ranges for Fry Habitat Capacity to reflect the fact that most WCT populations in the Missouri are isolated in relatively short stream segments (under

3 km) where 3,000 fry may be the upper limit of capacity. They also added another class to make fry capacities 3,001-6,000 (Low); 6,001 - 9,000 (Moderate); and greater than 9,000 (High). Note: Danny Lee grouped the upper two classes creating a new "High" range (7,000-20,000); Moderate (4,000-7,000); and Low (1,000-4,000).

Sub-Adult Survival

Sub-adult survival has an important influence on the structure of salmonid populations, influencing year-class strength and resilience. Survival from age 1 to adult may vary substantially between resident and migratory life history forms and be strongly influenced by human caused disturbance and environmental conditions. Interactions with non-native salmonids, especially brook trout, may influence sub-adult survival. Competitive for space and food, or direct mortality from predation may reduce survival of sub-adults.

Sub-adult survival rates in the high range (38-50%) would generally be expected for resident populations that do not migrate out of the local watershed, and where high quality pools, complex cover, or other habitats important for rearing and overwinter are widely available. The population would be allopatric (the only fish species present) or exist within native species assemblages.

Moderate sub-adult survival rates (26-38%) may occur in allopatric populations occupying degraded habitats; or in populations occupying high quality habitats if they are exposed to competition or predation influences from non-native fishes.

Low survival rates (<26%) during this stage would be expected for populations in degraded habitats with limited rearing and over-wintering habitats and where non-native species are present. Low sub-adult survival would also be expected for migratory populations that must use migratory corridors and associated rearing environments (larger rivers, lakes, ocean) where human caused or natural changes (dams and diversions, introduced and or enhanced predator populations, water quality) have significantly reduced survival.

Rationale: Shepard and Sanborn did not change any of the rates for sub-adult survival because they did not have any empirical data or strong enough inferences to do so. However, they did incorporate an explanation on the influence of non-natives (see "Rationale" - "Early Rearing and Overwinter Survival") ...{for streams where non-natives , especially brook trout, occur **with** WCT they recommend that **FRY Habitat Capacity** be rated as "Low" and **Sub-Adult Survival** as "Low" or "Moderate"}.
Therefore, the ranges remain as Low (14-26%); Moderate (26-38%); and High (38-50%).

Adult Survival

A number of factors may influence adult survival (annual survival during and following the year of first maturity), but exploitation is particularly common for westslope cutthroat. Exploitation may put some populations of westslope cutthroat at high risk of extinction either by directly driving populations to collapse or by reducing population size and resilience and indirectly increasing risks associated with other factors.

For moderate or slow growing populations in unproductive waters, unrestricted fishing effort of 100 to 200 angler hours per km can result in serious over exploitation of mature fish (Rieman and Apperson 1989).For estimated exploitation of 60% or greater, or slow growing interior populations with angling effort in excess of 200 hours per km annually and not restricted by any form of special regulation (e.g., size, catch and release) should be considered evidence of low (<30%) adult survival. Alternatively, direct evidence that the adult population has been seriously depressed in number, or age/size structure by angling would warrant a low score. Any other factors such as food, cover, and competition with non-native fishes that might be deemed to have an important influence on survival at this stage should be considered (see "Rationale" - "Early Rearing and Overwinter Survival").

Adult survival greater than 50% should be expected in systems that are generally inaccessible or otherwise receive little or no fishing pressure; or in systems where fishing is limited strictly to catch and release, or harvest would occur only during periods of clear surplus production. Habitat conditions should also provide abundant food and cover for adult fish (post maturity) throughout the year. Pre-spawning mortality is low and fishing mortality is low. Pre-spawning conditions should also be considered in determining adult survival rates.

Rationale: Shepard and Sanborn increased the upper survival level for adults from 60% to 80% based on estimates from unexploited populations. Natural mortality rates of adults has been documented to be 30% (70% survival) in some Idaho streams. Shepard and Sanborn believe that an upper survival level of 80% is reasonable in non-exploited, remote waters where there is high quality habitat. Note: Danny Lee created three equal classes: Low (10-30%); Moderate (30-50%); and High (50-70%).

Age of First Maturity (age 3 to age 6)

Age of maturity, longevity, and fecundity will influence reproductive potential and the potential growth rate of a population. These characteristics ultimately influence the resilience of a population to exploitation and disturbance. Faster growing individuals may mature earlier but available information suggest that differences tend to be larger among species than among populations or life history forms of the same species.

