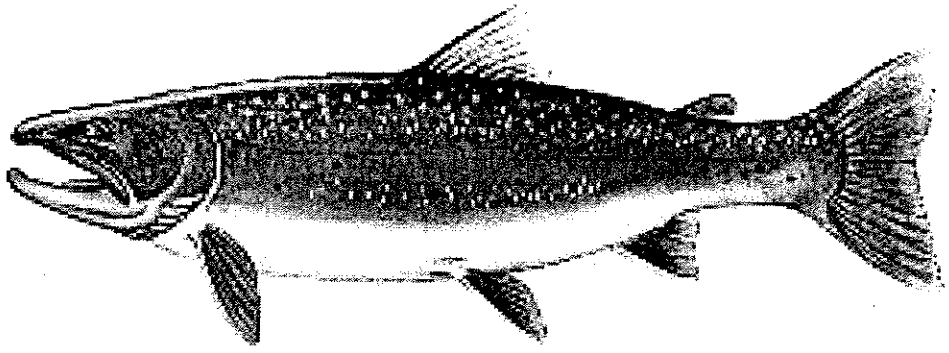
BLACKFOOT RIVER DRAINAGE

BULL TROUT STATUS REPORT



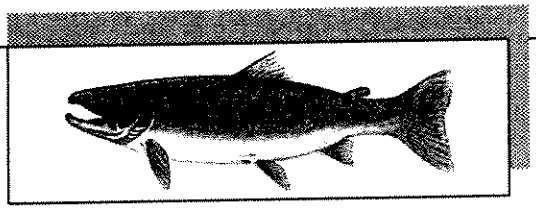
June 1995

Prepared for

The Montana Bull Trout Restoration Team

By

The Montana Bull Trout Scientific Group



Montana Bull Trout Restoration Team

Bonneville Power Administration

Confederated Salish & Kootenai Tribes

Department of State Lands

Montana Chapter American Fisheries Society

Montana Fish, Wildlife & Parks

National Wildlife Federation

Plum Creek Timber Co.

US Fish & Wildlife Service

US Forest Service

TO: Bull Trout Restoration Interested Parties

Bull trout, a native Montana fish, has been the subject of extensive study and broad discussion since Governor Racicot appointed the Bull Trout Restoration Team in early 1994.

The bull trout status reports reflect a portion of both the study and discussion which has occurred during the last two years. These status reports, prepared by the Bull Trout Scientific Group, are designed to provide information about bull trout populations, habitat needs, and threats.

Status Reports have been prepared for bull trout populations in 11 restoration/conservation areas:

- Bitterroot River
- Lower Clark Fork River, downstream of Thompson Falls
- Middle Clark Fork River from Thompson Falls to Milltown, including the lower Flathead River to Kerr Dam
- Upper Clark Fork River, including Rock Creek
- Blackfoot River
- Flathead Lake, including the North and Middle Forks of the Flathead River, Stillwater and Whitefish rivers
- South Fork Flathead River, upstream of Hungry Horse Dam
- Swan Lake/River
- Lower Kootenai River, below Kootenai Falls
- Middle Kootenai River, between Kootenai Falls and Libby Dam
- Upper Kootenai River/Lake Koocanusa, upstream of Libby Dam

Each of these 11 restoration/conservation areas consist of a number of critical populations. The areas have been delineated on the basis of natural barriers and dam-caused fragmentation of historically connected river systems.

These status reports are **working documents**; they are the result of a collaboration of biologists, hydrologists, and other scientists and have drawn on information and research done by people working within each management area.

These documents are intended to provide the most current and accurate information available to the Bull Trout Restoration Team (see Introduction, p. 1) and the local bull trout watershed groups, which will assist them in making informed decisions affecting

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the restoration and conservation of bull trout in Montana. It is hoped that the watershed groups will develop specific recovery actions to help restore bull trout in watersheds throughout western Montana.

The status reports describe risks to bull trout in each watershed. This description of threats and risks to the fish is the best scientific judgement of the Scientific Group and is based on information provided by the local biologists. New and additional information provided by the public, the watershed groups, and the field biologists will add to our understanding of these risks as recovery proceeds. A status review is a continuous process, hence the description of these reports as "working documents."

Likewise, the restoration goal described in each status report is based on the best science available. The goal describes what would be necessary to recover fully functioning bull trout populations in each watershed and may not reflect what is realistically practical in all watersheds, considering time, budget, local interest, and/or other overriding constraints. It is presented as a goal, not necessarily as an inflexible expected outcome.

It is the sincere hope of the Restoration Team and Scientific Group that these documents will assist the watershed groups in "going forth and doing good things" for bull trout.

As always, we welcome your comments regarding bull trout restoration. Please send your thoughts or call Glenn Marx, Governor's Office, Capitol Station, Helena, MT 50620 (444-5506) or Shelley Spalding, Montana Fish, Wildlife and Parks, P.O. Box 20071, Helena, MT 59620 (444-7409).

Sincerely,

Larry F. Peterman

Larry Peterman, Chairman
Bull Trout Restoration Team

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EXECUTIVE SUMMARY

Bull trout were one of three salmonids native to the Blackfoot River. It is believed bull trout were once widely distributed in the tributary streams. The present distribution of bull trout is much reduced from historic levels in this drainage.

Risks

Mining and introduced species are rated as the two predominant risks to bull trout restoration. Mining impacts include the direct loss of habitat, particularly in the upper and southern portions of the basin - as well as water quality effects (lowered pH - sulfates) that pervade the system. These impacts persist and new mines may be developed in the future, potentially leading to further losses of habitat and more water quality degradation.

Introduced species (brook, brown and rainbow trout) were identified as a high risk to bull trout through hybridization (brook), predation (brown) and possible competition (brook, brown and rainbow). Since habitat availability and quality has been reduced through several factors (mining, forestry, agriculture, etc.), and since brook trout and brown trout habitat preferences overlap with bull trout, these processes/interactions may synergistically act to reduce carrying capacity for bull trout.

Other risk factors identified by the Montana Bull Trout Scientific Group include habitat impacts from forest practices (sedimentation from roads, loss of woody debris), grazing and rural residential development. Also, the Milltown Dam and irrigation diversions in the basin were considered risks since they directly remove fish from the population.

The local basin scoping group disagreed with the science team on one issue relative to the risk ratings. The scoping team identified residential development as a very high risk to bull trout

restoration, whereas the science team did not.

Further research is needed to determine if thermal problems and conflicts with sport fish management are risks to bull trout recovery.

Core Areas and Nodal Habitats

Core areas (those which currently support the strongest remaining populations of bull trout) are the North Fork of the Blackfoot River drainage, Monture Creek drainage, Copper Creek drainage, Gold Creek drainage, Cottonwood Creek drainage, the Clearwater River drainage above Rainy Lake, Deer Creek drainage, Placid Creek drainage, Belmont Creek drainage, Landers Fork drainage, East Fork Clearwater River drainage, West Fork Clearwater River drainage, and Morrell Creek drainage. Other watersheds are being considered as core areas and may be added to the list when more information becomes available.

Nodal habitats (containing critical overwintering areas and migratory corridors) are the Blackfoot River, Clearwater River, and the Clearwater chain of lakes (Salmon, Seeley, Placid, Inez, Alva, Rainy, and Clearwater).

The Restoration Goal

Maintenance of self-sustaining bull trout populations in all the watersheds where they presently exist and maintenance of the population genetic structure throughout the watershed is the first component of the restoration goal. Under this goal, the objectives are for all existing populations to at least remain stable or increase from current numbers in the future.

Increasing and maintaining the connectivity between the Blackfoot River and its tributaries is considered imperative for the long term survival of the species in this drainage. A key component of the restoration goal is to maintain the self-reproducing migratory life form in the Blackfoot River, with spawning distributed among all core drainages. Restoring the connectivity between the Blackfoot drainage and the Clark Fork River is also a component of the restoration goal.

Specifically, a baseline of redd counts should be established in all drainages that presently support spawning migratory fish. If the total baseline exceeds 100 redds or 2000 individuals in the Blackfoot drainage, an increasing trend should be the goal. If the baseline is below 100 redds or 2000 individuals, then an increase to this level should be the preliminary goal with an increasing trend thereafter.

