CHARACTERIZATION OF THE LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE GRAND CANYON

TRIP REPORT 1 - 1993
January 8, 1993 - January 23, 1993

Prepared For:

Bureau of Reclamation

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INTRODUCTION

This report presents pertinent details associated with Trip 1, 1993. Included in the report are a summary of the trip logistics, personnel and research schedule, data collected, problems encountered, pertinent observations and recommendations. Most information is presented in a tabular format to provide a quick synopsis of pertinent trip details and results. We emphasize that these data are hand tabulated to provide these synopses as soon as possible. The data are then computerized and checked for accuracy. The purpose of these trip reports is to provide information from BIO/WEST trips as quickly as possible to aid other researchers.

LOGISTICS, RESEARCH SCHEDULE AND PERSONNEL

Table 1 presents a summary of logistics and the research schedule for Trip 1, 1993. Table 2 is a list of personnel who were present or participated in research activities for Trip 1, 1993.

DATA COLLECTED

Table 3 is a summary of gear types used, sampling effort and fish captured by gear type for Trip 1, 1993. Table 4 is a summary of all humpback chubs handled during Trip 1, 1993. Table 5 summarizes the radio contacts during Trip 1, 1993 and presents original fish release locations and radiotag data.

Humpback Chubs Captured

A total of 260 humpback chub were captured during Trip 1, 1993 including 94 YOY (<101 mm TL), 55 juveniles (100-199 mm TL), and 111 adults (>199 mm TL). All humpback chub were captured in Reach 1 between RM 60 and RM 71. One hundred twenty-seven chubs were captured with seines including 8 adult, 42 juveniles and 77 YOY. Thirty-three chubs, including 11 adults, 11 juveniles and 11 YOY were captured electrofishing. Netting produced 94 humpback chub including 92 adults and 2 juveniles. Six YOY chubs were also captured in unbaited minnow traps.

Over 80% of adult humpback chub handled during Trip 1, 1993 were recaptures. A preliminary analysis of tagging data indicates that approximately 10-15% of these fish were originally marked by BIO/WEST. It is assumed that the remainder of the recaptures were originally marked by AGF or ASU in the LCR. Recapture rates during Trip 1, 1993 represent the highest ever observed by BIO/WEST in the main channel Colorado River, Grand Canyon.

One humpback chub, from which muscle and fin tissues were removed for the Gila taxonomy study was recaptured during Trip 1, 1993. The fish was in good condition and photographs were taken. The fish was originally captured and processed on May 12, 1992, measuring 355 mm TL and weighing 407 g. When recaptured the fish measured 362 mm TL and weighed 563 g. All wounds associated with tissue samples were healed with no signs of infection or other abnormalities.

Five juvenile humpback chubs fin clipped by ASU in the LCR were recaptured by BIO/WEST during Trip 1, 1993. Two fish were marked with upper caudal, right pelvic clips; two fish had upper caudal left pelvic clips; and one had a lower caudal, left pelvic fin clip combination.

Radiotelemetry

No humpback chubs were implanted with radio transmitters during Trip 1, 1993.

One fish implanted during Trip 9 (September), 1992 was recontacted during one surveillance run during Trip 1, 1993. No observations were conducted during Trip 1, 1993.

Two previosly radio-tagged humpback chubs were recaptured during Trip 1, 1993. The first fish was recaptured by electrofishing on January, 15, 432 days after being implanted. The fish was originally captured on November 9, 1991 at RM 60.1, measuring 423 mm TL and weighing 605 g. The fish was recaptured at RM 61.2, measuring 425 mm TL and weighing 658 g. Excluding transmitter weight the fish gained 42 g since it was originally handled. The fish was active and in excellent condition. The primary incision site was completely healed with no sign of infection or other abnormalities. The antenna exit was also in excellent condition with no sign of infection or tissue damage. Fatty-like, epidermal tissue had grown around the antenna exit, extending approximately 2-3 mm up the antenna. Photographs were taken, the antenna was clipped and the fish released.

The second recaptured fish was netted on January 16 at RM 63.75. Attempts to identify the fish from our database led us to discover that the fish was last handled by AGF at RK 0.38 in the LCR on June 3, 1992. At that time AGF personel recaptured the fish, checked the transmitter, and scanned for a PIT tag. The transmitter was inactive so the antenna was clipped and no PIT tag was detected. A new PIT tag was implanted by AGF and the fish was photographed and released. At the time that AGF handled the fish it measured 394 mm TL and weighed 418 g. The fish was classified as a spent female. When the fish was recaptured by BIO/WEST 175 days later it measured 391 mm TL and weighed 602 g. Since BIO/WEST's original PIT tag was not detected, it is not possible at this time to determine the original capture weight. Attempts will be made to determine the fish's identity from photographs taken by BIO/WEST and AGF. It must be noted that based on timing of captures, field notes on the condition of the fish and weight gain, it is assumed that the fish spawned during 1992 despite the presence of the radiotransmitter.

The omnidirectional remote telemetry station located at RM 60.5 was found inactive on January 11. Despite normal battery outputs the station was not logging and data memory was full of junk data. Initialization parameters and frequency tables were also scrambled. This problem has occurred during three previous trips and is suspected to be associated with static electricity buildup around the station. No data was salvaged from the station for the December and early January period. The station was dismantled and removed from the site.

Habitat Mapping

GCES surveyors and consultants from Global Hydrographic completed a partial bathemetry survey of the LCR confluence area. Stage information on main channel pooling caused from a high volume flood event out of the LCR was also collected.

Bench Marks

No new bench marks were established during Trip 1, 1993.

OBSERVATIONS

1. A large flood eminating from the headwaters of the LCR passed the confluence area during Trip 1, 1993. It is estimated that flows peaked in early afternoon on January 13. Discharge from the LCR was higher than any observed by BIO/WEST during the course of this investigation (since October 1990) and effects on the main channel both above and below the LCR confluence were profound. Water in the main channel appeared to back as far upstream as RM 60.0, with noticable decreases in water velocity (ponding) and significant stage effects, possibly as much as two vertical feet. Large amounts of sediment deposition occurred from the mouth of the LCR downstream. Significant changes in channel morphology occurred as the result of sediment deposition in these areas.

2. Densities of fish, especially humpback chub were extremely high for approximately 2 to 3 miles below the confluence of the LCR following the flood observed during Trip 1, 1993. Numerous adult, juvenile and YOY chub were captured in low velocity shoreline habitats using electrofishing and seining. Many of the fish appeared to be in relatively poor condition, with numerous abrasions, worn fins and looked gaunt and stressed. It is speculated that a large number of these fish had moved or were flushed from the LCR in response to the flood. This is evidenced by recapture of 5 juvenile humpback chub originally marked by ASU in the LCR and unusually high recapture rates for adults (approximately 80%).

3. Seining and electrofishing catch rates of juvenile and YOY humpback chub were extremely high for 2 to 3 miles below the confluence of the LCR during Trip 1, 1993. Catch rates continually decreased downstream of this point to approximately RM 68 (near Tanner Rapid). Below Tanner Rapid early life stages of humpback chub were rare (2 were captured electrofishing at RM 69.3). It is believed that many of the young humpback chub that disperse into the main channel initially occupy shoreline habitats immediately below the LCR confluence. The distinct geomorphic break that occurs around Lava Canyon (RM 65.5) creates channel morphology with higher gradient providing relatively little protected, slow velocity habitat. Fish that are flushed or disperse into this reach may be forced to continue downstream. With this recent influx of young fish into the main channel, continued main channel sampling effort by BIO/WEST and AGF should provide additional information on dispersal patterns of these fish in the main channel.

4. One large juvenile green sunfish (120 mm TL) was captured at RM 60.1 during Trip 1, 1993. This is only the second individual of this species captured by BIO/WEST during this investigation. It is assumed that this fish entered the main channel via the LCR then dispersed upstream over a mile in the main channel.

5. Two subreaches were sampled in Reach 0 (Lee's Ferry, RM 0.0 to Kwagunt Rapid RM 56.0) during Trip 1, 1993. Sampling was conducted above Soap Creek Rapid and in the Nankoweep area. At both sites, catch was dominated by rainbow trout. One flannelmouth sucker captured at Nankoweep represented the only native species handled in these two areas. Noteworthy observations on trout in these areas include the capture of a very large brown trout (approximately 9 pounds) in the Nankoweep area and an abundance of finglerling trout captured in the Soap Creek area.

6. High densities of Gammurus were observed clinging to debri in nets fished in the Soap Creek area. This phenomena was not observed in nets fished at sites lower in the Canyon.

PROBLEMS ENCOUNTERED AND SOLUTIONS

1. During the Trip 1, 1993 BIO/WEST was informed that AGF had recently implaced coded wire nose tags in a significant number of rainbow trout fingerlings that were released between Glen Canyon Dam and Lee's Ferry. Since BIO/WEST has recently expanded its study area to include the reach from Lee's Ferry downstream to Kwagunt Rapid, the probability of BIO/WEST handling some of these fish is very high. Lack of coordination between BIO/WEST and managing agencies precluded BIO/WEST from collecting information on dispersal of these fish downstream of Lee's Ferry. It would seem that understanding dispersal of trout released at Lee's Ferry into the river system would be beneficial to AGF for managing the trout fishery above Lee's Ferry, and to BIO/WEST for expanding our understanding of non-native/native species interactions in the canyon.

2. Inclement weather during Trip 1, 1993 resulted in flooding from numerous tributaries into Marble and Grand Canyons. Frequent rain storms, high turbidities and copious amounts of floating debris (including large trees, > 3 m long) in the main channel affected timing, efficiency and duration of sampling effort to some extent during the trip in all reaches of the study area.

3. Recapture rates of 80% for adult humpback chub suggest the possibility that handling of the population by GCES researchers is excessive. It may be prudent to review research objectives of each entity handling humpback chub in the LCR or Colorado River to determine if the need exists to handle and mark such a large segment of the population. Under current sampling pressure, any proposal for additional handling of the population necessary to achieve specific objectives, should be mitigated by reduced handling associated with other facets of the overall research.

RECOMMENDATIONS

1. We recommend continued and enhanced coordination among the researchers in Grand Canyon. This coordination is essential to insure that all researchers are aware of others activities.

2. We recommend that AGF provid BIO/WEST with an electromagnetic detector to identify rainbow trout marked with coded wire tags. Downstream information on dispersal by these fish is valuable for determining the fate of fish released in the tailwaters of Glen Canyon Dam.

Table 1. Logistics and Research Schedule for Trip 01, 1993 Team 1.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
1/08	11.0	Soap Creek	X	X		
1/09	11.0	Soap Creek		X		
1/10	58.2	Awatubi	X	X		
1/11	58.2	Awatubi		X		
1/12	58.2	Awatubi		X		
1/13	61.3	LCR	X	X	X	X
1/14	61.3	LCR		X	X	
1/15	61.3	LCR		X	X	
1/16	65.4	Lava Chuar	X	X	X	
1/17	65.4	Lava Chuar		X	X	
1/18	71.0	Cardenas	X	X	X	X
1/19	71.0	Cardenas		X	X	
1/20	87.5	Cremation	X			
1/21	150.0	Upset Rapid	X			
1/22	217.0	217 Mile Canyon	X			
1/23	225.0	Diamond Creek	X			

[1] T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 1. Logistics and Research Schedule for Trip 01, 1993 Team 2.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
1/08	33.5	33.5	X			
1/09	51.5	Little Nankoweap	X			
1/10	51.5	Little Nankoweap		X		
1/11	94	Monument Creek	X	X		
1/12	94	Monument Creek				
1/13	94	Monument Creek		X		
1/14	108.4	Lower Bass	X	X		
1/15	408.4	Lower Bass		X		
1/16	120	Blacktail	X	X		
1/17	120	Blacktail		X		
1/18	137.1	Pancho's	X	X		
1/19	137.1	Pancho's		X		
1/20	166	Above National	X	X		
1/21	166	Above National		X		
1/22	214	214 Mile	X			
1/23	225.6	Diamond Creek	X			

[1] T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 2. Personnel Participating in Trip 01, 1993.

PERSONNEL	AFFILIATION	DATES	COMMENTS
TEAM #1			
B. Masslich	BIO/WEST	1/14 - 1/21	Project Leader
T. Wasowicz	BIO/WEST	1/08 - 1/21	Senior Biologist
P. Weiss	BIO/WEST	1/08 - 1/21	Out Bright Angel
B. Cowdell	BIO/WEST	1/08 - 1/21	Out Bright Angel
S. Rogers	BIO/WEST	1/08 - 1/21	Out Bright Angel
G. Warren	BIO/WEST	1/08 - 1/21	Out Bright Angel
G. Schubilske	BIO/WEST VOLUNTEER	1/08 - 1/23	
D. Kendrick	BIO/WEST VOLUNTEER	1/08 - 1/21	Out Bright Angel
A. Haden	GCES	1/08 - 1/23	
M. Yard	GCES	1/14 - 1/19	Out Tanner
F. Protiva	GCES	1/08 - 1/19	Out Tanner
M. Gonzales	GCES	1/08 - 1/14	Chopper In/Out
R. Hume	GLOBAL HYDROGRAPHIC	1/10 - 1/14	Chopper In/Out
R. Hamilton	GLOBAL HYDROGRAPHIC	1/10 - 1/14	Chopper In/Out
K. Smith	OARS	1/08 - 1/23	
A. Cassidy	OARS	1/08 - 1/23	
L. Bleifuss	OARS	1/08 - 1/23	Trip Leader
Team 2			
Bill Leibfried	BIO/WEST	1/08 - 1/23	Project Leader
Gloria Hardwick	BIO/WEST	1/08 - 1/23	
Erika Prats	BIO/WEST	1/08 - 1/23	
Teresa Yates	BIO/WEST	1/08 - 1/23	
Chris Heck	BIO/WEST	1/08 - 1/23	
Bruce Roberts	BIO/WEST VOLUNTEER	1/08 - 1/23	
Todd Tyrell	BIO/WEST VOLUNTEER	1/08 - 1/23	
Stuart Reeder	OARS	1/08 - 1/23	Trip Leader
John Toner	OARS	1/08 - 1/23	
Cindy Krznarich	OARS	1/08 - 1/23	

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 01, 1993. THESE DATA ARE PRELIMINARY

[1]	[2]	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH	GS
Reach 0 EL N=12 156 hr	A				120	1					
	J				32						
	Y										
Reach 1 EL N=67 587.4 hr	A	11	6	1	131	1	2	17	8	1	
	J	11	1		18	1		2			
	Y	11									
Reach 2 EL N=15 334.6 hr	A				12	21		25			
	J				5	3					
	Y										
Reach 3 EL N=7 139.7 hr	A		1		1			16		4	
	J		1	1							
	Y										
Reach 0 TL N=14 28 hr	A				11						
	J										
	Y										
Reach 1 TL N=89 178 hr	A	32	12		67	1	1				
	J	1									
	Y										
Reach 2 TL N=23 46 hr	A		1					1			
	J										
	Y										

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 01, 1993. THESE DATA ARE PRELIMINARY

[1]	[2]	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH	GS
Reach 3 TL N=12 24 hr	A							1			
	J										
	Y										
Reach 0 TK N=7 14 hr	A				4						
	J										
	Y										
Reach 1 TK N=73 146 hr	A	35	9	1	16				1		
	J	1		1							
	Y										
Reach 2 TK N=14 28 hr	A										
	J										
	Y										
Reach 3 TK N=12 24 hr	A										
	J										
	Y										
Reach 1 TM N=18 36 hr	A	16	4		1						
	J										
	Y										
Reach 1 TN N=17 34 hr	A	5	4		4						
	J										
	Y										

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 01, 1993. THESE DATA ARE PRELIMINARY

[1]	[2]	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH	GS
Reach 2 TN N=13 26 hr	A		1								
	J										
	Y										
Reach 0 GP N=7 14 hr	A				9						
	J										
	Y										
Reach 1 GP N=12 24 hr	A	4	1		10						
	J										
	Y										
Reach 2 GP N=8 16 hr	A		2								
	J										
	Y										
Reach 3 GP N=1 2 hr	A										
	J										
	Y										
Reach 1 GM N=17 34 hr	A				1						
	J										
	Y										
Reach 1 GX N=5 10 hr	A				1						
	J										
	Y										

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 01, 1993. THESE DATA ARE PRELIMINARY

[1]	[2]	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH	GS
Reach 2 HL N=2 4 hr	A				11	1					
	J										
	Y										
Reach 0 MT N=7 161 hr	A										
	J										
	Y										
Reach 1 MT N=44 676 hr	A									1	
	J										
	Y	6									
Reach 2 MT N=7 14 hr	A								3		
	J										
	Y										
Reach 0 SB N=13	A				2						
	J				6						
	Y										
Reach 1 SB N=45	A	8	2	2	19				32	44	
	J	42	1	2	2		1	1		29	
	Y	77									

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 01, 1993. THESE DATA ARE PRELIMINARY

[1]	[2]	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH	GS
Reach 2 SB N=20	A				6				1		
	J		1		6						
	Y										
Reach 3 SB N=2	A								1		
	J										
	Y										
TOTALS	A	111	43	2	428	25	3	60	46	50	0
	J	55	4	4	68	4	1	3	0	29	1
	Y	94	0	0	0	0	0	0	0	0	0

[1]- Gear Types
EL = Electrofishing
TL = 75'x6'x1½"x12" trammel net
TK = 75'x5'x1"x12" trammel net
TM = 50"x6'x1"x12 trammel net
TN = 50'x6'x1½"x12" trammel net
GP = 100'x6'x1½" gill net
GM = 10'x6'x2" gill net
GX = 100', 2" to ½" @ ½" increment, experimental gill net
HL = Large hoop net (4'diameter)
MT = Minnow trap
SB = 30'x4x1/4" seine

[2] - A = Adult
J = Juvenile
Y = Young of year

[3] - HB = humpback chub
FM = flannelmouth sucker
BH = bluehead sucker
RB = rainbow trout
BR = brown trout
CC = channel catfish
CP = carp
SD = speckled dace
FH = fathead minnow
GS = green sunfish

Table 4. Summary of Humpback Chub handled during Trip 1, 1993.

	DATE	TYPE	SAMPLE NUMBER	PITTAG TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
1	930110	N	031	7F7D237E68	Y	PITTAG	375	553	RA	N	52.30
2	930113	N	096	7F7D086C43	Y	PITTAG	398	597	RA	N	60.90
3	930113	N	096	7F7F0E4F6E	Y	PITTAG	317	256	RA	N	61.90
4	930113	N	097	7F7F273517	Y	PITTAG	359	511	RA	N	61.15
5	930113	N	098	7F7F006D22	Y	PITTAG	294	266	RA	N	61.15
6	930113	N	099	7F7D464056	Y	PITTAG	225	98	RA	N	60.85
7	930113	N	100	7F7B017F48	Y	PITTAG	398	578	RA	N	60.90
8	930114	E	028	7F7F2A6D44	Y	PITTAG	405	534	RA	N	61.75
9	930114	E	028	7F7B081644	N		407	611	RA	N	61.75
10	930114	E	029	7F7F272714	Y	PITTAG	338	470	RA	N	61.90
11	930114	E	029	7F7D32596A	Y	PITTAG	293	224	RA	N	61.90
12	930114	E	029	7F7F27251C	Y	PITTAG	327	326	RA	N	61.90
13	930114	E	029	7F7D3E7934	N		366	545	RA	N	61.90
14	930114	E	029	7F7D3E7068	N		330	329	RA	N	61.90
15	930114	N	104	7F7F183960	Y	PITTAG	458	1165	RA	N	60.90
16	930114	N	105	7F7D241C35	Y	PITTAG	310	289	RA	N	61.15
17	930114	N	108	7F7D180455	Y	PITTAG	298	242	RA	N	61.15
18	930114	N	110	7F7B020145	N		300	301	RA	N	60.90
19	930114	N	110	7F7F3F452B	Y	PITTAG	314	287	RA	N	60.90
20	930114	N	110	7F7F26597F	Y	PITTAG	409	670	RA	N	60.90

Table 4. Summary of Humpback Chub handled during Trip 1, 1993.

	DATE	TYPE	SAMPLE NUMBER	PITTAG TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
21	930114	N	111	7F7F3F4B3A	Y	PITTAG	345	402	RA	N	61.15
22	930114	N	112	7F7F3F4B54	Y	PITTAG	392	494	RA	N	61.30
23	930114	N	112	7F7D181B25	Y	PITTAG	364	568	RA	N	61.30
24	930114	N	116	7F7F05055A	Y	PITTAG	398	625	RA	N	61.30
25	930114	N	118	7F7F3C4225	Y	PITTAG	365	424	RA	N	60.90
26	930114	N	120	7F7F3E603B	Y	PITTAG	358	511	RA	N	61.30
27	930114	N	122	7F7D2C5023	Y	PITTAG	380	475	RA	N	60.90
28	930114	N	124	7F7D22655B	Y	PITTAG	310	265	RA	N	61.30
29	930115	E	032	DP1	N		77	2	RA	N	60.72
30	930115	E	036	DP1	N		112	12	RA	N	60.90
31	930115	E	037	DP1	N		97	8	RA	N	61.20
32	930115	E	037	DP1	N		116	11	RA	N	61.20
33	930115	E	038	7F7F1F6A79	Y	PITTAG	425	658	RN	Y	61.20
34	930115	N	128	7F7B024F45	Y	PITTAG	361	550	RA	N	61.90
35	930115	N	128	7F7D171333	Y	PITTAG	339	426	RA	N	61.90
36	930115	N	128	7F7D2C363F	Y	PITTAG	300	236	RA	N	61.90
37	930115	N	130	7F7B016D41	N		262	189	RA	N	62.25
38	930115	N	131	7F7F2D4331	Y	PITTAG	264	175	RA	N	61.90
39	930115	N	131	7F7D2B2B7C	Y	PITTAG	292	183	RA	N	61.90
40	930115	N	125	7F7D22266D	Y	PITTAG	337	464	RA	N	62.10

Table 4. Summary of Humpback Chub handled during Trip 1, 1993.

	DATE	TYPE	SAMPLE NUMBER	PITTAG TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
41	930115	N	125	7F7F332616	Y	PITTAG	294	219	RA	N	62.10
42	930115	N	125	7F7F29020A	Y	PITTAG	354	433	RA	N	62.10
43	930115	N	125	7F7D225674	Y	PITTAG	331	410	RA	N	62.10
44	930115	N	142	7F7F183A0B	Y	PITTAG	274	194	RA	N	60.40
45	930115	N	142	7F7F2C141E	Y	PITTAG	284	219	RA	N	60.40
46	930115	N	142	7F7D2C2915	Y	PITTAG	382	542	RA	N	60.40
47	930115	N	142	7F7F3F4B3A	Y	PITTAG	345	387	RA	N	60.40
48	930115	N	142	7F7D305007	Y	PITTAG	394	589	RA	N	60.40
49	930115	N	133	7F7D3F0042	Y	PITTAG	385	560	RA	N	60.20
50	930115	N	133	7F7F183B78	Y	PITTAG	408	537	RA	N	60.20
51	930115	N	134	7F7D2B331F	Y	PITTAG	384	553	RA	N	60.40
52	930115	N	134	7F7F3F4630	Y	PITTAG	346	353	RA	N	60.40
53	930115	N	134	7F7F220655	Y	PITTAG	402	593	RA	N	60.40
54	930115	N	134	7F7B03544A	N		300	264	RA	N	60.40
55	930115	N	134	7F7F26597F	Y	PITTAG	406	657	RA	N	60.40
56	930115	N	125	7F7D1A4C4A	Y	PITTAG	359	474	RA	N	62.10
57	930115	N	126	7F7D440E52	N		360	454	RA	N	61.90
58	930115	N	126	7F7B024F45	N		362	549	RA	N	61.90
59	930115	N	126	7F7F484533	Y	PITTAG	330	340	RA	N	61.90
60	930115	N	126	7F7F295129	Y	PITTAG	311	335	RA	N	61.90

Table 4. Summary of Humpback Chub handled during Trip 1, 1993.

	DATE	TYPE	SAMPLE NUMBER	PITTAG TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
61	930115	N	126	7F7D2B1968	Y	PITTAG	364	405	RA	N	61.90
62	930115	N	126	7F7D170B23	Y	PITTAG	336	356	RA	N	61.90
63	930115	N	134	7F7F3E4E3D	Y	PITTAG	385	577	RA	N	60.40
64	930115	N	134	7F7F27034F	Y	PITTAG	393	558	RA	N	60.40
65	930115	N	139	7F7D17580D	Y	PITTAG	255	147	RA	N	60.50
66	930115	N	139	7F7F394A23	Y	PITTAG	404	785	RA	N	60.50
67	930115	N	140	7F7F3C6E1B	Y	PITTAG	265	189	RA	N	60.60
68	930115	N	142	7F7D7C297F	Y	617CY	327	295	RA	N	60.40
69	930115	N	142	7F7D226A12	Y	PITTAG	322	288	RA	N	60.40
70	930115	N	126	7F7D181171	Y	PITTAG	258	116	RA	N	61.90
71	930115	N	126	7F7D176B4E	Y	PITTAG	283	179	RA	N	61.90
72	930115	N	126	7F7F2D4331	Y	PITTAG	266	169	RA	N	61.90
73	930115	N	126	7F7F276978	Y	PITTAG	232	112	RA	N	61.90
74	930115	N	126	7F7D180C51	Y	PITTAG	252	166	RA	N	61.90
75	930115	N	126	7F7D2B252A	Y	PITTAG	261	170	RA	N	61.90
76	930115	N	125	7F7D401900	N		316	298	RA	N	62.10
77	930116	S	023	7F7F3E637D	Y	PITTAG	285	172	RA	N	62.30
78	930116	S	023	DP1	N		100	6	RA	N	62.30
79	930116	S	023	DP1	N		80	4	RA	N	62.30
80	930116	S	024	DP1	N		65	0	RA	N	62.60

Table 4. Summary of Humpback Chub handled during Trip 1, 1993.

	DATE	TYPE	SAMPLE NUMBER	PITTAG TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
81	930116	S	024	DP1	N		80	6	RA	N	62.60
82	930116	S	024	DP1	N		125	11	RA	N	62.60
83	930116	S	025	DP1	N		68	0	RA	N	62.80
84	930116	S	025	DP1	N		91	0	RA	N	62.80
85	930116	S	025	DP1	N		67	0	RA	N	62.80
86	930116	S	025	DP1	N		56	0	RA	N	62.80
87	930116	S	025	DP1	N		63	0	RA	N	62.80
88	930116	S	020	7F7F206531	Y	PITTAG	385	601	RA	N	61.90
89	930116	S	020	7F7D2B1968	Y	PITTAG	368	384	RA	N	61.90
90	930116	S	020	7F7D170B23	Y	PITTAG	335	347	RA	N	61.90
91	930116	S	021	DP1	N		107	12	RA	N	61.90
92	930116	S	022	7F7D7C2901	N		167	32	RA	N	61.90
93	930116	S	022	##########	Y	UCLP	131	12	RA	N	61.90
94	930116	S	022	DP1	N		120	12	RA	N	61.90
95	930116	S	022	DP1	N		85	5	RA	N	61.90
96	930116	S	022	DP1	N		91	7	RA	N	61.90
97	930116	S	022	DP1	N		108	8	RA	N	61.90
98	930116	S	022	DP1	N		80	4	RA	N	61.90
99	930116	S	022	DP1	N		93	7	RA	N	61.90
100	930116	S	022	DP1	N		68	3	RA	N	61.90

Table 4. Summary of Humpback Chub handled during Trip 1, 1993.

	DATE	TYPE	SAMPLE NUMBER	PITTAG TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
101	930116	S	022	DP1	N		87	4	RA	N	61.90
102	930116	S	022	DP1	N		151	16	RA	N	61.90
103	930116	S	022	DP1	N		82	6	RA	N	61.90
104	930116	S	022	DP1	N		102	11	RA	N	61.90
105	930116	S	022	DP1	N		145	21	RA	N	61.90
106	930116	S	022	DP1	N		105	0	RA	N	61.90
107	930116	S	022	DP1	N		93	5	RA	N	61.90
108	930116	S	022	DP1	N		142	23	RA	N	61.90
109	930116	S	024	DP1	N		100	5	RA	N	62.60
110	930116	S	024	DP1	N		82	3	RA	N	62.60
111	930116	S	024	DP1	N		66	0	RA	N	62.60
112	930116	S	024	DP1	N		68	0	RA	N	62.60
113	930116	S	024	DP1	N		97	6	RA	N	62.60
114	930116	S	024	DP1	N		77	0	RA	N	62.60
115	930116	S	024	DP1	N		126	18	RA	N	62.60
116	930116	S	025	DP1	N		75	0	RA	N	62.80
117	930116	S	025	DP1	N		74	0	RA	N	62.80
118	930116	S	025	DP1	N		80	0	RA	N	62.80
119	930116	S	025	DP1	N		88	0	RA	N	62.80
120	930116	S	025	DP1	N		97	0	RA	N	62.80

Table 4. Summary of Humpback Chub handled during Trip 1, 1993.

	DATE	TYPE	SAMPLE NUMBER	PITTAG TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
121	930116	S	025	DP1	N		76	0	RA	N	62.80
122	930116	S	025	DP1	N		78	0	RA	N	62.80
123	930116	S	025	DP1	N		67	0	RA	N	62.80
124	930116	S	025	DP1	N		78	0	RA	N	62.80
125	930116	S	025	DP1	N		89	0	RA	N	62.80
126	930116	S	025	DP1	N		83	0	RA	N	62.80
127	930116	S	025	DP1	N		90	0	RA	N	62.80
128	930116	S	025	DP1	N		84	0	RA	N	62.80
129	930116	S	025	DP1	N		70	0	RA	N	62.80
130	930116	S	025	DP1	N		95	0	RA	N	62.80
131	930116	S	025	DP1	N		78	0	RA	N	62.80
132	930116	S	025	DP1	N		86	0	RA	N	62.80
133	930116	S	025	DP1	N		74	0	RA	N	62.80
134	930116	S	025	DP1	N		78	0	RA	N	62.80
135	930116	S	025	DP1	N		93	0	RA	N	62.80
136	930116	S	025	DP1	N		87	0	RA	N	62.80
137	930116	S	025	DP1	N		96	0	RA	N	62.80
138	930116	S	025	DP1	N		88	0	RA	N	62.80
139	930116	S	025	DP1	N		90				0RAN62.80
140	930116	S	025	DP1	N		85	0	RA	N	62.80

Table 4. Summary of Humpback Chub handled during Trip 1, 1993.

	DATE	TYPE	SAMPLE NUMBER	PITTAG TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
141	930116	S	025	DP1	N		83	0	RA	N	62.80
142	930116	S	025	DP1	N		91	0	RA	N	62.80
143	930116	S	025	DP1	N		110	0	RA	N	62.80
144	930116	S	025	DP1	N		98	0	RA	N	62.80
145	930116	S	025	DP1	N		137	15	RA	N	62.80
146	930116	S	025	DP1	N		135	15	RA	N	62.80
147	930116	S	025	DP1	N		136	19	RA	N	62.80
148	930116	S	025	DP1	N		90	0	RA	N	62.80
149	930116	S	025	DP1	N		126	0	RA	N	62.80
150	930116	S	025	DP1	N		100	0	RA	N	62.80
151	930116	S	025	7F7D170C47	Y	PITTAG	343	293	RA	N	62.80
152	930116	S	025	##########	Y	LPUC	125	13	RA	N	62.80
153	930116	S	025	##########	Y	LPLC	108	0	RA	N	62.80
154	930116	S	025	##########	Y	RPUC	117	0	RA	N	62.80
155	930116	S	025	DP1	N		96	6	RA	N	62.80
156	930116	S	025	DP1	N		106	0	RA	N	62.80
157	930116	S	025	DP1	N		133	14	RA	N	62.80
158	930116	E	040	7F7F25601C	Y	PITTAG	355	395	RA	N	62.20
159	930116	E	040	7F7F33197D	Y	PITTAG	203	69	RA	N	62.20
160	930116	E	040	DP1	N		68	2	RA	N	62.20

Table 4. Summary of Humpback Chub handled during Trip 1, 1993.

	DATE	TYPE	SAMPLE NUMBER	PITTAG TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
161	930116	E	040	DP1	N		85	5	RA	N	62.20
162	930116	E	041	DP1	N		81	5	RA	N	63.75
163	930116	E	043	DP1	N		141	18	RA	N	64.50
164	930116	N	146	7F7B017073	N		366	502	RA	N	60.40
165	930116	N	158	7F7D1A3559	Y	PITTAG	331	320	RA	N	60.40
166	930116	N	167	7F7B016B2D	N		345	379	RA	N	64.80
167	930116	N	166	7F7D3F7F4A	N		244	184	RA	N	65.15
168	930116	N	166	7F7F3E3D73	Y	PITTAG	352	404	RA	N	65.15
169	930116	N	169	7F7D3E755D	N		238	167	RA	N	65.15
170	930116	N	146	7F7D305007	Y	PITTAG	382	591	RA	N	60.40
171	930116	N	146	7F7F183A0B	Y	PITTAG	276	193	RA	N	60.40
172	930117	S	037	7F7B022A59	N		179	56	RA	N	65.30
173	930117	S	027	DP1	N		85	5	RA	N	63.50
174	930117	S	027	DP1	N		80	4	RA	N	63.50
175	930117	S	027	DP1	N		75	4	RA	N	63.50
176	930117	S	027	DP1	N		65	2	RA	N	63.50
177	930117	S	028	DP1	N		58	1	RA	N	63.50
178	930117	S	030	DP1	N		96	6	RA	N	63.89
179	930117	S	030	DP1	N		92	7	RA	N	63.89
180	930117	S	030	DP1	N		88	5	RA	N	63.80

Table 4. Summary of Humpback Chub handled during Trip 1, 1993.

	DATE	TYPE	SAMPLE NUMBER	PITTAG TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
181	930117	S	030	DP1	N		77	6	RA	N	63.80
182	930117	S	030	DP1	N		86	5	RA	N	63.80
183	930117	S	030	DP1	N		77	4	RA	N	63.80
184	930117	S	033	##########	Y	DP1	112	9	RA	N	63.95
185	930117	S	033	DP1	N		80	4	RA	N	63.95
186	930117	S	034	7F7F287D72	Y	PITTAG	320	268	RA	N	63.90
187	930117	S	035	DP1	N		103	9	RA	N	63.90
188	930117	S	035	DP1	N		69	4	RA	N	63.90
189	930117	S	035	DP1	N		136	16	RA	N	63.90
190	930117	S	035	DP1	N		128	14	RA	N	63.90
191	930117	S	035	DP1	N		55	1	RA	N	63.90
192	930117	S	035	DP1	N		137	17	RA	N	63.90
193	930117	S	035	DP1	N		75	3	RA	N	63.90
194	930117	S	035	DP1	N		114	9	RA	N	63.90
195	930117	S	035	DP1	N		72	3	RA	N	63.90
196	930117	S	035	DP1	N		61	2	RA	N	63.90
197	930117	S	037	DP1	N		123	18	RA	N	65.30
198	930117	S	037	DP1	N		110	9	RA	N	65.30
199	930117	S	037	DP1	N		109	9	RA	N	65.30
200	930117	S	037	DP1	N		85	4	RA	N	65.30

Table 4. Summary of Humpback Chub handled during Trip 1, 1993.

	DATE	TYPE	SAMPLE NUMBER	PITTAG TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
201	930117	E	045	DP1	N		92	7	RA	N	63.50
202	930117	E	045	DP1	N		101	8	RA	N	63.50
203	930117	E	045	DP1	N		92	8	RA	N	63.50
204	930117	E	047	DP1	N		101	9	RA	N	63.50
205	930117	E	047	DP1	N		109	12	RA	N	63.50
206	930117	E	047	DP1	N		87	6	RA	N	63.50
207	930117	E	048	DP1	N		71	6	RA	N	63.10
208	930117	E	051	7F7B032749	N		236	141	RA	N	65.30
209	930117	E	051	7F7D3F7C3E	N		166	49	RA	N	65.30
210	930117	N	203	7F7B037509	Y	0314260FY	362	514	RA	N	64.45
211	930117	N	203	7F7B081833	N		337	428	RA	N	64.45
212	930117	N	202	7F7F2D474E	Y	PITTAG	330	312	RA	N	64.90
213	930117	N	202	DP1	Y	UCRP	134	0	RA	N	64.90
214	930117	N	204	7F7B024778	N		193	84	RA	N	0.00
215	930117	N	191	7F7D25627A	Y	PITTAG	357	487	RA	N	63.75
216	930117	N	191	7F7F290562	Y	PITTAG	267	185	RA	N	63.75
217	930117	N	191	7F7F182E5E	Y	PITTAG	349	456	RA	N	63.75
218	930117	N	191	7F7F32471C	Y	PITTAG	372	565	RA	N	63.75
219	930117	N	191	7F7D02673F	Y	PITTAG	362	563	RA	N	63.75
220	930117	N	185	7F7B033B47	N		251	177	RA	N	65.25

Table 4. Summary of Humpback Chub handled during Trip 1, 1993.

	DATE	TYPE	SAMPLE NUMBER	PITTAG TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
221	930117	N	191	7F7D401825	Y	0315162FY	349	467	RA	N	63.75
222	930117	N	191	7F7B02490C	N		339	436	RA	N	63.75
223	930117	N	191	7F7F2C162C	Y	PITTAG	372	511	RA	N	63.75
224	930117	N	191	7F7F05011F	Y	PITTAG	374	514	RA	N	63.75
225	930117	N	191	7F7F183340	Y	PITTAG	335	350	RA	N	63.75
226	930117	N	191	7F7D4D7901	Y	PITTAG	391	602	RN	Y	63.75
227	930117	N	190	7F7F28477D	Y	PITTAG	397	611	RA	N	63.30
228	930117	N	190	7F7F3E4953	Y	PITTAG	336	441	RA	N	63.30
229	930117	N	190	7F7F20632D	Y	PITTAG	355	521	RA	N	63.30
230	930117	N	190	7F7D3F7C41	N		325	394	RA	N	63.30
231	930117	N	190	7F7F394914	Y	PITTAG	307	262	RA	N	63.30
232	930117	N	190	7F7D1A496D	Y	PITTAG	369	399	RA	N	63.30
233	930117	N	190	7F7B02512B	N		341	471	RA	N	63.30
234	930118	S	043	CP1	N		110	8	RA	N	66.30
235	930118	S	043	CP1	N		72	2	RA	N	66.30
236	930118	S	043	CP1	N		80	4	RA	N	66.30
237	930118	S	045	##########	N		52	1	RA	N	67.00
238	930118	S	046	DP1	N		85	5	RA	N	68.05
239	930118	S	048	CP1	N		73	3	RA	N	68.00
240	930118	S	048	##########	N		56	2	RA	N	68.00

Table 4. Summary of Humpback Chub handled during Trip 1, 1993.

	DATE	TYPE	SAMPLE NUMBER	PITTAG TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
241	930118	S	048	7F7F480965	Y	318CRS	174	48	RA	N	68.00
242	930118	S	042	DP1	N		126	19	RA	N	66.30
243	930118	S	039	7F7E431741	N		159	40	RA	N	65.65
244	930118	S	039	DP1	N		135	27	RA	N	65.65
245	930118	S	039	DP1	N		150	33	RA	N	65.65
246	930118	S	039	DP1	N		115	13	RA	N	65.65
247	930118	S	039	DP1	N		128	20	RA	N	65.65
248	930118	S	039	DP1	N		91	7	RA	N	65.65
249	930118	E	053	CP1	N		83	6	RA	N	66.20
250	930118	E	055	CP1	N		125	18	RA	N	66.90
251	930118	E	055	CP1	N		85	3	RA	N	66.90
252	930118	E	057	CP1	N		106	0	RA	N	67.60
253	930118	T	034	DP1	N		100	0	RA	N	64.45
254	930118	T	034	DP1	N		76	0	RA	N	64.45
255	930118	T	034	DP1	N		78	0	RA	N	64.45
256	930118	T	034	DP1	N		84	0	RA	N	64.45
257	930118	T	034	DP1	N		76	0	RA	N	64.45
258	930118	T	044	DP1	N		99	0	RA	N	64.40
259	930119	E	064	CP1	N		120	14	RA	N	69.10
260	930119	E	067	CP1	N		75	3	RA	N	69.70

Table 5. A list of radio frequencies contacted on Trip 01, 1993 and locations relative to capture and release sites.

			-------River Mile-------		
FREQ/PULSE	TAG SIZE (gm)	DATE (time)	CAPTURE	RELEASE	LOCATE
40.740/60	11	921030 930118(1225)	60.4	60.4	61.3

CHARACTERIZATION OF THE LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE GRAND CANYON

TRIP REPORT 2 - 1993
February 10 - 26, 1993

Prepared For:

Bureau of Reclamation

Prepared By:

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BIO/WEST INC.
1063 West 1400 North
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March 5, 1993

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LIST OF TABLES

INTRODUCTION

This report presents pertinent details associated with Trip 2, 1993. Included in the report are a summary of trip logistics, personnel and research schedule, data collected, problems encountered, pertinent observations and recommendations. Most information is presented in a tabular format to provide a quick synopsis of pertinent trip details and results. We emphasize that these data are hand tabulated to provide these synopses as soon as possible. The data are later computerized and checked for accuracy. The purpose of these trip reports is to provide information from BIO/WEST trips as quickly as possible to aid other researchers.

LOGISTICS, RESEARCH SCHEDULE AND PERSONNEL

Table 1 presents a summary of logistics and the research schedule for Trip 2, 1993. Table 2 is a list of personnel who were present or participated in research activities for Trip 2, 1993.

DATA COLLECTED

Table 3 is a summary of gear types used, sampling effort and fish captured by gear type for Trip 2, 1993. Table 4 is a summary of all humpback chubs handled during Trip 2, 1993. Table 5 summarizes the radio contacts during Trip 2, 1993 and presents original fish release locations and radiotag data.

Humpback Chubs Captured

A total of 115 humpback chub were captured during Trip 2, 1993 including 16 YOY (<101 mm TL), 22 juveniles (100-199 mm TL), and 77 adults (>199 mm TL). All but 5 adult humpback chub were captured in Reach 1 between RM 60 and RM 66. In that reach, twelve chubs were captured with seines including 6 juveniles and 6 YOY. Twenty-six chubs, including six adults, 11 juveniles and 9 YOY were captured electrofishing. Netting produced 69 humpback chub including 66 adults and 3 juveniles. Three chubs, one YOY and two juveniles were also captured in unbaited minnow traps.

Five adult humpback chub were captured in Reach 2 between RM 124 and RM 129. All five were captured in nets. Of the five fish, two were recaptures of fish previously tagged in the same locale.

Approximately 75% of adult humpback chub handled during Trip 1, 1993 were recaptures. This represents the second highest recapture rate observed by BIO/WEST in the main channel, second only to an 80% recapture rate observed in January 1993.

One adult humpback chub (approximately 250 mm) was found dead and floating in a large backwater at RM 62.5. Advanced bacterial growth on the surface of the fish indicated that the fish had been dead for some period of time before it was found. No PIT tag or other form of mark was found on the fish. The cause of death was not apparent. Examination of stomach and intestinal contents were inconclusive because gut contents were mostly decayed and unrecognizable. It is speculated that the death of the fish may have been related to recent flood events out of the LCR. The carcass was skeletonized and will be transferred to Rob Clarkson of AGF.

Radiotelemetry

One humpback chub was implanted with a radio transmitter in Reach 2 during Trip 2, 1993 (Table 5). This was the first humpback chub to be implanted outside of Reach 1. Initiation of telemetry studies in Reach 2 is consistent with 1993 study plans presented to the ACT in December of 1992. Originally it was thought that at least two fish would be needed to conduct a viable telemetry study. This was based on the idea that smaller fish captured in Reach 2 would restrict the size of transmitters to 9 grams with a life expectancy of 50 days. The fish implanted in during Trip 2 weighed 728 grams which allowed the use of an 11 gram transmitter with a life expectancy of 120 days. The life expectancy of the radiotag will allow a greater opportunity to track the fish and implant additional fish in the area while the tag is still active.

An omni-directional remote telemetry station was installed and activated at RM 125.4, the release location of the implanted fish. The station is located in Tapeats ledges approximately 80 feet above river level on river left. Station components included two 20 mm ammunition cans that house two 12 volt gel cell batteries, one receiver and one data logger, one omni-directional whip antenna and a small solar panel. The NPS was notified as to the location of the station on March 2, 1993. BIO/WEST plans to install a second remote station, similar to the one described above during the March Trip. Both remote stations are set up so they can easily be dismantled and moved to locations most suitable for monitoring radiotagged fish utilizing the area. It is anticipated that these stations may be moved to several locations within a river reach extending from approximately RM 124 to RM 129. The NPS will be informed of all activities related to installation of remote telemetry stations in this area.

Habitat Mapping

No habitat mapping was conducted during Trip 2, 1993. Jack Schmidt (USU) and Ned Andrews (USGS) participated for a portion of the trip measuring sediment deposition from the January flood event from the LCR.

Bench Marks

No new bench marks were established during Trip 2, 1993.

OBSERVATIONS

1. Unseasonable wet weather during February continued to result in high tributary input during the majority of Trip 2, 1993. High main channel turbidities and excessive floating debris affected sampling efficiency during the trip. Main channel flows were particularly affected late in the trip in response high runoff water in the LCR, similar in magnitude to the flood event out of the LCR in January.

2. High catch rates of humpback chubs in deep eddies above the confluence of the LCR suggest that prespawn staging activities were occurring during Trip 2, 1993.

3. High catch rates of humpback chubs immediately below the confluence of the LCR suggest that a large number of fish are still occupying this area. It is speculated that many of these fish have recently moved out of the LCR in response to unusually high flows. High recapture rate (75%) of PIT tagged fish, the majority of which have been tagged by ASU and AGF lend support to this hypothesis.

4. Approximately 5-10% of the humpback chubs handled during Trip 2, 1993 exhibited tubercles.

5. Moderate numbers of YOY and juvenile humpback chub were captured electrofishing and seining in main channel habitats. Personal observations suggest that densities of these life stages in the main channel are lower than in January. It is speculated that many of the younger humpback chubs had moved into newly created return channel/backwater habitats created during the January flood from the LCR. BIO/WEST did not sample these habitat types during Trip 2, 1993.

6. Five adult humpback chubs were captured in Reach 2 between RM 124 and RM 127. Consistent capture of chubs in this area continues to suggest that an aggregation or small population of fish utilize this area.

7. A majority of rainbow trout captured in Reach 0 were scanned with a metal detector to determine presence of coded wire tags. No tags were detected in any trout captured during Trip 2, 1993.

PROBLEMS ENCOUNTERED AND SOLUTIONS

1. High turbidities and copious floating debris in the main channel affected sampling efficiency. Nets were exchanged more frequently and two netters were used electrofishing when possible to increase efficiency

RECOMMENDATIONS

1. We recommend continued and enhanced coordination among the researchers in Grand Canyon. This coordination is essential to insure that all researchers are aware of others activities.

2. We recommend that AGF continue to provide BIO/WEST with an electromagnetic detector to identify rainbow trout marked with coded wire tags. Downstream information on dispersal by these fish is valuable for determining the fate of fish released in the tailwaters of Glen Canyon Dam.

Table 1. Logistics and Research Schedule for Trip 2, 1993 Team 1.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
2/11	16.5	Hot Na Na Wash	X	X		
2/12	16.5	Hot Na Na Wash		X		
2/13	30.0	30 Mile	X	X		
2/14	30.0	30 Mile		X		
2/15	61.2	LCR	X	X		X
2/16	61.2	LCR		X		X
2/17	61.2	LCR		X		X
2/18	65.4	Lava Chuar	X	X		X
2/19	65.4	Lava Chuar		X		X
2/20	108.0	Bass Camp	X			
2/21	126.0	Randy's Rock	X	X		
2/22	126.0	Randy's Rock		X		
2/23	137.2	Poncho's Kitchen	X	X	X	
2/24	177.0	Above Lava Falls	X			
2/25	224.0	224 Mile Canyon	X			
2/26	279.0	Pearce Ferry	X			

[1] T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 2. Personnel Participating in Trip 2, 1993.

PERSONNEL	AFFILIATION	DATES	COMMENTS
TEAM #1			
B. Masslich	BIO/WEST	2/10 - 2/26	Project Leader
T. Wasowicz	BIO/WEST	2/10 - 2/26	Senior Biologist
P. Weiss	BIO/WEST	2/10 - 2/26	
E. Prats	BIO/WEST	2/10 - 2/26	
P. Trinca	BIO/WEST	2/10 - 2/26	
L. Brown	BIO/WEST	2/10 - 2/26	
C. Young	BIO/WEST VOLUNTEER	2/10 - 2/19	Out Tanner
C. Scully	BIO/WEST VOLUNTEER	2/10 - 2/26	
J. Schmidt	USU	2/16 - 2/19	Out Tanner
N. Andrews	USGS	2/16 - 2/19	Out Tanner
S. Ford	OARS VOLUNTEER	2/10 - 2/15	Out on boat
S. Bledso	OARS	2/10 - 2/26	OARS Tr. Leader
R. Running	OARS	2/10 - 2/26	
K. Burnett	OARS	2/10 - 2/26	

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 2, 1993. THESE DATA ARE PRELIMINARY

[1]	[2]	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH
Reach 0 EL N=27 3.28 hr	A				134			3		
	J				35					
	Y									
Reach 1 EL N=34 3.84 hr	A	6	1		25			2	8	1
	J	11			10			2		1
	Y	9								
Reach 2 EL N=25 2.95 hr	A					1		11		
	J		1		4					
	Y									
Reach 0 TK N=37 74 hr	A		1		58					
	J									
	Y									
Reach 1 TK N=30 60 hr	A	27	8	4	1					
	J	3	1							
	Y									
Reach 2 TK N=15 30 hr	A	4			1			1		
	J									
	Y									
Reach 0 TL N=6 12 hr	A				12					
	J									
	Y									

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 2, 1993. THESE DATA ARE PRELIMINARY

[1]	[2]	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH
Reach 1 TL N=8 16 hr	A	9	5		3					
	J									
	Y									
Reach 2 TL N=8 16 hr	A									
	J									
	Y									
Reach 0 TM N=4 8 hr	A				6					
	J									
	Y									
Reach 1 TM N=16 32 hr	A	10		1	4					
	J									
	Y									
Reach 2 TM N=12 24 hr	A									
	J									
	Y									
Reach 0 TN N=10 20 hr	A				41					
	J									
	Y									
Reach 1 TN N=13 26 hr	A	16	4		11					
	J									
	Y									

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 2, 1993. THESE DATA ARE PRELIMINARY

[1]	[2]	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH
Reach 2 TN N=4 8 hr	A									
	J									
	Y									
Reach 0 TW N=8 16 hr	A									
	J									
	Y									
Reach 1 TW N=5 10 hr	A	1								
	J									
	Y									
Reach 2 TW N=1 2 hr	A									
	J									
	Y									
Reach 1 TY N=6 12 hr	A	3	2		7					
	J									
	Y									
Reach 0 GM N=16 32 hr	A									
	J									
	Y									

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 2, 1993. THESE DATA ARE PRELIMINARY

[1]	[2]	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH
Reach 2 GM N=2 4 hr	A	1								
	J									
	Y									
Reach 0 GP N=4 8 hr	A				4					
	J									
	Y									
Reach 0 SG N=3 50 m	A									
	J									
	Y									
Reach 1 SG N=14 380 m	A				3				1	6
	J	6			1					
	Y	6								
Reach 1 MT N=40 1358 hr	A									
	J	2								
	Y	1								
Reach 0 TOTALS	A		1		256			3		
	J				35					
	Y									
	T		1		291			3		

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 2, 1993. THESE DATA ARE PRELIMINARY

[1]	[2]	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH
Reach 1 TOTALS	A	72	20		54			2	9	8
	J	22	1		11			2		1
	Y	16								
	T	110	21		65			4	9	9
Reach 2 TOTALS	A	5		5	1	1		12		
	J		1		4					
	Y									
	T	5	1	5	5	1		12		
TOTAL FISH		115	23	5	361	1		19	9	9

[1]- Gear Types
EL = Electrofishing
TL = 75'x6'x1½"x12" trammel net
TK = 75'x5'x1"x12" trammel net
TM = 50"x6'x1"x12 trammel net
TN = 50'x6'x1½"x12" trammel net
TY = TK w/attached floats
TW = 75'x6'x½x10 trammel net
GP = 100'x6'x1½" gill net
GM = 10'x6'x2" gill net
SG 30'x5'x¼" seine
MT = Minnow trap

[2] - A = Adult
J = Juvenile
Y = Young of year

[3] - HB = humpback chub
FM = flannelmouth sucker
BH = bluehead sucker
RB = rainbow trout
BR = brown trout
CC = channel catfish
CP = carp
SD = speckled dace
FH = fathead minnow

Table 4. Summary of Humpback Chub handled during Trip 2, 1993.