The expected age of maturity is best determined from specific life history studies but useful approximations can be made from other studies of the same species and life history in similar environments. Recent information on westslope cutthroat populations in the Upper Missouri Basin (Downs and Shepard, in prep.) give the following proportions for age at first maturity in females:

age 3: 30%

age 4: 40%
age 5: 20%
age 6: 10%

Unless specific data exists for the population being evaluated, it is suggested these proportions be used.

Rationale: Shepard and Sanborn included a prior belief **Age at First Maturity** which is represented by the **values presented above**. The proportional distribution of age at first maturity is based on sampling of resident populations in the upper Missouri River basin and is consistent with proportions found in the scientific literature. Shepard and Sanborn believe that these values should be used for resident populations within the UMRB unless stream specific data is available.

Fecundity

Higher fecundity increases reproductive potential, resulting in higher resilience to exploitation or disturbance. Often migratory and resident life history forms of the same species in the same area will have dramatically different growth rates and sizes at maturity and therefore, it is important to consider whether both are present in the system. In general, if a migrant and resident form exist within the watershed the assessment and characterization of growth should focus on the dominant form. Fecundity is directly related to body size, and the relationship is similar among salmonids. If specific data are not available, mean body size of adult females can be used to score fecundity.

Low fecundity is expected for most resident westslope cutthroat trout populations where mean body size of mature females is less than 200 mm (200-500 eggs per adult female). In resident populations where mature female size consistently exceeds 200 mm, fecundity of 500-800 eggs per female would be expected. Since resident westslope cutthroat rarely exceed 300 mm in length, moderate or high fecundity rates would not be expected.

Fecundity in the 800-1,100 eggs per female range, although not expected, may occur in migratory populations were mature fish exceed 300 mm in length. It is not expected that any westslope cutthroat trout within the upper Missouri system would have fecundities over 1,100.

Rationale: Shepard and Sanborn altered the ranges identified in the Draft BayVAM Guidelines (Rieman and Lee, 10/19/94) based on fecundity data collected on resident populations of WCT in the upper Missouri River basin. This allowed for more refined fecundity estimates for these populations. Shepard and Sanborn assigned lower fecundities to WCT populations inhabiting smaller, colder, and less productive habitats where adults attain a smaller maximum length (150-200mm) then for larger adults (200-300 mm) in populations inhabiting larger, more productive habitats. Note: Recommendations revised fecundities were further modified by Danny Lee to allow for a more uniform classification. Low (200-500); Moderate (500-800); High

800=1,100: and Very High (1100-1500). "Very High" was added by Danny Lee and **should not** be used in the upper Missouri River basin WCT analysis.

II.4. LOCAL POPULATION CHARACTERISTICS

The model provides two ways to derive local population characteristics. These characteristics can be derived using information output from the individual life stage portion of the model, or can be input by the user based on their knowledge of an individual population. The local population characteristics which the BayVAM model use are population size and resilience, temporal variability, and catastrophic risk.

Since it is possible for the equilibrium population size and population resiliency to come from two levels, the life stage or population levels, some weighting of the evidence is required. Thus, module users must state whether they wish the population-level information to be given less, equal, more, or much more weight than the life-stage information. In general, life stage information should be weighted more than population information unless time trend population data has been collected.

No changes were recommended by Shepard and Sanborn to this portion of the model.

Initial Population Size

The size of a population influences risk of extinction through environmental variability. Although small watersheds are likely to support smaller populations than large watersheds, population size is best inferred with some basic information on fish density and distribution. Recent estimates of several isolated populations demonstrate that watersheds with only a few kilometers of available habitat can support tens to thousands of individuals. If the data necessary to extrapolate an approximation are available they should be used. Total populations that exceed 850 adults and are not expected to drop below these numbers are considered "high". Adult populations that are consistently below 450 individuals should be considered "low". When estimating adult numbers, consider all mature fish alive in a given year, not just those spawning. It should be noted that initial population size has relatively little effect on model outputs other than setting initial conditions.

No changes were recommended by Shepard and Sanborn to this node.

Expected Population Size (high, moderate, low, zero)

The information collected at the individual life stage level collectively will predict an expected equilibrium population size. If independent data or information are available that would lead to an independent estimate of the expected number of adults to be found within the basin, this can be included in the analysis. A "high" score would correspond to an estimated adult population size of greater than 850 adults; "moderate" = 450-850 adults; "low" = less than 450. If population monitoring data exists which shows a consistent downward trend, the population is likely headed to extinction, so an equilibrium size of "zero" is appropriate.

