STATE OF MONTANA
FISH HATCHERY SYSTEM REVIEW

FOR

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

HELENA, MONTANA

SUBMITTED BY:

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EXECUTIVE SUMMARY

The Montana Department of Fish, Wildlife and Parks (FWP) provides for the stewardship of the fish, wildlife, parks, and recreational resources of Montana.This report evaluates the overall effectiveness of the FWP hatchery program, including facility utilization, broodstock management and genetics programs, as well as their fish health program. It also identifies additional needs for hatchery fish as requested by fishery managers and potential sources of fish available from private industry along with cost information.

To identify practical needs for additional propagated fish, resource managers in the seven FWP regions were requested to develop projected fish-stocking needs to adequately manage all fisheries resources in the state. Their response is presented in a condensed statewide summary by species and strain of fish, along with the actual numbers of fish stocked by the hatchery system.

A site visit was made to each of the nine state hatcheries. Operational procedures were reviewed with the hatchery managers, along with an inspection of the facilities. Hatchery profiles were developed from information gathered during the visits and interviews with hatchery personnel. Graphs depicting typical annual use of hatchery building and raceway facilties by the various species and strains of fish were developed for each hatchery, rather than presenting extensive tables of data, which can vary from year to year.

In the hatchery profiles, it will be seen that available space (troughs and raceways) is a constraint on increased production in some facilities, while available water flow is a limiting factor in others. Also to be considered, is the generally applied fisheries management policy of Spring and early summer stocking to increase survival of fish in the wild. This management practice guides and limits many hatchery operations, which is apparent in the profiles.

An extremely positive benefit provided to the public by FWP hatcheries is in the form of public education and outreach. Tours are provided to thousands of visitors at hatcheries each year. Another important public education program is in the form of field trips for students of all ages that are provided by FWP hatchery personnel.

It has been demonstrated that the genetic integrity of wild fish stocks can be maintained in captive broodstocks, if adequate safeguards are taken to avoid loss of genetic diversity. In 1988, a Broodstock Management Policy was developed for FWP hatcheries. The purpose of the policy was to establish sound genetic management of the State's hatchery-maintained broodstocks, fish health procedures for broodstock, and procedures to maintain genetic purity.

Montana Department of Fish, Wildlife and Parks hatcheries have a fish health monitoring and evaluation program. All hatcheries are visited by a certified fish health inspector, or his representative annually, and each lot of fish is sampled, to determine if designated pathogens of special concern are present in the hatchery population. Historically, rarely have designated pathogens been identified in fish at any FWP hatcheries during the history of the fish health inspection program, spanning a time period of over 25 years (bacterial kidney disease was effectively eradicated at the Yellowstone River Trout Hatchery). **At no time has whirling disease been found in any Department of Fish, Wildlife and Parks (or federal and private) fish hatchery in the State of Montana.**

The use of private fish hatchery operators to supply fish for state programs is addressed in detail in the section on Privatization of Fish Hatchery Production. The purpose of this review is to evaluate the efficiency of existing State fish hatcheries, and determine if an increased demand for hatchery production could be provided by one or more hatcheries in the private sector. Private growers in Montana capable of providing fish in significant numbers were visited or contacted by telephone. Most of these hatcheries are quite small and would have difficulty supplying large numbers of fish 4- inches or greater in length. In addition, demands for their fish for use in private ponds have been increasing and most growers sell all their fish by June or July.

Currently rainbow trout, and Westslope and Yellowstone strains of cutthroat trout are available from private growers. When considering the use of private growers to supply fish for state programs, the availability of sufficient numbers of genetically pure and diverse stocks of fish in the size and quantity required must be considered; they must be able to provide species and strains of fish that meet fisheries management needs. This can pose a problem; a comparison of numbers of actual planted fish for 1995 with the projected future needs (pages 9-12) demonstrates the annual diversity in species and strain requirements which can occur, and the flexibility required in the hatchery system to meet those needs. This flexibility may not be readily accomodated by the private sector.

All private growers have customers they supply fish to each year on a continuing basis and are hesitant to jeopardize their existing market to provide fish to the Department of Fish, Wildlife and Parks. In general, costs of purchasing most fish from private growers are higher than those required for fish production at FWP hatcheries. The increased costs are related to the profit margin required for private hatcheries to exist. They also reflect the increased demand for private fish for stocking private ponds.

STATE OF MONTANA FISH HATCHERY SYSTEM REVIEW

The Montana Department of Fish, Wildlife and Parks (FWP) provides for the stewardship of the fish, wildlife, parks, and recreational resources of Montana. FWP operates nine fish hatcheries. Eight of these are owned by FWP; of these, seven are coldwater hatcheries and one is a warmwater hatchery. One hatchery (Murray Springs Trout Hatchery) is owned and funded by the US Army Corp of Engineers and is operated under contract by FWP.This report prepared and submitted by Piper Technology is a comprehensive study of the states 9 owned or operated fish hatcheries to evaluate the efficiency of the hatcheries and to answer the question can increased demand for hatchery fish production be provided by the state hatchery system, or perhaps by another entity such as the Montana private hatchery sector? The operational review and analysis centered around specific hatchery standards is based on the hatchery's historic performance data. Performance standards were developed from the background information. These standards allowed evaluation of operational efficiency and lead to recommended improvements for those facilities having correctable problems. The report evaluates the overall effectiveness of the FWP hatchery program including facility utilization, broodstock management and genetics programs, as well as the fish health program. It also identifies additional needs for hatchery fish as requested by fishery managers and potential sources of fish available from private industry along with cost information.

The evaluation also identifies the ancillary benefits derived to individual hatcheries and the hatchery system, from tourism and educational opportunities. While there may be additional costs to the hatcheries associated with these activities, the resulting benefits to citizens, hatchery staff, and employee training programs may realize greater direct and indirect benefits.

FISHERIES MANAGEMENT PROGRAM

From it's inception and until the early 1950s fish management activities consisted of law enforcement and stocking fish after the first state fish hatchery was built in1908. In this period the hatchery system served as an arm of the Fish and Game Department under the Board of Fish and Game Commissioners and the State Game Warden (Director). In this role the hatchery system stocked fish in waters deemed necessary by the Commission and Director. In the 1950s trained biologists began to study the relationships between resident fish populations and their habitat. As the knowledge of fish biology increased, the role of fish hatcheries began to change. Today, stocked fish are compatible with resident populations, and in numerous cases, used to restore native fish to their historic habitat.

Stocking hatchery fish is a necessary tool, which enables fishery managers to achieve specific fisheries resource objectives. Thus, fish hatchery production is driven by resource management goals.

Currently, the following species and strains of fish are maintained at Montana State hatcheries as broodstock to provide fish for the state fisheries program: Arlee strain rainbow trout, Yellowstone and Westslope strain cutthroat trout, and largemouth and smallmouth bass. Additionally, wild kokanee salmon are spawned and the eggs incubated at the Flathead Lake Salmon Hatchery, Somers, Montana. Some eggs are distributed to other state hatcheries for hatching and rearing, however, the majority are hatched and fry reared at the Flathead Lake facility. The Desmet strain of rainbow trout is spawned at Willow Creek, a tributary of Harrison Reservoir, Montana, and the eggs incubated in a quarantine facility at the Washoe Park State Trout Hatchery, Anaconda. Since the Washoe Park Hatchery is dedicated as a broodstock station for Westslope cutthroat trout, all eggs incubated at the hatchery from species other than Westslope cutthroat are distributed to other state hatcheries for rearing.

Other species and strains of fish reared by the state hatchery system include: Eagle Lake, Kamloops, and Erwin strains of rainbow trout, brown trout, grayling, chinook salmon, and walleye. These fish are obtained as eggs through cooperative arrangements with fish and game agencies in other states, the U.S. Fish and Wildlife Service, or by spawning wild fish in Montana watersheds.

The use of private fish hatchery operators to supply fish for state programs is addressed in detail in the section on Privatization of Fish Hatchery Production. Currently rainbow trout, and Westslope and Yellowstone strains of cutthroat trout are available from private growers.

Projected Stocking Needs

A total of 37,201,033 coldwater and warmwater fish ranging in size from fry (0-2 inches), fingerlings (2-8 inches), catchables (8+ inches), and broodstock were stocked in state waters during the period July 1, 1995 to June 30, 1996; this represents 207,095 pounds of fish. The state hatchery system is operating at full or near-full capacity at the present time. Because of this limitation, fisheries resource managers most frequently request numbers and sizes of fish which they know are currently available from the hatchery system, even though greater fish numbers may be appropriate for the waters being managed. To identify practical needs for additional propagated fish, resource managers in the seven FWP regions were requested to develop projected fish-stocking needs to adequately manage all fisheries resources in the state. Their response is presented in the following condensed statewide summary by species and strain of fish, along with the actual numbers of fish planted by the hatchery system. A comparison of numbers of actual planted fish for 1995 with the projected future needs

Demonstrates the annual diversity in species and strain requirements which can occur, and the flexibility required in the hatchery system to meet those needs. A reduction in the number of fish requested does not necessarily result in a reduction in fish production, since management programs sometimes shift from greater numbers of small fish to fewer numbers of larger-sized fish, resulting in increased fish weight being produced at a hatchery. Fish-stocking needs by FWP geographic regions are presented in Appendix A; a complete listing by stocking site is filed with the Fisheries Division, FWP, Helena):

Rainbow Trout

Strain	Size	1997 Projected numbers	1995 Actual numbers stocked
Arlee	fry	350,000	
	fingerling	1,914,680	1,744,928
	catchable	4,770	26,870
	broodstock	320	included in catchables
Arlee x Eagle Lake	fingerling	125,000	130,678
Desmet	fry	6,130	
	fingerling	409,500	370,885
Eagle Lake	fry	4,902	
	fingerling	1,492,650[a]	963,869
	catchable	125,000	42,299
Erwin	fingerling	78,800	38,575
	catchable	13,000	22,354
Kamloops	fingerling	52,500[b]	117,923
	catchable	26,450	
McConaughy	fingerling	52,000[c]	100,006
Hebgen Lake	catchables		30

Strain	Size	1997 Projected number	1995 Actual numbers planted
	Brook Trout		
Wyoming	fry	3,500	
	fingerling	8,000	
	Brown Trout		
Missouri River	fingerling	150,000	
Wyoming	fingerling	60,000	5,000
(undesignated)	fingerling	18,000	
	Cutthroat Trout		
Westslope Cutthroat	eyed-eggs	160,000	20,000
	fry	259,050	282,866
	fingerling	199,550[d]	447,769
	catchable	8,200	2,588
	broodstock	500	included in catchables
Yellowstone Cutthroat	fry	244,400	243,822
	fingerling	619,525	232,444
	catchable	650	756
	Golden Trout		
Sylvan Lake	fry	500	

Strain	Size	1997 Projected numbers	1995 Actual numbers planted
	Grayling		
Red Meadow	fry	45,000[e]	124,680
Red Rocks Lakes	eyed eggs	25,000	
	fry	100,000	
Madison River	fingerling	1,500	
Axolotyl Lakes	fingerling	5,000	
Big Hole	fingerling		6,582
	Chinook Salmon		
	fingerling	250,000	17,500
	Kokanee Salmon		
Lake Mary Ronan	fry	1,085,000	396,664
	fingerling	1,200,000	99,925
Little Bitterroot Lake	fry		41,273
Swan Lake	fry		626,472
	fingerling		97,130
Rereg reservoir	fry		12,395
	fingerling		42,672
(undesignated)	fry		410,493
	fingerling		910,150
	Catfish		
	fry	180,000	
	fingerling	14,200	

Strain	Size	1997 Projected numbers	1995 Actual numbers planted
	Largemouth Bass		
	fry	150,800[f]	
	fingerling	8,400	160,387
	Northern Pike		
	fry	507,000	200,000
	Smallmouth Bass		
	fry	140,000	
	fingerling		37,200
	catchable		784
	Tiger Muskie		
	fingerling	10,000	
	Walleye		
	fry	36,450,000	27,800,000
	fingerling	2,123,000	1,954,465

Footnote: fry = 0-2 inches, fingerling = 2-8 inches, catchable = 8+ inches, broodstock.

Footnotes (a - f) on reverse

STATE FISH HATCHERY SYSTEM

The propagation and stocking of fish has been a vital part of Fish, Wildlife & Parks (FWP) activities since early in this century. The first Montana hatchery began operation in 1908 at what is now Washoe Park Trout Hatchery, Anaconda. Since then a number of hatcheries have come into and left the inventory of facilities which were involved in production or distribution of fish.

Currently, nine hatcheries are operated by FWP and are located at Anaconda, Arlee, Big Timber, Bridger, Great Falls, Lewistown, Somers, Miles City and Eureka. Eight are state owned and one, Murray Springs Trout Hatchery, Eureka, is owned and funded by the U.S. Army Corp of Engineers, and operated under contract by FWP. This is a mitigation hatchery to partially offset the loss of fisheries habitat due to construction of Libby Dam and impoundment of Lake Koocanusa.

Historically, hatcheries no longer in operation were located at Emigrant, Hamilton, Libby, McNeil Pike Hatchery at Fresno Lake, Ovando and Polson. During the 1930s, two satellite fish-holding stations were operated to stock fish which were reared at other hatcheries. These were located at Red Lodge and Beaver Creek near Havre, and were operated for a few months during the summer. The Red Lodge station served the Big Timber and Emigrant hatcheries. Fish were transported to the site and Forest Service horse and mule pack trains distributed the fish in the surrounding mountains. At Beaver Creek, fish were transported to the station from the Great Falls hatchery and distributed into local waters.

Over the years, hatchery operations have changed dramatically. The Montana hatchery system today is a highly sophisticated operation with scientifically managed broodstocks, computerized fish growth and feeding rate projections, and fish distribution vehicles that assure the fish are provided complete life support during transportation and stocking. In addition, horse and mule pack trains have been replaced, in part, by air stocking with helicopters and fixed wing aircraft.

<u>Hatchery Operations Review</u>
A site visit was made to each of the nine state hatcheries. Operational procedures were reviewed with the hatchery managers, along with an inspection of the facilities. Fish production data was available at each hatchery, compiled in a computerized reporting program **Hatch 2**, developed by FWP's Fisheries Information Services Unit. The program is a useful tool to assist managers in the daily and seasonal operation of their facilities, and includes an accurate tracking system for egg and fish inventories, fish distribution (planting), fish production (performance) data, and fish health monitoring. Additionally, the projected weight and length of fish can be determined for planning space, water flow, and feeding rate requirements. Hatchery operations information was also available in *Hatchery Bureau Hatchery System Analysis* (1995).

Water chemistry Information was available for each hatchery and was found to be in the normal range for trout waters. Alkalinity and water hardness at most hatcheries is considered to be moderate with alkalinity ranging between 144 to 192 ppm and hardness between 140 to 310 ppm. Thus, water quality is excellent for trout production. Water hardness at Bluewater Trout Hatchery is considered to be very high, due to a high sulfate content; however, alkalinity is similar to that of the other hatcheries. Fish growth at Bluewater is excellent. The pH of water supplies is also very good, ranging from 7.4 to 8.1

It was very obvious from the start of the review, that many hatchery managers conduct a diversified yearly production program, and cooperate extensively among themselves in achieving their annual goals. Fish allocations to stocked waters are frequently shared to accomplish fishery management programs most efficiently, and interim production of some species is accomplished in addition to the hatchery's planned yearly program. All personnel are well trained and experienced in hatchery management, and are highly motivated toward producing high-quality fish for the resource.

Public Outreach

An extremely positive benefit provided to the public by FWP hatcheries is in the form of public education and outreach. Tours are provided to thousands of visitors at hatcheries each year. Another important public education program is in the form of field trips for students of all ages that are provided by FWP hatchery personnel. This is the highlight of the year for many students. In addition, hatchery personnel are also involved as instructors during other public outreach programs such as National Fishing Week activities and Project Wild. Some also assist the high school biology teacher in the classroom, as well as curriculum development.

Hatchery profiles were developed from information gathered during the site visits and interviews with hatchery personnel. Rearing troughs and outdoor raceways are typically used to intensively rear trout and salmon (Figure 1). Graphs depicting representative annual use of hatchery building and raceway facilties by the various species and strains of fish were developed for each hatchery, rather than presenting extensive tables of data, which can vary from year to year. The profiles include a production-schedule figure, which readily illustrates the annual commitment of the facility to each species and strain of fish being reared, along with the resulting fish distribution accomplished. Production schedules, annual use of facilities, and fish distribution are oriented in a traditional calendar-year format, rather than fiscal year (starting in July), to more appropriately follow the seasonal sequence of events and activities. Specific, comprehensive production data is available, upon request, from the Bureau of Fish Hatcheries, FWP, Helena. Publications, reports, and fishery management data utilized in this report are listed in the References.

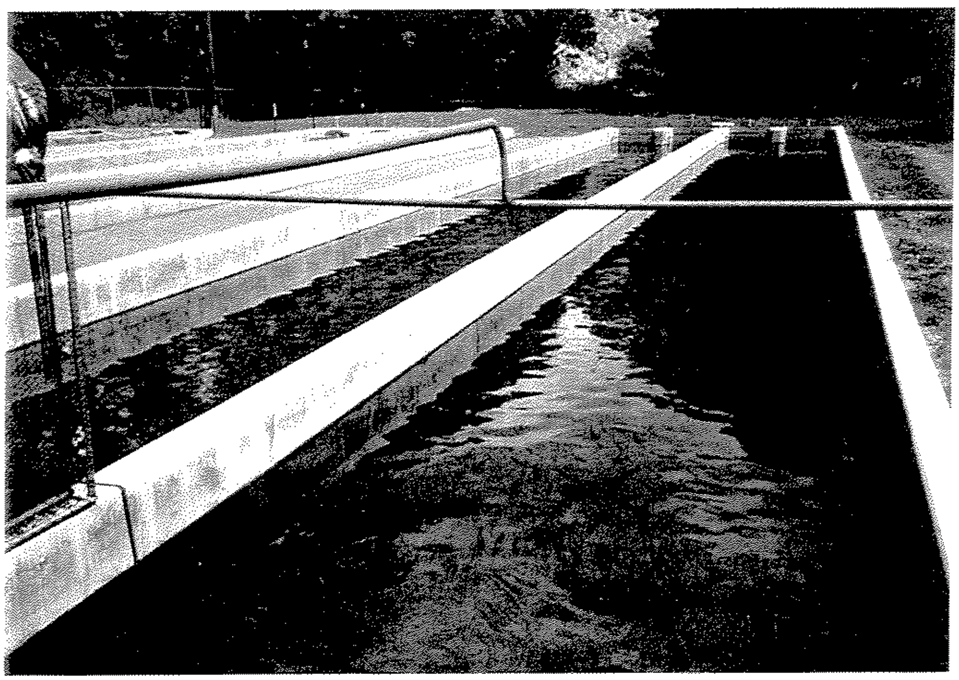


Figure 1. Troughs and tanks are typically used for early-rearing of trout and salmon fry in the hatchery building, and may involve incubating and hatching eggs at some facilities (top; Washoe Park Trout Hatchery). Generally, when fish are 2-3 inches in length, they are moved to outside raceways for rearing, until they are the appropriate size for stocking (bottom ; Washoe Park Trout Hatchery). These raceways are also used to maintain trout broodstock.