BLACKFOOT RIVER DRAINAGE BULL TROUT STATUS REPORT

INTRODUCTION

In January, 1994, the Governor of Montana established a Bull Trout Restoration Team to develop a restoration plan for bull trout in Montana. The Restoration Team created a Scientific Group to provide guidance on technical issues related to the restoration of this fish.

The Scientific Group reviewed the status of bull trout (*Salvelinus confluentus*) and the risks to the survival of the species. In addition, the Scientific Group prepared reports on three of the most significant issues in bull trout restoration: (1) land management concerns in bull trout restoration, (2) removal or suppression of introduced species and, (3) the use of hatcheries and transplantation in bull trout restoration. Because the threats facing bull trout vary widely across the state, separate reports were prepared for each of the twelve bull trout restoration/conservation areas in Montana, except Rock Creek which is included in the Upper Clark Fork report (Figure 1). These restoration/conservation areas have been delineated largely due to fragmentation of historically connected systems. Loss of interconnectivity results from migration barriers like dams or other habitat changes, such as altered thermal conditions or dewatering. Each of the twelve restoration/conservation areas contains core and nodal habitats for bull trout restoration.

This status report covers the Blackfoot River drainage. It describes the current and historic status of bull trout, identifies core and nodal habitats, describes major risks to bull trout survival and presents restoration goals and suggestions for further research to aid restoration.

The Blackfoot River originates at the confluence of Beartrap and Anaconda creeks, southwest of Rogers Pass (Figure 2). The river flows approximately 133 mi in a generally westerly direction through a mostly forested valley to its confluence with the Clark Fork River near the town of Bonner, Montana (Moore et al. 1991).

The Blackfoot River has a drainage area of approximately 2300 mi^2. Average annual discharge near the mouth of the river is 1578 cfs (USGS 1995).

Topography and geology of the upper Blackfoot River and several of its tributaries were strongly influenced by glacial activity. Glaciers deposited extensive outwashes of gravel and morainal drifts. These glacial deposits influence streamflows in some reaches of the main Blackfoot and in some tributaries. Tributaries flowing through glacial deposits often have intermittent sections (Ingman 1988).

Land ownership in the Blackfoot Valley is 44% National Forest, 5% Bureau of Land Management, 7% State of Montana, 20% Plum Creek Timber Company, and 24% other private ownership.

Figure 1. Bull Trout Restoration/Conservation Areas in Montana.

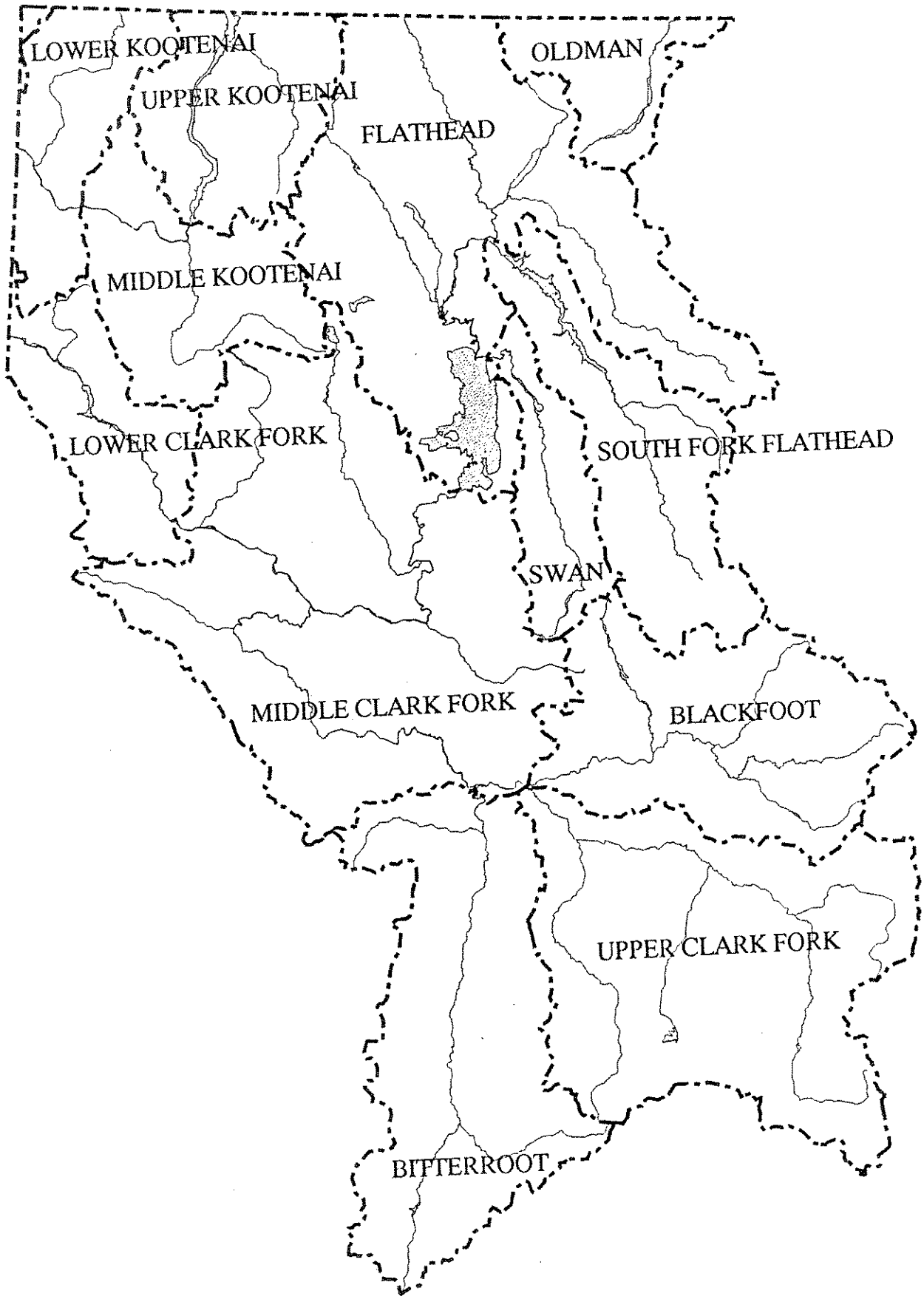
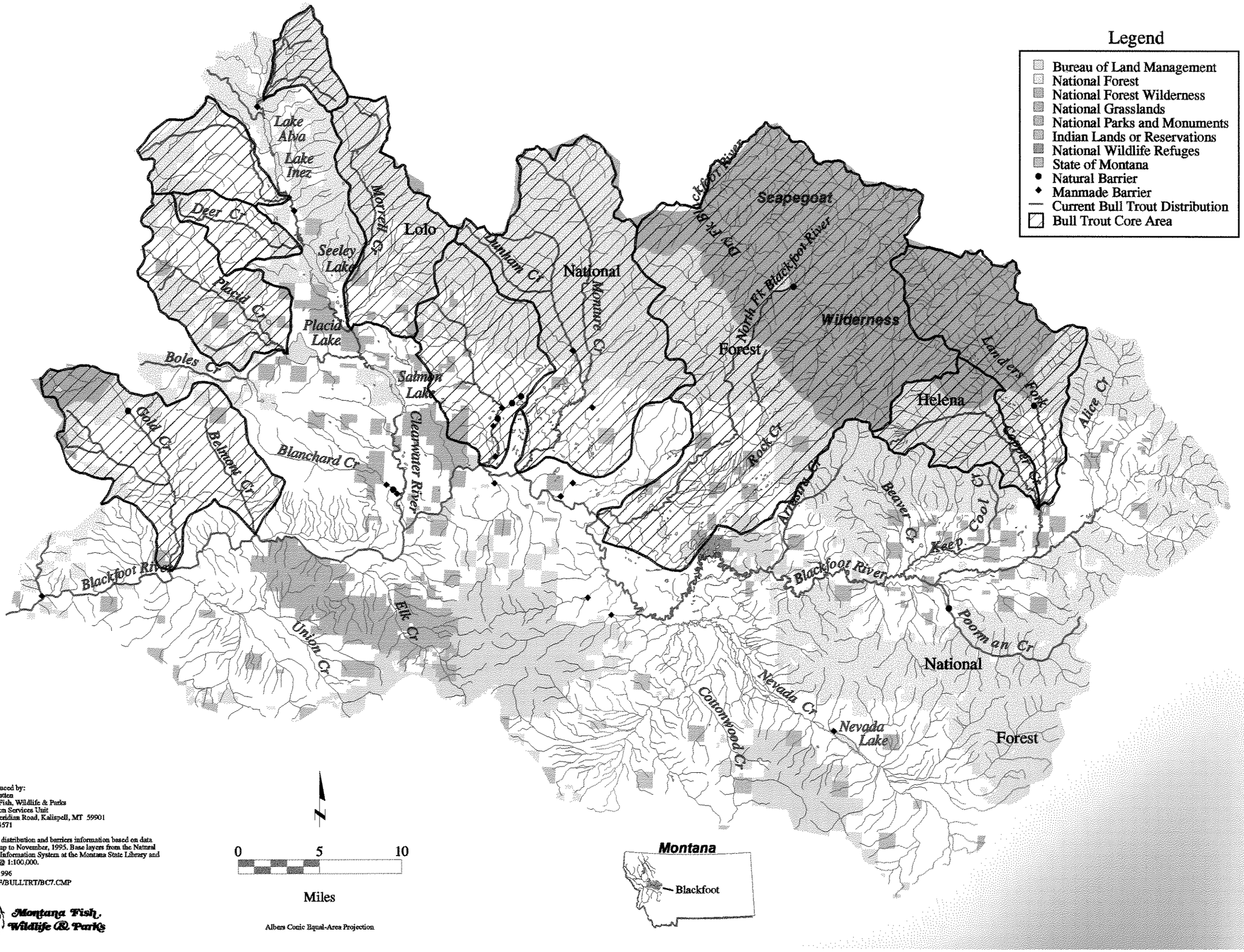