Population Resilience (high, moderate, low, none)

Populations with negative growth rates face a "deterministic" extinction unless stabilized by compensation in survival or reproductive rates. A population may have no clear trend in abundance but its inherent resilience will still determine its ability to resist or recover from future disturbance. Both the trend and resilience of a population will be the integration of survival, age at maturity and reproductive potential. The characteristics defined under Individual Life Stages should provide the necessary evidence of resilience but often information will be limited or conflicting. Trends in populations and inferences about resilience may also be possible from information on the population as a whole that will either support or outweigh information available for individual life stages.

A "high" population resilience should show no negative trend in abundance with at least 10 years of good density or population estimates. If the population has been reduced by a short term disturbance, it is clearly recovering. Alternatively densities should be consistent with those reported for strong populations in good habitat. Local habitat quality should be high, and human disturbance or recent natural events should not have altered watershed condition or channel equilibrium. Available estimates of growth and survival should be consistent with other strong populations. If a migratory form is present, the complementary environments (e.g. larger river, lake, ocean, and migratory corridors) do not impose any unusual or increased mortality (e.g. fishing, predation, overwinter survival, smolt survival).

"Low" resilience could be evident from a slow decline in population trend information although inter-annual variability may make the trend statistically insignificant. Low resilience might be expected if habitat has been disrupted to some degree such that a significant reduction in abundance, growth, or survival of any life stage is anticipated in relation to the best habitats and likely will not recover to predisturbance conditions within one to two generations. Alternatively a low resilience should be characteristic of a population that appears stable at densities well below those expected for the system; or a population that has been depressed by a short term or recently eliminated disturbance (e.g. exploitation) but shows no evidence of recovery.

A "None" resilience should be concluded from any significant negative trend in number that has extended for several generations. A decline might be inferred from a substantial reduction in population size that can be associated with a continuing, irreversible (in the short term) loss of critical habitat quality or quantity.

Temporal Variability in First Year Survival or Adult Numbers (Juvenile CV and Adult CV

in Model)

The most influential determinant of temporal variability in population number is believed to result from environmental variation affecting spawning success and early rearing. Variation in population size may be strongly influenced by the natural disturbance regime but also by the condition of the local habitat and distribution of the population through space. In our underlying model, temporal variability in the population results from fluctuations in juvenile survival. It is mitigated by the degree of population resilience, i.e., more resilient populations exhibit lower levels of variability in population numbers. If information is available on variation in first year survival, it can be incorporated into the analysis in the "Juvenile CV" node. In addition, we can use information on the coefficient of variation in adult numbers to infer both environmental variability and population resilience. Estimates of the coefficient of variation in either juvenile survival/abundance or in total/adult population number are best made from extended time series of population size or density. If this type of information is available, it should provide a more realistic of value the variability experienced by that population, especially if the time series of data is relatively long (ie. ten years or longer). If this data is unavailable, inferences can be made from habitat and population age structure information, however, the confidence in classes assigned from these type of data should be lower.

"Low" variability in juvenile survival could be inferred from low variability in channel events such as extreme flows, or other environmental conditions that likely influence spawning and incubation, and in systems with highly diverse, widely distributed and complex habitats available all life stages. In general, habitat complexity and spatial diversity should strongly influence temporal variability even in noisy environments. The availability of refuges and distribution of the population and critical life stages over a broader area makes the whole population less vulnerable to localized disturbance. Such complexity is characteristic of large watersheds where all resident life stages or necessary habitats (spawning, early rearing) are widely distributed throughout. Ideally multiple tributary streams would exist, each being capable of supporting all life stages should others be lost. There should be no evidence or expectation of year class failures and all age classes would be fully represented in population samples (Coefficient of Variation [CV] in fry survival less than 40%).

"High" temporal variability is expected in systems where survival and recruitment clearly respond to frequent (1 or more per generation) events. Year-class failures would be common and population samples would often show uneven distribution of age classes. High variability might be anticipated in simplified or spatially restricted habitats critical for individual life stages, and in watersheds with only a single tributary stream available for any life stage, especially where extreme flow events (rain on snow, drought) or bedload scour is common. (CV in fry survival is between 65% and 90%).

Evidence temporal variability based on time series of adult numbers can be divided into four categories based on the CV in the adult index: low = CV <25%, moderate = 25% <CV <50%, high = 50% <CV <100%, and very high = CV > 100%.

