

Hungry Horse Fisheries Losses Attributable to the Construction and Operation of Hungry Horse Dam

Excerpts from the following documents:

Montana Fish, Wildlife & Parks and Confederated Salish and Kootenai Tribes. 1991.
Fisheries Mitigation Plan for Losses Attributable to the Construction and Operation of Hungry Horse Dam. Montana Fish, Wildlife & Parks and Confederated Salish and Kootenai Tribes, Kalispell and Pablo, Montana. 71 pp.

Montana Fish, Wildlife & Parks and Confederated Salish and Kootenai Tribes. 1993.
Hungry Horse Dam fisheries mitigation implementation plan. Montana Department of Fish, Wildlife, and Parks and Confederated Salish and Kootenai Tribe, Kalispell and Pablo, Montana. 43 pp.

Fisheries Losses

1. Replace lost annual production (minimum of 65,000 westslope cutthroat annually) from the inundated 43 miles of tributaries and 35 miles of South Fork Flathead River using a mix of habitat improvement, improvement in fish passage and hatchery production.
2. Replace lost annual production of 250,000 young bull trout in the lost stream sections using a mix of the above fisheries techniques.
3. Replace lost annual production of 100,000 kokanee adults initially through hatchery production and pen rearing in Flathead Lake, partially replace lost forage for lake trout in Flathead Lake.

Implementation Update

The mitigation and implementation plans predict that about 50 percent of the above losses can be achieved by changing dam operation (IRCs, VARQ, selective withdrawal, seasonal flow windows and ramping rates in the NPCC Mainstem Amendments). The remaining 50 percent of the losses can be mitigated through "non-operational mitigation", or those actions that do not require modifying dam operation. These include habitat enhancement and protection through land purchase or conservation easements, fish passage improvements, artificial production and offsite mitigation. The Plans state that the loss statement must be reviewed if dam operation does not become more beneficial to the fisheries.

Mitigation of the 78 miles of stream/river habitat can not be fully achieved by reconnecting blocked habitat or repairing damaged habitat in the Flathead Watershed. Offsite mitigation will be required to fully mitigate these habitat losses.

The Implementation Plan calls for experimental hatchery propagation of native fish species. The Sekokini Springs Natural Rearing Facility (currently being reviewed by ISRP in the 3-step APR process) was designed to develop "within-drainage" WCT stocks to conserve genetic variability as restoration actions proceed.

Fisheries Crediting

The Hungry Horse and Libby Mitigation Programs have Council approved resident fish loss statements. Fisheries crediting cannot occur unless fisheries losses are established.

Montana Fish, Wildlife & Parks and the Confederated Salish and Kootenai Tribes devised an Fish Crediting system for inundation losses when Hungry Horse Dam filled. To simplify the crediting process, MFWP and CSKT agreed to credit BPA for kilometers of fish habitat protected through land acquisition and conservation easements.

No crediting system has been developed for annual operation losses.

We have demonstrated that complete mitigation of the fisheries losses attributable to the construction and operation of Libby and Hungry Horse Dams cannot be achieved onsite. Offsite mitigation may not be sufficient offset the difference to achieve 100 percent fulfillment.

Table 4-3. Mean WCT estimates per 100m of stream for juveniles greater than 75mm by stream order and gradient categories for tributary reaches to the North, Middle and South Forks of the Flathead River (Zubik and Fraley 1986).

Stream Order	Gradient (%)	Mean Estimate
2	1.2 - 1.9	22.7
2	2.0 - 2.7	56.9
2	2.8 - 3.8	77.6
2	3.9 - 6.9	31.0
2	7.0 - 12.3	18.8
3	0.5 - 1.0	22.3
3	1.1 - 1.6	38.9
3	1.7 - 2.2	62.9
3	2.3 - 4.0	25.4
3	4.1 - 5.3	43.9
3	5.4 - 17.0	19.2
4	0.4 - 1.0	5.2
4	1.1 - 1.6	24.0
4	1.7 - 4.2	13.5
5	0.2 - 1.8	14.3
Mean		31.9

Table 1-1. Estimated Number of Adfluvial Cutthroat Juveniles Lost (standing stock) by Stream Order and Gradient Categories (for gradients less than six percent) in tributary reaches inundated by Hungry Horse Reservoir (lost to all spawning adults and rearing juveniles).