N	DATE	TYPE	SAMPLE	PIT TAG	RECAPTURE	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
1	930215	N	086	7F7E42764F	Y	PITTAG	280	191	RA	N	61.25
2	930215	N	086	7F7F3F4E5C	Y	PITTAG	316	393	RA	N	61.25
3	930215	N	087	7F7F2D5C62	Y	PITTAG	398	730	RA	N	61.30
4	930215	N	087	7F7F456130	Y	PITTAG	400	582	RA	N	61.30
5	930215	N	087	7F7F39622E	Y	PITTAG	377	431	RA	N	61.30
6	930215	N	087	7F7F29013F	Y	PITTAG	328	412	RA	N	61.30
7	930215	N	087	7F7F3C4554	Y	PITTAG	418	733	RA	N	61.30
8	930215	N	087	7F7F190640	Y	PITTAG	448	885	RA	N	61.30
9	930215	N	088	7F7D177F73	Y	PITTAG	390	562	RA	N	61.20
10	930215	N	088	7F7B022377	N		332	303	RA	N	61.20
11	930215	N	088	7F7B020256	N		393	639	RA	N	61.20
12	930215	N	090	7F7B034E34	N		340	304	RA	N	61.30
13	930215	E	003	DP-1	N		94	4	RA	N	63.10
14	930215	E	005	DP-1	N		136	14	RA	N	61.60
15	930216	N	093	7F7F26172F	Y	PITTAG	244	145	RA	N	60.95
16	930216	N	097	7F7D173C3E	Y	PITTAG	337	431	RA	N	60.95
17	930216	N	101	7F7D2C436B	Y	PITTAG	278	177	RA	N	60.95
18	930216	N	101	7F7D2B7135	Y	PITTAG	340	402	RA	N	60.95
19	930216	N	107	7F7D1B692D	Y	PITTAG	390	564	RA	N	60.45
20	930216	N	112	7F7D225724	Y	PITTAG	332	401	RA	N	61.15
21	930216	N	112	7F7B08E744	N		239	142	RA	N	61.15

Table 4. Summary of Humpback Chub handled during Trip 2, 1993.

N	DATE	TYPE	SAMPLE	PIT TAG	RECAPTURE	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
22	930216	N	114	7F7F45541A	Y	PITTAG	420	656	RA	N	60.45
23	930216	E	011	7F7F3E4B62	N		304	306	RA	N	62.10
24	930216	E	011	7F7F290012	N		165	41	RA	N	62.10
25	930216	E	011	DP-1	N		117	10	RA	N	62.10
26	930216	E	011	DP-1	N		143	21	RA	N	62.10
27	930216	E	014	7F7F183B78	Y	PITTAG	407	542	RA	N	61.10
28	930216	E	015	DP-1	N		154	28	RA	N	61.10
29	930217	N	117	7F7D2C333C	Y	PITTAG	267	166	RA	N	60.40
30	930217	N	124	7F7F3C6B66	Y	PITTAG	276	188	RA	N	62.25
31	930217	N	125	7F7B01602D	Y	CARLIN SCAR	387	545	RA	N	61.85
32	930217	N	126	7F7E432266	Y	PITTAG	383	611	RA	N	61.70
33	930217	N	126	7F7F19684D	Y	PITTAG	306	280	RA	N	61.70
34	930217	N	127	7F7F2A494A	N		325	369	RA	N	61.50
35	930217	N	127	7F7D400A25	N		305	299	RA	N	61.50
36	930217	N	127	7F7F3D0C7A	Y	PITTAG	351	427	RA	N	61.50
37	930217	N	127	7F7F324902	Y	PITTAG	353	383	RA	N	61.50
38	930217	N	127	7F7D225B08	Y	PITTAG	358	462	RA	N	61.50
39	930217	N	129	7F7F2C1775	Y	PITTAG	351	378	RA	N	61.70
40	930217	N	130	7F7F205C0A	Y	PITTAG	326	350	RA	N	61.50
41	930217	N	130	7F7D173B21	Y	PITTAG	332	348	RA	N	61.50
42	930217	N	130	7F7D2B1756	Y	PITTAG	301	348	RA	N	61.50

Table 4. Summary of Humpback Chub handled during Trip 2, 1993.

N	DATE	TYPE	SAMPLE	PIT TAG	RECAPTURE	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
43	930217	N	130	7F7B081C36	Y	CARLIN TAG	388	645	RA	N	61.50
44	930217	N	132	7F7B08175D	N		358	401	RA	N	61.70
45	930217	N	132	7F7B026226	N		395	627	RA	N	61.70
46	930217	N	132	7F7F031D6A	Y	PITTAG	407	648	RA	N	61.70
47	930217	N	132	7F7F3E6075	Y	PITTAG	380	553	RA	N	61.70
48	930217	N	132	7F7D2C4938	Y	PITTAG	332	373	RA	N	61.70
49	930217	N	133	7F7D3C3A5A	N		322	280	RA	N	61.50
50	930217	N	133	7F7F19043E	Y	PITTAG	376	445	RA	N	61.50
51	930217	N	133	7F7D2F4367	Y	PITTAG	338	451	RA	N	61.50
52	930217	N	133	7F7D2A6459	Y	CARLIN SCAR	368	447	RA	N	61.50
53	930217	N	134	7F7F271B55	Y	PITTAG	405	686	RA	N	61.95
54	930217	N	134	7F7F290F54	Y	PITTAG	233	114	RA	N	61.95
55	930217	N	135	7F7D3C5223	N		355	464	RA	N	61.70
56	930217	N	135	7F7D7C2D7D	Y	037CYS	371	503	RA	N	61.70
57	930217	E	016	7F7D2A4D75	Y	PITTAG	262	158	RA	N	62.50
58	930217	E	016	7F7F3E4F04	N		355	477	RA	N	62.50
59	930217	E	016	7F7F2D5F2D	N		390	619	RA	N	62.50
60	930217	E	016	DP-1	N		90	4	RA	N	62.50
61	930217	E	016	DP-1	N		125	12	RA	N	62.50
62	930217	E	017	DP-1	N		81	3	RA	N	62.60
63	930217	E	017	##########	N		55	2	RA	N	62.60

Table 4. Summary of Humpback Chub handled during Trip 2, 1993.

N	DATE	TYPE	SAMPLE	PIT TAG	RECAPTURE	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
64	930217	E	017	DP-1	N		78	4	RA	N	62.60
65	930217	E	017	DP-1	N		70	2	RA	N	62.60
66	930217	E	025	7F7D180C09	Y	PITTAG	257	176	RA	N	60.50
67	930217	E	025	DP-1	N		157	34	RA	N	60.50
68	930217	S	008	DP-1	N		121	13	RA	N	62.11
69	930217	S	009	DP-1	N		125	14	RA	N	62.50
70	930217	S	010	DP-1	N		112	14	RA	N	62.75
71	930217	S	011	DP-1	N		75	4	RA	N	63.10
72	930218	N	141	7F7F291869	Y	PITTAG	391	626	RA	N	63.85
73	930218	N	141	7F7F2F2031	Y	PITTAG	374	430	RA	N	63.85
74	930218	N	141	7F7D224926	Y	PITTAG	402	596	RA	N	63.85
75	930218	N	141	7F7D22572C	Y	PITTAG	309	309	RA	N	63.85
76	930218	N	142	7F7F396046	Y	PITTAG	408	668	RA	N	63.30
77	930218	N	142	7F7B082545	N		365	560	RA	N	63.30
78	930218	N	143	7F7F1F2C28	N		344	378	RA	N	63.70
79	930218	N	144	7F7F3C2419	Y	PITTAG	370	521	RA	N	63.85
80	930218	N	144	7F7D225B5F	Y	PITTAG	334	387	RA	N	63.85
81	930218	N	138	7F7D2A7C21	Y	PITTAG	323	303	RA	N	63.70
82	930218	N	138	7F7F255C73	Y	PITTAG	399	619	RA	N	63.70
83	930218	N	138	7F7F183340	Y	PITTAG	340	355	RA	N	63.70
84	930218	N	138	7F7D027D75	Y	PITTAG	395	470	RA	N	63.70

Table 4. Summary of Humpback Chub handled during Trip 2, 1993.

N	DATE	TYPE	SAMPLE	PIT TAG	RECAPTURE	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
85	930218	N	139	7F7D223305	Y	PITTAG	271	205	RA	N	63.30
86	930218	N	140	7F7D09081A	Y	PITTAG	327	399	RA	N	63.70
87	930218	E	027	7F7B034612	N		175	52	RA	N	65.00
88	930218	E	027	DP-1	N		93	6	RA	N	65.00
89	930218	E	029	DP-1	N		136	22	RA	N	65.30
90	930218	T	043	##########	N		72	0	RA	N	64.75
91	930218	T	046	##########	N		88	0	RA	N	64.75
92	930218	T	046	##########	N		111	0	RA	N	64.75
93	930219	N	146	7F7D3C4B12	N		191	70	RA	N	65.20
94	930219	N	148	7F7B026517	N		218	116	RA	N	64.95
95	930219	N	151	7F7F3C2925	Y	PITTAG	226	97	RA	N	64.95
96	930219	N	154	7F7D08572A	Y	PITTAG	222	96	RA	N	64.80
97	930219	N	161	7F7B023A76	N		294	232	RA	N	65.20
98	930219	N	161	7F7B036E2B	N		305	311	RA	N	65.20
99	930219	E	032	DP-1	N		75	4	RA	N	63.60
100	930219	E	033	DP-1	N		71	2	RA	N	63.40
101	930219	E	033	DP-1	N		74	2	RA	N	63.40
102	930219	E	033	DP-1	N		103	9	RA	N	63.40
103	930219	S	014	DP-1	N		142	25	RA	N	64.85
104	930219	S	014	DP-1	N		129	19	RA	N	64.85
105	930219	S	014	DP-1	N		125	18	RA	N	64.85

Table 4. Summary of Humpback Chub handled during Trip 2, 1993.

N	DATE	TYPE	SAMPLE	PIT TAG	RECAPTURE	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
106	930219	S	014	DP-1	N		77	4	RA	N	64.85
107	930219	S	014	DP-1	N		76	3	RA	N	64.85
108	930219	S	014	DP-1	N		79	3	RA	N	64.85
109	930219	S	014	DP-1	N		76	3	RA	N	64.85
110	930219	S	014	##########	N		49	0	RA	N	64.85
111	930222	N	168	7F7F264E78	Y	PITTAG	262	197	RA	N	127.30
112	930222	N	178	7F7F48091D	Y	PITTAG	266	192	RA	N	127.30
113	930222	N	183	7F7D44173F	N		293	331	RA	N	127.50
114	930222	N	164	7F7B021735	N		210	93	RA	N	127.30
115	930223	N	194	7F7B081768	N		387	768	RI	Y	126.25

Table 5. Summary of radio-transmitter implants in humpback chub during Trip 2, 1993.											
#	DATE	PITTAG	TL	WT	FREQ	PULSE RATE (pulses/min)	RADIOTAG SIZE (gms)	LIFE EXPEC-TANCY (days)	ESTIMATED DATE OF EXTINCTION	CAPTURE (rm)	RELEASE (rm)
1	930223	7F7BO81768	387	768	40.600	40	11	120	930623	125.4	125.4

Table 6. A list of radio frequencies contacted on Trip 2, 1993 and locations relative to capture and release sites.					
			--------River Mile--------		
FREQ/PULSE	TAG SIZE (gm)	DATE (time)	CAPTURE	RELEASE	LOCATE
40.600/40	11	921030	125.4	125.4	

CHARACTERIZATION OF THE LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE GRAND CANYON

TRIP REPORT 3 - 1993
March 10 - 25, 1993

Prepared For:

Bureau of Reclamation

Prepared By:

Richard A. Valdez, Principal Investigator
William J. Masslich, Project Leader
William Leibfried, Project Leader

BIO/WEST INC.
1063 West 1400 North
Logan, UT. 84321

April 5, 1993

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LIST OF TABLES

INTRODUCTION

This report presents pertinent details associated with Trip 3, 1993. Included in the report are a summary of trip logistics, personnel and research schedule, data collected, problems encountered, pertinent observations and recommendations. Most information is presented in a tabular format to provide a quick synopsis of pertinent trip details and results. We emphasize that these data are hand tabulated to provide these synopses as soon as possible. The data are later computerized and checked for accuracy. The purpose of these trip reports is to provide information from BIO/WEST trips as quickly as possible to aid other researchers.

LOGISTICS, RESEARCH SCHEDULE AND PERSONNEL

Table 1 presents a summary of logistics and the research schedule for Trip 3, 1993. Table 2 is a list of personnel who were present or participated in research activities for Trip 3, 1993.

DATA COLLECTED

Table 3 is a summary of gear types used, sampling effort and fish captured by gear type for Trip 3, 1993. Table 4 is a summary of all humpback chubs handled during Trip 3, 1993. Table 5 presents information on humpback chub implanted with radiotransmitters during Trip 2 and 3, 1993. Table 6 summarizes the radio contacts during Trip 3, 1993 and presents original fish release locations and radiotag data.

Humpback Chubs Captured

A total of 112 humpback chub were captured during Trip 3, 1993 including 26 YOY (<101 mm TL), 31 juveniles (100-199 mm TL), and 55 adults (>199 mm TL). All but 11 adult humpback chub were captured in Reach 1 between RM 60 and RM 66. In Reach 1, 16 chubs were captured with seines including two adults, nine juveniles and five YOY. Thirty-two chubs, including one adult, 16 juveniles and 15 YOY were captured electrofishing. Netting produced 46 humpback chub including 41 adults and five juveniles. Seven chubs, six YOY and one juvenile were also captured in unbaited minnow traps.

Of the 44 adult humpback chub captured in Reach 1, 30 or 68% were PIT tagged recaptures. No humpbacks bearing Floy or Carlin tags were recaptured during Trip 3, 1993. One YOY humpback chub captured at RM 62.75 was a recaptured fin clipped fish, bearing a ASU fin clip combination of a left pelvic, upper caudal.

Ten adult humpback chub were captured in Reach 2 between RM 126 and RM 128. All ten were captured in nets. Of the ten fish, 6 were recaptures of fish previously tagged in the same locale by BIO/WEST. Three of the recaptures were of fish sampled for the Gila Taxonomy project. The tissue plug scars were completely healed and the fish were in good condition. Two humpback chubs from Reach 2 exhibited tubercles. One chub exhibited spawning coloration.

One adult humpback chub was captured in Reach 0 at RM 29.9. The fish was an unusually large adult, weighing 956 gms and appeared in excellent condition. The fish was not a recapture. This represents the first humpback chub captured by BIO/WEST in Reach 0.

Radiotelemetry

Two humpback chubs were implanted during Trip 2, 1993 in Reach 2. Both fish were from the Middle Granite Gorge area. One fish was implanted with a 9 gm transmitter and one with an 11 gm transmitter.

The chub implanted in February 1993 was located at the same river mile where released. Radiotelemetry observations were initiated and continued for several days. No major movements were observed.

A second omni-directional remote telemetry station was installed and activated at RM 127.4 left, between release sites of both newly implanted chubs. The other remote station was checked and downloaded during the trip.

Habitat Mapping

Habitat mapping was conducted at RM 126.1, the location of the February implanted chub.

Bench Marks

Two new bench marks were established during Trip 3, 1993. One is located on river left at 126.1, and the other river left at RM 127.2.

OBSERVATIONS

1. Main channel turbidities were high both above and below the LCR during Trip 3, 1993. Consistent runoff from both the Paria and LCR created the turbid conditions. The LCR was flowing relatively high and rising during the trip. It is assumed that rising flows in the LCR are associated with normal spring time runoff from headwater reaches.

2. The capture of numerous gravid and running rainbow trout in and around springs near RM 30 suggest that several of the springs may provide local areas of suitable spawning habitat in the main channel. Temperature of water flowing from the springs measured 15° C, compared to 7-8°C in the main channel.

3. Three rainbow trout were observed in the lower 200 m of Lava Creek during a cursory survey on March 22. BIO/WEST regularly camps at the Lava Creek and has not observed rainbows utilizing the drainage prior to this. It is probable that these fish were engaged in spawning activities. Water temperatures in the creek were ranging from 10 to 12°C and turbidities were low. Although Lava Creek is normally intermittent in character, spring runoff during 1990-92 has been short in duration and low in volume and has, at best, provided marginal spawning habitat for rainbow trout. During 1993 flows have been consistently high since January providing consistent access to the tributary and stable spawning habitat. It is speculated that unusually wet weather during the later part of 1992 and early 1993 may be creating similar conditions in many of the 'normally' intermittent tributaries in the canyon and suitable spawning habitat may be available in areas that are typically not utilized. This being the case, it would not be surprising to observe a strong year class of naturally spawned trout in the Canyon during 1993.

4. Densities of humpback chub, particularly large adults, above the confluence of the LCR were unusually low during Trip 3, 1993. Since fish were observed staging near the LCR in February, low densities were expected at locations removed from the mouth of the LCR. However, in the last two years high numbers of fish have consistently been captured in eddies and runs immediately above the confluence during all months of the year. Low numbers of fish in this area (numbers of flannelmouth sucker were also unusually low) suggest an unusual staging response by both humpback chubs and flannelmouth sucker possibly related to recent flood events from the LCR. It is speculated that fish have either moved en masse into the LCR or are staging in areas other than those observed by BIO/WEST during the last two years.

5. Moderate numbers of adult humpback chub were captured in the main channel in a two mile reach below the LCR confluence. This observation combined with the paucity of adult humpback chub captured above the LCR confluence area suggest that the fish were staging in areas below the LCR, or had already ascended the LCR for spawning.

6. Moderate numbers of juvenile and YOY humpback chubs were captured in shoreline habitat below the confluence of the LCR. Most fish were captured in shoreline habitat provided by large talus and vegetated cutbanks.

7. Significant sediment deposition occurred during the February flood event out of the LCR. Depositional patterns were similar to those observed following the January flood event. Many of the sand bars that were deposited and subsequently eroding after January were rebuilt. More

stable sand bars were similar in size or slightly larger. Deposition resulting from the two LCR floods has significantly altered the channel morphology below the LCR. Most significant changes were incurred in a three mile reach below the confluence. Many eddies and other habitats that existed prior to the flooding have been replaced by massive sand deposits. Significant changes in habitat availability and structure have resulted from the new deposition.

8. Six of the ten chubs caught in Reach 2 were recaptured fish from the same locale as originally captured. This along with previous recapture data from this reach suggest an aggregation or small population of chubs utilizing this area.

9. Three of the ten chubs from Reach 2 exhibited tubercles or spawning coloration.

10. Bright Angel Creek and Havasu Creek were sites of spawning native suckers during Trip 3, 1993. The majority of spawning suckers in Bright Angel Creek were flannelmouths while bluehead suckers dominated in Havasu Creek. One small hoop net set overnight caught over 100 bluehead suckers.

PROBLEMS ENCOUNTERED AND SOLUTIONS

1. High turbidities in the main channel affected sampling efficiency. Two netters were used electrofishing when possible to increase efficiency.

2. The remote station at RM 126.1 was downloaded by only contained 3 blocks of data. The sensitivity was increased and the station was logging properly when it was left.

RECOMMENDATIONS

1. We recommend continued and enhanced coordination among the researchers in Grand Canyon. This coordination is essential to insure that all researchers are aware of others activities.

Table 1. Logistics and Research Schedule for Trip 3, 1992 Team 1.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
3/10	20.5	North Canyon	X	X		
3/11	20.5	North Canyon		X		
3/12	30.0	30 Mile	X	X		
3/13	30.0	30 Mile		X		
3/14	58.0	Awatubi	X	X		
3/15	58.0	Awatubi		X		X
3/16	61.3	LCR	X	X		X
3/17	61.3	LCR		X		X
3/18	61.3	LCR		X		X
3/19	61.3	LCR		X		X
3/20	65.4	Lava Chuar	X	X		X
3/21	65.4	Lava Chuar		X		X
3/22	65.4	Lava Chuar		X		X
3/23	139	Fishtail	X			
3/24	214	214 Mile	X			
3/25	225	Diamond Creek	X			

[1] T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 1. Logistics and Research Schedule for Trip 3, 1992 Team 2.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
3/10	30.1	Fence Fault				
3/11	87.1	Cremation	X	X		
3/12	87.1	Cremation		X		
3/13	108.4	Lower Bass	X	X		
3/14	108.4	Lower Bass		X		
3/15	126.2	Randy's Rock	X	X	X	
3/16	126.2	Randy's Rock		X	X	X
3/17	126.2	Randy's Rock		X	X	X
3/18	126.2	Randy's Rock		X	X	X
3/19	143.3	Across from Kanab Creek	X	X		
3/20	143.3	Across from Kanab Creek		X		
3/21	155.6	Last Chance	X	X		
3/22	155.6	Last Chance		X		
3/23	214	214 Mile	X	X		
3/24	214	214 Mile		X		
3/25	225.7	Diamond Creek	X			

[1] T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 2. Personnel Participating in Trip 3, 1993.

PERSONNEL	AFFILIATION	DATES	COMMENTS
TEAM #1			
B. Masslich	BIO/WEST	3/10 - 3/23	Project Leader Out Kaibab
P. Weiss	BIO/WEST	3/10 - 3/23	Out Kaibab
L. Brown	BIO/WEST	3/10 - 3/23	Out Kaibab
Y. Converse	BIO/WEST	3/10 - 3/23	Out Kaibab
C. Heck	BIO/WEST	3/10 - 3/23	Out Kaibab
J. Kennedy	BIO/WEST VOLUNTEER	3/10 - 3/25	
P. Kelsey	BIO/WEST VOLUNTEER	3/10 - 3/25	
D. Perault	BIO/WEST VOLUNTEER	3/10 - 3/23	Out Kaibab
J. Jones	OARS	3/10 - 3/25	
D. Clark	OARS	3/10 - 3/25	
M. Becker	OARS	3/10 - 3/25	
Team 2			
B. Leibfried	BIO/WEST	3/10 - 3/21	Project Leader Hike out Havasu
E. Prats	BIO/WEST	3/10 - 3/25	
J. Johnson	BIO/WEST	3/10 - 3/25	
T. Yates	BIO/WEST	3/10 - 3/25	
J. Mansour	BIO/WEST	3/10 - 3/25	
A. Laroue	BIO/WEST VOLUNTEER	3/10 - 3/25	Volunteer
J. Boutwell	BOR	3/10 - 3/25	
J. Smith	BIO/WEST VOLUNTEER	3/10 - 3/25	Volunteer
S. Bledsoe	OARS	3/10 - 3/25	Trip Leader
J. Hall	OARS	3/10 - 3/25	
S. Stevens	OARS	3/10 - 3/25	
E. Barksdale	OARS	3/10 - 3/25	

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 3, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	BK	CC	CP	SD	PK	FH
Electrofishing Reach 0 N=23	A				146		1		3			
	J				34	1						
	Y											
Electrofishing Reach 1 N=72	A	1			118	3			5	12	1	2
	J	16			12				1			
	Y	15			2							
Electrofishing Reach 2	A		2		9	20			31	1		
	J				4	1						
	Y											
Electrofishing Reach 3	A											
	J			Data not available								
	Y											
Nets Reach 0 N=124	A	1	1		121							
	J											
	Y											
Nets Reach 1 N=64	A	41	11	13	56				1			
	J	5										
	Y											
Nets Reach 2 N=226 452 hr	A	10	22	10	9	37			11			
	J											
	Y											

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 3, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	BK	CC	CP	SD	PK	FH
Nets Reach 3 N=22 44 hr	A		2					2	2			
	J											
	Y											
Seines Reach 1 N=25	A	2		1	18				1			
	J	9			1			1				
	Y	5										
Hoops Reach 2 N=6 144 hr	A		9	1	4	2				13		
	J		2	1	1							
	Y											
Hoops Reach 3 N=1 24 hr	A		2	92								
	J			32								
	Y											
Traps Reach 1 N=226	A											
	J	1										
	Y	6										
Traps Reach 2 N=14 336 hr	A									22		
	J											
	Y											
Traps Reach 3 N=4 96 hr	A											
	J											
	Y											

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 3, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	BK	CC	CP	SD	PK	FH
Totals	A	55	49	117	481	62	1	2	54	48	1	2
	J	31	2	33	52	2	0	1	1	0	0	0
	Y	26	0	0	2	0	0	0	0	0	0	0
	T	112	51	150	535	64	1	3	55	48	1	2

[2] - A = Adult
J = Juvenile
Y = Young of year

[3] - HB = humpback chub
FM = flannelmouth sucker
BH = bluehead sucker
RB = rainbow trout
BR = brown trout
BK = brook trout
CC = channel catfish
CP = carp
SD = speckled dace
PK = plains killifish
FH = fathead minnow

Table 4. Summary of Humpback Chub handled during Trip 3, 1993.

N	DATE	TYPE	SAMPLE	PIT TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
1	930312	N	038	7F7B081513	N		456	956	RA	N	29.90
2	930315	N	077	7F7D084D41	Y	PITTAG	337	478	RI	Y	127.1
3	930316	N	086	7F7F1F1F02	Y	PITTAG	328	416	RS	N	127.5
4	930316	N	094	7F7F332967	N		256	190	RA	N	127.5
5	930316	N	101	7F7D077D5A	Y	PITTAG	272	216	RA	N	127.5
6	930316	N	108	7F7F333501	N		214	110	RA	N	127.1
7	930316	N	109	7F7F264E78	Y	PITTAG	262	191	RA	N	127.1
8	930316	N	097	7F7B03423C	Y	PITTAGSCAR	215	110	RA	N	60.20
9	930316	N	097	7F7B020017	N		188	82	RA	N	60.20
10	930316	N	107	7F7B080D69	N		251	175	RA	N	60.20
11	930316	N	110	7F7F290365	Y	PITTAG	310	234	RA	N	60.50
12	930317	N	116	7F7D075A72	Y	PITTAG	267	220	RA	N	127.5
13	930317	N	118	7F7F332327	N		235	149	RA	N	127.1
14	930317	E	033	DP-1	N		88	5	RA	N	62.60
15	930317	E	034	7F7F284A77	N		180	60	RA	N	62.60
16	930317	E	035	DP-1	N		66	3	RA	N	63.50
17	930317	T	039	DP-1	N		114	10	RA	N	61.70
18	930317	N	117	7F7D7C1A40	N		182	69	RA	N	60.90
19	930317	N	117	7F7D3E631C	N		191	78	RA	N	60.90
20	930317	N	118	7F7D446705	N		240	120	RA	N	60.90

Table 4. Summary of Humpback Chub handled during Trip 3, 1993.

N	DATE	TYPE	SAMPLE	PIT TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
21	930317	N	126	7F7D2B1D78	Y	PITTAG	213	93	RA	N	60.90
22	930317	N	127	7F7D2B1659	Y	PITTAG	300	304	RA	N	60.90
23	930317	N	131	7F7F484445	Y	PITTAG	313	304	RS	N	61.30
24	930317	N	131	7F7F050619	Y	PITTAG	280	227	RS	N	61.30
25	930317	N	131	7F7F2D1611	Y	PITTAG	210	93	RA	N	61.30
26	930317	N	131	7F7D226448	Y	PITTAG	214	98	RA	N	61.30
27	930317	N	135	7F7B03572E	N		392	700	RS	N	61.15
28	930318	N	149	7F7F332C08	N		298	310	RS	N	126.1
29	930318	E	041	DP-1	N		70	2	RA	N	63.50
30	930318	E	041	DP-1	N		105	7	RA	N	63.50
31	930318	E	041	DP-1	N		77	3	RA	N	63.50
32	930318	E	041	DP-1	N		78	4	RA	N	63.50
33	930318	E	044	DP-1	N		111	13	RA	N	63.20
34	930318	E	044	7F7F477C41	N		172	50	RA	N	63.20
35	930318	E	045	DP-1	N		74	2	RA	N	63.50
36	930318	E	045	DP-1	N		77	3	RA	N	63.50
37	930318	E	045	7F7E43231D	Y	PITTAG	232	108	RA	N	63.50
39	930318	N	139	7F7F182F27	Y	PITTAG	356	505	RS	N	61.50
39	930318	N	147	7F7D2B0063	Y	PITTAG	247	143	RA	N	61.50
40	930318	N	147	7F7B024316	N		328	410	RS	N	61.50

Table 4. Summary of Humpback Chub handled during Trip 3, 1993.

N	DATE	TYPE	SAMPLE	PIT TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
41	930318	N	147	7F7F26590F	Y	PITTAG	376	449	RS	N	61.50
42	930318	N	147	7F7F3D0854	Y	PITTAG	354	646	RS	N	61.50
43	930318	N	147	7F7D172A36	Y	PITTAG	333	424	RS	N	61.50
44	930319	N	156	7F7D073D48	Y	PITTAG	386	874	RI	Y	127.5
45	930319	S	002	7F7F256823	Y	PITTAG	355	498	RA	N	61.70
46	930319	S	007	DP-1	Y	LPUC	76	4	RA	N	62.75
47	930319	S	008	DP-1	N		103	10	RA	N	62.75
48	930319	S	008	DP-1	N		121	13	RA	N	62.75
49	930319	S	008	DP-1	N		89	7	RA	N	62.75
50	930319	S	008	DP-1	N		93	7	RA	N	62.75
51	930319	E	049	7F7D3C4E18	N		196	77	RA	N	60.30
52	930319	E	052	7F7B034004	N		161	35	RA	N	61.20
53	930319	N	156	7F7B02371C	N		237	130	RA	N	61.50
54	930319	N	158	7F7B02083B	N		208	86	RA	N	62.50
55	930319	N	158	7F7D44176F	N		220	90	RA	N	62.50
56	930319	N	164	7F7D225A0E	Y	PITTAG	422	766	RS	N	61.50
57	930319	N	166	7F7D3C4A62	N		275	217	RS	N	61.50
58	930319	N	170	7F7D152D79	Y	PITTAG	351	365	RA	N	61.70
59	930319	N	173	7F7D1B737B	Y	PITTAG	295	182	RA	N	62.20
60	930319	N	174	7F7D24234D	Y	PITTAG	344	502	RS	N	61.50

Table 4. Summary of Humpback Chub handled during Trip 3, 1993.

N	DATE	TYPE	SAMPLE	PIT TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
61	930319	N	174	7F7B022377	Y	PITTAG	336	314	RS	N	61.50
62	930319	N	174	7F7B035620	N		374	584	RS	N	61.55
63	930319	N	174	7F7D1E2706	Y	PITTAG	320	358	RS	N	61.55
64	930320	E	055	DP-1	N		86	4	RA	N	60.90
65	930320	E	060	CP-1	N		100	11	RA	N	66.80
66	930320	E	061	CP-1	N		89	5	RA	N	67.00
67	930320	E	066	7F7F471C3B	N		181	62	RA	N	64.60
68	930320	E	066	DP-1	N		124	14	RA	N	64.60
69	930320	E	067	DP-1	N		116	14	RA	N	64.80
70	930320	T	169	DP-1	N		96	7	RA	N	63.10
71	930320	T	170	DP-1	N		94	7	RA	N	63.10
72	930320	T	171	DP-1	N		88	3	RA	N	63.10
73	930320	N	176	7F7D40030C	N		386	775	RS	N	63.70
74	930320	N	176	7F7B082A78	N		331	428	RA	N	63.70
75	930320	N	177	7F7B080F12	N		285	172	RA	N	63.30
76	930320	N	177	7F7D30155A	Y	PITTAG	353	478	RA	N	63.30
77	930320	N	177	7F7F287523	Y	PITTAG	195	74	RA	N	63.30
78	930320	N	177	7F7F2C0E67	Y	PITTAG	200	81	RA	N	63.30
79	930320	N	178	7F7B022545	N		225	97	RA	N	64.15
80	930320	N	180	7F7B082179	N		295	210	RA	N	63.30

Table 4. Summary of Humpback Chub handled during Trip 3, 1993.

N	DATE	TYPE	SAMPLE	PIT TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
81	930320	N	180	7F7F28477D	Y	PITTAG	395	531	RA	N	63.30
82	930320	N	180	7F7F485B00	Y	PITTAG	369	481	RA	N	63.30
83	930320	N	180	7F7F3C4518	Y	PITTAG	327	387	RA	N	63.30
84	930320	N	180	7F7D516157	Y	PITTAG	228	122	RA	N	63.30
85	930320	N	182	7F7F044801	Y	PITTAG	412	758	RA	N	63.70
86	930320	N	183	7F7D441567	N		184	74	RA	N	63.30
87	930320	N	184	7F7B025253	N		191	76	RA	N	64.15
88	930321	S	010	DP-1	N		101	8	RA	N	63.40
89	930321	S	011	DP-1	N		146	29	RA	N	63.40
90	930321	S	011	7F7D224D68	Y	PITTAG	202	65	RA	N	63.40
91	930321	S	011	DP-1	N		135	21	RA	N	63.40
92	930321	S	013	7F7F1F1451	N		178	56	RA	N	63.50
93	930321	S	015	DP-1	N		86	5	RA	N	63.70
94	930321	S	015	DP-1	N		74	3	RA	N	63.70
95	930321	S	015	DP-1	N		70	4	RA	N	63.70
96	930321	S	015	DP-1	N		95	6	RA	N	63.70
97	930321	S	015	DP-1	N		85	6	RA	N	63.70
98	930321	E	068	DP-1	N		75	4	RA	N	64.30
99	930321	E	070	DP-1	N		139	28	RA	N	64.10
100	930321	E	070	DP-1	N		59	2	RA	N	64.10

Table 4. Summary of Humpback Chub handled during Trip 3, 1993.

N	DATE	TYPE	SAMPLE	PIT TAG	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
101	930321	E	072	DP-1	N		74	3	RA	N	64.90
102	930321	E	072	#######	N		31	1	RA	N	65.10
103	930321	T	195	DP-1	N		95	7	RA	N	65.05
104	930321	T	195	DP-1	N		76	4	RA	N	65.05
105	930321	T	198	DP-1	N		92	5	RA	N	65.40
106	930322	E	073	DP-1	N		73	5	RA	N	64.80
107	930322	E	074	DP-1	N		55	2	RA	N	65.00
108	930322	E	074	DP-1	N		46	1	RA	N	64.90
109	930322	E	078	DP-1	N		64	2	RA	N	64.50
110	930322	E	078	DP-1	N		80	3	RA	N	64.50
111	930322	E	079	DP-1	N		77	4	RA	N	64.50
112	930322	E	079	DP-1	N		60	1	RA	N	64.50

Table 5. Summary of radio-transmitter implants in humpback chub during Trip 2, 1993.											
#	DATE	PITTAG	TL	WT	FREQ	PULSE RATE (pulses/min)	RADIOTAG SIZE (gms)	LIFE EXPECTANCY (days)	ESTIMATED DATE OF EXTINCTION	CAPTURE (rm)	RELEASE (rm)
1	930223	7F7BO81768	387	768	40.600	40	11	120	930623	126.1	126.1

Table 5. Summary of radio-transmitter implants in humpback chub during Trip 3, 1993.											
#	DATE	PITTAG	TL	WT	FREQ	PULSE RATE (pulses/min)	RADIOTAG SIZE (gms)	LIFE EXPECTAN-CY (days)	ESTIMATED DATE OF EXTINCTION	CAPTURE (rm)	RELEASE (rm)
1	930316	7F7D084141	337	478	40.660	40	9	50	930505	127.1	127.1
2	930319	7F7D073D4A	386	874	40.730	40	11	120	930719	127.5	127.5

Table 6. A list of radio frequencies contacted on Trip 3, 1993 and locations relative to capture and release sites.

			-------River Mile-------		
FREQ/PULSE	TAG SIZE (gm)	DATE (time)	CAPTURE	RELEASE	LOCATE
[1]40.660/36	9	930316(1154)	127.1	127.2	
/36		930316(1419)			127.2
/36		930316(1824)			127.2
/36		930316(2227)			127.2
/38		930317(0709)			127.2
/36		930317(1005)			127.2
/36		930317(1212)			127.2
/36		930319(0700)			127.2
		930319(1112)			127.2
/38					
40.600/40	11	930223	126.1	126.1	
/43		930315(1415)			126.1
/44		930319(1106)			126.1
[1]40.730/40	11	930319	127.5	127.5	
/40		930319(1115)			127.5

[1]Fish implanted during this trip.

CHARACTERIZATION OF THE LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE GRAND CANYON

TRIP REPORT 4 - 1993
April 8 - 23, 1993

Prepared For:

Bureau of Reclamation

Prepared By:

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May 4, 1993

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INTRODUCTION

This report presents pertinent details associated with Trip 4, 1993. Included in the report are a summary of trip logistics, personnel and research schedule, data collected, problems encountered, pertinent observations and recommendations. Most information is presented in a tabular format to provide a quick synopsis of pertinent trip details and results. We emphasize that these data are hand tabulated to provide these synopses as soon as possible. The data are later computerized and checked for accuracy. The purpose of these trip reports is to provide information from BIO/WEST trips as quickly as possible to aid other researchers.

LOGISTICS, RESEARCH SCHEDULE AND PERSONNEL

Table 1 presents a summary of logistics and the research schedule for Trip 4, 1993. Table 2 is a list of personnel who were present or participated in research activities for Trip 4, 1993.

DATA COLLECTED

Table 3 is a summary of gear types used, sampling effort and fish captured by gear type for Trip 4, 1993. Table 4 is a summary of all humpback chubs handled during Trip 4, 1993. Table 5 presents information on humpback chub implanted with radiotransmitters during Trip 2 and 3, 1993. Table 6 summarizes the radio contacts during Trip 4, 1993 and presents original fish release locations and radiotag data.

Humpback Chubs Captured

A total of 143 humpback chub were captured during Trip 4, 1993 including 44 YOY (<101 mm TL), 51 juveniles (100-199 mm TL), and 48 adults (>199 mm TL). In Reach 1, 25 chubs were captured with seines including 11 juveniles and 14 YOY. Forty-three chubs, including three adults, 29 juveniles and 11 YOY were captured electrofishing. Netting produced 30 humpback chub including 27 adults and three juveniles. Twenty-six chubs, 19 YOY and seven juvenile were also captured in unbaited minnow traps.

Four adult humpback chub (3 females and 1 male) were captured in Reach 0 between RM 30.5 - 31.3. All four fish appeared in excellent condition. None of the fish were recaptures. Three of the fish were captured in the same net, in a small eddy about 10 m offshore of a spring. Water at the source of the spring measured 19°C, compared to a mainchannel temperature of 8°C. The water temperature at the approximate point of capture of the three chub was 12°C.

Of the 30 adult humpback chub captured in Reach 1, 18 (or 60%) were PIT-tagged recaptures. No humpbacks bearing Floy or Carlin tags were recaptured during Trip 4, 1993. Three sub-adult humpback chub captured between RM 61.9 - 63.7 were recaptured fin clipped fish, bearing ASU fin clip combinations of left pelvic, lower caudal; right and left pelvic, upper caudal; and right pelvic, upper caudal.

Fifteen humpback chub (13 adults, 2 juveniles) were captured in Reach 2 between RM 126.1 and RM 128.8. Of the 13 adults, seven were recaptures of fish previously tagged in the same locale by

BIO/WEST. Of nine males captured in Reach 2, five were running milt and two others exhibited tubercles.

One juvenile humpback chub (181 mm TL), collected in a trammel net at RM 63.7, was sacrificed for investigation of possible tapeworm infestation. The abdomen of the fish was severely distended and its skin vascularized and discolored; the remainder of the body of the fish appeared emaciated. The described afflictions were not attributable to the sampling gear, nor was the fish a recapture. The fish was dissected in the field, photographed, and preserved, to be turned over to AGF for detailed examination. Cursory internal observation revealed unidentified fluid filled sacks on eith side of the ribcage, and a large abnormal tissue mass. No tapeworms were found.

Radiotelemetry

No humpback chubs were implanted during Trip 4, 1993.

Both chubs implanted in March 1993 were located at the same river mile where released. Radiotelemetry observations on both fish were initiated and continued for several days. Some significant movement of both fish was observed. The chub implanted in February was not located during this trip, but was logged on the remote station several days prior to our arrival to the area.

Both remote stations were checked and downloaded during the trip. The remote station at RM 127.1 had logged 15,000 blocks of data. The sensitivity was lowered to filter out unusable "noise" and the logger reactivated. The station at RM 126.1 had not logged any data. This station was reprogrammed and initialized to log data.

Habitat Mapping

Habitat mapping was conducted at RM 127.1 and 127.5, the location of the March-implanted chubs.

Bench Marks

No new bench marks were established during Trip 4, 1993.

OBSERVATIONS

1. Main channel turbidities were low above the LCR and low to high below the LCR during Trip 4, 1993. The LCR was flowing moderately high but stable during the trip.

2. Gravid and running rainbow trout were collected in and around springs near RM 30, suggesting that several of the springs may provide local areas of suitable spawning habitat in the main channel. Temperature of water flowing from the springs measured as high as 19°C, compared to 8°C in the main channel. Rainbow trout and speckled dace were also observed in Lava Creek (RM 65.5).

3. Flannelmouth suckers were abundant around the mouth of the Paria River (RM 1).

4. Densities of humpback chub, particularly large adults, were low above the confluence of the LCR during Trip 4, 1993. Sampling with nets in and around the mouth of the LCR also captured few chubs. Catch rates were moderate below the LCR to Lava Canyon. This indicates that chubs have ascended the LCR for the 1993 spawning period.

5. One juvenile chub (143 mm TL) was captured by electrofishing above the LCR at RM 60.6.

6. Moderate numbers of juvenile and YOY humpback chubs were captured in shoreline habitat below the confluence of the LCR. Most fish were captured in shoreline habitat provided by large talus and vegetated cutbanks.

7. Two B/W fin-punched juvenile chubs were recaptured in minnow traps. The fish appeared to be in excellent condition, showing no adverse affects due to the mark, although the fish appeared to have been marked during the same trip.

PROBLEMS ENCOUNTERED AND SOLUTIONS

1. Fouling of nets with Cladophera probably affected netting sampling efficiency at the first camp, around RM 5. Nets typically had to be replaced after only 2 - 3 hours of fishing. Accumulations of Cladophera, combined with low turbidity levels, probably increased net avoidance by fish.

2. Two outboard motors were running rough midway through the trip. The outboards were switched with spares in the field and will be repaired in the shop before the next trip.

RECOMMENDATIONS

1. We recommend continued and enhanced coordination among the researchers in Grand Canyon. This coordination is essential to insure that all researchers are aware of others activities.

2. We recommend a continued radiotelemetry effort in the Middle Granite Gorge to continue to accumulate information on this population through the spawning period and possibly through the remainder of the year.

Table 1. Logistics and Research Schedule for Trip 4, 1992.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
04/08	4.8	Below Navajo Bridge	X	X		
04/09	4.8	Below Navajo Bridge		X		
04/10	30.0	30-Mile	X	X		
04/11	30.0	30-Mile		X		
04/12	61.2	LCR	X	X		
04/13	61.2	LCR		X		
04/14	61.2	LCR		X		
04/15	65.4	Lava Chuar	X	X		X
04/16	65.4	Lava Chuar		X		X
04/17	102	102-Mile	X			
04/18	126.2	Middle Granite Gorge	X	X	X	X
04/19	126.2	Middle Granite Gorge		X	X	X
04/20	126.2	Middle Granite Gorge		X	X	X
04/21	165.0	Below Tuckup	X			
04/22	220	220-Mile	X			
04/23	225.8	Diamond Creek - Take Out	X			

[1]T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 2. Personnel Participating in Trip 4, 1993.

PERSONNEL	AFFILIATION	DATES	COMMENTS
B. Leibfried	BIO/WEST	4/12 - 4/23	Chopper In - LCR
T. Wasowicz	BIO/WEST	4/08 - 4/23	Senior Biologist
P. Trater	BIO/WEST	4/08 - 4/23	Biologist
C. Heck	BIO/WEST	4/08 - 4/23	Biologist
L. Brown	BIO/WEST	4/08 - 4/23	Biologist
Y. Converse	BIO/WEST	4/08 - 4/23	Biologist
D. McCabe	BIO/WEST	4/08 - 4/23	Biologist/Boatman
P. Dean	BIO/WEST VOLUNTEER	4/08 - 4/23	
M. Nevel	BIO/WEST VOLUNTEER	4/08 - 4/23	
A. Haden	GCES	4/12 - 4/13	Chopper In/Out Powell
F. Protiva	GCES	4/12 - 4/13	Chopper In/Out Powell
R. Valdez	BIO/WEST	4/14 - 4/16	In/Out Tanner
W. Homan	PHOENIX ZOO	4/08 - 4/17	Out Bright Angel
B. Starrett	PHOENIX ZOO	4/08 - 4/17	Out Bright Angel
T. Anderson	OARS	4/08 - 4/23	
J. Toner	OARS	4/08 - 4/23	Trip Leader
S. Posegate	OARS	4/08 - 4/23	
J. Kennedy	OARS VOLUNTEER	4/09 - 4/23	

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 4, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH
Electrofishing Reach 0 N=23	A	0	26	0	79	1	0	7	0	0
	J	0	0	0	21	0	0	0	0	0
	Y	0	0	0	1	0	0	0	0	0
Electrofishing Reach 1 N=27	A	3	1	0	19	1	1	5	9	2
	J	29	0	9	0	0	0	1	0	0
	Y	11	0	0	1	0	0	0	0	0
Electrofishing Reach 2 N=5	A	0	0	0	2	1	0	10	0	4
	J	1	0	0	0	0	0	0	0	0
	Y	0	0	0	1	0	0	0	0	0
Electrofishing Reach 3 N=0	A	0	0	0	0	0	0	0	0	0
	J	0		0		0	0	0	0	0
	Y	0	0	0	0	0	0	0	0	0
Nets Reach 0 N=78	A	4	8	0	56	0	0	2	0	0
	J	0	0	0	0	0	0	0	0	0
	Y	0	0	0	0	0	0	0	0	0
Nets Reach 1 N=133	A	27	22	4	27	0	1	4	0	0
	J	3	0	0	0	0	0	0	0	0
	Y	0	0	0	0	0	0	0	0	0
Nets Reach 2 N=71	A	14	1	1	2	0	0	1	0	0
	J	0	0	0	0	0	0	0	0	0
	Y	0	0	0	0	0	0	0	0	0

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 4, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH
Seines Reach 0 N=3	A	0	0	0	0	0	0	0	0	0
	J	0	0	0	0	0	0	0	0	0
	Y	0	0	0	0	0	0	0	0	0
Seines Reach 1 N=38	A	0	0	1	5	0	0	0	50	11
	J	11	1	4	0	0	0	0	0	0
	Y	14	0	0	0	0	0	0	0	0
Traps Reach 1 N=226	A	0	0	0	0	0	0	0	1	1
	J	7	0	0	0	0	0	0	0	0
	Y	19	0	0	0	0	0	0	0	0
Totals	A	48	58	6	190	3	2	29	60	17
	J	51	1	13	21	0	0	1	0	0
	Y	44	0	0	3	0	0	0	0	0
	T	143	59	19	214	3	2	30	60	17

[2] - A = Adult
J = Juvenile
Y = Young of year

[3] - HB = humpback chub
FM = flannelmouth sucker
BH = bluehead sucker
RB = rainbow trout
BR = brown trout
CC = channel catfish
CP = carp
SD = speckled dace
FH = fathead minnow

Table 4. Summary of Humpback Chub handled during Trip 4, 1993.

