STUDY OF BOULDER RIVER FISHERY

Montana Department of Fish, Wildlife and Parks

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ABSTRACT

This fisheries investigation was initiated as the result of proposals to mine platinum group metals in the Beartooth Mountains, headwaters of the Boulder River. Thirteen sections of the Boulder River were electrofished: two in lower Boulder, one in West Boulder and ten in the East Boulder and its tributaries. A total of 7,946 fish were captured in the Boulder River from November 1981 to June 1982. The total catch consisted of 1,901 rainbow trout *(Salmo gairdneri)*, 3,254 brown trout *(Salmo trutta)*, 2,732 mountain whitefish *(Prosopium williamsoni)* and 58 brook trout *(Salvelinus fontinalis)*. Tags were placed on 2,017 trout, 8 inches and larger.

In Section B1 (lower Boulder), whitefish were the most abundant sport fish in spring and fall, followed by brown trout and rainbow trout. Order of abundance in Section B2 (lower Boulder) in fall was brown trout, mountain whitefish and rainbow trout. In spring, mountain whitefish were most common, followed by brown trout and rainbow trout. In the lower East Boulder, brown and rainbow trout were most abundant in spring and fall, with the order reversed in the upper East Boulder.

Actively spawning brown trout were observed on redds at Sections B3, B4, B6 and B9 in fall 1981. Only one pair of rainbow trout was observed spawning in the main Boulder above the mouth of the East Boulder in spring 1982; however, numerous ripe rainbows were captured throughout the drainage.

In spring and fall, increased numbers of large, ripe trout were captured in the lower Boulder, suggesting immigration of spawning Yellowstone trout.

INTRODUCTION

In the spring of 1981, BEAK Consultants, Inc. began an inventory of the Boulder River fishery for PGM Resources who propose hardrock mining in the upper East Boulder River drainage. Sampling done by BEAK on the upper drainage was good; however, it was mainly limited to areas around the mine and mill site. Since a mining complex in the East Boulder drainage could potentially affect the fishery in the lower drainage, fisheries biologist, Russ Penkal (DFWF), expanded the survey to include the lower Boulder drainage in the fall of 1981. Additional sampling was done in the spring of 1982.

OBJECTIVES

1) Determine the significance of the East Boulder and the Boulder River (downstream from the East Boulder River) as spawning and juvenile rearing area for migrant rainbow and brown trout in the Boulder and Yellowstone rivers.

2) Quantify the resident fishery in the East Boulder and Boulder rivers in selected sections.

3) Identify critical spawning and rearing areas for trout.

STUDY AREA

The Boulder River originates in the Absaroka-Beartooth Wilderness and flows northerly for approximately 60 miles, merging with the Yellowstone River at Big Timber. The Boulder drains 523 square miles, of which nearly 25% is private land and 75% is in the Gallatin National Forest (Marcuson, 1980). The average discharge of the Boulder River is 616 ft^3/s near Big Timber (ESGS, 1980).

In the fall of 1981 and spring of 1982, two sections of the lower Boulder were electrofished (Fig. 1, Table 1). A section of the West Boulder near its confluence