Figure 2. Bull trout distribution and core areas in the Blackfoot drainage.



Map produced by:
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Bull trout distribution and barriers information based on data collected up to November, 1995. Base layers from the Natural Resource Information System at the Montana State Library and digitized @ 1:100,000.

May 16, 1996
/GIS/JBFF/BULLTRT/BC7.CMP

Montana Fish, Wildlife & Parks

HISTORIC AND CURRENT STATUS OF BULL TROUT IN THE BLACKFOOT RIVER DRAINAGE

Historic Distribution

Historically, bull trout were likely widely distributed throughout the Blackfoot drainage. Evermann (1892), who traveled through Montana in the 1890's sampling fish, stated that bull trout were common in most of the larger affluents of the Columbia River in Montana, including the Blackfoot River. There are two other salmonid species native to the Blackfoot River - westslope cutthroat trout (*Oncorhynchus clarki lewisi*) and mountain whitefish (*Prosopium williamsoni*). There are no major natural barriers to fish migration that would have excluded bull trout from any significant portions of the Blackfoot River drainage.

Historically, there may have been a connection between migratory bull trout in the Clark Fork River and in the Blackfoot River. The Salish place name for Missoula, Milltown, and Butte refers to the bull trout that were caught there (Malouf 1974). The Flatheads were reported to have camped at Milltown at the junction of the Blackfoot and Clark Fork rivers while they fished for bull trout (Griswold and Larom 1954). Historic data collected by agencies prior to 1970 is listed in Table 1.

The connection between the lower Clark Fork and the Blackfoot was broken by the construction of Milltown Dam in 1906. Each spring, concentrations of fish are still observed at the base of Milltown Dam. In June, 1992, a 30-inch male and female bull trout died in an accidental dewatering of the sluice bay downstream of Milltown Dam. It is assumed that these fish were attempting an upstream migration past the Dam. A research project is currently underway to investigate the impacts of Milltown Dam on bull trout and other fish species (D.J. Peters, Montana Fish, Wildlife, and Parks, personal communication).

Table 1. A list of waters in the Blackfoot drainage surveyed prior to 1970 which were found to contain bull trout.

Name	Years Sampled	Citation	Comments
Canyon Lake	1968	FWP file data	
Clearwater Lake	1969, 1994	FWP file data	
Inez Lake	1955,1956,1957, 1958,1961,1966, 1968,1969 1955	FWP file data Peters 1964	Age and growth
Lake Alva	1958,1966,1968 1955	FWP file data Peters 1964	Age and growth data
Marshall Lake	1956,1965,1968	FWP file data	
Placid Lake	1957, 1968 1955,1956 1970	FWP file data Peters 1964 Mitchell 1970	Age and growth data
Rainy Lake	1955,1956,1957, 1958,1968,1969, 1994	FWP file data	
Salmon Lake	1955,1956,1957, 1959,1961,1962, 1963 1948,1955,1961	FWP file data Peters 1964	Age and growth data
Seeley Lake	1957 1948,1955	FWP file data Peters 1964	Age and growth data
Clearwater River	1957	FWP file data and Peters 1964	Age and growth data
Copper Creek	1968	FWP file data	
Cottonwood Creek	1954	FWP file data	
Nevada Creek	1957	FWP file data	
Morrell Creek	1970	Newell 1970	
Belmont Creek	1950	Peters 1964	Age and growth data

Unpublished information from landowners and anglers gathered by Montana Fish, Wildlife, and Parks also indicates that bull trout were more widely distributed in the tributaries of the Blackfoot River in the past than they are at present. Elk Creek (below highway 200), Keep Cool Creek, Grentier Spring Creek (tributary to Poorman Creek), Bear Creek, and Blanchard Creek are believed to have contained bull trout in the past, but are not there at the present time. Dick Creek is believed to have contained bull trout within the last decade, but they are not known to be in this stream at present. The spring creek systems in the Lincoln area and Dry Creek were likely historic bull trout streams. A large bull trout was caught in a private pond on Chamberlain Creek within the last decade, but current status is unknown (D.J. Peters, Montana Fish, Wildlife, and Parks, Missoula, Montana, personal communication).

The Landers Fork supported bull trout spawning within the last 15 years, but no redds have been found in recent surveys (D.J. Peters, personal communication).

Current Distribution

Bull trout populations in the Blackfoot River drainage have been the subject of recent research efforts. The mainstem Blackfoot River contains migratory bull trout. The abundance of these fish varies by reach. Generally, electrofishing data indicate that from the mouth of the Blackfoot to the North Fork of the Blackfoot River bull trout are considered uncommon. From the North Fork of the Blackfoot River to Poorman Creek, bull trout are rare. From Poorman Creek to the Landers Fork, bull trout are expected but not verified and from the Landers Fork to the headwaters, bull trout are rare. However, creel census data indicate that bull trout may be more common than previously thought in the section of the Blackfoot River from Lincoln to Nevada Creek. Data collected in 1994 indicate that bull trout comprised 9% of the catch in that section of river (representing about 86 fish caught and released). In the lower Blackfoot River (mouth to Whitaker Bridge section) bull trout comprised about 1% to 2% of the catch (about 206 fish caught and released) (D.J. Peters, personal communication).

In recent years, electrofishing mark-recapture estimates in the mainstem Blackfoot River, downstream of the North Fork of the Blackfoot, and in the North Fork itself have found between 0.75 and 2.4 bull trout > 12"/1000' of river. Since 1989, the numbers of fish appear to be increasing, although the numbers are still low (FWP unpublished file data).

In the winter, bull trout appear to congregate in boulder dominated reaches of the lower Blackfoot River (D.J. Peters, FWP, personal communication).

Lengthy bull trout migrations have been documented in the Blackfoot drainage. Twice, Montana Fish, Wildlife, and Parks has tagged bull trout in the Johnsrud section of the Blackfoot River and later found these fish upstream in the North Fork of the Blackfoot River, a distance of over 50 miles. Fish in the Blackfoot River are known to move into the Clearwater River drainage as well (D.J. Peters, FWP, personal communication).

A research project is currently underway to evaluate bull trout movements in this drainage. In 1994, 13 bull trout in the Blackfoot River drainage were fitted with radio telemetry devices. Preliminary results indicate that radioed bull trout moved extensively, apparently even when not on spawning runs (Peters 1994).

An upstream migration of subadult bull trout has been noted in the North Fork of the Blackfoot River. These fish concentrate in the lower reaches of the North Fork in the summer, then migrate into the lower reaches of the tributaries just before, or along with, migrating spawning adults. However, the subadult fish do not move all the way to the spawning areas with the adult fish (D.J. Peters, FWP, personal communication).

A basin-wide catch and release only season for bull trout was implemented in 1990 to reduce angler impacts. (This was expanded to a statewide bull trout fishing closure in 1992).