	DATE	TYPE	SAMPLE	TAG NUMBER[1]	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
1	930411	N	069	7F7D08201A	N		415	628	RA	N	30.50
2	930411	N	069	7F7D08013E	N		446	686	RA	N	30.50
3	930411	N	069	7F7D084D00	N		364	543	RA	N	30.50
4	930411	N	071	7F7D085A4C	N		367	469	RA	N	31.30
5	930412	N	086	7F7D173714	Y	PITTAG	328	342	RA	N	60.50
6	930412	E	025	LC1[2]	N		143	23	RA	N	60.60
7	930413	N	124	7F7D176A16	Y	PITTAG	365	506	RA	N	0.10 LCR
8	930413	N	124	7F7D224E32	Y	PITTAG	348	469	RA	N	0.10 LCR
9	930413	N	126	7F7D3E7931	N		220	115	RA	N	61.15
10	930413	N	105	7F7F7F0E43	Y	PITTAG	301	280	RA	N	61.15
11	930413	N	106	7F7F3E6339	Y	PITTAG	276	210	RA	N	61.25
12	930413	N	118	7F7D08545E	Y	PITTAG	442	629	RA	N	0.10 LCR
13	930413	N	118	7F7D224A40	Y	PITTAG	355	373	RA	N	0.10 LCR
14	930413	N	120	7F7D1A4C71	Y	PITTAG	193	67	RA	N	61.15
15	930413	N	121	7F7F03194E	Y	PITTAG	330	308	RA	N	61.25
16	930413	E	033	DP1	N		123	13	RA	N	62.80
17	930413	E	035	DP1	N		117	15	RA	N	62.80
18	930413	E	035	DP1	N		100	8	RA	N	62.80
19	930413	E	035	DP1	N		132	17	RA	N	62.80
20	930413	S	005	DP1	N		114	12	RA	N	0.01 LCR
21	930413	S	012	DP1	N		83	5	RA	N	61.45

Table 4. Summary of Humpback Chub handled during Trip 4, 1993.

	DATE	TYPE	SAMPLE	TAG NUMBER[1]	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
22	930413	E	035	DP1	N		78	4	RA	N	62.80
23	930413	E	035	DP1	N		77	4	RA	N	62.80
24	930414	N	129	7F7D224908	Y	PITTAG	252	138	RA	N	60.90
25	930414	N	129	7F7F7E5D7C	Y	PITTAG	247	113	RA	N	60.90
26	930414	E	037	DP1	Y	LP2LC	155	31	RA	N	61.90
27	930414	E	038	DP1	N		110	10	RA	N	61.90
28	930414	S	021	DP1	N		107	10	RA	N	62.70
29	930414	S	021	DP1	N		106	10	RA	N	62.70
30	930414	S	021	DP1	N		79	4	RA	N	62.70
31	930414	S	021	DP1	N		105	10	RA	N	62.70
32	930414	S	021	DP1	N		105	8	RA	N	62.70
33	930414	S	018	DP1	N		80	5	RA	N	62.70
34	930414	S	016	DP1	N		86	5	RA	N	62.65
35	930414	T	019	DP1	N		113	8	RA	N	61.70
36	930414	T	025	DP1	N		101	7	RA	N	61.85
37	930414	T	024	DP1	N		88	3	RA	N	61.85
38	930414	S	021	DP1	N		124	14	RA	N	62.70
39	930414	S	021	DP1	Y	UCLPRP	119	16	RA	N	62.70
40	930414	N	148	7F7D08647D	N		285	284	RA	N	61.50
41	930414	N	151	7F7D170C31	Y	PITTAG	328	393	RA	N	61.95
42	930414	E	040	7F7F2C124A	Y	PITTAG	233	112	RA	N	62.75

Table 4. Summary of Humpback Chub handled during Trip 4, 1993.											
	DATE	TYPE	SAMPLE	TAG NUMBER[1]	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
43	930414	E	040	DP1	N		137	21	RA	N	62.75
44	930414	E	040	DP1	N		143	26	RA	N	62.75
45	930414	E	040	DP1	N		109	11	RA	N	62.75
46	930414	E	040	DP1	N		99	8	RA	N	62.75
47	930414	E	040	DP1	N		85	5	RA	N	62.75
48	930414	S	021	DP1	N		100	9	RA	N	62.70
49	930414	T	031	DP1	N		84	4	RA	N	61.70
50	930415	N	161	7F7D2A585F	Y	PITTAG	262	140	RA	N	62.65
51	930415	N	176	7F7D2B3248	Y	PITTAG	309	321	RA	N	63.35
52	930415	N	176	7F7D246850	Y	PITTAG	338	397	RA	N	63.35
53	930415	N	174	7F7B021968	N		397	752	RA	N	63.85
54	930415	N	174	7F7B080F17	N		185	63	RA	N	63.85
55	930415	E	041	7F7F39114D	Y	PITTAG	262	134	RA	N	61.50
56	930415	E	041	7F7D7C2816	N		221	99	RA	N	61.50
57	930415	E	042	DP1	N		83	6	RA	N	62.80
58	930415	E	043	##########	N		53	1	RA	N	63.50
59	930415	E	043	DP1	N		83	4	RA	N	63.50
60	930415	E	045	DP1	N		66	3	RA	N	64.70
61	930415	E	044	##########	N		57	1	RA	N	65.10
62	930415	E	044	DP1	N		67	2	RA	N	65.10
63	930415	E	044	DP1	N		101	10	RA	N	65.10

Table 4. Summary of Humpback Chub handled during Trip 4, 1993.

	DATE	TYPE	SAMPLE	TAG NUMBER[1]	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
64	930415	E	044	DP1	N		110	12	RA	N	65.10
65	930415	E	044	DP1	N		76	3	RA	N	65.10
66	930415	E	045	DP1	N		89	4	RA	N	64.70
67	930415	E	045	##########	N		61	1	RA	N	64.70
68	930415	E	045	DP1	N		132	21	RA	N	64.70
69	930415	E	045	DP1	N		132	20	RA	N	64.70
70	930415	E	045	DP1	N		77	6	RA	N	64.70
71	930415	E	045	DP1	N		152	34	RA	N	64.70
72	930415	E	045	DP1	N		118	15	RA	N	64.70
73	930415	E	045	DP1	N		117	16	RA	N	64.70
74	930415	E	045	DP1	N		105	4	RA	N	64.70
75	930415	E	046	DP1	N		160	37	RA	N	64.50
76	930415	E	046	DP1	N		134	28	RA	N	64.50
77	930415	E	046	DP1	N		85	4	RA	N	64.50
78	930415	E	046	DP1	N		77	3	RA	N	64.50
79	930415	E	047	DP1	N		79	4	RA	N	64.30
80	930415	E	047	DP1	N		71	3	RA	N	64.30
81	930415	E	047	DP1	N		73	3	RA	N	64.30
82	930415	S	023	DP1	N		101	8	RA	N	63.80
83	930415	S	024	##########	N		66	1	RA	N	63.80
84	930415	S	024	##########	N		69	1	RA	N	63.80

Table 4. Summary of Humpback Chub handled during Trip 4, 1993.

	DATE	TYPE	SAMPLE	TAG NUMBER[1]	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
85	930415	S	024	DP1	N		73	1	RA	N	63.80
86	930415	S	024	##########	N		51	0	RA	N	63.80
87	930415	S	024	DP1	N		92	0	RA	N	63.80
88	930415	S	026	DP1	N		87	0	RA	N	64.70
89	930415	N	186	F7B025015	N		349	357	RA	N	63.85
90	930415	N	182	7F7B025015	N		349	357	RA	N	63.85
91	930416	E	047	##########	N		53	1	RA	N	64.30
92	930416	N	199	##########	N		181	68	DT	N	--
93	930416	S	032	DP1	N		106	10	RA	N	68.00
94	930416	S	032	DP1	N		100	7	RA	N	68.00
95	930416	S	038	DP1	N		72	3	RA	N	65.65
96	930416	S	038	DP1	N		70	4	RA	N	65.65
97	930416	S	038	DP1	N		77	4	RA	N	65.65
98	930416	S	038	DP1	N		74	5	RA	N	65.65
99	930416	N	205	7F7F477C79	N		200	81	RA	N	65.20
100	930416	N	205	7F7B033B47	Y	PITTAG	251	178	RA	N	65.20
101	930416	N	205	7F7F480516	N		182	70	RA	N	65.20
102	930416	N	209	7F7F480853	N		197	94	RA	N	65.25
103	930416	N	210	7F7F30323E	N		361	468	RA	N	65.20
104	930416	T	047	DP1	Y	UCRP2	130	1	RA	N	63.70
105	930416	T	047	DP1	N		76	0	RA	N	63.70

Table 4. Summary of Humpback Chub handled during Trip 4, 1993.

	DATE	TYPE	SAMPLE	TAG NUMBER[1]	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
106	930416	T	048	DP1	N		89	0	RA	N	63.70
107	930416	T	048	DP1	N		70	0	RA	N	63.70
108	930416	N	204	7F7B026517	Y	PITTAG	215	112	RA	N	65.25
109	930416	N	205	7F7F47342F	N		205	90	RA	N	65.20
110	930416	N	205	7F7F472931	N		201	89	RA	N	65.20
111	930416	T	041	DP1	N		97	0	RA	N	63.40
112	930416	T	042	DP1	N		101	0	RA	N	63.40
113	930416	T	043	DP1	N		106	0	RA	N	63.40
114	930416	T	046	DP1	N		80	0	RA	N	63.70
115	930416	T	046	DP1	N		66	0	RA	N	63.70
116	930416	T	046	DP1	N		93	0	RA	N	63.70
117	930416	T	046	DP1	N		68	0	RA	N	63.70
118	930417	T	063	DP1	N		88	8	RA	N	63.70
119	930417	T	063	DP1	N		95	7	RA	N	63.70
120	930417	T	060	DP1	Y	DP1	90	6	RA	N	63.70
121	930417	T	060	DP1	Y	DP1	91	6	RA	N	63.70
122	930417	T	060	DP1	N		70	3	RA	N	63.70
123	930417	T	060	DP1	N		69	2	RA	N	63.70
124	930417	T	061	DP1	N		81	4	RA	N	63.70
125	930417	T	062	DP1	N		69	3	RA	N	63.70
126	930417	T	062	DP1	N		90	5	RA	N	63.70

Table 4. Summary of Humpback Chub handled during Trip 4, 1993.

	DATE	TYPE	SAMPLE	TAG NUMBER[1]	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
127	930417	T	059	DP1	N		117	15	RA	N	63.40
128	930417	T	064	DP1	N		115	12	RA	N	63.70
129	930418	N	218	7F7D077D5A	Y	PITTAG	271	206	RA	N	127.10
130	930418	N	218	7F7F480804	N		205	96	RA	N	127.10
131	930418	N	219	7F7D085367	Y	PITTAG	237	153	RA	N	127.10
132	930419	N	236	7F7F472C54	N		245	153	RA	N	126.10
133	930419	N	244	7F7F332967	Y	PITTAG	253	189	RA	N	127.10
134	930419	N	223	7F7F48046C	N		210	104	RA	N	127.10
135	930419	N	223	7F7F477B76	N		194	92	RA	N	127.10
136	930419	N	225	7F7F1F1F02	Y	PITTAG	330	391	RA	N	126.20
137	930419	N	227	7F7F1F1B05	N		221	102	RA	N	127.15
138	930420	N	253	7F7F302331	N		323	357	RS	N	127.10
139	930420	N	257	7F7F48091D	Y	PITTAG	268	184	RA	N	127.15
140	930420	N	258	7F7F265D61	N		272	244	RA	N	127.10
141	930420	E	050	UC1	N		102	10	RA	N	128.85
142	930421	N	279	7F7D087B21	Y	PITTAG	304	308	RS	N	175.70
143	930421	N	279	7F7F480969	Y	PITTAG	292	309	RS	N	175.70

[1]LC1 = lower caudal fin punch
UC1 = upper caudal fin punch
DP1 = dorsal fin punch
[2]Error in punch protocal, should have been dorsal punch

Table 5. Summary of radio-transmitter implants in humpback chub during Trip 2, 1993.											
#	DATE	PITTAG	TL	WT	FREQ	PULSE RATE (pulses/min)	RADIOTAG SIZE (gms)	LIFE EXPECTANCY (days)	ESTIMATED DATE OF EXTINCTION	CAPTURE (rm)	RELEASE (rm)
1	930223	7F7BO81768	387	768	40.600	40	11	120	930623	126.1	126.1

Table 5. Summary of radio-transmitter implants in humpback chub during Trip 3, 1993.											
#	DATE	PITTAG	TL	WT	FREQ	PULSE RATE (pulses/min)	RADIOTAG SIZE (gms)	LIFE EXPECTAN-CY (days)	ESTIMATED DATE OF EXTINCTION	CAPTURE (rm)	RELEASE (rm)
1	930316	7F7D084141	337	478	40.660	40	9	50	930505	127.1	127.1
2	930319	7F7D073D4A	386	874	40.730	40	11	120	930719	127.5	127.5

Table 6. A list of radio frequencies contacted on Trip 4, 1993 and locations relative to capture and release sites.

			-------River Mile-------		
FREQ/PULSE	TAG SIZE (gm)	DATE (time)	CAPTURE	RELEASE	LOCATE
40.730/40	11	930319	127.5	127.5	
/42		930417(1248)			127.5
/41		930418(2155)			127.4
40.660/40	9	930316	127.1	127.1	
/34		930419(1000)			127.2

CHARACTERIZATION OF THE LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE GRAND CANYON

TRIP REPORT 5 - 1993
May 6 - 25, 1993

Prepared For:

Bureau of Reclamation

Prepared By:

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BIO/WEST INC.
1063 West 1400 North
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June 4, 1993

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INTRODUCTION

This report presents pertinent details associated with Trip 5, 1993. Included in the report are a summary of trip logistics, personnel and research schedule, data collected, problems encountered, pertinent observations and recommendations. Most information is presented in a tabular format to provide a quick synopsis of pertinent trip details and results. We emphasize that these data are hand tabulated to provide these synopses as soon as possible. The data are later computerized and checked for accuracy. The purpose of these trip reports is to provide information from BIO/WEST trips as quickly as possible to aid other researchers.

LOGISTICS, RESEARCH SCHEDULE AND PERSONNEL

Table 1 presents a summary of logistics and the research schedule for Trip 5, 1993. Table 2 is a list of personnel who were present or participated in research activities for Trip 5, 1993.

DATA COLLECTED

Table 3 is a summary of gear types used, sampling effort and fish captured by gear type for Trip 5, 1993. Table 4 is a summary of all humpback chubs handled during Trip 5, 1993. Table 5 presents information on humpback chub implanted with radiotransmitters during Trip 2 and 3, 1993. Table 6 summarizes the radio contacts during Trip 5, 1993 and presents original fish release locations and radiotag data.

Humpback Chubs Captured

A total of 233 humpback chub were captured during Trip 5, 1993 including 142 juveniles (31-199 mm TL), and 91 adults (>199 mm TL). In Reach 1, 25 juveniles were captured with seines. Forty-one chubs, including two adults, and 39 juveniles were captured electrofishing. Netting produced 84 humpback chub including 68 adults and 16 juveniles. Fifty-seven juvenile chubs were also captured in unbaited minnow traps.

Of the 70 adult humpback chub captured in Reach 1, 46 (or 66%) were PIT-tagged recaptures. One humpback bearing a yellow Floy tag was also recaptured during Trip 5, 1993. Two fin punched sub-adult humpback chub were recaptured between RM 61.9 - 65.4. This represents a 1.4% recapture rate for juvenile chubs (2 of 138). Both fin punches were partially healed indicating that the marks were relatively old, but were distinguishable by the disruption of the fin rays. The fin punched fish were in excellent condition and showed no signs of stress or injury assoicated with the mark.

One ripe male adult humpback chub was captured in Reach 0 at RM 30.3. The fish appeared in excellent condition and was not a recapture. This fish was captured in the same location as three chubs captured in April, in a small eddy about 10 m offshore of a spring. Water at the source of the spring measured 21.5°C, compared to a mainchannel temperature of 9°C. The water temperature at the approximate point of capture of the three chub was 16°C.

Twenty-three humpback chubs were captured in Reach 2 during Trip 5, 1993 including 20 adults and three juvenile. All adults were captured in nets and the juveniles were captured electrofishing. Of these 20 adult chubs, 6 were recaptures of previously tagged fish. A large number of these fish

exhibited spawning tubercles or expressed milt. Fourteen of these fish were captured between RM 126 and 129.

Two chubs were captured in Reach 3 during Trip 5, 1993. Both were caught in one seine haul at RM 187.6. These chubs were 38 and 58 mm TL.

Stomach contents of 16 humpback chubs, 10 in Reach 1, and 6 in Reach 2, were collected using non-lethal stomach pumping techniques.

Radiotelemetry

No humpback chubs were implanted during Trip 5 1993.

Two radio-implanted chubs from the Middle Granite Gorge were monitored during Trip 5, 1993. Only localized movements were observed. One implanted chub had moved approximately 0.5 mile downstream since last observed in April 1993.

One radiotagged humpback chub with an active transmitter was recaptured at RM 127.6 during Trip 5. The fish was originally radiotagged on March 19, 1993 and recaptured on May 21, 1993 resulting in an elapsed time of 63 days. Length and weight of the fish when implanted were 386 mm and 874 gm. When recaptured the fish measured 405 mm and weighed 854 (adjusted 11 gms for weight of transmitter), resulting in a weight loss of 20 gms. The fish appeared in excellent condition. Both the main incision and antenna exit were well healed with no signs of infection. One suture was still in place along the main incision and removed. The fish was photographed and released at the capture location.

Habitat Mapping

Habitat mapping was done in conjuction with 24 hour observations made on two radiotagged humpback chubs between RM 127 and RM 128.

Bench Marks

Two new bench marks were established in Reach 2 during Trip 5, 1993. One is located on river left at 127.4 and the other is on river right at 127.7.

OBSERVATIONS

1. Main channel turbidities were low until May 16 when they increased to high in the late morning. Following this time, main channel turbidity stayed high for the remainder of the trip. The LCR ran near base flow and was blue in color between May 10 and May 19. Increases in main channel turbidity were assumed to be the result of storm runoff out of the Paria River.

2. High numbers of spent adult humpback chubs were captured in and around the mouth of the LCR during Trip 5. It is speculated that these fish have spawned in the LCR and are in the process of or staging for migration back into the main channel. In areas away from the mouth of the LCR, catch rates of adult humpback chubs were low.

3. Netting in the main channel in areas away from the LCR confluence area produced higher numbers of adult humpback chub (14 fish) downstream of the confluence area versus the reach above the LCR (1 fish). It is speculated that higher densities of humpback chub below the LCR may be a related to two factors: 1) More non-spawning small adults may utilize reaches below the LCR than above and/or; 2) unusual flood events observed in the LCR during January and February may have transported fish from the LCR into the main channel that are still occupying main channel habitats. All adult humpback chubs captured in the main channel during Trip 5 were relatively small adults (<450 gms).

4. Seining main channel habitats during clear water was ineffective for catching juvenile humpback chub. However, when turbidities increased, seining effectiveness increased dramatically. Areas seined during low turbidity were reoccupied during turbid conditions. Under high turbidities humpback chubs were captured in areas where none were captured during low turbidities. Most habitat seined included sand beaches in runs and eddies. This suggest that habitat suitability of these areas was strongly related to cover provided by turbidity.

5. Unbaited minnow traps were very effective at catching juvenile humpback chub during Trip 5. Humpback chubs were captured in a variety of shoreline types including sheer wall, boulder tallus, boulder debri fans and vegetated cut banks. High catch rates in minnow traps across habitat types suggest that densities of juvenile humpback chubs were very high in the main channel during Trip 5, 1993.

6. The capture of one large ripe male humpback chub near a spring at RM 30.3 suggests that limited spawning or attempts at spawning may be occuring in the plumes of these springs between RM 29 and RM 30. Capture of 4 humpback chubs (3 females and 1 tubercled male) in the plume of these springs in April support this hypothesis. Water temperatures observed in the spring during Trip 5 were 21.5°C while temperatures of the plumes created by the plume were 16°C.

7. Over 50% of all humpback chubs captured in Reach 2 during Trip 5,1993 exhibited spawning tubercles or expressed milt.

8. Twenty-four percent of chubs captured in Reach 2 were recaptures of previously PIT-tagged fish.

9. The three recaptured chubs from the Middle Granite Gorge were from the same locale as originally captured. This along with previous recapture data from this site suggest an aggregation or small population of chubs utilizing this area.

10. Kanab and Havasu Creeks were sites of spawning native suckers during Trip 5, 1993. Kanab Creek was dominated by flannelmouths while Havasu Creek was dominated by blueheads.

11. One striped bass was captured at RM 219.9. This fish was a small male with no signs of reproductive condition. The capture of this fish follows the observed trend of spring movements by striped bass seen on previous trips during the past two years.

PROBLEMS ENCOUNTERED AND SOLUTIONS

1. High spring flows from Bright Angel and Shinumo Creeks prohibited sampling the inflow areas of these tributaries during Trip 5, 1993. Sampling was performed as near the creek mouths as possible using hoop or trammels nets.

2. The remote telemetry station at RM 127.4 had logged over 5000 blocks of data. All three implanted fish were being logged while field crews only observed two implanted fish during surveillance observations. The sensitivity was adjusted and logging of data continued.

RECOMMENDATIONS

1. We recommend continued and enhanced coordination among the researchers in Grand Canyon. This coordination is essential to insure that all researchers are aware of others activities.

2. We recommend a continued radiotelemetry effort in the Middle Granite Gorge to continue to accumulate information on this population through the spawning period and possibly through the remainder of the year.

Table 1. Logistics and Research Schedule for Trip 5, 1992, Team 1.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
05/06	19.0	19 Mile Canyon	X	X		
05/07	19.0	19 Mile Canyon		X		
05/08	30.0	30 Mile Canyon	X	X		
05/09	30.0	30 Mile Canyon		X		
05/10	58.4	Awatubi Canyon	X	X		
05/11	58.4	Awatubi Canyon		X		
05/12	61.3	LCR	X	X		
05/13	61.3	LCR		X		
05/14	61.3	LCR		X		
05/15	61.3	LCR		X		
05/16	65.4	Lava Canyon	X	X		
05/17	65.4	Lava Canyon		X		
05/18	65.4	Lava Canyon		X		X
05/19	114.0	114 Mile Canyon	X			
05/20	126.4	Randy's Rock	X	X	X	X
05/21	126.4	Randy's Rock		X	X	X
05/22	126.4	Randy's Rock		X	X	X
05/23	166.2	National Canyon	X			
05/24	219.8	220 Mile Canyon	X			
05/25	225.8	Diamond Creek - Take Out	X			

[1]T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 1. Logistics and Research Schedule for Trip 5, 1992 Team 2.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
5/06	36.0	Below Red Wall	X			
5/07	83.9	Clear Creek	X	X		
5/08	83.9	Clear Creek		X		
5/09	87.1	Cremation	X	X		
5/10	87.1	Cremation		X		
5/11	108.3	Upper Bass	X	X		
5/12	108.3	Upper Bass		X		
5/13	126.4	Randy's Rock	X	X	X	
5/14	126.4	Randy's Rock		X	X	X
5/15	126.4	Randy's Rock		X	X	X
5/16	126.4	Randy's Rock		X	X	X
5/17	143.3	Across from Kanab Creek	X			
5/18	143.3	Across from Kanab Creek		X		
5/19	156.4	Last Last Chance	X	X		
5/20	156.4	Last Last Chance		X		
5/21	184.5	190 Mile	X	X		
5/22	184.5	190 Mile		X		
5/23	220.1	220 Canyon	X	X		
5/24	220.1	220 Canyon		X		
5/25	225.7	Diamond Creek	X			

[1] T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 2. Personnel Participating in Trip 5, 1993.			
PERSONNEL	**AFFILIATION**	**DATES**	**COMMENTS**
Team 1			
B. Masslich	BIO/WEST	5/6 - 5/25	Project Leader
T. Wasowicz	BIO/WEST	5/6 - 5/25	Senior Biologist
B. Cowdell	BIO/WEST	5/6 - 5/25	Senior Biologist
L. Brown	BIO/WEST	5/6 - 5/25	
P. Weiss	BIO/WEST	5/6 - 5/25	
S. Pope	AGF	5/12 - 5/16	Chopper in LCR
T. Hufnagel	AGF	5/12 - 5/16	Chopper in LCR
K. Roney	BIO/WEST VOLUNTEER	5/6 - 5/25	
C. Graham	BIO/WEST VOLUNTEER	5/6 - 5/25	
K. Smith	OARS	5/6 - 5/25	Trip Leader
B. Schimpp	OARS	5/6 - 5/25	
T. Hillman	OARS	5/6 - 5/25	
Team 2			
B. Leibfried	BIO/WEST	5/6 - 5/25	Project Leader
E. Prats	BIO/WEST	5/6 - 5/25	Senior Biologist
C. Heck	BIO/WEST	5/6 - 5/25	
P. Trator	BIO/WEST	5/6 - 5/25	
D. McCabe	BIO/WEST	5/6 - 5/25	
M. Littlefield	BIO/WEST VOLUNTEER	5/6 - 5/25	
G. Champorial	BIO/WEST VOLUNTEER	5/6 - 5/25	
M. Houston	BIO/WEST VOLUNTEER	5/6 - 5/25	
T. Anderson	OARS	5/6 - 5/25	Trip Leader
H. Anderson	OARS	5/6 - 5/25	
C. Hanson	OARS	5/6 - 5/25	

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 5, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	BB	SB	FB	RK	FV	SU	FH
Electrofishing Reach 0 N=37	A				211	1		4								
	J															
	Y				7											
Electrofishing Reach 1 N=69	A	2	1		88			12	32	2						1
	J	39	1		6											
	Y				1											
Electrofishing Reach 2 N=19	A		5	3	21	69		33	3							
	J	1	2	2	5			1								
	Y															
Electrofishing Reach 3 N=29	A		11	2				11	5		1					2
	J		5	3	1	1										
	Y															
Nets Reach 0 N=39	A	1	3		31											
	J															
	Y															
Nets Reach 1 N=149	A	68	28	2	31		1	2						1		
	J	16														
	Y															
Nets Reach 2 N=361	A	20	115	14	20	14	1	16								
	J	2														
	Y															

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 5, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	BB	SB	FB	RK	FV	SU	FH
Nets Reach 3 N=73	A		1				2	13								
	J															
	Y															
Seines Reach 1 N=25	A			1	2				6							
	J	25														
	Y															
Seines Reach 3 N=14	A							1	209				1			14
	J	2	35	50							1					
	Y		16	8											3	
Traps Reach 1 N=255	A								12							
	J	57														
	Y															
Traps Reach 2 N=118	A								16							1
	J			1												
	Y					1										
Traps Reach 3 N=16	A								38							
	J															
	Y															
Hoop Nets Reach 2 N=9	A		124	17					8							
	J		30	4												
	Y															

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 5, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	BB	SB	FB	RK	FV	SU	FH
Hoop Nets Reach 3 N=2	A		6	7					6							
	J			29												
	Y															
Totals	A	91	294	46	404	84	4	92	335	2	1	0	1	1	0	18
	J	142	73	89	12	1	0	1	0	0		1	0	0	0	0
	Y	0	16	8	7	1	0	0	0	0	0	0	0	0	3	0
	T	233	383	143	423	86	4	93	335	2	1	1	1	1	3	18

[2] - A = Adult
J = Juvenile
Y = Young of year

[3] - HB = humpback chub
FM = flannelmouth sucker
BH = bluehead sucker
RB = rainbow trout
BR = brown trout
CC = channel catfish
CP = carp
SD = speckled dace
BB = black bullhead
SB = striped bass
FB = flannelmouth/bluehead hybrid
PK = plains killifish
FV = flannelmouth variant
SU = unidentified sucker
FH = fathead minnow

Table 4. Summary of Humpback Chub handled during Trip 5, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
1	930507	N	004	7F7D075F53	N		341	398	RS	N	83.90
2	930508	N	025	7F7F265815	N		291	295	RS	N	83.80
3	930509	N	034	7F7B017115	N		448	879	RA	N	30.30
4	930510	N	044	7F7D075C61	Y	PITTAG	237	121	RA	N	58.90
5	930510	N	089	7F7D075F53	Y	PITTAG	344	390	RA	N	87.40
6	930511	N	103	7F7F480225	N		191	83	RA	N	108.35
7	930511	N	103	1F0F5F0271	N		215	102	RA	N	108.35
8	930512	N	111	1F0F761B41	N		175	66	RA	N	108.35
9	930512	N	117	1F0F5F264D	N		291	229	RA	N	108.15
10	930513	E	029	DP1	N		124	17	RA	N	62.60
11	930513	E	030	DP1	N		82	4	RA	N	63.20
12	930513	E	030	DP1	N		72	2	RA	N	63.20
13	930513	E	030	DP1	N		101	8	RA	N	63.20
14	930513	E	030	DP1	N		76	4	RA	N	63.20
15	930513	E	030	DP1	N		85	6	RA	N	63.20
16	930513	E	030	DP1	N		89	6	RA	N	63.20
17	930513	E	030	DP1	N		121	14	RA	N	63.20
18	930513	E	030	DP1	N		128	16	RA	N	63.20
19	930513	E	032	DP1	N		62	2	RA	N	63.20
20	930514	E	037	7F7B020156	N		185	58	RA	N	60.20
21	930514	E	037	7F7D7C3002	N		184	51	RA	N	60.20

Table 4. Summary of Humpback Chub handled during Trip 5, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
22	930514	E	037	7F7B034C2E	N		169	44	RA	N	60.20
23	930514	E	037	DP1	N		149	35	RA	N	60.20
24	930514	E	037	DP1	N		121	16	RA	N	60.20
25	930514	T	075	DP1	N		124	16	RA	N	61.70
26	930514	T	077	DP1	N		120	14	RA	N	61.70
27	930514	N	097	7F7B082F16	N		378	412	RA	N	61.35
28	930514	N	097	7F7B080C5B	N		294	206	RA	N	61.35
29	930514	N	097	7F7D3E6976	N		286	214	RA	N	61.35
30	930514	N	097	7F7B024B4B	N		347	294	RA	N	61.35
31	930514	N	097	7F7F391A72	Y	PITTAG	426	677	RA	N	61.35
32	930514	N	097	7F7D2B4811	Y	PITTAG	379	513	RA	N	61.35
33	930514	N	097	7F7D2B3018	Y	PITTAG	396	534	RA	N	61.35
34	930514	N	097	7F7F20127C	Y	PITTAG	355	351	RA	N	61.35
35	930514	N	097	7F7F337034	Y	PITTAG	339	317	RA	N	61.35
36	930514	N	097	7F7D2A5563	Y	PITTAG	389	561	RA	N	61.35
37	930514	N	097	7F7F183B78	Y	PITTAG	407	438	RA	N	61.35
38	930514	N	097	7F7D180568	Y	PITTAG	356	402	RA	N	61.35
39	930514	N	100	7F7D085017	Y	PITTAG	433	649	RA	N	61.25
40	930514	N	101	7F7D081F06	Y	PITTAG	402	590	RA	N	61.25
41	930514	N	102	7F7F27675F	Y	PITTAG	247	112	RA	N	61.35
42	930514	N	102	7F7F214A27	Y	PITTAG	383	432	RA	N	61.35

Table 4. Summary of Humpback Chub handled during Trip 5, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
43	930514	N	102	7F7F2C0A2D	Y	PITTAG	299	181	RA	N	61.35
44	930514	N	102	7F7F20127C	Y	PITTAG	356	357	RA	N	61.35
45	930514	N	102	7F7D08750D	Y	PITTAG	331	287	RA	N	61.35
46	930514	N	102	7F7D086C43	Y	PITTAG	395	442	RA	N	61.35
47	930514	N	102	7F7F456E60	Y	PITTAG	344	289	RA	N	61.35
48	930514	N	103	7F7D2C244E	Y	PITTAG	360	504	RA	N	61.40
49	930514	N	103	7F7F213C43	Y	PITTAG	400	538	RA	N	61.40
50	930514	N	103	7F7F331E1D	Y	PITTAG	359	342	RA	N	61.40
51	930514	N	103	7F7F2C1502	Y	PITTAG	308	202	RA	N	61.40
52	930514	N	103	7F7D1B6F64	Y	PITTAG	329	326	RA	N	61.40
53	930514	N	103	7F7B032E18	Y	0314516FY	325	308	RA	N	61.40
54	930514	N	103	7F7D3F7B1E	N		379	441	RA	N	61.40
55	930514	N	103	7F7B026C7C	N		398	493	RA	N	61.40
56	930514	N	103	7F7B080D63	N		385	479	RA	N	61.40
57	930514	N	103	7F7B081206	N		340	319	RA	N	61.40
58	930514	N	103	7F7B08111B	N		365	455	RA	N	61.40
59	930514	N	104	7F7D225A0E	Y	PITTAG	424	571	RA	N	61.15
60	930514	N	105	7F7F2C0A7C	Y	PITTAG	430	632	RA	N	61.25
61	930514	N	105	7F7E432641	Y	PITTAG	398	481	RA	N	61.25
62	930514	N	105	7F7D08640D	Y	PITTAG	402	495	RA	N	61.25
63	930514	N	105	7F7D026134	N		422	589	RA	N	61.25

Table 4. Summary of Humpback Chub handled during Trip 5, 1993.											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
64	930514	N	105	7F7D081718	N		413	548	RA	N	61.25
65	930514	N	105	7F7D081D3B	N		410	587	RA	N	61.25
66	930514	N	105	7F7D073E03	N		374	360	RA	N	61.25
67	930514	N	157	7F7D085367	Y	PITTAG	235	166	RA	N	127.10
68	930514	N	163	7F7A1A5946	N		265	284	RS	N	127.10
69	930515	E	046	7F7B082774	N		450	655	RA	N	60.65
70	930515	E	047	7F7D3E7931	Y	PITTAG	221	116	RA	N	61.10
71	930515	E	047	##########	Y	LCLP	153	33	RA	N	61.10
72	930515	N	098	7F7F272208	Y	PITTAG	376	501	RA	N	61.40
73	930515	N	098	7F7F1F1B54	N		412	612	RA	N	61.40
74	930515	N	098	7F7F1F1255	N		362	380	RA	N	61.40
75	930515	T	101	DP1	Y	DP1	85	5	RA	N	61.70
76	930515	N	102	7F7D2B0C6F	Y	PITTAG	387	446	RA	N	61.35
77	930515	N	102	7F7F326920	Y	PITTAG	347	358	RA	N	61.35
78	930515	N	102	7F7B081713	N		241	150	RA	N	61.35
79	930515	N	102	7F7B03397D	N		261	138	RA	N	61.35
80	930515	N	102	7F7B025C50	N		256	142	RA	N	61.35
81	930515	N	102	7F7B081A39	N		376	431	RA	N	61.35
82	930515	N	102	7F7B080A38	N		406	590	RA	N	61.35
83	930515	N	110	7F7B080A77	Y	PITTAG	318	268	RA	N	61.95
84	930515	N	115	7F7F274234	Y	PITTAG	250	132	RA	N	61.95

Table 4. Summary of Humpback Chub handled during Trip 5, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
85	930515	N	119	7F7B020B10	Y	PITTAG	349	291	RA	N	61.70
86	930515	N	120	7F7F272427	Y	PITTAG	373	432	RA	N	61.95
87	930515	N	120	7F7F217C36	Y	PITTAG	290	181	RA	N	61.95
88	930515	N	121	7F7F200651	Y	PITTAG	402	611	RA	N	62.15
89	930515	N	121	7F7B03561C	N		390	369	RA	N	62.15
90	930515	T	131	DP1	N		123	17	RA	N	62.50
91	930515	T	141	DP1	N		91	5	RA	N	63.15
92	930515	T	152	DP1	N		95	7	RA	N	61.15
93	930515	T	154	DP1	N		67	2	RA	N	61.15
94	930515	N	184	1F0F7D6273	N		266	201	RS	N	126.30
95	930515	N	187	1F0C6F0165	N		205	105	RA	N	126.10
96	930516	S	011	DP1	N		86	6	RA	N	62.25
97	930516	S	011	DP1	N		95	6	RA	N	62.25
98	930516	S	012	DP1	N		131	21	RA	N	62.30
99	930516	S	015	DP1	N		75	2	RA	N	62.25
100	930516	S	017	DP1	N		82	4	RA	N	63.70
101	930516	S	018	DP1	N		126	20	RA	N	63.70
102	930516	S	018	DP1	N		61	1	RA	N	63.70
103	930516	S	018	DP1	N		79	4	RA	N	63.70
104	930516	S	018	DP1	N		66	3	RA	N	63.70
105	930516	S	018	DP1	N		70	3	RA	N	63.70

Table 4. Summary of Humpback Chub handled during Trip 5, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
106	930516	S	018	DP1	N		87	5	RA	N	63.70
107	930516	S	018	DP1	N		93	5	RA	N	63.70
108	930516	S	018	DP1	N		72	3	RA	N	63.70
109	930516	S	018	DP1	N		57	0	RA	N	63.70
110	930516	S	018	DP1	N		75	3	RA	N	63.70
111	930516	S	018	DP1	N		72	2	RA	N	63.70
112	930516	S	018	DP1	N		70	2	RA	N	63.70
113	930516	S	018	DP1	N		57	1	RA	N	63.70
114	930516	S	018	DP1	N		63	2	RA	N	63.70
115	930516	S	018	DP1	N		66	2	RA	N	63.70
116	930516	S	018	DP1	N		79	4	RA	N	63.70
117	930516	S	018	DP1	N		65	2	RA	N	63.70
118	930516	S	018	DP1	N		73	3	RA	N	63.70
119	930516	S	018	DP1	N		74	2	RA	N	63.70
120	930516	S	019	DP1	N		66	2	RA	N	64.00
121	930516	E	049	7F7B81013#	N		181	54	RA	N	63.00
122	930516	E	051	DP1	N		122	14	RA	N	64.10
123	930516	E	052	DP1	N		98	8	RA	N	65.00
124	930516	E	053	DP1	N		68	2	RA	N	64.90
125	930516	E	053	DP1	N		88	6	RA	N	64.90
126	930516	E	053	DP1	N		147	30	RA	N	64.90

Table 4. Summary of Humpback Chub handled during Trip 5, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
127	930516	E	053	DP1	N		163	35	RA	N	64.90
128	930516	E	053	7F7D1D4A51	Y	PITTAG	157	39	RA	N	64.90
129	930516	N	122	7F7F334836	Y	PITTAG	411	484	RS	N	63.30
130	930516	N	122	7F7D401825	Y	PITTAG	351	433	RS	N	63.30
131	930516	N	125	7F7F390927	Y	PITTAG	329	319	RS	N	63.30
132	930516	N	130	7F7F2C1502	Y	PITTAG	310	205	RS	N	63.30
133	930516	N	130	7F7B035552	N		387	453	RS	N	63.30
134	930516	N	131	7F7F295D4F	Y	PITTAG	381	461	RS	N	63.70
135	930516	T	146	DP1	N		84	3	RA	N	62.50
136	930516	T	158	DP1	N		80	4	RA	N	63.15
137	930516	T	160	##########	N		0	0	RA	N	64.50
138	930516	T	161	DP1	N		77	3	RA	N	63.15
139	930516	T	161	DP1	N		78	4	RA	N	63.15
140	930516	T	170	DP1	N		101	11	RA	N	64.50
141	930516	T	170	DP1	N		72	3	RA	N	64.50
142	930516	N	203	1F0F662943	N		250	150	RA	N	126.35
143	930516	N	208	1F0F7D597C	N		313	372	RS	N	126.35
144	930516	N	219	1F0F630B64	N		215	111	RA	N	129.00
145	930516	N	220	1F0F6F6201	N		205	93	RA	N	128.80
146	930516	N	231	7F7F1F1140	Y	PITTAG	260	238	RS	N	127.60
147	930516	N	236	7F7F333501	Y	PITTAG	215	108	RA	N	127.60

Table 4. Summary of Humpback Chub handled during Trip 5, 1993.											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
148	930517	E	057	DP1	N		145	24	RA	N	64.30
149	930517	E	059	DP1	N		102	11	RA	N	64.20
150	930517	E	060	DP1	N		72	4	RA	N	63.90
151	930517	E	063	DP1	N		123	17	RA	N	63.50
152	930517	E	063	DP1	N		120	10	RA	N	63.50
153	930517	E	063	DP1	N		123	16	RA	N	63.50
154	930517	E	064	DP1	N		94	6	RA	N	63.30
155	930517	N	140	7F7F390838	Y	PITTAG	364	378	RS	N	65.20
156	930517	N	140	7F7F275859	Y	PITTAG	393	505	RS	N	65.20
157	930517	N	141	DP1	N		122	17	RA	N	65.20
158	930517	N	141	DP1	N		123	18	RA	N	65.20
159	930517	N	141	DP1	N		119	13	RA	N	65.20
160	930517	N	141	DP1	N		120	14	RA	N	65.20
161	930517	N	141	DP1	N		123	16	RA	N	65.20
162	930517	N	141	DP1	N		138	21	RA	N	65.20
163	930517	N	141	DP1	N		131	18	RA	N	65.20
164	930517	N	141	DP1	N		123	14	RA	N	65.20
165	930517	N	141	DP1	N		119	18	RA	N	65.20
166	930517	N	141	DP1	N		121	16	RA	N	65.20
167	930517	N	141	DP1	N		145	23	RA	N	65.20
168	930517	N	141	DP1	N		123	18	RA	N	65.20

Table 4. Summary of Humpback Chub handled during Trip 5, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
169	930517	N	141	DP1	N		118	14	RA	N	65.20
170	930517	N	141	DP1	N		119	16	RA	N	65.20
171	930517	N	141	DP1	N		132	17	RA	N	65.20
172	930517	N	141	DP1	N		119	13	RA	N	65.20
173	930517	T	177	DP1	N		78	3	RA	N	63.15
174	930517	T	177	DP1	N		92	5	RA	N	63.15
175	930517	T	182	DP1	N		88	6	RA	N	64.50
176	930517	T	183	DP1	N		82	5	RA	N	64.50
177	930517	T	183	DP1	N		84	5	RA	N	64.50
178	930517	T	184	DP1	N		72	3	RA	N	64.50
179	930517	T	185	DP1	N		65	2	RA	N	64.50
180	930517	T	185	DP1	N		79	4	RA	N	64.50
181	930517	T	185	DP1	N		79	4	RA	N	64.50
182	930517	T	185	DP1	N		60	1	RA	N	64.50
183	930517	T	189	DP1	N		113	14	RA	N	63.90
184	930517	T	190	DP1	N		53	1	RA	N	63.90
185	930517	T	192	DP1	Y	DP1	78	3	RA	N	64.50
186	930517	T	193	DP1	N		96	9	RA	N	64.50
187	930517	T	195	DP1	N		92	9	RA	N	64.50
188	930517	T	199	DP1	N		78	4	RA	N	63.15
189	930517	T	201	DP1	N		78	4	RA	N	63.15

Table 4. Summary of Humpback Chub handled during Trip 5, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
190	930517	T	201	DP1	N		56	2	RA	N	63.15
191	930517	T	201	DP1	N		63	3	RA	N	63.15
192	930517	T	205	DP1	N		88	7	RA	N	65.35
193	930517	T	207	DP1	N		102	9	RA	N	61.15
194	930517	T	212	DP1	N		124	12	RA	N	63.15
195	930517	T	213	DP1	N		98	8	RA	N	63.15
196	930517	T	213	DP1	N		77	4	RA	N	63.15
197	930517	T	213	DP1	N		103	12	RA	N	63.15
198	930517	T	214	DP1	N		72	3	RA	N	63.15
199	930517	T	214	DP1	N		93	6	RA	N	63.15
200	930517	T	214	DP1	N		87	5	RA	N	63.15
201	930517	T	214	DP1	N		93	7	RA	N	63.15
202	930517	T	215	DP1	N		88	5	RA	N	63.15
203	930517	T	215	DP1	N		88	6	RA	N	63.15
204	930517	T	215	DP1	N		68	3	RA	N	63.15
205	930517	T	215	DP1	N		64	2	RA	N	63.15
206	930517	T	215	DP1	N		54	1	RA	N	63.15
207	930517	T	218	DP1	N		89	7	RA	N	63.90
208	930517	T	219	DP1	N		83	6	RA	N	63.90
209	930517	T	219	DP1	N		112	13	RA	N	63.90
210	930517	T	224	DP1	N		84	4	RA	N	64.50

Table 4. Summary of Humpback Chub handled during Trip 5, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
211	930517	T	225	DP1	N		97	5	RA	N	64.50
212	930517	N	237	1F0C7B2436	N		260	195	RS	N	129.00
213	930517	N	239	1F0C73570B	N		212	102	RA	N	128.70
214	930517	N	239	1F0F677873	N		230	112	RA	N	128.70
215	930518	E	065	DP1	N		111	11	RA	N	63.60
216	930518	E	065	DP1	N		73	3	RA	N	63.60
217	930518	E	065	DP1	N		82	6	RA	N	63.60
218	930518	E	065	DP1	N		56	1	RA	N	63.60
219	930518	E	066	DP1	N		90	6	RA	N	63.60
220	930518	E	066	DP1	N		64	2	RA	N	63.60
221	930518	E	067	DP1	N		98	8	RA	N	64.30
222	930518	N	151	7F7D3E755D	Y	PITTAG	242	162	RA	N	64.80
223	930518	N	156	7F7F3E3531	Y	PITTAG	374	369	RS	N	64.80
224	930518	T	228	DP1	N		94	7	RA	N	62.70
225	930518	T	228	DP1	N		86	5	RA	N	62.70
226	930518	T	228	DP1	N		84	5	RA	N	62.70
227	930518	T	237	DP1	N		112	12	RA	N	63.90
228	930519	E	067	DP1	N		72	3	RA	N	64.30
229	930519	N	286	7F7F29650E	Y	PITTAG	387	580	RA	N	156.40
230	930521	N	011	7F7D073D4A	Y	PITTAG	405	865	RR	Y	127.60
231	930522	E	017	DP1	N		53	2	RA	N	128.30

Table 4. Summary of Humpback Chub handled during Trip 5, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
232	930523	S	007	DUC	N		58	2	RA	N	187.60
233	930523	S	007	##########	N		38	1	RA	N	187.60

Table 5. Summary of radio-transmitter implants in humpback chub during Trip 2, 1993.											
#	DATE	PITTAG	TL	WT	FREQ	PULSE RATE (pulses/min)	RADIOTAG SIZE (gms)	LIFE EXPECTANCY (days)	ESTIMATED DATE OF EXTINCTION	CAPTURE (rm)	RELEASE (rm)
1	930223	7F7BO81768	387	768	40.600	40	11	120	930623	126.1	126.1

Table 5. Summary of radio-transmitter implants in humpback chub during Trip 3, 1993.											
#	DATE	PITTAG	TL	WT	FREQ	PULSE RATE (pulses/min)	RADIOTAG SIZE (gms)	LIFE EXPECTAN-CY (days)	ESTIMATED DATE OF EXTINCTION	CAPTURE (rm)	RELEASE (rm)
1	930316	7F7D084141	337	478	40.660	40	9	50	930505	127.1	127.1
2	930319	7F7D073D4A	386	874	40.730	40	11	120	930719	127.5	127.5

Table 6. A list of radio frequencies contacted on Trip 5, 1993 and locations relative to capture and release sites.

			-------River Mile-------		
FREQ/PULSE	TAG SIZE (gm)	DATE (time)	CAPTURE	RELEASE	LOCATE
40.660/40	9	930316	127.1	127.1	
/32		930514(2230)			127.65
/38		930515(2157)			127.65
/31		930520(1608)			127.7
/31		930521(1107)			128.5
40.730/40	11	930319	127.5	127.5	
/36		930515(2147)			127.55
/35		930516(1320)			127.55
		930521(1046)			127.1
		930521(2125)			127.7

CHARACTERIZATION OF THE LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE GRAND CANYON

TRIP REPORT 6 - 1993
June 10 - 25, 1993

Prepared For:

Bureau of Reclamation

Prepared By:

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BIO/WEST INC.
1063 West 1400 North
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June 30, 1993

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INTRODUCTION

This report presents pertinent details associated with Trip 6, 1993. Included in the report are a summary of trip logistics, personnel and research schedule, data collected, problems encountered, pertinent observations and recommendations. Most information is presented in a tabular format to provide a quick synopsis of pertinent trip details and results. We emphasize that these data are hand tabulated to provide these synopses as soon as possible. The data are later computerized and checked for accuracy. The purpose of these trip reports is to provide information from BIO/WEST trips as quickly as possible to aid other researchers.

LOGISTICS, RESEARCH SCHEDULE AND PERSONNEL

Table 1 presents a summary of logistics and the research schedule for Trip 6, 1993. Table 2 is a list of personnel who were present or participated in research activities for Trip 6, 1993.

DATA COLLECTED

Table 3 is a summary of gear types used, sampling effort and fish captured by gear type for Trip 6, 1993. Table 4 is a summary of all humpback chubs handled during Trip 6, 1993. Table 5 presents information on humpback chub implanted with radiotransmitters during Trip 2 and 3, 1993. Table 6 summarizes the radio contacts during Trip 6, 1993 and presents original fish release locations and radiotag data.

Humpback Chubs Captured

A total of 120 humpback chub were captured during Trip 6, 1993 including 48 juveniles (41-199 mm TL), and 72 adults (>199 mm TL). In Reach 1, 17 chubs, including 4 adults, and 13 juveniles were captured electrofishing. Netting produced 71 humpback chub including 62 adults and 9 juveniles. Twenty-four juvenile chubs were also captured in unbaited minnow traps.

Of the 65 adult humpback chub captured in Reach 1, 49 were PIT-tagged recaptures. This represents a 75% recapture rate of adult humpback chub in Reach 1 and equals the second highest recapture rate seen during one field trip. BIO/WEST observed a 75% recapture rate in February 1993 and an 80% recapture rate in January 1993. Most of the recaptured fish were marked by other investigators.

Eight humpback chubs were captured in Reach 2 during Trip 5, 1993 including 6 adults and 2 juveniles. Of the six adult humpback chub captured in Reach 2, three were PIT-tagged recaptures of fish originally tagged in Reach 2.

Stomach contents of 10 adult humpback chub in Reach 1 were collected using non-lethal stomach pumping techniques.

Radiotelemetry

No humpback chubs were implanted during Trip 6 1993.

One radiotagged humpback chub (PIT Tag No. 7F7D073D4A) was contacted and located a total of eight times during Trip 6, 1993. The fish was moving actively between RM 126.6 and RM 127.6. This fish was recaptured at RM 127.5 on June 19, 1993. The fish was originally radiotagged on March 19, 1993 and recaptured the first time on May 21, 63 days after implant. The fish weighed 854 grams at that time, 20 grams less than when originally captured (874 grams). When recaptured for the second time during Trip 6, 1993, 91 days following implant, the fish weighed 855 grams, or 30 g less than when implanted. The fish appeared in excellent condition at both recaptures. Both the main incision and antenna exit were well healed with no signs of infection. The fish was photographed and released at the capture location.

Both remote stations operating in Reach 2 were functioning normally and downloaded twice during Trip 6, 1993.

Habitat Mapping

Juvenile habitat mapping was conducted in 5 locations during Trip 6, 1993. All locations mapped represented areas where juvenile humpback chub were captured during the field trip.

Bench Marks

No new bench marks were established during Trip 6, 1993.