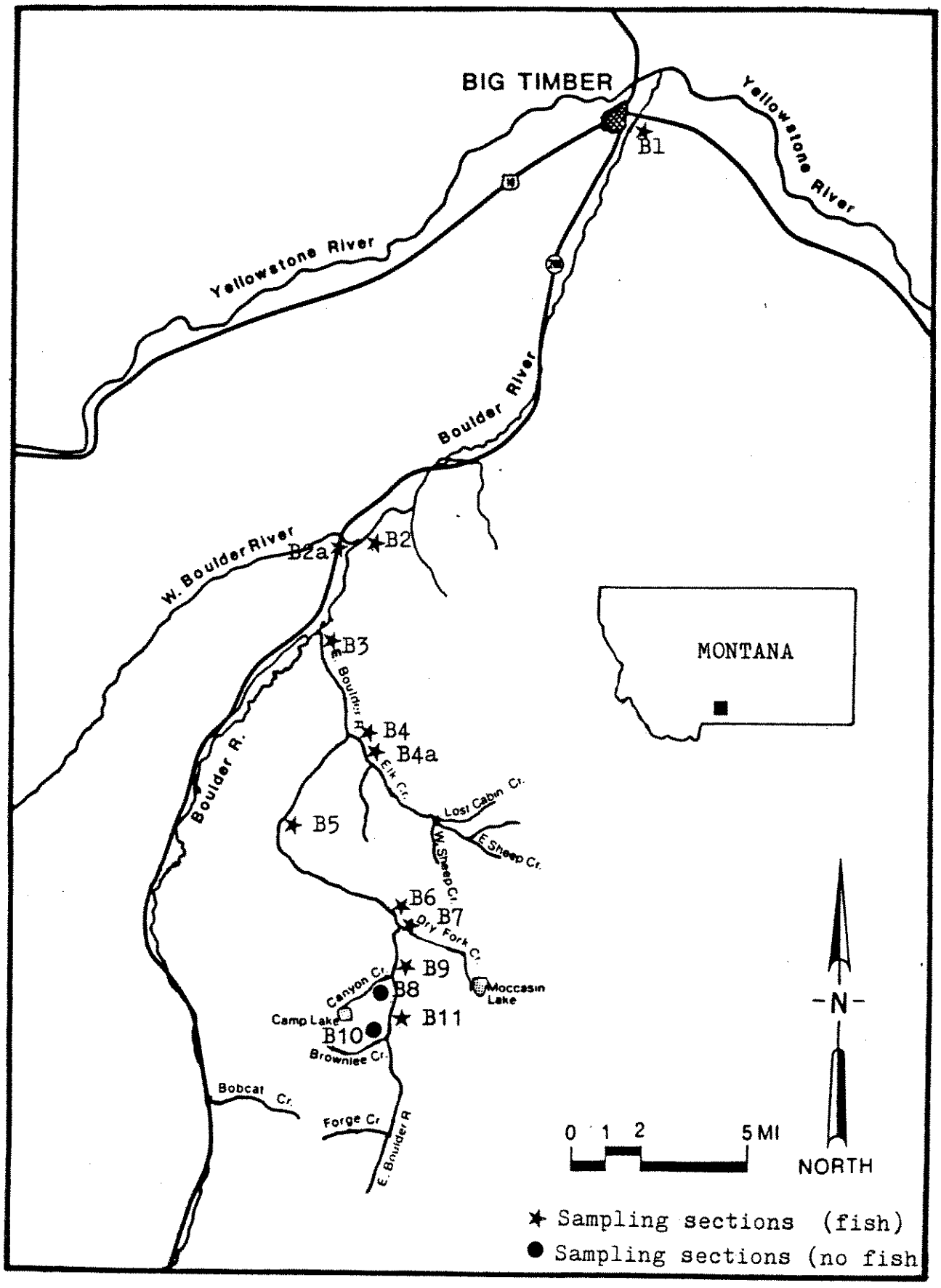

Fig. 1. Location of electrofishing sections on the Boulder River.

Table 1. Location of sampling stations and fish species collected

Stream	Section Number	Location T	R	S	Length (Feet)	Species[1] Collected in Order of Abundance
Boulder River (near mouth)	B1	1N	14E	14	5,140	MWf, LL, Rb, MC, MSu, LnD, Eb, WSu
Boulder River (downstream West Boulder)	B2	2S	13E	15	5,069	LL, MWf, Rb, MC, MSu, Ct, Eb
West Boulder River	B2a	2S	13E	15	1,000	LL, Rb, MWf
East Boulder River (mouth)	B3	2S	13E	33	2,442	LL, Rb, MC, MWf, Eb, Ct
Elk Creek (mouth)	B4	3S	13E	10	968	LL, Rb, Eb
Elk Creek (approximately 3 miles upstream)	B4a	3S	13E	15	-	Eb, LL, Rb
East Boulder River (USFS Campground)	B5	3S	13E	29	1,196	Rb, LL, Eb, RbxCt, Ct
East Boulder River (downstream Dry Fork)	B6	3S	13E	32	1,300	Rb, LL
Dry Fork Creek (mouth)	B7	4S	13E	12	175	Rb, LL
Canyon Creek (mouth)	B8	4S	13E	14	547	No fish collected.
East Boulder River (downstream Canyon Creek)	B9	4S	13E	14	1,155	Rb, LL, RbxCt
Brownlee Creek (mouth)	B10	4S	13E	26	153	No fish collected.
East Boulder River (downstream Brownlee Creek)	B11	4S	13E	11	910	Ct

[1]Species abbreviations: MWf = mountain whitefish, LL = brown trout, Rb = rainbow trout, MC = mottled sculpin, MSu = mountain sucker, LnD = longnose dace, Eb = eastern brook trout, WSu = white sucker, RbxCt = rainbow-cutthroat hybrid.

with the Boulder was sampled only in the spring of 1982. The mouth of the East Boulder, mouth of Elk Creek and a section of the East Boulder near the Forest Service campground were sampled both in 1981 and 1982. The remaining sections were sampled in 1981 only (Fig. 1, Table 1).

METHODS

Electrofishing was the only method used to obtain fish samples. On the lower two sections of the Boulder, electrofishing was done with a 10-foot fiberglass boat. Electrical power was provided by a 220-volt, 3500 watt generator. Electrical output was regulated by a variable voltage pulsating unit (Coeffelt VVP-15). Output current varied from 300 to 600 volts d-c and from 1-3 amps. Due to the low conductivity of the water, a large aluminum plate was attached to the bottom of the boat to act as a cathode. A hand-held portable probe was used as the anode. Fish were captured as a three-man crew floated the electrofishing boat downstream. The upper sections of the river were electrofished by wading upstream with a backpack shocking unit (Smith-Root VVP VII).

Captured fish were weighed to the nearest 0.01 pound and total lengths were measured to the nearest 0.1 inch. Whitefish were fin-clipped with a distinctive mark for each section. Trout were fin-clipped, and those 8 inches and larger were tagged with Floy tags. Sexes of trout were determined when possible. Scale samples were taken by 0.5-inch length intervals.

Population estimates for brown and rainbow trout were made by methods similar to those used by Vincent et al., 1981. Calculations were made by the following computer program:

$$N = \frac{(M+1)(C+1)}{R+1} - 1 \text{ where:}$$

N = population estimate
M = number of fish marked
C = number of fish in recapture sample
R = number of marked fish in recapture sample (C)

If prerequisites of the computer program could not be met, the Schumacher-Eschmeyer method (Ricker, 1975) was used:

$$N = \frac{(CtMt^2)}{(MtRt)}$$

N = population estimate
M = number of fish marked at start of day t
C = total number of fish samples on day t
R = number of fish recaptured on day t

Water temperatures and conductivity were measured at each sampling section for each sampling day.

Catch per unit effort (CPUE)/1,000 feet was calculated by dividing the total number of fish captured each season by the number of runs.

RESULTS

A total of 7,946 fish were captured in the Boulder River drainage from November 1981 to June 1982. The number of tagged trout totaled 2,017. Numbers of each game species captured were as follows:

Fall 1981		Spring 1982	
Rb	1,158	Rb	743
LL	1,667	LL	1,587
MWf	1,142	MWf	1,590
Eb	50	Eb	8
Ct	1	Ct	0

Section B1 (Table 2)

The percent composition for fall 1981 was 76% whitefish, 19% brown trout and 5% rainbow trout. In spring 1982, it was 67% whitefish, 22% brown trout and 11% rainbow trout.

Schumacher-Eschmeyer estimates of yearling and older rainbow trout, indicate 99/1,000 feet in spring 1982, CPUE was 4.4. No estimate could be made for fall 1981 due to insufficient recaptures; however, the CPUE was 2.1. Lengths ranged from 5.3-17.3 inches in 1981 and averaged 9.3 inches. In 1982, they ranged from 3.7-23.2 inches and averaged 10.5 inches. The percent of the population 12 inches and larger was 23% in 1981 and 34% in 1982.