Misidentification of bull trout and lack of compliance with regulations continues to plague the attempt at reducing bull trout mortality by anglers (D.J. Peters, FWP, personal communication).

Surveys of the Blackfoot River tributaries have found that in general, south flowing tributaries on contain bull trout, whereas tributaries which flow north do not, although some of these north flowing streams may have been utilized by bull trout historically (Figure 2).

Spawning areas within the tributary streams are very localized and relatively small and seem to have strong groundwater influence. Bull trout have been observed using these same small spawning areas in consecutive years (D.J. Peters, FWP, personal communication; R. Pierce, FWP, personal communication).

Most tributaries contain brook trout (*Salvelinus fontinalis*) (except Copper Creek, the Landers Fork, and Belmont Creek), but little work has been done to document the extent of hybridization between brook trout and bull trout in the basin. Bull trout X brook trout hybrids have been documented in Poorman Creek (R. Leary, University of Montana, Missoula, Montana, personal communication), but analysis of a sample of 15 fish from Belmont Creek showed they were bull trout (Leary 1992).

Bull trout redd numbers are available for a few tributaries. Redd surveys on the North Fork of the Blackfoot found 26 redds in 1991, and 38 redds in 1992. Redd surveys on Monture Creek found 25 redds in 1991, 34 redds in 1992, 44 redds in 1993, and 49 redds in 1994 (FWP unpublished file data). The North Fork of the Blackfoot and Monture Creek are among the most important spawning streams in the drainage.

Increasing redd counts in these streams may be a response to more restrictive angling regulations. Improved habitat conditions as a result of habitat restoration projects may be benefitting bull trout, but it is too early to assess these effects. It would be premature to conclude

that overall bull trout populations are increasing, with such a short period of record and small numbers of redds.

Bull trout population densities have been estimated in the West Fork of the Clearwater River and Deer Creek (tributary to the Clearwater River) in recent years (Lolo National Forest unpublished data, 1993).

Several streams are suspected to contain low numbers of bull trout but the status of the species in these streams is unclear. A bull trout was collected in Nevada Creek in 1993, directly downstream of Nevada Creek Reservoir. However, most of the few remaining bull trout in Nevada Creek are believed to be above the reservoir. Poorman Creek appears to contain low numbers of bull trout, which are isolated as a result of natural dewatering from the mainstem Blackfoot River most, if not all, of the time. Bull trout were collected in Hogum Creek in 1987 and Arrastra Creek in 1990 but their current status is unknown. The East Fork of the North Fork of the Blackfoot River and Dick Creek may have a few remnant bull trout but their presence has not been documented in recent years. No information is available about the historic status of bull trout in Union Creek and Ward Creek. Union Creek has been sampled extensively in recent years and no bull trout have been found.

A number of lakes in the upper Blackfoot River drainage (primarily within the Clearwater River drainage) support migratory populations of bull trout. Lakes Alva, Inez and Rainy were intentionally poisoned in the 1960's to remove "rough fish" and bull trout were poisoned as well. Current data on these populations are limited, but bull trout may be recovering in Rainy Lake. Bull trout are also present in Seeley Lake, Lake Alva, and Lake Inez. Rainy Lake is believed to have the most abundant bull trout population in this group. Coopers Lake (in the Ovando area) also contains a potentially disjunct migratory bull trout population (D.J. Peters, FWP, personal communication).

Within the upper Clearwater chain of lakes, barriers exist below Rainy Lake, Lake Alva, and Lake Inez. Bull trout are known to collect at the barrier below Rainy Lake and possibly at the others as well. Discussions are underway about possibly removing these barriers (D.J. Peters, FWP, personal communication). There is no information available about the current status of bull trout in Marshall and Canyon Lakes (D.J. Peters, personal communication; L. Walch, Helena National Forest, Helena, Montana, personal communication; R. Pierce, FWP, personal communication) .

The Blackfoot Challenge is an organization developed by some people of the Blackfoot Valley with the purpose of supporting cooperative resource management, to help manage for the future, and to keep the area's desired characteristics. The Challenge is comprised of individuals, land owners, residents, recreationists, special interest groups and federal, state, and local agencies. Participants in the Challenge come together to coordinate efforts, distribute information, and foster open communication.

Members of the Challenge have assisted in the initiation of a number of stream improvement projects. In six streams, fish passage barriers have been removed, opening approximately 47 miles of stream to spawning fish. In 17 streams, mixtures of fish habitat, wetlands, and rangeland improvement measures have been applied or are in progress. Approximately 147 mi. of stream have been affected by the restoration efforts. The results of these projects have been substantial localized improvement in water quality and fisheries resources.

In general, the status of bull trout in this drainage appears to be precarious. While the available data indicates that bull trout may be increasing in some portions of the drainage, particularly in the North Fork Blackfoot and Monture Creek areas, it appears that bull trout have been completely lost from portions of the drainage in recent years.

CORE AREAS AND NODAL HABITATS FOR BULL TROUT IN THE BLACKFOOT DRAINAGE

Core areas are drainages that currently contain the strongest remaining populations of bull trout and are usually relatively undisturbed. These watersheds need to have the most stringent level of protection as they will potentially provide the stock for recolonization.

Core areas (those which currently support the strongest remaining populations of bull trout) are the North Fork of the Blackfoot River drainage, Monture Creek drainage, Copper Creek drainage, Gold Creek drainage, Cottonwood Creek drainage, the Clearwater River above Rainy Lake, Deer Creek drainage, Placid Creek drainage, Belmont Creek drainage, Landers Fork drainage, East Fork Clearwater River drainage, West Fork Clearwater River drainage, and Morrell Creek drainage. Other watersheds are being considered as core areas and may be added to the list when more information becomes available.

Nodal habitats (containing critical overwintering areas, migratory corridors, and other critical habitat) are the Blackfoot River, Clearwater River and the Clearwater chain of lakes (Salmon, Seeley, Placid, Inez, Alva, Rainy, and Clearwater).

RISKS TO BULL TROUT IN THE BLACKFOOT RIVER DRAINAGE

The risks to bull trout in the blackfoot River drainage are listed in Table 2. The risks were evaluated by the Scientific Group based on the degree to which a risk factor was presumed to contribute to the past and current decline of the species (designated as current/historic in the table) and the threat that the risk factor poses to future restoration of the fish (designated as restoration in the table). Those risks which are of greatest concern are noted with a double asterisk.

Mining and introduced species are rated as the two predominant risks to bull trout restoration. Mining impacts include the direct loss of habitat, particularly in the upper and southern portions of the basin - as well as water quality effects (lowered pH - sulfates) that pervade the system. These impacts persist and new mines may be developed in the future, potentially leading to further losses of habitat and more water quality degradation.

Introduced species (brook, brown and rainbow trout) were identified as a high risk to bull trout through hybridization (brook), predation (brown) and possible competition (brook, brown and rainbow). Since habitat availability and quality has been reduced through several factors (mining, forestry, agriculture, etc.), and since brook trout and brown trout habitat preferences overlap with bull trout, these processes/interactions may synergistically act to reduce carrying capacity for bull trout.

Other risk factors identified by the Montana Bull Trout Scientific Group include habitat impacts from forest practices (sedimentation from roads, loss of woody debris), grazing and rural residential development. Also, the Milltown Dam and irrigation diversions in the basin were considered risks since they directly remove fish from the population.

The local basin scoping group disagreed with the science team on one issue relative to the risk ratings. The scoping team identified residential development as a very high risk to bull trout restoration, whereas the science team did not.

The potential risks to bull trout in the Blackfoot River drainage are listed in Table 2. The risks were evaluated based on the degree to which a risk contributed to the past and current decline of the species (designated as current/historic in the table) and the threat the risk factor poses to future restoration of the fish (designated as restoration in the table). Those risks which are of greatest concern are noted with a double asterisk. Other high risk threats are denoted with a single asterisk. Further research is needed to determine if thermal problems and conflicts with sport fish management are risks to bull trout recovery.

