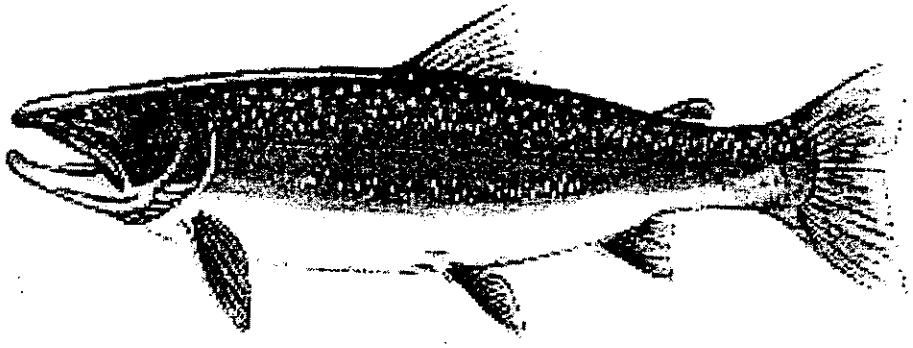
SWAN RIVER DRAINAGE

BULL TROUT STATUS REPORT

(Including Swan Lake)



Feburary 1996

Prepared for

The Montana Bull Trout Restoration Team

By

The Montana Bull Trout Scientific Group

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EXECUTIVE SUMMARY

This document addresses historic and current status and distribution of bull trout in Swan Lake and the Swan River drainage. Core areas are described and major threats to the population(s) are identified. Disjunct populations of bull trout in the drainage are also described, with core areas delineated.

Bull trout are one of four salmonid species native to the Swan River. Bull trout are distributed in Swan Lake, the Swan River, and most of the larger tributary streams. The migratory life form is dominant in the Swan drainage. Long term population trend information is not available. However, in the last 15 years, an increasing trend in spawning escapement has been observed.

Prior to the turn of the century, bull trout in Flathead Lake had access to the Swan drainage, although the extent of migration and genetic interchange are unknown. Bigfork Dam, constructed in 1902, blocked upstream access to the Swan drainage. The situation was later only partially corrected with a largely ineffective fish ladder, which is now disabled. Downstream movement of bull trout over this dam has been documented but is also unquantified.

Risks

The greatest future threats to this population stem from illegal introductions and proliferation of introduced fish species. Emphasis must be placed on the threat of illegal introductions because of the proximity of lake trout in Flathead Lake immediately downstream from Bigfork Dam and the recent history of large numbers of illegal introductions in northwest Montana. Swan Lake supports an introduced *Mysis* shrimp population and, if lake trout were also introduced, it is likely they would rapidly become the dominant fish species. In addition, brook trout are widespread in the Swan drainage and are known to hybridize with bull trout in certain Swan tributaries, providing a current level of risk. There is also documentation that illegally introduced northern pike in Swan Lake prey

on juvenile and subadult bull trout. The potential for deterioration of habitat conditions, primarily as a result of forest management activities, is also a cause for concern. About three-fourths of the watershed is managed for timber harvest under ownership of the U.S. Forest Service, Plum Creek Timber Co., or Montana Department of Natural Resources and Conservation (DNRC).

CORE AREAS AND NODAL HABITATS

Core areas for Swan Lake (those which currently support the strongest remaining populations of bull trout) are the Elk, Goat, Squeezer, Lion, Piper, Jim, Lost, Woodward and Cold Creek drainages.

Nodal habitats (containing critical overwintering areas, migratory corridors, and other critical habitat) are Swan Lake and the Swan River upstream of the lake.

Disjunct nodal habitat occurs in Holland Lake, with its core area in Holland Creek, and in Lindbergh Lake, with its core area in the Swan River drainage upstream of the lake.

CONSERVATION GOAL

As with any biological system, there remains uncertainty as to what key components will be necessary to maintain a healthy bull trout population in the Swan River drainage into the next century. Based on current knowledge, the Swan drainage is in a relatively healthy condition as it pertains to meeting bull trout life history requirements.

In the Swan River drainage, the Scientific Group believes a "conservation" strategy is most applicable. A "restoration" strategy was endorsed in most of the other bull trout management units. A conservation strategy would, at a minimum, maintain bull trout population abundance, distribution, and genetic structure. This does not infer that management activities focused on

increasing habitat capabilities or addressing risk factors for bull trout are not necessary in the Swan, but rather, that there is less immediacy in this drainage due to the increasing trend of the Swan Lake bull trout population in most monitored segments. The conservation goal in the Swan drainage is: To maintain a self-sustaining bull trout population dominated by the migratory life form; maintain stable bull trout population levels within the current distribution, especially in core areas; maintain the population genetic structure both within and between tributaries in the Swan River drainage; quantify and maintain the existing pattern of inter-annual variation in spawner escapement between streams; maintain the age structure of the spawning population; maintain the existing connectivity within the Swan River drainage; and minimize the opportunity for introduced species to spread throughout the drainage upstream from Bigfork Dam while exploring options for upstream migration of native species from Flathead Lake.

SWAN RIVER DRAINAGE BULL TROUT STATUS REPORT

INTRODUCTION

In January, 1994, the Governor of Montana established a Bull Trout Restoration Team to develop restoration plans for bull trout (*Salvelinus confluentus*) 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 is preparing components of a Montana Bull Trout Restoration Plan which includes a review of the status of bull trout, risks to the survival of the species, and restoration or conservation goals. In addition, the Scientific Group is preparing reports on three of the major issues in bull trout restoration - land use impacts, removal and suppression of introduced species, and the use of hatcheries in restoration. Because the risks and threats facing bull trout vary widely across the state, separate reports were prepared for each of twelve major restoration/conservation areas identified in Montana, except for Rock Creek which is included in the Upper Clark Fork report. These 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 regimes or dewatering (Figure 1). Each of the twelve restoration/conservation areas presently contain core areas (drainages currently supporting the strongest remaining populations) and nodal habitats (waters which provide migratory corridors, overwintering areas, or other critical life history requirements) for bull trout currently present.

This document addresses historic and current status and distribution, describes major risks, and delineates core areas and nodal habitats for bull trout in the Swan River drainage of northwest Montana.

The Swan River flows generally north for approximately 66 miles from its headwaters in the

Swan and Mission mountain ranges to where it enters Flathead Lake at the town of Bigfork, Montana (Figure 2). Fifty-three named tributaries enter the river from the Swan and Mission mountain ranges. Three relatively large lakes are linked directly to the Swan River drainage. The southern-most is Lindbergh Lake (726 acres), which the upper Swan River flows through. Approximately five miles downstream from Lindbergh Lake, Holland Creek enters the river after flowing through Holland Lake (408 acres). The Swan River then flows approximately 35 miles to Swan Lake, the largest lake in the drainage (2,680 acres). Leaving Swan Lake, the river continues its course for 14 miles downstream to a small run-of-the-river impoundment created by Bigfork Dam. Bigfork Dam (built in 1902) is 12 feet high and contains a 4.1 megawatt hydroelectric facility. It is currently owned and operated by Pacificorp and is scheduled for Federal Energy Regulatory Commission (FERC) relicensing in the year 2002. Downstream from Bigfork Dam, the Swan River cascades through a mile-long, high-gradient reach prior to entering Flathead Lake.

The Swan River drainage area is 671 mi^2, measured at the outlet of Swan Lake. The river flows through a heavily forested, glaciated valley that is three to six miles wide and relatively flat. The average elevation drop for the 53-mile river section between Lindbergh and Swan lakes is 24 feet per mile (Leathe and Enk 1985).