Brown trout numbers for young-of-year and older were estimated at 110/1,000 feet in fall 1981 and 143/1,000 feet in spring 1982; the CPUE was 6.8 and 8.4, respectively. Browns 12 inches and larger made up 34% of the population in 1981 and 32% in 1982. Lengths ranged from 3.9-19.9 inches in 1981 and 3.4-17.8 inches in 1982. Average lengths were 10.9 inches (fall) and 9.9 inches (spring).

Whitefish were estimated at 795/1,000 feet in 1981 and 589/1,000 feet in 1982; the CPUE was 27.9 (fall) and 25.8 (spring). Sizes ranged from 4.0-18.7 inches in 1981, averaging 12.1 inches and from 4.3-16.1 inches in 1982, averaging 11.5 inches.

Section B2 (Table 3)

The percent composition for Section B2 consisted of 35% whitefish, 54% brown trout and 11% rainbow trout in fall 1981. In 1982, it was 51% whitefish, 40% brown trout and 9% rainbow trout.

Petersen estimates for rainbow trout age one and older were 105/1,000 feet in fall 1981 and 43/1,000 feet in spring 1982 (Schumacher-Eschmeyer estimate); the CPUE was 3.8 and 3.1 for fall and spring, respectively. The size range of fish captured in 1981 was 3.2-15.7 inches, averaging 10.6 inches. In 1982, the size range was 3.2-22.3 inches, averaging 12.1 inches. The percent of the rainbow trout 12 inches and larger was 42% in 1981 and 60% in 1982.

The brown trout estimate for fish 2 years and older in fall 1981 was 233/1,000 feet, (CPUE 22.3), and 122/1,000 feet for fish 1 year and older in spring 1982, (CPUE 17.2). Lengths of browns ranged from 2.5-23.2 inches in 1981 and 3.7-17.0 inches in 1982. Mean lengths were 11.8 inches (1981) and 11.9 inches (1982). Fish 12 inches and larger made up 54% of the population in 1981 and 58% in 1982.

Schumacher-Eschmeyer estimates for yearling and older mountain whitefish were 248/1,000 feet in 1981 and 502/1,000 feet for 2-year olds and older in 1982; the CPUE was 11.9 and 22.7 for fall and spring, respectively. Sizes ranged from 6.7-16.5 inches in 1981, averaging 12.6 inches; ranges in 1982 were 6.8-18.3 inches, averaging 12.1 inches.

Section B2a (Table 4)

The fishery at Section B2a was composed of 20% whitefish, 76% brown trout and

Table 2. Fish population estimates for Boulder River, 1981-1982

Boulder River (Near Mouth) - B1							
Date	Age Class	Mean Length (in.)	Mean Weight (lbs.)	Estimated Number Per: 1,000 ft. Stream	Acre	Estimated Weight (lbs.) Per: 1,000 ft. Stream	Acre
				Rainbow Trout			
1981	I-IV	9.28	0.33	Too few recaptures to calculate.			
1982	I-V	10.05	0.59	99 (52-1,053)	57 (30-604)	58 (31-621)	34 (18-356)
				Brown Trout			
1981	0-V	10.09	0.58	110 (92-135)	63 (52-77)	64 (54-78)	37 (30-45)
1982	I-IV	9.09	0.40	143 (133-155)	82 (76-88)	58 (53-62)	33 (30-35)
				Whitefish			
1981	No Scales	12.01	0.60	795 (688-942)	454 (393-538)	477 (413-565)	272 (236-323)
1982	II-III	11.05	0.52	589 (543-644)	338 (311-369)	306 (282-335)	178 (162-192)

Table 3. Fish population estimates for Boulder River, 1981-1982

Boulder River (downstream from West Boulder) - B2

Date	Age Class	Mean Length (in.)	Mean Weight (lbs.)	Estimated Number Per: 1,000 ft. Stream	Estimated Number Per: Acre	Estimated Weight (lbs.) Per: 1,000 ft. Stream	Estimated Weight (lbs.) Per: Acre
				Rainbow Trout			
1981	I	6.9	0.14	24	10	3.4	1.4
	II	11.1	0.52	37	15	19.4	8.3
	III	12.8	0.76	24	10	18.3	7.5
	IV	13.8	0.94	20	8	18.3	7.5
			Total	105 (±53)	43 (±22)	60 (±30)	24 (±13)
1982	I-V	12.1	.88	43 (32-64)	17 (13-26)	37 (28.2-56.3)	15 (11.4-22.9)
				Brown Trout			
1981	II	9.5	0.35	84	35	29.1	11.9
	III	13.1	0.85	86	35	73.7	30.2
	IV	14.6	1.16	43	18	49.7	20.4
	V	16.5	1.78	19	8	33.5	13.7
			Total	233 (±42)	96 (±17)	186 (±39)	76 (±16)
1982	I-V	11.9	.62	122 (103-152)	50 (42-63)	75.6 (64-76)	31 (26-39)
				Whitefish			
1981	I-VII	12.6	0.64	248 (176-420)	102 (72-172)	160 (113-270)	66 (46-111)
1982	II-IV	12.1	0.60	502 (454-563)	206 (186-231)	301 (272-338)	124 (112-139)

Table 4. Fish population estimates for West Boulder River, 1981-1982

West Boulder River (Near Mouth) - B2A							
Date	Age Class	Mean Length (in.)	Mean Weight (lbs.)	Estimated Number Per: 1,000 ft. Stream	Acre	Estimated Weight (lbs.) Per: 1,000 ft. Stream	Acre
				Rainbow Trout			
1982	IV-V	9.04	.38				
				Brown Trout			
1982	I-V	9.19	.41	416 (346-522)	725 (603-910)	171 (142-214)	298 (247-373)
				Whitefish			
1982	Too Few Scales	12.07	.63	153 (106-266)	266 (185-463)	96	168 (106-292)

4% rainbow trout in spring 1982; no sampling was done in fall 1981.