OBSERVATIONS

1. Main channel turbidities were generally low during Trip 6, 1993. Short term increases in turbidity associated with the ascending limb of the hydrograph were observed on most days. However, sediment from tributary sources did not significantly affect main channel turbidities during the trip.

2. LCR turbidities were unusually low during Trip 6, 1993. Visibility through the water in the LCR was approximately 20 feet based on rough estimates made during snorkeling. High water clarity in this system provided an excellent opportunity to conduct direct visual observations of habitat use for all life stages of humpback chubs and other native fish in addition to allowing for an accurate census of predatory species such as channel catfish. Several observations of humpback chub were made by BIO/WEST personnel (B. Masslich) during informal snorkeling in the lower 200 meters of the LCR and are included listed below for those interested (all observations were made on June 12 between 1000 and 1200 hrs):

   a. One adult humpback chub (≈300 mm) was observed utilizing a pool approximately 100 meters upstream of the confluence of the LCR. Maximum depth in the pool was ≈2 meters. Velocities in the pool ranges from 0 to ≈1 m/s. The fish was observed moving widely in the pool, utilizing a range of depths and velocities but generally staying in the lower half of the water column. The fish would frequently move into small eddies behind large boulders for brief periods of time. It was highly likely that the activity of the fish was initially influenced by the presence of the observer but seemed to grow accustomed after a period of time, at one point passing within one meter of the observer. During the observation the fish used an area of ≈100 square meters before moving upstream out of sight. Total observation time was about 2 minutes.

   b. One juvenile humpback chub (≈120 mm) was observed utilizing a small eddy created by an imbedded boulder on the bottom. Water depth at the fishes location was ≈1.5 m and water velocity ≈-0.1 m/s. The fish was observed at this location for approximately 30 seconds before it moved upstream, possibly flushed by presence of the observer.

   c. Three young-of-year humpback chub were observed utilizing the interstitial space between two large boulders approximately 75 meters up the LCR from the confluence. The fish ranged from ≈20-25 mm TL. The area utilized by the fish was approximately 0.5 square meters. Water velocity in the area used by the fish ranged from 0.0 to near 0.5 m/s. The fish were observed spending most of the time in calm water but occasionally moved near the shear zone of the small eddy created by a ≈1.0 m/s current flowing past their location. Several times the fish appeared to get caught in the current passing their location and had to swim very vigorously to return back to the space between the boulders. During the observation the fish were feeding on drifting material as well as foraging off the surface of boulders. Items eaten by the fish could not be identified. Water depth at the fishes location was ≈0.25 m. Total observation time was about 4 minutes.

   d. A snorkeling census was made of the lower intermittent channel at the confluence of the LCR. At the time of the survey main channel flows were low and no water was flowing through the lower channel. A pool approximately 40 meters long and 5 meters wide was examined to determine numbers of small humpback chub that were utilizing the area. Maximum depth in the

pool was ≈1 m. Approximately 10 unidentified larval fish were observed utilizing a very shallow, warm area at the top end of the pool. One large channel catfish (≈7 lb.) was observed under Tapeats ledges near the middle of the pool. Approximately 30-40 small fish, mostly speckled dace (no chubs were positively identified) were packed into a small scoured area under a Tapeats ledge at the base of the pool. As the observer moved down the pool careful it did not appear that any fish were being pushed. It is speculated that this group of young fish were utilizing this portion of the pool in response to the large catfish that was resting approximately 2 meters from their location. Based on the limited area and cover available in the pool it is speculated that predation of young fish was a limiting factor in the pool at the time of the observation. No attempts were made to capture the catfish for stomach analysis.

3. Twenty-one rainbow trout were captured netting and electrofishing above the confluence of the LCR during Trip 6 versus 7 rainbows captured below the confluence of the LCR. It is speculated that prolonged turbidity from the LCR during the last year may have resulted in emigration of rainbow trout from areas below the confluence of the LCR. Assuming this is the case, levels of predation on young native fish using this reach may be reduced temporarily. It is unknown the time it will take for immigration of trout back into the area under conditions of low turbidity as observed during Trip 6.

4. A juvenile humpback chub (≈110 mm) was observed in Chuar Creek during Trip 6, 1993. The fish was observed at 1300 on June 16 while observing a school of speckled dace in a small artificial pool 10 m upstream of the confluence of Chuar Creek and the Colorado River. The pool was created by a small handmade boulder demand measured approximately 5 meters in length with a maximum depth of 0.3 meters. While watching dace swimming in the pool, the young chub swam into the pool from upstream. A second person was called over to see the fish. At this time the fish became very flighty, darting around in the pool and eventually came out of the water, flopped over the small dam and swam downstream toward the confluence at which time visual contact with the fish was lost. It is speculated that the fish had probably moved into the creek earlier in the year when flows in the creek were relatively high (>1 cfs) and warmer than the main channel. Flow in Chuar creek at the time of the observation was ≈0.25 cfs.

5. Four juvenile humpback chub (100-120 mm) were observed feeding at the break of an eddy at RM 65.4 on June 17 at approximately 2300 hr. The fish were utilizing water depths ranging from 0.5 to 1.5 feet approximately 1 to 3 feet from shore. Water velocities at the fishes location ranged from 0.1 to 0.3 m/s over a sand substrate. The fish were observed orienting themselves into the current at the break of the eddy and feeding on material drifting into the eddy and settling out. Total observation time was approximately 30 minutes. It is speculated that these fish moved out of the cover of a vegetated shoreline just downstream of the eddy to feed during the night in clear water then returned to the cover during the day. Several humpback chub in the same size range were captured along this vegetated bank in unbaited minnow traps. It had been speculated by BIO/WEST that juvenile humpback chubs were utilizing these areas as feeding sites during the day during high turbidity (see Trip Report #8 and #9, 1992). This observation indicates that these areas may also be important feeding sites during night in low turbidity situations.

6. High catch rates of adult humpback chubs between 60 mile Rapid and Chuar Creek suggest that a substantial number of humpback chubs have migrated back into the main channel from the LCR following spawning. A large proportion of the fish appeared relatively flaccid and spent.

7. A female striped bass (539 mm TL, 1928 g) was captured angling from the mouth of Kanab Creek. This fish was captured using a spin casting rod with a fluorescent 1/4 oz "Crocodile" spoon

8. Three striped bass were captured by electrofishing in the mouth of Havasu Creek. Several unidentified suckers were noted in the stomach of one fish (complete identification of stomach contents has not yet been completed)

PROBLEMS ENCOUNTERED AND SOLUTIONS

1. No substantial problems were encountered in Trip 6, 1993.

RECOMMENDATIONS

1. We recommend continued and enhanced coordination among the researchers in Grand Canyon. This coordination is essential to insure that all researchers are aware of others activities.

2. We recommend that radiotelemetry efforts in the Middle Granite Gorge be discontinued after July 1993. BIO/WEST has had the opportunity to monitor three radiotagged fish in the area since March of 1993 and has collected adequate information to address objectives of the telemetry study in Reach 2. Further telemetry studies would require intensive effort in the area and result in little additional information.

Table 1. Logistics and Research Schedule for Trip 6, 1993.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
06/10	43.7	Pres. Harding Rapid	X	X		
06/11	43.7	Pres. Harding Rapid		X		
06/12	61.3	LCR	X	X		X
06/13	61.3	LCR		X		X
06/14	61.3	LCR		X		X
06/15	65.4	Lava Chuar	X	X		X
06/16	65.4	Lava Chuar		X		X
06/17	65.4	Lava Chuar		X		X
06/18	87.0	Cremation	X	X		
06/19	126.5	Randy's Rock	X	X	X	X
06/20	126.5	Randy's Rock		X	X	X
06/21	126.5	Randy's Rock		X	X	X
06/22	143.3	Kanab Creek	X	X		
06/23	156.6	Havasu Creek	X	X		
06/24	225.4	Above Diamond Creek	X			
06/25	225.6	Diamond Creek - Take Out	X			

[1]T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 2. Personnel Participating in Trip 6, 1993.			
PERSONNEL	**AFFILIATION**	**DATES**	**COMMENTS**
B. Masslich	BIO/WEST	06/10 - 06/19	Project Leader - Out Bright Angel
B. Cowdell	BIO/WEST	06/10 - 06/25	Senior Biologist
D. McCabe	BIO/WEST	06/10 - 06/25	
K. Pruhs	BIO/WEST	06/10 - 06/25	
Y. Converse	BIO/WEST	06/10 - 06/25	
G. Hardwick	BIO/WEST	06/10 - 06/25	
C. Heck	BIO/WEST	06/10 - 06/25	
E. Prats	BIO/WEST	06/19 - 06/25	In Bright Angel
R. Traeger	BIO/WEST VOLUNTEER	06/10 - 06/25	
M. Locatelli	BIO/WEST VOLUNTEER	06/10 - 06/25	
L. Allen	BIO/WEST VOLUNTEER	06/10 - 06/25	
D. Metz	USFWS	06/10 - 06/25	
S. Reeder	OARS	06/10 - 06/25	Trip Leader
B. Schimpp	OARS	06/10 - 06/25	
C. Knzarek	OARS	06/10 - 06/25	

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 6, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CP	SD	SB	PK	FH
Electrofishing Reach 0 N=9	A				66						
	J				2						
	Y										
Electrofishing Reach 1 N=30	A	4	1		18		3	11			2
	J	13									
	Y				2			1			
Electrofishing Reach 2 N=23	A	1	5			1	2	1	3	1	
	J	1	2								
	Y										
Nets Reach 0 N=27	A				21						
	J				1						
	Y										
Nets Reach 1 N=77	A	62	18	3	8						
	J	9									
	Y										
Nets Reach 2 N=64	A	5	18	1	3		2		1[4]		
	J										
	Y										

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 6, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CP	SD	SB	PK	FH
Traps Reach 1 N=355	A							23			
	J	24									
	Y										
Traps Reach 2 N=20	A										
	J	1									
	Y										
Totals	A	72	42	4	116	1	7	35	4	1	2
	J	48	2	0	3	0	0	0	0	0	0
	Y	0	0	0	2	0	0	1	0	0	0
	T	120	44	4	121	1	7	36	4	1	2

[2] - A = Adult
J = Juvenile
Y = Young of year

[3] - HB = humpback chub
FM = flannelmouth sucker
BH = bluehead sucker
RB = rainbow trout
BR = brown trout
CP = carp
SD = speckled dace
SB = striped bass
PK = plains killifish
FH = fathead minnow

[4] Caught angling from Kanab Creek

Table 4. Summary of Humpback Chub handled during Trip 6, 1993.

N	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
1	930612	N	033	7F7D7C2A70	N		247	134	RA	N	60.20
2	930612	N	033	7F7D400864	N		208	91	RA	N	60.20
3	930612	N	033	7F7D400652	N		185	76	RA	N	60.20
4	930612	N	033	7F7B081865	N		178	62	RA	N	60.20
5	930612	N	033	7F7F3E2A49	Y	PITTAG	353	319	RS	N	60.20
6	930612	N	038	7F7D1B6F35	Y	PITTAG	222	114	RA	N	60.20
7	930612	N	038	7F7B02636D	N		222	100	RA	N	60.20
8	930613	E	019	7F7F041A2A	Y	PITTAG	374	446	RA	N	62.70
9	930613	E	019	7F7F104276	N		394	571	RA	N	62.70
10	930613	N	029	7F7D2C462E	Y	PITTAG	412	595	RS	N	60.20
11	930613	N	029	7F7F041C04	Y	PITTAG	380	531	RS	N	60.20
12	930613	N	030	7F7F3C2E01	Y	PITTAG	345	360	RS	N	60.40
13	930613	N	031	7F7F3C4471	Y	PITTAG	324	283	RS	N	60.50
14	930613	N	031	7F7D17345F	Y	PITTAG	440	560	RS	N	60.50
15	930613	N	031	7F7B01677C	Y	PITTAG	357	487	RS	N	60.50
16	930613	N	035	7F7F050668	Y	PITTAG	331	252	RS	N	60.40
17	930613	N	035	7F7F33292F	Y	PITTAG	315	264	RA	N	60.40
18	930613	N	035	7F7E427E38	Y	PITTAG	365	342	RS	N	60.40
19	930613	N	035	7F7F455430	Y	PITTAG	405	519	RS	N	60.40

Table 4. Summary of Humpback Chub handled during Trip 6, 1993.

N	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
20	930613	N	039	7F7D087C24	Y	PITTAG	285	228	RA	N	60.20
21	930613	N	044	7F7F3C4554	Y	PITTAG	415	614	RA	N	61.15
22	930613	N	045	7F7F197D0D	Y	PITTAG	365	421	RA	N	61.20
23	930613	N	052	7F7B080D12	N		202	77	RA	N	60.80
24	930613	N	053	7F7D175211	Y	PITTAG	257	128	RA	N	60.90
25	930614	E	021	DP1	N		119	16	RA	N	60.70
26	930614	N	058	7F7F26597F	Y	PITTAG	405	520	RA	N	61.70
27	930614	N	059	7F7D226C0F	Y	PITTAG	343	294	RA	N	61.95
28	930614	N	059	7F7F3D0A6C	Y	PITTAG	372	488	RA	N	61.95
29	930614	N	060	7F7D3C3F78	N		386	519	RA	N	62.15
30	930614	N	061	7F7F00607A	Y	PITTAG	460	803	RA	N	61.50
31	930614	N	061	7F7A2A5563	Y	PITTAG	389	562	RA	N	61.50
32	930614	N	062	7F7F200471	Y	PITTAG	337	323	RA	N	61.70
33	930614	N	062	7F7A1B6E1F	Y	PITTAG	327	270	RA	N	61.70
34	930614	N	062	7F7F183C3A	Y	PITTAG	403	562	RA	N	61.70
35	930614	N	062	7F7A18134E	Y	PITTAG	395	490	RA	N	61.70
36	930614	N	062	1F0F5F7C77	Y	PITTAG	396	476	RA	N	61.70
37	930614	N	063	7F7A1B7556	Y	PITTAG	388	409	RA	N	61.95
38	930614	N	063	7F7A22695E	Y	PITTAG	316	239	RA	N	61.95

Table 4. Summary of Humpback Chub handled during Trip 6, 1993.

N	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
39	930614	N	064	7F7B022F16	N		370	352	RA	N	62.15
40	930614	N	064	7F7A3F7A0B	N		231	124	RA	N	62.15
41	930614	N	064	7F7F256046	Y	PITTAG	356	308	RA	N	62.15
42	930614	N	064	7F7A173824	Y	PITTAG	322	281	RA	N	62.15
43	930614	N	064	7F7F3F4A24	Y	PITTAG	340	342	RA	N	62.15
44	930614	N	064	7F7F276A5B	Y	PITTAG	368	374	RA	N	62.15
45	930614	N	064	7F7F19721A	Y	PITTAG	323	282	RA	N	62.15
46	930614	N	064	7F7A242F7B	Y	PITTAG	228	98	RA	N	62.15
47	930614	N	065	7F7A075B5B	N		395	555	RA	N	61.50
48	930614	N	066	7F7A3E6F77	N		375	405	RA	N	61.70
49	930614	T	119	##########	N		82	6	RA	N	62.50
50	930614	T	119	##########	N		87	6	RA	N	62.50
51	930614	T	119	##########	N		87	6	RA	N	62.50
52	930614	T	139	DP1#######	N		90	7	RA	N	62.70
53	930614	T	141	DP1#######	N		88	5	RA	N	63.15
54	930614	T	142	DP1#######	N		88	5	RA	N	63.15
55	930614	T	142	DP1#######	N		125	17	RA	N	63.15
56	930615	N	073	1F0F6D7570	N		392	551	RS	N	63.70
57	930615	N	073	1F0F770853	N		352	366	RS	N	63.70

Table 4. Summary of Humpback Chub handled during Trip 6, 1993.

N	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
58	930615	N	073	7F7F330318	Y	PITTAG	375	466	RS	N	63.70
59	930615	N	073	7F7F32281B	Y	PITTAG	349	369	RS	N	63.70
60	930615	N	073	7F7F2D5F11	Y	PITTAG	431	620	RS	N	63.70
61	930615	N	074	7F7D2C244E	Y	PITTAG	359	486	RA	N	63.90
62	930615	T	154	DP1	N		105	8	RA	N	61.75
63	930615	T	166	DP1	N		70	2	RA	N	62.70
64	930615	T	169	DP1	N		90	9	RA	N	62.70
65	930615	T	173	DP1	N		80	3	RA	N	63.15
66	930615	T	184	DP1	N		66	3	RA	N	62.70
67	930615	T	218	DP1	N		93	8	RA	N	63.15
68	930615	T	274	DP1	N		79	3	RA	N	63.45
69	930615	T	275	DP1	N		82	4	RA	N	63.45
70	930616	N	079	7F7D2B0803	Y	PITTAG	355	337	RA	N	64.80
71	930616	N	080	1F0F7C5402	N		400	545	RA	N	64.80
72	930616	N	082	7F7D2B147F	Y	PITTAG	361	380	RA	N	65.25
73	930616	N	084	7F7F214B50	Y	PITTAG	211	79	RA	N	64.80
74	930616	N	084	1F0F6A4E1A	N		196	88	RA	N	64.80
75	930616	N	084	1F0F7D5E77	N		216	100	RA	N	64.80
76	930616	N	087	7F7D2C161C	Y	PITTAG	396	487	RA	N	65.25

Table 4. Summary of Humpback Chub handled during Trip 6, 1993.

N	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
77	930616	N	089	1F0F701A4A	N		224	99	RA	N	64.80
78	930616	T	269	DP1	N		76	4	RA	N	65.40
79	930616	T	269	DP1	N		111	12	RA	N	65.40
80	930616	T	270	DP1	N		110	13	RA	N	65.40
81	930616	T	293	DP1	N		110	12	RA	N	65.40
82	930616	T	323	DP1	N		120	13	RA	N	65.40
83	930617	E	038	7F7D18104D	Y	PITTAG	348	299	RA	N	63.50
84	930617	E	038	DP1	N		104	11	RA	N	63.50
85	930617	E	038	DP1	N		99	7	RA	N	63.50
86	930617	E	038	DP1	N		111	11	RA	N	63.50
87	930617	E	038	DP1	N		105	9	RA	N	63.50
88	930617	E	038	DP1	N		88	6	RA	N	63.50
89	930617	E	038	DP1	N		83	3	RA	N	63.50
90	930617	E	038	DP1	N		77	4	RA	N	63.50
91	930617	E	039	DP1	N		80	5	RA	N	65.00
92	930617	E	039	7F7F1A1C32	N		176	49	RA	N	65.00
93	930617	E	039	DP1	N		109	11	RA	N	65.00
94	930617	E	039	DP1	N		113	12	RA	N	65.00
95	930617	E	039	DP1	N		90	7	RA	N	65.00

Table 4. Summary of Humpback Chub handled during Trip 6, 1993.

N	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
96	930617	E	039	DP1	N		70	3	RA	N	65.00
97	930617	N	100	1F0F654528	N		404	566	RA	N	64.70
98	930617	N	100	7F7F183807	Y	PITTAG	399	593	RA	N	64.70
99	930617	N	100	7F7F184753	Y	PITTAG	404	477	RA	N	64.70
100	930617	N	100	DP1	N		151	31	RA	N	64.70
101	930617	N	100	DP1	N		146	30	RA	N	64.70
102	930617	N	100	DP1	N		111	12	RA	N	64.70
103	930617	N	100	DP1	N		111	12	RA	N	64.70
104	930617	N	100	DP1	N		110	12	RA	N	64.70
105	930617	N	101	7F7F182C41	Y	PITTAG	384	442	RA	N	64.40
106	930617	N	101	7F7D1B7971	Y	PITTAG	395	487	RA	N	64.40
107	930617	N	104	1F0F7C5402	Y	PITTAG	409	532	RA	N	64.70
108	930617	N	104	DP1	N		127	15	RA	N	64.70
109	930617	T	308	##########	N		57	2	RA	N	63.90
110	930617	T	342	DP1	N		84	5	RA	N	65.55
111	930617	T	343	DP1	N		85	5	RA	N	64.00
112	930617	T	347	DP1	N		100	6	RA	N	64.55
113	930619	N	001	7F7D073D4A	Y	PITTAG	391	855	RR	Y	127.52
114	930619	N	001	7F7F264B5A	N		364	595	RA	N	127.52

Table 4. Summary of Humpback Chub handled during Trip 6, 1993.											
N	**Date**	**Type**	**Sample No.**	**PIT tag**	**Recap**	**Old Tag**	**TL**	**WT**	**Disp**	**Radio**	**RM Release**
115	930619	N	004	7F7D076335	Y	PITTAG	301	276	RA	N	127.10
116	930619	N	004	7F7F284154	N		287	235	RA	N	127.10
117	930620	E	043	7F7B1F102A	N		208	81	RA	N	127.60
118	930620	E	046	UC1	N		130	20	RA	N	127.70
119	930621	N	035	7F7F1F1E5C	Y	PITTAG	292	283	RA	N	127.10
120	930621	T	003	DP1	N		100	7	RA	N	127.50

Table 5. Summary of radio-transmitter implants in humpback chub during Trip 2, 1993.

#	DATE	PITTAG	TL	WT	FREQ	PULSE RATE (pulses/min)	RADIOTAG SIZE (g)	LIFE EXPECTANCY (days)	ESTIMATED DATE OF EXTINCTION	CAPTURE (rm)	RELEASE (rm)
1	930223	7F7BO81768	387	768	40.600	40	11	120	930623	126.1	126.1

Table 5. Summary of radio-transmitter implants in humpback chub during Trip 3, 1993.

#	DATE	PITTAG	TL	WT	FREQ	PULSE RATE (pulses/min)	RADIOTAG SIZE (g)	LIFE EXPECTANCY (days)	ESTIMATED DATE OF EXTINCTION	CAPTURE (rm)	RELEASE (rm)
1	930316	7F7D084141	337	478	40.660	40	9	50	930505	127.1	127.1
2	930319	7F7D073D4A	386	874	40.730	40	11	120	930719	127.5	127.5

Table 6. A list of radio frequencies contacted on Trip 6, 1993 and locations relative to capture and release sites.

			--------River Mile--------		
FREQ/PULSE	TAG SIZE (g)	DATE (time)	CAPTURE	RELEASE	LOCATE
40.730/40	11	930319	127.5	127.5	
/34		930619(1801)			127.6
/34		930619(2300)			127.5
/34		930621(0935)			127.05
/34		930621(1134)			126.9
/34		930621(1414)			126.7
/32		930621(2015)			126.8
/32		930621(2145)			126.6

CHARACTERIZATION OF THE LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE GRAND CANYON

TRIP REPORT 7 - 1993
July 8 - 27, 1993

Prepared For:

Bureau of Reclamation

Prepared By:

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William Masslich, Project Leader
William Leibfried, Project Leader

BIO/WEST INC.
1063 West 1400 North
Logan, UT. 84321

August 6, 1993

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INTRODUCTION

This report presents pertinent details associated with Trip 7, 1993. Included in the report are a summary of trip logistics, personnel and research schedule, data collected, problems encountered, pertinent observations and recommendations. Most information is presented in a tabular format to provide a quick synopsis of trip details and results. We emphasize that these data are hand tabulated to provide these synopses as soon as possible. The data are later computerized and checked for accuracy. The purpose of these trip reports is to provide information from BIO/WEST trips as quickly as possible to aid other researchers.

LOGISTICS, RESEARCH SCHEDULE AND PERSONNEL

Table 1 presents a summary of logistics and the research schedule for Trip 7, 1993. Table 2 is a list of personnel who were present or participated in research activities for Trip 7, 1993.

DATA COLLECTED

Table 3 is a summary of gear types used, sampling effort and fish captured by gear type for Trip 7, 1993. Table 4 is a summary of all humpback chubs handled during Trip 7, 1993. Table 5 summarizes the radio contacts during Trip 7, 1993 and presents original fish release locations and radiotag data.

Humpback Chubs Captured

A total of 431 humpback chub were captured during Trip 7, 1993 including 247 young-of-year (YOY)(<65 mm), 90 juveniles (66-199 mm TL), and 94 adults (>199 mm TL). No chub were captured in Reach 0. In Reach 1, a total of 409 humpback chubs were captured including 246 YOY, 85 juveniles and 78 adults. Forty YOY were captured with seines. One hundred eighty-seven chubs, including 15 adults, 58 juveniles and 114 YOY were captured electrofishing. Netting produced 66 humpback chub including 63 adults and 3 juveniles. One hundred sixteen chubs were also captured in unbaited minnow traps including 24 juveniles and 92 YOY.

Of the 78 adult humpback chub captured in Reach 1, 60 (or 77%) were PIT-tagged recaptures (includes those captured and marked by other investigators). This represents the second highest recapture rate observed by BIO/WEST for adult humpback chubs in Reach 1. Other high recapture rates were observed in 1993, including 80% in January, 75% in February, 68% in March, 60% in April, 66% in May and 75% in June.

Twenty-two humpback chubs were captured in Reach 2 during Trip 7, 1993 including 16 adults and five juveniles and one YOY. Fifteen adults and 1 juvenile were captured in nets. One adult and two juveniles were captured electrofishing and one YOY and 2 juveniles were captured in unbaited minnow traps. Of these 17 adult chubs, 7 were recaptures of previously tagged fish. All were captured near their original capture location. Seventeen of these fish were captured between RM 126 and 128. No chubs were captured in Reach 3.

Stomach contents of 20 humpback chubs, 15 in Reach 1 and 5 in Reach 2, were collected using non-lethal stomach pumping techniques.

One YOY humpback chub captured electrofishing at RM 75.1 on July 13 was discovered dead in the live well at the end of the electrofishing run. The fish was missing an eye and based on its overall appearance was assumed to be either dead or in very poor condition prior to capture. The fish measured 64 mm TL and weighed 2 grams. The carcass was preserved for transport to Flagstaff and will be transferred to AGF as soon as possible.

Observed Condition of Humpback Chub

All chubs captured with the exception of one juvenile captured at RM 68.3 appeared healthy and in good condition. The juvenile captured at RM 68.3 had a distended abdomen and appeared slightly malnourished, possibly as a result of a tapeworm infestation. The fish was released at the point of capture.

Non-lethal stomach pumping of 15 humpback chubs indicated that tapeworms were present in approximately 33% of the fish that were successfully evacuated.

Radiotelemetry

No humpback chubs were implanted during Trip 7 1993.

One radio-implanted chub from the Middle Granite Gorge was located by radiotelemetry during Trip 7, 1993. The fish (40.730) was located during a routine surveillance run on July 16 at RM 126.2. This was the only contact with the fish during the four days of telemetry surveillance. It is assumed that the transmitter expired.

Both remote telemetry stations were downloaded successfully during Trip 7, 1993. These data show upstream movement by 40.730 about one week prior to arrival of the B/W crew to the Middle Granite Gorge area this month.

Habitat Mapping

Juvenile habitat mapping was conducted in seventeen locations between the confluence of the LCR and Tanner Rapid.

Bench Marks

No new bench marks were established during Trip 7, 1993.

OBSERVATIONS

1. Main channel turbidities were low for the duration of Trip 7, 1993. Daily increases in fluctuations in turbidity associated with bed load disturbance from peak flows were observed during most days. Turbidities ranged from 7 to 35 NTU's during a flow cycle, with highest turbidities observed during the descending limb of the hydrograph soon after peak flow.

2. High densities of YOY humpback chub were observed in the main channel from the confluence of the LCR (RM 61.3) to Nevill's Rapid (RM 75.3) during Trip 7, 1993. YOY humpback were captured in nearly all shoreline types by electrofishing, seining and minnow trapping. Highest catch rates were along shoreline types including talus, debris flows and vegetated cutbanks. Shoreline types such as sand beaches and shear walls yielded lower catch rates. Based on observations of movement and transport of YOY and juvenile chub from the LCR into the main channel during previous years, the presence of such high numbers of YOY humpback chub in the main channel during Trip 7 is anomalous. During previous years dramatic increases in numbers of YOY and juvenile humpback chub in the main channel were generally associated with a flood event in the LCR. No such event has occurred in the LCR following the spring runoff which ended in late April-early May. Since that time the LCR has run at base flow. It is speculated that movement of these young fish may be associated with one or a combination of the following factors:

   a) Flood events during January and February of 1993 scoured the LCR channel possibly increasing availability of suitable spawning habitat for humpback chub and resulted in an exceptionally successful spawn. Unusually high numbers of YOY chubs in the main channel may be reflective of normal emigration associated with very high densities of fish in the LCR.

   b) Scouring of the LCR by unusually high winter and early spring flows appear to have resulted in unusually high water clarity in the LCR during June and July. It is possible that high water clarity in the LCR may be unsuitable for YOY humpback chub resulting in emigration into the main channel.

   c) Scouring of the LCR as described above may have temporarily altered benthic and planktonic communities resulting in decreased food availability for high numbers of YOY fish in the system again resulting in emigration into the main channel.

3. Water clarity in the LCR was unusually high in July. Numerous YOY humpback chubs (ranging from approximately 30 to 60 mm) were observed while snorkeling in the lower one kilometer. Several juvenile and one adult humpback chub were also observed and photographed. Numerous channel catfish and carp were also observed and photographed.

4. Two brown trout were captured in Reach 1 during Trip 7, 1993, one at RM 62.1 and one at 68.4. Both browns were captured in conjunction with high numbers of YOY and juvenile humpback chub and were sacrificed for stomach content analysis. A total of 6 humpback chubs were found in the stomach contents of both fish (2 in one fish and 4 in the other) averaging 94 mm standard length, with a range of 78-120 mm. A total length of 162 mm was measured for one of the chubs that was freshly ingested.

5. All rainbow trout captured in conjunction with YOY humpback chub were sacrificed for stomach analysis. Fish remains were tentatively identified in the stomach of three of these fish and preserved for lab identification.

6. Unbaited minnow traps were very effective at catching YOY and juvenile humpback chub during Trip 7. Humpback chubs were captured in a variety of shoreline types including sheer wall, boulder talus, boulder debris fans and vegetated cut banks. High catch rates in minnow traps across habitat types suggest that densities of both YOY and juvenile humpback chubs were very high in the main channel during Trip 7, 1993.

7. Two small chub, 76 and 68 mm TL were captured in minnow traps at RM 126.1. This is the first collection of chub this small from the Middle Granite Gorge area.

8. Thirty-two percent of chubs captured in Reach 2 were recaptures of previously PIT tagged fish.

9. The seven recaptured chubs from the Middle Granite Gorge were from the same locale as originally captured. This along with previous recapture data from this site suggest an aggregation or small population of chubs utilizing this area.

10. Mainstem river warming was apparent during Trip 7, 1993. River temperatures were 14.5 °C at RM 143 and 16.5 °C at RM 214.

11. Fifteen striped bass were captured during Trip 7, 1993. Six were caught in nets above Kanab Creek in Reach 2. In Reach 3, 9 bass were captured by both electrofishing and netting. Sites below Havasu Creek and at RM 214 produced striped bass. These fish were mostly non-reproductive males between 1 and 2 pounds. The capture of these fish follows the observed trend of summer movements by striped bass seen on previous trips during the past two years.

PROBLEMS ENCOUNTERED AND SOLUTIONS

1. One PIT tagger was malfunctioning during Trip 7, 1993. some sampling efficiency was lost by having shuttle fish to be PIT tagged. this instrument will be serviced as soon as possible.

RECOMMENDATIONS

1. We recommend continued and enhanced coordination among the researchers in Grand Canyon. This coordination is essential to insure that all researchers are aware of others activities.

Table 1. Logistics and Research Schedule for Trip 7, 1993, Team 1.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
7/08	2.8	Cathedral Wash	X	X		
7/09	2.8	Cathedral Wash		X		
7/10	30.2	Near South Canyon	X	X		
7/11	30.2	Near South Canyon		X		
7/12	58.2	Awatubi	X	X		
7/13	58.2	Awatubi		X		
7/14	61.2	LCR	X	X		
7/15	61.2	LCR		X		
7/16	61.2	LCR		X		
7/17	65.4	Lava Chuar	X	X		X
7/18	65.4	Lava Chuar		X		X
7/19	65.4	Lava Chuar		X		X
7/20	67.8	Near Tanner Canyon	X	X		X
7/21	67.8	Near Tanner Canyon		X		X
7/22	71.0	Cardenas	X	X		
7/23	89.3	Below Pipe Creek	X	X		
7/24		Travel	X			
7/25		Travel	X			
7/26	214	214 Mile	X			
7/27	225	Diamond Creek	X			

[1]T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 1. Logistics and Research Schedule for Trip 7, 1993, Team 2.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
7/08	30.3	Fence Fault	X			
7/09	75.3	75 Mile Creek	X	X		
7/10	75.3	75 Mile Creek		X		
7/11	75.3	75 Mile Creek		X		
7/12	91.2	91 Mile Creek	X	X		
7/13	91.2	91 Mile Creek		X		
7/14	119.5	119.5	X	X		
7/15	119.5	119.5		X		
7/16	126.4	Randy's Rock	X	X	X	
7/17	126.4	Randy's Rock		X	X	
7/18	126.4	Randy's Rock		X	X	
7/19	126.4	Randy's Rock		X	X	
7/20	143.3	Across from Kanab	X	X		
7/21	143.3	Across from Kanab		X		
7/22	161	Below Havasu	X	X		
7/23	161	Below Havasu		X		
7/24	198	Parashout	X			
7/25	214.1	214 Mile Creek	X	X		
7/26	214.1	214 Mile Creek		X		
7/27	225.7	Diamond Creek	X			

[1]T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 2. Personnel Participating in Trip 7, 1993.			
PERSONNEL	**AFFILIATION**	**DATES**	**COMMENTS**
Team 1			
B. Masslich	BIO/WEST	7/8 - 7/24	Project Leader
T. Wasowicz	BIO/WEST	7/8 - 7/24	Senior Biologist
C. Heck	BIO/WEST	7/8 - 7/24	Out Bright Angel
D. Hickman	BIO/WEST	7/8 - 7/24	Out Bright Angel
P. Trater	BIO/WEST	7/8 - 7/24	Out Bright Angel
C. Jensen	BIO/WEST VOLUNTEER	7/8 - 7/27	
P. Metz	BIO/WEST VOLUNTEER	7/8 - 7/24	Out Bright Angel
G. Miner	BIO/WEST VOLUNTEER	7/8 - 7/24	Out Bright Angel
S. Reeder	OARS	7/8 - 7/24	Trip Leader
C. Krznarich	OARS	7/8 - 7/27	
T. Jones	OARS	7/8 - 7/27	
Team 2			
B. Leibfried	BIO/WEST	7/8 - 7/23	Project Leader/Out Havasu
E. Prats	BIO/WEST	7/8 - 7/27	Senior Biologist
J. Mansour	BIO/WEST	7/8 - 7/27	
M. Murov	BIO/WEST	7/8 - 7/27	
P. Weiss	BIO/WEST	7/8 - 7/27	
J. Weiss	GCES	7/8 - 7/27	Biologist
C. Valentine	BOR	7/8 - 7/27	Biologist
P. Kelsey	BIO/WEST VOLUNTEER	7/8 - 7/27	
J. Pomeroy	BIO/WEST VOLUNTEER	7/8 - 7/27	
P. Gaudet	BIO/WEST VOLUNTEER	7/8 - 7/27	
T. Deutschlander	OARS	7/8 - 7/27	Trip Leader
S. Plassman	OARS	7/8 - 7/27	
K.C. Deutschlander	OARS	7/8 - 7/27	

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 7, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	FMxBH	SU	FH	SB
Electrofishing Reach 0 N=32	A		17		68			8	2				
	J				15								
	Y				3								
Electrofishing Reach 1 N=84	A	15	11	2	138	2		14	24	1		5	
	J	58	1		18			1					
	Y	114		1	16								
Electrofishing Reach 2 N=60	A	1	9	4	51	12		22	2			1	
	J	2	3	1	10	3							
	Y			1	1								
Electrofishing Reach 3 N=20	A		1		1	1		27	3				7
	J		1		3								
	Y												
Nets Reach 0 N=35	A		2		23								
	J												
	Y												
Nets Reach 1 N=90	A	63	26	8	22	1							
	J	3											
	Y												
Nets Reach 2 N=234	A	15	38	3	5	14		5					6
	J	1											
	Y												

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 7, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	FMxBH	SU	FH	SB
Nets Reach 3 N=60	A		7	1			7	5					2
	J												
	Y												
Traps Reach 1 N=580	A								8			2	
	J	24			1				1				
	Y	92	1	1	3								
Traps Reach 2 N=123	A			1					11			1	
	J	2											
	Y	1						1					
Traps Reach 3 N=15	A												
	J						No Fish						
	Y												
Seines Reach 1 N=15	A		3		2			1				7	
	J		1										
	Y	40	75	15					16		1	3	
Seines Reach 2 N=8	A											1	
	J			2									
	Y			1									
Totals	A	94	114	19	310	30	7	82	50	1	0	17	15
	J	90	6	3	47	3	0	1	1	0	0	0	0
	Y	247	76	19	23	0	0	1	16	0	1	3	0
	T	431	196	41	380	33	7	84	67	1	1	20	15

[2] - A = Adult
J = Juvenile
Y = Young of year

[3] - HB = humpback chub
FM = flannelmouth sucker
BH = bluehead sucker
RB = rainbow trout
BR = brown trout
CC = channel catfish
CP = carp
SD = speckled dace
FMxBH = flannelmouth sucker bluehead hybrid
SU = unidentified sucker
FH = fathead minnow
SB = striped bass

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
1	930710	S	001	##########	N		31	0	RA	N	75.30
2	930710	S	002	##########	N		45	0	RA	N	75.30
3	930710	S	002	##########	N		47	0	RA	N	75.30
4	930710	S	004	##########	N		51	0	RA	N	75.30
5	930710	T	018	##########	N		51	0	RA	N	75.00
6	930710	T	030	##########	N		46	0	RA	N	75.20
7	930710	T	030	##########	N		48	0	RA	N	75.20
8	930710	T	030	##########	N		48	0	RA	N	75.20
9	930711	E	006	##########	N		55	3	RA	N	74.50
10	930711	E	011	7F7B035268	Y	PITTAG	184	50	RA	N	74.60
11	930711	N	042	7F7F1F104D	N		265	180	RA	N	75.00
12	930711	N	042	LCP	N		140	25	RA	N	75.00
13	930711	N	042	LCP	N		127	16	RA	N	75.00
14	930711	N	044	1F201D3272	N		218	107	RA	N	75.20
15	930711	S	013	##########	N		54	0	RA	N	75.60
16	930711	S	013	##########	N		47	0	RA	N	75.60
17	930711	S	013	##########	N		47	0	RA	N	75.60
18	930711	S	013	##########	N		53	0	RA	N	75.60
19	930712	E	012	##########	N		76	3	RA	N	74.80
20	930712	E	012	##########	N		50	1	RA	N	74.80
21	930712	E	013	##########	N		45	1	RA	N	74.90

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
22	930712	E	016	7F7F26547A	N		215	103	RA	N	90.60
23	930712	E	016	UCP	N		126	18	RA	N	90.60
24	930712	E	036	1F1F720050	N		200	67	RA	N	58.50
25	930712	E	038	1F20094276	N		222	98	RA	N	58.85
26	930712	E	038	1F20132509	N		151	30	RA	N	58.85
27	930712	E	038	7F20193A7E	N		408	583	RA	N	58.85
28	930712	E	038	7F7D180413	Y	PITTAG	393	544	RA	N	58.85
29	930712	E	038	7F7D177F6B	Y	PITTAG	353	368	RA	N	58.85
30	930712	E	038	7F7F191C48	Y	PITTAG	350	426	RA	N	58.85
31	930712	E	038	7F7F3E3E15	Y	PITTAG	338	334	RA	N	58.85
32	930712	E	038	1F2022643B	N		177	58	RA	N	58.85
33	930712	N	043	7F7F48032E	Y	PITTAG	331	309	RA	N	58.25
34	930712	T	033	##########	N		47	0	RA	N	75.20
35	930712	T	033	##########	N		45	0	RA	N	75.20
36	930712	T	035	LCP	N		83	5	RA	N	75.00
37	930712	T	035	##########	N		50	1	RA	N	75.00
38	930712	T	037	LCP	N		78	5	RA	N	74.00
39	930712	T	041	##########	N		41	0	RA	N	74.15
40	930712	T	050	##########	N		50	1	RA	N	92.10
41	930713	E	015	LCP	N		109	13	RA	N	75.10
42	930713	E	015	##########	N		64	2	DP	N	0.00

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
43	930713	N	046	7F7F48032E	Y	PITTAG	329	292	RS	N	58.85
44	930713	N	046	7F7F191C48	Y	PITTAG	345	455	RS	N	58.85
45	930713	N	046	7F7F287559	Y	PITTAG	373	478	RS	N	58.85
46	930713	N	047	7F73E26409	Y	PITTAG	378	456	RS	N	58.30
47	930713	N	047	7F7F265A51	Y	PITTAG	403	663	RS	N	58.30
48	930713	N	047	7F7B034F6A	N		409	633	RS	N	58.30
49	930713	N	050	7F7D085017	Y	PITTAG	434	768	RA	N	58.85
50	930714	E	054	##########	N		52	1	RA	N	63.20
51	930714	E	054	##########	N		46	1	RA	N	63.20
52	930714	E	054	##########	N		45	1	RA	N	63.20
53	930714	E	054	##########	N		41	1	RA	N	63.20
54	930714	E	054	##########	N		44	1	RA	N	63.20
55	930714	E	055	##########	N		47	1	RA	N	62.70
56	930714	E	055	##########	N		52	1	RA	N	62.70
57	930714	E	055	DP-1	N		83	3	RA	N	62.70
58	930714	E	055	##########	N		40	1	RA	N	62.70
59	930714	E	055	##########	N		48	1	RA	N	62.70
60	930714	E	055	##########	N		41	1	RA	N	62.70
61	930714	E	055	##########	N		52	1	RA	N	62.70
62	930714	E	055	##########	N		45	1	RA	N	62.70
63	930714	E	055	##########	N		47	1	RA	N	62.70

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.											
N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
64	930714	E	055	##########	N		50	1	RA	N	62.70
65	930714	E	055	##########	N		40	1	RA	N	62.70
66	930714	E	055	##########	N		43	1	RA	N	62.70
67	930714	E	056	DP-1	N		78	4	RA	N	62.60
68	930714	E	056	##########	N		54	0	RA	N	62.60
69	930714	E	056	##########	N		52	0	RA	N	62.60
70	930714	E	056	##########	N		49	0	RA	N	62.60
71	930714	E	056	##########	N		50	1	RA	N	62.60
72	930714	E	056	##########	N		47	1	RA	N	62.60
73	930714	E	056	##########	N		44	1	RA	N	62.60
74	930714	E	056	##########	N		46	1	RA	N	62.60
75	930714	E	056	##########	N		44	1	RA	N	62.60
76	930714	E	056	##########	N		46	1	RA	N	62.60
77	930714	E	056	##########	N		46	1	RA	N	62.60
78	930714	N	054	7F7E42752E	Y	PITTAG	352	379	RS	N	60.60
79	930714	N	058	7F7D2C0926	Y	PITTAG	328	302	RS	N	60.40
80	930715	E	057	DP-1	N		105	4	RA	N	62.00
81	930715	E	061	##########	N		51	1	RA	N	62.40
82	930715	E	065	7F7F206E03	Y	PITTAG	377	433	RA	N	61.70
83	930715	E	065	##########	N		39	1	RA	N	61.70
84	930715	E	066	DP-1	N		120	12	RA	N	61.70

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
85	930715	E	066	1F20432658	N		160	40	RA	N	61.70
86	930715	E	069	##########	N		50	1	RA	N	62.10
87	930715	E	069	##########	N		50	1	RA	N	62.10
88	930715	E	118	CP-1	N		110	15	RA	N	70.50
89	930715	E	118	CP-1	N		106	10	RA	N	70.50
90	930715	E	119	##########	N		42	1	RA	N	70.70
91	930715	E	120	##########	N		57	1	RA	N	70.90
92	930715	N	062	7F7D256D01	Y	PITTAG	370	418	RS	N	61.15
93	930715	N	062	7F7F196371	Y	PITTAG	386	420	RS	N	61.15
94	930715	N	062	7F7D293C39	Y	PITTAG	417	594	RS	N	61.15
95	930715	N	062	7F7B024455	N		349	373	RS	N	61.15
96	930715	N	062	7F7B015053	Y	PITSCAR	369	494	RS	N	61.15
97	930715	N	062	7F7B034F4C	N		201	86	RA	N	61.15
98	930715	N	064	7F7D40087B	N		322	270	RA	N	61.15
99	930715	N	064	7F7F284B09	Y	PITTAG	340	410	RA	N	61.15
100	930715	N	065	7F7B026829	N		211	105	RA	N	60.95
101	930715	N	066	7F7F2B7C12	Y	PITTAG	395	572	RA	N	61.15
102	930715	N	066	7F7D180455	Y	PITTAG	305	282	RA	N	61.15
103	930715	N	066	7F7D177E1C	Y	PITTAG	327	309	RA	N	61.15
104	930715	N	066	7F7F3E3C5C	Y	PITTAG	408	632	RN	Y	61.15
105	930715	N	066	7F7F213D47	Y	PITTAG	393	530	RA	N	61.15

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
106	930715	N	066	7F7F272830	Y	PITTAG	320	260	RA	N	61.15
107	930715	N	066	7F7D3B1A3D	Y	PITTAG	210	96	RA	N	61.15
108	930715	N	066	7F7D40182C	N		227	123	RA	N	61.15
109	930715	N	066	7F7B025912	N		415	654	RA	N	61.15
110	930715	N	066	7F7D44106C	N		378	455	RA	N	61.15
111	930715	N	066	7F7B02160C	N		385	498	RA	N	61.15
112	930715	N	068	7F7D2B331F	Y	PITTAG	390	489	RA	N	60.90
113	930715	N	110	1F1F707161	N		342	430	RA	N	119.00
114	930715	N	129	1F0F756C71	N		285	265	RA	N	119.00
115	930715	T	099	DP-1	N		48	1	RA	N	62.35
116	930715	T	099	DP-1	N		52	1	RA	N	62.35
117	930715	T	100	DP-1	N		51	1	RA	N	62.35
118	930715	T	108	DP-1	N		124	18	RA	N	60.90
119	930715	T	146	DP-1	N		57	1	RA	N	62.35
120	930715	T	146	DP-1	N		53	1	RA	N	62.35
121	930715	T	161	DP-1	N		51	1	RA	N	61.40
122	930715	T	161	DP-1	N		52	1	RA	N	61.40
123	930715	T	162	DP-1	N		50	1	RA	N	61.40
124	930715	T	165	DP-1	N		62	1	RA	N	61.40
125	930716	E	074	7F7B081802	Y	PITTAG	315	0	RA	N	60.20
126	930716	E	074	1F20180128	N		193	71	RA	N	60.20

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
127	930716	E	074	7F7D226369	Y	PITTAG	185	50	RA	N	60.20
128	930716	E	074	1F20150329	N		152	27	RA	N	60.20
129	930716	E	074	##########	Y	LPLC	144	19	RA	N	60.20
130	930716	N	070	7F7D225848	Y	PITTAG	368	444	RA	N	60.90
131	930716	N	070	7F7D18196F	Y	PITTAG	367	441	RA	N	60.90
132	930716	N	070	7F7F291869	Y	PITTAG	385	476	RA	N	60.90
133	930716	N	070	7F7D180568	Y	PITTAG	356	449	RA	N	60.90
134	930716	N	071	7F7D3C4558	N		436	730	RA	N	61.20
135	930716	N	075	7F7D2A4465	Y	PITTAG	389	436	RA	N	61.25
136	930716	N	077	7F7D47335F	Y	PITTAG	238	119	RA	N	61.95
137	930716	N	078	7F7F3E494D	Y	PITTAG	400	522	RA	N	61.50
138	930716	N	079	7F7D2B4232	Y	PITTAG	360	358	RA	N	61.70
139	930716	N	079	7F7F28784B	Y	PITTAG	332	271	RA	N	61.70
140	930716	N	079	7F7F2D1E67	Y	PITTAG	349	390	RA	N	61.70
141	930716	N	081	7F7D224E3B	Y	PITTAG	360	355	RA	N	61.95
142	930716	N	081	7F7D295823	Y	PITTAG	235	100	RA	N	61.95
143	930716	N	081	7F7D2B2E19	Y	PITTAG	241	107	RA	N	61.95
144	930716	N	081	7F7D177059	Y	PITTAG	202	86	RA	N	61.95
145	930716	N	081	7F7D3F7C40	N		234	104	RA	N	61.95
146	930716	N	082	7F7F273416	Y	PITTAG	332	309	RA	N	62.10
147	930716	N	084	7F7D2B1C10	Y	PITTAG	363	355	RA	N	61.70

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
148	930716	N	084	7F7D17616A	Y	PITTAG	381	382	RA	N	61.70
149	930716	N	147	7F7F1F1508	Y	PITTAG	232	122	RA	N	127.50
150	930716	N	147	7F7F264B5A	Y	PITTAG	357	608	RS	N	127.50
151	930716	S	008	##########	N		42	1	RA	N	62.70
152	930716	S	008	##########	N		43	1	RA	N	62.70
153	930716	S	008	##########	N		51	1	RA	N	62.70
154	930716	S	008	##########	N		42	1	RA	N	62.70
155	930716	S	008	##########	N		40	1	RA	N	62.70
156	930716	T	151	DP-1	N		60	1	RA	N	62.35
157	930716	T	154	DP-1	N		57	1	RA	N	62.35
158	930716	T	181	DP-1	N		60	1	RA	N	62.35
159	930716	T	181	DP-1	N		50	1	RA	N	62.35
160	930716	T	181	DP-1	N		55	1	RA	N	62.35
161	930716	T	181	DP-1	N		50	1	RA	N	62.35
162	930716	T	182	DP-1	N		48	1	RA	N	62.35
163	930716	T	182	DP-1	N		49	1	RA	N	62.35
164	930716	T	193	DP-1	N		67	2	RA	N	61.95
165	930717	E	077	##########	N		123	21	RA	N	61.20
166	930717	E	080	DP-1	N		87	4	RA	N	64.60
167	930717	E	080	DP-1	N		131	21	RA	N	64.60
168	930717	E	081	DP-1	N		105	12	RA	N	65.00