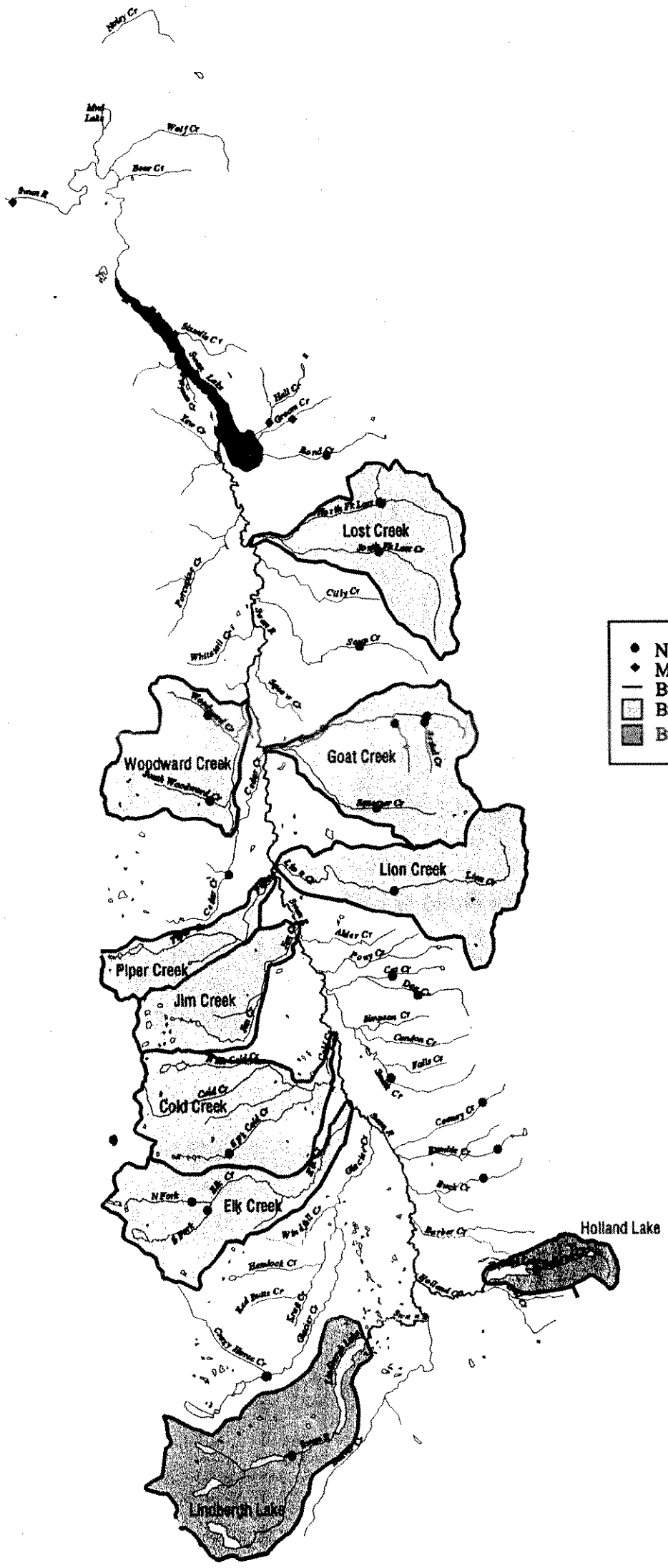
Mean annual flow of the Swan River is 159 cubic feet per second (cfs) at a gauging point four miles downstream from Lindbergh Lake, near Condon (USGS 1993), and 1,158 cfs immediately downstream from Swan Lake (USGS 1995). Peak discharge, typically occurring in June, is determined by the amount and rate of snowmelt. Peak spring flow in the river and tributaries is usually 15 to 30 times greater than low flow measured in the fall (Leathe and Enk 1985).

Land ownership is mixed. Approximately 45 percent of the drainage is managed by the Flathead National Forest, 20 percent by Plum Creek Timber Co., 10 percent by MDNR, and 25 percent by other private landowners. Timber production is the dominant land management activity.

Figure 1. Bull Trout Restoration/Conservation Areas in Montana

Bull Trout Core Habitat & Nodal Areas

Swan



Legend

- Natural Barrier
- Manmade Barrier
- Bull Trout Nodal Habitat
- Bull Trout Core Area
- Bull Trout Disjunct Population

Map produced by:
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Bull trout distribution, core areas, and barriers information based on data collected up to November, 1997. Base layers from the Natural Resource Information System at the Montana State Library and digitized @ 1:100,000.

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Montana Fish, Wildlife & Parks

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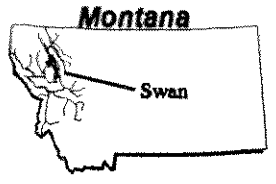
Miles

Albers Conic Equal-Area Projection



Available fisheries information focuses on the migratory life form of bull trout which occupy Swan Lake or the Swan River as adults. These fish migrate into tributary drainages upstream from Swan Lake to spawn. The juvenile fish rear in the tributaries for 1-3 years before moving back downstream to the river and lake, where they spend several additional years as subadults prior to maturity at the age of about six years. The resident life form of bull trout is suspected to occur in low numbers in several tributary streams, but conclusive documentation is not presently available.

Two bull trout populations existing in Holland and Lindbergh lakes are considered disjunct. Disjunct populations are defined as those in headwaters lakes that appear to be self-reproducing but functionally isolated from the rest of the drainage. In these two cases, fish probably pass downstream from the Holland and Lindbergh populations into the Swan River and/or Swan Lake. Upstream migration into the disjunct waters is not precluded so true isolation may not occur. Holland and Lindbergh lakes support migratory bull trout populations which utilize the lakes' inlet tributary systems for spawning and rearing. During late summer, warm water temperatures in the outlet streams of these two lakes likely discourage upstream migration of spawning adults from Swan Lake. There is, however, a need to research the connection between the Holland and Lindbergh lake populations and that in the mainstem Swan.

Bull trout populations in the rest of the Flathead River drainage are addressed in a separate report.

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

Historic Distribution

Historically, bull trout were one of four native salmonid species distributed throughout the Swan River drainage. The others were westslope cutthroat trout (*Oncorhynchus clarki lewisi*), pygmy whitefish (*Prosopium coulteri*), and mountain whitefish (*Prosopium williamsoni*) (Brown 1971). Bull trout are distributed throughout the Swan and Flathead River drainages, but little quantitative information exists regarding historic bull trout abundance. Anecdotal accounts from the late 1800's to present are numerous, mostly describing bull trout in Flathead Lake and the mainstem Flathead River. Early accounts for the Swan drainage suggest good catches of large fish were seasonally common in the Swan River and certain tributaries. Catches of bull trout from Swan Lake were reportedly common year around.

Evermann (1892), who traveled through Montana in the late 1890's sampling fish, stated that bull trout were common in most of the larger tributaries of the Columbia River in Montana.

The U.S. Forest Service reported that, in 1937-1938, bull trout were present in Swan and Holland lakes and the Swan River as well as in Lion, Fatty, Elk, Cedar, Cold, Pony, Dog, Cat, Condon, Piper, Jim, Glacier, Rumble, Buck, Barber and Cooney creeks (Flathead National Forest 1948). According to the report, the information therein was "not based on a detailed study, but is a composite of the information available at the present time." The omission of reference to bull trout in the "Lower Swan District", including Woodward, Goat, Squeezer, Lost and Soup creeks, is probably an omission, or error, in the report.