Catastrophic Risk (high, moderate, low)

Catastrophic events are low frequency events that substantially affect all members of a population. Catastrophic impacts on habitat may take years to recover. Thus, populations are at risk through the event itself, but also are likely to be less resilient and thus at greater risk to some future disturbance following the event.

Massive debris flow and scour, droughts, volcanic eruptions, earthquakes, glaciers, fire storms, toxic spills, and dam failures are all examples of catastrophic events for salmonid populations. Catastrophic events are by nature unpredictable and have been rarely considered in viability assessments. Such events, however, may strongly influence the risks of extinction for many populations. The potential for a catastrophic event will be influenced by physiographic characteristics of the watershed, and by the distribution of fish, critical habitats or refuge . In some cases human disturbance or development may significantly increase the potential for catastrophe from natural extreme events. Some poorly managed watersheds, for example, may suffer catastrophic changes to stream habitats as a result of an extreme hydrologic event within a stream channel impacted by management or by debris or sediment torrents triggered by a combination of natural (climatic) and management (logging and roading) conditions.

A "high" catastrophic potential would be appropriate where a half or more of the population (50% or more) could be lost in a single event expected within 20 to 70 years. Watersheds with high risk also are prone to major channel events such as debris torrents, massive bedload scour or extensive channel dewatering, perhaps because of the combination of intensive watershed disruption and high frequency of extreme hydrologic events (rain on snow, drought). Major fires might result in catastrophic loss in portions of a watershed. Fire likely would not have a high catastrophic potential unless the population were restricted to a relatively small area (single stream), or if the fire occurred in concert with other disturbance of the watershed substantially increasing the risk of a hydrologic event.

"Moderate" catastrophic potential is likely for most watersheds exposed to some human disturbance. This level corresponds to an event expected on a frequency of 70-120 years.

"Low" catastrophic potential could be appropriate for large watersheds that essentially are not exposed to human disturbance or development, are stable geologically and hydrologically, and have populations with all life stages, range of elevations, and multiple tributary streams. Probability of a catastrophic event less than 1 in 120 years.

QUESTIONNAIRE: PART B
(6TH CODE HUC OCCUPIED BY WCT POPULATION)

Interdisciplinary Teams (ID) Teams used existing data, occular measurements, and/or professional judgement to rate the effects on aquatic systems within the occupied 6th code HUC from each of the following management activities or human-related disturbances (roads, grazing, etc.). "Occupied" 6th code HUCs were defined as those which were identified in Part A as being occupied by a westslope cutthroat trout population with greater than 90% genetic purity.

The following rating system, based on USDA, Intermountain Research Station's "Natural Aquatic Habitat Condition" database, was used to estimate contribution of effects to aquatic systems within the 20,000 - 40,000 acre occupied watershed:

No Management; Low (1-10%); Moderate (11-20%); High (Greater than 20%)

A narrative description supporting the rating was required, as well as, supporting documentation if rating was outside of the percentages given above. ID Teams were also asked to address each of the key factors listed under each management activity/human-related disturbance. Finally, ID Teams were asked to compare this with information used to complete Part A of the questionnaire and to identify whether or not conditions in the 6th code HUC were different. If so, supporting documentation was require.

PART B

1. Roads

Effects Of Roads On Aquatic Systems Within 6th Code HUC: (Place X on appropriate line)

DQR____

No Roads____ **Low____** **Moderate____** **High____**

Narrative should address the following factors: landtype, road condition, road location(s), stream crossings, road density, and any other factors which may affect aquatic systems within the 6th code HUC.

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Are Conditions Different Than Within the Occupied Stream/Sub-Drainage (Part A)?

If yes, why?

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2. Grazing

Effects Of Grazing On Aquatic Systems Within 6th Code HUC:(Place X on appropriate line)

DQR___

No Grazing/Browsing____ Low____ Moderate____ High____

Narrative should address the following factors: landtype, class of stock, soil type, stream channel type (Rosgen), riparian community, % of HUC grazed and any other factors which may affect aquatic systems within the 6th code HUC.

Are Conditions Different Than Within the Occupied Stream/Sub-Drainage (Part A)?

If yes, why?

3. Mining/Oil & Gas

Effects Of Mining, Oil or Gas Exploration and Development On Aquatic Systems Within 6th Code HUC:
(Place X on appropriate line)

DQR___

No Mining/O&G____ Low____ Moderate____ High____

Narrative should address the following factors: landtype, physical (e.g. Placer mining, oil or gas well, etc.) or chemical (e.g. acid mine drainage, tailings, addits, reserve pits, etc.), % HUC affected and any other factors which may affect aquatic systems within the 6th code HUC.