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
169	930717	E	081	##########	N		67	1	RA	N	65.00
170	930717	E	082	##########	N		50	1	RA	N	64.70
171	930717	E	083	DP-1	N		106	6	RA	N	65.10
172	930717	E	083	DP-1	N		135	14	RA	N	65.10
173	930717	E	083	DP-1	N		120	14	RA	N	65.10
174	930717	E	083	##########	N		52	1	RA	N	65.10
175	930717	E	083	##########	N		49	1	RA	N	65.10
176	930717	E	083	##########	N		44	1	RA	N	65.10
177	930717	E	083	##########	N		57	1	RA	N	65.10
178	930717	E	084	DP-1	N		103	8	RA	N	65.20
179	930717	E	084	##########	N		60	1	RA	N	65.20
180	930717	E	084	##########	N		51	1	RA	N	65.20
181	930717	E	084	DP-1	N		91	3	RA	N	65.20
182	930717	E	084	DP-1	N		96	13	RA	N	65.20
183	930717	E	084	##########	N		46	1	RA	N	65.20
184	930717	E	084	1F20520B64	N		180	39	RA	N	65.20
185	930717	E	084	DP-1	N		99	7	RA	N	65.20
186	930717	E	085	7F7B023868	Y	PITTAG	383	548	RA	N	65.25
187	930717	E	085	7F7D1B7A32	Y	PITTAG	404	542	RA	N	65.25
188	930717	E	085	7F7D183247	Y	PITTAG	358	389	RA	N	65.25
189	930717	E	085	7G7G331N17	Y	PITTAG	360	428	RA	N	65.25

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
190	930717	E	085	7G7F173S5F	Y	PITTAG	357	358	RA	N	65.25
191	930717	E	085	1F200D456F	N		182	0	RA	N	65.25
192	930717	E	085	##########	N		42	0	RA	N	65.25
193	930717	E	085	DP-1	N		107	9	RA	N	65.25
194	930717	E	085	##########	N		35	1	RA	N	65.25
195	930717	E	085	##########	N		49	1	RA	N	65.25
196	930717	E	085	##########	N		43	1	RA	N	65.25
197	930717	E	117	##########	N		43	1	RA	N	70.30
198	930717	N	086	7F7B025433	N		194	70	RA	N	64.50
199	930717	N	086	7F7B035F2F	N		206	83	RA	N	64.50
200	930717	N	088	7F7F2D1172	Y	PITTAG	354	394	RS	N	63.30
201	930717	N	088	7F7F2D4C15	Y	PITTAG	375	497	RS	N	63.30
202	930717	N	088	7F7B080B61	N		360	434	RS	N	63.30
203	930717	N	090	7F7D3C5027	N		209	89	RA	N	64.50
204	930717	N	091	7F7F323A42	Y	PITTAG	346	310	RA	N	63.30
205	930717	N	094	7F7D181B0E	Y	PITTAG	385	481	RA	N	64.50
206	930717	N	159	1F0F60767C	N		184	69	RA	N	127.50
207	930717	N	167	7F7B1E6C70	N		204	88	RA	N	127.60
208	930717	T	257	DP-1	N		46	1	RA	N	63.50
209	930717	T	262	DP-1	N		51	1	RA	N	64.05
210	930717	T	262	DP-1	N		55	1	RA	N	64.05

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
211	930717	T	271	DP-1	N		61	2	RA	N	65.40
212	930717	T	274	DP-1	N		50	1	RA	N	65.40
213	930717	T	275	DP-1	N		51	1	RA	N	65.40
214	930717	T	281	DP-1	N		89	7	RA	N	63.45
215	930717	T	283	DP-1	N		50	1	RA	N	63.45
216	930717	T	283	DP-1	N		52	1	RA	N	63.45
217	930717	T	286	DP-1	N		59	2	RA	N	63.50
218	930717	T	287	DP-1	N		74	3	RA	N	63.50
219	930717	T	287	DP-1	N		51	1	RA	N	63.50
220	930717	T	289	DP-1	N		55	1	RA	N	63.50
221	930717	T	291	DP-1	N		88	4	RA	N	64.05
222	930717	T	291	DP-1	N		87	4	RA	N	64.05
223	930717	T	293	DP-1	N		58	1	RA	N	64.05
224	930717	T	293	DP-1	N		59	1	RA	N	64.05
225	930717	T	294	DP-1	N		53	1	RA	N	64.05
226	930717	T	296	DP-1	N		59	1	RA	N	64.55
227	930717	T	297	DP-1	N		97	7	RA	N	64.55
228	930717	T	297	DP-1	N		64	2	RA	N	64.55
229	930717	T	307	##########	N		50	1	RA	N	63.10
230	930717	T	309	##########	N		44	1	RA	N	63.10
231	930718	E	056	7F7D084B48	N		190	60	RA	N	125.80

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
232	930718	E	086	DP-1	N		88	8	RA	N	63.50
233	930718	E	086	DP-1	N		113	10	RA	N	63.50
234	930718	E	086	##########	N		44	1	RA	N	63.50
235	930718	E	086	##########	N		44	1	RA	N	63.50
236	930718	E	086	##########	N		49	1	RA	N	63.50
237	930718	E	086	##########	N		47	1	RA	N	63.50
238	930718	E	086	DP-1	N		82	3	RA	N	63.50
239	930718	E	086	DP-1	N		88	6	RA	N	63.50
240	930718	E	086	DP-1	N		92	5	RA	N	63.50
241	930718	E	088	DP-1	N		111	17	RA	N	63.50
242	930718	E	089	##########	N		55	1	RA	N	63.70
243	930718	E	089	##########	N		50	1	RA	N	63.70
244	930718	E	089	##########	N		52	1	RA	N	63.70
245	930718	E	089	##########	N		48	1	RA	N	63.70
246	930718	E	089	##########	N		48	1	RA	N	63.70
247	930718	E	089	##########	N		41	1	RA	N	63.70
248	930718	E	089	##########	N		42	1	RA	N	63.70
249	930718	E	089	##########	N		41	1	RA	N	63.70
250	930718	E	090	DP-1	N		85	8	RA	N	63.90
251	930718	E	090	DP-1	N		111	16	RA	N	63.90
252	930718	E	091	##########	N		42	1	RA	N	64.00

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
253	930718	E	091	##########	N		52	1	RA	N	64.00
254	930718	E	091	DP-1	N		93	6	RA	N	64.00
255	930718	N	095	7F7F39614C	Y	PITTAG	353	361	RS	N	61.80
256	930718	N	095	7F7B081073	Y	PITTAG	369	464	RS	N	61.80
257	930718	N	102	7F7F183539	Y	PITTAG	359	458	RS	N	65.20
258	930718	N	181	1FDC6F0165	Y	PITTAG	220	125	RA	N	127.50
259	930718	N	192	1F20183B6E	N		267	189	RS	N	127.60
260	930718	N	197	1F20393553	N		281	240	RS	N	127.60
261	930718	S	011	##########	N		48	1	RA	N	64.50
262	930718	S	011	##########	N		41	1	RA	N	64.50
263	930718	S	011	##########	N		34	1	RA	N	64.50
264	930718	S	012	##########	N		42	1	RA	N	63.70
265	930718	T	313	DP-1	N		84	4	RA	N	63.45
266	930718	T	314	DP-1	N		47	1	RA	N	64.45
267	930718	T	314	##########	N		55	1	RA	N	63.45
268	930718	T	314	##########	N		56	1	RA	N	63.45
269	930718	T	314	##########	N		80	3	RA	N	63.45
270	930718	T	315	DP-1	Y	DP-1	71	2	RA	N	63.45
271	930718	T	317	##########	N		52	1	RA	N	63.50
272	930718	T	319	##########	N		54	1	RA	N	63.50
273	930718	T	321	##########	N		58	1	RA	N	65.40

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
316	930719	T	402	DP-1	N		100	7	RA	N	63.45
317	930719	T	403	##########	N		60	2	RA	N	63.45
318	930719	T	405	##########	N		54	1	RA	N	63.45
319	930719	T	418	DP-1	N		86	5	RA	N	64.35
320	930720	E	098	CP-1	N		124	17	RA	N	66.40
321	930720	E	100	CP-1	N		102	13	RA	N	66.90
322	930720	E	100	##########	N		44	1	RA	N	66.90
323	930720	E	100	##########	N		49	1	RA	N	66.90
324	930720	E	102	##########	N		48	1	RA	N	67.15
325	930720	E	102	##########	N		52	1	RA	N	67.15
326	930720	E	103	##########	N		100	8	RA	N	67.30
327	930720	E	103	##########	N		50	1	RA	N	67.30
328	930720	E	103	##########	N		40	1	RA	N	67.30
329	930720	N	240	7F7F1F1B05	Y	PITTAG	235	116	RA	N	127.60
330	930720	T	150	UCP	N		76	4	RA	N	126.10
331	930720	T	150	UCP	N		68	3	RA	N	126.10
332	930720	T	427	##########	N		50	1	RA	N	67.15
333	930720	T	447	##########	N		50	1	RA	N	67.85
334	930720	T	451	DP-1	N		94	5	RA	N	67.15
335	930720	T	453	DP-1	N		94	5	RA	N	67.15
336	930720	T	454	DP-1	N		112	10	RA	N	67.15

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
337	930720	T	475	DP-1	N		109	10	RA	N	67.95
338	930720	T	508	##########	N		53	1	RA	N	67.15
339	930720	T	509	##########	N		49	1	RA	N	67.15
340	930720	T	512	##########	N		45	1	RA	N	67.05
341	930720	T	512	##########	N		54	1	RA	N	67.05
342	930720	T	517	##########	N		61	1	RA	N	67.95
343	930720	T	519	##########	N		54	1	RA	N	67.95
344	930721	E	104	CP-1	N		103	5	RA	N	67.00
345	930721	E	104	##########	N		46	1	RA	N	67.00
346	930721	E	105	##########	N		37	1	RA	N	67.40
347	930721	E	107	##########	N		47	1	RA	N	67.80
348	930721	E	107	##########	N		52	1	RA	N	67.80
349	930721	E	109	##########	N		59	1	RA	N	68.00
350	930721	E	111	##########	N		58	1	RA	N	68.20
351	930721	E	111	##########	N		85	4	RA	N	68.20
352	930721	E	112	CP-1	N		100	7	RA	N	68.40
353	930721	E	112	CP-1	N		100	9	RA	N	68.40
354	930721	E	112	CP-1	N		52	1	RA	N	68.40
355	930721	E	112	CP-1	N		114	13	RA	N	68.40
356	930721	E	112	CP-1	N		118	15	RA	N	68.40
357	930721	E	113	##########	N		44	1	RA	N	68.40

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
358	930721	E	113	##########	N		50	1	RA	N	68.40
359	930721	E	113	##########	N		46	1	RA	N	68.40
360	930721	E	113	##########	N		43	1	RA	N	68.40
361	930721	E	113	##########	N		47	1	RA	N	68.40
362	930721	E	113	##########	N		52	1	RA	N	68.40
363	930721	E	113	##########	N		53	1	RA	N	68.40
364	930721	E	113	##########	N		46	1	RA	N	68.40
365	930721	E	113	##########	N		52	1	RA	N	68.40
366	930721	E	113	##########	N		46	1	RA	N	68.40
367	930721	N	119	7F7F183B78	Y	PITTAG	400	486	RA	N	66.90
368	930721	N	119	7F7F214D20	N		419	705	RA	N	66.90
369	930721	S	015	##########	N		51	1	RA	N	67.90
370	930721	S	015	##########	N		46	1	RA	N	67.90
371	930721	S	015	##########	N		48	1	RA	N	67.90
372	930721	S	015	##########	N		54	1	RA	N	67.90
373	930721	S	015	##########	N		43	1	RA	N	67.90
374	930721	S	015	##########	N		51	1	RA	N	67.90
375	930721	S	015	##########	N		52	1	RA	N	67.90
376	930721	S	015	##########	N		49	1	RA	N	67.90
377	930721	S	015	##########	N		39	1	RA	N	67.90
378	930721	S	015	##########	N		55	1	RA	N	67.90

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
379	930721	S	015	##########	N		51	1	RA	N	67.90
380	930721	S	015	##########	N		57	1	RA	N	67.90
381	930721	S	015	##########	N		53	1	RA	N	67.90
382	930721	S	015	##########	N		50	1	RA	N	67.90
383	930721	S	015	##########	N		58	1	RA	N	67.90
384	930721	S	015	##########	N		50	1	RA	N	67.90
385	930721	T	457	DP-1	N		76	4	RA	N	67.05
386	930721	T	466	##########	N		59	1	RA	N	67.95
387	930721	T	467	##########	N		46	1	RA	N	67.95
388	930721	T	471	##########	N		49	1	RA	N	67.15
389	930721	T	481	##########	N		54	1	RA	N	67.15
390	930721	T	482	##########	N		51	1	RA	N	67.15
391	930721	T	482	##########	N		47	1	RA	N	67.15
392	930721	T	495	##########	N		47	1	RA	N	67.95
393	930721	T	524	##########	N		49	1	RA	N	67.95
394	930722	E	114	##########	N		40	1	RA	N	69.60
395	930722	E	114	##########	N		45	1	RA	N	69.60
396	930722	E	115	CP-1	N		99	11	RA	N	70.00
397	930722	E	115	CP-1	N		101	9	RA	N	70.00
398	930722	E	115	CP-1	N		98	10	RA	N	70.00
399	930722	E	115	CP-1	N		80	5	RA	N	70.00

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
400	930722	E	115	##########	N		57	1	RA	N	70.00
401	930722	E	115	##########	N		49	1	RA	N	70.00
402	930722	E	115	##########	N		46	1	RA	N	70.00
403	930722	E	116	##########	N		42	1	RA	N	70.20
404	930722	E	116	##########	N		47	1	RA	N	70.20
405	930722	E	116	##########	N		51	1	RA	N	70.20
406	930722	E	116	##########	N		50	1	RA	N	70.20
407	930722	E	116	##########	N		51	1	RA	N	70.20
408	930722	E	116	##########	N		35	1	RA	N	70.20
409	930722	E	116	##########	N		46	1	RA	N	70.20
410	930722	E	116	##########	N		37	1	RA	N	70.20
411	930722	E	117	##########	N		43	1	RA	N	70.30
412	930722	E	121	1F2023326C	N		177	33	RA	N	71.00
413	930722	E	121	CP-1	N		76	2	RA	N	71.00
414	930722	E	122	##########	N		43	1	RA	N	71.20
415	930722	E	122	##########	N		38	1	RA	N	71.20
416	930722	E	122	##########	N		45	1	RA	N	71.20
417	930722	E	122	##########	N		45	1	RA	N	71.20
418	930722	E	122	1F166E0B52	N		174	54	RA	N	71.20
419	930722	S	018	##########	N		41	1	RA	N	70.40
420	930722	T	547	##########	N		54	1	RA	N	70.50

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
421	930722	T	548	##########	N		55	1	RA	N	70.50
422	930722	T	552	##########	N		55	1	RA	N	71.05
423	930722	T	554	##########	N		51	1	RA	N	71.05
424	930722	T	576	##########	N		47	1	RA	N	71.05
425	930722	T	578	DP-1	N		85	5	RA	N	71.05
426	930722	T	580	DP-1	N		94	6	RA	N	71.05
427	930723	E	123	##########	N		49	1	RA	N	71.20
428	930723	E	123	CP-1	N		60	2	RA	N	71.20
429	930723	E	124	CP-1	N		85	4	RA	N	72.00
430	930723	E	124	##########	N		51	1	RA	N	72.00
431	930723	E	124	##########	N		49	1	RA	N	72.00

Table 5. A list of radio frequencies contacted on Trip 7, 1993 and locations relative to capture and release sites.

			--------River Mile--------		
FREQ/PULSE	TAG SIZE (g)	DATE (time)	CAPTURE	RELEASE	LOCATE
40.730/40 /32	11	930319 930716	127.5	127.5	126.2

CHARACTERIZATION OF THE LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE GRAND CANYON

TRIP REPORT 7 - 1993
July 8 - 27, 1993

Prepared For:

Bureau of Reclamation

Prepared By:

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William Masslich, Project Leader
William Leibfried, Project Leader

BIO/WEST INC.
1063 West 1400 North
Logan, UT. 84321

August 6, 1993

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INTRODUCTION

This report presents pertinent details associated with Trip 7, 1993. Included in the report are a summary of trip logistics, personnel and research schedule, data collected, problems encountered, pertinent observations and recommendations. Most information is presented in a tabular format to provide a quick synopsis of trip details and results. We emphasize that these data are hand tabulated to provide these synopses as soon as possible. The data are later computerized and checked for accuracy. The purpose of these trip reports is to provide information from BIO/WEST trips as quickly as possible to aid other researchers.

LOGISTICS, RESEARCH SCHEDULE AND PERSONNEL

Table 1 presents a summary of logistics and the research schedule for Trip 7, 1993. Table 2 is a list of personnel who were present or participated in research activities for Trip 7, 1993.

DATA COLLECTED

Table 3 is a summary of gear types used, sampling effort and fish captured by gear type for Trip 7, 1993. Table 4 is a summary of all humpback chubs handled during Trip 7, 1993. Table 5 summarizes the radio contacts during Trip 7, 1993 and presents original fish release locations and radiotag data.

Humpback Chubs Captured

A total of 431 humpback chub were captured during Trip 7, 1993 including 247 young-of-year (YOY)(<65 mm), 90 juveniles (66-199 mm TL), and 94 adults (>199 mm TL). No chub were captured in Reach 0. In Reach 1, a total of 409 humpback chubs were captured including 246 YOY, 85 juveniles and 78 adults. Forty YOY were captured with seines. One hundred eighty-seven chubs, including 15 adults, 58 juveniles and 114 YOY were captured electrofishing. Netting produced 66 humpback chub including 63 adults and 3 juveniles. One hundred sixteen chubs were also captured in unbaited minnow traps including 24 juveniles and 92 YOY.

Of the 78 adult humpback chub captured in Reach 1, 60 (or 77%) were PIT-tagged recaptures (includes those captured and marked by other investigators). This represents the second highest recapture rate observed by BIO/WEST for adult humpback chubs in Reach 1. Other high recapture rates were observed in 1993, including 80% in January, 75% in February, 68% in March, 60% in April, 66% in May and 75% in June.

Twenty-two humpback chubs were captured in Reach 2 during Trip 7, 1993 including 16 adults and five juveniles and one YOY. Fifteen adults and 1 juvenile were captured in nets. One adult and two juveniles were captured electrofishing and one YOY and 2 juveniles were captured in unbaited minnow traps. Of these 17 adult chubs, 7 were recaptures of previously tagged fish. All were captured near their original capture location. Seventeen of these fish were captured between RM 126 and 128. No chubs were captured in Reach 3.

Stomach contents of 20 humpback chubs, 15 in Reach 1 and 5 in Reach 2, were collected using non-lethal stomach pumping techniques.

One YOY humpback chub captured electrofishing at RM 75.1 on July 13 was discovered dead in the live well at the end of the electrofishing run. The fish was missing an eye and based on its overall appearance was assumed to be either dead or in very poor condition prior to capture. The fish measured 64 mm TL and weighed 2 grams. The carcass was preserved for transport to Flagstaff and will be transferred to AGF as soon as possible.

Observed Condition of Humpback Chub

All chubs captured with the exception of one juvenile captured at RM 68.3 appeared healthy and in good condition. The juvenile captured at RM 68.3 had a distended abdomen and appeared slightly malnourished, possibly as a result of a tapeworm infestation. The fish was released at the point of capture.

Non-lethal stomach pumping of 15 humpback chubs indicated that tapeworms were present in approximately 33% of the fish that were successfully evacuated.

Radiotelemetry

No humpback chubs were implanted during Trip 7 1993.

One radio-implanted chub from the Middle Granite Gorge was located by radiotelemetry during Trip 7, 1993. The fish (40.730) was located during a routine surveillance run on July 16 at RM 126.2. This was the only contact with the fish during the four days of telemetry surveillance. It is assumed that the transmitter expired.

Both remote telemetry stations were downloaded successfully during Trip 7, 1993. These data show upstream movement by 40.730 about one week prior to arrival of the B/W crew to the Middle Granite Gorge area this month.

Habitat Mapping

Juvenile habitat mapping was conducted in seventeen locations between the confluence of the LCR and Tanner Rapid.

Bench Marks

No new bench marks were established during Trip 7, 1993.

OBSERVATIONS

1. Main channel turbidities were low for the duration of Trip 7, 1993. Daily increases in fluctuations in turbidity associated with bed load disturbance from peak flows were observed during most days. Turbidities ranged from 7 to 35 NTU's during a flow cycle, with highest turbidities observed during the descending limb of the hydrograph soon after peak flow.

2. High densities of YOY humpback chub were observed in the main channel from the confluence of the LCR (RM 61.3) to Nevill's Rapid (RM 75.3) during Trip 7, 1993. YOY humpback were captured in nearly all shoreline types by electrofishing, seining and minnow trapping. Highest catch rates were along shoreline types including talus, debris flows and vegetated cutbanks. Shoreline types such as sand beaches and shear walls yielded lower catch rates. Based on observations of movement and transport of YOY and juvenile chub from the LCR into the main channel during previous years, the presence of such high numbers of YOY humpback chub in the main channel during Trip 7 is anomalous. During previous years dramatic increases in numbers of YOY and juvenile humpback chub in the main channel were generally associated with a flood event in the LCR. No such event has occurred in the LCR following the spring runoff which ended in late April-early May. Since that time the LCR has run at base flow. It is speculated that movement of these young fish may be associated with one or a combination of the following factors:

   a) Flood events during January and February of 1993 scoured the LCR channel possibly increasing availability of suitable spawning habitat for humpback chub and resulted in an exceptionally successful spawn. Unusually high numbers of YOY chubs in the main channel may be reflective of normal emigration associated with very high densities of fish in the LCR.

   b) Scouring of the LCR by unusually high winter and early spring flows appear to have resulted in unusually high water clarity in the LCR during June and July. It is possible that high water clarity in the LCR may be unsuitable for YOY humpback chub resulting in emigration into the main channel.

   c) Scouring of the LCR as described above may have temporarily altered benthic and planktonic communities resulting in decreased food availability for high numbers of YOY fish in the system again resulting in emigration into the main channel.

3. Water clarity in the LCR was unusually high in July. Numerous YOY humpback chubs (ranging from approximately 30 to 60 mm) were observed while snorkeling in the lower one kilometer. Several juvenile and one adult humpback chub were also observed and photographed. Numerous channel catfish and carp were also observed and photographed.

4. Two brown trout were captured in Reach 1 during Trip 7, 1993, one at RM 62.1 and one at 68.4. Both browns were captured in conjunction with high numbers of YOY and juvenile humpback chub and were sacrificed for stomach content analysis. A total of 6 humpback chubs were found in the stomach contents of both fish (2 in one fish and 4 in the other) averaging 94 mm standard length, with a range of 78-120 mm. A total length of 162 mm was measured for one of the chubs that was freshly ingested.

5. All rainbow trout captured in conjunction with YOY humpback chub were sacrificed for stomach analysis. Fish remains were tentatively identified in the stomach of three of these fish and preserved for lab identification.

6. Unbaited minnow traps were very effective at catching YOY and juvenile humpback chub during Trip 7. Humpback chubs were captured in a variety of shoreline types including sheer wall, boulder talus, boulder debris fans and vegetated cut banks. High catch rates in minnow traps across habitat types suggest that densities of both YOY and juvenile humpback chubs were very high in the main channel during Trip 7, 1993.

7. Two small chub, 76 and 68 mm TL were captured in minnow traps at RM 126.1. This is the first collection of chub this small from the Middle Granite Gorge area.

8. Thirty-two percent of chubs captured in Reach 2 were recaptures of previously PIT tagged fish.

9. The seven recaptured chubs from the Middle Granite Gorge were from the same locale as originally captured. This along with previous recapture data from this site suggest an aggregation or small population of chubs utilizing this area.

10. Mainstem river warming was apparent during Trip 7, 1993. River temperatures were 14.5 °C at RM 143 and 16.5 °C at RM 214.

11. Fifteen striped bass were captured during Trip 7, 1993. Six were caught in nets above Kanab Creek in Reach 2. In Reach 3, 9 bass were captured by both electrofishing and netting. Sites below Havasu Creek and at RM 214 produced striped bass. These fish were mostly non-reproductive males between 1 and 2 pounds. The capture of these fish follows the observed trend of summer movements by striped bass seen on previous trips during the past two years.

PROBLEMS ENCOUNTERED AND SOLUTIONS

1. One PIT tagger was malfunctioning during Trip 7, 1993. some sampling efficiency was lost by having shuttle fish to be PIT tagged. this instrument will be serviced as soon as possible.

RECOMMENDATIONS

1. We recommend continued and enhanced coordination among the researchers in Grand Canyon. This coordination is essential to insure that all researchers are aware of others activities.

Table 1. Logistics and Research Schedule for Trip 7, 1993, Team 1.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
7/08	2.8	Cathedral Wash	X	X		
7/09	2.8	Cathedral Wash		X		
7/10	30.2	Near South Canyon	X	X		
7/11	30.2	Near South Canyon		X		
7/12	58.2	Awatubi	X	X		
7/13	58.2	Awatubi		X		
7/14	61.2	LCR	X	X		
7/15	61.2	LCR		X		
7/16	61.2	LCR		X		
7/17	65.4	Lava Chuar	X	X		X
7/18	65.4	Lava Chuar		X		X
7/19	65.4	Lava Chuar		X		X
7/20	67.8	Near Tanner Canyon	X	X		X
7/21	67.8	Near Tanner Canyon		X		X
7/22	71.0	Cardenas	X	X		
7/23	89.3	Below Pipe Creek	X	X		
7/24		Travel	X			
7/25		Travel	X			
7/26	214	214 Mile	X			
7/27	225	Diamond Creek	X			

[1]T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 1. Logistics and Research Schedule for Trip 7, 1993, Team 2.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
7/08	30.3	Fence Fault	X			
7/09	75.3	75 Mile Creek	X	X		
7/10	75.3	75 Mile Creek		X		
7/11	75.3	75 Mile Creek		X		
7/12	91.2	91 Mile Creek	X	X		
7/13	91.2	91 Mile Creek		X		
7/14	119.5	119.5	X	X		
7/15	119.5	119.5		X		
7/16	126.4	Randy's Rock	X	X	X	
7/17	126.4	Randy's Rock		X	X	
7/18	126.4	Randy's Rock		X	X	
7/19	126.4	Randy's Rock		X	X	
7/20	143.3	Across from Kanab	X	X		
7/21	143.3	Across from Kanab		X		
7/22	161	Below Havasu	X	X		
7/23	161	Below Havasu		X		
7/24	198	Parashout	X			
7/25	214.1	214 Mile Creek	X	X		
7/26	214.1	214 Mile Creek		X		
7/27	225.7	Diamond Creek	X			

[1]T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 2. Personnel Participating in Trip 7, 1993.

PERSONNEL	AFFILIATION	DATES	COMMENTS
Team 1			
B. Masslich	BIO/WEST	7/8 - 7/24	Project Leader
T. Wasowicz	BIO/WEST	7/8 - 7/24	Senior Biologist
C. Heck	BIO/WEST	7/8 - 7/24	Out Bright Angel
D. Hickman	BIO/WEST	7/8 - 7/24	Out Bright Angel
P. Trater	BIO/WEST	7/8 - 7/24	Out Bright Angel
C. Jensen	BIO/WEST VOLUNTEER	7/8 - 7/27	
P. Metz	BIO/WEST VOLUNTEER	7/8 - 7/24	Out Bright Angel
G. Miner	BIO/WEST VOLUNTEER	7/8 - 7/24	Out Bright Angel
S. Reeder	OARS	7/8 - 7/24	Trip Leader
C. Krznarich	OARS	7/8 - 7/27	
T. Jones	OARS	7/8 - 7/27	
Team 2			
B. Leibfried	BIO/WEST	7/8 - 7/23	Project Leader/Out Havasu
E. Prats	BIO/WEST	7/8 - 7/27	Senior Biologist
J. Mansour	BIO/WEST	7/8 - 7/27	
M. Murov	BIO/WEST	7/8 - 7/27	
P. Weiss	BIO/WEST	7/8 - 7/27	
J. Weiss	GCES	7/8 - 7/27	Biologist
C. Valentine	BOR	7/8 - 7/27	Biologist
P. Kelsey	BIO/WEST VOLUNTEER	7/8 - 7/27	
J. Pomeroy	BIO/WEST VOLUNTEER	7/8 - 7/27	
P. Gaudet	BIO/WEST VOLUNTEER	7/8 - 7/27	
T. Deutschlander	OARS	7/8 - 7/27	Trip Leader
S. Plassman	OARS	7/8 - 7/27	
K.C. Deutschlander	OARS	7/8 - 7/27	

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 7, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	FMxBH	SU	FH	SB
Electrofishing Reach 0 N=32	A		17		68			8	2				
	J				15								
	Y				3								
Electrofishing Reach 1 N=84	A	15	11	2	138	2		14	24	1		5	
	J	58	1		18			1					
	Y	114		1	16								
Electrofishing Reach 2 N=60	A	1	9	4	51	12		22	2			1	
	J	2	3	1	10	3							
	Y			1	1								
Electrofishing Reach 3 N=20	A		1		1	1		27	3				7
	J		1		3								
	Y												
Nets Reach 0 N=35	A		2		23								
	J												
	Y												
Nets Reach 1 N=90	A	63	26	8	22	1							
	J	3											
	Y												
Nets Reach 2 N=234	A	15	38	3	5	14		5					6
	J	1											
	Y												

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 7, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	FMxBH	SU	FH	SB
Nets Reach 3 N=60	A		7	1			7	5					2
	J												
	Y												
Traps Reach 1 N=580	A								8			2	
	J	24			1				1				
	Y	92	1	1	3								
Traps Reach 2 N=123	A			1					11			1	
	J	2											
	Y	1						1					
Traps Reach 3 N=15	A												
	J						No Fish						
	Y												
Seines Reach 1 N=15	A		3		2			1				7	
	J		1										
	Y	40	75	15					16		1	3	
Seines Reach 2 N=8	A											1	
	J			2									
	Y			1									
Totals	A	94	114	19	310	30	7	82	50	1	0	17	15
	J	90	6	3	47	3	0	1	1	0	0	0	0
	Y	247	76	19	23	0	0	1	16	0	1	3	0
	T	431	196	41	380	33	7	84	67	1	1	20	15

[2] - A = Adult
J = Juvenile
Y = Young of year

[3] - HB = humpback chub
FM = flannelmouth sucker
BH = bluehead sucker
RB = rainbow trout
BR = brown trout
CC = channel catfish
CP = carp
SD = speckled dace
FMxBH = flannelmouth sucker bluehead hybrid
SU = unidentified sucker
FH = fathead minnow
SB = striped bass

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
1	930710	S	001	##########	N		31	0	RA	N	75.30
2	930710	S	002	##########	N		45	0	RA	N	75.30
3	930710	S	002	##########	N		47	0	RA	N	75.30
4	930710	S	004	##########	N		51	0	RA	N	75.30
5	930710	T	018	##########	N		51	0	RA	N	75.00
6	930710	T	030	##########	N		46	0	RA	N	75.20
7	930710	T	030	##########	N		48	0	RA	N	75.20
8	930710	T	030	##########	N		48	0	RA	N	75.20
9	930711	E	006	##########	N		55	3	RA	N	74.50
10	930711	E	011	7F7B035268	Y	PITTAG	184	50	RA	N	74.60
11	930711	N	042	7F7F1F104D	N		265	180	RA	N	75.00
12	930711	N	042	LCP	N		140	25	RA	N	75.00
13	930711	N	042	LCP	N		127	16	RA	N	75.00
14	930711	N	044	1F201D3272	N		218	107	RA	N	75.20
15	930711	S	013	##########	N		54	0	RA	N	75.60
16	930711	S	013	##########	N		47	0	RA	N	75.60
17	930711	S	013	##########	N		47	0	RA	N	75.60
18	930711	S	013	##########	N		53	0	RA	N	75.60
19	930712	E	012	##########	N		76	3	RA	N	74.80
20	930712	E	012	##########	N		50	1	RA	N	74.80
21	930712	E	013	##########	N		45	1	RA	N	74.90

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
22	930712	E	016	7F7F26547A	N		215	103	RA	N	90.60
23	930712	E	016	UCP	N		126	18	RA	N	90.60
24	930712	E	036	1F1F720050	N		200	67	RA	N	58.50
25	930712	E	038	1F20094276	N		222	98	RA	N	58.85
26	930712	E	038	1F20132509	N		151	30	RA	N	58.85
27	930712	E	038	7F20193A7E	N		408	583	RA	N	58.85
28	930712	E	038	7F7D180413	Y	PITTAG	393	544	RA	N	58.85
29	930712	E	038	7F7D177F6B	Y	PITTAG	353	368	RA	N	58.85
30	930712	E	038	7F7F191C48	Y	PITTAG	350	426	RA	N	58.85
31	930712	E	038	7F7F3E3E15	Y	PITTAG	338	334	RA	N	58.85
32	930712	E	038	1F2022643B	N		177	58	RA	N	58.85
33	930712	N	043	7F7F48032E	Y	PITTAG	331	309	RA	N	58.25
34	930712	T	033	##########	N		47	0	RA	N	75.20
35	930712	T	033	##########	N		45	0	RA	N	75.20
36	930712	T	035	LCP	N		83	5	RA	N	75.00
37	930712	T	035	##########	N		50	1	RA	N	75.00
38	930712	T	037	LCP	N		78	5	RA	N	74.00
39	930712	T	041	##########	N		41	0	RA	N	74.15
40	930712	T	050	##########	N		50	1	RA	N	92.10
41	930713	E	015	LCP	N		109	13	RA	N	75.10
42	930713	E	015	##########	N		64	2	DP	N	0.00

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
43	930713	N	046	7F7F48032E	Y	PITTAG	329	292	RS	N	58.85
44	930713	N	046	7F7F191C48	Y	PITTAG	345	455	RS	N	58.85
45	930713	N	046	7F7F287559	Y	PITTAG	373	478	RS	N	58.85
46	930713	N	047	7F73E26409	Y	PITTAG	378	456	RS	N	58.30
47	930713	N	047	7F7F265A51	Y	PITTAG	403	663	RS	N	58.30
48	930713	N	047	7F7B034F6A	N		409	633	RS	N	58.30
49	930713	N	050	7F7D085017	Y	PITTAG	434	768	RA	N	58.85
50	930714	E	054	##########	N		52	1	RA	N	63.20
51	930714	E	054	##########	N		46	1	RA	N	63.20
52	930714	E	054	##########	N		45	1	RA	N	63.20
53	930714	E	054	##########	N		41	1	RA	N	63.20
54	930714	E	054	##########	N		44	1	RA	N	63.20
55	930714	E	055	##########	N		47	1	RA	N	62.70
56	930714	E	055	##########	N		52	1	RA	N	62.70
57	930714	E	055	DP-1	N		83	3	RA	N	62.70
58	930714	E	055	##########	N		40	1	RA	N	62.70
59	930714	E	055	##########	N		48	1	RA	N	62.70
60	930714	E	055	##########	N		41	1	RA	N	62.70
61	930714	E	055	##########	N		52	1	RA	N	62.70
62	930714	E	055	##########	N		45	1	RA	N	62.70
63	930714	E	055	##########	N		47	1	RA	N	62.70

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
64	930714	E	055	##########	N		50	1	RA	N	62.70
65	930714	E	055	##########	N		40	1	RA	N	62.70
66	930714	E	055	##########	N		43	1	RA	N	62.70
67	930714	E	056	DP-1	N		78	4	RA	N	62.60
68	930714	E	056	##########	N		54	0	RA	N	62.60
69	930714	E	056	##########	N		52	0	RA	N	62.60
70	930714	E	056	##########	N		49	0	RA	N	62.60
71	930714	E	056	##########	N		50	1	RA	N	62.60
72	930714	E	056	##########	N		47	1	RA	N	62.60
73	930714	E	056	##########	N		44	1	RA	N	62.60
74	930714	E	056	##########	N		46	1	RA	N	62.60
75	930714	E	056	##########	N		44	1	RA	N	62.60
76	930714	E	056	##########	N		46	1	RA	N	62.60
77	930714	E	056	##########	N		46	1	RA	N	62.60
78	930714	N	054	7F7E42752E	Y	PITTAG	352	379	RS	N	60.60
79	930714	N	058	7F7D2C0926	Y	PITTAG	328	302	RS	N	60.40
80	930715	E	057	DP-1	N		105	4	RA	N	62.00
81	930715	E	061	##########	N		51	1	RA	N	62.40
82	930715	E	065	7F7F206E03	Y	PITTAG	377	433	RA	N	61.70
83	930715	E	065	##########	N		39	1	RA	N	61.70
84	930715	E	066	DP-1	N		120	12	RA	N	61.70

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
85	930715	E	066	1F20432658	N		160	40	RA	N	61.70
86	930715	E	069	##########	N		50	1	RA	N	62.10
87	930715	E	069	##########	N		50	1	RA	N	62.10
88	930715	E	118	CP-1	N		110	15	RA	N	70.50
89	930715	E	118	CP-1	N		106	10	RA	N	70.50
90	930715	E	119	##########	N		42	1	RA	N	70.70
91	930715	E	120	##########	N		57	1	RA	N	70.90
92	930715	N	062	7F7D256D01	Y	PITTAG	370	418	RS	N	61.15
93	930715	N	062	7F7F196371	Y	PITTAG	386	420	RS	N	61.15
94	930715	N	062	7F7D293C39	Y	PITTAG	417	594	RS	N	61.15
95	930715	N	062	7F7B024455	N		349	373	RS	N	61.15
96	930715	N	062	7F7B015053	Y	PITSCAR	369	494	RS	N	61.15
97	930715	N	062	7F7B034F4C	N		201	86	RA	N	61.15
98	930715	N	064	7F7D40087B	N		322	270	RA	N	61.15
99	930715	N	064	7F7F284B09	Y	PITTAG	340	410	RA	N	61.15
100	930715	N	065	7F7B026829	N		211	105	RA	N	60.95
101	930715	N	066	7F7F2B7C12	Y	PITTAG	395	572	RA	N	61.15
102	930715	N	066	7F7D180455	Y	PITTAG	305	282	RA	N	61.15
103	930715	N	066	7F7D177E1C	Y	PITTAG	327	309	RA	N	61.15
104	930715	N	066	7F7F3E3C5C	Y	PITTAG	408	632	RN	Y	61.15
105	930715	N	066	7F7F213D47	Y	PITTAG	393	530	RA	N	61.15

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
106	930715	N	066	7F7F272830	Y	PITTAG	320	260	RA	N	61.15
107	930715	N	066	7F7D3B1A3D	Y	PITTAG	210	96	RA	N	61.15
108	930715	N	066	7F7D40182C	N		227	123	RA	N	61.15
109	930715	N	066	7F7B025912	N		415	654	RA	N	61.15
110	930715	N	066	7F7D44106C	N		378	455	RA	N	61.15
111	930715	N	066	7F7B02160C	N		385	498	RA	N	61.15
112	930715	N	068	7F7D2B331F	Y	PITTAG	390	489	RA	N	60.90
113	930715	N	110	1F1F707161	N		342	430	RA	N	119.00
114	930715	N	129	1F0F756C71	N		285	265	RA	N	119.00
115	930715	T	099	DP-1	N		48	1	RA	N	62.35
116	930715	T	099	DP-1	N		52	1	RA	N	62.35
117	930715	T	100	DP-1	N		51	1	RA	N	62.35
118	930715	T	108	DP-1	N		124	18	RA	N	60.90
119	930715	T	146	DP-1	N		57	1	RA	N	62.35
120	930715	T	146	DP-1	N		53	1	RA	N	62.35
121	930715	T	161	DP-1	N		51	1	RA	N	61.40
122	930715	T	161	DP-1	N		52	1	RA	N	61.40
123	930715	T	162	DP-1	N		50	1	RA	N	61.40
124	930715	T	165	DP-1	N		62	1	RA	N	61.40
125	930716	E	074	7F7B081802	Y	PITTAG	315	0	RA	N	60.20
126	930716	E	074	1F20180128	N		193	71	RA	N	60.20

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
127	930716	E	074	7F7D226369	Y	PITTAG	185	50	RA	N	60.20
128	930716	E	074	1F20150329	N		152	27	RA	N	60.20
129	930716	E	074	##########	Y	LPLC	144	19	RA	N	60.20
130	930716	N	070	7F7D225848	Y	PITTAG	368	444	RA	N	60.90
131	930716	N	070	7F7D18196F	Y	PITTAG	367	441	RA	N	60.90
132	930716	N	070	7F7F291869	Y	PITTAG	385	476	RA	N	60.90
133	930716	N	070	7F7D180568	Y	PITTAG	356	449	RA	N	60.90
134	930716	N	071	7F7D3C4558	N		436	730	RA	N	61.20
135	930716	N	075	7F7D2A4465	Y	PITTAG	389	436	RA	N	61.25
136	930716	N	077	7F7D47335F	Y	PITTAG	238	119	RA	N	61.95
137	930716	N	078	7F7F3E494D	Y	PITTAG	400	522	RA	N	61.50
138	930716	N	079	7F7D2B4232	Y	PITTAG	360	358	RA	N	61.70
139	930716	N	079	7F7F28784B	Y	PITTAG	332	271	RA	N	61.70
140	930716	N	079	7F7F2D1E67	Y	PITTAG	349	390	RA	N	61.70
141	930716	N	081	7F7D224E3B	Y	PITTAG	360	355	RA	N	61.95
142	930716	N	081	7F7D295823	Y	PITTAG	235	100	RA	N	61.95
143	930716	N	081	7F7D2B2E19	Y	PITTAG	241	107	RA	N	61.95
144	930716	N	081	7F7D177059	Y	PITTAG	202	86	RA	N	61.95
145	930716	N	081	7F7D3F7C40	N		234	104	RA	N	61.95
146	930716	N	082	7F7F273416	Y	PITTAG	332	309	RA	N	62.10
147	930716	N	084	7F7D2B1C10	Y	PITTAG	363	355	RA	N	61.70

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
148	930716	N	084	7F7D17616A	Y	PITTAG	381	382	RA	N	61.70
149	930716	N	147	7F7F1F1508	Y	PITTAG	232	122	RA	N	127.50
150	930716	N	147	7F7F264B5A	Y	PITTAG	357	608	RS	N	127.50
151	930716	S	008	##########	N		42	1	RA	N	62.70
152	930716	S	008	##########	N		43	1	RA	N	62.70
153	930716	S	008	##########	N		51	1	RA	N	62.70
154	930716	S	008	##########	N		42	1	RA	N	62.70
155	930716	S	008	##########	N		40	1	RA	N	62.70
156	930716	T	151	DP-1	N		60	1	RA	N	62.35
157	930716	T	154	DP-1	N		57	1	RA	N	62.35
158	930716	T	181	DP-1	N		60	1	RA	N	62.35
159	930716	T	181	DP-1	N		50	1	RA	N	62.35
160	930716	T	181	DP-1	N		55	1	RA	N	62.35
161	930716	T	181	DP-1	N		50	1	RA	N	62.35
162	930716	T	182	DP-1	N		48	1	RA	N	62.35
163	930716	T	182	DP-1	N		49	1	RA	N	62.35
164	930716	T	193	DP-1	N		67	2	RA	N	61.95
165	930717	E	077	##########	N		123	21	RA	N	61.20
166	930717	E	080	DP-1	N		87	4	RA	N	64.60
167	930717	E	080	DP-1	N		131	21	RA	N	64.60
168	930717	E	081	DP-1	N		105	12	RA	N	65.00

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
169	930717	E	081	##########	N		67	1	RA	N	65.00
170	930717	E	082	##########	N		50	1	RA	N	64.70
171	930717	E	083	DP-1	N		106	6	RA	N	65.10
172	930717	E	083	DP-1	N		135	14	RA	N	65.10
173	930717	E	083	DP-1	N		120	14	RA	N	65.10
174	930717	E	083	##########	N		52	1	RA	N	65.10
175	930717	E	083	##########	N		49	1	RA	N	65.10
176	930717	E	083	##########	N		44	1	RA	N	65.10
177	930717	E	083	##########	N		57	1	RA	N	65.10
178	930717	E	084	DP-1	N		103	8	RA	N	65.20
179	930717	E	084	##########	N		60	1	RA	N	65.20
180	930717	E	084	##########	N		51	1	RA	N	65.20
181	930717	E	084	DP-1	N		91	3	RA	N	65.20
182	930717	E	084	DP-1	N		96	13	RA	N	65.20
183	930717	E	084	##########	N		46	1	RA	N	65.20
184	930717	E	084	1F20520B64	N		180	39	RA	N	65.20
185	930717	E	084	DP-1	N		99	7	RA	N	65.20
186	930717	E	085	7F7B023868	Y	PITTAG	383	548	RA	N	65.25
187	930717	E	085	7F7D1B7A32	Y	PITTAG	404	542	RA	N	65.25
188	930717	E	085	7F7D183247	Y	PITTAG	358	389	RA	N	65.25
189	930717	E	085	7G7G331N17	Y	PITTAG	360	428	RA	N	65.25

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
190	930717	E	085	7G7F173S5F	Y	PITTAG	357	358	RA	N	65.25
191	930717	E	085	1F200D456F	N		182	0	RA	N	65.25
192	930717	E	085	##########	N		42	0	RA	N	65.25
193	930717	E	085	DP-1	N		107	9	RA	N	65.25
194	930717	E	085	##########	N		35	1	RA	N	65.25
195	930717	E	085	##########	N		49	1	RA	N	65.25
196	930717	E	085	##########	N		43	1	RA	N	65.25
197	930717	E	117	##########	N		43	1	RA	N	70.30
198	930717	N	086	7F7B025433	N		194	70	RA	N	64.50
199	930717	N	086	7F7B035F2F	N		206	83	RA	N	64.50
200	930717	N	088	7F7F2D1172	Y	PITTAG	354	394	RS	N	63.30
201	930717	N	088	7F7F2D4C15	Y	PITTAG	375	497	RS	N	63.30
202	930717	N	088	7F7B080B61	N		360	434	RS	N	63.30
203	930717	N	090	7F7D3C5027	N		209	89	RA	N	64.50
204	930717	N	091	7F7F323A42	Y	PITTAG	346	310	RA	N	63.30
205	930717	N	094	7F7D181B0E	Y	PITTAG	385	481	RA	N	64.50
206	930717	N	159	1F0F60767C	N		184	69	RA	N	127.50
207	930717	N	167	7F7B1E6C70	N		204	88	RA	N	127.60
208	930717	T	257	DP-1	N		46	1	RA	N	63.50
209	930717	T	262	DP-1	N		51	1	RA	N	64.05
210	930717	T	262	DP-1	N		55	1	RA	N	64.05

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
211	930717	T	271	DP-1	N		61	2	RA	N	65.40
212	930717	T	274	DP-1	N		50	1	RA	N	65.40
213	930717	T	275	DP-1	N		51	1	RA	N	65.40
214	930717	T	281	DP-1	N		89	7	RA	N	63.45
215	930717	T	283	DP-1	N		50	1	RA	N	63.45
216	930717	T	283	DP-1	N		52	1	RA	N	63.45
217	930717	T	286	DP-1	N		59	2	RA	N	63.50
218	930717	T	287	DP-1	N		74	3	RA	N	63.50
219	930717	T	287	DP-1	N		51	1	RA	N	63.50
220	930717	T	289	DP-1	N		55	1	RA	N	63.50
221	930717	T	291	DP-1	N		88	4	RA	N	64.05
222	930717	T	291	DP-1	N		87	4	RA	N	64.05
223	930717	T	293	DP-1	N		58	1	RA	N	64.05
224	930717	T	293	DP-1	N		59	1	RA	N	64.05
225	930717	T	294	DP-1	N		53	1	RA	N	64.05
226	930717	T	296	DP-1	N		59	1	RA	N	64.55
227	930717	T	297	DP-1	N		97	7	RA	N	64.55
228	930717	T	297	DP-1	N		64	2	RA	N	64.55
229	930717	T	307	##########	N		50	1	RA	N	63.10
230	930717	T	309	##########	N		44	1	RA	N	63.10
231	930718	E	056	7F7D084B48	N		190	60	RA	N	125.80

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
232	930718	E	086	DP-1	N		88	8	RA	N	63.50
233	930718	E	086	DP-1	N		113	10	RA	N	63.50
234	930718	E	086	##########	N		44	1	RA	N	63.50
235	930718	E	086	##########	N		44	1	RA	N	63.50
236	930718	E	086	##########	N		49	1	RA	N	63.50
237	930718	E	086	##########	N		47	1	RA	N	63.50
238	930718	E	086	DP-1	N		82	3	RA	N	63.50
239	930718	E	086	DP-1	N		88	6	RA	N	63.50
240	930718	E	086	DP-1	N		92	5	RA	N	63.50
241	930718	E	088	DP-1	N		111	17	RA	N	63.50
242	930718	E	089	##########	N		55	1	RA	N	63.70
243	930718	E	089	##########	N		50	1	RA	N	63.70
244	930718	E	089	##########	N		52	1	RA	N	63.70
245	930718	E	089	##########	N		48	1	RA	N	63.70
246	930718	E	089	##########	N		48	1	RA	N	63.70
247	930718	E	089	##########	N		41	1	RA	N	63.70
248	930718	E	089	##########	N		42	1	RA	N	63.70
249	930718	E	089	##########	N		41	1	RA	N	63.70
250	930718	E	090	DP-1	N		85	8	RA	N	63.90
251	930718	E	090	DP-1	N		111	16	RA	N	63.90
252	930718	E	091	##########	N		42	1	RA	N	64.00

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
253	930718	E	091	##########	N		52	1	RA	N	64.00
254	930718	E	091	DP-1	N		93	6	RA	N	64.00
255	930718	N	095	7F7F39614C	Y	PITTAG	353	361	RS	N	61.80
256	930718	N	095	7F7B081073	Y	PITTAG	369	464	RS	N	61.80
257	930718	N	102	7F7F183539	Y	PITTAG	359	458	RS	N	65.20
258	930718	N	181	1FDC6F0165	Y	PITTAG	220	125	RA	N	127.50
259	930718	N	192	1F20183B6E	N		267	189	RS	N	127.60
260	930718	N	197	1F20393553	N		281	240	RS	N	127.60
261	930718	S	011	##########	N		48	1	RA	N	64.50
262	930718	S	011	##########	N		41	1	RA	N	64.50
263	930718	S	011	##########	N		34	1	RA	N	64.50
264	930718	S	012	##########	N		42	1	RA	N	63.70
265	930718	T	313	DP-1	N		84	4	RA	N	63.45
266	930718	T	314	DP-1	N		47	1	RA	N	64.45
267	930718	T	314	##########	N		55	1	RA	N	63.45
268	930718	T	314	##########	N		56	1	RA	N	63.45
269	930718	T	314	##########	N		80	3	RA	N	63.45
270	930718	T	315	DP-1	Y	DP-1	71	2	RA	N	63.45
271	930718	T	317	##########	N		52	1	RA	N	63.50
272	930718	T	319	##########	N		54	1	RA	N	63.50
273	930718	T	321	##########	N		58	1	RA	N	65.40