Insufficient recaptures of tagged rainbow trout resulted in no population estimate for the spring; however, the CPUE was 3.1. Sizes ranged from 5.1-15.4 inches and averaged 9.4 inches. Fish larger than 12 inches made up 58% of the population.

A Schumacher-Eschmeyer estimate for brown trout age one and older was 416/1,000 feet; CPUE was 40.0. Ranges of lengths were 2.5-14.2 inches. The mean length was 9.2 inches. The percent of fish 12 inches and larger was 18%.

Whitefish numbers were estimated at 153/1,000 (Schumacher-Eschmeyer); the CPUE was 10.0. Sizes ranged from 10.3-14.5 inches, with a mean length of 12.7 inches.

Section B3 (Table 5)

Species composition was 19% rainbow trout, 8% whitefish and 73% brown trout in 1981; in 1982 it was 19% rainbow trout, 16% whitefish and 65% brown trout.

Rainbow trout ages 1 year and older were estimated at 25/1,000 feet in fall (CPUE 21.7) and 182/1,000 feet in spring (CPUE 8.1). Sizes ranged from 2.0-14.9 inches in 1981, averaging 5.2 inches. In 1982, sizes were 2.2-15.0 inches, averaging 6.2 inches. In 1981, 7% of the rainbow trout were 12 inches or larger, while in 1982, 8% were larger.

Estimates of brown trout, yearlings and older, in 1981 were 611/1,000 feet of stream (CPUE 83.1) and were 282/1,000 feet in 1982 (CPUE 28.0). Mean lengths were 9.0 inches and 8.4 inches in fall and spring, respectively. Range of lengths was 2.3-22.4 inches and 2.4-17.1 inches in fall and spring, respectively. The percent of browns 12 inches and larger was 48% in 1981 and 24% in 1982.

Whitefish young-of-year and older were estimated at 188/1,000 feet in 1982, with too few recaptures in 1981 to obtain an estimate (CPUE was 5.2 in fall and 7.0 in spring). Lengths ranged from 4.6-14.7 inches in 1981, averaging 10.5; from 4.8-15.5 inches in 1982, averaging 12.7 inches.

Four brook trout were captured in 1982 and lengths ranged from 6.3-9.8 inches.

Section B4 (Table 6)

Species composition in 1981 was 88% brown trout, 10% rainbow trout and 2% brook trout, with 64% brown trout and 36% rainbow trout in 1982.

The population estimate of rainbow trout 1 year old and older was 17/1,000 feet (CPUE 20.0) in 1981 and 77/1,000 feet (CPUE 9.0) in 1982 (Schumacher-Eschmeyer). Lengths ranged from 5.3-10.4 inches in 1981 and 3.0-11.1 inches in 1982. The mean length was 7.4 inches in 1981 and 7.3 inches in 1982. No rainbow trout were 12 inches or larger in 1981 or 1982.

Brown trout numbers were estimated at 157/1,000 feet in 1981 and 98/1,000 feet in 1982; the CPUE was 36.0 and 85.5, respectively. Sizes ranged from 3.1-14.6 inches in 1981, averaging 7.1 inches. In 1982 they were 3.2-13.0 inches, averaging 7.8 inches. Fish 12 inches and over made up 28% of the brown trout population in 1981 and 1% in 1982.

Ten brook trout were captured in 1981. Lengths ranged from 4.2-9.3 inches and mean length was 6.7 inches. No brook trout were captured in 1982.

Table 5. Fish population estimates for East Boulder River, 1981-1982

East Boulder River Near Mouth - B3

Date	Age Class	Mean Length (in.)	Mean Weight (lbs.)	Estimated Number Per: 1,000 ft. Stream	Estimated Number Per: Acre	Estimated Weight (lbs.) Per: 1,000 ft. Stream	Estimated Weight (lbs.) Per: Acre
				Rainbow Trout			
1981	I	6.1	0.10	9	14	0.90	1.32
	II	9.2	0.32	9	13	2.72	3.97
	III	11.3	0.57	5	7	2.57	3.75
	IV+	12.2	0.84	3	4	2.25	3.29
			Total	26 (±6)	38 (±8.4)	8.6 (±2.5)	12.6 (±3.6)
1982	O-IV	6.2	0.17	182	264	30.9	44.9
				Brown Trout			
1981	O	3.4	0.02	336	491	5.6	8.2
	I	6.6	0.13	112	164	14.4	21.1
	II	10.4	0.46	42	61	19.4	28.3
	III	13.5	0.97	71	105	69.0	100.9
	IV	15.5	1.41	42	61	59.2	86.5
	V+	18.2	2.15	7	10	14.3	20.9
			Total	611 (±177)	892 (±259)	181.8 (±32.8)	265.8 (±47.9)
1982	O-V	8.4	.32	282 (259-308)	409 (377-447)	90.2 (83-98)	130.9 (121-143)
				Whitefish			
1981	O-VII	10.5	0.55	Too few recaptures to calculate.			
1982	II-IV	12.7	0.66	188 (173-207)	273 (251-300)	124.1 (114.2-136.6)	180.2 (166-498)

Table 6. Fish population estimates for East Boulder River, 1981-1982

Elk Creek (Near Mouth) - B4

Date	Age Class	Mean Length (in.)	Mean Weight (lbs.)	Estimated Number Per: 1,000 ft. Stream	Estimated Number Per: Acre	Estimated Weight (lbs.) Per: 1,000 ft. Stream	Estimated Weight (lbs.) Per: Acre
				Rainbow Trout			
1981	I	7.1	0.15	15	63	2.2	9.6
	II+	8.3	0.18	2	7	0.3	1.3
			Total	17 (±5)	70 (±23)	2.5 (±1.0)	10.9 (±4.5)
1982	II-IV	7.3	0.19	77			
				Brown Trout			
1981	I	6.2	0.09	102	443	9.2	40.1
	II	9.3	0.30	50	217	15.2	66.1
	III+	13.8	1.00	5	24	5.4	23.3
			Total	157 (±19)	684 (±81)	30 (±5.2)	129.5 (±22.5)
1982	II-IV	7.8	0.19	98			
				Brook Trout			
1981	No Scales	6.7	0.07	-	-	-	-

Section B4a (Table 7)

This section was only sampled in fall 1981. No population estimate was made due to insufficient recapture of tagged fish. Species composition consisted of 60% brook trout, 20% rainbow trout and 20% brown trout; mean lengths were 4.6, 8.6 and 5.4, respectively. The length range was 3.3-7.9 inches for brook trout, 7.5-9.6 inches for brown trout and 2.6-7.7 inches for rainbow trout. No rainbow or brown trout 12 inches and larger were captured.