Facility Carrying Capacity

Fish population density is commonly stated as pounds of fish per cubic foot of rearing space. Pond loading is described as pounds of fish per gallon of water inflow per minute. Fish size, however, is an important variable which must be taken into account. As fish size changes, so do feeding and metabolic dynamics. Water flow and space requirements are referred to as *Flow Indexes* and *Density Indexes* as reported by Piper et al. (1982). These expressions of hatchery carrying capacity are practical and effective in estimating and reporting fish hatchery production. Flow Index relates pounds of fish per gallon per minute water flow to fish size in inches; Density Index relates pounds of fish per cubic foot of rearing unit to fish size in inches. Montana State fish hatchery personnel utilize this information through their **Hatch 2** program in planning and managing their facility's production capacity.

In the following profiles, it will be seen that available space (troughs and raceways) is a constraint on increased production in some facilities, while available water flow is a limiting factor in others. Also to be considered, is the generally applied fisheries management policy of Spring and early summer stocking to increase survival in the wild. This management practice guides and limits many hatchery operations, which is apparent in the profiles. Although economic considerations dictate that fish production be maintained as high as possible, a reduction in fish density has been reported by some fish culturists to increase fish quality and reduce the incidence of some diseases (Wedemeyer and Wood 1974). This management approach is in use in a number of Montana hatcheries, where reduction of fish density effectively controls outbreaks of parasite infestations such as *Costia* spp. Hatcheries with diversified and complex production programs, involving the rearing of a number of species and strains of fish, must ensure that these groups (and sometimes sub-lots of these groups) are maintained separately. This results in some imposed inefficiency in utilizing tanks and raceways, since the total space of the rearing unit may not be needed to provide a suitable density index for the fish.

Metabolite production (ammonia, NH_4), and the resulting un-ionized ammonia (NH_3), which is toxic to fish, is related to the amount of food fed to the fish (Piper et al. l982). At reduced water flows and heavy fish loading, un-ionized ammonia concentration can be a problem; this is not an inherent problem in Montana State hatcheries, which maintain conservative Flow Indexes. However, several hatcheries reuse water through consecutive series of raceways, and aeration of the water is required to maintain adequate oxygen concentration. Oxygen supplementation systems (i.e., Low Head Oxygenation, LHOs) can effectively be used to maintain optimum oxygen concentrations, where water is reused through series of raceways.

Hatchery Production Efficiency

The conversion of food into fish flesh is the measure commonly used to judge the efficiency of fish production in a hatchery. Overfeeding is wasteful in terms of unconsumed food, but underfeeding is just as wasteful in terms of lost production. Feed conversion data (weight of food fed/fish weight gain) was reviewed at each hatchery. The **Hatch2** computer program was used extensively by hatchery personnel to determine appropriate feeding rates, and resulted in very efficient feed utilization. Feed conversions generally ranged from 1.0 to 1.47 (1994 data); the state average feed cost was $0.43 per pound of fish weight gain. Several hatchery managers use the feeding program to control growth rate, enabling them to provide appropriate-sized fish at the time requested by fisheries resource managers. This practice avoids production of fish larger than the resource program requires, increasing production efficiency and reducing fish-rearing costs.

A brief profile of each state-operated hatchery follows:

Big Springs Trout Hatchery - Lewistown

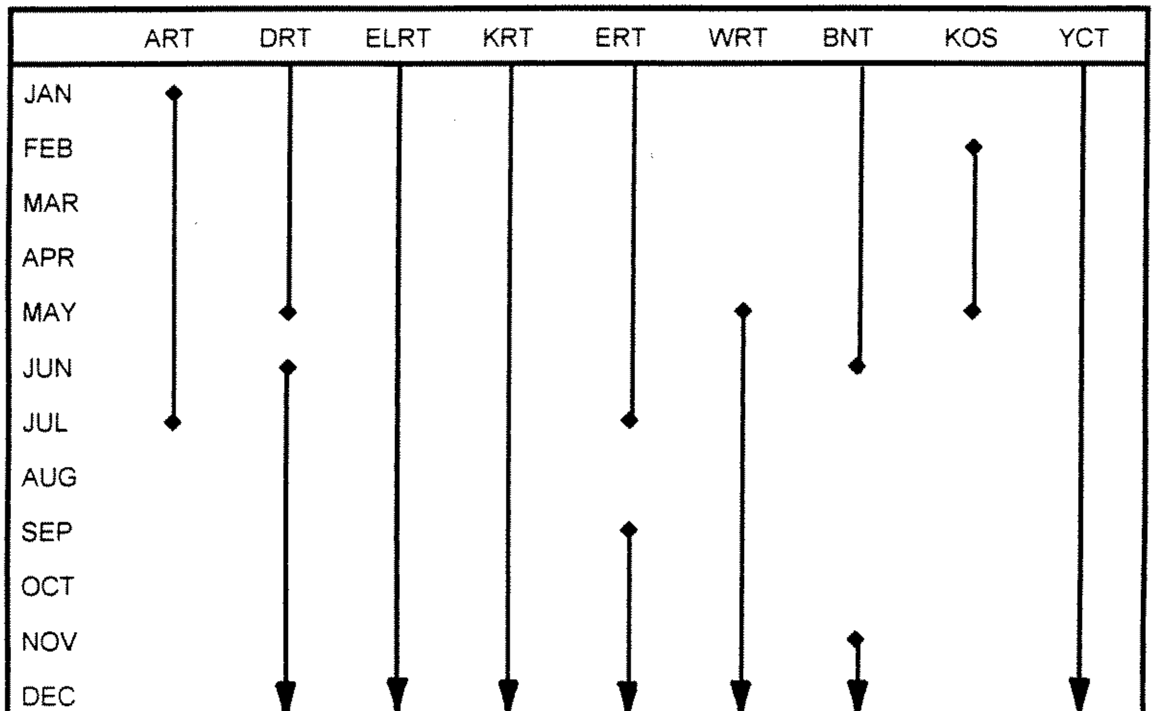
Big Springs Hatchery is located seven miles South of Lewistown and is the largest producing coldwater fish hatchery in the state's system. It can produce and distribute over 2.5 million fish of a variety of strains of rainbow, cutthroat, and brown trout, and kokanee salmon (Table 1); the number varies annually. This hatchery is composed of two separate units. One is located at the head of Big Springs Creek (upper unit), and is the location for the hatchery building and eight outside raceways. The second (lower unit) is located three-fourth mile North of the upper unit; it's water supply is the overflow from a covered spring which is the city of Lewistown's water supply. A majority of fish production occurs at the lower unit. Inside the hatchery building there are 24 31.3x3x2.3-foot concrete tanks and 20 15x2x1.3-foot fiberglass troughs. There are a total of 38 outside concrete raceways: 17 95.6x7.3x2-foot, 13 59.6x7.3x2.3-foot, and 8 60x7x2.2-foot. Typical annual use, by months, of hatchery and raceway facilities is shown in Figure 2.

Water to the upper hatchery is supplied from Upper Big Spring and Middle Big Spring. Total flow is 3,300 gal/min, with a temperature of 56 °F. The lower hatchery is supplied with water from two springs: Big Springs supplies about 14,000 gal/min of 51° F water; Lehman Spring about 5,500 gal/min of 54° F. water.

The Big Springs Hatchery has the most diversified and complex production program of the State's hatchery system, and is operated at maximum production. As mentioned earlier in this report, such hatcheries involving the rearing of a number of species and strains of fish, must ensure that these groups (and sometimes sub-lots of these groups) are maintained separately, resulting in some imposed inefficiency in utilizing tanks and raceways, since the total space of the rearing unit may not be needed to provide a suitable density index for the fish.To reduce the incidence of such fish diseases as infestations of *Costia* sp., a maximum density index of 0.3 is maintained.

A preliminary engineering report, designed for limiting hatchery vulnerability to whirling disease at Big Springs, has been developed. It prioritized improvements to protect the hatchery from whirling disease and enhance and protect the quality of water used.

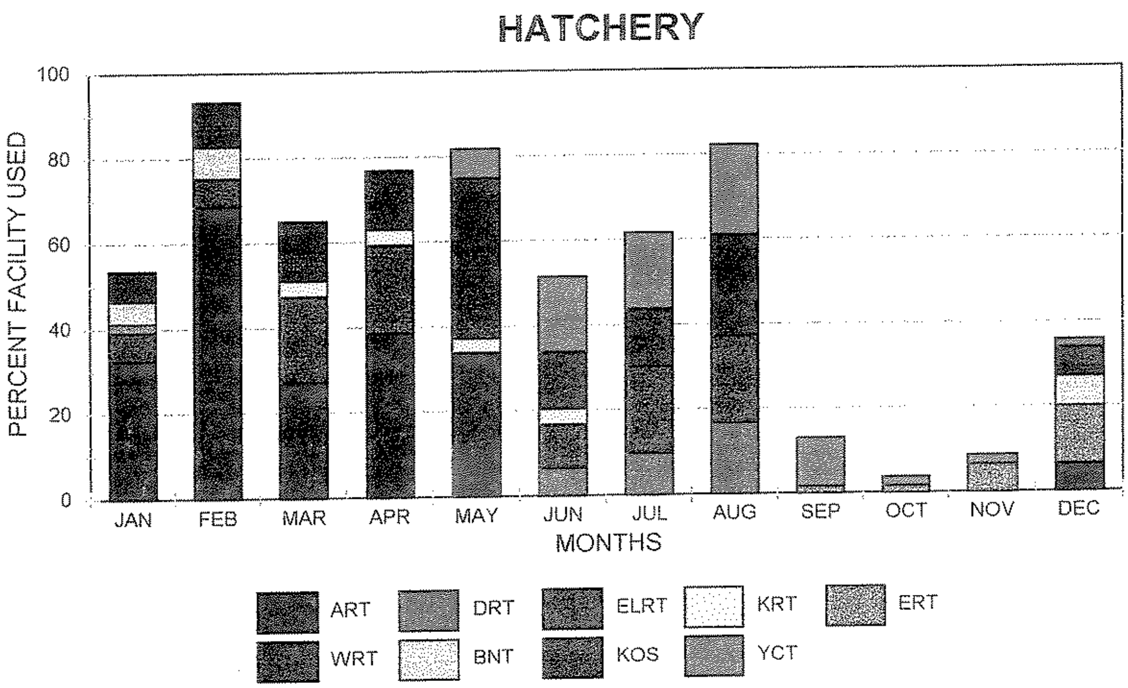
Table 1. Typical annual production schedule and resulting distribution of fish, by species or strain, reared at Big Springs Fish Hatchery, Lewistown, Montana; number of fish in thousands, fish size in inches (in parentheses). A line not terminated by a bullet (◆), indicates a carryover of fish either from or to another calendar year. **Sub-groups of fish (i.e., early and late spawning lots) within a species or strain may overlap within a calendar year and not appear as individual lots**. ART = Arlee rainbow trout, DRT = Desmet rainbow trout, ELRT = Eagle Lake rainbow trout, KRT = Kamloops rainbow trout, ERT = Erwin rainbow trout, WRT = undesigated-strain rainbow trout, BNT = brown trout, KOS = kokanee salmon, YCT = Yellowstone cutthroat trout.



FISH DISTRIBUTION

	ART	DRT	ELRT	KRT	ERT	WRT	BNT	KOS	YCT
APR 95	125 (3)	5 (6)			20(8)				
MAY 95	78 (4)	262 (6)	91(3,8)		2 (9)			100 (2)	23(6)
JUN 95	21 (4)	14 (7)	15 (4)	33 (7)	11 (9)		5 (4)	97 (3)	20 (7)
JUL 95	312 (5)		2 (4)		3(10)				
AUG 95									43(3)
SEP 95			44 (6)						
APR 96		60 (5)			23 (7)	23 (6)			
MAY 96		46 (6)	83 (3,7)		2 (8)	189 (7)			20 (6)
JUN 96		21 (6)	64 (3,7)	30 (8)	9 (9)		55 (4)		18 (7)
JUL 96			105 (8)		4 (10)				
Total	**536**	**408**	**404**	**63**	**74**	**212**	**55**	**197**	**124**

Figure 2. Typical annual percent use, by month, of hatchery building tanks and outside raceways to rear Arlee (ART), Desmet (DRT), Eagle Lake (ELRT), Kamloops (KRT), Erwin (ERT), and Undesignated (WRT) strains of rainbow trout; brown trout (BNT), kokanee salmon (KOS), and Yellowstone cutthroat trout (YCT) at Big Springs Trout Hatchery.



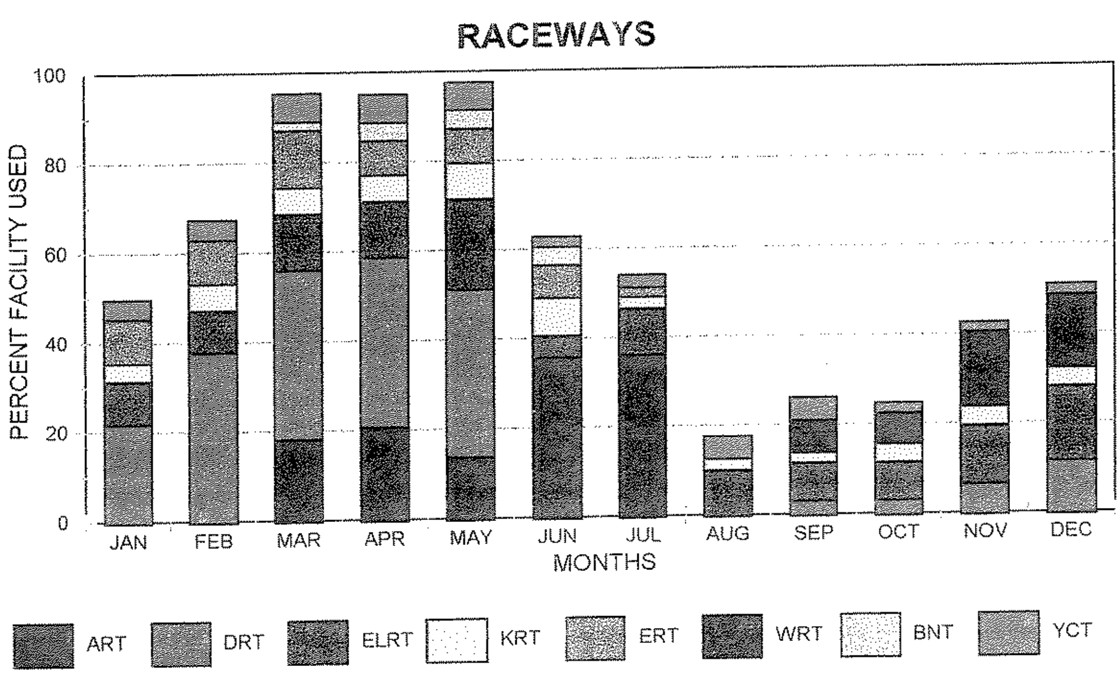
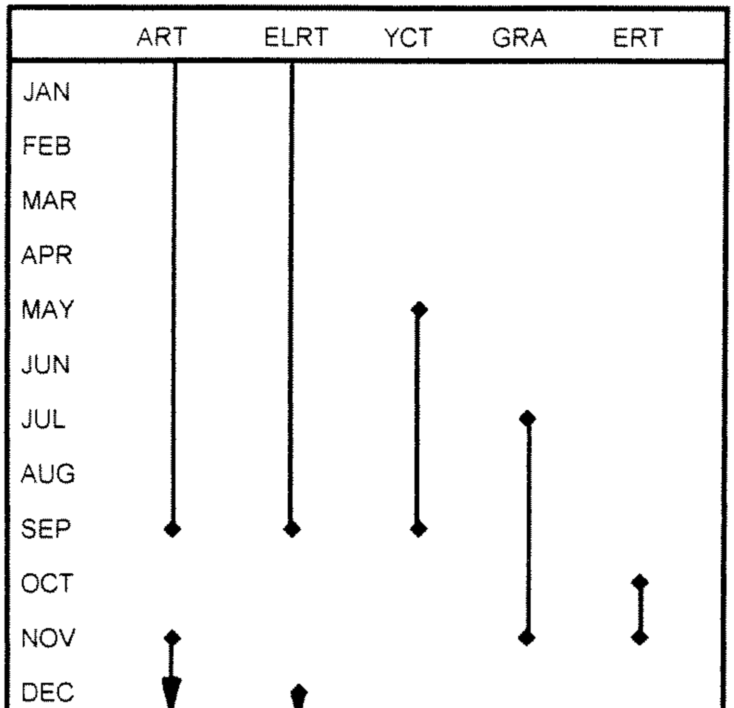


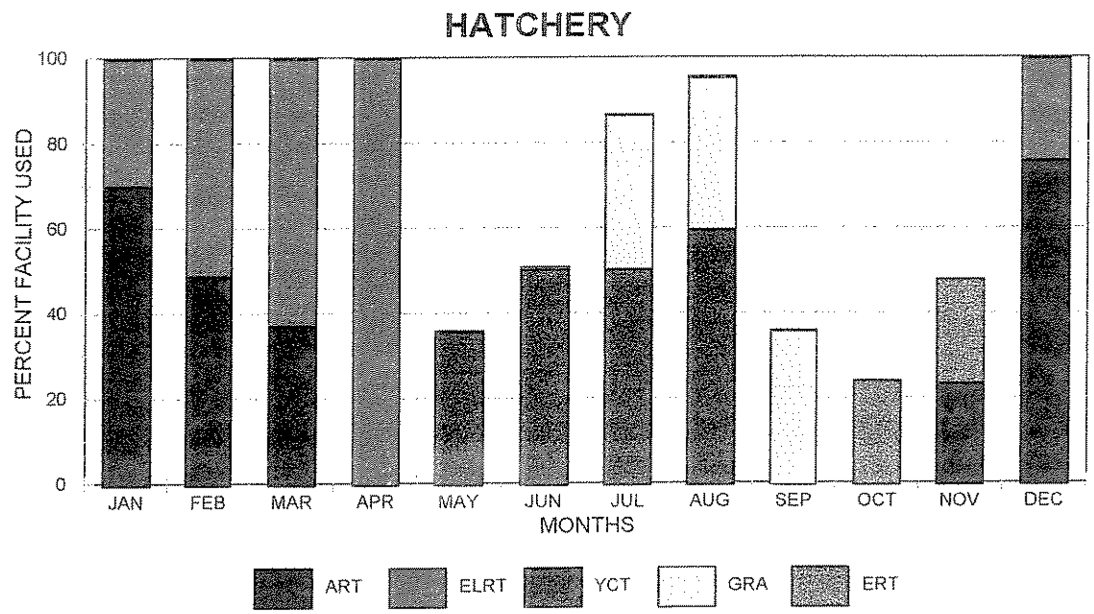
Table 2. Typical annual production schedule and resulting distribution of fish, by species or strain, reared at Bluewater Fish Hatchery, Bridger, Montana; number of fish distributed in thousands, followed by fish size in inches in parentheses. A line not terminated by a bullet (◆), indicates a carryover of fish either from or to another calendar year. Sub-groups of fish (i.e., early and late spawning lots) within a species or strain may overlap within a calendar year and not appear as individual lots. ART = Arlee rainbow trout, ELRT = Eagle Lake rainbow trout, YCT = Yellowstone cutthroat trout, GRA = grayling, ERT = Erwin rainbow trout.