Stream order	Gradients (%)	Number of reaches	Length (meter)	Average number of WCT per 100m (mean)	Total calculated loss (# of fish)
2	0.4 - 1.8	4	4,770	22.7	1,083
2	2.2 - 2.6	2	4,004	56.9	2,278
2	2.8 - 3.6	5	5,370	77.6	4,167
2	4.0 - 5.8	8	5,108	31.6	1,614
3	0.6-0.6	1	8,692	22.3	1,938
3	2.6-3.8	9	9,384	25.4	2,384
3	4.3-5.9	5	4,096	43.4	1,778
4	0.9-0.9	1	3,956	5.2	206
4	2.0-3.5	4	12,874	13.5	1,738
Total		39	58,254		17,186

Source: Fisheries Mitigation Plan for Losses Attributable to the Construction and Operation of Hungry Horse Dam (1991)

Table 1-2. Estimated Number of Adfluvial Cutthroat Juveniles Lost (standing stock) by Stream Order and Gradient Categories (for gradients less than six percent) in Tributary Reaches above full pool (includes upper South Fork drainage) lost to spawning and rearing fish from Flathead Lake but available to spawners from Hungry Horse Reservoir.

Stream order	Gradients (%)	Number of reaches	Length (meter)	Average number of WCT per 100m (mean)	Total calculated loss (# of fish)
2	1.5-1.5	1	877	22.7	199
2	2.2-2.3	4	9,739	56.9	5,541
2	2.8-3.8	7	13,905	77.6	10,790
2	3.9-5.9	32	79,047	31.6	24,979
3	0.7-1.0	2	10,916	22.3	2,434
3	1.1-1.4	2	9,898	38.9	3,850
3	1.7-2.2	8	51,918	62.9	32,656
3	2.6-4.0	20	86,468	25.4	21,963
3	4.1-5.9	20	62,865	43.4	27,283
4	0.3-0.6	8	38,963	5.2	2,026
4	1.1-1.3	5	40,337	24.0	9,681
4	1.7-4.8	13	68,778	13.5	9,285
5	0.6-0.8	3	53,220	14.3	7,610
Total		125	526,931		158,297
Grand Total Table 1-1 and 1-2					175,483

Source: Fisheries Mitigation Plan for Losses Attributable to the Construction and Operation of Hungry Horse Dam (1991)

Appendix 27

Libby Dam Fisheries Loss Statement

Excerpt from Fisheries Mitigation and Implementation Plan for Losses Attributable to the Construction and Operation of Libby Dam. 1998.

Fisheries Losses in the Flooded Kootenai River and Libby Reservoir Tributaries

Quantification of fisheries losses due to hydropower operations is often difficult. Historical data are limited, and in some instances only anecdotal information exists. We used a three-pronged approach to quantify riverine fish losses; 1) all available data were collected from agency reports, data files, newspaper reports and other historical accounts; 2) where pre-dam data were available, population estimates were repeated and compared to historic abundance estimates; and 3) losses in river and stream sections that no longer exist or are severely degraded were estimated using fisheries information from similar, representative streams. Losses are presented in an annual loss figure.

One hundred nine miles (175,355 m) of the Kootenai River and forty miles (63,628 m) of tributary stream habitat were lost because of the inundation of the Kootenai River in the U.S. and Canada (Figure 2). The inundated stream reaches encompassed a variety of essential stream habitat types for resident and adfluvial fish. These inundated habitat types provided fish species with spawning, juvenile rearing, migratory passage, and resident habitat (Table 6.)