Table 2. **Risks to bull trout.** ** = highest risks in Blackfoot
* = high risk in Blackfoot

RISK	CURRENT/HISTORIC	RESTORATION
Environmental Instability		
Drought		
Landslide/Geology		
Flood/Rain on Snow		
Fire		
Introduced Species		
Private Ponds		
Legal Introductions	*	**
Illegal Introductions		*
Fisheries Management	*	*
Barriers		
Culverts		
Diversions	*	**
Thermal	*	*
Dams	*	**
Habitat		
Rural Residential Development		*
Mining	*	**
Grazing	*	**
Agriculture	*	*
Dam Operations		
Forestry	*	**
Recreational Developments		
Transportation		
Population		
Population Trend	*	*
Distribution/Fragmentation		
Abundance		
Biological Sampling		
Angling	*	*
Illegal Harvest	*	*

Environmental Instability

Drought, Landslide/geology, Flood/Rain on Snow, Fire

There are two components to the risk from environmental instability. First, the likelihood of a catastrophic event occurring and, second, the risk to the bull trout population if such an event should occur.

In the Blackfoot, fire, flood, landslides, and drought are more likely to occur than rain on snow events. (Rain on snow is a common term used to describe cloudy weather periods when warm winds and rain combine to produce rapid snowmelt. These events generally occur during early to mid- winter periods.) Man's activities have increased the chances of some of these events occurring. However, these events are not a major cause for concern in most of the drainage because the bull trout population retains some connectivity between the mainstem and tributaries. Under current conditions if a catastrophic event were to cause a local extinction of the species, there are opportunities for bull trout to recolonize the habitat in most portions of the drainage. In those areas where resident fish occur and are no longer influenced by migratory forms, the risk from environmental instability would be high.

Introduced Species

The introduced fish species found in the Blackfoot drainage include brook, brown (*Salmo trutta*), rainbow (*Oncorhynchus mykiss*), and Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*), largemouth bass (*Micropterus salmoides*), northern pike (*Esox lucius*), walleye (*Stizostedion vitreum*), and pumpkinseed sunfish (*Lepomis gibbosus*). The introduced salmonids, particularly brook trout, are believed to be the greatest threat to bull trout. Introduced species may have been one of the most significant factors in the decline of the bull trout in this drainage.

Bull trout hybridize with brook trout and the offspring are generally sterile (Leary et al. 1983). Brook trout are widely distributed in the Blackfoot River drainage. Belmont Creek, the Landers Fork and Copper Creek may now be the only significant bull trout watersheds where no brook trout have been found to date. Hybridization has been confirmed in Poorman Creek (R. Leary, University of Montana, Missoula, Montana, personal communication). The available data indicate that hybridization between brook and bull trout can be an unstable situation resulting in a dramatic decline or replacement of bull trout (Leary et al. 1993).

Brown trout are suspected to adversely affect bull trout (Pratt and Huston 1993, Rode 1990, Moyle 1976, Nelson 1965). At this point the mechanism of the supposed adverse interaction (whether competition or predation) between bull trout and brown trout or other introduced species is not known and more information is needed.

The density of brown trout is consistent within the mainstem of the Blackfoot River from the mouth to Monture Creek, but due to differing densities of rainbow trout, their percentage of the overall population varies. In the Johnsrud area, brown trout comprise approximately 5 - 10% of the total trout population, and the numbers appear to be increasing. Near the Monture Creek confluence with of the Blackfoot River, overall trout densities are lower and brown trout comprise approximately 30 - 40% of the trout population. Total trout densities appear to be increasing in this section of the Blackfoot in recent years.

In the section of the Blackfoot River above Monture Creek and below the town of Lincoln, trout numbers (dominated by brown trout) are higher than in the section immediately downstream. The lower portions of Monture Creek and the associated spring creek system are important brown trout spawning areas. Above the town of Lincoln, brown trout numbers decline (D.J. Peters, FWP, personal communication; R. Pierce, FWP, personal communication).

Brown trout are commonly found in Blackfoot River tributary streams as well as in the mainstem river. This is unlike some other Montana river systems. The Blackfoot drainage would

be a good location for research on brown trout - bull trout interactions because there is a definite overlap between the ranges of the two species and historicbaseline data is available.

The impact of recent habitat improvement efforts on the relative abundance of brown trout and bull trout is unknown. If these projects benefit brown trout to a greater extent than they benefit bull trout then they could have the unintended consequence of increasing brown trout numbers at the expense of bull trout. Further monitoring is needed to determine the specific impacts of habitat improvement.

The presence of walleye and northern pike in the Clearwater River drainage is also of concern. The interaction between these species and bull trout are unknown.

Private Ponds

The stocking of non-native trout species in private ponds is a concern in the Blackfoot drainage. The human population in the drainage is growing and many people are constructing ponds on their property. Although there is a requirement that private ponds be licensed by Montana Fish, Wildlife, and Parks before they are stocked with fish, many people are unaware of, or disregard, the law. The existing permit system is inadequate to control the spread of introduced species. The concern is that brook trout, or other species, may spread from ponds into waters, including bull trout waters, where they do not presently exist.

Legal Introductions (very high risk)

At the present time, the fish species stocked in the Blackfoot River drainage by MFWP are westslope cutthroat trout, rainbow trout, largemouth bass, grayling (*Thymallus arcticus*) and kokanee (*Oncorhynchus nerka*) (in Seeley Lake). Largemouth bass are stocked in Placid Lake and Seeley Lake. Interactions between largemouth bass and bull trout are unknown so the agency stocking policy in these waters should be reviewed.

In the past, FWP, other agencies, and individuals have stocked a variety of introduced species, including brook trout, brown trout, rainbow trout, and others. These fish have established self-reproducing populations in many Blackfoot River drainage waters. It is the legacy of these past stocking practices that poses a significant threat to the survival of bull trout today.

Illegal Introductions (high risk)

Illegal introductions of non-native fish species is another increasing concern. In addition to the risks posed by spreading non-native species, there is also a risk of introducing fish pathogens. Both northern pike and walleye have been illegally introduced into western Montana waters. These fish are not native to western Montana. But are now found in many western Montana waters, including lakes in the Clearwater River drainage. In some areas of Montana, northern pike have completely replaced the existing trout fishery (J. DosSantos, Confederated Salish and Kootenai Tribes, Pablo, Montana, personal communication; J. Vashro, FWP, Kalispell, Montana, personal communication).

It is impossible to predict what species might be illegally introduced or what impact those fish may have on the native fauna. It is clear that continued illegal fish introductions will complicate restoration efforts for bull trout.

Fisheries Management (high risk)

The Blackfoot River is managed primarily as a rainbow and brown trout fishery. At this time, there is no solid information as to whether rainbow and brown trout are a detriment to bull trout in this drainage. Current fishery management goals in the Blackfoot River involve increasing the numbers of both native (westslope cutthroat and bull trout) and introduced species (rainbow and brown trout). No harvest is allowed on the native species and limited harvest is permitted on rainbow and brown trout.

Future sport fishery management goals directed to recreational fishing for introduced species may prove to be in conflict with the goal of restoring bull trout in this drainage. If bull trout are to persist over the long term, it may be necessary for the focus of fisheries management to shift to a goal of further protecting imperiled native species.

Barriers

Several streams contain natural barriers. There are waterfalls in the upper reaches of Morrell, Monture, North Fork of the Blackfoot, Landers Fork and Gold creeks. These barriers may or may not be complete fish passage barriers. In any case, there is no recommendation to modify these barriers.

Culverts

Historically, impassible culverts may have been a major problem for migratory bull trout in the Blackfoot River drainage. However, in recent years, many of the most problematic culverts have been replaced, including culverts in Bear, Belmont, Blanchard, Rock, Chamberlain and Arrastra creeks.

Diversions (very high risk)

Irrigation diversions are a significant threat to the restoration of the migratory bull trout population in some watersheds, particularly Poorman and Nevada creeks and the North Fork of the Blackfoot River. Diversions may make it impossible for fish to migrate upstream from the Blackfoot River into the tributaries to spawn. In addition, downstream migrants may be trapped in the irrigation ditches and prevented from making it into the river. Recent research in the Blackfoot drainage has found that substantial numbers of bull trout are found in ditches (D.J. Peters, personal communication).

Several diversion structures in the drainage have been renovated to provide fish passage and eliminate entrainment, however, more work needs to be done.

Thermal (high risk)

Rieman and McIntyre (1993) concluded that temperature represents a critical habitat characteristic for bull trout. Temperatures in excess of 59° F are thought to limit bull trout distribution in many systems (Bjornn 1961; Brown 1992; Fraley and Shepard 1989).