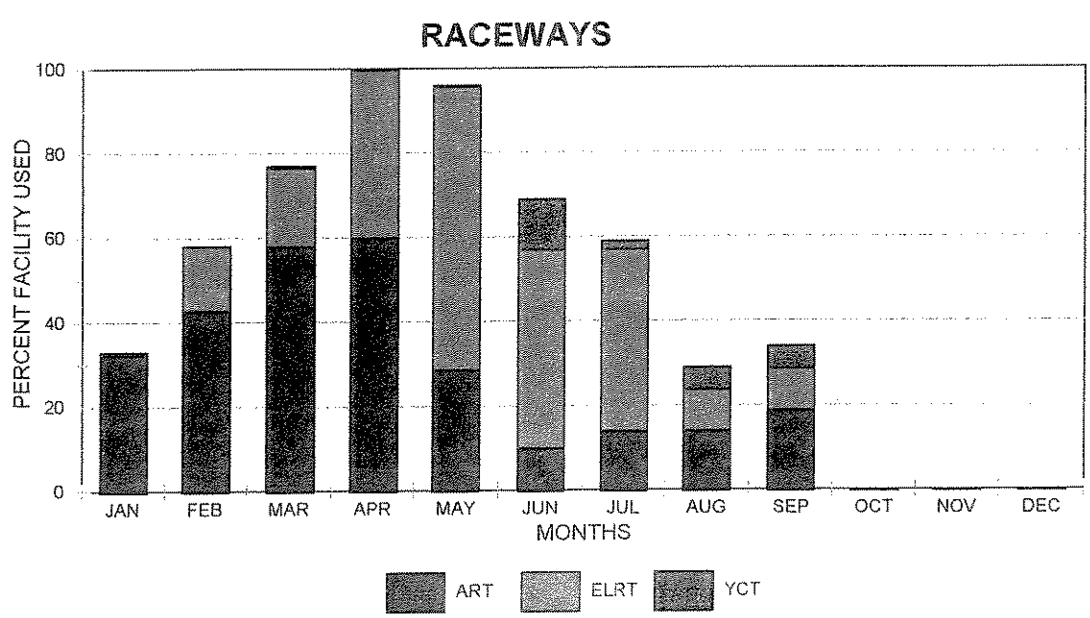


FISH DISTRIBUTION

	ART	ELRT	YCT	GRA	ERT
APR 95	32 (7)				
MAY 95	136 (7)	121 (4)			
JUN 95	81 (6) 7 (8)	200 (5)			
JUL 95	9 (9)				
AUG 95	3 (9)	18 (8)			
SEP 95	3 (11)	6 (8)			
SEP 96	4.8 (9.5))	8 (9) 4.5 (6.5)	100 (3)		
Nov 96				18 (3.5)	100 (1.3)
Total	**278.8**	**357.5**	**100.0**	**18.0**	**100.0**

Figure 3. The annual percent use, by month, of hatchery building tanks and outside raceways to rear Arlee (ART), Eagle Lake (ELRT), and Erwin (ERT) strains of rainbow trout, Yellowstone cutthroat trout (YCT), and grayling (GRA) at Bluewater Springs Trout Hatchery.





Flathead Lake Salmon Hatchery - Somers

The hatchery is located on the northwest shore of Flathead lake, and is at the center of the kokanee recovery efforts for Flathead Lake. This hatchery collects eggs from wild spawning kokanee populations, incubates them to the eyed stage, and distributes some eggs to other stations for hatching and rearing. Flathead Lake hatchery has the capability to handle over eight million salmon eggs. Available egg supplies have supported the stocking of two to four million kokanee into Flathead Lake over the past four years.

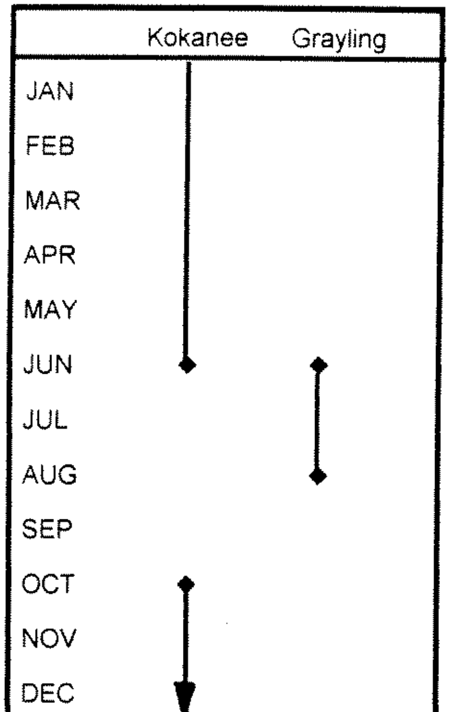
Over 1 million fingerling salmon and grayling have been raised and distributed per year (Table 3); the number varies annually. In addition, about 2.4 million eyed kokanee eggs are shipped to the Creston National Fish Hatchery and other FWP hatcheries for their salmon programs. The facility is an old hatchery (1912). The original tanks are still in use in the hatchery building: 34 14x1.2x.7-foot concrete troughs, as well as 2 each 28x4x2, 28x4x2.5 and 14x3x2.5-foot concrete tanks. There are no outside raceways at the Flathead Lake hatchery. Typical annual use of the hatchery facilities is shown in Figure 4.

Spring water is used for incubation and rearing of fish until June, when water flows are low and fish loading is greatest; lake water is then used. However in summer when water temperatures rise, fish may develop Columnaris disease.

The estimated spring water flow is shown in Figure 4. With full development of the spring above the hatchery, which is currently in progress, increased fish production is possible. A new pipeline will carry water from the spring to the hatchery. This will provide a 52° F water flow of approximately 700 gal/min; water rights are for 1200 gal/min. The additional spring water will allow faster growth of their fish, and may allow them to raise fish, normally reared at Big Springs Hatchery, Lewistown, to a larger size for planting in Lake Mary Ronan.

Development of a multiple-intake pipeline from the lake would provide the option for both a variable and consistent temperature for use in the hatchery. However, without ultraviolet light or ozone disinfection of the lake water, the potential exists for diseases to occur.

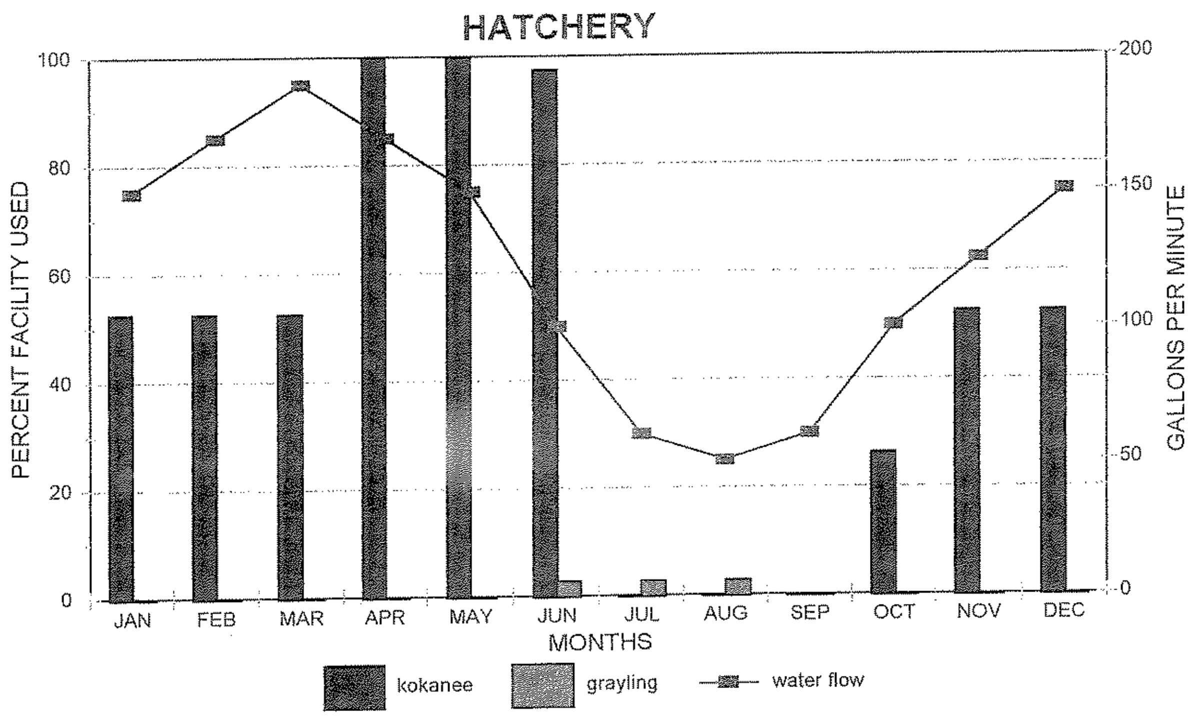
Table 3.Typical annual production schedule and resulting distribution of fish, by species or strain, reared at Flathead Lake Salmon Hatchery, Somers, Montana; number of fish distributed in thousands, followed by fish size in inches in parentheses. A line not terminated by a bullet (◆), indicates a carryover of fish either from or to another calendar year.



FISH DISTRIBUTION

	Kokanee	Grayling
Jul 95		42.2 (0.7)
Aug 95		82.5 (0.8)
Apr 96	219 (1.1)	
May 96	787 (1.6)	
Jun 96	95 (1.9)	
Total	**1101**	**124.7**

Figure 4. The annual percent use, by month, of hatchery building tanks to rear kokanee salmon (KOS) and grayling (GRA) at Flathead Lake Salmon Hatchery.The estimated monthly water flow available from springs is also shown.



Giant Springs Trout Hatchery - Great Falls

Giant Springs Hatchery is located adjacent to Heritage Park near Great Falls. The water supply is from one of the large springs arising in the area, and is the headwaters of the world's shortest river, the Roe River. The water temperature is 54°F; water flow to the hatchery is 650-700 gal/min, outside facilities receive 8,400 gal/min. Oxygen concentration of incoming water is only 6.7ppm (66% saturation), which limits fish loading. Introduction of supplemental oxygen through aeration or oxygen injection would increase the hatchery carrying capacity. A study was conducted at Giant Springs investigating the use of an oxygen-injection system (Dwyer and Peterson 1993), and an aeration system is planned that will almost double fish production.

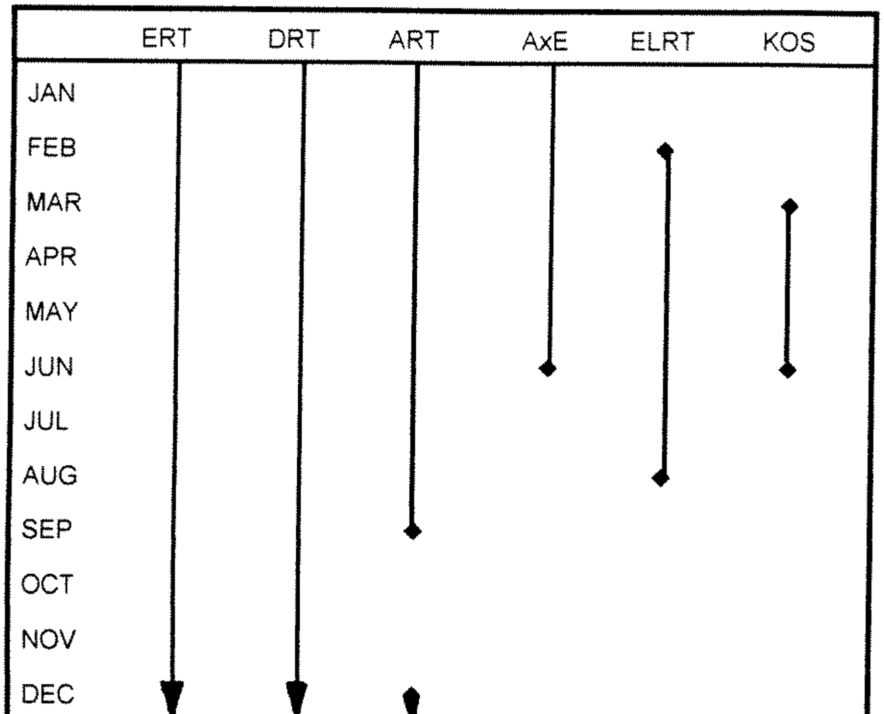
Up to 1 million fingerlings and catchable trout have been raised and distributed per year (Table 4); the number varies annually. Currently, Erwin, Arlee, Desmet, Eagle Lake, and Arlee x Eagle Lake strains of rainbow trout are raised, along with kokanee salmon. The Giant Springs Hatchery has a diversified and complex production program, and is operated at maximum production.

The hatchery building contains 20 16x1.2x0.7-foot and 21 16x2x1.6-foot fiberglass troughs. There are 24 64x8x2.3-foot outside concrete raceways, and one 30-foot diameter concrete tank. Typical annual use of hatchery and raceway facilities is shown in Figure 5. Increased fish production in the outside raceways is possible, if additional oxygen is provided through aeration, and the appropriate species and strains of fish are compatible with the current program. However, this may require expansion of the hatchery building, as well as increasing the number of outside raceways. Increased production in the hatchery building could be accomplished, if eggs from appropriate species and strains of fish could be distributed more evenly over the calendar year, in contrast to being concentrated to a three to four month period.

To reduce the incidence of some fish diseases, fish are reared to a maximum density index of 0.3 inside the hatchery building until they are 1.5 inches in length, then the index can be increased to 0.8; this effectively controls bacterial gill disease.

A preliminary engineering report, designed for limiting hatchery vulnerability to whirling disease at Giant Springs, has been developed. It prioritized improvements to protect the hatchery from whirling disease and enhance and protect the quality of water used.

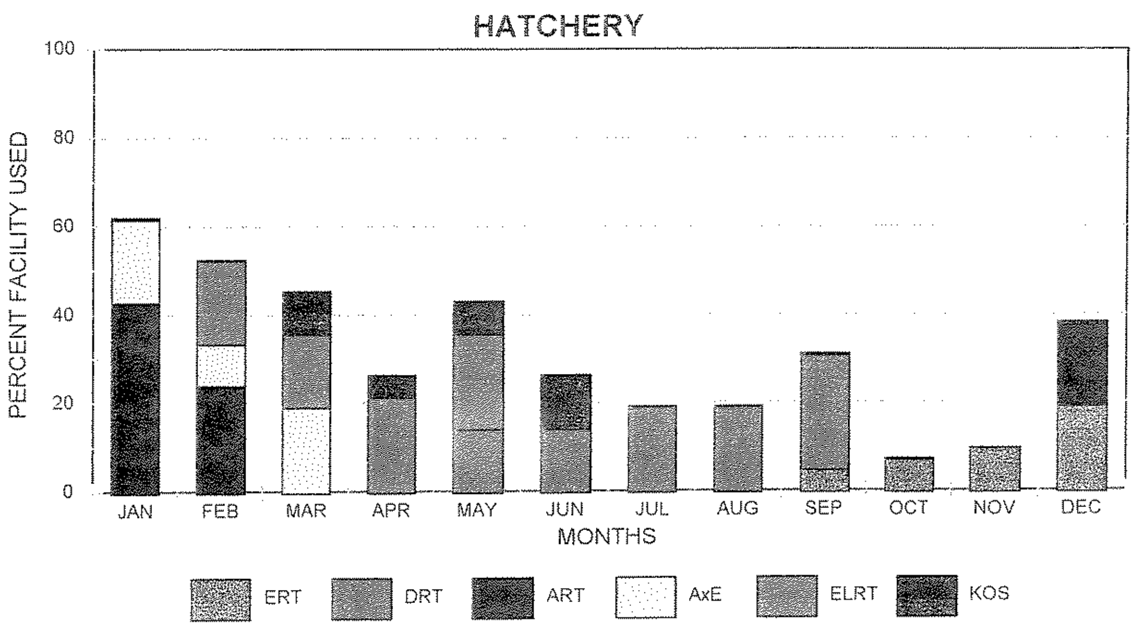
Table 4. Typical annual production schedule and resulting distribution of fish, by species or strain, reared at Giant Springs Fish Hatchery, Great Falls, Montana; number of fish distributed in thousands, followed by fish size in inches in parentheses. A line not terminated by a bullet (◆), indicates a carryover of fish either from or to another calendar year. **Sub-groups of fish (i.e., early and late spawning lots) within a species or strain may overlap within a calendar year and not appear as individual lots**. ERT = Erwin strain rainbow trout, DRT = Desmet strain rainbow trout, ART = Arlee strain rainbow trout, AxE = Arlee x Eagle Lake strains, ELRT = Eagle Lake rainbow trout, KOS = kokanee salmon.