A total of 57,183 tributary trout *Oncorhynchus spp.* were initially lost in 1972 in the U.S. and Canada due to the impoundment of the Kootenai River. Assuming populations are density dependent, a calculated 57,183 fish are lost on an annual basis (Table 7).

Pages 117-118 Kootenai Subbasin Plan

Libby Reservoir

175 km of the Kootenai River lost to inundation by reservoir
Annual loss of 15,000 trout and 377,000 mountain whitefish from inundated river

134 km of tributary stream habitat lost to inundation
Annual loss of 57,000 juvenile *Oncorhynchus spp.* from inundated tributaries

25 km blocked by road construction around the reservoir
Annual loss of 5,990 juvenile *Oncorhynchus spp.* from blocked tributaries

Kootenai River

Annual loss of 2,100 juvenile westslope cutthroat trout

90 percent reduction in burbot fishery

White sturgeon endangered

Bull trout threatened

Table 6. Stream order, reach length and gradient of potential fish-bearing tributaries (U.S.) lost due to the impoundment of the Libby Dam, MT.

Stream Name	Order	Reach #	Length (m)	Gradient (%)
Young Creek	3	1	335.5	3.6
		2	227.2	5.4
		3	637.5	2.9
Tobacco River	4	1	1891.6	0.5
		2	1305.4	1.4
		3	4251.7	0.4
Murray Creek	2	1	1490.2	1.2
		2	814.4	3.7
Dodge Creek	3	1	1995.6	0.6
		2	337.0	12.7
Poverty Creek	2	1	659.4	3.7
Pinkham Creek+	3	1	829.9	1.5
		2	480.4	3.8
Cadette Creek*	2	1	79.3	15.4
Sullivan Creek	2	1	603.9	5.1
Boulder Creek*	2	1	793.0	4.6
Gold Creek	2	1	557.5	7.7
Sutton Creek	3	1	862.8	2.1
		2	761.3	3.2
Big Creek	4	1	2912.8	1.5
McGuire Creek*	2	1	1026.6	4.2
N.F. Parsnip Creek	2	1	1339.6	3.2
Parship Creek	3	1	1311.5	3.3
Geibler Creek	2	1	767.4	6.4
Bristow Creek	3	1	1647	1.1
		2	1320.7	2.3
Barron Creek*	2	1	1361.8	3.6
Ural Creek	2	1	1009.6	1.8
		2	477.3	6.4
Ten Mile Creek	3	1	2693.2	1.8
Five Mile Creek	3	1	1483.8	4.1
Cripple Horse Creek+	3	1	1993.8	0.9
		2	1550.0	2.8
Jackson Creek	2	1	1117.8	1.6
		2	402.6	9.1
Little Jackson Creek	2	1	487.4	11.3
Canyon Creek+	3	1	2316.5	2.4
Linklator Creek	2	1	2877.0	1.6
Gold Creek	3	1	2907.0	1.6
Elk Creek	4	1	6584.0	0.6
Kikomun Creek	3	1	1450.0	3.2
Sand Creek	3	1	2360.0	1.7
TOTAL			63,628.1	

(* definite fish barrier, (+) probable fish barrier

Table 7. Estimated number of tributary *Oncorhynchus spp.* >75mm lost due to the installation of Libby Dam, Libby, Montana, using stream order classification and gradient categories as indices of fish population density.

Stream Order	Gradients (%)	Length (m)	Number of Reaches	Mean #/ 100 m	Total Lost
2	1.2-1.8	10,107.5	5	96	9,703
2	3.2-3.7	4,175.2	4	123	5,135
2	4.6-6.4	2,641.6	4	123	3,249
2	7.7-11.3	1,447.5	3	18	261
3	0.6-1.8	14,696.5	7	90	13,227
3	2.1-2.9	6,687.5	5	77	5,149
3	3.2-5.4	6,049.7	7	68	4,114
3	12.7-12.7	337.0	1	71	239
4	0.4-0.5	6,143.3	2	16	983
4	1.4-1.5	10,802.2	3	140	15,123
TOTAL		63,628.1	41		57,183

Loss estimates indicate 40 percent of the total loss was realized from third order streams (22,729 trout), 32 percent of the loss from second order streams (18,348 trout) and 28 percent of the loss from fourth order streams (16,106 trout).