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.											
N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
274	930718	T	322	##########	N		44	1	RA	N	65.40
275	930718	T	323	##########	N		46	1	RA	N	65.40
276	930718	T	323	##########	N		44	1	RA	N	65.40
277	930718	T	332	##########	N		48	1	RA	N	64.55
278	930718	T	344	##########	N		58	1	RA	N	63.45
279	930718	T	348	##########	N		55	1	RA	N	63.50
280	930718	T	348	##########	N		56	1	RA	N	63.50
281	930718	T	351	##########	N		47	1	RA	N	63.50
282	930718	T	352	##########	N		50	1	RA	N	63.50
283	930718	T	353	##########	N		50	1	RA	N	63.50
284	930718	T	357	DP-1	N		106	10	RA	N	64.55
285	930718	T	359	DP-1	N		95	6	RA	N	64.55
286	930718	T	363	##########	N		55	1	RA	N	65.40
287	930718	T	364	##########	N		50	1	RA	N	65.40
288	930718	T	372	##########	N		50	1	RA	N	63.45
289	930719	E	092	##########	N		48	1	RA	N	64.40
290	930719	E	093	##########	N		42	1	RA	N	64.30
291	930719	E	093	##########	N		49	1	RA	N	64.30
292	930719	E	093	##########	N		48	1	RA	N	64.30
293	930719	E	093	##########	N		45	1	RA	N	64.30
294	930719	E	096	CP-1	N		61	2	RA	N	65.90

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
295	930719	N	107	7F7D224D66	Y	PITTAG	378	511	RS	N	65.25
296	930719	N	200	1F0F7D2431	N		212	87	RA	N	127.60
297	930719	N	201	7F7D076335	Y	PITTAG	287	272	RS	N	127.50
298	930719	N	204	1F0F5F7003	N		198	92	RA	N	127.60
299	930719	N	208	1F0937445D	N		225	129	RA	N	127.60
300	930719	N	209	7F7F1F1567	Y	PITTAG	263	183	RS	N	127.50
301	930719	N	215	1F20393553	Y	PITTAG	279	245	RA	N	127.50
302	930719	S	014	##########	N		48	1	RA	N	65.60
303	930719	S	014	##########	N		49	1	RA	N	65.60
304	930719	S	014	##########	N		55	1	RA	N	65.60
305	930719	S	014	##########	N		52	1	RA	N	65.60
306	930719	S	014	##########	N		55	1	RA	N	65.60
307	930719	S	014	##########	N		49	1	RA	N	65.60
308	930719	T	367	##########	N		51	1	RA	N	63.10
309	930719	T	368	##########	N		51	1	RA	N	63.10
310	930719	T	378	##########	N		56	1	RA	N	63.50
311	930719	T	378	##########	N		46	1	RA	N	63.50
312	930719	T	386	##########	N		55	1	RA	N	64.55
313	930719	T	391	DP-1	N		79	3	RA	N	65.40
314	930719	T	393	##########	N		52	1	RA	N	65.40
315	930719	T	395	##########	N		52	1	RA	N	65.40

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
316	930719	T	402	DP-1	N		100	7	RA	N	63.45
317	930719	T	403	##########	N		60	2	RA	N	63.45
318	930719	T	405	##########	N		54	1	RA	N	63.45
319	930719	T	418	DP-1	N		86	5	RA	N	64.35
320	930720	E	098	CP-1	N		124	17	RA	N	66.40
321	930720	E	100	CP-1	N		102	13	RA	N	66.90
322	930720	E	100	##########	N		44	1	RA	N	66.90
323	930720	E	100	##########	N		49	1	RA	N	66.90
324	930720	E	102	##########	N		48	1	RA	N	67.15
325	930720	E	102	##########	N		52	1	RA	N	67.15
326	930720	E	103	##########	N		100	8	RA	N	67.30
327	930720	E	103	##########	N		50	1	RA	N	67.30
328	930720	E	103	##########	N		40	1	RA	N	67.30
329	930720	N	240	7F7F1F1B05	Y	PITTAG	235	116	RA	N	127.60
330	930720	T	150	UCP	N		76	4	RA	N	126.10
331	930720	T	150	UCP	N		68	3	RA	N	126.10
332	930720	T	427	##########	N		50	1	RA	N	67.15
333	930720	T	447	##########	N		50	1	RA	N	67.85
334	930720	T	451	DP-1	N		94	5	RA	N	67.15
335	930720	T	453	DP-1	N		94	5	RA	N	67.15
336	930720	T	454	DP-1	N		112	10	RA	N	67.15

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
337	930720	T	475	DP-1	N		109	10	RA	N	67.95
338	930720	T	508	##########	N		53	1	RA	N	67.15
339	930720	T	509	##########	N		49	1	RA	N	67.15
340	930720	T	512	##########	N		45	1	RA	N	67.05
341	930720	T	512	##########	N		54	1	RA	N	67.05
342	930720	T	517	##########	N		61	1	RA	N	67.95
343	930720	T	519	##########	N		54	1	RA	N	67.95
344	930721	E	104	CP-1	N		103	5	RA	N	67.00
345	930721	E	104	##########	N		46	1	RA	N	67.00
346	930721	E	105	##########	N		37	1	RA	N	67.40
347	930721	E	107	##########	N		47	1	RA	N	67.80
348	930721	E	107	##########	N		52	1	RA	N	67.80
349	930721	E	109	##########	N		59	1	RA	N	68.00
350	930721	E	111	##########	N		58	1	RA	N	68.20
351	930721	E	111	##########	N		85	4	RA	N	68.20
352	930721	E	112	CP-1	N		100	7	RA	N	68.40
353	930721	E	112	CP-1	N		100	9	RA	N	68.40
354	930721	E	112	CP-1	N		52	1	RA	N	68.40
355	930721	E	112	CP-1	N		114	13	RA	N	68.40
356	930721	E	112	CP-1	N		118	15	RA	N	68.40
357	930721	E	113	##########	N		44	1	RA	N	68.40

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.											
N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
358	930721	E	113	##########	N		50	1	RA	N	68.40
359	930721	E	113	##########	N		46	1	RA	N	68.40
360	930721	E	113	##########	N		43	1	RA	N	68.40
361	930721	E	113	##########	N		47	1	RA	N	68.40
362	930721	E	113	##########	N		52	1	RA	N	68.40
363	930721	E	113	##########	N		53	1	RA	N	68.40
364	930721	E	113	##########	N		46	1	RA	N	68.40
365	930721	E	113	##########	N		52	1	RA	N	68.40
366	930721	E	113	##########	N		46	1	RA	N	68.40
367	930721	N	119	7F7F183B78	Y	PITTAG	400	486	RA	N	66.90
368	930721	N	119	7F7F214D20	N		419	705	RA	N	66.90
369	930721	S	015	##########	N		51	1	RA	N	67.90
370	930721	S	015	##########	N		46	1	RA	N	67.90
371	930721	S	015	##########	N		48	1	RA	N	67.90
372	930721	S	015	##########	N		54	1	RA	N	67.90
373	930721	S	015	##########	N		43	1	RA	N	67.90
374	930721	S	015	##########	N		51	1	RA	N	67.90
375	930721	S	015	##########	N		52	1	RA	N	67.90
376	930721	S	015	##########	N		49	1	RA	N	67.90
377	930721	S	015	##########	N		39	1	RA	N	67.90
378	930721	S	015	##########	N		55	1	RA	N	67.90

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
379	930721	S	015	##########	N		51	1	RA	N	67.90
380	930721	S	015	##########	N		57	1	RA	N	67.90
381	930721	S	015	##########	N		53	1	RA	N	67.90
382	930721	S	015	##########	N		50	1	RA	N	67.90
383	930721	S	015	##########	N		58	1	RA	N	67.90
384	930721	S	015	##########	N		50	1	RA	N	67.90
385	930721	T	457	DP-1	N		76	4	RA	N	67.05
386	930721	T	466	##########	N		59	1	RA	N	67.95
387	930721	T	467	##########	N		46	1	RA	N	67.95
388	930721	T	471	##########	N		49	1	RA	N	67.15
389	930721	T	481	##########	N		54	1	RA	N	67.15
390	930721	T	482	##########	N		51	1	RA	N	67.15
391	930721	T	482	##########	N		47	1	RA	N	67.15
392	930721	T	495	##########	N		47	1	RA	N	67.95
393	930721	T	524	##########	N		49	1	RA	N	67.95
394	930722	E	114	##########	N		40	1	RA	N	69.60
395	930722	E	114	##########	N		45	1	RA	N	69.60
396	930722	E	115	CP-1	N		99	11	RA	N	70.00
397	930722	E	115	CP-1	N		101	9	RA	N	70.00
398	930722	E	115	CP-1	N		98	10	RA	N	70.00
399	930722	E	115	CP-1	N		80	5	RA	N	70.00

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.											
N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
400	930722	E	115	##########	N		57	1	RA	N	70.00
401	930722	E	115	##########	N		49	1	RA	N	70.00
402	930722	E	115	##########	N		46	1	RA	N	70.00
403	930722	E	116	##########	N		42	1	RA	N	70.20
404	930722	E	116	##########	N		47	1	RA	N	70.20
405	930722	E	116	##########	N		51	1	RA	N	70.20
406	930722	E	116	##########	N		50	1	RA	N	70.20
407	930722	E	116	##########	N		51	1	RA	N	70.20
408	930722	E	116	##########	N		35	1	RA	N	70.20
409	930722	E	116	##########	N		46	1	RA	N	70.20
410	930722	E	116	##########	N		37	1	RA	N	70.20
411	930722	E	117	##########	N		43	1	RA	N	70.30
412	930722	E	121	1F2023326C	N		177	33	RA	N	71.00
413	930722	E	121	CP-1	N		76	2	RA	N	71.00
414	930722	E	122	##########	N		43	1	RA	N	71.20
415	930722	E	122	##########	N		38	1	RA	N	71.20
416	930722	E	122	##########	N		45	1	RA	N	71.20
417	930722	E	122	##########	N		45	1	RA	N	71.20
418	930722	E	122	1F166E0B52	N		174	54	RA	N	71.20
419	930722	S	018	##########	N		41	1	RA	N	70.40
420	930722	T	547	##########	N		54	1	RA	N	70.50

Table 4. Summary of Humpback Chub handled during Trip 7, 1993.

N	DATE	TYPE	SAMPLE	TAG NUMBER	RECAP	OLD TAG	TL	WT	DISP	RADIO	RM RELEASE
421	930722	T	548	##########	N		55	1	RA	N	70.50
422	930722	T	552	##########	N		55	1	RA	N	71.05
423	930722	T	554	##########	N		51	1	RA	N	71.05
424	930722	T	576	##########	N		47	1	RA	N	71.05
425	930722	T	578	DP-1	N		85	5	RA	N	71.05
426	930722	T	580	DP-1	N		94	6	RA	N	71.05
427	930723	E	123	##########	N		49	1	RA	N	71.20
428	930723	E	123	CP-1	N		60	2	RA	N	71.20
429	930723	E	124	CP-1	N		85	4	RA	N	72.00
430	930723	E	124	##########	N		51	1	RA	N	72.00
431	930723	E	124	##########	N		49	1	RA	N	72.00

Table 5. A list of radio frequencies contacted on Trip 7, 1993 and locations relative to capture and release sites.

			--------River Mile--------		
FREQ/PULSE	TAG SIZE (g)	DATE (time)	CAPTURE	RELEASE	LOCATE
40.730/40 /32	11	930319 930716	127.5	127.5	126.2

CHARACTERIZATION OF THE LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE GRAND CANYON

TRIP REPORT 8 - 1993
August 12 - 27, 1993

Prepared For:

Bureau of Reclamation

Prepared By:

Richard A. Valdez, Principal Investigator
Bryan Cowdell, Senior Biologist

BIO/WEST INC.
1063 West 1400 North
Logan, UT. 84321

September 8, 1993

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INTRODUCTION

This report presents pertinent details associated with Trip 8, 1993. Included in the report are a summary of trip logistics, personnel and research schedule, data collected, problems encountered, pertinent observations and recommendations. Most information is presented in a tabular format to provide a quick synopsis of trip details and results. We emphasize that these data are hand tabulated to provide these synopses as soon as possible. The data are later computerized and checked for accuracy. The purpose of these trip reports is to provide information from BIO/WEST trips as quickly as possible to aid other researchers.

LOGISTICS, RESEARCH SCHEDULE AND PERSONNEL

Table 1 presents a summary of logistics and the research schedule for Trip 8, 1993. Table 2 is a list of personnel who were present or participated in research activities for Trip 8, 1993.

DATA COLLECTED

Table 3 is a summary of gear types used, sampling effort and fish captured by gear type for Trip 8, 1993. Table 4 is a summary of all humpback chubs handled during Trip 8, 1993.

Humpback Chubs Captured

A total of 730 humpback chub were captured in Reach 1 during Trip 8, 1993 including 581 young-of-year (YOY)(<60 mm), 109 juveniles (60-199 mm TL), and 40 adults (>199 mm TL). No chub were captured in Reach 0. Fifty-one juvenile and 190 YOY were captured with seines. Three hundred and fifty-nine chubs, including 3 adults, 32 juveniles and 324 YOY were captured electrofishing. Netting produced 37 adult humpback chub and 1 juvenile. Ninety-two chubs were also captured in unbaited minnow traps including 25 juveniles and 67 YOY.

Of the 40 adult humpback chub captured in Reach 1, 35 (or 85%) were PIT-tagged recaptures (includes those captured and marked by other investigators). This represents the highest recapture rate observed by BIO/WEST for adult humpback chubs in Reach 1. Other high recapture rates were observed in 1993, including 80% in January, 75% in February, 75% in June and 77% in July.

Stomach contents of 21 humpback chubs were collected in Reach 1 using non-lethal stomach pumping techniques.

One YOY humpback chub was found dead in a minnow trap at RM 63.9 on August 18. The fish measured 58 mm TL. The carcass was preserved for transfer to AGF.

Observed Condition of Humpback Chub

All chubs captured, with the exception of one juvenile appeared healthy and in good condition. The juvenile, captured at RM 62.15, had a white discoloring along the caudal peduncle and appeared weak and in poor condition. The chub was not a recapture and not pit-tagged due to its condition. The fish was released at the point of capture.

Non-lethal stomach pumping of 21 humpback chubs indicated that tapeworms were present in approximately 25% of the fish that were successfully evacuated.

Habitat Mapping

Juvenile habitat mapping was conducted in twelve locations between the confluence of the LCR and Tanner Rapid.

Bench Marks

One temporary bench mark was established at Tanner Canyon. The benchmark was placed in the ledges on the left side at RM 68.25.

OBSERVATIONS

1. Runoff from the Paria River created high main channel turbidity until August 16. Mainchannel turbidity was low from August 16 - 19. Heavy rains caused high main channel turbidity at approximately 4:00 pm on August 19. Turbidity was high for the remainder of Trip 8, 1993.

2. Heavy rains caused a flash flood in Tanner Canyon at 4:30 pm on August 19. The flood created a large debris fan just above Tanner Rapid, which noticeably decreased water velocity and increased river stage approximately one vertical foot for 0.4 miles upstream.

3. High densities of YOY humpback chub were observed in the main channel from the confluence of the LCR (RM 61.3) to Hance Rapid (RM 76.5) during Trip 8, 1993. YOY humpback were captured in nearly all shoreline types by electrofishing, seining and minnow trapping.

4. Water clarity in the LCR was high in August. Numerous YOY humpback chubs (ranging from approximately 40 to 60 mm TL) were observed while snorkeling in the lower one kilometer.

5. All rainbow trout captured in conjunction with YOY humpback chub were sacrificed for stomach analysis.

6. A juvenile night heron was observed feeding on several small fish in a backwater just above Unkar Rapid (RM 72.3, left side). Seining in the area revealed large numbers of YOY humpback chub.

PROBLEMS ENCOUNTERED AND SOLUTIONS

1. One outboard motor would not shift into reverse. This motor was repaired by changing the lower-unit, the old gearbox will be serviced as soon as possible.

RECOMMENDATIONS

1. We recommend continued and enhanced coordination among the researchers in Grand Canyon. This coordination is essential to insure that all researchers are aware of others activities.

Table 1. Logistics and Research Schedule for Trip 8, 1993.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
8/12	12.9	Above Sheer Wall Rapid	X	X		
8/13	12.9	Above Sheer Wall Rapid		X		
8/14	61.3	LCR	X	X		
8/15	61.3	LCR		X		X
8/16	61.3	LCR		X		X
8/17	62.95	Above Carbon Creek	X	X		X
8/18	62.95	Above Carbon Creek		X		X
8/19	68.4	Tanner Canyon	X	X		X
8/20	68.4	Tanner Canyon		X		X
8/21	71.2	Cardenas	X	X		
8/22	71.2	Cardenas		X		
8/23	75.6	Below Nevills Rapid	X	X		
8/24	89.3	Below Pipe Creek	X	X		
8/25	166.5	National Canyon	X			
8/26	224	224 Mile	X			
8/27	225	Diamond Creek	X			

[1]T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 2. Personnel Participating in Trip 8, 1993.

PERSONNEL	AFFILIATION	DATES	COMMENTS
B. Cowdell	BIO/WEST	8/12 - 8/25	Senior Biologist
E. Prats	BIO/WEST	8/12 - 8/25	Senior Biologist
P. Weiss	BIO/WEST	8/12 - 8/25	Out Bright Angel
L. Brown	BIO/WEST	8/12 - 8/25	Out Bright Angel
P. Trater	BIO/WEST	8/12 - 8/25	Out Bright Angel
D. Brown	BIO/WEST Volunteer	8/12 - 8/25	Out Bright Angel
D. Covey	BIO/WEST Volunteer	8/12 - 8/25	Out Bright Angel
S. Hawxhurst	BIO/WEST Volunteer	8/12 - 8/25	Out Bright Angel
S. Beldsoe	OARS	8/12 - 8/27	Trip Leader
L. Neimi	OARS	8/12 - 8/27	
S. Rhodes	OARS	8/12 - 8/27	
J. Winnicki	OARS	8/12 - 8/27	

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 8, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	SU	FH	FV	BB
Electrofishing Reach 0 N=8	A					270							
	J					6							
	Y												
Electrofishing Reach 1 N=67	A	3	7	2	50			8	79		6		
	J	29	1	8	18						1		
	Y	327	1	1	6					2			
Nets Reach 0 N=20	A				40								
	J												
	Y												
Nets Reach 1 N=	A	38	21	3	17	2	1	2				1	1
	J												
	Y												
Traps Reach 1 N=425	A								23				
	J	25											
	Y	68											
Seines Reach 1 N=	A				1				29		19		
	J	49	5	25	5			1					
	Y	191	4	34				1					
Totals	A	41	28	5	378	2	1	10	131	0	25	1	1
	J	103	6	33	29	0	0	1	0	0	1	0	0
	Y	586	5	35	6	0	0	1	0	2	0	0	0
	T	730	39	73	413	2	1	12	131	2	26	1	1

[2] - A = Adult
J = Juvenile
Y = Young of year

[3] - HB = humpback chub
FM = flannelmouth sucker
BH = bluehead sucker
RB = rainbow trout
BR = brown trout
CC = channel catfish
CP = carp
SD = speckled dace
SU = unidentified sucker
FH = fathead minnow
FV = flannelmouth varient
BB = black bullhead

Table 4. Summary of Humpback Chub handled during Trip 8, 1993. (Includes only 147 of 730 fish captured)

N	Date	Type	Sample No	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
1	930814	N	021	7F7F3F4630	Y	PITTAG	351	351	RA	N	61.00
2	930814	N	021	1F1E2D2F67	N		197	73	RA	N	61.00
3	930814	N	022	7F7D180135	Y	PITTAG	408	609	RS	N	60.82
4	930814	N	022	7F7D026134	Y	PITTAG	424	695	RS	N	60.82
5	930814	N	022	7F7F3F3C78	Y	PITTAG	376	401	RS	N	60.82
6	930814	N	022	7F7F3E4105	Y	PITTAG	370	406	RS	N	60.82
7	930814	N	023	7F7D2A6D2B	Y	PITTAG	370	417	RS	N	60.18
8	930814	N	023	7F7F213E0E	Y	PITTAG	345	395	RA	N	60.18
9	930814	N	023	7F7F33365A	Y	PITTAG	402	749	RS	N	60.18
10	930814	N	023	7F7B032E18	Y	PITTAG	328	351	RS	N	60.18
11	930814	N	023	7F7F271358	Y	PITTAG	333	294	RS	N	60.18
12	930814	T	013	DP-1	N		109	11	RA	N	61.25
13	930815	E	016	1F1F635708	N		360	496	RA	N	62.60
14	930815	N	028	7F7D4D7D2E	Y	PITTAG	415	588	RA	N	60.41
15	930815	N	028	7F7D177356	Y	PITTAG	325	342	RA	N	60.41
16	930815	N	029	7F7F3E2460	Y	PITTAG	402	625	RA	N	60.18
17	930815	N	029	7F7D305007	Y	PITTAG	384	513	RA	N	60.18
18	930815	N	030	7F7D175211	Y	PITTAG	266	148	RA	N	60.92
19	930815	N	031	7F7D2A6D2B	Y	PITTAG	371	422	RA	N	60.41
20	930815	N	033	7F7D2B6D78	Y	PITTAG	412	621	RS	N	61.28
21	930815	N	038	7F7F334A6F	Y	PITTAG	386	424	RA	N	61.51

Table 4. Summary of Humpback Chub handled during Trip 8, 1993. (Includes only 147 of 730 fish captured)

N	Date	Type	Sample No	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
22	930815	N	039	7F7F0E4F6E	Y	PITTAG	318	230	RA	N	61.20
23	930815	N	041	7F7F334240	Y	PITTAG	384	407	RA	N	61.51
24	930815	S	003	DP-1	N		61	1	RA	N	61.90
25	930815	S	003	DP-1	N		63	1	RA	N	61.90
26	930815	S	003	DP-1	N		63	1	RA	N	61.90
27	930815	S	003	DP-1	N		63	1	RA	N	61.90
28	930815	T	066	DP-1	N		109	15	RA	N	60.90
29	930815	T	067	DP-1	N		129	21	RA	N	60.90
30	930815	T	075	DP-1	N		108	11	RA	N	61.25
31	930816	E	024	DP-1	N		60	2	RA	N	62.30
32	930816	E	026	7F7F276360	Y	PITTAG	400	662	RA	N	61.50
33	930816	E	026	1F20084673	N		412	655	RA	N	61.50
34	930816	E	026	DP-1	N		138	22	RA	N	61.50
35	930816	N	042	7F7F183017	Y	PITTAG	320	300	RS	N	61.95
36	930816	N	042	7F7D2C3A73	Y	PITTAG	373	392	RS	N	61.95
37	930816	N	046	7F7F445D54	Y	PITTAG	375	405	RS	N	63.30
38	930816	N	046	7F7D286A61	Y	PITTAG	368	441	RS	N	63.30
39	930816	T	100	DP-1	N		71	2	RA	N	62.15
40	930816	T	110	DP-1	N		98	8	RA	N	62.15
41	930817	E	027	1F2049492F	Y	LCLP2	164	37	RA	N	0.00
42	930817	E	030	DP-1	N		64	2	RA	N	64.50
43	930817	E	030	DP-1	N		54	1	RA	N	64.50

Table 4. Summary of Humpback Chub handled during Trip 8, 1993. (Includes only 147 of 730 fish captured)

N	Date	Type	Sample No	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
44	930817	E	030	DP-1	N		55	1	RA	N	64.50
45	930817	E	032	DP-1	N		62	1	RA	N	64.30
46	930817	E	032	DP-1	N		42	1	RA	N	64.30
47	930817	E	032	DP-1	N		53	1	RA	N	64.30
48	930817	E	032	DP-1	N		53	1	RA	N	64.30
49	930817	E	032	DP-1	N		39	1	RA	N	64.30
50	930817	E	033	DP-1	N		47	1	RA	N	64.90
51	930817	E	033	DP-1	N		120	15	RA	N	64.90
52	930817	E	034	DP-1	N		55	1	RA	N	65.20
53	930817	N	051	1F20280B0E	N		223	100	RA	N	63.30
54	930817	N	052	1F20241607	N		320	313	RS	N	63.70
55	930817	N	053	1F204F5220	Y	559CR	354	330	RS	N	63.88
56	930817	N	053	7F7F450369	Y	PITTAG	405	504	RS	N	63.88
57	930817	N	053	1F1E442956	N		385	662	RS	N	63.88
58	930817	N	054	7F7F273722	Y	PITTAG	369	487	RS	N	63.30
59	930817	S	008	DP-1	N		61	1	RA	N	63.40
60	930817	T	134	DP-1	N		91	6	RA	N	63.15
61	930817	T	149	DP-1	N		79	5	RA	N	64.55
62	930817	T	162	DP-1	N		99	5	RA	N	63.50
63	930818	E	035	DP-1	N		53	2	RA	N	64.80
64	930818	N	061	7F7D173A5D	Y	PITTAG	361	369	RS	N	64.79
65	930818	N	063	7F7D47612C	Y	PITTAG	357	318	RS	N	65.14

Table 4. Summary of Humpback Chub handled during Trip 8, 1993. (Includes only 147 of 730 fish captured)

N	Date	Type	Sample No	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
66	930818	N	064	7F7F274E5B	Y	PITTAG	345	320	RA	N	64.79
67	930818	S	013	DP-1	N		60	1	RA	N	64.30
68	930818	S	013	DP-1	N		62	1	RA	N	64.30
69	930818	S	013	DP-1	N		67	1	RA	N	64.30
70	930818	S	013	DP-1	N		63	1	RA	N	64.30
71	930818	S	013	DP-1	N		60	1	RA	N	64.30
72	930818	S	013	DP-1	N		62	1	RA	N	64.30
73	930818	T	194	DP-1	N		64	2	RA	N	63.15
74	930818	T	203	DP-1	N		60	1	RA	N	64.55
75	930819	E	040	DP-1	N		100	8	RA	N	63.50
76	930819	N	067	7F7F295347	Y	PITTAG	399	575	RA	N	65.31
77	930819	N	068	7F7F27034F	Y	PITTAG	402	513	RA	N	65.14
78	930819	N	069	7F7F3F4E3B	Y	PITTAG	375	314	RS	N	64.79
79	930819	T	244	LCP	N		76	4	RA	N	67.95
80	930819	T	245	LCP	N		66	3	RA	N	67.95
81	930819	T	268	LCP	N		103	9	RA	N	68.20
82	930820	E	049	LCDP	N		59	1	RA	N	67.00
83	930820	E	049	LC-1	N		130	18	RA	N	67.00
84	930820	E	049	1F1F685505	N		155	33	RA	N	67.00
85	930820	T	280	LCP	N		109	12	RA	N	68.45
86	930821	E	050	LC-1	N		70	2	RA	N	67.80
87	930821	E	051	LC1	N		104	10	RA	N	68.10

Table 4. Summary of Humpback Chub handled during Trip 8, 1993. (Includes only 147 of 730 fish captured)

N	Date	Type	Sample No	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
88	930821	E	051	LC1	N		56	1	RA	N	68.10
89	930821	N	092	7F7F3E472A	Y	PITTAG	310	299	RA	N	71.20
90	930821	S	016	LC	N		85	5	RA	N	70.30
91	930821	S	017	LC	N		76	4	RA	N	70.30
92	930821	T	308	LCP	N		65	2	RA	N	71.40
93	930821	T	318	LCP	N		96	7	RA	N	72.40
94	930822	E	061	LC	N		94	7	RA	N	70.00
95	930822	E	063	LC	N		69	3	RA	N	72.20
96	930822	S	020	LCP	N		82	5	RA	N	71.80
97	930822	S	024	LC	N		65	2	RA	N	72.20
98	930822	S	024	LC	N		60	1	RA	N	72.20
99	930822	S	024	LC	N		60	1	RA	N	72.20
100	930822	S	024	LC	N		64	1	RA	N	72.20
101	930822	T	378	LCP	N		76	3	RA	N	72.40
102	930823	E	067	LC	N		61	2	RA	N	71.60
103	930823	E	069	LC	N		69	2	RA	N	75.30
104	930823	E	069	LC	N		115	12	RA	N	75.30
105	930823	E	069	LC	N		119	14	RA	N	75.30
106	930823	E	071	LC	N		58	2	RA	N	75.80
107	930823	E	073	LC	N		66	2	RA	N	75.90
108	930823	S	026	LC	N		111	10	RA	N	76.50
109	930823	S	026	LC	N		116	14	RA	N	76.50

Table 4. Summary of Humpback Chub handled during Trip 8, 1993. (Includes only 147 of 730 fish captured)

N	Date	Type	Sample No	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
110	930823	S	026	LC	N		120	15	RA	N	76.50
111	930823	S	026	7F7F1F0B31	N		151	31	RA	N	76.50
112	930823	S	026	LC	N		121	15	RA	N	76.50
113	930823	S	026	LC	N		94	4	RA	N	76.50
114	930823	S	026	LC	N		114	10	RA	N	76.50
115	930823	S	026	LC	N		86	7	RA	N	76.50
116	930823	S	026	LC	N		120	14	RA	N	76.50
117	930823	S	026	LC	N		97	7	RA	N	76.50
118	930823	S	026	LC	N		100	8	RA	N	76.50
119	930823	S	026	LCP	N		96	7	RA	N	76.50
120	930823	S	026	LCP	N		102	10	RA	N	76.50
121	930823	S	026	LC	N		104	9	RA	N	76.50
122	930823	S	026	LC	N		112	12	RA	N	76.50
123	930823	S	026	LC	N		74	2	RA	N	76.50
124	930823	S	026	LC	N		95	7	RA	N	76.50
125	930823	S	026	LC	N		96	7	RA	N	76.50
126	930823	S	026	LC	N		48	0	RA	N	76.50
127	930823	S	026	LC	N		120	15	RA	N	76.50
128	930823	S	026	LC	N		124	17	RA	N	76.50
129	930823	S	026	LC	N		76	4	RA	N	76.50
130	930823	S	026	LC	N		94	7	RA	N	76.50
131	930823	S	026	LC	N		92	6	RA	N	76.50

Table 4. Summary of Humpback Chub handled during Trip 8, 1993. (Includes only 147 of 730 fish captured)

N	Date	Type	Sample No	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
132	930823	S	026	LC	N		129	18	RA	N	76.50
133	930823	S	026	LC	N		76	3	RA	N	76.50
134	930823	S	026	LC	N		93	6	RA	N	76.50
135	930823	S	026	LC	N		113	13	RA	N	76.50
136	930823	S	026	LC	N		74	3	RA	N	76.50
137	930823	S	026	LC	N		124	15	RA	N	76.50
138	930823	S	026	LC	N		74	3	RA	N	76.50
139	930823	T	418	LCP	N		109	10	RA	N	76.40
140	930823	T	423	LCP	N		109	9	RA	N	76.50
141	930824	E	075	LC	N		112	9	RA	N	76.30
142	930824	E	075	LC	N		65	2	RA	N	76.30
143	930824	E	075	LC	N		82	4	RA	N	76.30
144	930824	E	075	LC	N		62	2	RA	N	76.30
145	930824	T	401	LCP	N		100	7	RA	N	75.70
146	930824	T	401	LCP	N		81	4	RA	N	75.70
147	930824	T	401	LCP	N		75	3	RA	N	75.70

CHARACTERIZATION OF THE LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE GRAND CANYON

TRIP REPORT 9 - 1993
September 9 - 28, 1993

Prepared For:

Bureau of Reclamation

Prepared By:

Richard A. Valdez, Principal Investigator
William Masslich, Project Leader
William Leibfried, Project Leader

BIO/WEST INC.
1063 West 1400 North
Logan, UT. 84321

October 20, 1993

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INTRODUCTION

This report presents pertinent details associated with Trip 9, 1993. Included in the report are a summary of trip logistics, personnel and research schedule, data collected, problems encountered, pertinent observations and recommendations. Most information is presented in a tabular format to provide a quick synopsis of trip details and results. We emphasize that these data are hand tabulated to provide these synopses as soon as possible. The data are later computerized and checked for accuracy. The purpose of these trip reports is to provide information from BIO/WEST trips as quickly as possible to aid other researchers.

LOGISTICS, RESEARCH SCHEDULE AND PERSONNEL

Table 1 presents a summary of logistics and the research schedule for Trip 9, 1993. Table 2 is a list of personnel who were present or participated in research activities for Trip 9, 1993.

DATA COLLECTED

Table 3 is a summary of gear types used, sampling effort and fish captured by gear type for Trip 9, 1993. Table 4 is a list of all humpback chubs marked or recaptured during Trip 9, 1993.

Humpback Chubs Captured

A total of 1,141 humpback chub were captured during Trip 9, 1993 including 769 young-of-year (YOY)(<65 mm), 286 juveniles (66-199 mm TL), and 86 adults (>199 mm TL). Nine adult chub were captured in Reach 0, seven by netting and two by electrofishing. In Reach 1, a total of 1066 humpback chubs were captured including 737 YOY, 275 juveniles and 54 adults. A total of 520 humpback chubs including 310 YOY, 209 juveniles and one adult were captured with seines. Three hundred seventy six chubs, including 5 adults, 30 juveniles and 341 YOY were captured electrofishing. Netting produced 48 adult humpback chub. One hundred and twenty two chubs were also captured in unbaited minnow traps including 36 juveniles and 86 YOY.

Of the 54 adult humpback chub captured in Reach 1, 42 (or 78%) were PIT-tagged recaptures (includes those captured and marked by other investigators). In Reach 0, one of seven adult humpback chubs were recaptures. The recaptured fish in Reach 0 was a fish tagged in the same area (near Fence Fault) in May of 1993.

Sixty-six chub were caught in Reach 2. Thirty-five were YOY, 11 were juvenile and 20 were adults. Every gear type caught chub. YOY chub were caught seining intermittently in the Inner Gorge to Bright Angel Creek. Fewer were captured downstream. Most of the adult chub came from the Middle Granite gorge. Recaptures from this area were about 30-40 percent.

One adult chub was recaptured at RM 108.5 during Trip 9, 1993 that was originally tagged in July 1992 at RM 127.5. This fish had grown in both weight and length and was in good condition. This upstream movement of about 20 miles is the longest upstream movement by humpback chub during this study.

Stomach contents of 21 humpback chubs, 15 in Reach 1 and 6 in Reach 2, were collected using non-lethal stomach pumping techniques.

Two YOY humpback chub captured in a minnow trap at RM 63.9 on September 18 were discovered dead in the trap during a routine check. The fish measured 80 and 61 mm TL. The carcasses were preserved for transport to Flagstaff and will be transferred to AGF as soon as possible.

Observed Condition of Humpback Chub

All chubs captured appeared healthy and in good condition with the exception of a small percentage of both juvenile and YOY chubs captured at various locations which again exhibited a slight swelling of the abdominal area and appeared slightly gaunt, possibly as a result of tape worm infestation. This abdominal swelling has been noticed in some individuals during most trips, but generally affects much less than 1% of the fish captured.

Radiotelemetry

Both remote stations from the Middle Granite Gorge were decommissioned during Trip 9, 1993. All equipment was removed from the sites and no tract of their existence was left behind. No humpback chubs were implanted during Trip 9 1993.

Habitat Mapping

Juvenile habitat mapping was conducted in fifteen locations between the confluence of the LCR and Tanner Rapid.

Bench Marks

No new bench marks were established during Trip 9, 1993.

OBSERVATIONS

1. Main channel turbidities above the LCR were low for the duration of Trip 9, 1993. Daily increases in fluctuations in turbidity associated with bed load disturbance from peak flows were observed during most days. Turbidities were high below the confluence of the LCR for the duration of Trip 9, 1993.

2. High densities of YOY humpback chub were observed in the main channel from the confluence of the LCR (RM 61.3) to Hance Rapid (RM 78.4) during Trip 9, 1993. YOY humpback were captured in nearly all shoreline types by electrofishing, seining and minnow trapping. Highest catch rates were along shoreline types including talus, debris flows and vegetated cutbanks.

3. One rainbow trout captured seining along with numerous YOY humpback chubs was sacrificed for stomach analysis. Observations of stomach contents in the field indicated that the carcasses of at least three small fish were among the food items. Stomach contents were preserved for lab identification.

4. Unbaited minnow traps were very effective at catching YOY and juvenile humpback chub during Trip 9 despite high turbidities. Humpback chubs were captured in a variety of shoreline types including sheer wall, boulder talus, boulder debris fans and vegetated cut banks. High catch rates in minnow traps across habitat types and under turbid conditions strongly suggest that densities of both YOY (40 mm - 60 mm) and juvenile humpback chubs were very high in the main channel during Trip 9, 1993.

5. The majority of adult fish captured by the lower crew during Trip 9, 1993 were from the Middle Granite Gorge. The consistent high recapture success indicates an affinity for this area by this aggregation of chub.

6. No striped bass were captured during Trip 9, 1993. The high turbidity and cooler water temperatures this month may be a factor in this observation.

7. One 25 mm TL green sunfish was caught electrofishing at RM 173.

PROBLEMS ENCOUNTERED AND SOLUTIONS

1. The addition of one research boat by GCES for the purposes of surveying created some minor difficulties during Trip 9, 1993. We recommend that if additional research boats are going to be added to the manifest of a trip, a boatman should accompany the boat or arrangements should be made for the safe transport of the boat to the takeout. The boat was transported, rolled and loaded on a 37' support raft.

2. The lower crew netting boat had to be repaired several times during Trip 9, 1993 due to failure of previous seam patching. This resulted in extra manpower to repair the boat on-site and loss of netting effort. The boat will be repaired and be in working order for the November trip.

RECOMMENDATIONS

1. Further study into the Middle Granite Gorge aggregation of chubs should be implemented.

2. We recommend continued and enhanced coordination among the researchers in Grand Canyon. This coordination is essential to insure that all researchers are aware of others activities.

Table 1. Logistics and Research Schedule for Trip 9, 1993, Team 1.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
09/09	30.0	Fence Fault	X	X		
09/10	30.0	Fence Fault		X		
09/11	51.8	Little Nankoweep	X	X		
09/12	51.8	Little Nankoweep		X		
09/13	58.3	Awatubi	X	X		
09/14	58.3	Awatubi		X		
09/15	61.3	LCR	X	X		X
09/16	61.3	LCR		X		X
09/17	61.3	LCR		X		X
09/18	65.4	Lava Chuar	X	X		X
09/19	65.4	Lava Chuar		X		X
09/20	65.4	Lava Chuar		X		X
09/21	68	Tanner	X	X		X
09/22	68	Tanner		X		X
09/23	71	Cardinas	X	X		
09/24	87	Cremation	X	X		
09/25	119	119 Mile	X			
09/26	168	Fern Glen	X			
09/27	224	224	X			
09/28	225	Take Out/Diamond	X			

[1]T&R =Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 1. Logistics and Research Schedule for Trip 9, 1993 Team 2.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
09/09	30.3	Fence Fault	X			
09/10	75.8	Papago Creek	X	X		
09/11	75.8	Papago Creek		X		
09/12	87.1	Cremation	X	X		
09/13	87.1	Cremation		X		
09/14	108.3	Lower Bass	X	X		
09/15	108.3	Lower Bass		X		
09/16	119.3	119.3	X	X		
09/17	119.3	119.3		X		
09/18	126.4	Middle Granite Gorge		X		
09/19	126.4	Middle Granite Gorge		X		
09/20	126.4	Middle Granite Gorge		X		
09/21	143.3	Kanab Creek	X	X		
09/22	143.3	Kanab Creek		X		
09/23	156.4	Last Last Chance	X			
09/24	156.4	Last Last Chance				
09/25	172.8	172.8	X	X		
09/26	172.8	172.8				
09/27	225.4	225.4	X	X		
09/28	225.7	Diamond Creek	X	X		

[1] T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 2. Personnel Participating in Trip 9, 1993, Team 1.

PERSONNEL	AFFILIATION	DATES	COMMENTS
B. Masslich	BIO/WEST	09/09 - 09/23	Out Tanner
R. Valdez	BIO/WEST	09/19 - 09/21	In/Out Tanner
B. Cowdell	BIO/WEST	09/09 - 09/25	Out Bright Angel
T. Hougaard	BIO/WEST	09/19 - 09/21	In/Out Tanner
D. McCabe	BIO/WEST	09/09 - 09/25	Out Bright Angel
Y. Converse	BIO/WEST	09/09 - 09/25	Out Bright Angel
L. Brown	BIO/WEST	09/09 - 09/25	Out Bright Angel
J. Witzman	BIO/WEST VOLUNTEER	09/09 - 09/25	Out Bright Angel
S. George	BIO/WEST VOLUNTEER	09/09 - 09/28	
H. George	BIO/WEST VOLUNTEER	09/09 - 09/28	
L. Crist	BOR	09/09 - 09/15	In/Out Tanner
C. Brode	GCES	09/09 - 09/15	Helicopter out LCR
B. Ford	GCES VOLUNTEER	09/09 - 09/15	Helicopter out LCR
D. Walker	GCES VOLUNTEER	09/09 - 09/15	Helicopter out LCR
C. Genious	OARS	09/09 - 09/28	
K. Burnett	OARS	09/09 - 09/28	
S. Rhodes	OARS	09/09 - 09/28	

Table 2. Personnel Participating in Trip 9, 1993, Team 2.			
PERSONNEL	**AFFILIATION**	**DATES**	**COMMENTS**
W. Leibfried	BIO/WEST	09/09 - 09/28	Project Leader
E. Prats	BIO/WEST	09/09 - 09/28	
T. Yates	BIO/WEST	09/09 - 09/28	
P. Trater	BIO/WEST	09/09 - 09/28	
C. Heck	BIO/WEST	09/09 - 09/28	
M. Hensley	BIO/WEST VOLUNTEER	09/09 - 09/28	
C. Sands	BIO/WEST VOLUNTEER	09/09 - 09/28	
T. Wester	BIO/WEST VOLUNTEER	09/09 - 09/28	
S. Bledsoe	OARS	09/09 - 09/28	Trip Leader
K. Smith	OARS	09/09 - 09/28	
M. Richards	OARS	09/09 - 09/28	

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 9, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH	GS
Electrofishing Reach 0 N=18	A	2			36						
	J				6						
	Y										
Electrofishing Reach 1 N=53	A	5	7	7	50		1	6	1	98	
	J	30	2	4	14			1	2	2	
	Y	341	1	2	3				44	2	
Electrofishing Reach 2 N=49	A	3	9		4	25		12	4	7	
	J		2	6	4	4				2	
	Y		1	3							
Electrofishing Reach 3 N=9	A		1					2		1	
	J		3	2					1		
	Y										1
Nets Reach 0 N=59	A	7	3		48						
	J										
	Y										
Nets Reach 1 N=135	A	48	17	9	37	1	1	1			
	J										
	Y										
Nets Reach 2 N=301	A	20	66	33	6	21	1	11			
	J	1									
	Y										

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 9, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH	GS
Nets Reach 3 N=38	A		6	2				13			
	J										
	Y										
Seines Reach 1 N=31	A	1			3				7	40	
	J	209	3	10	1				14	26	
	Y	310	6	25	2		1		2		
Seines Reach 2 N=50	A		3						1	3	
	J	6	3	5	3				2	2	
	Y	27		2	1					3	
Seines Reach 3 N=3	A		2						1	1	
	J		2		1						
	Y									1	
Traps Reach 1 N=330	A										
	J	36			1						
	Y	86			3					1	
Traps Reach 2 N=102	A								15		
	J	3									
	Y	4									
Hoops Reach 2 N=5	A			5	1	2		1	2		
	J	1	4	3							
	Y	1									

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 9, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH	GS
Hoops Reach 3 N=2	A								7		
	J			3	2						
	Y										
Totals	A	86	114	56	185	49	3	46	38	150	0
	J	286	19	33	32	4	0	1	19	32	0
	Y	769	8	32	9	0	1	0	46	7	1
	T	1,141	141	121	226	53	4	47	103	189	1

[2] - A = Adult
J = Juvenile
Y = Young of year

[3] - HB = humpback chub
FM = flannelmouth sucker
BH = bluehead sucker
RB = rainbow trout
BR = brown trout
CC = channel catfish
CP = carp
SD = speckled dace
FH = fathead minnow
GS = green sunfish
FV = flannelmouth variant

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
1	930909	E	002	1F10116060	N		423	688	RA	N	30.90
2	930909	E	002	1F1E483A41	N		411	591	RA	N	30.90
3	930910	N	014	1F1F621947	N		371	422	RA	N	30.70
4	930910	N	016	1F200B5462	N		460	1122	RA	N	30.90
5	930910	N	019	1F1E2C3463	N		330	356	RA	N	30.70
6	930910	N	021	7F7B017115	Y	PITTAG	448	765	RA	N	30.90
7	930910	N	023	1F20051329	N		395	562	RA	N	30.60
8	930910	N	024	1F1F70537F	N		385	660	RA	N	30.70
9	930910	N	024	1F1F754B02	N		405	711	RA	N	30.70
10	930910	S	006	1F1F6B3A1D	N		183	52	RA	N	75.90
11	930910	S	006	1F1F731F30	N		182	53	RA	N	75.90
12	930910	S	006	1F20143F6E	N		199	79	RA	N	75.90
13	930910	S	006	1F20194761	N		173	46	RA	N	75.90
14	930910	S	006	LCP	N		90	6	RA	N	75.90
15	930910	S	006	LCP	N		95	6	RA	N	75.90
16	930910	S	006	LCP	N		58	3	RA	N	75.90
17	930910	S	006	LCP	N		72	3	RA	N	75.90
18	930910	S	006	LCP	N		64	2	RA	N	75.90
19	930910	S	006	LCP	N		124	15	RA	N	75.90
20	930910	S	006	LCP	N		96	7	RA	N	75.90
21	930910	S	006	LCP	N		92	5	RA	N	75.90

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
22	930910	S	006	LCP	N		107	9	RA	N	75.90
23	930910	S	006	LCP	N		69	2	RA	N	75.90
24	930910	S	006	LCP	N		83	5	RA	N	75.90
25	930910	S	006	LCP	N		102	7	RA	N	75.90
26	930910	S	006	LCP	N		119	11	RA	N	75.90
27	930910	S	006	LCP	N		113	10	RA	N	75.90
28	930910	S	006	LCP	N		126	14	RA	N	75.90
29	930910	S	006	LCP	Y	LCP	113	11	RA	N	75.90
30	930910	S	006	LCP	N		116	12	RA	N	75.90
31	930910	S	006	LCP	N		108	7	RA	N	75.90
32	930910	S	006	LCP	N		88	5	RA	N	75.90
33	930910	S	006	LCP	N		100	7	RA	N	75.90
34	930910	S	006	LCP	N		110	9	RA	N	75.90
35	930910	S	006	LCP	N		121	14	RA	N	75.90
36	930910	S	006	LCP	N		136	18	RA	N	75.90
37	930910	S	006	LCP	N		135	19	RA	N	75.90
38	930910	S	006	LCP	N		147	28	RA	N	75.90
39	930910	S	006	LCP	N		151	28	RA	N	75.90
40	930910	S	006	LCP	N		146	28	RA	N	75.90
41	930910	S	006	LCP	N		149	26	RA	N	75.90
42	930910	S	006	LCP	N		166	38	RA	N	75.90
43	930910	S	006	LCP	N		153	27	RA	N	75.90

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
44	930910	S	006	LCP	N		141	24	RA	N	75.90
45	930910	S	006	LCP	N		135	19	RA	N	75.90
46	930910	S	006	LCP	N		127	14	RA	N	75.90
47	930910	S	006	LCP	N		157	25	RA	N	75.90
48	930910	S	006	LCP	N		167	37	RA	N	75.90
49	930910	S	006	LCP	N		151	27	RA	N	75.90
50	930910	S	006	LCP	N		146	24	RA	N	75.90
51	930911	E	001	LCP	N		59	1	RA	N	76.05
52	930911	E	001	LCP	N		57	1	RA	N	76.05
53	930911	E	001	LCP	N		48	1	RA	N	76.05
54	930911	E	002	LCP	N		61	2	RA	N	76.10
55	930911	E	002	LCP	N		53	1	RA	N	76.10
56	930911	E	002	LCP	N		52	1	RA	N	76.10
57	930911	E	003	LCP	N		63	1	RA	N	76.40
58	930911	N	002	LCP	N		57	1	RA	N	76.10
59	930911	N	002	LCP	N		120	14	RA	N	76.10
60	930911	N	002	LCP	N		63	2	RA	N	76.10
61	930911	N	002	LCP	N		56	1	RA	N	76.10
62	930911	N	002	LCP	N		53	1	RA	N	76.10
63	930911	S	001	LCP	N		63	2	RA	N	76.40
64	930911	S	002	1F2003013D	N		169	32	RA	N	76.40
65	930911	S	002	LCP	N		84	3	RA	N	76.40

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
66	930911	S	002	LCP	N		150	26	RA	N	76.40
67	930911	S	002	LCP	N		106	11	RA	N	76.40
68	930911	S	002	LCP	N		110	8	RA	N	76.40
69	930911	S	002	LCP	N		138	21	RA	N	76.40
70	930911	S	002	LCP	N		112	7	RA	N	76.40
71	930911	S	002	LCP	N		119	11	RA	N	76.40
72	930911	S	002	LCP	N		98	7	RA	N	76.40
73	930911	S	002	LCP	N		152	28	RA	N	76.40
74	930911	T	005	LCP	N		61	2	RA	N	76.30
75	930911	T	007	LCP	N		60	2	RA	N	76.30
76	930911	T	007	LCP	N		63	3	RA	N	76.30
77	930911	T	009	LCP	N		71	3	RA	N	76.30
78	930911	T	010	LCP	N		60	1	RA	N	76.30
79	930911	T	014	LCP	N		83	4	RA	N	75.90
80	930912	E	004	LCP	N		105	8	RA	N	76.40
81	930912	E	005	LCP	N		114	19	RA	N	75.90
82	930912	E	005	LCP	N		82	9	RA	N	75.90
83	930912	E	005	LCP	N		60	2	RA	N	75.90
84	930912	E	006	LCP	N		104	8	RA	N	76.40
85	930912	E	006	LCP	N		84	3	RA	N	76.40
86	930912	E	007	LCP	N		138	21	RA	N	76.40
87	930912	S	015	LCP	N		95	9	RA	N	78.50