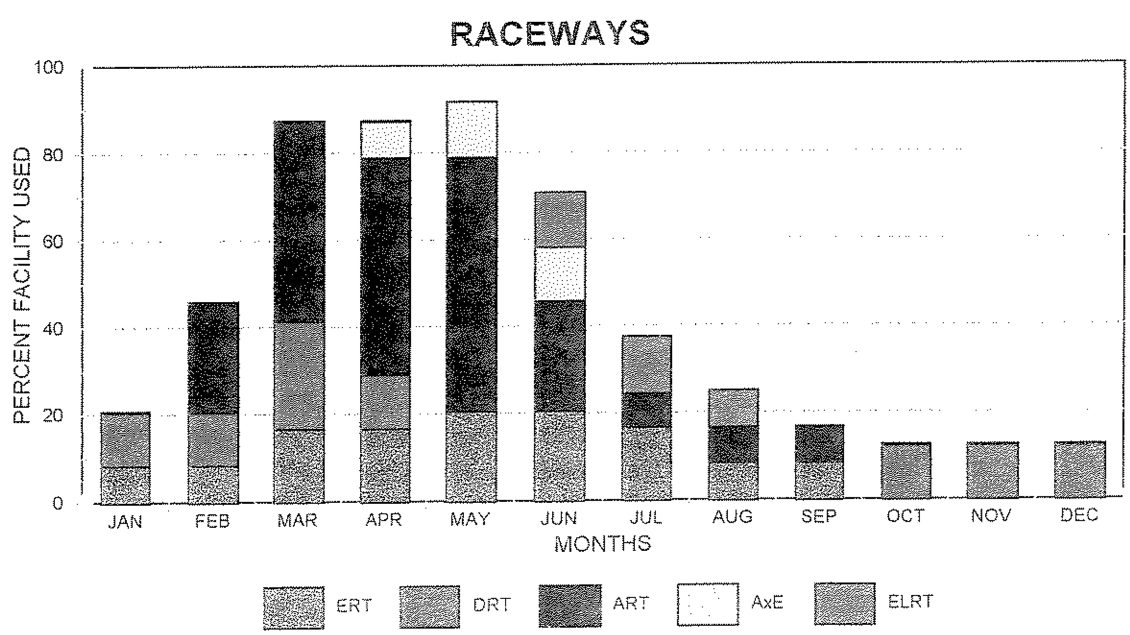


Fish Distribution

	ERT	DRT	ART	AxE	ELRT	KOS
Apr 95			32 (2-3) 11.3 (4-5)			
May 95		34 (5.7)	177 (4-5)		26.9 (7.0)	
Jun 95	4.4 (6.5)		142 (4-5)	106 (4)	2.7 (8.0)	42.7 (2.6)
Jul 95	12.5 (7-8)		124 (5-7)	24.5 (4)	75.5 (4.0)	
Aug 95	6.1 (7-8)		4.7 (7-8)		31 (4.0)	
Sep 95			25.4 (7-8)			
Total	**23.0**	**34.0**	**516.4**	**130.5**	**136.1**	**42.7**

Figure 5. Typical annual percent use, by month, of hatchery building tanks and outside raceways to rear Erwin (ERT), Desmet (DRT), Arlee (ART), Arlee x Eagle Lake (AxE), Eagle Lake (ELRT) strains of rainbow trout, and kokanee salmon (KOS) at Giant Springs Trout Hatchery.





Jocko River Trout Hatchery - Arlee

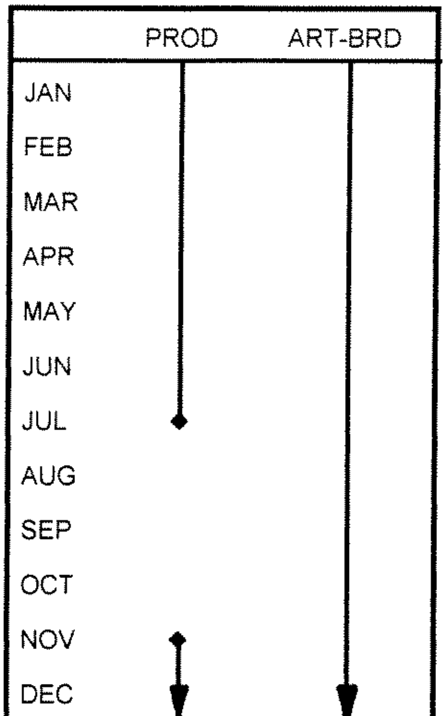
Jocko Hatchery is located one-fourth mile North of Arlee, Montana, and has been a broodstock station since the early 1950s; it produces over five million eggs annually. Additionally, fingerling and catchable trout have been raised and distributed each year (Table 5); the number varies annually. Broodstock are planted from all year-classes, to provide the larger, catchable-size fish. The hatchery is dedicated as a broodstock station, and no other species of trout are reared there. The Arlee strain of rainbow trout is used extensively in FWP management of lakes and reservoirs. Eggs are shipped to most rainbow trout hatcheries throughout the state, where they are raised for stocking into lakes and reservoirs. In addition, the U.S. Fish and Wildlife Service maintains the Arlee strain as broodstock, and ships eggs to their hatcheries throughout the country. When available, excess eggs are sold to private growers within the state of Montana each year.

The hatchery building contains 8 32x4.5x2.1-foot concrete tanks and 17 16x1.2x1.1-foot fiberglass troughs available for fish rearing. There are 5 100x10x5.4-foot outside concrete raceways used for broodstock only, and 9 100x10x4-foot raceways available for fish production. Typical annual use of hatchery and raceway facilities is shown in Figure 6.

Water temperatures may vary from 43-50° F, and are usually coldest in late winter and early spring. Water flows vary considerably throughout the year, usually lowest in late winter and highest in August (Figure 6). Water is sometimes reused from the upper production raceways to the lower broodstock units, and water management varies with annual fluctuation in available water. Water cannot be reused from the hatchery building, so fish are moved to outside raceways as soon as possible to conserve water in the Spring. Unfortunately, the low water flow period occurs when fish loading is at its peak. Early fish distribution helps alleviate this problem.

A broodstock management plan is in place at the Jocko River hatchery. Genetic monitoring is performed each year at the University of Montana Population Genetics Laboratory by Dr. Robb Leary. Evaluation of the broodstock program and genetic analysis are presented each fall during the broodstock committee meetings.

Table 5. Typical annual production schedule and resulting distribution of fish, by species or strain, reared at Jocko River Trout Hatchery, Arlee, Montana; number of fish distributed in thousands, followed by fish size in inches in parentheses. A line not terminated by a bullet (◆), indicates a carryover of fish either from or to another calendar year. **Sub-groups of fish (i.e., early and late spawning lots) within a species or strain may overlap within a calendar year and not appear as individual lots.** PROD = production groups, Arlee rainbow trout; ART-BRD = Arlee rainbow trout broodstock, all age groups.

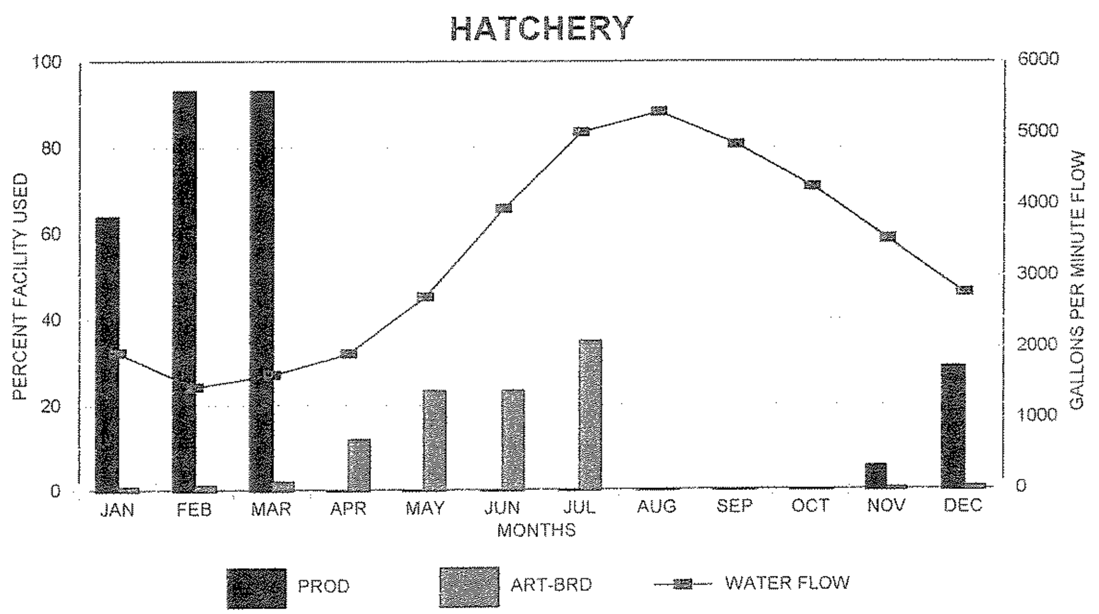


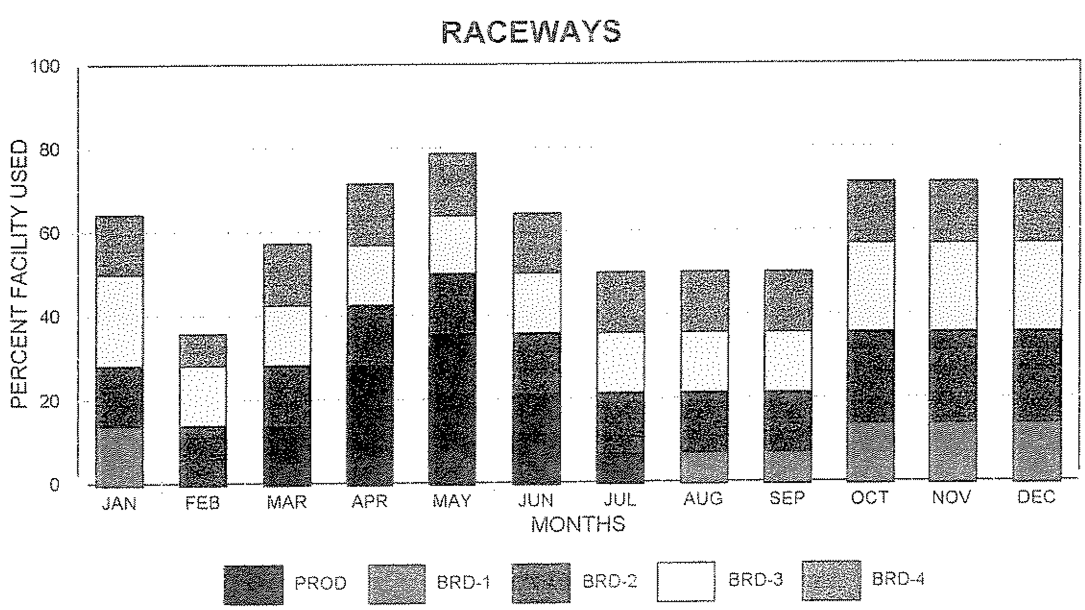
FISH DISTRIBUTION

	PROD	ART-BRD
NOV 95		0.3 (20-25)
DEC 95		0.9 (15-26)
FEB 96		1.7 (9.0)
MAY 96	71.7 (3.5)	2.0 (11.0)
JUN 96	105 (4.5)	2.2 (11.45)
AUG 96	6 (5.0)[a]	0.07 (12.5)
Total	**182.7**	**7.17**

[a]normally stocked in July

Figure 6. Typical annual percent use, by month, of hatchery building tanks and outside raceways to maintain various year-classes of Arlee strain rainbow trout broodstock (BRD followed by year class, ART-BRD = less than one year old), and rear Arlee-strain production fish (PROD) for distribution, at Jocko River Trout Hatchery. Available water flow for the station is shown in gallons per minute on the hatchery building graph.





Miles City Hatchery - Miles City

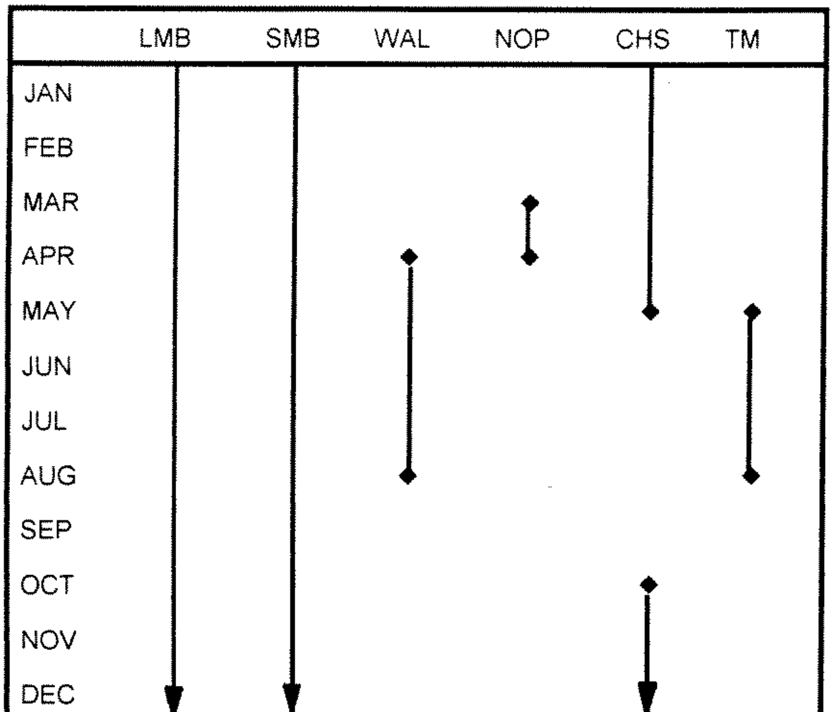
Miles City Hatchery is located between I-94 and the city of Miles City and is the only warmwater hatchery in the state hatchery system. Its production includes walleye, northern pike, largemouth and smallmouth bass, tiger muskie. In 1990, over 40 million fry and fingerling were reared and distributed to support fishery management of warmwater species (Table 6).

Water for the hatchery is pumped from the Yellowstone River to a hatchery reservoir, which serves as a setttling basin to remove silt. This water is used to fill 45 earthen rearing ponds, measuring 52 acres, and is also the water supply to the hatchery building,150-200 gal/min of filtered water, heated to 45°F during the winter, when river water temperatures are extremely low. Both lake trout and chinook salmon have been reared in the hatchery building, using heated water. A serious limiting factor to intensive production of fish in troughs or tanks is the small water flow available in the hatchery.

The hatchery building contains 16 12x3x2.5-foot concrete tanks, 43 10x3x1.6-foot fiberglass troughs, and six 6-foot diameter x 3-foot deep tanks. Outdoors, there are eight 70x7x4-foot concrete raceways, also supplied with reservoir water. Typical annual use of hatchery building and earthen pond facilities is shown in Figure 7. Note that adult largemouth and smallmouth bass broodstock are maintained in the hatchery building for eight months of the year; spawning and summer maintenance occurs in earthen ponds (19% of the station pond space for each species), during the period May through August. Future broodstock (as young -of-the-year) are reared in the hatchery and fed a formulated trout feed; forage fish are also provided as food.

There is a potential conflict for pond space in the Spring, if walleye production requires a major portion of the space, when pond water temperatures are suitable for bass spawning activity (Figure 7; May). Walleye fingerlings (4-6 inches) have been reared intensively in hatchery troughs, and fed a formulated trout diet. This practice can reduce some of the pond requirement for walleye. Early-spawned walleye eggs, obtained from the State of Colorado, would allow early harvest of fingerlings to provide pond space for bass spawning activity.

Table 6. Typical annual production schedule and resulting distribution of fish, by species or strain, reared at Miles City Fish Hatchery, Miles City, Montana; number of fish distributed in thousands, followed by fish size in inches in parentheses. A line not terminated by a bullet (◆), indicates a carryover of fish either from or to another calendar year.year.**Sub-groups of fish (i.e., early and late spawning lots) within a species or strain may overlap within a calendar year and not appear as individual lots.** LMB = largemouth bass, SMB = smallmouth bass, WAL = walleye, NOP = northern pike, CHS = chinook salmon, TM = tiger muskie.