Elevated temperatures are found in Nevada Creek, Douglas Creek, Nevada Spring Creek, Cottonwood Creek (near Helmville), Willow Creek (near Sauerkraut Creek), Union Creek, Elk Creek and the Clearwater River. The Blackfoot River is significantly warmer downstream of the confluence of Nevada Creek than upstream, during the summer. Summer water temperatures in Nevada Creek and the Blackfoot River below Nevada Creek were significantly above levels considered optimal for trout (Pierce and Peters 1990).

Probable causes of elevated temperatures are grazing in riparian zones, logging, and irrigation return flows.

Temperature appears to be a habitat problem in many tributaries and in portions of the mainstem Blackfoot River, but temperature may not be a migration barrier. Preliminary data indicate that, in the Blackfoot system, fish migration primarily occurs before warm water temperatures occur. Further research is needed to determine the specific causes of temperature increases and the impact on bull trout.

Dams (very high risk)

Milltown Dam was constructed on the Clark Fork River in 1906 and 1907 just downstream of the confluence of the Blackfoot River and the Clark Fork River (Periman 1985).

This dam is a run-of-the-river hydroelectric facility that blocks upstream fish passage.

The Montana Power Company, which owns and operates Milltown Dam, is currently involved in re-licensing the dam under the authority of the Federal Energy Regulatory Commission. A fisheries mitigation plan is being developed which includes provisions for providing selective fish passage at this facility. This project is in the experimental phase and its ultimate success is unknown.

There is a small dam at the mouth of the Blackfoot River (at the Stimpson Lumber Mill) that may be a seasonal fish passage barrier. The Nevada Creek dam and dams on the Clearwater Lakes (Seely Lake and Placid Lake) are also fish passage barriers. Fish passage barriers were installed at the outlets of Rainy Lake and Lake Inez in the 1960's in an attempt to control the reintroduction of "rough fish" into these lakes following chemical rehabilitation to remove them. Montana Fish, Wildlife and Parks is researching the possibility of removing these barriers.

Habitat Risk Factors

Rural Residential Development (high risk)

The human population is growing in the Blackfoot River drainage, particularly in the area around Lincoln. Alteration of riparian zones is often a major impact associated with human development.

The impacts of human development may be partially mitigated by an active program to acquire conservation easements to protect fragile lands. In addition, newly adopted rules by Missoula County require protection of riparian zones However, much of the upper Blackfoot drainage is not in Missoula County.

Mining (very high risk)

Mining in the headwaters of the Blackfoot River began in approximately 1865. A variety of minerals and commodities including gold, silver, lead, and copper were recovered from numerous small placer and hard rock mining operations. Although milling has not been widespread in the drainage, milled tailings were discharged into the headwaters at several sites (Moore et al. 1991).

Mining has had an extensive impact on aquatic ecosystems in the Blackfoot River drainage. Numerous mines have been developed in the southern and western portions of the basin. Impacts include the direct loss of aquatic habitat and, particularly in the upper portions of the drainage, chemical impacts to water quality. Overall, the Montana Department of Health and Environmental Sciences lists 11 streams that suffer water quality impairment as a result of mining activities including: Beartrap Creek, Day Gulch, Douglas Creek, Elk Creek, Jefferson Creek, Poorman Creek, Sandbar Creek, Washington Creek, Washoe Creek, West Fork Ashby Creek and Willow Creek (MT DHES 1994).

Mine drainage from adits and waste piles continues to contaminate waters in the headwaters of the drainage. Contaminant input from mine effluent in the headwaters into the Blackfoot River is apparent from downstream trends of solute constituents. The pH of effluent in contaminated tributaries that flow into the upper 3 mi. of the river ranges from 3 to 6.5. Concentrations of sulfate are extremely high in the more acidic tributaries and decrease downstream from those sources (Moore et al. 1991). Alkalinity is also depressed for about 20 miles due to the effects of acid mine drainage (Ingman et al. 1990). Both acidity and sulfate show downstream attenuation from the headwater sources in the Blackfoot River (Moore et al. 1991). Inflows of limestone groundwater or springs below Lincoln enhance the river's buffering capacity against changes in pH and the effects of metals (Ingman et al. 1990).

Trace metal contamination originates from a small number of headwater tributaries, particularly the Mike Horse Mine. Concentrations of solutes decrease rapidly in the upper few miles below their sources. However, solute metal contaminants transfer to the particulate phase and at least some Cd and Zn remain bioavailable over long stretches of the river (Moore et al. 1991).

The Mike Horse Mine tailings dam washed out in 1975 sending tons of metal contaminated tailings into the upper Blackfoot River. These tailings continue to impact aquatic life in the Blackfoot River. Studies of fish populations conducted before and after the tailings pond failure indicate acute mortalities of brook and cutthroat trout (Spence 1975; Moore et al. 1991) and fish population densities remain reduced (Peters and Spoon 1989, Moore et al. 1991).

Studies of a suppressed population of brook trout located in the upstream portions of the drainage suggest substantial bioavailability of cadmium, zinc and copper in conjunction with the high concentrations in sediments and water. Preliminary data indicate that metal influences may be moving downstream (Moore et al. 1991). These metals have been shown to adversely affect both trout and their food web.

Sediment impacts in Elk Creek are the result of numerous active and inactive placer mines and from a roadway that follows the stream and washes out periodically (Ingman 1988).

New mines may be developed in the drainage as well. A large open pit gold mine with cyanide heap leach processing (the McDonald gold project) is being planned for the Lincoln area and is of serious concern. It is likely that mining will continue to be of interest in the basin because of the presence of minerals.

Grazing (very high risk)

Historic grazing use of the Blackfoot River drainage may have been one of the most

significant factors in causing the decline of bull trout. Grazing directly affects streams by reducing bank stability and riparian vegetation. This, in turn, increases sediment loads and water temperatures.

Grazing impacts have been decreasing in recent years as a result of cooperative efforts between landowners and agencies. The scoping group who provided input to this report was divided over the question of whether grazing continues to be a high risk to bull trout. Generally, the consensus of the group was that there has been excellent progress in recent years reducing grazing impacts in the Blackfoot but that the efforts need to continue.

Agriculture (water quantity and quality) (high risk)

Agricultural practices increased stream sediment loads when willows were removed and the native prairie was broken up and planted with tame grasses. There are still some new areas being put under tillage. Most of the sediment impacts occur at the time when the land is first tilled.

Poor water quality, poor habitats, and depressed fisheries in Nevada Creek and to some degree the Blackfoot River below Nevada Creek can be attributed to agricultural practices in the Nevada and Ovando Valleys. Alteration of stream flows below Nevada Creek reservoir, including dewatering of the stream channel even for short periods, can eliminate viable trout fisheries. Irrigation return flows add excessive amounts of nutrients and sediment and increase water temperatures (Pierce and Peters 1990). McGuire (1991) found evidence of persistent nonpoint source pollution (nutrient enrichment, sedimentation, and elevated water temperatures) in the Blackfoot River below the confluence of Nevada Creek.

Agricultural impacts to water quality have been noted in 193 miles of tributary streams to the Blackfoot River (MT DHES 1994). Chronic dewatering is found in 82.4 miles of 18 streams within the drainage (FWP 1991a).

Dam Operations

There are no hydroelectric facilities in this drainage. Milltown Dam does impact the lowest reach of the Blackfoot River, but it is not located within the drainage.

At times, flow below Nevada Creek Dam is severely reduced. This would impede recovery of bull trout in Nevada Creek. However, overall, dam operations are not a significant risk in the Blackfoot drainage.

Forestry (very high risk)

Past forestry practices (road construction, log skidding, riparian harvest, clearcutting, terracing) were often damaging to watershed condition and were probably a contributing cause of the decline of bull trout. The effects of these practices include increased sediment in streams, increased peak flows, thermal modifications, loss of instream woody debris and channel instability.

There were log drives in the mainstem Blackfoot and Clearwater rivers which probably had an unquantifiable, but significant, impact on aquatic habitat. Evermann (1892) wrote of the Blackfoot River, "At Bonner, a mile or so above the mouth, is a very large sawmill, and the river for 3 or 4 miles above the mill is literally filled with logs which have been cut from the heavily timbered country through which the river flows and which were being floated down to the mill... The mountains on either side are of highly metamorphic sandstone, and in most places densely timbered, but at the present rate of destruction it will not be many years until these magnificent forests are wholly destroyed, the mountains made barren, and the volume and beauty of the streams greatly diminished."