Are Conditions Different Than Within the Occupied Stream/Sub-Drainage (Part A)?

If yes, why?

4. **Timber Harvest**

Effects Of Timber Harvest On Aquatic Systems Within 6th Code HUC: (Place X on appropriate line)

DQR___

No Timber Harvest____ Low____ Moderate____ High____

Narrative should address the following factors: riparian harvest, fuelwood cutting, logging techniques, % of HUC harvested, number of re-entries, regeneration success and any other factors which may affect aquatic systems within the 6th code HUC.

Are Conditions Different Than Within the Occupied Stream/Sub-Drainage (Part A)?

If yes, why?

5. **Water Withdrawals/Impoundments**

Effects Of Water Withdrawals/Impoundments on Aquatic Systems Within 6th code HUC: (Place X on appropriate line)

DQR___

No Water Withdrawals/Impoundments___ Low____Moderate____ High____

Narrative should address the following factors: diversions (location, quantity in relation to baseflow, season of diversion, etc.), impoundments (number and size any other factors which may affect aquatic systems within the 6th code HUC.

Are Conditions Different Than Within the Occupied Stream/Sub-Drainage (Part A)?

If yes, why?

6. Angling Pressure

Effects from Angling on Aquatic Systems Within 6th code HUC: (Place X on appropriate line)

No Angling Pressure____ Low____ High____ DQR____

"Low" (i.e., WCT occupied section of stream relatively inaccessible to public; little physical evidence of angling pressure or use within the area adjacent to the stream.

"High" (i.e., WCT occupied section of stream is very accessible to public with well-maintained roads and/or proximity to heavily traveled corridors; physical evidence present within the area adjacent to the stream of moderate to heavy angler pressure or use.

Narrative should address the following factors: road access, proximity to local population centers and/or recreational development areas, fish densities and any other information on angling pressure which may affect aquatic systems within the 6th code HUC.

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Are Conditions Different Than Within the Occupied Stream/Sub-Drainage (Part A)?

If yes, why?

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7. Non-Native Fish Distribution and Abundance

Effects of Non-Native Fish species on Aquatic Systems Within 6th Code HUC: (Place X on appropriate line)

None(Native Fish are Not Present)____Low____Moderate____High____ DQR____

"**Low**" - Brown trout only; "**Moderate**" - rainbow or yellowstone cutthroat trout; "**High**" - brook trout or brook trout in combination with rainbow and/or yellowstone cutthroat trout.

Narrative should address the following factors: presence or absence of non-native fish species; if present, identify species present, distribution and abundance, proximity to WCT population, assessment of risk to WCT population, and other information which may be pertinent to describing effects to aquatic systems within the 6th code HUC.

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Are Conditions Different than Within the Occupied Stream/Sub-Drainage (Part A)?

If yes, why?

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8. Forest Plan Allocation

Effects of Forest or Resource Plan Allocations on Aquatic Systems Within 6th Code HUC: (Place X on appropriate line)

DQR____

No Effect____Low (1-25%) Moderate(26-50%)____High (Over 50%)____

Narrative should address factors such as Management Area Prescriptions and other allocations of National Forest System and BLM lands.

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Are Conditions Different Than Within the Occupied Stream/Sub-Drainage (Part A)?

If yes, why?

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9. **Catastrophic Risk (Fire)**

Potential Catastrophic Fire to adversely effect Aquatic Systems Within 6th Code HUC based on existing conditions: (Place X on appropriate line)

DQR____

No Effect____ Low (1-25%) Moderate(26-50%)____High(Over 50%)____

Narrative should address factors such fuel loading, riparian condition, absence of "refuge" areas, and other factors that would help evaluate the risk of a catastrophic fire to aquatic systems within the 6th code HUC: lands.

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Are Conditions Different Than Within the Occupied Stream/Sub-Drainage (Part A)?

If yes, why?

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10. **Cumulative Effects**

Of the previously identified land management activities that are adversely affecting aquatic resources within the 6th Code HUC, what is the cumulative adverse effect on aquatic systems?

DQR____

No Effect____ **Low____** **Moderate____** **High____**

Narrative should identify those activities/factors that are having the greatest adverse effect on aquatic systems within the HUC. ____

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Are conditions Different Than Within the Occupied Stream/Sub-Drainage (Part A)?

If yes, why?

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