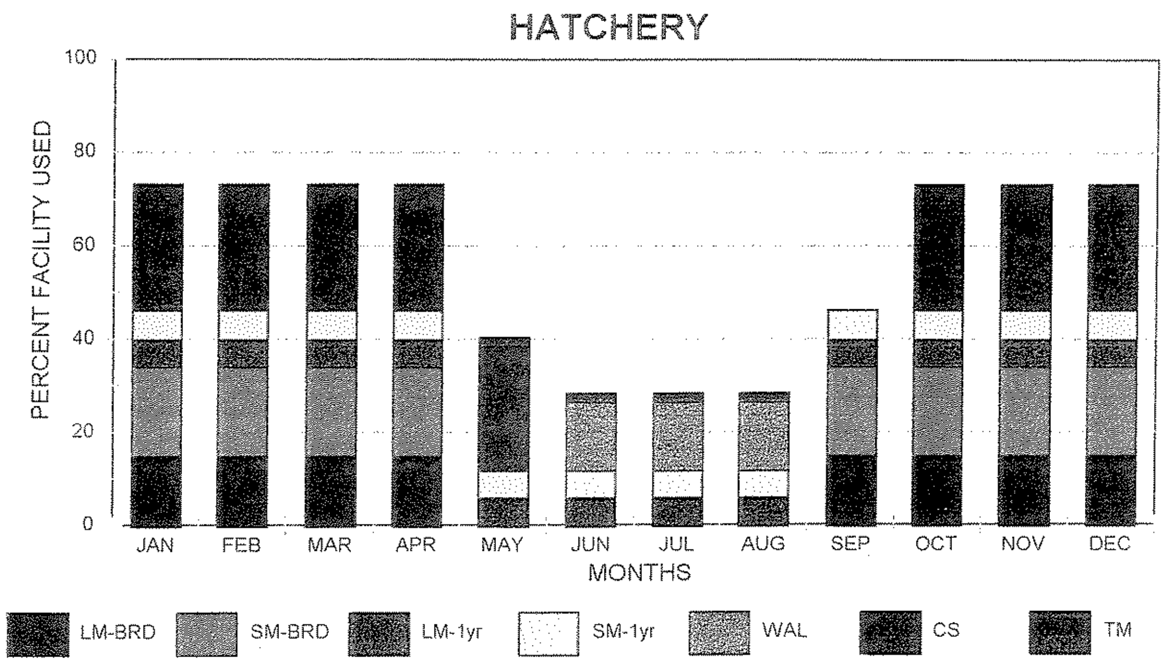


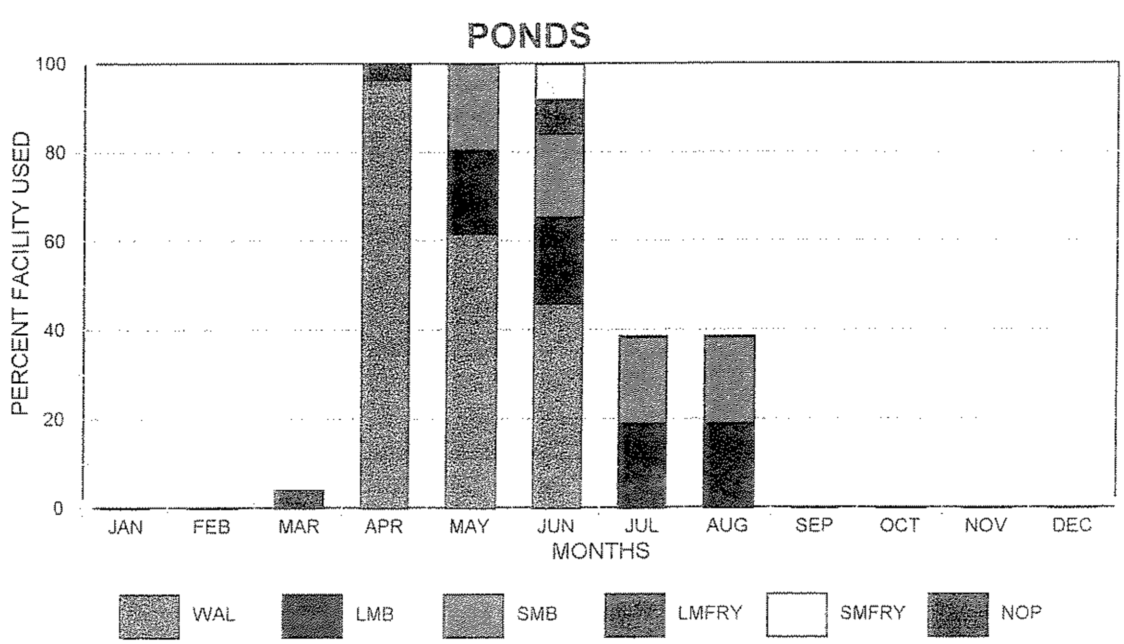
FISH DISTRIBUTION

	LMB	SMB	WAL	NOP	CHS	TM
May 95			29 [a] fry	400 fry		
Jun 95	269 (1-2)	79 (1-2)	3 [a] (1-2)	108 (1-2)		
Aug 95			23 (4-6)			
May 97					130 (3)	
Aug 97						5 (1-2)[b]
Total	**269**	**79**	**32.02[a]**	**508**	**130**	**5[b]**

[a] millions
[b] scheduled for 1997 stocking.

Figure 7. Typical annual percent use, by month, of hatchery building tanks and outside ponds to rear largemouth bass (LMB), smallmouth (SMB), walleye (WAL), northern pike (NOP), chinook salmon (CHS), and tiger muskies (TM) at Miles City Fish Hatchery.





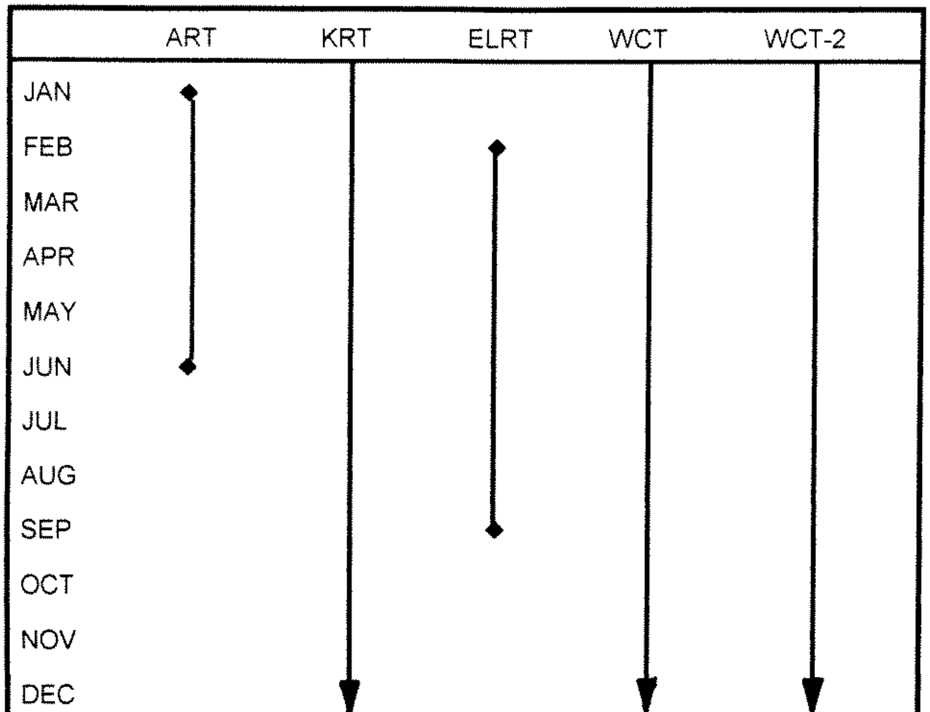
Murray Springs Hatchery - Eureka

Murray Springs Hatchery is located seven miles northwest of Eureka and is owned and funded by the U.S. Army Corp of Engineers, and operated by FWP. It was built as a mitigation hatchery to offset the loss of fishery habitat when Lake Koocanusa was impounded. Up to 1.2 million fingerling and catchable trout have been raised and distributed per year (Table 7); the number varies annually. The hatchery is primarily responsible for raising Westslope cutthroat trout for Lake Koocanusa, but Arlee, Kamloops, and Eagle Lake strains of rainbow trout are also produced. Some Westslope cutthroat are over-wintered in a two-year program, to produce larger-sized fish for planting (Table 7); most fish production is utilized in and around Lake Koocanusa.

The hatchery building contains 16 12x3.5x1.8-foot concrete tanks, each with 124 cubic feet of rearing space. There are ten 80x8x2.25-foot (1440 cubic feet) and six 55x8x3.75-foot (1600 cubic feet) outdoor concrete raceways. Typical annual use of hatchery building and raceway facilities is shown in Figure 8.

Murray springs has a constant 52°F temperature, and flows fluctuate from 3,000 to 6,500 gal/min; low water flows are during April and May. Water is pumped from an underground spring, using five electric pumps: one 500 gal/min, two 1,000 gal/min, and two 2,000 gal/min. Generally, 4,500 gal/min waterflow is provided to the hatchery; 3,700 gal/min is supplied to the 10 80-foot long raceways during December to June. Pumping costs are approximately $1,000 per week; electricity is purchased through an arrangement between Bonneville Power Adminstration, U.S. Army Corp of Engineers, and Lincoln Electric Cooperative. The cost contributes significantly to the higher rearing cost of fish.

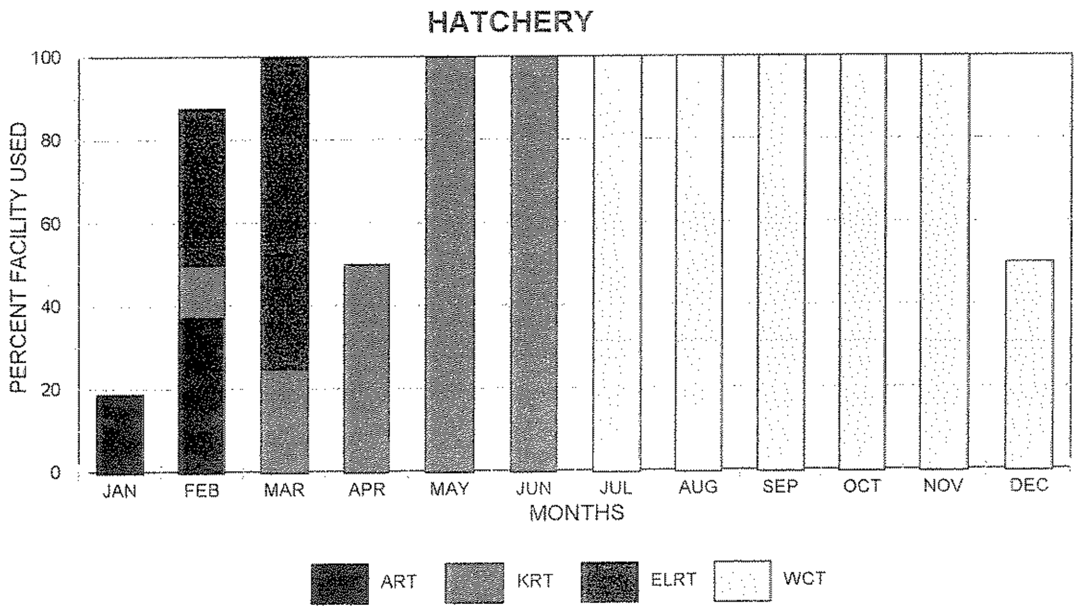
Table 7. Typical annual production schedule and resulting distribution of fish, by species or strain, reared at Murray Springs Fish Hatchery, Eureka, Montana; number of fish distributed in thousands, followed by fish size in inches in parentheses. A line not terminated by a bullet (◆), indicates a carryover of fish either from or to another calendar year. **Sub-groups of fish (i.e., early and late spawning lots) within a species or strain may overlap within a calendar year and not appear as individual lots**. ART = Arlee strain rainbow trout, KRT = Kamloops strain rainbow trout, ELRT = Eagle Lake strain rainbow trout, WCT = first-year groups, Westslope cutthroat trout, WCT-2 = Westslope cutthroat trout 2-year-old production.

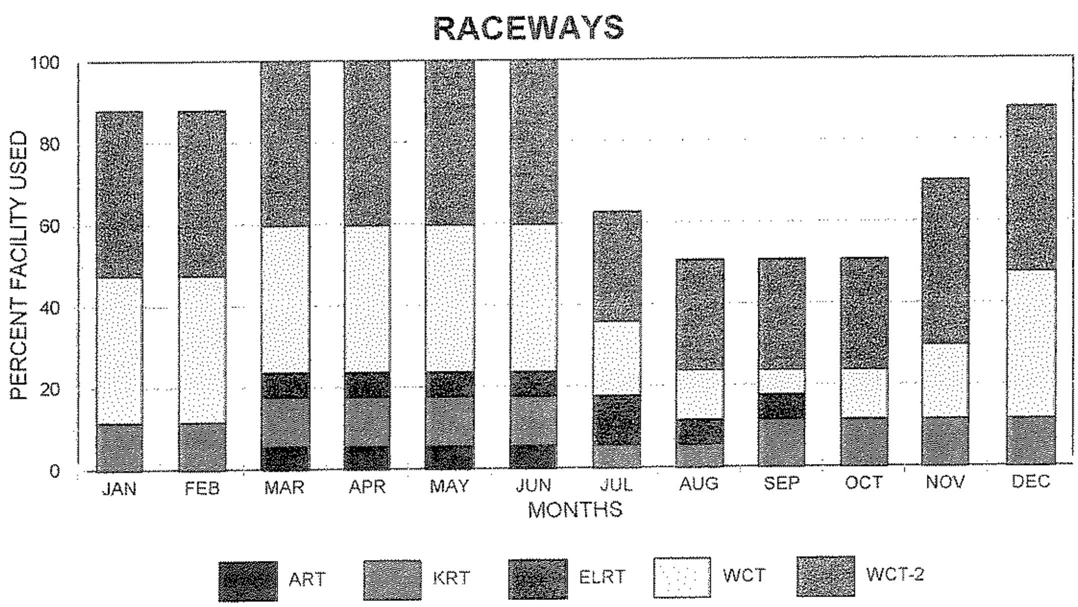


Fish Distribution

	ART	KRT	ELRT	WCT	WCT-2
Apr 95	52.5 (3.1)	10.1 (6.3)			
May 95	31.8 (3.7)	8.9 (6.6)	36.7 (2.3)	144.6 (3.5)	29.9 (7.5)
Jun 95		16.5 (7.0)	2.5 (2.4)	81.7 (4.0)	0.23 (8+) 50.80 (7.5)
Jul 95				23.8 (4.0)	
Aug 95		5.8 (3.0)	75.6 (3.7)	105.7 (1.3)	
Sep 95		45.9 (3.3)	35.8 (3.8)	2.0 (2.1)	
Total	**84.3**	**87.2**	**150.6**	**357.8**	**80.93**

Figure 8. Typical annual percent use, by month, of hatchery building tanks and outside raceways to rear Arlee strain (ART), Kamloops strain (KRT), and Eagle Lake strain (ELRT) rainbow trout; Westslope cutthroat trout first-year production (WCT) and two-year-old production (WCT-2) at Murray Springs Trout Hatchery.





Washoe Park Trout Hatchery - Anaconda

This is the first fish hatchery operated by FWP and is located within the city of Anaconda, adjacent to Washoe Park. It began operations in 1908, with the collection and incubation of large numbers of eggs from Georgetown Lake and Harrison reservoir. Eyed eggs were shipped to other hatcheries in the state for hatching, rearing and stocking.

The hatchery is dedicated as a broodstock station, and is responsible for the management of a wild-based, genetically diverse, westslope cutthroat trout broodstock. *The current broodstock is derived from a collection of fluvial and adfluvial fish from 14 tributaries of Hungry Horse and Noxon Reservoirs.* Offspring from these broodstock can survive and spawn in the wild in a variety of habitats. The station receives requests for approximately 1.5 million eggs each year. Westslope broodstock are spawned from mid-May through mid-July. In addition, eggs are collected from Desmet strain rainbow trout in Harrison Reservoir, Eagle Lake strain of rainbows in Clark Canyon Reservoir, and undesignated wild rainbows in Canyon Ferry Reservoir. The eggs are incubated to the eyed stage in a quarantine facility; all eggs incubated at the hatchery from species other than Westslope cutthroat (and most of the Westslope cutthroat eggs) are distributed to other state hatcheries for rearing. Fish distribution includes150,000 3-4 inch fingerling Westslope cutthroat planted from May through July; 10,000 1.5 inch fry planted in August, along with surplus four-year-old male and five-year-old female broodstock (Table 8). In addition 20,000 eyed eggs are planted in June and July; the numbers can vary annually.

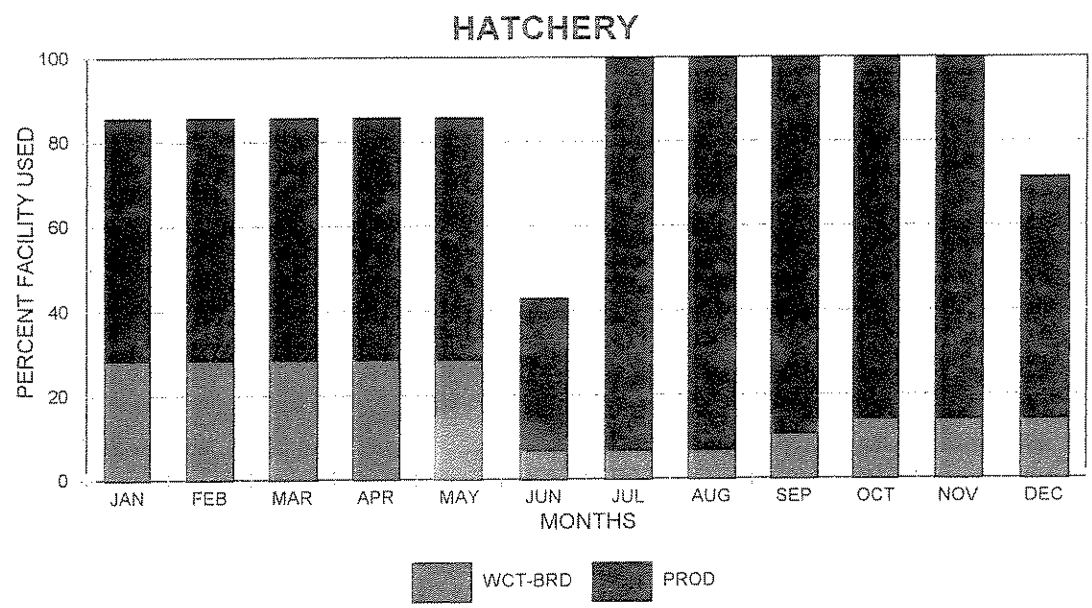
There are several sources of water for the Washoe Park Hatchery: (1) approximately 400 gal/min, 56°Fspring water; (2) 2500 gal/min, 46°F gravity-flow water collection system; and up to 2355 gal/min creek water. Creek water is no longer used, due to the discovery of whirling disease in areas of Montana.