Section B5 (Table 8)

Species composition for this section was 86% rainbow trout, 11% brown trout an 3% brook trout in 1981; in 1982 it was 92% rainbow trout, 7% brown trout and 1% brook trout.

Rainbow trout 1 year old and older were estimated at 490/1,000 feet in 1981 and 1,378/1,000 feet for yearlings and older in 1982; the CPUE was 139.2 (fall) and 82.4 (spring). Rainbows ranged in length from 1.8-10.3 inches in 1981 and from 1.2-11.6 inches in 1982. Mean lengths were 5.8 inches in 1981 and 5.2 inches in 1982. No rainbow trout 12 inches or larger were captured in 1981 or 1982.

Estimated numbers of brown trout in 1981 for young-of-year and older was 49/1,000 feet (CPUE 18.4); in 1982 for 1 year olds and older it was 38/1,000 feet (CPUE 6.3). Lengths varied from 1.9-14.2 inches (1981), averaging 8.6 inches, and 2.4-14.4 inches (1982), averaging 9.1 inches. A total of 9% of the brown trout were 12 inches and over in 1981, while 13% were in 1982.

Brook trout numbers were not determined because of too few recaptures during both years. The sizes ranged from 4.9-8.3 inches (1981) and 2.7-5.3 inches (1982). The mean lengths were 6.3 inches (1981) and 4.0 (1982).

Section B6 (Table 9)

No sample was taken in spring 1982, but the species composition in 1981 was 82% rainbow trout and 18% brown trout.

Rainbow yearlings and older were estimated at 311/1,000 feet, with a size range from 1.7-11.2 inches; CPUE was 125.3. Mean length was 6.5 inches. No fish over 12 inches were captured.

Brown trout yearlings and older were estimated at 89/1,000 feet; the CPUE was 26.9. The lengths ranged from 2.2-11.3 inches, averaging 6.6 inches. None of the fish were 12 inches or larger.

Section B7

No sample was taken in 1982, and no estimate was made in 1981; the CPUE for rainbow trout was 31.4 and 20.0 for brown trout. Eleven rainbow trout were taken in two runs, with lengths ranging from 3.3-7.6 inches. The average length was 4.7 inches. Seven brown trout were taken during two runs and averaged 6.4 inches. The length range was 3.8-10.3 inches.

Section B8

Electrofished 100 yards of Canyon Creek; no fish captured.

Section B9 (Table 10)

Fish were not sampled in 1982. Ninety percent of the fish were rainbow trout

Table 7. Fish population estimates for Boulder River, 1981-1982

Elk Creek (3 mi. upstream from its mouth) B4a

Date	Age Class	Mean Length (in.)	Mean Weight (lbs.)	Estimated Number Per: 1,000 ft. Stream	Estimated Number Per: Acre	Estimated Weight (lbs.) Per: 1,000 ft. Stream	Estimated Weight (lbs.) Per: Acre
				Rainbow Trout			
1981	No Scales	5.4	0.08	Too few recaptures to calculate.			
				Brown Trout			
1981	No Scales	8.6	0.25	Too few recaptures to calculate.			
				Brook Trout			
1981	No Scales	4.6	0.04	Too few recaptures to calculate.			

Table 8. Fish population estimate for East Boulder River, 1981-1982

East Boulder River (USFS Campground) - B5

Date	Age Class	Mean Length (in.)	Mean Weight (lbs.)	Estimated Number Per: 1,000 ft. Stream	Estimated Number Per: Acre	Estimated Weight (lbs.) Per: 1,000 ft. Stream	Estimated Weight (lbs.) Per: Acre
				Rainbow Trout			
1981	I	4.3	0.03	259	287	8.6	9.5
	II	6.1	0.09	94	105	8.8	9.8
	III	8.0	0.23	86	95	19.5	21.7
	IV	9.0	0.32	46	51	14.8	16.4
	V+	9.9	0.42	5	5	2.0	2.2
			Total	490 (±110)	543 (±122)	53.7 (±8.7)	59.7 (±9.7)
1982	O-V	5.2	0.13	1,378 (1,055-1,988)	1,539 (1,179-2,221)	179.1 (137.2-258.4)	200.1 (153.3-288.1)
				Brown Trout			
1981	II	7.4	0.17	15	17	2.6	2.9
	III	9.6	0.39	16	18	6.3	7.1
	IV+	11.5	0.60	17	19	10.5	11.7
			Total	49 (±19)	55 (±21)	19.4 (±7.5)	21.7 (±8.4)
1982	I-IV	9.1	0.35	38 (27-65)	42 (30-73)	13.3 (9.5-22.8)	14.7 (10.5-25.6)

Table 8a. Number and weight of trout estimated in the East Boulder River near the U. S. Forest Service campground (B5) during summer (1980) and autumn (1974)

Date	Species	Age Class	Estimated Number/ 1,000-foot Stream	Estimated Weight (lb.)/ 1,000-foot Stream
1974[1]	Rb	I-IV and older	255 (±43)	24.6 (±2.8)
1980[2]	Rb	I-V and older	394 (±81)	40.0 (±7.0)
1974[1]	LL	II-IV and older	69	16.9
1980[2]	LL	No estimate		

[1]Stewart (1977).