As adults, migratory bull trout occupy large lakes in the Flathead drainage. Spawning and rearing occur in specific tributaries to the North, Middle, and South forks of the Flathead as well as

in the Stillwater, Whitefish and Swan river drainages. Some genetic exchange among the tributaries likely occurs through straying. However, scientific observations, supported by preliminary genetic evaluation (Kanda et al 1994), suggest bull trout imprint strongly on their natal stream and return to specific drainages to spawn.

Construction of Bigfork Dam in 1902 blocked upstream access from Flathead Lake to the Swan drainage, eliminating approximately 15 percent of potential spawning and rearing habitat for the Flathead drainage bull trout population (Montana Fish, Wildlife and Parks (FWP) - unpublished file data). A fish ladder was constructed in the 1920's to enable migratory fish to pass over the 12-foot high concrete diversion dam and access the Swan River drainage, but apparently it did not work well. This ladder did not become fully operational until upgrades were made in 1959 (Domrose 1974).

The U.S. Forest Service noted in a report covering the years 1937-1938 that:

> "Several detrimental factors have influenced the fish population in this region. Three dams with inadequate fish ladders have curtailed normal spawning migrations in the area. The Bigfork power dam on Swan River is of importance in this respect" (Flathead National Forest 1948).

The Bigfork Dam fish ladder was subsequently disabled in the late 1980's due to concern over the potential for introduced fish species, primarily lake trout (*Salvelinus namaycush*) and lake whitefish (*Coregonus clupeaformis*), to migrate upstream from the Flathead drainage into the Swan drainage.

Current Distribution - Migratory Population

Much of the current distribution information is documented in a 1982-1985 study designed to evaluate cumulative effects of small hydro projects on fishery resources in the Swan drainage

(Leathe and Enk 1985). Researchers found bull trout to be the primary migratory species, with adult fish residing in Swan, Holland, and Lindbergh lakes.

Presently, the fishery in the Swan River drainage is thought to be isolated from Flathead Lake by Bigfork Dam, although limited downstream movement does occur (Leathe and Enk 1985). In the early 1980's, one spawning bull trout tagged in Goat Creek, a tributary of the Swan River, moved downstream through Swan Lake, over Bigfork Dam into Flathead Lake, and then was recaptured nine months later approximately 34 miles up the Flathead River. The extent of this movement was 74 miles (Leathe and Enk 1985).

During sampling of the upper Swan River downstream of Cygnet Lake in 1982, no bull trout were captured. A few juvenile bull trout have been captured from the Swan River between the Salmon Prairie and the Piper Creek bridges, but it is likely that this reach of the river is generally used by bull trout primarily as a migration corridor (Leathe and Enk 1985).

Spawning and rearing occurs in tributaries to each of the lakes (Swan, Holland, and Lindbergh). It has been noted that adult bull trout from Swan Lake spawn in at least 13 of the 53 named tributary streams. Rearing fish were observed in ten additional streams (Leathe and Enk 1985).

In Swan drainage surveys, bull trout were found to be most abundant in stream reaches having (1) gradients of six percent or less; (2) coarse, unembedded substrate material; and (3) summer maximum water temperatures of less than 16°C. Spawning by migratory fish occurred in tributaries with late summer flows exceeding 10 cfs (Leathe and Enk 1985).

Field crews began monitoring spawner escapement by conducting extensive redd counts and limited trapping in Swan drainage tributaries in 1982. These counts provide information on the number of adult bull trout spawning on an annual basis. During the past 14 years, crews have monitored high density spawning areas in four Swan River tributaries (Table 1). A redd count of 501 in 1995 indicated the bull trout spawning run out of Swan Lake was the strongest on record, 65

percent above the previous 13-year average of 304 redds (T. Weaver, personal communication, FWP, Kalispell, 1995). All four monitoring streams supported above-average redd numbers, with new record high counts occurring in Squeezer and Lion creeks. The number of redds observed in the four monitoring streams in recent years has demonstrated a significantly increasing trend ($p < .05$) (Weaver 1994). Based on the 1995 redd counts and the fecundity work done by Fraley and Shepard (1989) on similar-sized females in the Flathead Lake spawning run, over 2.5 million eggs were deposited in monitoring areas during the 1995 spawning run. Basin-wide redd counts suggest that 68 percent of all spawning by migratory bull trout from Swan Lake occurs in these four monitoring areas (FWP - unpublished file data).

Table 1. Summary of Swan drainage bull trout spawning site inventories from 1982-1995 in the stream sections monitored annually (Weaver 1995).

YEAR/STREAM	ELK	GOAT	SQUEEZER	LION	TOTAL
1982	56	33	41	63	193
1983	91	39	57	49	236
1984	93	31	83	88	295
1985	19	40	24	26	109[a]
1986	53	56	55	46	210
1987	162	31	64	33	290
1988	201	46	9[a]	65	321[a]
1989	186	34	67	84	371
1990	136	27	42	58	263
1991	140	31	101	94	366
1992	143	17	115	100	375
1993	139	64	106	123	432
1994	195	66	91	141	493
1995	150	32	149	170	501
(AVERAGE- 1982-1995)	126	39	72	81	318

[a] High flows may have obliterated some redds

In addition to the annual monitoring counts, crews have completed occasional bull trout redd counts in other spawning streams (Table 2). Variable lengths of these streams have been surveyed, and since the timing and conditions of the surveys were not necessarily consistent, these numbers are presented only to indicate relative presence, not necessarily comparative abundance. Results suggest that Jim, Piper, Cold, Lost and Woodward creeks all support substantial bull trout spawning runs.

Table 2. **Bull trout redd counts from other spawning streams monitored intermittently in the Swan River drainage. Variable stream lengths were surveyed and timing and conditions of surveys were inconsistent. Thus, counts do not necessarily indicate comparative abundance.**

Creek	1982	1983	1984	1989	1990	1991	1992	1993	1994	1995
Jim	*	7	6	39	22	40	45	43	53	56
Piper	0	0	1	25	*	18	*	*	*	10
Cold	1	9	6	*	*	5	*	*	*	21
Lost	11	7	19	*	13	6	*	*	17	21
Woodward	0	3	*	*	*	36	*	*	*	77

* - No counts conducted

Bull trout spawning and/or rearing have also been documented at low numbers in several other tributary drainages, including Kraft, Cedar, Glacier, Soup, Buck, Condon, Cooney and Dog creeks. In 1995, all but Cedar Creek from this list were surveyed in the fall; redds were found only in Soup Creek (FWP - unpublished file data).

Juvenile bull trout in tributary streams in the Swan River drainage grow slowly relative to other bull trout populations (Leathe and Enk 1985). Growth accelerates rapidly after these fish emigrate from tributary streams, primarily as one and two year old fish. Fish longer than 27 inches (total length) are not uncommon in Swan River spawning runs. The growth and condition of Swan Lake bull trout in the early 1980's (Leathe and Enk 1985) was higher than that reported for nearby Flathead Lake (Leathe and Graham 1982). Incremental growth of repeat spawners captured in Goat

Creek during successive years (1983 and 1984) was nearly 2 inches (Leathe and Enk 1985).