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
88	930912	S	015	LCP	N		118	18	RA	N	78.50
89	930912	T	016	LCP	N		78	4	RA	N	75.90
90	930912	T	016	LCP	N		99	7	RA	N	75.90
91	930912	T	018	LCP	N		84	5	RA	N	75.90
92	930912	T	018	LCP	N		119	13	RA	N	75.90
93	930912	T	018	LCP	N		60	1	RA	N	75.90
94	930912	T	022	LCP	N		80	5	RA	N	76.30
95	930912	T	026	LCP	Y	LCP	82	4	RA	N	76.00
96	930912	T	026	LCP	N		54	1	RA	N	76.00
97	930912	T	026	LCP	N		53	1	RA	N	76.00
98	930912	T	026	LCP	N		54	1	RA	N	76.00
99	930912	T	026	LCP	N		62	1	RA	N	76.00
100	930912	T	029	LCP	N		64	2	RA	N	76.00
101	930912	T	029	LCP	N		62	2	RA	N	76.00
102	930912	T	029	LCP	N		56	2	RA	N	76.00
103	930913	E	022	1F20094276	Y	PITTAG	218	100	RA	N	58.80
104	930913	N	069	1F20045F5E	N		375	402	RA	N	58.30
105	930913	N	069	7F7D085406	Y	PITTAG	401	525	RA	N	58.30
106	930913	N	069	7F7F332850	Y	PITTAG	360	444	RA	N	58.30
107	930913	N	069	7F7F3E2640	Y	PITTAG	380	417	RA	N	58.30
108	930913	N	069	7F7F3E3867	Y	PITTAG	387	448	RA	N	58.30
109	930914	N	046	1F1E2C2F68	N		260	177	RA	N	108.20

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
110	930914	N	049	1F1E2C494E	N		260	194	RA	N	108.30
111	930914	N	050	1F1E4A7D7C	N		244	186	RA	N	108.30
112	930914	N	078	7F7F332850	Y	PITTAG	356	446	RA	N	59.15
113	930914	N	080	7F7F3D0C7A	Y	PITTAG	354	386	RA	N	59.05
114	930914	N	086	7F7F3E3867	Y	PITTAG	387	448	RA	N	58.00
115	930915	E	032	1F1F63045B	N		208	96	RA	N	62.30
116	930915	E	032	7F7F330526	Y	PITTAG	385	541	RA	N	62.30
117	930915	E	032	DP1	N		99	8	RA	N	62.30
118	930915	N	079	1F20026659	N		263	159	RA	N	108.50
119	930915	N	102	7F7B081206	Y	PITTAG	342	382	RS	N	60.55
120	930915	N	102	7F7D440D7F	Y	PITTAG	352	398	RS	N	60.55
121	930915	N	102	7F7F3A005E	Y	PITTAG	343	321	RS	N	60.55
122	930915	N	102	7F7F3C3E72	Y	PITTAG	341	339	RA	N	60.55
123	930915	N	102	7F7F3E3C40	Y	PITTAG	335	324	RS	N	60.55
124	930915	N	102	7F7F484445	Y	PITTAG	327	301	RS	N	60.55
125	930915	N	105	1F1E4D7E78	Y	CARLIN	383	645	RA	N	60.20
126	930915	N	107	7F7F3C3E72	Y	PITTAG	341	339	RA	N	0.00
127	930915	S	001	DP1	N		68		RA	N	62.75
128	930915	S	001	DP1	N		86		RA	N	62.75
129	930915	S	002	DP1	N		63	1	RA	N	62.70
130	930915	S	002	DP1	N		75	0	RA	N	62.70
131	930915	S	002	DP1	N		70	0	RA	N	62.70

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
132	930915	S	002	DP1	N		64	0	RA	N	62.70
133	930915	S	004	DP1	N		62	0	RA	N	62.70
134	930915	S	004	DP1	N		65	0	RA	N	62.70
135	930915	S	004	DP1	N		71	0	RA	N	62.70
136	930915	S	004	DP1	N		64	0	RA	N	62.70
137	930915	S	004	DP1	N		102	8	RA	N	62.70
138	930915	S	004	DP1	N		70	0	RA	N	62.70
139	930915	S	004	DP1	N		65	0	RA	N	62.70
140	930915	S	004	DP1	N		70	0	RA	N	62.70
141	930915	S	004	DP1	N		70	0	RA	N	62.70
142	930915	S	004	DP1	N		68	0	RA	N	62.70
143	930916	E	033	DP1	N		76	2	RA	N	61.35
144	930916	E	033	DP1	N		56	1	RA	N	61.35
145	930916	E	034	DP1	N		65	1	RA	N	62.10
146	930916	E	034	DP1	N		68	1	RA	N	62.10
147	930916	N	092	7F7F284926	Y	PITTAG	232	121	RA	N	108.50
148	930916	N	112	1F0F790653	Y	PITTAG	455	834	RS	N	61.15
149	930916	N	112	1F20385336	N		410	546	RS	N	61.15
150	930916	N	112	7F7D1B6C59	Y	PITTAG	414	677	RS	N	61.15
151	930916	N	112	7F7D1B7209	Y	PITTAG	424	662	RS	N	61.15
152	930916	N	112	7F7F456C3C	Y	PITTAG	395	345	RS	N	61.15
153	930916	N	114	7F7F3E382D	Y	PITTAG	335	277	RA	N	60.85

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
154	930916	N	114	7F7F447F69	Y	PITTAG	370	380	RA	N	60.85
155	930916	N	115	7F7D170A34	Y	PITTAG	430	563	RA	N	60.90
156	930916	N	115	7F7F3C277A	Y	PITTAG	352	369	RA	N	60.90
157	930916	T	003	UCP	N		65	3	RA	N	108.60
158	930916	T	003	UCP	N		133	22	RA	N	108.60
159	930916	T	046	UCP	N		75	3	RA	N	108.60
160	930916	T	047	UCP	N		84	5	RA	N	108.60
161	930916	T	047	UCP	N		82	5	RA	N	108.60
162	930916	T	078	DP1	N		62	0	RA	N	61.30
163	930916	T	083	DP1	N		66	0	RA	N	61.70
164	930916	T	084	DP1	N		62	0	RA	N	61.70
165	930917	E	038	1F204F363C	N		161	32	RA	N	62.40
166	930917	E	038	7F7B021765	N		244	136	RA	N	62.50
167	930917	E	039	DP1	N		66	4	RA	N	62.50
168	930917	E	039	DP1	N		70	4	RA	N	62.50
169	930917	E	039	DP1	N		69	4	RA	N	62.50
170	930917	E	039	DP1	N		70	3	RA	N	62.50
171	930917	E	040	DP1	N		66	2	RA	N	62.50
172	930917	E	041	DP1	N		81	7	RA	N	62.50
173	930917	N	119	7F7D027D75	Y	PITTAG	401	593	RA	N	61.15
174	930917	N	126	1F1F6E094B	N		373	450	RA	N	61.75
175	930917	N	126	1F2F461E4E	N		339	262	RA	N	61.75

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
176	930917	N	126	7F7D180249	Y	PITTAG	372	442	RS	N	61.75
177	930917	N	126	7F7D51556A	Y	PITTAG	363	453	RA	N	61.75
178	930917	N	127	7F7D1B6833	Y	PITTAG	275	182	RA	N	61.95
179	930917	N	130	7F7B024F45	Y	PITTAG	365	434	RA	N	63.70
180	930917	N	130	7F7D07603D	Y	PITTAG	295	252	RA	N	63.70
181	930917	N	130	7F7D22647A	Y		346	359	RA	N	61.75
182	930917	N	130	7F7D241874	Y	PITTAG	358	370	RS	N	61.75
183	930917	N	130	7F7F256325	Y	PITTAG	351	403	RS	N	61.75
184	930917	N	130	7F7F264D42	Y	PITTAG	385	521	RA	N	63.70
185	930917	N	130	7F7F295D4F	Y	PITTAG	378	501	RA	N	63.70
186	930917	N	130	7F7F450C5C	Y	PITTAG	395	656	RS	N	61.75
187	930917	N	130	7F7F477E3D	Y	PITTAG	359	360	RS	N	61.75
188	930917	S	007	1F1E487506	N		357	417	RA	N	61.85
189	930917	T	113	DP1	N		70	0	RA	N	61.30
190	930917	T	118	DP1	N		63	0	RA	N	61.30
191	930917	T	119	DP1	N		64	0	RA	N	61.30
192	930918	E	042	7F7D400C65	N		367	394	RA	N	62.65
193	930918	E	042	DP1	N		73	3	RA	N	62.65
194	930918	E	042	DP1	N		80	3	RA	N	62.65
195	930918	E	042	DP1	N		97	8	RA	N	62.65
196	930918	E	042	DP1	N		66	3	RA	N	62.65
197	930918	E	043	1F1E395832	N		163	40	RA	N	64.40

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
198	930918	E	043	DP1	N		118	12	RD	N	64.40
199	930918	E	044	DP1	N		133	22	RA	N	63.50
200	930918	E	044	DP1	N		136	22	RA	N	63.50
201	930918	E	044	DP1	N		136	25	RA	N	63.50
202	930918	E	044	DP1	N		107	12	RA	N	63.50
203	930918	N	145	7F7F477B76	Y	PITTAG	223	122	RA	N	127.55
204	930918	N	148	1F20077743	N		239	135	RA	N	127.10
205	930918	N	149	7F7D084B48	Y	PITTAG	206	90	RA	N	127.55
206	930918	N	150	1F0937445D	Y	PITTAG	237	143	RA	N	127.50
207	930918	S	009	1F1F591257	N		198	72	RA	N	63.90
208	930918	S	009	1F203F1270	N		159	37	RA	N	63.90
209	930918	S	009	DP1	N		96	0	RA	N	63.90
210	930918	S	009	DP1	N		79	3	RA	N	63.90
211	930918	S	009	DP1	N		112	13	RA	N	63.90
212	930918	S	009	DP1	N		132	18	RA	N	63.90
213	930918	S	009	DP1	N		93	7	RA	N	63.90
214	930918	S	009	DP1	N		77	3	RA	N	63.90
215	930918	S	009	DP1	N		72	4	RA	N	63.90
216	930918	S	009	DP1	N		103	9	RA	N	63.90
217	930918	S	009	DP1	N		65	1	RA	N	63.90
218	930918	S	009	DP1	N		97	7	RA	N	63.90
219	930918	S	009	DP1	N		85	4	RA	N	63.90

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
220	930918	S	009	DP1	N		70	2	RA	N	63.90
221	930918	S	009	DP1	N		134	21	RA	N	63.90
222	930918	S	009	DP1	N		122	14	RA	N	63.90
223	930918	S	009	DP1	N		130	17	RA	N	63.90
224	930918	S	009	DP1	N		140	25	RA	N	63.90
225	930918	S	009	DP1	N		102	8	RA	N	63.90
226	930918	S	009	DP1	N		98	7	RA	N	63.90
227	930918	S	009	DP1	N		85	8	RA	N	63.90
228	930918	S	009	DP1	N		129	18	RA	N	63.90
229	930918	S	009	DP1	N		142	25	RA	N	63.90
230	930918	S	009	DP1	N		115	11	RA	N	63.90
231	930918	S	009	DP1	N		122	16	RA	N	63.90
232	930918	S	009	DP1	N		98	7	RA	N	63.90
233	930918	S	009	DP1	N		90	6	RA	N	63.90
234	930918	S	009	DP1	N		152	30	RA	N	63.90
235	930918	S	009	DP1	N		143	24	RA	N	63.90
236	930918	S	009	DP1	N		153	29	RA	N	63.90
237	930918	S	009	DP1	N		96	6	RA	N	63.90
238	930918	S	009	DP1	N		115	11	RA	N	63.90
239	930918	S	009	DP1	N		105	9	RA	N	63.90
240	930918	S	009	DP1	N		115	12	RA	N	63.90
241	930918	S	009	DP1	N		113	13	RA	N	63.90

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
242	930918	S	009	DP1	N		144	21	RAN63.90		
243	930918	S	009	DP1	N		115	13	RA	N	63.90
244	930918	S	009	DP1	N		126	16	RA	N	63.90
245	930918	S	009	DP1	N		128	16	RA	N	63.90
246	930918	S	009	DP1	N		143	26	RA	N	63.90
247	930918	S	009	DP1	N		107	9	RA	N	63.90
248	930918	S	009	DP1	N		135	25	RA	N	63.90
249	930918	S	009	DP1	N		142	23	RA	N	63.90
250	930918	S	009	DP1	N		125	15	RA	N	63.90
251	930918	S	009	DP1	N		144	25	RA	N	63.90
252	930918	S	009	DP1	N		128	17	RA	N	63.90
253	930918	S	009	DP1	N		110	11	RA	N	63.90
254	930918	S	009	DP1	N		91	6	RA	N	63.90
255	930918	S	009	DP1	N		104	9	RA	N	63.90
256	930918	S	009	DP1	N		112	11	RA	N	63.90
257	930918	S	009	DP1	N		120	16	RA	N	63.90
258	930918	S	047	UCP	N		112	13	RA	N	120.50
259	930918	S	052	1F1F7D5E67	N		196	69	RA	N	122.85
260	930918	S	052	UCP	N		133	18	RA	N	122.85
261	930918	S	052	UCP	N		82	4	RA	N	122.85
262	930919	N	046	1F1F6E567E	N		165	37	RA	N	63.80
263	930919	N	046	DP1	N		132	16	RA	N	63.80

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
264	930919	N	142	7F7F395960	Y	PITTAG	371	490	RA	N	64.45
265	930919	N	153	1F20122B04	N		205	88	RA	N	127.55
266	930919	N	153	1F201D4A5A	N		212	96	RA	N	127.55
267	930919	N	153	7F7B1F102A	Y	PITTAG	218	90	RA	N	127.55
268	930919	N	156	1F20393553	Y	PITTAG	287	226	RS	N	127.10
269	930919	N	157	7F7F1F1E5C	Y	PITTAG	301	320	RS	N	127.55
270	930919	N	157	7F7F333501	Y	PITTAG	238	140	RA	N	127.55
271	930919	N	158	7F7D075A72	Y	PITTAG	278	241	RS	N	127.50
272	930919	N	162	1F0F7D2431	Y	PITTAG	215	98	RA	N	127.55
273	930919	S	010	7F7B026D52	N		161	34	RA	N	64.70
274	930919	S	010	7F7D7C276D	N		180	51	RA	N	64.70
275	930919	S	010	7F7F265C3A	N		172	40	RA	N	64.70
276	930919	S	010	7F7F284D2D	N		182	57	RA	N	64.70
277	930919	S	010	DP1	N		125	16	RA	N	64.70
278	930919	S	010	DP1	N		125	16	RA	N	64.70
279	930919	S	010	DP1	N		132	21	RA	N	64.70
280	930919	S	010	DP1	N		143	22	RA	N	64.70
281	930919	S	010	DP1	N		117	11	RA	N	64.70
282	930919	S	010	DP1	N		131	20	RA	N	64.70
283	930919	S	010	DP1	N		105	11	RA	N	64.70
284	930919	S	010	DP1	N		135	20	RA	N	64.70
285	930919	S	010	DP1	N		154	30	RA	N	64.70

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
286	930919	S	010	DP1	N		130	19	RA	N	64.70
287	930919	S	010	DP1	N		135	19	RA	N	64.70
288	930919	S	010	DP1	N		132	19	RA	N	64.70
289	930919	S	010	DP1	N		135	21	RA	N	64.70
290	930919	S	010	DP1	N		85	5	RA	N	64.70
291	930919	S	010	DP1	N		130	15	RA	N	64.70
292	930919	S	010	DP1	N		125	19	RA	N	64.70
293	930919	S	010	DP1	N		104	8	RA	N	64.70
294	930919	S	010	DP1	N		107	7	RA	N	64.70
295	930919	S	010	DP1	N		113	12	RA	N	64.70
296	930919	S	010	DP1	Y	DP1	121	19	RA	N	64.70
297	930919	S	010	DP1	N		118	11	RA	N	64.70
298	930919	S	010	DP1	N		131	16	RA	N	64.70
299	930919	S	010	DP1	N		105	12	RA	N	64.70
300	930919	S	010	DP1	N		107	8	RA	N	64.70
301	930919	S	010	DP1	N		112	16	RA	N	64.70
302	930919	S	010	DP1	N		86	5	RA	N	64.70
303	930919	S	010	DP1	N		110	10	RA	N	64.70
304	930919	S	010	DP1	N		140	23	RA	N	64.70
305	930919	S	010	DP1	N		113	10	RA	N	64.70
306	930919	S	010	DP1	N		143	22	RA	N	64.70
307	930919	S	010	DP1	N		97	6	RA	N	64.70

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
308	930919	S	010	DP1	N		107	10	RA	N	64.70
309	930919	S	010	DP1	N		95	5	RA	N	64.70
310	930919	S	010	DP1	N		122	12	RA	N	64.70
311	930919	S	010	DP1	N		131	16	RA	N	64.70
312	930919	S	010	DP1	N		100	8	RA	N	64.70
313	930919	S	010	DP1	N		136	21	RA	N	64.70
314	930919	S	010	DP1	N		144	26	RA	N	64.70
315	930919	S	010	DP1	N		145	25	RA	N	64.70
316	930919	S	010	DP1	N		153	31	RA	N	64.70
317	930919	S	010	DP1	N		111	11	RA	N	64.70
318	930919	S	010	DP1	N		94	7	RA	N	64.70
319	930919	S	010	DP1	N		134	21	RA	N	64.70
320	930919	S	010	DP1	N		112	11	RA	N	64.70
321	930919	S	010	DP1	N		130	20	RA	N	64.70
322	930919	S	010	DP1	N		78	4	RA	N	64.70
323	930919	S	010	DP1	N		88	5	RA	N	64.70
324	930919	S	010	DP1	N		97	6	RA	N	64.70
325	930919	S	010	DP1	N		97	7	RA	N	64.70
326	930919	S	010	DP1	N		117	16	RA	N	64.70
327	930919	S	010	DP1	N		107	11	RA	N	64.70
328	930919	S	010	DP1	N		85	4	RA	N	64.70
329	930919	S	010	DP1	N		57	1	RA	N	64.70

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
330	930919	S	010	DP1	N		114	10	RA	N	64.70
331	930919	S	010	DP1	N		113	10	RA	N	64.70
332	930919	S	010	DP1	N		77	3	RA	N	64.70
333	930919	S	010	DP1	N		90	4	RA	N	64.70
334	930919	S	010	DP1	N		86	6	RA	N	64.70
335	930919	S	010	DP1	N		132	18	RA	N	64.70
336	930919	S	010	DP1	N		82	5	RA	N	64.70
337	930919	S	010	DP1	N		106	8	RA	N	64.70
338	930919	S	011	DP1	N		141	23	RA	N	64.70
339	930919	T	153	DP1	N		110	12	RA	N	63.50
340	930919	T	153	DP1	N		98	7	RA	N	63.50
341	930919	T	154	DP1	N		97	7	RA	N	63.50
342	930919	T	157	DP1	N		98	7	RA	N	63.55
343	930920	N	047	DP1	N		80	3	RA	N	64.55
344	930920	N	047	DP1	N		86	4	RA	N	64.55
345	930920	N	149	1F200C783D	N		237	125	RA	N	64.95
346	930920	N	149	7F7F3C3956	Y	PITTAG	234	121	RA	N	64.95
347	930920	N	151	1F1F62352B	N		401	649	RA	N	65.30
348	930920	N	155	1F201B3A6C	N		353	438	RA	N	65.30
349	930920	N	155	7F7D2B147F	Y	PITTAG	369	454	RA	N	65.30
350	930920	N	155	7F7F3C330D	Y	PITTAG	356	454	RA	N	65.30
351	930920	N	155	7F7F3E3E12	Y	PITTAG	393	571	RA	N	65.30

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
352	930920	N	201	1F2032741B	N		319	360	RS	N	128.90
353	930920	N	206	1F20493048	N		215	43	RA	N	127.50
354	930920	S	012	1F20226936	N		167	45	RA	N	64.80
355	930920	S	012	DP1	N		80	6	RA	N	64.80
356	930920	S	012	DP1	N		102	16	RA	N	64.80
357	930920	S	012	DP1	N		94	6	RA	N	64.80
358	930920	S	012	DP1	N		85	4	RA	N	64.80
359	930920	S	012	DP1	N		135	18	RA	N	64.80
360	930920	S	012	DP1	N		142	25	RA	N	64.80
361	930920	S	013	DP1	N		119	14	RA	N	64.80
362	930920	T	184	DP1	N		83	0	RA	N	63.55
363	930920	T	190	DP1	N		72	0	RA	N	63.70
364	930921	N	051	DP1	N		90	6	RA	N	63.75
365	930921	N	051	DP1	N		71	2	RA	N	63.75
366	930921	N	052	LCP1	N		122	21	RA	N	66.10
367	930921	N	052	LCP1	N		105	9	RA	N	66.10
368	930921	N	052	LCP1	N		108	12	RA	N	66.10
369	930921	N	212	1F20367D0E	N		184	53	RA	N	127.55
370	930921	N	214	1F2F453D30	N		240	132	RA	N	128.90
371	930921	N	217	1F20183B6E	Y	PITTAG	268	158	RS	N	127.55
372	930921	S	016	LCP1	N		103	11	RA	N	66.30
373	930921	S	020	LCP1	N		129	15	RA	N	67.00

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
374	930921	S	020	LCP1	N		80	3	RA	N	67.00
375	930921	T	196	DP1	N		98	0	RA	N	64.40
376	930921	T	202	DP1	N		105	8	RA	N	63.50
377	930921	T	208	DP1	N		66	0	RA	N	63.55
378	930921	T	209	DP1	N		110	10	RA	N	63.55
379	930921	T	222	DP1	N		56	0	RA	N	64.40
380	930921	T	227	LCP1	N		95	0	RA	N	67.75
381	930921	T	232	LCP1	N		116	11	RAN67.55		
382	930921	T	233	LCP1	N		101	9	RA	N	67.55
383	930921	T	244	LCP1	N		108	13	RA	N	68.00
384	930922	S	022	LCP1	N		89	9	RA	N	68.30
385	930922	S	022	LCP1	N		119	15	RA	N	68.30
386	930922	T	267	LCP1	N		91	7	RA	N	68.00
387	930922	T	269	LCP1	N		94	8	RA	N	68.00
388	930922	T	270	LCP1	N		91	6	RA	N	68.00
389	930923	N	062	LCP1	N		81	6	RA	N	70.90
390	930923	N	252	1F1F5D7868	N		221	90	RA	N	142.40
391	930923	S	025	LCP1	N		73	3	RA	N	72.50
392	930923	S	025	LCP1	N		103	0	RA	N	72.50
393	930923	S	025	LCP1	N		70	0	RA	N	72.50
394	930923	S	025	LCP1	N		115	14	RA	N	72.50
395	930923	S	025	LCP1	N		95	7	RA	N	72.50

Table 4. Summary of Humpback Chub handled during Trip 9, 1993. (Includes 412 marked or recaptured of 1,141 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
396	930923	S	025	LCP1	N		122	16	RA	N	72.50
397	930923	S	025	LCP1	N		118	16	RA	N	72.50
398	930923	S	025	LCP1	N		114	11	RA	N	72.50
399	930923	S	025	LCP1	N		93	7	RA	N	72.50
400	930923	S	025	LCP1	N		107	9	RA	N	72.50
401	930923	S	025	LCP1	N		120	16	RA	N	72.50
402	930923	S	025	LCP1	N		125	19	RA	N	72.50
403	930923	S	025	LCP1	N		87	6	RA	N	72.50
404	930923	S	025	LCP1	N		90	6	RA	N	72.50
405	930923	T	272	LCP1	N		106	10	RA	N	70.40
406	930923	T	272	LCP1	N		90	7	RA	N	70.40
407	930924	T	274	LCP1	N		75	4	RA	N	70.40
408	930924	T	277	LCP1	N		78	3	RA	N	70.60
409	930924	T	277	LCP1	N		86	6	RA	N	70.60
410	930924	T	278	LCP1	N		117	13	RA	N	70.60
411	930924	T	286	LCP1	N		73	0	RA	N	72.30
412	930925	N	312	1F2021643C	N		393	523	RS	N	156.45

CHARACTERIZATION OF THE LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE GRAND CANYON

TRIP REPORT 10 - 1993
October 7 - 22, 1993

Prepared For:

Bureau of Reclamation

Prepared By:

Richard A. Valdez, Principal Investigator
William Masslich, Project Leader

BIO/WEST INC.
1063 West 1400 North
Logan, UT. 84321

October 30, 1993

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LIST OF TABLES

INTRODUCTION

This report presents pertinent details associated with Trip 10, 1993. Included in the report are a summary of trip logistics, personnel and research schedule, data collected, problems encountered, pertinent observations and recommendations. Most information is presented in a tabular format to provide a quick synopsis of trip details and results. We emphasize that these data are hand tabulated to provide these synopses as soon as possible. The data are later computerized and checked for accuracy. The purpose of these trip reports is to provide information from BIO/WEST trips as quickly as possible to aid other researchers.

LOGISTICS, RESEARCH SCHEDULE AND PERSONNEL

Table 1 presents a summary of logistics and the research schedule for Trip 10, 1993. Table 2 is a list of personnel who were present or participated in research activities for Trip 10, 1993.

DATA COLLECTED

Table 3 is a summary of gear types used, sampling effort and fish captured by gear type for Trip 10, 1993. Table 4 is a summary of all humpback chubs marked or recaptured during Trip 10, 1993.

Humpback Chubs Captured

A total of 754 humpback chub were captured during Trip 10, 1993 including 643 young-of-year (YOY)(<80 mm), 67 juveniles (80-199 mm TL), and 44 adults (>199 mm TL). Seven of these chub (all adults) were captured in nets in Reach 0. In Reach 1, 21 juveniles and 255 YOY were captured with seines. Three hundred and fifty-six chubs, including 10 juveniles and 246 YOY were captured electrofishing. Netting produced 37 adult humpback chub and 2 juveniles. One hundred and seventy-six chubs were also captured in unbaited minnow traps, including 34 juveniles and 142 YOY.

Of the 37 adult humpback chub captured in Reach 1, 31 (or 84%) were PIT-tagged recaptures (includes those captured and marked by other investigators). In Reach 0, three of the seven (43%) adults captured were PIT-tag recaptures. However, two of these fish were recaptures of fish tagged during the same trip. The third fish was originally tagged at RM 29.8 during Trip 3, 1993, approximately 0.5 miles from its original capture location.

Stomach contents of 10 humpback chubs were collected in Reach 1 using non-lethal stomach pumping techniques.

Two incidental mortalities of YOY humpback chub occurred during Trip 10, 1993. One YOY humpback chub was lost in a sein at RM 63.7 on October 17. The fish measured 58 mm TL. The second fish was found dead in the live well following an electrofishing run at RM 65.1 on October 17. The fish measured 44 mm TL. Both carcasses were preserved for transfer to AGF.

Observed Condition of Humpback Chub

All chubs captured, with the exception of one juvenile appeared healthy and in good condition. The juvenile, captured in the vicinity of Lava Chuar, had a extremely malformed skull, most likely a

congenital abnormality. Except for the skull abnormality, the fish was in good condition. Also noteworthy were the presence of parasitic copepods (Lernaea sp.), on approximately 0.5% of juvenile chubs handled. It is suspected that these fish recently resided in the LCR where temperature regimes are more suitable for these parasites.

Non-lethal stomach pumping of 10 humpback chubs indicated that tapeworms were present in approximately 20% of the fish that were successfully evacuated.

Habitat Mapping

Juvenile habitat mapping was conducted in ten locations between the confluence of the LCR and Tanner Rapid.

Bench Marks

No new bench marks were established during Trip 10, 1993.

OBSERVATIONS

1. Runoff from the Paria River created high main channel turbidity until October 14. Mainchannel turbidity above the LCR was low for approximately 1 day before another spate of turbidity created high turbidity above the LCR for the remainder of the trip. Turbidity below the LCR was high for the duration of Trip 10, 1993.

2. High densities of YOY humpback chub were observed in the main channel from the confluence of the LCR (RM 61.3) to Tanner Rapid (RM 68.5) during Trip 10, 1993. YOY humpback were captured in nearly all shoreline types by electrofishing, seining and minnow trapping.

3. All rainbow trout captured in conjunction with YOY humpback chub were sacrificed for stomach analysis. At least one trout appeared to have the remains of three unidentified fish in its stomach. These will be examined in the laboratory to confirm identification.

PROBLEMS ENCOUNTERED AND SOLUTIONS

1. Copious amount of debris from the Paria, significantly affected netting efforts during the first day of Trip 10, 1993, resulting in reduced sampling effort.

RECOMMENDATIONS

1. We recommend continued and enhanced coordination among the researchers in Grand Canyon. This coordination is essential to insure that all researchers are aware of others activities.

Table 1. Logistics and Research Schedule for Trip 10, 1993.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
10/07	11.1	Soap Creek	X	X		
10/08	11.1	Soap Creek		X		
10/09	30.3	Fence Fault	X	X		
10/10	30.3	Fence Fault		X		
10/11	58.4	Awatubi	X	X		
10/12	58.4	Awatubi		X		
10/13	61.3	LCR	X	X		X
10/14	61.3	LCR		X		X
10/15	61.3	LCR		X		X
10/16	65.4	Lava Chuar	X	X		X
10/17	65.4	Lava Chuar		X		X
10/18	68.3	Tanner	X	X		X
10/19	87.6	Cremation	X	X		X
10/20	132	Stone Creek	X			
10/21	193	Boulder Wash	X			
10/22	225	Diamond Creek	X			

[1]T&R =Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 2. Personnel Participating in Trip 10, 1993.

PERSONNEL	AFFILIATION	DATES	COMMENTS
B. Masslich	BIO/WEST	10/07 - 10/15	Project Leader
T. Wasowicz	BIO/WEST	10/07 - 10/20	Senior Biologist
C. Heck	BIO/WEST	10/07 - 10/20	Out Bright Angel
Y. Converse	BIO/WEST	10/07 - 10/20	Out Bright Angel
S. Reeder	BIO/WEST	10/07 - 10/20	Out Bright Angel
D. Hickman	BIO/WEST	10/07 - 10/20	Out Bright Angel
R. Ryel	BIO/WEST	10/07 - 10/15	Out Tanner
B. Pyle	BIO/WEST VOLUNTEER	10/07 - 10/20	Out Bright Angel
S. Lanigan	BIO/WEST VOLUNTEER	10/07 - 10/20	Out Bright Angel
K. McNeil	BIO/WEST VOLUNTEER	10/07 - 10/20	Out Bright Angel
K. Blakney	BOR	10/07 - 10/15	Out Tanner
S. Bledso	OARS	10/07 - 10/22	Trip Leader
K. Burnett	OARS	10/07 - 10/22	
M. Richards	OARS	10/07 - 10/22	

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 10, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CP	SD	PK	FH
Electrofishing Reach 0 N=19	A		1		142		3	2		
	J				76					
	Y				18					
Electrofishing Reach 1 N=51	A		5	1	61		4	38		39
	J	10	3	1	40		1		1	6
	Y	246	2		5					
Nets Reach 0 N=39	A	7	2	1	96		2			
	J									
	Y									
Nets Reach 1 N=70	A	37	33	4	48	2	1			
	J	2			1					
	Y									
Seines Reach 1 N=31	A		2		5			33	1	110
	J	21	8	1	2			6		
	Y	255	11	8						
Traps Reach 1 N=64	A							2		5
	J	34								
	Y	142								
Totals	A	44	43	6	352	2	10	75	1	154
	J	67	11	2	119	0	1	6	1	6
	Y	643	13	8	23	0	0	0	0	0
	T	754	67	16	494	2	11	81	2	160

[2] - A = Adult
J = Juvenile
Y = Young of year

[3] - HB = humpback chub
FM = flannelmouth sucker
BH = bluehead sucker
RB = rainbow trout
BR = brown trout
CP = carp
SD = speckled dace
PK = plains killifish
FH = fathead minnow

Table 4. Summary of Humpback Chub handled during Trip 10, 1993. (Includes 105 marked or recaptured of 754 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
1	931009	N	016	1F30734B73	N		403	692	RA	N	30.60
2	931009	N	017	1F1E4A3148	N		410	625	RA	N	30.70
3	931009	N	017	1F20473E3C	N		390	519	RA	N	30.70
4	931009	N	017	7F7B081513	Y	PITTAG	454	732	RA	N	30.70
5	931009	N	020	1F1E4A3148	Y	PITTAG	406	635	RA	N	30.70
6	931009	N	020	1F20443647	N		390	542	RA	N	30.70
7	931009	N	020	1F20473E3C	Y	PITTAG	382	521	RA	N	30.70
8	931011	N	042	1F1F760646	N		377	539	RA	N	58.25
9	931011	N	043	7F7F3F3D79	Y	PITTAG	340	340	RA	N	58.30
10	931011	N	049	7F7F3E2E05	Y	PITTAG	342	351	RA	N	58.25
11	931012	N	055	1F0F780C4E	Y	PITTAG	433	718	RA	N	59.10
12	931013	N	059	7F7F455273	Y	PITTAG	385	502	RA	N	60.20
13	931013	N	059	7F7F455E3F	Y	PITTAG	430	793	RA	N	60.20
14	931013	N	063	7F7B081802	Y	PITTAG	312	257	RA	N	60.20
15	931013	N	063	7F7D22515A	Y	PITTAG	296	197	RA	N	60.20
16	931013	N	063	7F7E432B20	Y	PITTAG	225	120	RA	N	60.20
17	931013	N	063	7F7F3F4B2D	Y	PITTAG	268	178	RA	N	60.20
18	931013	N	065	7F7D47774E	Y	PITTAG	389	528	RA	N	60.50
19	931013	N	066	7F7F042F46	Y	PITTAG	319	261	RA	N	60.85
20	931013	N	066	7F7F18323C	Y	PITTAG	258	163	RA	N	60.85
21	931013	N	067	7F7F485268	Y	PITTAG	323	450	RA	N	60.20

Table 4. Summary of Humpback Chub handled during Trip 10, 1993. (Includes 105 marked or recaptured of 754 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
22	931013	N	069	7F7D22655B	Y	PITTAG	326	265	RA	N	60.50
23	931013	S	004	1F20323D52	N		184	39	RA	N	61.50
24	931013	S	004	DP-1	N		96	6	RA	N	61.50
25	931013	S	008	1F200C062F	N		178	36	RA	N	61.90
26	931013	S	008	DP-1	N		131	15	RA	N	61.90
27	931013	S	008	DP-1	Y	UCLP2	145	21	RA	N	61.90
28	931013	S	008	DP-1	Y	UCLP2	145	21	RA	N	61.90
29	931013	S	008	DP-1	N		124	13	RA	N	61.90
30	931013	S	008	DP-1	N		82	4	RA	N	61.90
31	931013	T	082	DP-1	N		110	10	RA	N	60.95
32	931013	T	088	DP-1	N		90	6	RA	N	61.15
33	931013	T	096	DP-1	N		88	5	RA	N	61.70
34	931014	E	044	DP-1	N		82	3	RA	N	62.50
35	931014	E	050	DP-1	N		105	8	RA	N	63.50
36	931014	N	070	7F7D482A71	Y	PITTAG	312	252	RS	N	60.90
37	931014	N	076	7F7F05170F	Y	PITTAG	420	653	RS	N	61.20
38	931014	N	077	7F7D226C23	Y	PITTAG	310	290	RS	N	61.30
39	931014	S	010	7F2033305E	N		166	30	RA	N	62.25
40	931014	S	010	7F2033305E	N		67	0	RA	N	62.25
41	931014	S	010	DP-1	N		91	6	RA	N	62.25
42	931014	S	010	DP-1	N		86	5	RA	N	62.25
43	931014	S	011	1F1E2F553F	N		186	32	RA	N	62.25

Table 4. Summary of Humpback Chub handled during Trip 10, 1993. (Includes 105 marked or recaptured of 754 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
44	931014	S	011	1F1E32622F	Y	PITTAG	162	26	RA	N	62.25
45	931014	S	012	1F2F650F3E	Y	LCRP2	152	27	RA	N	62.70
46	931014	S	012	DP-1	N		154	19	RA	N	62.70
47	931014	S	012	DP-1	N		74	2	RA	N	62.70
48	931014	S	012	DP-1	N		145	18	RA	N	62.70
49	931014	S	012	DP-1	N		96	7	RA	N	62.70
50	931014	S	012	DP-1	N		130	18	RA	N	62.70
51	931014	S	012	DP-1	N		72	0	RA	N	62.70
52	931014	S	012	DP-1	N		113	15	RA	N	62.70
53	931014	S	012	DP-1	N		127	14	RA	N	62.70
54	931014	S	012	DP-1	N		120	15	RA	N	62.70
55	931014	S	012	DP-1	N		119	16	RA	N	62.70
56	931014	S	013	DP-1	N		74	0	RA	N	62.70
57	931014	S	013	DP-1	N		71	0	RA	N	62.70
58	931014	T	102	DP-1	N		131	14	RA	N	61.70
59	931014	T	112	DP-1	Y	DP-1	76	3	RA	N	60.95
60	931015	N	083	1F1F700C46	N		421	615	RA	N	61.70
61	931015	N	083	7F7D2A5563	Y	PITTAG	392	590	RA	N	61.70
62	931015	N	085	1F0938653B	Y	PITTAG	286	192	RA	N	62.10
63	931015	N	085	1F14756177	N		228	129	RA	N	62.10
64	931015	N	085	1F1F747559	Y	PITTAG	280	165	RA	N	62.10
65	931015	N	085	1F20427B04	N		188	66	RA	N	62.10

Table 4. Summary of Humpback Chub handled during Trip 10, 1993. (Includes 105 marked or recaptured of 754 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
66	931015	N	085	1F235A4D17	N		250	143	RA	N	62.10
67	931015	N	085	7F7D172A13	Y	PITTAG	238	110	RA	N	62.10
68	931015	N	085	7F7F26184E	Y	PITTAG	258	146	RA	N	62.10
69	931015	N	085	7F7F27263D	Y	PITTAG	300	230	RA	N	62.10
70	931015	N	087	7F7D177D40	Y	PITTAG	394	535	RA	N	61.70
71	931015	N	089	1F201A6D3A	N		247	151	RA	N	62.10
72	931015	T	151	DP-1	N		137	16	RA	N	61.70
73	931015	T	151	DP-1	N		136	14	RA	N	61.70
74	931015	T	152	DP-1	N		103	2	RA	N	61.70
75	931015	T	154	DP-1	N		113	2	RA	N	61.70
76	931015	T	156	DP-1	N		99	9	RA	N	61.30
77	931016	E	059	DP-1	N		120	14	RA	N	63.70
78	931016	E	060	UCP-1	Y	UCP-1	50	0	RA	N	63.70
79	931016	N	094	7F7D31706D	Y	PITTAG	386	680	RA	N	63.70
80	931016	N	095	7F7B026C7C	Y	PITTAG	403	584	RS	N	63.90
81	931016	N	095	7F7F182C70	Y	PITTAG	366	443	RS	N	63.90
82	931016	T	182	DP-1	N		95	6	RA	N	62.35
83	931016	T	182	DP-1	N		84	5	RA	N	62.35
84	931017	N	096	7F7F3F4802	Y	PITTAG	377	665	RS	N	64.95
85	931017	N	097	7F7D3F7F4A	Y	PITTAG	248	187	RS	N	65.20
86	931017	N	098	7F7F275859	Y	PITTAG	391	549	RS	N	65.20

Table 4. Summary of Humpback Chub handled during Trip 10, 1993. (Includes 105 marked or recaptured of 754 fish captured)											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
87	931017	N	099	######### #	N		183	71	RA	N	65.30
88	931017	N	099	7F7F3E317C	Y	PITTAG	320	286	RS	N	65.30
89	931017	T	226	DP-1	N		124	14	RA	N	65.25
90	931017	T	232	DP-1	N		103	9	RA	N	65.10
91	931017	T	241	DP-1	N		91	7	RA	N	64.55
92	931017	T	255	DP-1	N		78	2	RA	N	64.35
93	931017	T	255	DP-1	N		97	9	RA	N	64.35
94	931017	T	260	DP-1	N		97	7	RA	N	64.55
95	931017	T	260	DP-1	N		82	5	RA	N	64.55
96	931017	T	262	DP-1	N		102	9	RA	N	65.10
97	931017	T	262	DP-1	N		109	12	RA	N	65.10
98	931017	T	263	DP-1	N		86	5	RA	N	65.10
99	931017	T	264	DP-1	N		85	5	RA	N	65.10
100	931017	T	264	DP-1	N		91	7	RA	N	65.10
101	931017	T	273	DP-1	N		106	12	RA	N	65.40
102	931018	E	067	UCP-1	N		103	9	RA	N	68.10
103	931018	N	107	1F20111D13	N		230	128	RA	N	68.00
104	931018	T	288	DP-1	N		100	8	RA	N	65.10
105	931018	T	292	DP-1	N		104	4	RA	N	65.25

CHARACTERIZATION OF THE LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE GRAND CANYON

TRIP REPORT 11 - 1993
November 3 - 18, 1993

Prepared For:

Bureau of Reclamation

Prepared By:

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BIO/WEST INC.
1063 West 1400 North
Logan, UT. 84321

November 29, 1993

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INTRODUCTION

This report is the last of 36 trip reports scheduled to be submitted by BIO/WEST on this investigation. This report presents pertinent details associated with Trip 11, 1993. Included in the report are a summary of trip logistics, personnel and research schedule, data collected, problems encountered, pertinent observations and recommendations. Most information is presented in a tabular format to provide a quick synopsis of trip details and results. We emphasize that these data are hand tabulated to provide these synopses as soon as possible. The data are later computerized and checked for accuracy. The purpose of these trip reports is to provide information from BIO/WEST trips as quickly as possible to aid other researchers.

LOGISTICS, RESEARCH SCHEDULE AND PERSONNEL

Table 1 presents a summary of logistics and the research schedule for Trip 11, 1993. Table 2 is a list of personnel who were present or participated in research activities for Trip 11, 1993.

DATA COLLECTED

Table 3 is a summary of gear types used, sampling effort and fish captured by gear type for Trip 11, 1993. Table 4 is a summary of all humpback chubs marked or recaptured during Trip 11, 1993.

Humpback Chubs Captured

A total of 270 humpback chub were captured during Trip 11, 1993 including 226 young-of-year (YOY)(<80 mm), 5 juveniles (80-199 mm TL), and 39 adults (>199 mm TL). Four of these chub (all adults) were captured in nets in Reach 0. In Reach 1, 1 juvenile and 21 YOY were captured with seines. Fifty-four chubs, including 5 adults, 2 juveniles and 47 YOY were captured electrofishing. Netting produced 25 adult humpback chub. One hundred-and-sixty chubs were captured in unbaited minnow traps, including 2 juveniles and 158 YOY.

Five adult humpback chubs were captured with nets in Reach 2. Two were captured in the Shinumo Creek area and three were captured in the Middle Granite Gorge.

In Reach 0, two of four (50%) adults captured were PIT-tag recaptures. Both recaptured fish were originally tagged at the same location of capture (a spring along the mainstem at RM 30.5) -- one had been tagged in April 1993, and the other in October 1993. Of 30 adult humpback chub captured in Reach 1, 23 (or 77%) were PIT-tagged recaptures (includes those captured and marked by other investigators). Three of five chub captured in Reach 2 were recaptures (60%). Two chub recaptured at RM 108.3 were previously tagged by BIO/WEST in July 1991 at the same capture location. One chub recaptured at RM 127.1 was originally tagged in November 1992 at RM 127.5, and was recaptured again in March 1993 at the same location. All recaptured fish in Reach 2 had grown in both length and weight since being tagged.

Stomach contents of 22 humpback chubs, 20 from Reach 1 and two from Reach 2, were collected using the non-lethal stomach pumping technique. All fish were released in good condition.

One incidental mortality of a humpback chub occurred during Trip 11, 1993. The YOY chub (47-mm TL) was discovered dead in a minnow trap on November 9 at RM 61.4. The bucket containing the specimen to be preserved was inadvertently emptied into the river and the specimen was lost.

Observed Condition of Humpback Chub

All chubs captured appeared healthy and in good condition, although parasitic copepods (Lernaea sp.) were noted on several subadult chub handled. It is suspected that these fish recently resided in the LCR where temperature regimes are more suitable for these parasites.

Non-lethal stomach pumping of 22 humpback chubs indicated that tapeworms were present in approximately 15% of the fish that were successfully evacuated.

Habitat Mapping

Juvenile habitat mapping was conducted in five locations between the confluence of the LCR and Tanner Rapid.

Bench Marks

No new bench marks were established during Trip 11, 1993. All benchmarks in Reach 2 were photographed for future use and documentation.

OBSERVATIONS

1. Mainstem water turbidity was very low (Secchi readings of 1.0 to 3.4 m) from November 3 - 13. Excessive rain from November 11 - 15 increased turbidity levels, however Secchi readings never dropped below 0.4 m. The LCR was running and clear and low during the duration of sampling in Reach 1.

2. Observed densities of YOY humpback chub in the mainstem were considerably lower than in the previous several months. Extremely low seining catch rates in November (compared with high catch rates during high turbidity conditions in October) suggest that subadult humpback chub move into deeper, less accessible habitat with increasing water clarity. Minnow trap catch rates appear to correlate positively with water clarity -- this may be due to accessibility to deeper water habitat by traps (compared with seining) and/or greater utilization of cover (i.e., traps) by humpback chub under clear water conditions. Small numbers of subadult chub were captured fairly consistently from the LCR to Hance Rapid. No juvenile or YOY chub were captured in Reach 2.

3. Recapture rate for flannelmouth suckers in Reach 2 during this trip was 42 percent.

4. Approximately ten potential predators (including rainbow trout, brown trout, and channel catfish) were sacrificed for stomach analysis. Predation on humpback chub was confirmed for at least one predator -- the stomach of a brown trout (Total length = 495 mm; Weight = 1,514 g) collected at RM 65.15 contained one juvenile humpback chub (Total length ≈ 160 mm). The prey item had not been previously PIT-tagged. All other stomach samples will be examined in the laboratory for detailed analysis.

PROBLEMS ENCOUNTERED AND SOLUTIONS

1. An electrofishing boat on the upper crew was inoperative for the entire day of November 11 -- after a lengthy search, a short was discovered in the anode boom and repaired. Excessive rain prevented complete electrofishing coverage around Lava Chuar and Papago Creek study areas.

2. The netting boat on the lower crew had to be repaired due to failure of previous seam patching. This resulted in extra manpower required to repair the boat on-site and loss of netting effort.

3. On the upper crew, two outboard motors were running rough and had to be replaced with spares. The faulty motors will be repaired in the shop.

4. One outboard motor was damaged while running Horn Creek Rapid. It was replaced immediately with no loss of sample effort.

RECOMMENDATIONS

1. A program to monitor humpback chub during interim flows should be implemented in 1994. The large number of young chubs of the 1993 year class provides an opportunity to follow success of a large cohort through interim dam operations. If year class strength is a cyclic phenomenon, another opportunity to track such a cohort may not present itself for several years or more.

2. Continued study into the Middle Granite Gorge and 30-Mile aggregations of chub should be included in future research and monitoring efforts.

3. Food habits and food availability data collection should be incorporated into future research and monitoring for the 30-Mile, LCR, and Middle Granite Gorge chub assemblages.

Table 1. Logistics and Research Schedule for Trip 11, 1993, Team 1.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
11/03	30.3	Fence Fault	X			
11/04	30.3	Fence Fault		X		
11/05	58.3	Awatubi	X	X		
11/06	58.3	Awatubi		X		
11/07	61.2	LCR	X	X		
11/08	61.2	LCR		X		
11/09	61.2	LCR		X		
11/10	65.4	Lava Chuar	X	X		X
11/11	65.4	Lava Chuar		X		X
11/12	68.3	Tanner	X	X		X
11/13	68.3	Tanner		X		X
11/14	75.8	Papago	X	X		X
11/15	87.6	Cremation	X	X		
11/16	168	Fern Glen	X			
11/17	220	220-Mile	X			
11/18	225	Diamond Creek	X			

[1]T&R =Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 1. Logistics and Research Schedule for Trip 11, 1993, Team 2.

DATE	RM	LOCATION	RESEARCH ACTIVITIES			
			T&R[1]	FS	TE	HQ
11/03	30.3	Fence Fault	X			
11/04	71.2	Cardenas Creek	X	X		
11/05	71.2	Cardenas Creek		X		
11/06	87.1	Cremation	X	X		
11/07	87.1	Cremation		X		
11/08	108.4	Lower Bass	X	X		
11/09	108.4	Lower Bass		X		
11/10	108.4	Lower Bass		X		
11/11	126.2	Middle Granite Gorge	X	X		
11/12	126.2	Middle Granite Gorge		X		X
11/13	126.2	Middle Granite Gorge		X		X
11/14	143.3	Kanab Creek	X	X		
11/15	143.3	Kanab Creek		X		
11/16	174.1	Cove Canyon	X			
11/17	225	225 Mile	X			
11/18	225.7	Diamond Creek	X			

[1] T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 2. Personnel Participating in Trip 11, 1993, Team 1.

PERSONNEL	AFFILIATION	DATES	COMMENTS
T. Wasowicz	BIO/WEST	11/03 - 11/16	Senior Biologist
L. Brown	BIO/WEST	11/04 - 11/18	Biologist
T. McKay	BIO/WEST	11/03 - 11/18	Biologist
Y. Converse	BIO/WEST	11/10 - 11/18	In Tanner
B. Elwanger	BIO/WEST	11/03 - 11/18	Biologist/Boatman
M. Matter	BOR	11/10 - 11/16	In Tanner/Out B.A.
B. Hoskins	BIO/WEST VOLUNTEER	11/03 - 11/18	
J. Whinery	BIO/WEST VOLUNTEER	11/03 - 11/16	Out Bright Angel
A. Blyphus	OARS	11/03 - 11/18	Trip Leader
S. Reeder	OARS	11/03 - 11/18	
A. Cassidy	OARS	11/03 - 11/18	

Table 2. Personnel Participating in Trip 11, 1993, Team 2.