[2]MDFWP (1981).

Table 9. Fish population estimates for East Boulder River, 1981-1982

East Boulder River (Downstream from Dry Fork) - B6

Date	Age Class	Mean Length (in.)	Mean Weight (lbs.)	Estimated Number Per: 1,000 ft. Stream	Estimated Number Per: Acre	Estimated Weight (lbs.) Per: 1,000 ft. Stream	Estimated Weight (lbs.) Per: Acre
				Rainbow Trout			
1981	I	4.4	0.03	99	132	3.2	4.3
	II	6.0	0.08	62	82	5.2	7.0
	III	7.5	0.17	50	67	8.3	11.1
	IV	8.3	0.23	83	111	19.3	25.7
	V+	9.7	0.38	16	22	6.3	8.4
			Total	311 (±58)	415 (±77)	42.3 (±6.9)	56.5 (±9.2)
1982	No Sample.						
				Brown Trout			
1981	I	3.8	0.02	28	39	0.6	0.8
	II	6.8	0.11	25	34	2.9	3.8
	III+	8.9	0.28	36	48	10.0	13.4
			Total	89 (±30.8)	121 (±422)	13.5 (±4.6)	19 (±6.2)
1982	No Sample.						

Table 9a. Number and weight of trout estimated in the East Boulder River downstream from Dry Fork (B6) during summer (1972 and 1973)

Date	Species	Age Class	Estimated Number/ 1,000-foot Stream	Estimated Weight (lb.)/ 1,000-foot Stream
1972[1]	Rb	I-V and older	208 (±33)	19.0 (±2.5)
1973[1]	Rb	I-V and older	193 (±29)	22.0 (±2.5)
1972[1]	LL	II-IV and older	34 (±10)	4.5 (±1.2)
1973[1]	LL	II-IV and older	54 (±11)	7.1 (±2.1)

[1]Stewart (1977).

Table 10. Fish population estimates for East Boulder River, 1981

East Boulder River (Downstream from Canyon Creek) - B9

Date	Age Class	Mean Length (in.)	Mean Weight (lbs.)	Estimated Number Per: 1,000 ft. Stream	Estimated Number Per: Acre	Estimated Weight (lbs.) Per: 1,000 ft. Stream	Estimated Weight (lbs.) Per: Acre
				Rainbow Trout*			
1981	I	4.9	0.05	35	65	1.7	3.2
	II	6.1	0.10	5	9	0.5	0.9
	III	7.9	0.25	23	42	5.5	10.3
	IV	8.9	0.33	19	35	6.3	11.7
	V+	10.5	0.52	9	16	4.5	8.4
			Total	91 (±14)	167 (±26)	18.5 (±2.6)	34.5 (4.8)
				Brown Trout			
1981	II-VI	6.5	0.17	11 (±2.8)	21 (±5)	4.1 (±1.0)	7.8 (±1.9)

*Includes some fish which maybe rainbow-cutthroat hybrids.

and 10% were brown trout in 1981. The estimated number of rainbow trout ages 1 and older was 91/1,000 feet, with an average length of 6.5 inches; the CPUE was 56.7. Lengths ranged from 1.6-11.5 inches. No rainbow trout were 12 inches or larger.

Brown trout, ages 2 years and older, were estimated at 11/1,000 feet and averaged 9.9 inches in length; the CPUE was 6.1. The range of size was 6.1-13.4 inches. A total of 21% of the brown trout were 12 inches and larger.

Section B10

Electrofished 100 yards near the mouth of Brownlee Creek; no fish collected.

Section B11

Electrofished 100 years of East Boulder downstream from Brownlee Creek; one cutthroat trout was captured.

SPAWNING

Rainbow Trout

Ripe male and female rainbow trout were captured in the Boulder River in spring 1982 at Sections B1-B5.

One active redd was observed on the Clark Ranch, on the main Boulder upstream from the mouth of the East Boulder. Suitable spawning habitat (loose, clean, small gravel) was observed at Sections B3, B4 and B5.

Ripe rainbow males were first observed during sampling in mid-March 1982 on Sections B1, B2 and B3. Ripe females were first seen in late March. Both ripe males and females were observed until late May. The number of ripe rainbows did not peak during the spring, but appeared to maintain constant numbers over the sampling period.

Ripe male and female rainbow trout were first observed in late April at Sections B4 and B5. They continued to be observed until late May, the beginning spring runoff. Curiously, numerous rainbow trout (less than 2.0 inches) were observed from late April through May. A sample taken in late August contained large numbers of rainbow trout in the same size group.

Brown Trout

Ripe male and female brown trout were captured in the Boulder River in fall 1981 at Sections B1-B6 and B9. They were also captured at the outflow of a lake which drains into Dry Fork Creek approximately 1 mile upstream from its mouth.

Active brown trout redds were observed at: B3 (extensive number of redds at the tail end of pools throughout the section, B4 (in small pools especially in upper half of section), B6 (in a pool near the mouth of Dry Fork), B9 (at tail of pools) and in the outflow of the lake which drains into Dry Fork Creek.

Ripe male and female brown trout were first observed at all sampling sections in late October 1981. Ripe brown trout continued to be captured at sections B1-B3 until sampling was terminated in December.

Ripe whitefish were observed at essentially the same time as spawning brown trout, Sections B1-B3.

Movement related to spawning was indicated by rainbow and brown trout which were

tagged in the Boulder River and recovered at various locations in the Yellowstone River by anglers and electrofishing crews (Tables 11 and 12). Some movement of tagged trout was observed between sampling sections within the Boulder drainage itself (Table 13).

Based on ripe rainbow and brown trout captured in the Boulder and Stillwater rivers, the typical Yellowstone migrant spawner was assumed to be 12 inches in length, or larger.

DISCUSSION

In the spring of 1982 there was an apparent influx of migrant rainbow trout in Section B1. Rainbows 12 inches and larger made up 23% of the total rainbow population in the fall (1981) and 34% the following spring; the CPUE increased from 2.1 (fall) to 4.4 (spring). Rainbows comprised 5% of the section's game fish population in fall and 11% in spring.