Current Distribution - Disjunct Populations

The Swan River drainage contains two lakes, Holland and Lindbergh, which support disjunct bull trout populations. The degree to which bull trout in these lakes are connected to the migratory Swan Lake population is unknown. However, it is believed that these populations are functionally isolated due to thermal barriers. More research is needed on these lakes to define their status and appropriate restoration or conservation strategies.

Holland and Lindbergh Lakes each have a single spawning and rearing tributary, Holland Creek and the Upper Swan River, respectively. Ten to 18 redds have been counted annually in Holland Creek (FWP - unpublished file data). Redd surveys upstream from Lindbergh Lake took place during 1994. Crews observed 26 redds in the Swan River and a tributary upstream from Lindbergh Lake. Major cascades and falls likely prevent bull trout from reaching headwater areas in both the Holland and Lindbergh drainages (FWP - unpublished file data).

CORE AREAS AND NODAL HABITATS

Core areas are drainages that currently contain the strongest remaining populations of bull trout. They are usually relatively undisturbed. These watersheds need to have the most stringent levels of protection.

Core areas for the Swan Lake population include: Elk, Goat, Squeezer, Lion, Piper, Jim, Lost, Woodward and Cold creek drainages.

Nodal habitats are waters which provide migratory corridors, overwintering areas, or other habitat critical to the population at some point during the fishes' life history. Nodal habitats for this

population are provided by Swan Lake and the Swan River upstream.

Disjunct bull trout populations exist in Holland Lake and Lindbergh Lake. The core area for the Holland Lake population is Holland Creek upstream from the lake, with spawning and rearing occurring in only a short reach (less than 500m) of the creek due to natural barriers. The Lindbergh Lake population's core area is provided by the upper Swan River and the unnamed half-mile long outlet stream from Crystal Lake. Nodal habitat for these two populations is provided by the lakes themselves.

Frissell et al (1995) identified aquatic diversity areas, including critical watersheds, for the Swan drainage based on a multiple species assessment. Bull trout core areas and nodal habitats listed in this report would be valuable for conservation of other native species as well. The specific conservation needs of these species should be considered in the development and implementation of management strategies for bull trout.

RISKS TO BULL TROUT

The risks to bull trout in the Swan River drainage are listed in Table 3. The risks were evaluated by the Scientific Group based on the degree to which a risk was presumed to contribute to past and current status of the species (designated as "current/historic" in the table) and the threat the risk factor poses to future conservation of the fish ("conservation" in the table). No effort was made to assess risks for the disjunct populations in Holland and Lindbergh lakes, although many of the same factors apply. Those risks which are of greatest concern are noted with an asterisk. The risks which are the greatest concern to conservation of bull trout in this drainage in the future are noted with a double asterisk.

Table 3. Risks to bull trout, Swan River drainage. (* = High risk, ** = Very high risk to conservation)

RISK	CURRENT/HISTORIC	CONSERVATION
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 Development		
Transportation		
Population		
Population Trend		
Distribution/Fragmentation		
Abundance		
Biological Sampling		
Angling	*	*
Illegal Harvest	*	*

The greatest potential threats to this population are from illegal introductions and introduced fish species already present. Emphasis must be placed on the threat of illegal introductions, primarily because of the proximity of lake trout in Flathead Lake and the recent history of large numbers of illegal introductions in northwest Montana. Swan Lake supports introduced *Mysis* shrimp and, if lake trout were also introduced, it is likely they would rapidly become the dominant fish species, as they have in many other similar habitats. In addition, brook trout (*Salvelinus fontinalis*) are widespread in the Swan drainage and are known to hybridize extensively with bull trout in certain tributaries. Illegally introduced northern pike (*Esox lucius*) in Swan Lake also prey on juvenile and subadult bull trout. The potential for degraded habitat conditions, resulting primarily from forest management activities, is also a cause for concern. A detailed discussion of these risks follows.

Environmental Instability (Risk Factors)

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.

The interconnected system of tributaries in the Swan River drainage provides a buffer to potential impacts from catastrophic environmental events. If localized extinction did occur, it is likely that once conditions again became suitable in the impacted area, bull trout from elsewhere in the drainage would recolonize it. For disjunct populations, the risks of catastrophic events are much higher, since the isolation factor and restricted habitat make survival and/or recolonization less likely.

Major spawning and rearing areas in the Swan drainage are highly groundwater-influenced, reducing the risk from drought conditions. The upper reaches of most tributary drainages are

extremely steep with unstable soils. Mass wasting does occur naturally and the potential for increased sediment loads resulting from road construction and higher than normal water yield is a concern. Habitat quality in portions of several core area streams is less than optimal (Weaver and Fraley 1991).

However, all of the main spawning and rearing streams are largely undeveloped upstream from the portions that provide critical nursery areas.

Influence from flooding or rain-on-snow events is evident in several tributary drainages. In particular, channel stability problems have been observed during bull trout redd counts in Goat, Squeezer, Jim, Piper, Cold, Woodward, and Soup creeks (FWP - unpublished file data).

Introduced Species

Introduced fish species now present in the Swan drainage in pure or hybridized form include: brook trout, rainbow trout (*Oncorhynchus mykiss*), yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*), kokanee salmon (*Oncorhynchus nerka*), northern pike, yellow perch (*Perca flavescens*), largemouth bass (*Micropterus salmoides*), brook stickleback (*Culaea inconstans*) and central mudminnow (*Umbra lima*). An abundant population of *Mysis relicta*, an introduced freshwater invertebrate that feeds on zooplankton, is also established in Swan Lake.

Brook trout are the introduced species that present the greatest existing risk to bull trout because of competition and hybridization. Rieman and McIntyre (1993) felt that migratory bull trout may have a reproductive advantage over brook trout because of their large size and corresponding higher fecundity. However, recent genetic data (Kanda et.al. 1994) and observations from Squeezer Creek within the Swan River drainage (Kitano et al 1994), indicate that large, spawning, migratory bull trout mate with smaller brook trout, producing hybrid offspring. Hybrids have been observed in several of the primary bull trout nursery streams. Hybridized offspring are generally sterile (Leary et al. 1983). The available data suggest that hybridization between brook trout and bull trout can cause an unstable situation resulting in decline or replacement of bull trout (Leary et al. 1983). More

research is needed in this area.

Brook trout are widely dispersed throughout the drainage. Leathe and Enk (1985) reported brook trout presence in 40 of 74 tributary stream reaches surveyed. Brook trout were the most abundant species in low gradient reaches. Degraded habitat conditions appear to favor brook trout over westslope cutthroat trout in stream reaches where channel gradient is six percent or less (Leathe and Enk 1985). There are no bull trout streams in the Swan drainage that do not contain resident brook trout populations.

Cannibalism by bull trout as well as predation on bull trout by northern pike in Swan Lake is documented (S. Rumsey, personal communication, FWP, Kalispell, 1995). Northern pike distribution is concentrated in shallow portions of the lake. Pike present a risk to juvenile bull trout migrants in the river immediately upstream from the lake as well as to subadults in the lake. Under similar conditions in the nearby Clearwater River lakes drainage, predation by northern pike on salmonids was heavy (R. Berg, personal communication, FWP, Missoula, 1995).

Risks from interactions with yellow perch and largemouth bass are probably minimal at this time due to low numbers of these introduced species. Significant niche overlap may occur with rainbow trout, but competition and/or predation by rainbow trout on bull trout is not evident from current data (S. Rumsey, pers. comm., 1995). Rainbow trout are not known to interact with bull trout any differently than the native westslope cutthroat trout, which rainbow have largely replaced.