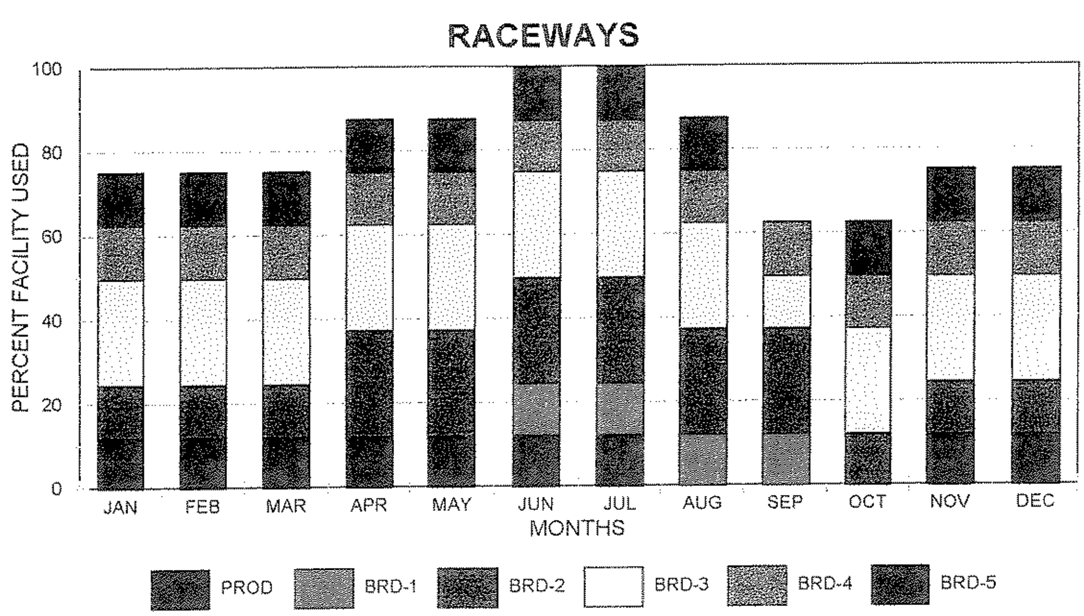
The hatchery building contains 28 2x16-foot troughs, with 37 cubic feet of rearing space and 20-30 gal/min water flow each. There are 8 10x100-foot outdoor concrete raceways, with 2850 cubic feet of rearing space and 250-500 gal/min water flow each. Typical annual use of the hatchery building and raceway faciliites is shown in Figure 9. Fish densities are maintained below a density index of 0.3 to reduce problems with *Costia* sp. in fry and fingerlings.

Table 8. Typical annual production schedule and resulting distribution of fish, by species or strain, reared at Washoe Park State Fish Hatchery, Anaconda, Montana; number of fish distributed in thousands, followed by fish size in inches in parentheses. A line not terminated by a bullet (◆), indicates a carryover of fish either from or to another calendar year. **Sub-groups of fish (i.e., early and late spawning lots) within a species or strain may overlap within a calendar year and not appear as individual lots**. PROD = Westslope cutthroat trout production lots, WCT-BRD = Westslope cutthroat trout broodfish, all age groups.

	PROD	WCT-BRD
JAN		
FEB		
MAR		
APR		
MAY		
JUN		
JUL		
AUG		
SEP		
OCT		
NOV		
DEC		
Fish Distribution		
May 95	50 (3.5)	
Jun 95	50 (3.6)	
Jul 95	50 (3.7)	
Aug 95	10 (1.5)	3 (10) 1 (14)
Total	**160**	**4**

Figure 9. Typical annual percent use, by month, of hatchery building tanks and outside raceways to maintain various year-classes of Westslope cutthroat trout broodstock (BRD followed by year class,WCT-BRD = less than one year old), and rear Westslope cutthroat production fish (PROD) for distribution, at Washoe Park Trout Hatchery.





Yellowstone River Trout Hatchery - Big Timber

The Yellowstone River Hatchery is located adjacent to the town of Big Timber, sharing its northern boundary. Water to the hatchery is supplied from springs at a constant 52°F temperature; flows vary from 400 to 700 gal/min (Figure 10). This can be a significant limiting factor on the number of production fish raised, since it is essential that adequate water flows are provided for the broodstock raceways. It is responsible for the management of the McBride strain Yellowstone cutthroat trout broodstock. This strain is a species of special concern in Montana. Approximately 1.5 million eggs are produced annually. The hatchery is dedicated as a broodstock station, and no other species of trout are reared there. Production of cutthroat fingerlings for planting in lakes is also an important part of the hatchery program. Fish are used successfully in a variety of habitats from high mountain lakes to low lying lakes and reservoirs. A typical annual production schedule, with resulting distribution of fish, is presented in Table 9.

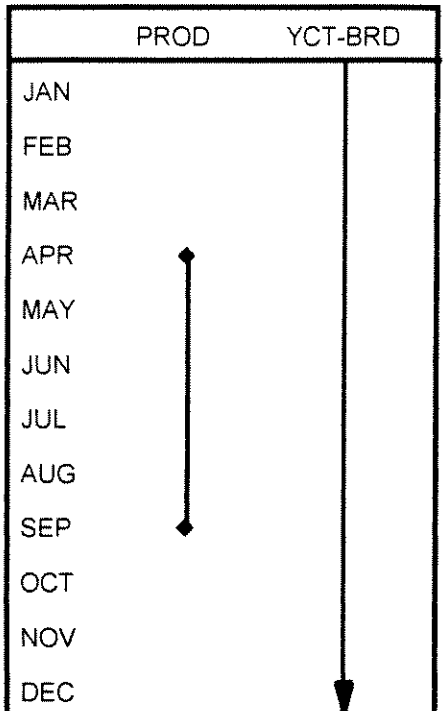
The broodstock is wild-based, with periodic crossing of wild gametes from McBride Lake, Yellowstone National Park. Approximately 2% of the annual egg production is used for future broodstock selection. The hatchery manager works closely with the FWP broodstock committee to insure genetic diversity of the broodstocks. A detailed spawning scheme is followed during spawning of fish. Each year tissues from 50 fish are analyzed by electrophoresis to insure that genetic purity and diversity is maintained.

The hatchery building contains 5 31x2.5x2.8 and 8 31x2.5x1.8-foot concrete tanks, and 5 15.4x1.2x0.75-foot fiberglass tanks. There are 6 100x6x3.5-foot outside concrete raceways. Representative annual use of hatchery and raceway facilities is shown in Figure 10.

Excess eggs are provided for research and other innovative Department programs. Occasionally eggs are sold to a private grower located on the Yellowstone River, who sells cutthroat trout to private pond holders in the Yellowstone drainage, where rainbow trout are not allowed to be stocked.

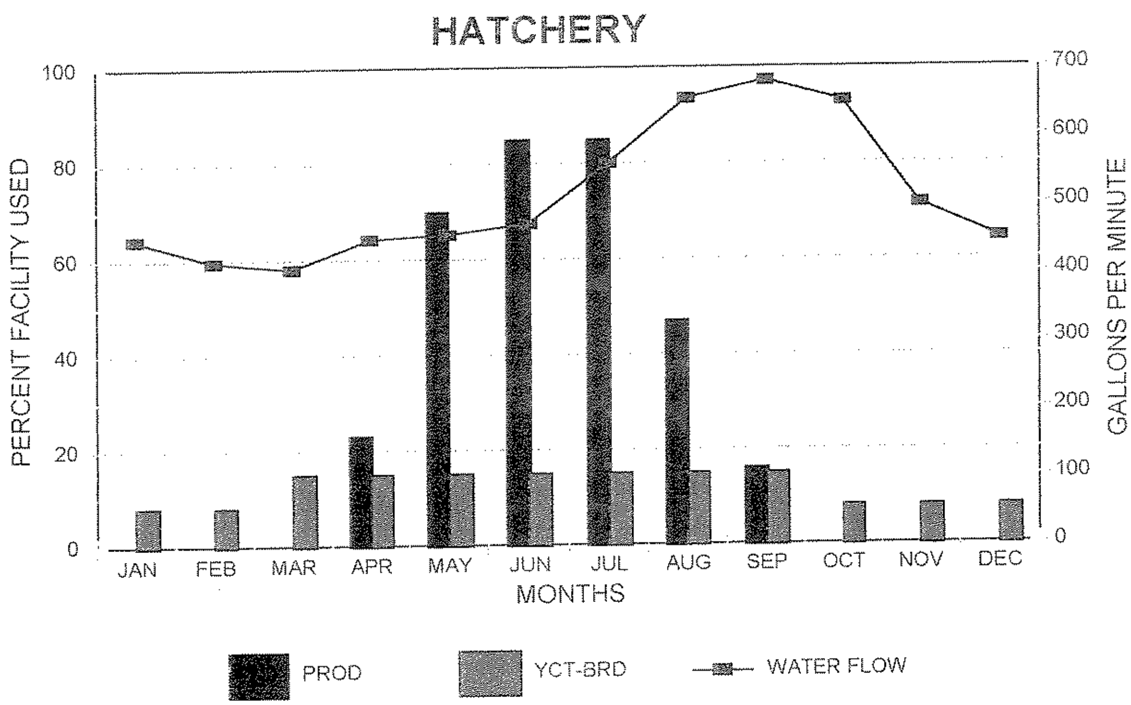
To keep fish diseases at a minimum, a maximum density index and flow index used for raising cutthroat trout at the Yellowstone River Hatchery are 0.3 and 1.3, respectively.

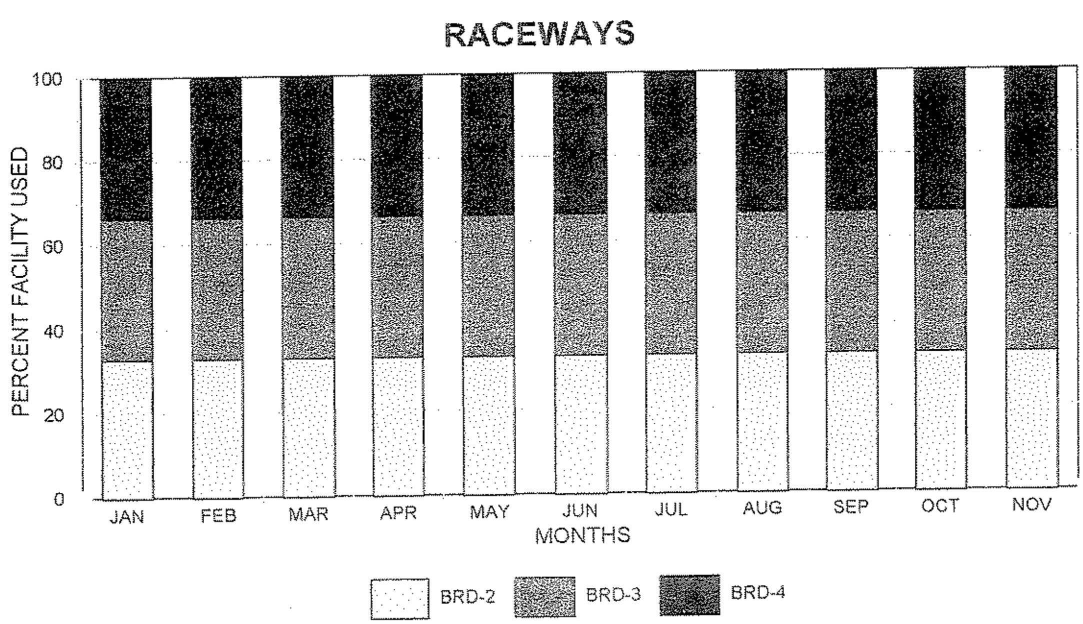
Table 9. Typical annual production schedule and resulting distribution of fish, by species or strain, reared at Yellowstone State Fish Hatchery, Big Timber, Montana; number of fish distributed in thousands, followed by fish size in inches in parentheses. A line not terminated by a bullet (◆), indicates a carryover of fish either from or to another calendar year. **Sub-groups of fish (i.e., early and late spawning lots) within a species or strain may overlap within a calendar year and not appear as individual lots**. PROD = production groups, Yellowstone cutthroat trout, YCT-BRD = Yellowstone cutthroat trout broodstock, all age groups.



FISH DISTRIBUTION	PROD	YCT-BRD
Jun 95	180 (1.8)	
Jul 95	73 (1.8)	0.38 (17)
Aug 95	62 (2.0)	
Sep 95	36 (2.3)	
Jun 96		0.02 (19)
Aug 96		0.23 (19)
Total	**351.0**	**0.63**

Figure 10. Typical annual percent use, by month, of hatchery building tanks and outside raceways to maintain various year-classes of Yellowstone cutthroat trout broodstock (BRD followed by year class,YCT-BRD = less than one year old), and rear Yellowstone cutthroat production fish (PROD) for distribution, at Yellowstone River Trout Hatchery. Total water flow for the station is shown in gallons per minute on the hatchery graph.





Broodstock Management and Genetics

Maintaining genetic diversity in hatchery fish populations is important, since hatchery fish can impact wild fish through a number of ecological interactions. Hatchery rearing and release guidelines must minimize biological selective factors, that may adversely affect genetic diversity. Therefore, hatcheries should use operational procedures that avoid adverse genetic effects on wild, natural, and hatchery fish populations. All fish produced and released should meet identified management objectives and follow genetic guidelines.

The proper management of broodstock encompasses many facets. Some of these are genetic monitoring, rearing environment, numbers of broodfish and genetic infusion to correct inbreeding. One of the most important elements is maintaining adequate numbers of fish. If numbers of parents in the stock are too low, inbreeding may occur at an accelerated rate, and may render the stock unacceptable for conservation purposes.

It has been demonstrated that the genetic integrity of wild stocks can be maintained in captive broodstocks, if adequate safeguards are taken to avoid loss of genetic diversity. As an example, greenback cutthroat trout *Salmo clarki,* maintained as captive broodstock at the Bozeman (Montana) Fish Technology Center, provided fry and fingerlings to reestablish wild populations in Colorado (Dwyer and Rosenlund 1988). Many factors influencing rate of inbreeding in broodstocks can be controlled with increased attention to the breeding and cultural techniques used in broodstock management (Kincaid 1995). In this way, genetically complete broodstock may be used to establish new populations, supplement existing populations, and serve as a genetic reserve (Dwyer and Leary 1995).

In 1988, a Broodstock Management Policy was developed for FWP hatcheries. The purpose of the policy was to establish sound genetic management of the State's hatchery-maintained broodstocks, fish health procedures for broodstock, and procedures to maintain genetic purity. A broodstock history is maintained at each brood hatchery, as well as records filed with the Division of Fisheries, FWP, Helena. A procedure manual for use at each facility has been developed. In addition, a Broodstock Committee composed of the hatchery managers, Fisheries Division administrators, and a University of Montana geneticist meet annually to discuss the program. Any changes to policy or plans, or the development of plans for new programs are reviewed and approved by the committee, and FWP manages it's broodstock with numbers of fish recommended by the Broodstock Committee to minimize inbreeding.

The Department of Fish, Wildlife, and Parks operate three trout and one warmwater broodstock hatcheries, that produce eggs for use in other hatcheries or management programs. A site visit was made to each of the broodstock hatcheries. Broodstock selection and spawning procedures were reviewed with the hatchery managers, along with an inspection of the facilities. The trout hatcheries are Jocko River Trout Hatchery, where Arlee strain rainbow trout broodstock are maintained ; Washoe Park Trout Hatchery, where genetically diverse Westslope cutthroat trout broodstock are maintained, and eggs collected from Desmet strain rainbow trout in Willow Creek Reservoir are incubated and shipped in the eyed-stage to other hatcheries for hatching and rearing; and Yellowstone River Trout Hatchery, where wild-based McBride strain Yellowstone cutthroat trout broodstock are periodically crossed with wild gametes from Yellowstone cutthroat in McBride Lake, located in Yellowstone National Park. The warmwater hatchery at Miles City maintains smallmouth and largemouth bass broodstocks, and collects eggs from wild fish. These broodstocks supply fry and fingerlings to support fishery management programs, both warmwater and coolwater species.

In general, a broodstock development plan has been implemented for FWP hatcheries, which is a state-of-the-art program. Gamete collection procedures are followed, where appropriate numbers of broodfish, using prescribed male:female ratios and fertilization protocols are used. There is also a genetic monitoring and evaluation program in place for broodstocks. The Broodstock Committee works closely with the Wild Trout Genetics Laboratory, University of Montana, Missoula, to insure that stocks are pure and that genetic diversity is being maintained.

In some instances, large numbers of eggs (hence more broodfish) are needed within a specific time period to meet stocking requirements, and more efficiently utilize hatchery rearing space. These circumstances may sometimes result in the production of eggs which are in excess of the fisheries management program. Excess eggs are provided for research and other innovative Department programs, and are sold to private hatchery operators in Montana.

Fish Health

Fishery resources must be protected from the adverse effects of disease. Fish populations, whether cultured or free-swimming, are exposed to bacteria and parasites and occasionally to viruses. Under certain conditions, these pathogens can cause disease outbreaks that lead to fish mortality. This can ultimately result in a significant impact on the fishery resource. Consequently, it is important that managers of a watershed, river, or hatchery facility be constantly aware of potential disease problems. Serious fish losses can occur when host and pathogen are present in an environment that favors the disease. Active fish disease management includes improving hatchery environmental conditions, providing pathogen-free water sources from wells and springs, and through a proper sanitation program (Post 1987; Roberts 1989) . Improvement of hatchery water delivery systems is a goal at FWP hatcheries as evident by the addition of new spring pipelines at the Jocko River, Washoe Park and Yellowstone River hatcheries. Improvements made in the water delivery system at the Yellowstone River hatchery was extremely important in eliminating bacterial kidney disease.

Health care standards must be followed in order to prevent the introduction or spread of diseases. These standards should include hatchery monitoring visits by fish health specialists; a fish health inspection program; hatchery sanitation procedures; water quality parameters; general cultural practices; and egg/fish transfer and release requirements.

Montana Department of Fish, Wildlife and Parks hatcheries have a fish health monitoring and evaluation program in place. All hatcheries are visited annually by a certified fish health inspector, or his representative, and each lot of fish is sampled, to determine if designated pathogens of special concern are present in the hatchery population. A list of designated pathogens is contained in the Administrative Rules of Montana, sub-chapter 5: Importation of Fish. The list identifies specific bacterial, parasitic, and viral pathogens that pose a threat to existing fisheries. Diseases that occur from pathogens of special concern may cause severe mortalities, may or may not be controlled by treating with drugs and usually require destruction of all fish and complete disinfection of the hatchery, both of which are extremely costly. Disease may also occur from infections or infestation of pathogens which are ubiquitous in water supplies, however. Such diseases are usually a result of stressful conditions related to crowding, poor water quality,and other environmental stresses. While most are easily treated, maintaining optimum carying capacity and water quality usually helps prevent disease. Hatcheries are visited by the fish health biologist, or fish are sent to him to examine when disease outbreaks occur, allowing him to identify the cause of the disease and recommend corrective procedures and treatment when appropriate.