The presence of large spawning rainbows in Section B2 was a little more obvious. Fish 12 inches and larger made up 60% of the rainbow trout population in spring and 42% in fall. The CPUE was nearly the same for both seasons: 11% (fall) and 9% (spring). Population estimates and percent composition indicated that rainbow numbers had diminished from fall to spring. This may have been the result of resident fish moving upstream to spawn.

In Section B3, the percent of fish 12 inches and larger that comprised the rainbow population increased from 7% (fall) to 8% (spring). Rainbows present in the spring and fall populations were nearly the same (19%); the CPUE dropped from 21 (fall) to 8 (spring), but the population estimate for rainbows rose from 26/1,000 feet (fall) to 182/1,000 feet (spring).

No rainbows 12 inches or larger were captured in other sections upstream from B3 in the East Boulder, but percent composition and population estimates for Sections B4 and B5 indicated that there was an increase in rainbow trout numbers in the spring of 1982. At Section B4, rainbows made up 10% of the population in fall and 36% in spring. At Section B5, rainbows rose from 86% to 92%. The population estimates for rainbows increased from 17/1,000 feet to 77/1,000 feet at Section B4, and from 490/1,000 feet to 1,378/1,000 feet for Section B5. The increase of rainbow trout numbers may indicate an upstream migration of resident rainbow trout from lower sections of the Boulder River.

Data suggest that an influx of brown trout may also occur in the lower sections of the Boulder River during fall. At Section B1, trout 12 inches and larger made up 34% of the brown trout population in fall 1981 and 32% in spring 1982. The percent composition dropped from 19-22% during this period; the CPUE was 6.8 (fall) to 8.4 (spring). The population estimate decreased from 110/1,000 feet in fall to 143/1,000 feet in spring. The decrease in total numbers of brown trout in this section may indicate a shift of spawners to sections further upstream.

Trout 12 inches and larger in the brown trout population at Section B2 were 54% (fall) and 58% (spring). Fewer numbers in the fall may have been the result of unsuitable spawning sites. Curiously, however, the total number of brown trout appeared to increase in this section during the fall. The percent composition of brown trout decreased from 54% (fall) to 40% (spring) as did CPUE, 22.3-17.2. The population estimate for fall was 233/1,000 feet, and 122/1,000 feet for spring.

More brown trout 12 inches and larger were captured in the fall than in spring, 48 and 24%, respectively. The percent composition was 73% brown trout in fall and

Table 11. Rainbow trout movement in the Boulder-Yellowstone system

No.	Tag No.	Length (in.)	Location Tagged	Date	Location Recaptured	Date	Approximate River Miles
1	B-194	10.9	Highway 200 Bridge (Yellowstone River)	4/19/79	1 mi. upstream from mouth of Boulder River	5/80	2
2	P-333	10.7	5 mi. upstream from Big Timber (Yellowstone River)	5/9/80	6 mi. upstream from mouth of Boulder River	7/15/80	11
3	P-48	13.7	6 mi. upstream from Big Timber (Yellowstone River)	5/6/80	6 mi. upstream from mouth of Boulder River	8/80	11
4	B-328	11.7	Near mouth of Boulder River (Yellowstone River)	4/20/79	6.5 mi. upstream from mouth of Boulder River	11/5/80	7
5	B-22	12.9	4 mi. upstream from Big Timber (Yellowstone River)	4/17/79	Vogel Bridge (Boulder River)	11/5/80	11
6	0-3634	11.8	Boulder River (B1)	4/21/82	Near Big Timber Bridge (Yellowstone River)	5/7/82	2
7	0-3529		Boulder River (B1)	4/14/82	Bratten Fishing Access (Yellowstone River)	5/29/82	31
8	0-3344	19.2	Boulder River (B2)	3/30/82	Reedpoint (Yellowstone River)	9/2/82	39
9	0-3549	12.6	Boulder River (B2)	4/14/82	4 mi. E of Big Timber (Yellowstone River)	8/21/82	20

Table 12. Brown trout movement in the Boulder-Yellowstone system

No.	Tag No.	Length (in.)	Location Tagged	Date	Location Recaptured	Date	Approximate River Miles
1	Y-176	9.3	4.5 mi. upstream from Columbus (Yellowstone River)	8/11/78	8.0 mi. upstream from mouth of Boulder River	7/26/80	51
2	B-983	15.9	3.5 mi. upstream from Big Timber (Yellowstone River)	4/18/80	4.0 mi. upstream from mouth of West Boulder River	9/27/80	28
3	Y-634	18.7	4.0 mi. downstream from Columbus (Yellowstone River)	5/2/80	3.0 mi. upstream from mouth of West Boulder River	7/15/80	73
4	Y-1277	15.2	Columbus Bridge (Yellowstone (River)	5/19/80	1.0 mi. upstream from mouth of East Boulder River	11/15/81	72
5	Y-1273	16.2	Columbus Bridge (Yellowstone River)	5/19/80	Near mouth of East Boulder River	7/23/81	71
6	O-1689	19.4	Boulder River (B2)	11/1/81	3.0 mi. upstream from Big Timber (Yellowstone River)	4/17/82	19
7	B-2390	8.9	Boulder River (B1)	3/17/82	Big Timber Bridge (Yellowstone River)	5/3/82	2
8	B-2238	17.0	Boulder River (B1)	11/14/82	Near mouth of Deer Creeks (Yellowstone River)	4/24/82	6
9.	B-2292	17.0	Boulder River (B2)	12/2/81	Greycliff (Yellowstone River)	3/31/82	25
10.	O-3371	12.7	Boulder River (B1)	3/30/81	.5 mi. above Big Timber (Yellowstone River)	5/24/82	3