Opossum shrimp (*Mysis relicta*) were introduced by FWP in Swan Lake in 1975 (Rumsey 1988). These organisms reached substantial densities by the early 1980's and are now well-established. The presence of *Mysis* generally benefits deep-dwelling fish species by providing a food source but may impact planktivorous fish by reducing the available crustacean zooplankton (Nesler and Bergersen 1991). Many lakes with established *Mysis* populations have experienced a decline, or in some cases, complete loss of kokanee. Kokanee have persisted in Swan Lake in spite of the presence of *Mysis*. Some kokanee utilize *Mysis* as a food source, particularly during winter months (Scott Rumsey, pers. comm., 1995). Bull trout in Swan Lake also use *Mysis* as a significant food

source, which may result in improved growth and survival during the sub-adult stage. Stomach samples from bull trout collected by gillnetting in 1988 and 1995 showed 67 percent of those with food present contained *Mysis* during both years (FWP - unpublished file data). At this time the presence of *Mysis* in Swan Lake does not appear to be detrimental to bull trout and may, in fact, benefit bull trout due to the important food source it provides.

Private Ponds

Numerous private ponds exist in the Swan drainage. Generally, rainbow trout, brook trout, "undesignated" cutthroat trout (cutthroat trout, subspecies unrecorded) and, more recently, westslope cutthroat have been planted. Although there is a permitting requirement prior to stocking private ponds, some people are unaware of, or circumvent, the law. As the local human population expands, more requests will occur. Overall, private fish ponds have likely contributed to dispersal of introduced species but, in light of the current widespread distribution of introduced species, the future threat from private ponds is not judged to be high.

Another current concern is the potential for whirling disease, caused by the parasite *Myxosoma cerebralis*, to be spread through the stocking of private ponds. In late October, 1995, the whirling disease parasite was confirmed in rainbow trout from the upper Swan River (FWP, news release, November 7, 1995, Helena). Potential ramifications for bull trout, cutthroat trout, and for the health of the Swan River and Swan Lake fisheries are unknown at this time.

Legal Introductions (high risk)

In the past, agencies have stocked a variety of introduced species in the Swan drainage. Many of these fish and invertebrates subsequently established self-sustaining populations. It is the legacy of these past stocking practices that poses a significant risk to the survival of bull trout today.

An early Forest Service report (Flathead National Forest 1948) described fishery conditions in the Flathead drainage in 1937 and 1938. It noted:

"At the present time it seems advisable to confine the stocking to native species except in isolated places where introduced species are firmly established. . . . The introduction of exotic species in the past has resulted in unfavorable biological balances in some cases, particularly in Flathead Lake. . . . In a few isolated examples an introduced species has established itself and produced better fishing than existed before its' planting. The reverse is true, however, in the majority of cases."

Hatchery stocking efforts have been extensive in lakes throughout this drainage. "Undesignated" cutthroat trout were planted in Swan, Holland and Lindbergh lakes from the mid-1920's through the mid-1980's. Prior to the mid-1960's, most of these "undesignated" cutthroat were probably Yellowstone cutthroat trout. Rainbow trout were also introduced in Swan, Holland, and Lindbergh lakes beginning in the mid-1920's. FWP discontinued these plants after 1966. Beginning in the late 1980's, FWP stocked pure-strain westslope cutthroat trout in the three large lakes.

A single stocking of brook trout occurred in Holland Lake in 1948. A Forest Service report on fishery surveys conducted in 1937-1938 reported that "No planting is recommended in Holland Lake because of presence of large numbers of rough fish." (Flathead National Forest 1948).

Kokanee salmon stocking in Lindbergh Lake began in 1944 and this program continues today. Coho salmon were planted in Lindbergh Lake in 1948. Kokanee were first planted in Holland Lake in 1951. This fishery is still maintained by stocking of kokanee because natural reproduction is limited. Swan Lake never received kokanee plants but a substantial shoreline spawning population developed, probably due to downstream drift from Lindbergh and/or Holland lakes. Kokanee from Flathead Lake also moved upstream to Swan Lake over the Bigfork Dam fish ladder after 1959.

Nearly 80 high mountain lakes exist in the Swan drainage. Many have been stocked with rainbow and/or undesignated cutthroat trout. Currently, only westslope cutthroat trout are stocked. Twenty-five other valley floor lakes in the Swan River drainage are managed fisheries, with most being stocked. In lakes with outlets to the river, management emphasis is directed to native westslope cutthroat trout. In some isolated water bodies or closed basins, rainbow trout and

largemouth bass have been, and may continue to be, stocked.

Stocking of fish in the Swan River and its tributaries has also been extensive. Brook trout were the earliest introductions, beginning in 1926 and extending until 1950. Although only six tributaries were known to have been stocked during that period, brook trout are now widely distributed.

Cutthroat trout were also stocked into tributary streams. Thirty-one of the 53 tributary streams were planted with 3.7 million cutthroat trout eggs and/or fry from 1931-1968. The genetic origin of these fish is unknown and they are listed as "undesignated" (Yellowstone and/or westslope cutthroat stocks).

The second most widely stocked species in the tributaries was rainbow trout. From 1931-1949, 13 tributaries were stocked with approximately 86,000 fish. Rainbow trout stocking also occurred directly in the Swan River.

In 1935, a single arctic grayling (*Thymallus arcticus*) introduction was made into Bond Creek (120,000 fish). Apparently, reproduction was limited and the population did not persist.

After 1968, the stocking of tributaries was largely discontinued with the exception of westslope cutthroat recovery projects in Wyman, Soup, and Hall creeks.

In summary, these introduced fish species have had a negative impact. Even though future legal stocking of introduced species is not perceived as a major threat, the influence of self-sustaining populations of fish established from earlier plants will continue.

Illegal Introductions (high risk)

The presence of northern pike, yellow perch, largemouth bass, brook stickleback and central mudminnows has resulted from illegal introductions. The problems created by illegal fish

introductions can be similar to those discussed under Legal Introductions (above). The difference is that these illegal efforts are not subjected to any environmental analysis and are most often detrimental. Illegal introductions frequently involve warmwater species (bass, perch, pike, walleye (*Stizostedion vitreum*) and/or nongame species (minnows, suckers, etc). In part, the agency stocking efforts of the past have contributed to this problem by providing closer sources of many of these species for illegal introduction. This problem occurs mainly in lakes and is currently unabated in the Flathead drainage. FWP has documented at least 50 illegal introductions in the state in the past five years, mostly in northwest Montana, and despite stepped up educational and enforcement efforts, the problem has not abated.

The greatest future threat to maintenance of the Swan Lake bull trout population is illegal introduction of lake trout. Lake trout are currently numerous in the Swan River downstream from Bigfork Dam and could easily be passed over the 12-foot high dam. It is highly probable that a major impact to the bull trout population would result from a lake trout introduction. In many waters where lake trout were introduced on top of existing bull trout populations, bull trout were extirpated (Donald and Alger 1993).

Similarly, the potential for a lake whitefish introduction is high given the proximity of a source in Flathead Lake and the Swan River downstream from the dam. Potential impacts from lake whitefish are less certain but there is concern. Illegal walleye introduction also represents a potential threat, although the degree to which they might thrive in Swan Lake is less certain.