To insure proper use of drugs and chemicals, a Drug Chemical Report is in place at each of the

State fish hatcheries. Each time a group of fish is treated with either a drug or chemical, the diagnosis, dosage, date, species, strain, and size of fish, as well as the duration of treatment are recorded. Only approved therapies are used, or if unapproved chemicals or drugs are used they are only used in conjunction with an FDA approved Investigational New Animal Drug application.

Fish health inspection reports for the past two years were examined for each hatchery. Historically, rarely have designated pathogens been identified in fish at any FWP hatcheries during the history of the fish health inspection program, spanning a time period of over 25 years (bacterial kidney disease was effectively eradicated at the Yellowstone River Trout Hatchery). **At no time has whirling disease been found in any FWP (or federal and private) fish hatchery in the State of Montana.**

To reduce the risk of transmitting diseases to hatcheries from wild fish a Wild Egg Collection Procedure for Salmonids has been developed for use during spawning of wild broodstocks. In addition, fish and reproductive fluids are tested for pathogens, then eggs are transferred to a quarantine area and held until pathogen testing is completed. Should a reportable pathogen be detected, eggs are destroyed. After eggs are spawned they are immediately disinfected and water hardened (a process by which water is absorbed by the egg immediately after being expelled from the fish) with an iodine solution to eliminate disease organisms that might be present on the surface, or possibly within the eggs. Accepted hatchery sanitation procedures are followed at each FWP hatchery.

Fish-rearing standards have been developed for each hatchery by the hatchery manager; using accepted hatchery carrying-capacity procedures helps prevent disease. Occasionally, rearing standards are exceeded, due to decreased water flow at the hatchery, or perhaps by delays in planting due to inclement weather conditions; this can increase the potential for disease outbreaks, if the situation isn't corrected.

Precautions against the Spread of Whirling Disease

The goal of any fish health program is the prevention of diseases. The potential risk involved in the possible downstream spread of whirling disease (WD) to the Giant Springs Hatchery, Great Falls is of concern to FWP, and the following precautions are planned to prevent the infection of both the Giant Springs hatchery and Big Springs Trout Hatchery, Lewistown hatcheries with WD. Methods to prevent the spread of the disease to the hatcheries are of concern to FWP. One extermely effective method in preventing whirling disease is to completely cover spring areas and eliminate fish from spring water supplied. This not only prevents the spread of disease from birds and other animals, but also prevents the disease by interrupting the life cycle of the parasite causing whirling disease. The following preventative precautions are planned to insure that the Great Falls and Lewistown hatcheries will not become infected with the parasite causing whirling disease:

Giant Springs Trout Hatchery, Great Falls -
Montana Department of Fish, Wildlife, and Parks has contracted with the firm of Thomas, Dean and Hoskins, Inc. (TD&H), engineering consultants, to evaluate alternative methods of providing a safe water supply for the Giant Springs Trout Hatchery, that will reduce the risk of transmission of WD to the hatchery. Five alternative methods of providing a safe water supply were evaluated and include the following: (1) a protected spring intake structure, (2) ultraviolet light (UV) disinfection, (3) ozone disinfection, (4) water filtration, and (5) deep wells.

While both ozone and ultraviolet disinfection are effective in destroying the infective stage (Triactinomyxon) of the parasite causing disease, the cost of installing and operating these systems are significant. Contrary to the report by TD&H, stating that oxygen would be added and nitrogen stripped during ozonation, and that packed columns are not necessary, we suggest that little to no oxygen would be added, that nitrogen would not be stripped, and that packed columns are necessary not only to increase oxygen and remove excess nitrogen, but to strip residual ozone from water before returning it to the fish. Ozone is extremely toxic to fish in small amounts. Ozone is also toxic to humans, and thus poses a significant human health risk to hatchery employees if not properly handled.

The use of water filtration for removing parasites is extremely costly to install and has a very high operating and maintenance cost and thus, should not be considered.

Geological reports suggest that in general, there is no guarantee that wells would be successful or produce the amount of water required. It concluded that a naturally flowing well capable of producing the amount of water required at the hydrolic head available is very unlikely.

The least expensive and most practical alternative is to construct a new protected water intake for the hatchery within the main spring pool. We agree with this recommendation. Installing a concrete collection box in the spring where a strong upward water flow exists, sealing around the bottom of the box, then covering with an esthetically appealing cover to prevent potential contamination with spores of *Myxobolus cerebralis* from birds, provides an extremely minimum risk situation.

Pumping from this structure through packed columns should increase oxygen content of the water to at least 90% saturation, and decrease total gas pressure to about 100% saturation by removing nitrogen gas. Low oxygen concentrations and total gas pressures due to high nitrogen gas concentrations have limited production at Giant Springs Hatchery since it began operation.

Installation of this aeration and degassing system should result in improved fish quality and increased fish production, due to the increase in oxygen content of the water that will occur. Chronic gas bubble disease has had a detrimental effect on fish quality at Giant Springs hatchery; both fish health and production efficiency will be improved with the proposed water treatment system.

Big Springs Trout Hatchery, Lewistown-

Montana Department of Fish, Wildlife and Parks also contracted with Robert Peccia & Associates, Helena, Montana, to prepare a preliminary engineering report designed for limiting hatchery vulnerability to WD at the Big Springs hatchery. The report developed a prioritized improvements program, not only to protect the hatchery from WD, but also, to enhance and protect the quality of water used by the fish, and improve the operational characteristics of the hatchery. In general, the improvements would include installation of pipelines to carry Big Spring water to two sites on the hatchery. These pipelines would bypass open spring areas that are open to waterfowl and other water birds, and animals which are potential carriers of the disease-causing spores of *Myxobolus cerebralis.* They would also replace open creek water supplies which have the potential of contaminating the hatchery with disease. A pipeline would also replace an open canal system that supplies water to the lower hatchery. Other recommendations are to cover existing springs, or additional springs that may be developed, to eliminate access by birds and other animals.

The use of pipelines requires the installation of additional packed columns to aerate the water. These columns will increase oxygen to near saturation, and even more importantly, will reduce nitrogen gas, and thus total gas pressure to near 100%. This step will enhance and protect the quality of water used by fish, and improve fish quality as well as the operational characteristics of the hatchery. The plan calls for the addition of two series of packed columns, to reduce total gas pressure to 100%. Pilot studies conducted at Big Springs Hatchery demonstrated that it is possible to reduce nitrogen to 103% and total gas pressure to 102%, respectively by passing water through only one series of columns. The second pass through packed columns will reduce total gas pressure to 100% The practicality and necessity of using a second set of columns to achieve 100% saturation needs to be weighed against the additional cost and benefits of installing such a system. Most hatcheries routinely operate satisfactorily using water with total gas pressures of 102-104% (Wedemeyer 1996; W. Orr, U.S. Fish & Wildlife Service, personal communications; C. Smith, personal observations).

One other option that was considered to prevent WD within the hatchery was ultraviolet light (UV) disinfection, a method that has been demonstrated to destroy Triactinomyxons (Hoffman et al. 1974), and which has been successfully used in hatcheries in Pennsylvania as a barrier to whirling disease. However, the high operation and maintenance cost, dependence upon electrical equipment, and necessity of having backup electrical generators, make a UV system the least desirable method. Such a system would not improve the quality of water and improve the operational characteristics of the hatchery. In addition, UV systems may not be 100% effective in preventing the disease (L. Harris, Colorado Department of Natural Resources, and T. Dotson, Montana FWP, personal communications). It would however, reduce bacteria and other potential pathogens and help reduce the threat of other disease and parasitic infections that occassionally occur.

Hatchery Production Alternatives

Other hatchery sites are available for consideration for fish production should the demand for hatchery fish increase. For example, the existing undeveloped hatchery site on Rose Creek near Flathead Lake, owned by FWP, appears to have good potential to provide additional fish to the State, if it is developed. It has a water flow of 2,000 gal/min and 54°F temperature. The question is whether the site could be sold or leased to a private individual(s) or a corporation to develop, and then contract fish rearing with the State, or a facility could be built and operated by the State.

Planned improvement at Bluewater Springs and Giant Springs fish hatcheries would provide increased trout production; warmwater (i.e., walleye) fish production could be increased at Miles City Hatchery with additional rearing facilities.

Other potential sites include an existing hatchery near Sheridan, Montana, that could be renovated and put into operation, a 54-58°F spring supplies 8,000 gal/min water; and Toston Springs, located near the town of Toston, Montana, with a 54°F water flow of about 52,000 gal/min.

PRIVATIZATION OF FISH HATCHERY PRODUCTION

Stocking of hatchery fish to achieve specific objectives is a management tool that is often necessary to maintain high quality fishing opportunities for the public. The purpose of the Hatchery System Review is not to consider privatization of existing State fish hatcheries, but to determine if an increased demand for hatchery production, be it from new programs or the infection of fish with *Myxobolus cerebralis* (whirling disease, WD) in a State hatchery that may eliminate the hatchery from production for a certain time period, could be provided by one or more of the other State hatcheries, or by another entity (Federal, Private sector). Also to be considered is whether or not another entity could retain the integrity of Montana Department of Fish, Wildlife & Park's (FWP) mission currently provided by the State hatchery system.

Recently, a moratorium was placed on the importation of live salmonids into the State of Montana. The moratorium was adopted because present testing procedures are thought by Montana biologists to be inadequate to detect the early stages of WD. This may lead to a permanent ban of live fish entering the State of Montana, even though fish test negative for diseases identified by FWP as prohibitive. Thus, the use of private hatcheries for meeting increased demands for fish required by FWP programs is limited to hatcheries within the state. Because of this moratorium we have not requested information from growers outside the state on costs or their ability to supply fish to FWP. However, should this moratorium be lifted, we have listed private growers in the states of Idaho, Wyoming and South Dakota that would consider selling live fish to the State. Because of disease considerations fish and or eggs are usually not accepted into Montana from most hatcheries in the states of Idaho, Oregon and Washington. We have however, listed private growers in Idaho capable of producing and selling eggs to FWP, since the importation ban does not include live salmonid eggs, if hatcheries supplying the eggs can meet disease inspection requirements.

When considering the use of private growers to supply fish for state programs, the availability of sufficient numbers of genetically pure and diverse stocks of fish in the size and quantity required must be assessed; they must be able to provide species and strains of fish that meet fisheries management needs. Cost alone cannot be used as a basis for privatization. The hatchery program for FWP is extremely diverse in the species and strains of fish they provide, primarily for management programs of lakes and reservoirs within the state. Each of these strains has an inherent capacity to perform best under certain water quality, habitat, food supply, and other conditions.

Species and strains reared in the state hatchery system include the Westslope and Yellowstone strains of cutthroat trout, and the Arlee, Desmet, Irwin, Eagle Lake, and Kamloops strains of rainbow trout. Eggs are obtained from broodstocks held at brood hatcheries, as well as from fish spawning naturally in tributaries to lakes and reservoirs.

The majority of private growers within Montana capable of providing fish in significant numbers and sizes required for most state planting schedules, were visited or contacted by telephone. With the exception of Nelson's Spring Creek Trout Hatchery on the Yellowstone River, most of these hatcheries are quite small and would have difficulty supplying large numbers of fish four inches or greater in length. In addition, demands for their fish for use in private ponds have been increasing and most sell all of their fish by June or July, especially in years when ponds and reservoirs are filled with water due to heavy spring rains. Due to increased demands for their fish, prices they receive are good. With the moratorium banning importation of live fish into the state, the demand for more fish and prices paid to private growers will probably increase even more.

Nelson's Spring Creek Trout Ranch is currently producing 9-inch and larger rainbow trout (RT) for sale in private lakes and ponds. However, they do have the ability to produce considerably more fish than they are currently raising. There is the potential of working cooperatively with Spring Creek Trout Hatchery, Lewistown, Montana. Eggs would be hatched and the fry raised in Lewistown to the small fingerling size, then fingerings would be transported to Nelson's for rearing to large fingerling and catchable sizes. While other growers could produce RT for FWP, numbers would be small and the incentive would have to be great. Most growers, however, expressed an interest in seeing what type of programs FWP might have to offer.

The potential exists for Rick Jore, Ronan, Montana, working with Alan Harriman, St. Ignatius, Montana, to raise large numbers of westslope cutthroat trout (WCT) fingerlings. Rick spawned about 500,000 eggs from his broodstock this year, and plans to increase his volume to one million eggs in 1997. These cutthroat trout have been tested by Dr. Fred Allendorf, University of Montana and found to be genetically pure WCT. While they may be acceptable for planting in certain waters, they may have to be tested further to determine genetic diversity, before they can be considered for use in WCT restoration projects.

All private growers have customers they supply fish to each year on a continuing basis and are hesitant to jeopardize their existing program to provide fish to FWP. Most felt they could provide some fish, but not large numbers. One grower, having held previous contracts with government agencies for fish sales, was somewhat hesitant to enter into additional contracts.

Some private growers have the Arlee strain of rainbow trout (ART), others the Kamloops strain (KRT) and some a mixture of other strains; FWP would have to accept the use of these strains of fish in their programs or provide eggs to the private growers on an equitable basis. Another option would be for FWP to establish a cooperative agreement with the U.S. Fish and Wildlife

Service's Ennis (Montana) National Fish Hatchery, to provide eggs from their 5 different strains of rainbow broodstock that could then be sold to private growers not having their own broodstock, enabling them to raise strains desired by FWP. One private grower expressed concern about potential disease introduction, if eggs from wild fish spawned by FWP were brought into his hatchery. Two strains of cutthroat trout, the Westslope (WCT) and Yellowstone (YCT), are raised at FWP hatcheries; these strains are also currently being raised for private pond stocking by two private growers within Montana.

Change orders to contracts and weather conditions often affect planting of fish. This may require the private grower to hold fish for an additional time period, until planting sites are accessible. This can pose a problem, if fish become crowded and water is not available, and if fish require additional feed beyond what was anticipated by the grower. This would result in additional costs in feed and transportation. These conditions will have to be identified in any contracts between FWP and private growers.

Many states have purchased fish from the private sector on a limited basis to supplement rather than replace state-produced fish. Purchasing, inspecting fish for quality and disease, and writing specifications for live fish is difficult. Fish quality is difficult to measure; consequently, the value of the product can not be measured directly at the time of stocking. Due to the large number of animals in raceways and the size variation of fish, it is difficult to get an accurate inventory. Fish also vary in appearance and hardiness, and have varying inherited characteristics. Electrophoresis, a test used to measure genetic purity and diversity in fish populations, can be relatively expensive.

A successful program between FWP and private growers should include the following:

1. The State must be able to provide specific strains of eggs or fish to the private growers.

2. The private growers must provide fish of necessary sizes at specified times of the year, so that private production is integrated into the State's stocking programs.

3. The private grower must provide high-quality, healthy fish that meet quality assurance standards developed and implemented by FWP, similar to the Fish Health/Condition Assessment Procedures, developed by Goede (1988).

4. The private grower must guarantee steady, long-term production.

5. The State must establish renewable contracts which will provide security to the grower and experience in supplying the agency's needs. A multi-year contract will enable a grower to enhance production to meet the State's needs of specified sizes and numbers of fish. *This can pose a problem in annual planning; a comparison of numbers of actual planted fish for 1995 with the projected future needs (pages 9-12, this report) demonstrates the annual diversity in species and strain requirements which can occur, and the flexibility required in the hatchery system to meet those needs. This flexibility may not be readily accomodated by the private sector.*

A list of private growers who could provide eggs and fish for FWP (* indicates fish only, ** indicates fish and eggs), should the ban on live fish be lifted are as follows:

Private Growers in South Dakota

Steve Simpson*
Trout Haven Ranch
P.O. Box 147
Buffalo Gap, SD 57722
(605) 833-2571

Greg Dittman*
Spearfish Trout Farm
Rural Route 1, Box 150
Spearfish, SD 57783
(605) 642-4167

Wayne Linstad*
Linstad Trout Farm
501 Third Ave
Belle Foursche, SD 57717
(605) 892-4776

Private Growers in Wyoming

Buck Hoem*
Homestead trout Ranch
Box 723
Saratoga, WY 82331
(307) 326-8136

Bill Nye*
Wyoming Trout Ranch
4727 Powell Highway
Cody, WY 82414
(307) 527-7446

Jack Huber*
Cedar Ridge Fish Hatchery
608 Pine
Newcastle, WY 82701
(307) 746-4394

Alvin and Dee Duncan*
Rawhide Valley Fish Farm
Route 1, Lingle, WY 82223
(307) 473-2307

Private Growers in Idaho

George Kimball**
Black Canyon Trout Farm
Grace, ID
(208) 425-3239

Dick Smith**
Lost River Trout Hatchery
Mackey, ID
(208) 588-2866

Private Growers in Montana

A list of private growers in the State of Montana as well as costs for various sizes of fish are as follows (costs do not include transportation cost for delivery. Delivery costs vary from $0.50 to $1.00 per mile one way; average cost of fish obtained from current price lists)

Hatchery	Size (inches)	Species	Cost/1000 fish
Alan Harriman	1.5-2.0	RT	$130
Harriman Trout Co.		WCT	175
9615 Fish Hatchery Road			
St. Ignatius, MT 59865	3.5-4.0	RT	275
(406) 745-4355		WCT	400
	4.5-12.0	All trout	$0.10/inch
	Over 12 inches	All trout	2.50/pound
	Mileage charge: $1.00/ mile one way.		
Roger Nelson			
Nelsons Spring Creek Trout Ranch	9.0 and larger	RT	$1.60/pound
Route 38, Box 2022			
Livingston, MT 59047	Mileage charge: $1.00/mile one way		
(406) 222-6560			

Hatchery	Size (inches)	Species	Cost/1000 fish
Tony Nowak	2.0	RT	$115
Spring Creek Trout Hatchery	4.0-5.0	RT	325
Route 1, Box 1600	5.0-7.0	RT	400
Lewistown, MT 59457			
(406) 538-3538			
	Delivery charge: $ 0.50/mile		
Dennis Sparks	2.0	RT	$ 90
Trout Haven	4.0	RT	210
Route 1, Box 1654	6.0	RT	350
Lewistown, MT 59457	8.0	RT	560
(406) 538-7897			
	Delivery charge: $0.50 per mile one way		
Lew Drain	4.0	RT	$ 400
Spring Creek Camp	6.0	RT	600
P.O. Box 1063	8.0	RT	800
Big Timber, MT 59011	10.0	RT	1,000
(406) 932-4387	12.0	RT	1,450
Tim Hughes	2.0	RT	$ 300
Aspen Springs	4.0	RT	600
283 Bunkhouse Road	6.0	RT	900
Darby, MT 59829	8.0	RT	1,200
(406) 821-4158	10.0	RT	1,500
	2.0	WCT	$ 400)
	4.0	WCT	800
	6.0	WCT	1,200
	8.0	WCT	1,600
	10.0	WCT	2,000

Hatchery	Size (inches)	Species	Cost/1000 fish
Rick Jore	eyed eggs	WCT	$ 30
5200 Cheff Lane	2.0	WCT	240
Ronan, MT 59864	4.0	WCT	600
(406) 664-2452	6.0	WCT	900
	8.0	WCT	1,600
	10.0	WCT	2,000

Delivery Charge: $0.60/mile one way

Rick has been spawning 500,000 eggs/year. He plans to increase this to 1 million in 1997.