Log drives were very damaging to fish and fish habitat at the time they occurred. Some of the impacts to the stream channel (eroded streambed, gouged banks, straightened channel,

blocked side channels, lost instream cover and woody debris) no doubt persist into the present (Sedell et al. 1991). Guth and Cohen (1991), in a caption of a photograph of a log jam at Bonner in 1899, state that sometimes logs being floated down river did not behave and there were tremendous log jams. Dynamite was usually used to break up the logs forming the jam.

Many drainages in the Blackfoot watershed have been extensively logged and have suffered damage from sedimentation (Ingman 1988). Silvicultural impairment to water quality has been noted in Belmont Creek, Bear Creek, Chamberlain Creek, Deer Creek, Keno Creek, Marcum Creek, McElwain Creek, North Fork Blackfoot River, Richmond Creek and the West Fork Clearwater River (MT DHES 1994).

Current forestry practices are more progressive, but the risk is still high because of the existing road system, forestry practices on non-industrial private land and the lingering results of past activities.

Recreational Development

Although there is heavy dispersed recreational use in this drainage, there is little large scale recreational development. This is a low risk to bull trout in the Blackfoot drainage.

Transportation

There is a major highway corridor that parallels much of the mainstem Blackfoot River. Potential spills of toxic substances are a concern in this area. In some specific locations, channelization of streams for roads and railroads are a significant impact. Road maintenance may impact bull trout when road sanding or deicing materials enter the stream or when road grading increases stream sediment loads.

Population Risk Factors

Trend (high risk)

In some portions of the drainage (North Fork of the Blackfoot River and Monture Creek areas), bull trout numbers appear to be increasing. However, in other streams, numbers of bull trout have declined in recent years (Nevada, Alice, Poorman, Beaver, Arrastra, Hogum, and Chamberlain creeks). No trend data is available for other portions of the drainage such as the Clearwater system and the lower portions of the Blackfoot River. Overall, the apparent downward trend in some streams continues to be a source of concern.

Distribution/Fragmentation

Disruption of migratory corridors increases stress, reduces growth and survival and leads to the loss of the migratory life history type. Resident stocks living upstream from barriers are at an increased risk of extinction (Rieman and McIntyre 1993). In the Blackfoot River, the migratory form still persists and most of the tributary drainages continue to be connected to the mainstem river. The effect of the loss of connection to the Clark Fork River due to Milltown Dam is unknown.

Abundance

If a population is small enough, random variation among individuals can lead to a decline in the population long enough for the population to go extinct. As a population is restricted in abundance, or as the variation in its birth rate or survival increases, the predicted mean time to extinction will decrease (Rieman and McIntyre 1993).

Low abundance was not judged to be a high risk in the Blackfoot drainage. However, the risk can be lessened further by increasing the numbers of fish in the drainage.

Biological Sampling Loss

As a result of research on the impacts of electrofishing on fish, electrofishing techniques and equipment have been modified to minimize electrofishing injury to fish. There is also a FWP policy minimizing the use of electrofishing in waters containing Species of Special Concern. Overall, the risk of loss of bull trout due to sampling was judged to be minimal.

Angling (high risk)

The Blackfoot River is one of the most popular fisheries in Region 2. In 1993, angling pressure was estimated at 34,179 angler days, up from 20,043 angler days in 1991 (FWP 1991b; FWP 1993).

The current risk from legal angler harvest is low because fishing for bull trout is no longer legal in this drainage. However, there is risk to bull trout from incidental hooking and handling mortality. There is no information on hooking mortality in catch and release bull trout fisheries. If, in the future, data indicate that hooking mortality is a significant problem, there could be additional gear restrictions and seasonal fishing closures in certain areas. Those drainages that receive significant fishing pressure (such as the mainstem Blackfoot River and the North Fork Blackfoot River) may be more likely to have hooking mortality problems than more lightly fished waters.

Illegal Harvest (high risk)

There is reason to believe that illegal harvest continues in the drainage. During the summer of 1994, two of seven bull trout equipped with radio tags disappeared and were suspected to be illegally harvested. Because of the presence of similar-looking species (brook, brown trout) in the drainage, misidentification is also a problem.

RESTORATION GOAL

The first component of the restoration goal is maintenance of the population genetic structure. This will require that all existing populations will at least remain stable or increase from current numbers in the future.

Maintaining and increasing the connectivity between the Blackfoot River and its tributaries is considered imperative for the long term survival of the species in this drainage. Otherwise it is believed that demographic factors, genetic factors, and natural or human caused catastrophic events will act in concert to gradually cause the elimination of remaining populations. A key component of the restoration goal for bull trout in the Blackfoot River drainage is to maintain the self-reproducing migratory life form in the Blackfoot River which has access to tributary streams and spawns in all core watersheds.

Specifically, a baseline of redd counts should be established in all drainages that presently support spawning migratory fish. If the total baseline exceeds 100 redds or 2000 individuals in the Blackfoot drainage, an increasing trend should be the goal. If the baseline is below 100 redds or 2000 individuals, then an increase to this level should be a preliminary goal with an increasing trend thereafter.

It should be recognized that this goal is based on the best information available at this time, but the level of uncertainty about the appropriateness of these numbers is high. Modifications of this goal may be appropriate in the future as more information becomes available.

The current bull trout management objective, stated in the 1990 Montana Fish, Wildlife, and Parks Blackfoot River Management Plan, is to increase the standing crop of adult bull trout larger than 5 lbs to 1 fish per 1000 ft (FWP 1990). This goal has not been met, but with the knowledge the FWP biologists currently have regarding viable population sizes and habitat selection, FWP believes that this bull trout management objective is conservative.

SOURCES OF UNCERTAINTY, DATA NEEDS

Distribution

Surveys are needed of fish populations in Alice, Hogum, Seven Up Pete, Copper, Landers Fork, Nevada, Lodgepole, Dunham and West Fork Twin creeks and especially in the Clearwater River drainage.

Further research is needed on the population genetic structure in the drainage.

Redd counts need to be conducted annually on an expanded network of streams.

Migratory Populations

Further research is needed on bull trout movement in general. In particular, little is known about bull trout movements in the Clearwater River system.

In addition, the overall degree of connectivity within the system is unclear. Some tributaries are known to be used by migratory bull trout but, in other tributaries, the use by migratory fish is unknown. These streams may contain resident bull trout, migratory bull trout, or both.

Ongoing radio telemetry work needs to be continued. The objectives of this work are to determine the annual, seasonal and diurnal movement and habitat utilization of migratory bull trout in the sub-adult and adult age classes, determine the biological significance of apparent bull trout concentrations below Milltown Dam, and identify key habitat for migratory bull trout.

Temperature

Temperature - is it a barrier in the lower end of the Blackfoot or Clearwater rivers? If so, what are the causes of the increased temperature? What can be done to reduce river temperatures?

Restoration

Habitat improvement efforts should be continued and monitoring of these projects should be continued and expanded.

We need to know more about the effects of habitat restoration as it affects the interactions between bull trout and other species, especially brook and brown trout.

Species Interactions

We need to know more about bull trout/brown trout, bull trout/walleye and bull trout/largemouth bass interactions. This drainage would be an excellent location to study these interactions. It would be worthwhile to know the reasons why the distribution of brown trout increased upstream during the recent drought years.

Fisheries Management

The impacts to bull trout of fisheries management that promotes larger brown and rainbow trout is unknown. Bull trout inhabit the mainstem of the Blackfoot River with these introduced species.

LITERATURE CITED

Bjornn, T.C. 1961. Harvest, age structure, and growth of game fish populations from Priest and Upper Priest Lakes. Transactions of the American Fisheries Society 100:423-438.

Brown, L.G. 1992. Draft management guide for the bull trout *(Salvelinus confluentus)* (Suckley) on the Wenatchee National Forest. Washington Department of Wildlife, Wenatchee, Washington.

Evermann, B.W. 1892. Report of the Commissioner of Fish and Fisheries reflecting the establishment of fish-cultural stations in the Rocky Mountain Region and Gulf states. 52D Congress, Senate, Miscellaneous Document Number 65, U.S. Government Printing Office.