Fisheries Management

Bull trout harvest is allowed in Swan Lake, with a daily creel limit of one fish, but the Swan River and tributaries are closed to fishing for bull trout. There has been a progression of increasingly restrictive regulations for bull trout (see "Angling", this report). Management emphasis is currently on protection of native species assemblages. Existing regulations require catch and release for both native westslope cutthroat and introduced rainbow trout in the lower half of the Swan River. Bull trout management is focused on maintaining the existing population at a stable level. A DRAFT

Fisheries Management Plan for the Swan drainage was prepared in 1991, but was never formally completed (S. Rumsey, pers. comm., 1995). A year-long creel survey on Swan Lake began in January, 1995 to assess angling influence. Management for large rainbow trout and northern pike may impact the bull trout population through predation, incidental catch and unintentional mortality. Liberal northern pike limits (15 fish daily) are currently in place regionwide.

Barriers

Culverts

Culverts are not considered a significant risk to passage of bull trout in the Swan drainage at this time. Nearly all core area streams have adequate passage due to bridges or suitable culverts. An exception occurs on Soup Creek, where bull trout migration may be difficult.

Diversions

Although there are minor diversions present on a few tributaries, none currently are believed to be fish migration barriers. There is some concern that illegal harvest of bull trout may regularly occur at a diversion in Lion Creek.

A flood of license applications for small hydropower projects stimulated a major study of their effects on fisheries during the early 1980's. Total losses of juvenile bull trout as a result of construction of 20 proposed microhydro projects was estimated to be 11-84 percent in individual streams, or 1-8 percent of the drainage-wide migratory bull trout production (Leathe and Enk 1985). Although none of the proposed projects has been built to date, future activity may occur.

Thermal

Rieman and McIntyre (1993) concluded that temperature is a critical habitat requirement for bull trout. Temperatures in excess of 59° F are thought to limit bull trout distribution in many

drainages, including the Flathead (Fraley and Shepard 1989).

It is suspected that natural thermal barriers occur seasonally in Holland Creek downstream from Holland Lake and in the Swan River downstream from Lindbergh Lake. The Swan River downstream from Swan Lake historically provided a migratory corridor to Flathead Lake, although thermal conditions may have seasonally precluded significant use by bull trout. These conditions are largely natural and are the main reason the Holland and Lindbergh lake populations are considered disjunct.

The shallow pool behind Bigfork Dam is warm during summer months and does not support extensive bull trout use.

Dams

Bigfork Dam fragmented the Swan drainage from the Flathead. The ramifications of this loss to either system are not well understood. Some genetic interchange between the Swan and Flathead drainages probably occurred historically.

The dam currently prevents introduced fish species present in the Flathead drainage from migrating upstream into the Swan drainage. This isolation is currently believed to be an overall benefit to the Swan bull trout population.

Habitat

Rural Residential Development (high risk)

At the present time, risks due to rural development are low. However, the human population in the Swan drainage is growing rapidly. Requests for "310" permits to alter the bed and/or immediate banks of streams in the drainage are increasing (FWP - unpublished file data). Private land in the drainage is concentrated along the Swan River and the lower portions of the tributary

drainages. These reaches provide critical migratory corridors and rearing habitat. It is likely that some corporate timber holdings in the drainage may be sold in the future. This could allow development adjacent to major spawning and rearing areas.

Development along streams exacerbates thermal problems, increases nutrient pollution, decreases bank stability and increases pressure to alter stream and riparian habitats. In addition, such development puts more legal and illegal anglers in direct contact with bull trout spawning and rearing streams, directly increasing mortality of fish.

Lakeshore development is also increasing, which could lead to water quality problems. Increased demand on aquatic resources in general is likely. Overall, threats from rural residential development are expected to be high in future years.

Mining

Current and historic mining does not threaten this bull trout population. There are no existing mining operations in the Swan drainage other than recreational gold panning. Depending on future market conditions, threats may increase, but mining is unlikely to be a serious threat in the future.

Grazing

There are several small grazing allotments on Flathead National Forest lands. Private stock grazing also occurs in close proximity to the Swan River and the lower portions of some important tributary drainages. There is some risk to bull trout but, at present, grazing is not considered to be a significant factor for bull trout conservation in this drainage.

Agriculture

There is a small amount of privately owned land with hay fields along the Swan River and the lower portions of several tributary drainages. The proximity of these private agricultural lands

to important migratory corridors may represent a threat, but the overall risk due to agriculture is not a major problem and the threat is not likely to increase substantially in the future.

Dam Operations

Bigfork Dam operation has little direct influence on habitat occupied by bull trout. Fish are known to enter the diversion canal and may become trapped when flows are reduced during maintenance activities. Pacificorp advises FWP prior to total dewatering of the canal so fish can be captured and moved back into the river instead of allowing them to die in the canal as flows decrease. The operation of Bigfork Dam probably has a greater influence on the fish population below the dam than on the Swan drainage population. Controlled spilling may make it more difficult for introduced species to gain access above the dam. The FERC license for the dam expires in 2002 and the review process for relicensing has begun.

Forestry (high risk)

Extensive logging and road construction began in the Swan drainage in the early 1950's. These activities, conducted on private, state, and federally owned lands, have progressively penetrated most major tributary drainages upstream. The extent of timber harvest and road development varies considerably within and between ownerships in the Swan drainage. The Forest Service and MDNR estimate that 20 percent and 27 percent of their lands, respectively, have had some degree of timber harvest activity. Plum Creek Timber Company estimates that approximately 70 percent of their land has had some degree of harvest activity.

Timber harvest and road construction can alter stream channels and associated fish habitat to varying degrees. Road culverts and bridges have potential to impact fish passage. Unnatural water yields that can result from timber harvest cause increased streambed and streambank erosion, increased sediment delivery to stream channels, and result in reduced fish habitat quality and quantity.

These effects have not been evaluated directly in the Swan, but have been documented in other Flathead drainages (Flathead Basin Commission 1991). Riparian and adjacent timber harvest have affected stream channel and streambank cover, stability, and integrity in the Swan. The Montana Department of Health and Environmental Sciences reports 49 miles of six streams in the Swan suffer impaired water quality as a result of silvicultural activities (MT DHES 1994).

Some habitat alterations may appear to have little biological significance on a site-specific basis. However, when their effects accrue over larger areas or longer time periods, the apparent biological severity of impacts often increase and cumulative effects emerge. In some cases, these cumulative effects have adversely affected the morphology and ecology of stream environments with a resultant loss in trout spawning and rearing habitat.

In Swan streams, monitoring of spawning and incubation habitat quality in major spawning tributaries suggests that there are relatively high sediment levels, even under natural conditions. Slight sediment increases may adversely impact bull trout fry survival to emergence and juvenile survival (Weaver and Fraley 1991). However, we caution that in the Swan drainage natural variation occurs in sediment levels between streams, largely as a result of geological and geomorphic differences, and this complicates analysis of the effects of human activities on sediment in streams.

Research conducted by Plum Creek Timber Co. suggests that bull trout spawning and distribution in the Swan is a function of geomorphology and patch size. Bull trout occur primarily in the larger watersheds, i.e. those over 2,000 hectares (G. Watson, pers. comm., Plum Creek Timber Co., Missoula, 1995; see also Rieman and McIntyre 1995). Plum Creek has thus far not observed particular relationships between bull trout distribution and management history within a given drainage (G. Watson, pers. comm.). Preliminary investigations comparing bull trout spawning locations to riparian landtypes (see Sirucek and Bachurski 1995) suggest that bull trout tend to spawn in locations exhibiting specific riparian landtypes and the degree of spawning in any tributary may be directly related to availability of specific landtypes (G. Watson, pers. comm.).