Tom Morgan	12.0	YCT	$1,440
Rainbow Springs	13.0	YCT	1,560
Route 85, Box 4101			
Livingston, MT 59047	9.0	RT	900
(406) 222-3922	10.0	RT	1,000

He raises about 20,000 YCT each year.

He could raise about 50,000 RT, but it takes 1.5 years to rear a 10-inch fish.

Costs Associated With Private and Public Fish Production

Costs associated with fish production at both private and public hatcheries are presented in the pages that follow. Costs obtained for FWP hatcheries were taken from the Annual Hatchery Cost Report for Fiscal Year 1994. They are direct costs and include salaries, feed, transportation for planting fish. Costs presented for private growers were developed from 1995-1996 price lists provided by hatchery owners, they do not reflect transportation costs. However, costs of transporting fish by private growers varies from $0.50 to $1.00/mile delivered, one way. In addition, costs include a profit margin since all business require profits. Should large numbers of fish, if available, be contracted by FWP from private growers, costs may be somewhat lower than those presented below.

Fish health inspections which involve examinations for disease, both visual and laboratory, are conducted at all state and private hatcheries listed in this report. Inspections are provided to private growers at no cost. However, costs of mileage for the inspection as well as per diem, express mail and miscellaneous supplies are charged to private growers by FWP. Average laboratory charges paid by FWP for the inspection of private fish during November, 1995 through November, 1996 was $472. Average costs paid by private growers to FWP to conduct inspections during the same time period was $270.

Since fish health inspections are already being provided to private growers by FWP, additional costs to FWP for inspections should not be forthcoming, or at least should be at a minimum should they decide to contract with private growers for purchase of additional fish.

Average cost/pound of hatchery fish as listed below are actual costs for rainbow trout at the Jocko River Trout Hatchery, and for cutthroat trout at both the Yellowstone River and Washoe Park hatcheries. However, at Big Springs, Bluewater, and Giant Springs trout hatcheries, costs we have listed for rainbow trout, obtained from information presented in the Annual Hatchery Cost Report, reflect a mixture of production costs for both rainbow and Yellowstone cutthroat trout, even though the majority of fish and those of larger sizes raised were rainbow. Discussions with managers of these hatcheries suggest that average costs for production of Yellowstone cutthroat trout are only slightly greater than those for rainbow trout. At Big Springs and Giant Springs trout hatcheries, cutthroat trout are raised to 4-5 inches for planting. Estimated cost above that for rainbow trout production is 1.0-1.5%. Therefore, costs listed below for rainbow trout at these hatcheries are only slightly inflated.

This is also true for average costs of cutthroat trout listed below for the Murray Springs hatchery, where Westslope cutthroat trout and rainbow trout are both being raised. The costs listed for producing cutthroat trout is depressed by about 1-1.5%, due to the lower costs of raising rainbow trout that is also included in the price. The higher cost of producing fish at Murray Springs is related to pumping costs associated with operating the station. These costs are paid by the U.S. Army Corp of Engineers.

Average costs of fish produced at broodstock hatcheries is higher than that of production hatcheries, and is most often related to higher feed costs for broodstock feeds, poorer feed efficiency of large broodfish, resulting in additional feed costs, and increased manpower costs related to spawning fish and handling and shipping eggs.

The extremely inflated fish costs identified with Washoe Park Hatchery are related to the high costs of maintaining a broodstock with limited stocking opportunity. In addition, the station is an important isolation unit for incubating eggs from wild fish or other sources whose health status has not been established. The broodstock is derived from a variety of wild populations, and is of value in maintaining and providing a genetically diverse, pure westslope cutthroat trout, for planting in waters where this species is native, and can survive and spawn in a variety of habitats . This strain of cutthroat is a species of special concern In Montana.

Average Cost for Private Fish, All Hatcheries

Species	Size (inches)	Cost/1000	Cost/lb
RT	2.0	$ 159	$50.00
RT	4.0	360	13.60
RT	6.0	570	6.55
RT	8.0	840	4.00
RT	10.0	1,028	2.57
RT	12.0	1,450	2.07
WCT	2.0	$ 320	$113.00
WCT	4.0	700	31.00
WCT	6.0	1,050	14.00
WCT	8.0	1,600	8.80
WCT	10.0	2,000	5.70
YCT	12	1,440	2.37
YCT	13	1,560	2.00

Cost for State Hatchery Fish

(Costs calculated from 1994 production records include transportation costs for planting fish)

Hatchery	Size (inches)	Species	Cost/1000	Cost/lb
Big Springs	2.0	RT	$ 56	$18.00
Lewistown, MT	4.0	RT	119	4.75
	6.0	RT	197	2.34
	8.0	RT	298	1.49
	10.0	RT	430	1.10
	12.0	RT	599	.89

Hatchery	Size (inches)	Species	Cost/1000	Cost/lb
Bluewater	2.0	RT	$ 84	$26.00
Bridger, MT	4.0	RT	176	6.90
	6.0	RT	284	3.29
	8.0	RT	415	2.02
	10.0	RT	578	1.44
	12.0	RT	779	1.13
Giant Springs	2.0	RT	$ 62	$19.00
Great Falls,MT	4.0	RT	131	5.12
	6.0	RT	213	2.47
	8.0	RT	316	1.54
	10.0	RT	446	1.11
	12.0	RT	609	.88
Murray Springs	2.0	WCT	$107	$38.00
Eureka, MT	4.0	WCT	223	9.93
	6.0	WCT	354	4.68
	8.0	WCT	510	2.85
	10.0	WCT	698	2.00
	12.0	WCT	927	1.53

Cost for State Hatchery Fish at Broodstock Hatcheries

Hatchery	Size (inches)	Species	Cost/1000	Cost/lb
Jocko River	2.0	RT	$ 115	$33.00
Arlee, MT	4.0	RT	240	8.70
	6.0	RT	383	4.12
	8.0	RT	555	2.52
	10.0	RT	765	1.77
	12.0	RT	1022	1.38

Hatchery	Size (inches)	Species	Cost/1000	Cost/lb
Yellowstone River	2.0	YCT	$ 136	$46.00
Big Timber, MT	4.0	YCT	291	12.30
	6.0	YCT	484	6.05
	8.0	YCT	732	3.86
	10.0	YCT	1056	2.85
	12.0	YCT	1473	2.30
Washoe Park	2.0	WCT	$ 884	$283.00
Anaconda, MT	4.0	WCT	1788	72.00
	6.0	WCT	2730	32.00
	8.0	WCT	3730	18.68
	10.0	WCT	4807	12.33
	12.0	WCT	5981	8.87

Cost for State Hatchery Fish

Size (inches)	Species	Cost/1000	Cost/lb
2.0	RT	$ 79	$24.00
4.0	RT	166	6.37
6.0	RT	269	3.05
8.0	RT	396	1.89
10.0	RT	555	1.35
12.0	RT	754	1.07
2.0	WCT	496	161.00
4.0	WCT	1,005	40.00
6.0	WCT	1,542	19.00
8.0	WCT	1,940	11.00
10.0	WCT	2,573	7.16
12.0	WCT	3,454	5.20
2.0	YCT	$ 136	$46.00
4.0	YCT	292	12.00
6.0	YCT	484	6.05
8.0	YCT	732	3.86
10.0	YCT	1,056	2.30

Average costs for warmwater fish and kokanee salmon are not included in this report, since private sources are not available.

In general, costs of purchasing most fish from private growers are more that those required for production at FWP hatcheries. The increased costs are related to the profit margin required for private hatcheries to exist. They also reflect the increased demand and supply for private fish for stocking private ponds. Because of the ban on importation of live fish from outside the state of Montana, the increased demand for private fish for stocking private ponds in Montana, and the small size of most private hatcheries in Montana, it is doubtful if significant numbers of fish could be provided from private hatcheries to FWP should a significant increase in demand occur.

<u>Other States Experiences with Purchasing Fish</u>

The list of unsuccessful efforts to privatize conservation hatcheries spans all major areas of the country and most types of fish (The Mayo Associates 1988; Huffaker et al. 1994). Several states have purchased fish from the private sector on a limited basis to supplement, rather than replace state-produced fish. Comments solicited from various states regarding their experiences with buying fish from private growers identified both advantages and disadvantages.

These were summarized in a report by Spencer & England (1995). Some states had positive results when dealing with private growers, however, these were in the minority. The main disadvantages were: (1) difficulty in developing reasonable, cost effective and easy to manage contracts, (2) the availability of specific species and strains of fish, (3) the problem of insuring quality and quantity of fish, (4) the difficulty of stocking fish from private facilities related to poor handling, (5) not meeting contracted delivery dates, and (6) failure to meet contract commitments when market opportunities became more favorable elsewhere.

Private aquaculture is a very successful form of agriculture and does an excellent job of food fish production and for supplying fish for farm pond and other private pond programs. However, it frequently suffers from under-capitalization, and sometimes lacks the flexibility to meet the long-term needs of natural resources programs. However, partnerships and contracts between state and private growers for purchasing fish to supplement existing state programs can be very effective.

Privatization of Construction, Facility and Ground Maintenance

The possibility of contracting with private companies for construction, maintenance and lawn care was discussed with each hatchery manager. With the exception of lawns and ground care, considerable work is contracted with the private sector, especially for major projects that include painting, roofing and major facility construction. When necessary, other maintenance such as plumbing, welding, etc. is usually done by local private vendors.

Vehicle maintenance is often handled by local service stations or automobile dealers. Small maintenance projects are usually handled by the hatchery staff when time and knowledge permit.

Routine lawn care is handled by the hatchery staff or part time summer help involved in fish culture operations. This usually works quite well, especially during slower time periods in late spring and summer, when most fish have been planted.

The major problem identified by hatchery managers regarding contracting for lawn care was cost, dependability of people doing the work, and in the case of some youth, the time required in training them; often it required considerable time and was almost easier to do the job themselves.

Considerable dollars are spent by FWP in Montana, primarily in local communities where hatcheries are located. Contracting is with the private sector for various types of maintenance and construction projects, both large and small.

Conclusions

Montana's sport fisheries are extremely dependent on successful hatchery programs, that depend on adequate funding and staffing for continued operational efficiency. The FWP hatchery system is a highly sophisticated operation, with scientifically managed broodstocks, computerized hatchery management, and growth rate projections, resulting in efficient hatchery mangement. It also has modern fish distribution vehicles that assure fish are provided complete life support during transportation and stocking.

All personnel are well trained in hatchery management, and are highly motivated towards producing high quality fish for the resource. Occasionally, duties include responsibilities other than raising fish. One extremely important benefit provided to the public by FWP hatcheries is public education.

The parasite, *Myxobolus cerebralis,* that causes whirling disease in trout has been found in fish in numerous waters within the State of Montana. **It has not however, been found in any federal, private, or state hatcheries within Montana**. Precautions to prevent the spread of the parasite to the Big Springs (Lewistown) and Giant Springs (Great Falls) hatcheries through proposed construction at both facilities,have been identified.

Private aquaculture is a very successful form of agriculture and does an excellent job of food fish production and supplying fish for farm pond and other private pond programs. However, it frequently suffers from under-capitalization, and sometimes lacks the flexibility to meet the long-term needs of natural resources programs. The list of unsuccessful efforts to privatize conservation hatcheries spans all major areas of the country and most types of fish (Huffaker, Hood & Bouck 1994). However, partnerships and contracts between state and private growers for purchasing fish to supplement existing state programs can be very effective. For example, in some situations it may be cost effective for FWP to contract for fish with private growers located close to waters that require long distance trucking from state hatcheries.

With the exception of westslope cutthroat trout, the cost of purchasing most fish from private growers in Montana is higher than the cost to produce fish at FWP hatcheries. This is an exception, since the cost of raising fish at agency hatcheries in several states exceeds the cost of purchasing fish from private growers. The higher costs of fish from private growers in Montana are related to the profit margin required for private hatcheries to exist. Cash reserves for unanticipated costs for marketing products may also add to private costs. They also reflect the increased supply and demand for stocking private ponds.

Good cost comparisons were not available for Yellowstone cutthroat trout, but production costs appear to be slightly lower in state hatcheries, than acquiring them from private sources.

Because of the ban on importation of live salmonids from outside the state of Montana, the increased demand for private fish for stocking private ponds in Montana, and the small size of most private hatcheries in the state, it is doubtful if large numbers of fish could be provided to FWP from private hatcheries. However, supplemental fish stocking in existing FWP programs, and perhaps providing fish for small scale, new management programs could be accomplished through contracts with private growers.

Other hatchery sites within the state of Montana potentially available for fish production are identified should the demand for hatchery fish increase. In addition, private hatcheries outside the state have been identified as potential suppliers of fish, should the need arise and the importation ban lifted.

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APPENDIX A:

The projected fish-stocking needs by FWP regions; a complete listing by stocking site is filed with the Fisheries Division, FWP, Helena:

Species	Strain	Number	Size
Region 1:			
Rainbow	Arlee	222,550	fingerling
		70	catchable
		320	broodstock
	Eagle Lake	2,500	fry
		31,000	fingerling
		5,000	catchable
	Kamloops	26,450	catchable
Brook trout	Wyoming	3,500	fry
		8,000	fingerling
Kokanee salmon	Lake Mary Ronan	895,000	fry
		1,100,000	fingerling
Grayling	Red Rocks Lakes	25,000	eyed eggs
		100,000	fry
	Red Meadow	42,000	fry
Westslope Cutthroat	Anaconda	160,000	eyed eggs
		258,050	fry
		170,550	fingerling
		500	broodstock
Smallmouth bass		30,000	fry

Species	Strain	Number	Size
Region 2:			
Rainbow	Arlee	109,250	fingerling
		4,500	catchable
	Eagle Lake	41,400	fingerling
	Kamloops	52,500	fingerling
	McConaughy	2,000	fingerling
Kokanee salmon	Lake Mary Ronan	100,000	fingerling
Westslope Cutthroat	Anaconda	29,000	fingerling
		8,200	catchable
Region 3:			
Rainbow trout	Arlee	12,500	fingerling
		200	Catchable
	Lake Desmet	375,500	fingerling
	Eagle Lakes	414,000	fingerling
		100,000	catchable
	Erwin	2,000	fingerling
Brown trout	Missouri River	150,000	fingerling
Golden trout	Sylvan Lake	500	fry
Grayling	Madison River	1,500	fingerling
	Axolotl Lakes	5,000	fingerling
Yellowstone Cutthroat	McBride Lake	23,200	fry
		142,825	fingerling
Walleye		10,000	fry
		5,000	fingerling

Species	Strain	Number	Size
Region 4:			
Rainbow trout	Arlee	466,400	fingerling
	Lake Desmet	34,000	fingerling
	Eagle Lake	106,225	fingerling
	Arlee x Eagle Lake	125,000	fingerling
	Erwin	28,300	fingerling
		13,000	catchable
Kokanee salmon	Lake Mary Ronan	40,000	fry
Grayling	Red Meadow	3,000	fry
Westslope Cutthroat	Anaconda	1,000	fry
Yellowstone Cutthroat	McBride Lake	7,500	fry
		63,500	fingerling
		650	catchable
Largemouth bass		28,000	fry
		2,000	fingerling
Smallmouth bass		30,000	fry
Walleye		123,000	fry
		15,000	fingerling
Region 5:			
Rainbow trout	Arlee	440,580	fingerling
	Desmet	6,130	fry
	Eagle Lake	2,420	fry
		20,000	catchable
	McConaughy	50,000	fingerling
	Erwin	3,500	fingerling

Species	Strain	Number	Size
Kokanee salmon	Lake Mary Ronan	150,000	fry
Yellowstone Cutthroat	McBride Lake	213,700	fry
		200	fingerling
Largemouth bass		46,000	fry
		6,400	fingerling
Catfish		14,200	fingerling
Walleye		4,000,000	fry
		300,000	fingerling
Tiger muskies		1,500	fingerling

Region 6:

Rainbow trout	Arlee	185,500	fingerling
	Eagle Lake	23,000	fingerling
	Erwin	45,000	fingerling
Brown trout		18,000	fingerling
Yellowstone Cutthroat	McBride Lake	13,000	fingerling
Largemouth bass		56,800	fry
Northern pike		100,000	fry
Catfish		180,000	fry
Smallmouth bass		40,000	fry
Walleye		32,791,000	fry
		14,000	fingerling
Chinook salmon		250,000	fingerling
Tiger muskies		8,500	fingerling

Species	Strain	Number	Size
Region 7:			
Rainbow trout	Arlee	350,000	fry
		477,900	fingerling
Yellowstone Cutthroat	McBride Lake	400,000	fingerling
Largemouth bass		20,000	fry
Northern pike		407,000	fry
Smallmouth bass		40,000	fry
Walleye		1,265,000	fry
Statewide:			
Brown trout	Wyoming	60,000	fingerling

Footnote: fry = 0-2 inches, fingerling = 2-8 inches, catchable = 8+ inches, broodstock.