Trout and Mountain Whitefish Losses in the Inundated Kootenai River

A total of 14,948 trout and 377,156 mountain whitefish were initially lost in 1972 due to the inundation of the Kootenai River in Canada and the U.S. Assuming these populations are entirely density dependent, 14,948 trout and 377,156 mountain whitefish are lost on an annual basis (Table 8), due to inundation of historic habitat.

Stream Habitat Losses

Prior to the impoundment of the Kootenai River, a total of 313,406 m (195 miles) of fluvial spawning and rearing habitat was available above Libby Dam, U.S. As a result of the dam construction, 134,141 m of the Kootenai River and tributaries were inundated (43 percent of the total potential habitat). In addition, 5,831 m of fluvial habitat was blocked due to road culverts. Thus, a total of 139,972 m of fluvial habitat (45 percent of the total potential) was lost due to the construction of Libby Dam (Table 9).

In addition to stream losses due to the inundation of the Kootenai River, tributary stream habitat above full pool has been severely degraded due to land management practices and the introduction of non-native species. A total of 90,824 m of degraded stream habitat is no longer available to adfluvial spawners. Consequently, a total of 230,797 m of fluvial habitat has been lost since 1972 (73 percent of the total potential habitat). Approximately 26 percent of the pre-dam fluvial distribution remains in the U.S. portion of the Kootenai Drainage above Libby Dam (Table 9).

Table 8. Estimated fish losses in the mainstem of the Kootenai River from 1972-1996.

Species	Annual Loss	Cumulative Loss Since Inundation (1972-1996)
<i>Oncorhynchus</i> trout (includes rainbow and westslope cutthroat trout) >7 inches	14,948	358,752
Mountain Whitefish >5.2 inches	377,156	9,051,744

Table 9. The total stream length of adfluvial habitat inundated by the construction of Libby Dam, existing adfluvial habitat above full pool, degraded adfluvial habitat, and adfluvial habitat blocked by culverts in the Kootenai River Drainage above Libby Dam, USA.

Stream Name	Stream Length Inundated (m)	Available Adfluvial Habitat above Full Pool (m)	Degraded Adfluvial Habitat above Full Pool (m)	Adfluvial Passage Blocked by Culverts (m)
Kootenai River (above Libby Dam)	86,961.6			
Canyon Creek	2,316.5	1,805.4		1,805.4
Cripple Horse Creek	1,993.8	4,026.0		
Jackson Creek	1,117.8	1,601.4		
Five Mile Creek	1,483.8	2,653.0	2,653.0	
Warland Creek	3,613.0	2,416.0		
Bristow Creek	1,647.0	8,760.0		
Big Creek:	2,912.8			
South Fork		30,514.0		
North Fork		4,842.0	4,842.0	
East Branch		4,800.0		
West Branch		4,000.0		
Sutton Creek	1,624.1	1,350.0		
Sullivan Creek	603.9	1,208.0		
Young Creek	1,200.2	6,215.0		
Pinkham Creek	1,310.3	4,035.0		
Tobacco River	7,448.7	24,478.0	24,478.0	
Fortine Creek	0.0	43,963.0	43,963.0	
Grave Creek	0.0	24,317.0		
Sinclair Creek	0.0	4,108.1	4,108.1	
Therriault Creek		5,390.0	5,390.0	
McGuire Creek	1,026.6			4,026.0
All other tributaries inundated (U.S.)	18,881.6			