Fraley, J.J. and B.B. Shepard. 1989. Life history, ecology, and population status of migratory bull trout (*Salvelinus confluentus*) in the Flathead Lake and River system, Montana. Northwest Science 63: 133-143.

FWP. Montana Fish, Wildlife, and Parks. 1990. Inventory of fishery resources in the Blackfoot River and major tributaries. Missoula, Montana.

FWP. Montana Fish, Wildlife, and Parks. 1991a. Dewatered Streams List (revised). Helena, Montana.

FWP. Montana Fish, Wildlife, and Parks. 1991b. Montana Statewide Angling Pressure. Helena, Montana.

FWP. Montana Fish, Wildlife, and Parks. 1993. Montana Statewide Angling Pressure. Helena, Montana.

Griswold, G. and D. Larom. 1954. The Hellgate Survey. in C. Malouf, ed. Anthropology and Sociology Paper Vol. 16, Montana State University, Missoula.

Guth, A.R. and S.B. Cohen. 1991. Pictorial history of the U.S. Forest Service 1891-1945, Northern Region. Pictorial Histories Publishing Co., Inc. Missoula, Montana.

Ingman, G.L. 1988. Blackfoot River Water Quality Study 1988-1989. Draft Study Plan. Montana Department of Health and Environmental Sciences, Water Quality Bureau, Helena, Montana.

Ingman, G.L., M.A. Kerr, D.L. McGuire. 1990. Water quality investigations in the Blackfoot River drainage, Montana. A report to the Big Blackfoot River and Oakbrook, Illinois chapters of

Trout Unlimited. Montana Department of Health and Environmental Sciences, Water Quality Bureau, Helena, Montana.

Leary, R.F., F.W. Allendorf, and S.H. Forbes. 1993. Conservation genetics of bull trout in the Columbia and Klamath River drainages. Conservation Biology 7:856-865.

Leary, R.F., F.W. Allendorf, and K.L. Knudsen. 1983. Consistently high meristic counts in natural hybrids between brook trout and bull trout. Systematic Zoology 32: 369-376.

Leary, R.F. 1992. letter to Don Peters, Montana Department of Fish, Wildlife, and Parks, Missoula, Montana, October 27, 1992. University of Montana, Division of Biological Sciences, Missoula, Montana.

Malouf, C. 1974. Economy and land use by the indians of western Montana. In Interior Salish and Eastern Washington Indians II. Garland Publishing Inc., New York and London.

McGuire, D.L. 1991. Aquatic macroinvertebrate survey of the Blackfoot River, Montana. August 1988 and 1989. Prepared for the Montana Department of Health and Environmental Sciences Water Quality Bureau, Helena, Montana.

Mitchell, L.G. 1970. Studies of *Myxosporida* of fishes of western Montana. Masters Thesis, University of Montana, Missoula, Montana.

MDHES. Montana Department of Health and Environmental Sciences. 1994. Montana Water Quality 1994. The Montana 305(b) Report. Water Quality Division, Helena, MT.

Moore, J.N., S.N. Luoma, and D. Peters. 1991. Downstream effects of mine effluent on an intermontane riparian system. Canadian Journal of Fisheries and Aquatic Sciences 48:222-232.

Moyle, P.B. 1976. Fish introductions in California. History and impacts on native fishes. Biological Conservation. 9:101-118.

Nelson, J.S. 1965. Effects of fish introductions and hydroelectric development on fishes in the Kamamskis River system, Alberta. Journal Fisheries Research Board of Canada 22: 721-753.

Newell, R.L. 1970. Productivity of Morrell Creek, a mountain stream with an intermittent flow section, Clark Fork drainage, Montana. Masters Thesis, University of Montana, Missoula, Montana.

Periman, R.A. 1985. Milltown project rehabilitation. In: Carlson, C.E. and L.L. Bahls. Proceedings of the Clark Fork River Symposium. Montana Academy of Sciences, Montana College of Mineral Science and Technology, Butte, Montana.

Peters, D. 1964. Fishery Investigation Laboratory: Age and growth studies and analysis of bottom samples in connection with pollution studies. Montana Department of fish and Game, Job Completion Report, F-23-R-6, I&II. Helena, Montana.

Peters, D. 1994. Bull trout movement and seasonal habitat utilization. Progress Report. Montana Fish, Wildlife, and Parks, Missoula, Montana.

Peters, D. and R. Spoon. 1989. Preliminary fisheries inventory of the Big Blackfoot River. Montana Fish, Wildlife, and Parks.

Pierce, R. and D. Peters. 1990. Aquatic studies in the Middle Blackfoot River, Nevada Creek, and Nevada Spring Creek corridors. Montana Department of Fish, Wildlife, and Parks, Missoula, Montana.

Pratt, K.L. and J.E. Huston. 1993. Status of bull trout (*Salvelinus confluentus*) in Lake Pend Oreille and the lower Clark Fork River: DRAFT. Prepared for Washington Water Power Company, Spokane, Washington.

Rieman, B.E. and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. United States Department of Agriculture, Forest Service, Intermountain Research Station, General Technical Report INT-302.

Rode, M. 1990. Bull trout, *Salvelinus confluentus* Suckley, in the McCloud River: Status and recovery recommendations. California Department of Fish and Game, Inland Fisheries Administrative Report Number 90-15.

Sedell, J.R., F.N. Leone, and W.S. Duval. 1991. Water transportation and storage of logs. in Meehan, W.R. editor. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19, Bethesda, Maryland.

Spence, L.E. 1975. Upper Blackfoot River - a preliminary inventory of aquatic and wildlife resources. Montana Department of Fish and Game. Helena, Montana.

USGS. U.S. Geological Survey. 1995. Water Resources Data, Montana, Water Year 1994. USGS Water Data Report. MT-94-1. Helena, Montana.

APPENDIX A

ACRONYMS

FWP	Montana Fish, Wildlife & Parks
MDHES	Montana Department of Health and Environmental Sciences
TMDL	Total Mean Daily Load
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UCFRBSC	Upper Clark Fork River Basin Steering Comittee

GLOSSARY

aggrade:	raise the grade or level of a river valley or streambed by depositing streambed material or material or debris
core area:	a drainage that currently contains the strongest remaining populations of bull trout in a restoration area; usually relatively undisturbed habitat
cover:	anything that provides visual isolation or physical protection for a fish, including vegetation that overhangs the water, undercut banks, rocks, logs and other woody debris, turbulent water surfaces, and deep water
disjunct population:	a population found in a headwater lake, that appears to be self-reproducing, but is functionally isolated from the rest of the system
drainage:	an area (basin) mostly bounded upstream by ridges or other topographic features, encompassing part or all of a watershed
entrainment:	displacement of fish from a reservoir through an outlet from a dam or from a river into an irrigation ditch
escapement:	adult fish which return to spawn
fragmentation:	the breaking up of a larger population of fish into smaller disconnected subpopulations
fry:	first-year fish

migratory:	describes the life history pattern in which fish spawn and spend their early rearing years in specific tributaries, but migrate to larger rivers, lakes or reservoirs as adults during their non-spawning time
nodal habitat:	waters which provide migratory corridors, overwintering areas, or other critical life history requirements
redd:	a disturbed area in the gravel, or a nest, constructed by spawning fish in order to bury the fertilized eggs
resident:	fish, which are often found in tributary or small headwater streams, where the fish spend their entire lives
risk:	a factor which has contributed to the past or current decline of the species
restoration:	the process by which the decline of a species is stopped or reversed, and threats to its survival are removed or decreased so that its long-term survival in nature can be ensured
Restoration Team:	a policy-level group with representatives from state and federal agencies, conservation organizations and private industry; created by Governor Racicot to establish a Bull Trout Restoration Plan for Montana
population:	an interbreeding group of fish that spawn in a particular river system (or part of it) and are reproductively isolated
riparian area:	lands adjacent to water such as creeks, streams and rivers and, where vegetation is strongly influenced by the presence of water
Scientific Group:	composed of agency, private and university scientists appointed by the Restoration Team to conduct technical analysis
threat:	a factor which jeopardizes the future conservation of the species
watershed:	a drainage basin which contributes water, organic matter, dissolved nutrients, and sediments to a river, stream or lake (USDA 1995)
Watershed Group:	a group of agency representatives, landowners and recreational and commercial users of a watershed, plus a liaison from the Scientific Group; created by the Restoration Team and charged with developing recovery actions to help restore bull trout

APPENDIX B

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