Analysis of existing data by researchers at the University of Montana Flathead Lake

Biological Station indicates that Swan River tributaries draining large areas of roadless lands are disproportionally important for the persistence and recovery of westslope cutthroat trout, bull trout, and amphibians (Frissell et al. 1995). Road density in a larger scale study of the Flathead basin is highly correlated with the proportion of a watershed that has been logged (Hauer and Blum 1991). In an unpublished analysis, Frissell et al. (C. Frissell, C. Baxter, and B. Cavallo, pers. comm., Flathead Lake Biological Station, The University of Montana, Polson, 1995) found that abundance of bull trout redds in larger Swan River tributary streams in 1983 and 1991 (as reported by Montana Fish, Wildlife and Parks) was inversely correlated to the road density and number of road crossings of streams in the tributary drainages. There was no significant correlation with drainage area, aspect, or any of several other geomorphic variables considered.

The Scientific Group believes that, in the Swan, bull trout distribution and spawning location is a function of habitat type. The combination of watershed size (drainage area) and riparian landtype may be important factors contributing to the specific physical characteristics required by bull trout for spawning (discharge, temperature, substrate quantity and quality, groundwater, etc.). However, there is also evidence that the quality of this habitat is affected by the level of development. These relationships must be further clarified to effect responsive management for bull trout and other native aquatic species.

Recent research by Butler et al. (1995) and Spencer (1991a) indicates that a seasonal deficit in dissolved oxygen has occurred in the deeper portions of Swan Lake in recent years; a phenomenon not observed in historical surveys. Stable isotope analysis was used to trace the source of the oxygen deficit to input of organic carbon from the Swan River into the lake during spring runoff and further suggested that recently-logged tributaries are one important source of that portion of the organic carbon pool most associated with oxygen depletion in the lake (Butler et al. 1995). This phenomenon clearly merits close monitoring and further investigation, given the potential consequences to bull trout habitat.

Recreational Development

Although recreational development is not presently considered to be a major risk, future growth of the human population may result in an increasing threat. Lakeshore development has increased recently, creating the potential for water quality problems.

The trail systems accessing the Bob Marshall and Mission Mountains Wilderness areas are located along streams with major bull trout spawning and rearing areas. Outfitter camps also concentrate human and stock use in specific areas. These uses will likely increase in future years.

Transportation

Highway 83 parallels the Swan River along its entire length. Analysis of sediment taken from deep within Swan Lake shows a spike corresponding with initial highway construction (Spencer 1991b). Recently, a project to widen this highway, along with installation of telephone and utility systems throughout the region, has raised the threat of increased sedimentation. There are many stream crossings on the east side of the Swan River that create the potential for catastrophic impacts resulting from a toxic material spill. The Swan drainage has no major tributary to buffer catastrophic impacts. Threats resulting from the transportation system in the drainage will likely become greater in the future as the highway is improved and traffic increases.

Population

Life History

The migratory life form of bull trout is dominant in the Swan drainage. The resident form is suspected to occur in low frequency but conclusive evidence of this is presently not available.

Trend

Due to a lack of historic information on bull trout abundance, no long-term trend assessment can be made. In recent years (since 1982), an increasing trend ($p<.05$) in the number of redds observed has been reported (Weaver 1994). This increase is based on annual counts in four index streams. The factors driving the apparent increase are not fully understood. It is likely that the additional food source provided by the recent establishment of Mysis relicta in Swan Lake, combined with progressively more restrictive angling regulations, are primarily responsible for the bull trout population increase.

Distribution/Fragmentation

Although Bigfork Dam has fragmented the Swan from the Flathead drainage, the Swan itself upstream from the lake remains intact. This interconnectedness provides a partial buffer from catastrophic events, both natural and man-caused.

Abundance

At present, the Swan drainage provides habitat for what is believed to be the largest migratory bull trout population remaining in the state of Montana. There are at least 23 tributaries which support some level of juvenile bull trout rearing (Leathe and Enk 1985). Bull trout spawning occurs in at least 10 tributary drainages. Recently, FWP estimated the total adult migratory population in the Swan drainage at around 5,000 fish (FWP - unpublished file data). Leathe and Enk (1985) estimated approximately 31,000 juveniles to be present in tributary drainages. This estimate would be higher in recent years due to the observed increase in redds, supported by documentation of increased juvenile abundance (Weaver, pers. comm., 1995). Overall, the Swan bull trout population is currently one of the healthiest in the state and is of major importance to the conservation and recovery of the species in Montana.

Biological Sampling Loss

The risks resulting from biological sampling have been minimal in past years but may increase as more research and management activities occur. There is an increasing trend in proposed research projects in the Swan drainage, which will be further accelerated due to the recent discovery of whirling disease in the drainage.

Risk due to electrofishing injury is unquantified for bull trout but there is evidence that most large trout are susceptible to electrofishing injury. As a result of FWP research into the impact of electrofishing on fish, electrofishing techniques and equipment have been modified to minimize electrofishing risk. There is also a FWP policy limiting the use of electrofishing in waters containing Species of Special Concern. Overall, the risk of losing bull trout from biological sampling was judged to be small.

Genetic research efforts to quantify brook trout x bull trout hybridization may create additional risk because some fish will be sacrificed. However, efforts to obtain samples through creel survey should minimize the need to kill fish for genetic analysis.

Angling (high risk)

Bull trout angling regulations have become more restrictive over time in the Swan drainage:

- Pre-1959 - Daily creel limit of 15 bull trout, not to exceed 10 pounds plus one fish, with an 18-inch minimum size.
- 1959 - Bull trout limit dropped to 10 fish, not to exceed 10 pounds plus one fish, with an 18-inch minimum.
- 1982 - Partial closure in the Elk Creek drainage; no fishing allowed at any time upstream from the road crossing in Section 16 (spawning reaches). Bull trout creel limit reduced to a single fish per day in all rivers and streams; lake limits at 10 pounds plus one fish. The 18-inch minimum still applies.

- 1985 - The entire Elk, Goat, Squeezer and Lion creek drainages were closed to angling year-around; 18 inch-minimum size eliminated elsewhere in drainage.
- 1990 - Illegal to possess a live bull trout (anglers must immediately kill or release fish captured); creel limit of one bull trout daily.
- 1993 - Statewide bull trout closure eliminated bull trout harvest in all of western Montana with the exception of Swan Lake and Hungry Horse Reservoir. Thus, bull trout harvest was eliminated in the Swan River and all its tributaries.
- 1995 - Bull trout fishery in Hungry Horse Reservoir closed. Swan Lake now the only water in Montana open to bull trout harvest, with a daily creel limit of one fish.

In an extensive creel survey conducted on Swan Lake between May 21, 1983 and May 18, 1984, anglers expended an estimated 21,734 hours of fishing effort (Leathe and Enk 1985). Unrelated statewide mail surveys, conducted by FWP, estimated that between 5,000 and 7,600 angler days of fishing pressure were expended on Swan Lake annually during the 1982-1985 license years (FWP 1986). In the specific Swan Lake survey, bull trout were the third most abundant fish species harvested and creeled bull trout averaged 18 inches in length (Leathe and Enk 1985). The total estimated harvest of 739 bull trout was distributed relatively evenly across all months of the year. Bull trout were sought by 92 percent of 154 ice fishing parties interviewed during the late fall and winter months (November through March). However, harvest was not particularly high during these months because overall fishing pressure was low in comparison to other months (Leathe and Enk 1985).