Table 13. Trout movement within the Boulder River drainage

No.	Tag No.	SP	Location	Date	Recapture	Date	Approx. River Mi
1	0/1149	LL	B3	10/23/81	B2	11/8/81	3
2	0/1702	LL	B2	11/1/81	B3	11/9/81	3
3	0/1377	LL	B2	10/26/81	B3	11/25/81	3
4	B/2095	Rb	B5	11/12/81	B3	12/1/81	7
5	0/1936	LL	B2	11/8/81	12 mi downstream from highway bridge	3/15/82	16
6	0/1570	LL	B3	10/30/81	B4	7/8/82	3
7	9/3683	Rb	B5	4/27/82	B1	7/10/82	26
8	0/1071	Rb	B2	10/23/81	B3	5/22/82	3
9	B/2009	Rb	B3	11/9/81	B2	4/24/82	3
10	B/3077	LL	B3	3/18/82	Main Boulder 1 mi above mouth of East Boulder River	5/2/82	1
11	0/3582	Rb	B2	4/15/82	Just below Natural Bridge-Boulder River	5/16/82	9
12	0/3626	LL	B3	5/13/82	3/4 mi below mouth East Boulder River	8/7/82	1

65% in spring; the CPUE was 83 in fall and 28 in spring. The population estimate for browns in the fall was 611/1,000 feet and 282/1,000 feet in the spring.

The mountain whitefish population did not appear to increase in the fall of 1981 based on the CPUE, percent composition, or population estimates, for Sections B2 and B3. Section B1 had an estimate of 795/1,000 feet in fall and 589/1,000 feet in spring. The CPUE was 28 (fall) and 26 (spring), and percent composition was 76% and 67% in fall and spring, respectively.

Tag return data for 1980-82 further substantiates the theory that rainbow and brown trout migrate within the Boulder River drainage, and within the Boulder-Yellowstone River system.

Observation of numerous active brown trout redds at Sections B3, B4, B6 and B9 suggests that the East Boulder River may be an important spawning area for the entire Boulder fishery. Although few active rainbow trout redds were observed in the spring of 1982, it is felt that further investigation will reveal the location of prime rainbow trout spawning areas.

It is important to note that trout exist in nearly all sections of the Boulder River and lack of population estimates does not indicate that species are not present. Failute to obtain an estimate may have resulted from 1) too few recaptures to obtain a valid estimate and 2) fluctuating fish populations due to spawning movements.

It should also be noted that this 1-year study is insufficient to fully appreciate the dynamics of the Boulder-Yellowstone fishery. Two more years, minimum, should be added to this survey.

RECOMMENDATIONS

1) Better population estimates should be obtained for sampling sections in the lower Boulder River.

2) More time should be devoted to locating prime spawning areas and juvenile rearing areas, especially for rainbow trout.

3) Creel census work is needed to determine fisherman harvest and recreational value of the Boulder River as it presently exists. The initiation of mining activity will not only impact water quality, but will no doubt increase fisherman use and harvest.

4) Fishery should be continuously monitored during mining activity.

5) Interaction of the Boulder-Yellowstone fishery should be evaluated more thoroughly, with special emphasis on importance of the Boulder River as a spawning area for Yellowstone trout.

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A P P E N D I X

Appendix 1. Conductivities and temperatures recorded at time of sampling

Section	Date (1982)	Cond. (mhos/cm^2)	Temp. (^{o}F)	Flow (cfs)
B1	3/17	260	39	-
	3/30	250	38	63
	4/8	225	38	62
	4/13	275	45	132
	4/21	275	40	132
	4/29	250	46	-
	5/6	150	41	500
B2	3/30	245	38	
	4/15	280	40	
	4/22	275	41	
	4/29	250	54	
B2a	4/19	275	39	
	4/30	200	43	
B3	3/18	411	36	
	4/15	500	39	
	4/23	500	48	
	5/3	300	55	
	5/13	330	41	
B4	5/18	400	49	
B5	4/27	275	40	
	5/6	150	43	
	5/14	175	42	
	5/21	175	40	

AVERAGE DAILY TEMPERATURES RECORDED AT SECTION B1

April-June 1982

	APRIL	MAY	JUNE
1	40	55	-
2	39	-	-
3	41	-	-
4	40	-	-
5	38	-	-
6	40	50	-
7	41	52	-
8	39	48	-
9	38	45	-
10	41	46	54
11	43	47	54
12	46	52	54
13	48	54	53
14	47	56	48
15	48	56	71
16	44	57	72
17	41	59	44
18	45	58	43
19	42	54	44
20	37	52	44
21	38	53	45
22	44	54	45
23	49	55	44
24	52	51	40
25	53	54	40
26	26	51	40
27	48	-	42
28	74	-	42
29	49	-	42
30	50	-	-
31	52	-	-
32			
33			
34			
35			

THERMOGRAPH READINGS AT END OF SECTION B1

April-June 1982

	APRIL		MAY		JUNE	
	MAX	MIN	MAX	MIN	MAX	MIN
1	43	36	59	51	-	-
2	42	35	-	-	-	-
3	45	34	-	-	-	-
4	43	36	-	-	-	-
5	43	33	-	-	-	-
6	46	33	54	46	-	-
7	45	36	55	48	-	-
8	42	35	50	46	-	-
9	43	33	46	43	-	-
10	47	35	47	44	54	53
11	50	36	50	43	57	50
12	49	42	58	45	57	50
13	52	43	58	49	56	49
14	52	42	62	50	51	45
15	51	44	59	53	49	44
16	46	42	60	53	49	45
17	47	36	64	53	45	42
18	50	39	60	55	45	40
19	47	37	57	50	46	42
20	40	34	55	48	46	42
21	46	32	58	48	47	42
22	52	36	58	50	47	42
23	56	41	58	51	44	40
24	58	45	54	47	40	40
25	59	47	57	50	40	39
26	50	44	53	48	40	39
27	52	44	-	-	44	39
28	55	45	-	-	44	39
29	53	44	-	-	43	39
30	55	44	-	-	-	-
31	59	44	-	-	-	-
33						
34						
35						