Bull trout anglers experienced an average catch rate of 0.26 fish per hour for the entire season. Winter catch rates were slightly higher. Bull trout anglers released a much larger percentage of their catch (65 percent) than did northern pike or kokanee anglers (3 percent and 4 percent released, respectively). Many bull trout anglers were cognizant of the life history of the species and voluntarily released subadult fish in spite of the fact that the bull trout limit in effect was 10 pounds and one fish, or 10 fish (Leathe and Enk 1985).

More recent angler pressure estimates are available from FWP. Mail surveys estimated angling

pressure on Swan Lake to be 7,690 anglers days in 1991 and 8,276 angler days in 1993. This indicates a modest increase in fishing pressure on the lake since 1983. On the Swan River, anglers expended an estimated 4,116 angler days in 1991 and 10,318 angler days in 1993, indicating an unexplained 250% increase in angling pressure in only two years (FWP 1992; FWP 1994).

Angling is considered a high risk in this drainage, in part because harvest of bull trout is still legal in Swan Lake. There are many unknowns associated with this fishery. A yearlong creel survey on Swan Lake was concluded in December, 1995 and will provide information on the current level of bull trout harvest and angler use on the lake.

Hybridization is also a concern with this population. If the level of hybridization with brook trout is higher than has been documented, then the bull trout population may be lower than is currently estimated. If so, this increases the risk from all sources of mortality, including angler harvest. A collection of bull trout samples (heads) from the recently concluded creel survey is being analyzed electrophoretically to determine whether hybridization is common in fish captured from the lake.

Illegal Harvest (high risk)

It is difficult to separate illegal harvest from legal angling. Long (1994) described poaching impacts on the Kootenai River bull trout population. Anecdotal evidence suggests that large numbers of adult bull trout were taken annually from the Swan River and several of the larger tributaries. Since major spawning streams are now closed to angling year-round, this problem has been reduced, but illegal harvest likely still occurs. Given the current status of bull trout in Montana and the concentration of large, highly vulnerable adult fish in relatively few tributaries, illegal harvest is considered to be a high risk in the Swan River drainage.

CONSERVATION GOAL

There is uncertainty about which factors will be necessary to maintain a healthy bull trout population into the next century. Based on current knowledge, this ecosystem is in a relatively healthy condition as it pertains to meeting bull trout life history requirements.

In the Swan River drainage, the Scientific Group believes a "conservation" strategy is most applicable. A "restoration" strategy was endorsed in most of the other bull trout management units. A conservation strategy would, at a minimum, maintain bull trout population abundance, distribution, and genetic structure. This does not infer that management activities focused on increasing habitat capabilities or addressing risk factors for bull trout are not necessary in the Swan but, rather, that there is less immediacy in this drainage due to the increasing trend of most monitored segments of the Swan Lake bull trout population.

The conservation goal for bull trout in the Swan River drainage is to:

1. Maintain a self-sustaining bull trout population dominated by the migratory life form;

2. Maintain stable population levels within the current bull trout distribution, especially in all core areas;

3. Maintain the population genetic structure both within and between tributaries in the Swan River drainage; (The genetic effects of an expanding Swan bull trout population on Flathead Lake populations is unknown.)

4. Quantify and maintain the existing pattern of inter-annual variation in spawner escapement between streams; (Currently, some go up while others go down. If these patterns begin to occur in synchrony, the likelihood of extinction is increased.)

5. Maintain the age structure of the spawning population;

6. Maintain the existing high degree of connectivity within the Swan River drainage;

7. Minimize the opportunity for movement of introduced species into the drainage above Bigfork Dam, but explore options for upstream migration of native species from Flathead Lake. (Currently there is no upstream passage at Bigfork Dam and lake trout and lake whitefish are present below the dam. If lake trout are established in the Swan drainage, the bull trout population will be negatively impacted. However, this lack of connectivity with the Flathead drainage may be detrimental to bull trout and cutthroat trout in both the Flathead and the Swan drainages. Selective passage of bull trout and westslope cutthroat trout at Bigfork Dam may be desirable at some point in the future but there is great concern that human error or equipment failure could result in inadvertent transport of lake trout upstream. Many do not believe the risk is worth taking.)

SOURCES OF UNCERTAINTY, DATA NEEDS

Unique Swan Populations

The Swan is the only drainage that the Scientific Group has evaluated where high levels of timber harvest occur, high sediment loads are documented, brook trout are abundant, and yet bull trout numbers are increasing. We need to evaluate the unique characteristics of this drainage (*Mysis* in the absence of lake trout?, geomorphology?, groundwater influences?) that have allowed bull trout to persist under these conditions.

Resident Fish

There are numerous uncertainties about the habitat needs of resident and migratory fish and

whether or not streams and rivers in the Swan are suitable for sustaining resident bull trout populations. In addition, we do not understand the mechanisms by which migratory life forms undergo transition to resident forms or how long this transition may take. The presence of resident bull trout has not been confirmed in the Swan drainage. Also, it is not clear if there are fluvial fish (those that spawn and rear in tributaries and then migrate to the river, without entering Swan Lake) in this population.

Distribution

We need to considerably expand the information available on the status and trend of bull trout in the disjunct populations in Holland and Lindbergh lakes. We also would benefit from a better understanding of the relationship of these populations and their downstream corridors to the migratory Swan Lake population. Finally, we need to evaluate the primary risks to each of the disjunct populations and establish conservation and/or restoration goals for each.

Food Webs

We need to better understand food web interactions in Swan Lake. The interaction of *Mysis* and bull trout in the absence of lake trout is an important research need.

Hydropower

The impact of hydropower operations at Bigfork Dam and the significance of this migration barrier are not well understood.

Human Development

Human development in the valley is expected to have negative effects on bull trout. We need to evaluate which factors related to this activity (pollution, habitat loss, poaching) are most likely

to affect bull trout and take steps to insure that bull trout needs are considered in planning future development.

Introduced Species

Is suppression and/or removal of introduced species, especially brook trout, possible in the Swan? Is it desirable or socially acceptable? Can bull trout continue to coexist with brook trout? How can we limit further introductions, especially of lake trout and lake whitefish? Can anglers accurately distinguish between bull trout and brook trout? These are all important questions related to bull trout that will require future planning and coordination. We need more information about the degree of hybridization that is occurring with brook trout, and the genetic risk it presents.

Land Management

The effectiveness of current Best Management Practices (BMP's) and the Streamside Management Zone (SMZ) law in protecting bull trout habitat need to be evaluated. Scientific evaluation of the cumulative effects of timber management on bull trout habitat needs to be strengthened. A comprehensive study of the relationship between road density, timber management, sediment levels, and bull trout population levels and spawning sites is needed.

Hydrologic Conditions

We need to quantify the relationship between "dry" and "wet" years and bull trout spawning success and/or juvenile survival.

Fisheries Management

The apparent conflict between fisheries management objectives for native species and those for recreational fisheries need to be evaluated. Where those conflicts are real, regulations and

management programs may need to be reevaluated and/or adjusted to clearly establish priorities.

Swan Lake

The quality of habitat, trophic status, water quality issues, density limitations for bull trout, and other aspects of the Swan Lake nodal habitat need to be investigated and related to management activities (both fisheries and land management) within the drainage.

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APPENDIX A

ACRONYMS

FWP	Montana Fish, Wildlife, and Parks
MDHES	Montana Department of Health and Environmental Services
TMDL	Total Mean Daily Load
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey

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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