PERSONNEL	AFFILIATION	DATES	COMMENTS
W. Leibfried	BIO/WEST	11/03 - 11/18	Project Leader
E. Prats	BIO/WEST	11/03 - 11/18	
T. Yates	BIO/WEST	11/03 - 11/18	
P. Trater	BIO/WEST	11/03 - 11/18	
C. Heck	BIO/WEST	11/03 - 11/18	
L. Bergey	BIO/WEST VOLUNTEER	11/03 - 11/18	
K. Hobsen	BIO/WEST VOLUNTEER	11/03 - 11/18	
S. Bledsoe	OARS	11/03 - 11/18	Trip Leader
B. Henderson	OARS	11/03 - 11/18	
S. Rhodes	OARS	11/03 - 11/18	
L. Henderson	OARS	11/03 - 11/18	

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 11, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH
Electrofishing Reach 0 N=4	A				15	1		2		
	J				76	6				
	Y									
Electrofishing Reach 1 N=48	A	5	10		35		1	1	11	22
	J	2	2		11			1	2	3
	Y	47		1						
Electrofishing Reach 2 N=14	A				1	13		4	3	5
	J									
	Y									
Nets Reach 0 N=8	A	4		1	17					
	J									
	Y									
Nets Reach 1 N=29	A	25	25	3	16	1	1	1		
	J									
	Y									
Nets Reach 2 N=112	A	5	31	1	3	4		6		
	J									
	Y									
Seines Reach 1 N=55	A		2		1				1	17
	J	1	2	6						3
	Y	21	4	10					2	1

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 11, 1993. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB[3]	FM	BH	RB	BR	CC	CP	SD	FH
Traps Reach 1 N=241	A								4	1
	J	2	1							
	Y	158			1					
Traps Reach 2 N=108	A								3	3
	J									
	Y		1	1						
Totals	A	39	68	5	88	19	2	14	22	48
	J	5	5	6	87	6	0	1	2	6
	Y	226	5	12	1	0	0	0	2	1
	T	270	78	23	176	25	2	15	26	55

[2] - A = Adult
J = Juvenile
Y = Young of year

[3] - HB = humpback chub
FM = flannelmouth sucker
BH = bluehead sucker
RB = rainbow trout
BR = brown trout
CC = channel catfish
CP = carp
SD = speckled dace
FH = fathead minnow

Table 4. Summary of Humpback Chub handled during Trip 11, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
1	931104	N	004	7F7D08013E	Y	PITTAG	450	840	RA	N	30.50
2	931104	N	004	7F7F200D21	N		425	722	RA	N	30.50
3	931104	N	008	1F20443647	Y	PITTAG	391	470	RA	N	30.50
4	931104	N	008	7F7F284922	N		430	610	RA	N	30.50
5	931105	E	003	DP-1	N		74	3	RA	N	70.20
6	931105	E	003	##########	N		51	1	RA	N	70.20
7	931105	N	011	7F7F48032E	Y	PITTAG	334	318	RA	N	58.25
8	931105	N	011	1F1F6E3C18	N		364	434	RA	N	58.25
9	931105	N	012	7F7D02652D	Y	PITTAG	377	496	RA	N	58.30
10	931105	N	015	7F7D331E08	Y	PITTAG	377	447	RA	N	58.25
11	931105	T	004	##########	N		50	1	RA	N	72.30
12	931105	T	012	##########	N		55	1	RA	N	70.90
13	931105	T	012	##########	N		57	1	RA	N	70.90
14	931105	T	013	##########	N		53	2	RA	N	70.90
15	931105	T	013	##########	N		52	1	RA	N	70.90
16	931105	T	014	##########	N		45	1	RA	N	70.90
17	931105	T	016	##########	N		58	1	RA	N	71.20
18	931106	T	001	##########	N		64	1	RA	N	60.90
19	931106	T	006	##########	N		70	2	RA	N	60.90
20	931106	T	026	##########	N		46	1	RA	N	70.90
21	931107	N	017	7F7F2D1442	Y	PITTAG	406	648	RS	N	60.90

Table 4. Summary of Humpback Chub handled during Trip 11, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
22	931107	N	018	7F7F027916	Y	PITTAG	412	639	RS	N	61.15
23	931107	N	019	7F7F3F452E	Y	PITTAG	388	502	RS	N	61.20
24	931107	N	019	7F7F26116A	Y	PITTAG	320	281	RS	N	61.20
25	931107	N	023	7F7F271C5C	Y	PITTAG	350	363	RS	N	61.20
26	931107	T	032	##########	N		65	3	RA	N	60.90
27	931107	T	035	##########	N		68	3	RA	N	60.90
28	931108	E	023	7F7D223101	Y	PITTAG	316	240	RA	N	62.20
29	931108	E	023	7F7F270625	Y	PITTAG	363	395	RA	N	62.20
30	931108	E	023	7F7F206054	Y	PITTAG	400	594	RA	N	62.20
31	931108	N	026	1F1E3C1275	N		309	264	RS	N	61.20
32	931108	N	027	7F7D154102	Y	PITTAG	344	394	RS	N	61.70
33	931108	N	028	7F7D222574	Y	PITTAG	227	87	RA	N	61.95
34	931108	N	028	1F20131F0F	N		381	592	RS	N	61.95
35	931108	N	030	1F1F60667C	N		354	443	RS	N	61.20
36	931108	T	053	##########	N		59	1	RA	N	63.10
37	931108	T	053	##########	N		57	2	RA	N	63.10
38	931108	T	053	##########	N		54	2	RA	N	63.10
39	931108	T	053	##########	N		53	1	RA	N	63.10
40	931108	T	053	##########	N		70	4	RA	N	63.10
41	931108	T	053	##########	N		61	1	RA	N	63.10
42	931108	T	055	##########	N		63	2	RA	N	63.10
43	931108	T	059	##########	N		60	2	RA	N	62.70

Table 4. Summary of Humpback Chub handled during Trip 11, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
44	931108	T	060	##########	N		70	3	RA	N	62.70
45	931109	E	031	7F7F21264E	Y	PITTAG	389	556	RA	N	62.20
46	931109	E	031	7F7F32330D	Y	PITTAG	375	431	RA	N	62.20
47	931109	E	032	##########	N		173	20	RA	N	61.70
48	931109	S	002	##########	N		57	0	RA	N	62.10
49	931109	S	005	##########	N		52	0	RA	N	62.30
50	931109	S	006	##########	N		47	0	RA	N	62.65
51	931109	T	076	##########	N		47	1	DR	N	62.70
52	931109	T	077	##########	N		120	14	RA	N	63.10
53	931109	T	077	##########	N		58	1	RA	N	63.10
54	931109	T	082	##########	N		72	2	RA	N	62.70
55	931109	T	082	##########	N		64	1	RA	N	62.70
56	931109	T	082	##########	N		50	1	RA	N	62.70
57	931109	T	082	##########	N		51	1	RA	N	62.70
58	931109	T	082	##########	N		49	1	RA	N	62.70
59	931109	T	082	##########	N		56	1	RA	N	62.70
60	931109	T	082	##########	N		49	1	RA	N	62.70
61	931109	T	082	##########	N		55	1	RA	N	62.70
62	931109	T	082	##########	N		59	1	RA	N	62.70
63	931109	T	082	##########	N		50	1	RA	N	62.70
64	931109	T	082	##########	N		56	1	RA	N	62.70
65	931109	T	082	##########	N		62	1	RA	N	62.70

Table 4. Summary of Humpback Chub handled during Trip 11, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
66	931109	T	082	##########	N		50	1	RA	N	62.70
67	931109	T	082	##########	N		52	1	RA	N	62.70
68	931109	T	082	##########	N		50	1	RA	N	62.70
69	931109	T	082	##########	N		53	1	RA	N	62.70
70	931109	T	082	##########	N		49	1	RA	N	62.70
71	931109	T	082	##########	N		46	1	RA	N	62.70
72	931109	T	082	##########	N		53	1	RA	N	62.70
73	931109	T	082	##########	N		50	1	RA	N	62.70
74	931109	T	082	##########	N		67	3	RA	N	62.70
75	931109	T	082	##########	N		52	1	RA	N	62.70
76	931109	T	082	##########	N		56	1	RA	N	62.70
77	931109	T	083	##########	N		48	1	RA	N	62.70
78	931109	T	083	##########	N		48	1	RA	N	62.70
79	931109	T	083	##########	N		51	1	RA	N	62.70
80	931109	T	084	##########	N		59	1	RA	N	62.70
81	931109	T	084	##########	N		65	1	RA	N	62.70
82	931109	T	084	##########	N		51	1	RA	N	62.70
83	931109	T	093	##########	N		55	1	RA	N	62.30
84	931109	T	094	##########	N		64	1	RA	N	62.30
85	931109	T	097	##########	N		130	14	RA	N	61.70
86	931110	E	033	##########	N		58	0	RA	N	64.20
87	931110	E	033	##########	N		60	0	RA	N	64.20

Table 4. Summary of Humpback Chub handled during Trip 11, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
88	931110	E	033	##########	N		48	0	RA	N	64.20
89	931110	E	033	##########	N		52	0	RA	N	64.20
90	931110	E	033	##########	N		47	0	RA	N	64.20
91	931110	E	033	##########	N		51	0	RA	N	64.20
92	931110	E	033	##########	N		50	0	RA	N	64.20
93	931110	N	032	7F7D076554	Y	PITTAG	307	278	RA	N	108.30
94	931110	N	033	1F200C783D	Y	PITTAG	234	120	RA	N	64.80
95	931110	N	033	7F7F1F7C69	N		216	97	RA	N	64.80
96	931110	N	034	7F2F205726	Y	PITTAG	378	549	RS	N	65.15
97	931110	N	034	7F7D255921	Y	PITTAG	387	590	RS	N	65.15
98	931110	N	034	7F7F21786B	N		392	443	RS	N	65.15
99	931110	N	034	7F7F19582E	Y	PITTAG	371	392	RS	N	65.15
100	931110	N	035	7F7F485E4E	Y	PITTAG	347	368	RS	N	65.20
101	931110	N	035	7F7F270F68	Y	PITTAG	413	641	RS	N	65.20
102	931110	N	036	7F7F1F1314	N	CARLN SCAR	375	541	RA	N	65.30
103	931110	N	036	7F7B015F73	Y	PITTAG	362	416	RA	N	65.30
104	931110	N	036	7F7D085F38	Y	PITTAG	252	206	RA	N	108.30
105	931110	N	037	7F7D180648	Y	PITTAG	290	228	RA	N	64.80
106	931110	T	104	##########	N		58	1	RA	N	63.10
107	931110	T	107	##########	N		49	1	RA	N	62.70
108	931110	T	107	##########	N		50	1	RA	N	62.70
109	931110	T	107	##########	N		55	1	RA	N	62.70

Table 4. Summary of Humpback Chub handled during Trip 11, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
110	931110	T	107	##########	N		61	1	RA	N	62.70
111	931110	T	107	##########	N		67	1	RA	N	62.70
112	931110	T	107	##########	N		64	1	RA	N	62.70
113	931110	T	107	##########	N		56	1	RA	N	62.70
114	931110	T	107	##########	N		51	1	RA	N	61.70
115	931110	T	108	##########	N		58	1	RA	N	62.70
116	931110	T	108	##########	N		59	1	RA	N	62.70
117	931110	T	108	##########	N		53	1	RA	N	62.70
118	931110	T	108	##########	N		57	1	RA	N	62.70
119	931110	T	122	##########	N		69	1	RA	N	61.70
120	931110	T	124	##########	N		52	1	RA	N	61.70
121	931110	T	124	##########	N		55	1	RA	N	61.70
122	931111	T	126	##########	N		63	1	RA	N	63.70
123	931111	T	127	##########	N		55	0	RA	N	63.70
124	931111	T	127	##########	N		55	0	RA	N	63.70
125	931111	T	127	##########	N		59	0	RA	N	63.70
126	931111	T	137	##########	N		50	0	RA	N	64.80
127	931111	T	138	##########	N		53	0	RA	N	64.80
128	931111	T	140	##########	N		64	0	RA	N	65.10
129	931111	T	143	##########	N		63	0	RA	N	65.10
130	931111	T	145	##########	N		62	0	RA	N	63.40
131	931111	T	145	##########	N		65	0	RA	N	63.40

Table 4. Summary of Humpback Chub handled during Trip 11, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
132	931111	T	145	##########	N		55	0	RA	N	63.40
133	931111	T	145	##########	N		47	0	RA	N	63.40
134	931111	T	145	##########	N		57	0	RA	N	63.40
135	931111	T	145	##########	N		50	0	RA	N	63.40
136	931111	T	145	##########	N		52	0	RA	N	63.40
137	931111	T	147	##########	N		55	0	RA	N	63.40
138	931111	T	147	##########	N		63	0	RA	N	63.40
139	931111	T	147	##########	N		47	0	RA	N	63.40
140	931111	T	147	##########	N		55	0	RA	N	63.40
141	931111	T	147	##########	N		54	0	RA	N	63.40
142	931111	T	147	##########	N		40	0	RA	N	63.40
143	931112	N	060	7F7F1F1F02	Y	PITTAG	344	419	RS	N	127.10
144	931112	N	072	1F1E4A5C1D	N		291	293	RS	N	127.10
145	931112	N	072	1F20303A57	N		280	207	RA	N	127.10
146	931112	S	021	##########	N		53	0	RA	N	68.00
147	931112	S	021	##########	N		44	0	RA	N	68.00
148	931112	S	023	##########	N		57	0	RA	N	68.30
149	931112	S	024	##########	N		48	0	RA	N	68.35
150	931113	E	034	##########	N		40	0	RA	N	68.00
151	931113	E	040	##########	N		47	0	RA	N	66.80
152	931113	E	043	##########	N		46	0	RA	N	63.25
153	931113	E	043	##########	N		55	0	RA	N	63.25

Table 4. Summary of Humpback Chub handled during Trip 11, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
154	931113	E	043	##########	N		52	0	RA	N	63.25
155	931113	T	154	##########	N		46	0	RA	N	67.85
156	931113	T	158	##########	N		52	0	RA	N	67.95
157	931113	T	158	##########	N		70	0	RA	N	67.95
158	931113	T	161	##########	N		52	0	RA	N	67.95
159	931113	T	162	##########	N		57	0	RA	N	67.95
160	931113	T	162	##########	N		51	0	RA	N	67.95
161	931113	T	162	##########	N		55	0	RA	N	67.95
162	931113	T	162	##########	N		53	0	RA	N	67.95
163	931113	T	163	##########	N		57	0	RA	N	68.00
164	931113	T	166	##########	N		45	0	RA	N	68.00
165	931114	E	044	##########	N		50	0	RA	N	68.25
166	931114	E	045	##########	N		45	0	RA	N	68.40
167	931114	E	045	##########	N		40	0	RA	N	68.40
168	931114	E	045	##########	N		47	0	RA	N	68.40
169	931114	E	045	##########	N		42	0	RA	N	68.40
170	931114	E	045	##########	N		50	0	RA	N	68.40
171	931114	E	045	##########	N		48	0	RA	N	68.40
172	931114	E	045	##########	N		37	0	RA	N	68.40
173	931114	E	045	##########	N		46	0	RA	N	68.40
174	931114	E	045	##########	N		53	0	RA	N	68.40
175	931114	E	045	##########	N		65	0	RA	N	68.40

Table 4. Summary of Humpback Chub handled during Trip 11, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
176	931114	E	045	##########	N		57	0	RA	N	68.40
177	931114	E	045	##########	N		66	0	RA	N	68.40
178	931114	E	045	##########	N		54	0	RA	N	68.40
179	931114	E	045	##########	N		51	0	RA	N	68.40
180	931114	E	045	##########	N		41	0	RA	N	68.40
181	931114	E	045	##########	N		40	0	RA	N	68.40
182	931114	E	045	##########	N		66	0	RA	N	68.40
183	931114	E	045	##########	N		52	0	RA	N	68.40
184	931114	E	045	##########	N		41	0	RA	N	68.40
185	931114	E	045	##########	N		43	0	RA	N	68.40
186	931114	E	045	##########	N		45	0	RA	N	68.40
187	931114	E	045	##########	N		50	0	RA	N	68.40
188	931114	E	045	##########	N		50	0	RA	N	68.40
189	931114	E	045	##########	N		46	0	RA	N	68.40
190	931114	E	046	##########	N		62	0	RA	N	70.10
191	931114	E	47	##########	N		42	0	RA	N	70.10
192	931114	E	048	##########	N		63	0	RA	N	74.90
193	931114	E	048	##########	N		50	0	RA	N	74.90
194	931114	E	048	##########	N		49	0	RA	N	74.90
195	931114	E	048	##########	N		35	0	RA	N	74.90
196	931114	E	048	##########	N		46	0	RA	N	74.90
197	931114	E	048	##########	N		46	0	RA	N	74.90

Table 4. Summary of Humpback Chub handled during Trip 11, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
198	931114	E	048	##########	N		40	0	RA	N	74.90
199	931114	S	028	##########	N		50	0	RA	N	62.35
200	931114	S	028	##########	N		46	0	RA	N	62.35
201	931114	S	028	##########	N		76	0	RA	N	62.35
202	931114	S	029	##########	N		44	0	RA	N	68.40
203	931114	S	030	##########	N		50	0	RA	N	68.40
204	931114	S	039	##########	N		42	0	RA	N	76.50
205	931114	S	039	##########	N		50	0	RA	N	76.50
206	931114	S	041	##########	N		43	0	RA	N	76.40
207	931114	S	041	##########	N		55	0	RA	N	76.40
208	931114	S	042	##########	N		52	0	RA	N	76.40
209	931114	S	043	##########	N		52	0	RA	N	76.30
210	931114	S	045	##########	N		69	0	RA	N	76.30
211	931114	S	045	##########	N		51	0	RA	N	76.30
212	931114	S	046	##########	N		146	0	RA	N	76.25
213	931114	S	049	##########	N		57	0	RA	N	75.80
214	931114	T	174	##########	N		55	0	RA	N	66.95
215	931114	T	181	##########	N		50	0	RA	N	67.95
216	931114	T	184	##########	N		51	0	RA	N	67.95
217	931114	T	184	##########	N		46	0	RA	N	67.95
218	931114	T	185	##########	N		56	0	RA	N	67.95
219	931114	T	185	##########	N		71	0	RA	N	67.95

Table 4. Summary of Humpback Chub handled during Trip 11, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
220	931114	T	186	##########	N		47	0	RA	N	68.00
221	931114	T	186	##########	N		47	0	RA	N	68.00
222	931114	T	192	##########	N		50	0	RA	N	68.15
223	931114	T	193	##########	N		52	0	RA	N	68.15
224	931115	T	195	##########	N		61	0	RA	N	76.45
225	931115	T	195	##########	N		51	0	RA	N	76.45
226	931115	T	196	##########	N		55	0	RA	N	76.45
227	931115	T	196	##########	N		50	0	RA	N	76.45
228	931115	T	196	##########	N		56	0	RA	N	76.45
229	931115	T	198	##########	N		64	0	RA	N	76.45
230	931115	T	198	##########	N		66	0	RA	N	76.45
231	931115	T	198	##########	N		54	0	RA	N	76.45
232	931115	T	198	##########	N		59	0	RA	N	76.45
233	931115	T	200	##########	N		59	0	RA	N	76.40
234	931115	T	200	##########	N		50	0	RA	N	76.40
235	931115	T	200	##########	N		57	0	RA	N	76.40
236	931115	T	200	##########	N		51	0	RA	N	76.40
237	931115	T	200	##########	N		73	0	RA	N	76.40
238	931115	T	200	##########	N		57	0	RA	N	76.40
239	931115	T	200	##########	N		49	0	RA	N	76.40
240	931115	T	200	##########	N		57	0	RA	N76.40	
241	931115	T	200	##########	N		57	0	RA	N	76.40

Table 4. Summary of Humpback Chub handled during Trip 11, 1993.

	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
242	931115	T	200	##########	N		57	0	RA	N	76.40
243	931115	T	200	##########	N		50	0	RA	N	76.40
244	931115	T	201	##########	N		54	0	RA	N	76.40
245	931115	T	201	##########	N		51	0	RA	N	76.40
246	931115	T	201	##########	N		61	0	RA	N	76.40
247	931115	T	201	##########	N		59	0	RA	N	76.40
248	931115	T	201	##########	N		56	0	RA	N	76.40
249	931115	T	201	##########	N		55	0	RA	N	76.40
250	931115	T	201	##########	N		51	0	RA	N	76.40
251	931115	T	201	##########	N		52	0	RA	N	76.40
252	931115	T	201	##########	N		55	0	RA	N	76.40
253	931115	T	201	##########	N		57	0	RA	N	76.40
254	931115	T	201	##########	N		60	0	RA	N	76.40
255	931115	T	201	##########	N		53	0	RAN76.40		
256	931115	T	202	##########	N		68	0	RA	N	76.40
257	931115	T	202	##########	N		54	0	RA	N	76.40
258	931115	T	203	##########	N		60	0	RA	N	76.40
259	931115	T	203	##########	N		50	0	RA	N	76.40
260	931115	T	203	##########	N		56	0	RA	N	76.40
261	931115	T	203	##########	N		52	0	RA	N	76.40
262	931115	T	208	##########	N		63	0	RA	N	75.80
263	931115	T	212	##########	N		55	0	RA	N	75.80

Table 4. Summary of Humpback Chub handled during Trip 11, 1993.											
	Date	Type	Sample No.	PIT tag	Recap	Old Tag	TL	WT	Disp	Radio	RM Release
264	931115	T	215	##########	N		41	0	RA	N	76.20
265	931115	T	215	##########	N		55	0	RA	N	76.20
266	931115	T	215	##########	N		54	0	RA	N	76.20
267	931115	T	217	##########	N		50	0	RA	N	76.20
268	931115	T	217	##########	N		56	0	RA	N	76.20
269	931115	T	217	##########	N		47	0	RA	N	76.20
270	931115	T	217	##########	N		43	0	RA	N	76.20

CHARACTERIZATION OF THE LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE GRAND CANYON

SUPPLEMENTAL REPORT FOR EXTENSION OF INTERIM MONITORING - 1994

July 12, 1994 - July 29, 1994

Prepared For:

Bureau of Reclamation

Prepared By:

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August 31, 1994

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INTRODUCTION

This supplemental report was submitted to the Bureau of Reclamation by BIO/WEST, Inc., in partial fulfillment of a modification of Reclamation Contract No. 0-CS-40-09110, entitled Characterization of the Life History and Ecology of the Humpback Chub (*Gila cypha*) in the Grand Canyon. This modification was made to extend data collection, associated with specific elements of the life history and ecology of humpback chub in Grand Canyon, into 1994. One 18-day trip, during July 12 - 29, was conducted during 1994 for this investigation. This report summarizes the logistics, personnel, research schedule, results and recommendations from this supplemental investigation.

New findings made during this supplemental investigation will be integrated into the Final Report for work conducted during 1990-1993. Results related to specific objectives of this supplemental investigation are also summarized in this report and related to previous findings where applicable.

OBJECTIVES

This supplemental investigation was conducted in the mainstem Colorado River by BIO/WEST, concurrent with Arizona Game and Fish (AGF) mainstem studies. Objectives of this supplemental investigation reflect specific emphasis on canyon areas and life history aspects of humpback chub. The objectives of the supplemental investigation were to:

1. Assess distribution, abundance, growth, habitat use and survival of the 1993 HB cohort in the mainstem below the LCR.
    a. Collect additional information on sympatric native and non-native species with young HB in the mainstem below the LCR.
    b. Assess predation of young HB by non-native predators in the LCR area.

2. Evaluate food habits of adult HB longitudinally through Grand Canyon.
    a. Assess longitudinal incidence of Asian tapeworm in adult HB in mainstem.

3. Collect additional information on life history and ecology of the 30-mile and Middle Granite Gorge HB aggregations.
    a. Refine density estimates of 30-mile and Middle Granite Gorge aggregations.
    b. Evaluate HB spawning in the 30-mile area.
    c. Map and characterize water quality of tepid springs in the 30-mile area.
    d. Quantify adult HB habitat in 30-mile and Middle Granite Gorge area.
    e. Refine information on distribution of adult HB in 30-mile and Middle Granite Gorge areas.
    f. Collect additional information on sympatric native and non-native species with adult HB in the 30-mile and Middle Granite Gorge Areas.

LOGISTICS, RESEARCH SCHEDULE AND PERSONNEL

Table 1 presents a summary of logistics and the research schedule for the supplemental investigation during July, 1994. Table 2 presents personnel who were present or participated in research activities during the trip.

DATA COLLECTED AND RESULTS

Table 3 presents a summary of gear types used, sampling effort and fish captured by gear type during the supplemental investigation in July, 1994. Appendix 1 is a summary of all humpback chubs handled during July, 1994.

Reach 0 - Fence Fault (30-Mile area)

Fence Fault Springs Survey. A total of 12 springs were identified in the Fence Fault and South Canyon areas between RM 30.3 and 31.8 (Figure 1). All springs, except Spring L (Vasey's Paradise), emanated from river level between the 10,000 and 15,000 cfs stage elevation. Other springs may have been present below this level but were not detected or observed. Most springs surfaced through fractures in Redwall limestone and were located in a 0.5 mile reach (RM 30.3 to 30.8) around Fence Fault. Only three springs at river level were located below this point.

Estimated discharge from springs ranged from less than 0.1 cfs (seeps) to 10 cfs (Table 4). Discharge of at least one spring (Spring H) varied with river stage. Temperatures of undiluted springs ranged from 21 to 21.5 °C with the exception of Spring L which was 17°C. Spring L (Vasey's Paradise) was located above river level, and possibly originated from a different groundwater source than other springs in the area. Differences in dissolved oxygen, pH, and conductivity measured in undiluted spring water from Spring G and Spring J also suggested different water sources for each side of the river. At Spring G, on river left, dissolved oxygen, pH, and, conductivity measured 4.36 mg/l, 6.34, and 2,230 μmhos, respectively. Readings at Spring J, on river right were 6.0 mg/l, 7.24, and 353 μmhos, respectively.

Configuration and area of thermal plumes associated with individual springs varied depending on morphology of the river channel at the spring source and magnitude of discharge from the spring. Springs A - G and K entered the river along fast eddies and runs. High current velocities and turbulence at the mouths of these springs resulted in rapid dilution of tepid spring water. Thermal plumes were characterized by a narrow band of warm water extending downstream and compressed against the shoreline. In contrast, Springs H, I and J entered the mainstem in slow eddies or runs. Thermal plumes of these springs tended to be larger and remained relatively stable, at flow fluctuations observed during the trip (10,000 to 15,000 cfs).

Physical characteristics of Spring J were examined in detail during July 1994. Thermal characteristics and configuration of the plume were measured and hand mapped at mainstem flows of approximately 15,000 cfs (Figure 2). Temperature at the spring's source was 21.5°C. Plume temperature was approximately 15°C, 2 m from the source, 12°C, at 3 m from the source and was not perceptibly different than the mainstem at 10 m from the source. Approximate area of the plume was 3 m wide and 10 m long. The mouth of the spring was located in a limestone shelf along the shoreline. Substrates in the plume were composed of bedrock limestone, boulders and sand.

Distribution and Abundance of Humpback Chub. A total of 19 humpback chubs, including 5 adults and 14 YOY were captured in the Fence Fault area. All adults and YOY were captured at one location (RM 30.7), near the confluence of a Spring J (Figure 1). During previous BIO/WEST sampling efforts in the Fence Fault area, approximately 69% (18 of 26) humpback chubs have been captured from this same location. Larval light traps were also used during July 1994 in an attempt to capture larval fish in and around springs near Fence Fault. Traps were fished over-night in calm water near the confluence of springs where possible or downstream of spring areas in calm waters of eddies or embayments. No larval fish were captured.

Two PIT tagged adult humpback chubs, marked on previous BIO/WEST sampling efforts in the area, were recaptured in July 1994, resulting in a recapture rate of 40%. One fish was originally captured on September 10, 1993 at RM 30.7 and the second on November 9, 1993 at RM 30.6. Population estimates of adult humpback chub in the 30-Mile aggregation were recalculated with the addition of data collect in July 1994. These computations resulted in a population of 37.6 fish, with a range of 20 to 120 fish. This number is slightly lower than the previous estimate of 39.8 fish as of November, 1993.

Humpback Chub Spawning. Three of the five adult humpback chubs captured in Reach 0 during July 1994 were lightly tubercled. Of these, one was a male expressing milt, and one was a female described as 'spent' based on abrasions on the ventral surface, swelling around the vent, and a flaccid abdomen. It was estimated that the female had spawned approximately two to four weeks prior to capture based on healing of abrasions and appearance of the vent area. Other humpback chubs exhibiting signs of spawning readiness have been captured near springs on previous BIO/WEST sampling trips, including one ripe male in May of 1993, and three tubercled adults (two males and one female) in September of 1993.

Approximately 100 YOY humpback chubs were observed in the mouth of the spring at RM 30.7 on July 14 (Photo 1). Fourteen fish were captured using an aquarium dip net to verify identification. These fish ranged in size from 18 mm to 31 mm total length (TL), with an average length of 24 mm. Three additional visits were made to the spring to observe the location of the fish in the plume. During each visit a temperature was taken at the location where the fish were observed. Temperatures utilized by the YOY humpback chub ranged from 16 to 19°C. The fish were consistently observed utilizing cover provided by boulders and sparse overhanging vegetation within 1.5 m from the source of the spring.

Standard length (SL) of YOY humpback chub captured at RM 30.7 was derived using the formula:

$$SL = TL * 0.822$$

Average standard length for the 14 fish captured was computed to be 20 mm. From this, it was estimated that these fish were approximately 36 days old, or hatched on June 8, 1994, based on the growth curve developed by Muth (1990) for humpback chub cultured from brood stock from the LCR at temperatures of 18 - 23°C:

$$Y = 7.2843e^{0.0280X}, \text{ where } Y = SL, \text{ and } X = \text{days after hatching}$$

The equation was written as follows to solve for X:

$$X = \frac{\ln Y - \ln 7.2843}{0.0280}$$

The presence of numerous small YOY humpback chub and the capture of a recently spent female provided strong evidence that humpback chub utilized Spring J for spawning during 1994. Approximately 2 to 3 m^2 of the thermal plume consistently maintained temperatures greater than 15°C, suitable for spawning and egg development. Substrates in this area were primarily bedrock limestone. Several limestone boulders and small amount of sand were also present. Crevices and interstitial spaces between boulders would have provided egg deposition areas with some protection against predators such as carp, which were frequently observed in the mouth of the spring during night time sampling. Sand was the prevalent substrate in areas of the plume away from the mouth of the spring.

The concentrated use of Spring J by of humpback chub appears to be a unique phenomena in the Fence Fault area. Netting and electrofishing adjacent to other springs in the area indicated only sporadic use by humpback chub. A large slow eddy on river right, approximately 0.5 miles downstream of Spring J, is the only other location in the area where humpback chubs have consistently been captured. No springs were found in the eddy during surveys in July, but existence of spring sources below river level cannot be ruled out without more exhaustive surveys. High catch rates of gravid and ripe rainbow trout and carp, adjacent to other springs in the area, indicated that these fish may also utilize springs as spawning habitat. Large numbers of ripe male and gravid female trout were captured in the mouth of Spring A during March 1993. Carp have been consistently captured in the vicinity of Springs J and H, including several ripe males.

Reach 1 - LCR Confluence to Red Creek.

Humpback Chub Captured. A total of 267 humpback chub were captured in between RM 60.0 and RM 76.5 including 34 adults, 79 juveniles and 154 YOY. Adult humpback chubs were captured in trammel nets between RM 60.0 and RM 65.4 for purposes of food habits studies. Sampling of adults was discontinued when sufficient numbers had been captured. Two juveniles were also captured in trammel nets. One hundred seventy three humpback chubs were captured electrofishing including 71 juveniles and 102 YOY. A total of 58 humpback chubs were captured in minnow traps including six juveniles and 52 YOY.

1993 Humpback Chub Cohort. A primary objective of sampling in July 1994 was to assess the distribution, abundance, growth and survival of the 1993 year class of humpback chub in Reach 1 of the mainstem Colorado River. Intensive electrofishing and minnow trapping between RM 61.3 and RM 76.5 was conducted to address this objective. Seining was also used initially, but was discontinued because of its ineffectiveness in clear water conditions in the mainstem during July.

Longitudinal distribution of subadult humpback chub between the LCR (RM 61.3) and Red Creek (RM 76.5) appeared to change little between the last three months of 1993 and July, 1994. Longitudinal catch rates for electrofishing and minnow trapping indicated that subadult humpback chub were distributed throughout the study reach during July 1994 (Figure 3). A similar breadth of distribution was also observed during September through November of 1993. Of interest however, was the large amount of longitudinal variation in catch rates during each sampling effort in 1993 compared to a relatively uniform catch rates during July 1994. This suggested that dispersal of young

humpback chub into the mainstem Colorado River during 1993 initially resulted in a "clumpy" distribution pattern that evened out substantially prior to July 1994.

Consistently lower longitudinal catch rates during July, 1994 compared to September through November of 1993, indicated that densities of subadult humpback chub had declined in the study reach. This was particularly evident in certain specific areas, such as RM 68. Comparison of pooled catch rates in the mainstem Colorado River from the LCR (RM 61.30) to Lava Canyon (RM 65.4) also indicated densities of humpback chub decreased during the same period (Table 5). Pooled electrofishing catch rates decreased 74.2% between September, 1993 and July 1994, while pooled minnow trapping catch rates decreased 71.5% for the same period.

Growth of the 1993 year class of humpback chub could not be detected from length-frequency data collected in Reach 1 (Figure 4). Lengths of subadult humpback chub captured during July, 1994, ranged from 18 to 195 mm TL, with an average of 63 mm. Similar length distributions were also seen in September through November, 1993. Shifts in the distribution to larger size class, that would have signified growth, were not apparent. It is likely that significant overlap in length distributions between cohorts reduced the effectiveness of length-based growth analysis. Differences in growth rates between the LCR and mainstem Colorado River, protracted spawning periods, and variation in timing of immigration of young humpback into the mainchannel are factors which may contribute to an overlap of sizes between year classes. Other techniques for distinguishing cohorts and estimating growth are currently being assessed and will be presented in the Final Report for BIO/WEST humpback chub studies.

Reach 2 - Middle Granite Gorge

Distribution and Abundance of Humpback Chub. A total of 14 humpback were captured in the Middle Granite Gorge area (Reach 2) including 10 adults and 4 juveniles. All adults were captured in trammel nets between RM 127.0 and RM 127.5. The four juveniles were captured between RM 125.8 and RM 127.5, two by electrofishing and two in minnow traps. All humpback chub captured in July 1993 were within the range established for the Middle Granite Gorge aggregation during previous BIO/WEST sampling from 1990 to 1993.

Population estimates of adult humpback chub in the Middle Granite Gorge aggregation were recalculated with the addition of data collect in July 1994. These computations resulted in a population of 108.3 fish, with a range of 76.0 to 155.9 fish. This estimate was slightly higher than the previous estimate of 103.9 fish as of November, 1993.

Longitudinal Food Habits Study - Humpback Chub

A total of 39 humpback chub were stomach-pumped for food habits analysis during July 1994. The technique was successful on 31 of 39 fish, resulting in either evacuation of the stomach contents or a determination that the stomach was empty (Table 6). The eight unsuccessful attempts were related to blockages of the fish's gastrointestinal tract that prevented the typical flushing action of the pump. This block may have been associated with large amounts of algae or other course materials that could not be flushed from the fishes gut without excessive pressure. Macroinvertebrates and algal drift were collected concurrent with stomach pumping efforts to assess availability of food items in the drift. Four sampling location were used for both drift sampling and stomach analysis (Table 7).

Drift. Invertebrate relative abundance in drift samples was dominated by Chironomidae at all four sites (Table 7). At Site 1, Annelid worms, included in other aquatics represented 45% of the drift (numbers of organisms). Simuliid relative abundance tended to increase in a downstream direction, from 8% at Site 2 to over 20% at Site 4. Relative abundance of Gammarus lacustris increased from slightly from 1.56% at Site 1 to 2.51% and 2.97% at Sites 2 and 3, respectively, then declined to 0.27% at Site 4. The low value at Site 1 was unusual given its proximity to Gammarus production below Glen Canyon Dam, relative to Sites 2 and 3.

Stomach Contents. The small sample size (N=1) of humpback chub gut contents successfully sampled from Site 1 (30-Mile area) limited analysis of food habits in this area of the canyon. Stomach contents of the fish that was successfully pumped was composed of 4 ml of Cladophora and four Chironomids. Partial gut contents retrieved from one other humpback chub at Site 1 included three Annelids. This was the only occurrence of Annelids in humpback chub gut contents from the July sample.

Simuliids were found in 19 of 22 (86.4%) humpback chub gut contents and represented the most commonly utilized food item at three sites within the study area, followed by Chironomids and Gammarus (Table 8)(Figure 5). Longitudinal trends in occurrence of food items suggested that Gammarus, Chironomids and Cladophora were utilized less in Middle Granite Gorge (Site 4) than around the LCR (Sites 3 and 4). Occurrence of other aquatic and terrestrial invertebrates exhibited no apparent longitudinal trends. Terrestrial food items in Grand Canyon may be primarily associated with tributary flooding, making their availability seasonal and ephemeral in nature. Little tributary flooding was observed during the July sampling trip.

Simuliids were the most prevalent invertebrate in the humpback chub diet, comprising an average of 34.6% of the volume of gut contents (Table 9). This taxa appeared to be particularly important in the Middle Granite Gorge area, where it occupied 88% of gut content volumes of six fish. Gammarus comprised an average of 13.1% of gut content volumes, and represented the second most prevalent invertebrate food item. Highest volumes of Gammarus were observed from the two sites near the LCR, and dropped substantially at the Middle Granite Gorge site. Volume of chironimids and other aquatic and terrestrial invertebrates were very small at all sampling sites. The occurrence of a small whiptail lizard (Cnemidophorus sp.) in the gut of one humpback chub from Middle Granite Gorge was not included in volumetric analysis. Volume of this lizard would have substantially increased the volume of terrestrial food items at the site. Cladophora comprised a relatively large portion of gut content volumes at the 30-Mile and LCR sampling sites, but was not found in gut contents from Middle Granite Gorge.

Numerically, Simuliids were the most abundant organism found in humpback chub stomachs followed by Chironimids and Gammarus (Table 10). Pupal and larval forms of Simuliids were much more prevalent that adult forms in humpback chub stomachs.

Food habits data collected during July 1994 indicated that Simuliids were the dominant food item for humpback chub in most areas of Grand Canyon. A limited sample from the 30-Mile aggregation indicated that Cladophora may be an important food item higher in the Canyon. Gammarus also appeared to be an important food item for humpback chub in the LCR area. Although Chironimids were the most abundant invertebrate found in the drift, utilization by humpback chub was relatively low. The apparent selectivity for Simuliids relative to their abundance in the drift indicated that

humpback chub do not rely on drifting food items for the bulk of their diet. It appears that either Simuliid behavior predisposes them to predation by humpback chub or they are actively sought for their energetic value. Blinn et al. (1992) reported that Simuliids have the highest energy value, 22.64 joules/mg dry wt., of common aquatic food items in Grand Canyon. It is interesting that Chironomids, which have the second highest energy value at 21.38 joules/mg dry wt., were apparently not selected by humpback chub. Further investigations into food habits of humpback chub and the life history of prey items may provide valuable insight into their foraging behavior.

Incidence of Asian Tapeworm. Asian tapeworms were found in stomach contents of 3 of 30 fish (10%) successfully stomach pumped (Table 11). Only humpback chub captured in Reach 1, below the LCR (RM 61.3) were infested with tapeworms. Three of 12 (25%) humpback chubs successfully pumped in this reach had tapeworms in the gut contents. Infestations ranged from 1 tapeworm in each of two fish and a minimum of 15 tapeworms in the third fish.

Stomachs of 10 fathead minnows were also examined for tapeworm in Reach 1 below the LCR. A tapeworm was found in one of the 10 fish, indicating a infestation rate of 10% for this species.

SUMMARY OF FINDINGS

1. Twelve springs with a wide range of discharges, physical characteristics, and water quality were identified in the Fence Fault area of Marble Canyon between RM 30.3 and 31.8. Sixty-nine percent (18 of 26) of all adult humpback chubs captured in the Fence Fault area have been captured in the vicinity of one of these springs, identified as Spring J.

2. Observations of 50 to 100 YOY humpback chubs in the mouth of Spring J, confirmed that humpback chubs successfully spawned in the thermal plume of the spring in 1994. Additional evidence was provided by the capture of a spent, adult female humpback chub in the vicinity of the spring during the trip.

3. Assuming that humpback chubs spawned in portions of the plumes where water temperatures were greater than 15°C, substrates used for spawning included limestone bedrock and limestones boulders ranging from 0.25 to 1.0 m in diameter. It is speculated that eggs were deposited in crevices in the bedrock or interstitial spaces around boulders to have survived predation by adult carp that frequented the spring outflow.

4. Distribution of subadult humpback chub (<200 mm) from the mouth of the LCR (RM 61.3) to Red Creek (RM 76.5) in July, 1994, was similar to distributions observed during September through November of 1993 and indicated that young humpback chub are utilizing suitable habitats throughout the reach.

5. Decreases in electrofishing and minnow trap catch rates from September 1993 to July 1994 suggest that densities of subadult humpback chub in Reach 1 below the LCR have decreased approximately 70%.

6. Growth of humpback chubs from the 1993 year-class could not be assessed due to the inability to distinguish cohorts from length-frequency data.

7. Food habits data collected during July 1994 indicated some longitudinal variation in diet of humpback chub in Grand Canyon, with Cladophora and Gammarus utilized more frequently by fish in the 30-Mile and LCR areas. Volumetrically and numerically, Simuliids were the dominant item in humpback chub gut contents at all sites except the 30-Mile area, where they were not found.

8. Asian tapeworm was found in 3 of 30 humpback chub stomachs contents examined during July, 1994. The three chubs infested with tapeworm were captured in Reach 1, below the confluence of the LCR, suggesting a possible link between the life cycle of the parasite and the LCR.

9. Asian tapeworm was found in 10% (1 of 10) of fathead minnow stomachs examined.

RECOMMENDATIONS

1. Spawning of humpback chub in Reach 0, from the confluence of the Paria (RM 1.0) to Kwagunt Rapid (RM 56.0) should continue to be evaluated. Emphasis should be placed on spring sources around faulted areas such as Fence Fault and Eminence Break.

2. A more complete water quality analysis, including gaseous nitrogen, of springs in the Fence Fault area should be conducted. This information could provide insight into why humpback chub and other fish species appear to exhibit preference for specific springs in the area.

3. The incidence of Asian tapeworm in humpback chub and other suitable host species in Grand Canyon should continue to be evaluated. Understanding the life history and ecology of this parasite and its affects on humpback chub populations may have implications in the future management of aquatic ecosystems of the mainstem Colorado River and its tributaries in Grand Canyon.

4. Techniques for marking subadult humpback chub, less than 150 mm, should be evaluated as a research item. Marking fish would enhance the ability of researchers to evaluate growth and movement of early life stages of humpback chub in Grand Canyon.

Table 1. Logistics and Research Schedule for Supplemental Investigation, July 1994.

Date	RM	Location	Research Activities		
			T&R[1]	FS	HQ
7/12	31.6	South Canyon	X	X	X
7/13	31.6	South Canyon		X	X
7/14	31.6	South Canyon		X	X
7/15	61.3	LCR	X	X	
7/16	61.3	LCR		X	
7/17	65.4	Lava Chuar	X	X	
7/18	65.4	Lava Chuar		X	
7/19	68.3	Tanner Cr.	X	X	X
7/20	68.3	Tanner Cr.		X	X
7/21	71.1	Cardenas Cr.	X	X	X
7/22	71.1	Cardenas Cr.		X	X
7/23	76.0	Popago Cr.	X	X	X
7/24	126.5	Randy's Rock	X	X	X
7/25	126.5	Randy's Rock		X	X
7/26	126.5	Randy's Rock		X	X
7/27	180.0	Below Lava Falls	X		
7/28	224.0	Above Diamond Cr.	X		
7/29	225.0	Diamond Cr.	X		

[1] T&R = Travel and Reconnaissance
FS = Fish Sampling
TE = Telemetry
HQ = Habitat Quantification

Table 2. Personnel Participating in Supplemental Trip, July 1994.

Personnel	Affiliation	Dates	Comments
B. Masslich	BIO/WEST	7/12 - 7/29	Project Leader
R. Valdez	BIO/WEST	7/18 - 7/20	Principal Investigator
B. Cowdell	BIO/WEST	7/12 - 7/29	Senior Biologist
P. Weiss	BIO/WEST	7/12 - 7/29	
E. Prats	BIO/WEST	7/12 - 7/29	
E. Converse	BIO/WEST	7/12 - 7/29	
R. Ryel	BIO/WEST	7/13 - 7/20	Statistical Consultant
L. Neimi	OARS	7/12 - 7/29	
T. Anderson	OARS	7/12 - 7/29	Trip Leader
A. Anderson	OARS	7/12 - 7/29	

Table 3. Summary of Fish Collected and Effort by Gear Type, Trip 1, 1994. THESE DATA ARE PRELIMINARY

Gear Type	Age	HB	FM	BH	RB	BR	CC	CP	SD	FH	GS	PK	SU
Electrofishing Reach 0 N=22 3.4 hr	A				52			1					
	J				39			0					
	Y				3			0					
Electrofishing Reach 1 N=59 9.93 hr	A	0	5	0	1	0			37	74	1		
	J	71	0	3	10	2			0	5	0		
	Y	102	5	0	75	0			0	3	0		
Electrofishing Reach 2 N=20 3.09 hr	A	0	0	0	2	3		4		15			0
	J	2	3	2	11	0		0		7			0
	Y	0	0	0	0	0		0		1			9
Nets Reach 0 N=30 60.18 hr	A	5	2		31			1					
	J	0	0		0			0					
	Y	0	0		0			0					
Nets Reach 1 N=19 46.12 hr	A	34	30	1	11								
	J	2	0	0	0								
	Y	0	0	0	0								
Nets Reach 2 N=25 60.37	A	10	3	1	1			3					
	J	0	0	0	0			0					
	Y	0	0	0	0			0					
Traps Reach 1 N=190 4,099.8 hr	A	0							7	7			
	J	6							0	0			
	Y	52							1	2			

Table 3. Continued.

Gear Type	Age	HB	FM	BH	RB	BR	CC	CP	SD	FH	GS	PK	SU
Traps Reach 2 N=70 1,394.3 hr	A	0								2			
	J	2								0			
	Y	0								0			
Seine Reach 1 N=7 709 m^2	A								1	29		1	
	J								0	0		0	
	Y								0	0		0	
Dip Net Reach 0 N=3	A	0											
	J	0											
	Y	14											
Light Traps Reach 0 N=17 192 m	A												
	J												
	Y												

A = Adult
J = Juvenile
Y = Young-of-year

HB = humpback chub
FM = flannelmouth sucker
BH = bluehead sucker
RB = rainbow trout
BR = brown trout
CC = channel catfish
CP = carp

SD = speckled dace
FH = fathead minnow
GS = green sunfish
PK = plains killifish
SU = unidentified sucker

Table 4. Physical and chemical characteristics of springs in the Fence Fault area, between RM 30 and RM 31.8.

Spring	RM	Estimated Discharge (cfs)	Estimate Area of Plume (m^2)	Temperature at source (°C)	Conductivity (µS/cm)	DO (mg/l)	pH
A	30.3	0.5-5.0	15	20.9			
B	30.3	-	-	-			
C	30.3	<0.1	<1	-			
D	30.4	-	-	-			
E	30.4	< 0.1	-	-			
F	30.4	1-3	20	21.0			
G	30.4	5-10	30-40	21.0	2300	4.36	6.34
H	30.5	Variable	10-40	21			
I	30.7	0.5	1-10	-			
J	30.8	2-4	10-30	21.54	353	6.6	7.24
K	31.6	-	-	-			
L	31.8	10-15	200	17			

Table 5. Summary of pooled monthly catch rates (arithmetic mean CPE)for electrofishing and minnow traps in the mainstem Colorado River from the LCR (RM 61.3) to Lava Canyon (RM 65.4), September 1993-July 1994.

	CPE-EL # Fish/10 hrs	% Change from previous sample	% Change from Sep 1993	CPE-MT #fish/100 hrs	% Change from previous sample	% Change from Sep 1993
Sep 1993	521.72	-	-	2.77	-	-
Oct 1993	493.37	-5.4	-5.4	6.44	132.5	132.5
Nov 1993	24.37	-95.1	-95.3	3.25	-49.5	17.3
Jul 1994	134.42	451.6	-74.2	0.79	-75.6	-71.5

Table 6. Summary of stomach pumping effectiveness for obtaining gut contents from 39 humpback chub from four sites in Grand Canyon during July 1994.

	No. Unsuccessful	% unsuccessful by site	No. successful with empty stomachs	% with empty stomachs by site	No. successful	% successful by site
Site 1 30-Mile N=5	2	40.0	2	40.0	1	20.0
Site 2 Above LCR N=10	1	10.0	1	10.0	8	80.0
Site 3 Below LCR N=17	4	23.5	6	35.3	7	41.2
Site 4 MGG N=7	1	14.3	0	0	6	85.7
Totals	**8**	**20.5**	**9**	**23.1**	**22**	**56.4**

Table 7. Relative abundance[1] of food items collected in drift samples taken concurrent with food habits studies at four sites in Grand Canyon, July 1994.

Site	GAMM %	SIM %	CHIR %	AQ OTHER %	TERR %	Avg # Inverts per sample
Site 1 30 Mile (RM 31.65) N=3	1.56	0	53.77	44.67	0	176.90
Site 2 Above LCR (RM >58, <61.5) N=3	2.51	7.59	87.46	1.67	0.78	1265.24
Site 3 Below LCR (RM ≥61.5, <70) N=3	2.97	6.79	84.34	5.02	0.88	1698.62
Site 4 MGG (RM 126-130) N=3	0.27	21.41	75.18	2.12	1.02	1496.21

[1]Relative abundances were calculated in $100m^3$ H_2O.

Table 8. Incidence of specific food items in gut contents of 22 humpback chub stomach pumped from 4 sites in Grand Canyon during July 1994. N=number of fish pumped with food.

	Number with Gammarus (% by site)	Number with Simulid (% by site)	Number with Chironomids (% by site)	Number with other Aquatics (% by site)	Number with Terrestrial (% by site)	Number with Cladophora (% by site)
Site 1 30-Mile N=1	-	-	1(100)	-	-	1(100)
Site 2 Above LCR N=8	7(87.5)	7(87.5)	7(87.5)	1(12.5)	3(37.5)	2(25.0)
Site 3 Below LCR N=7	5(71.4)	6(85.7)	6(85.7)	2(28.6)	4(57.1)	2(28.6)
Site 4 MGG N=6	2(33.3)	6(100)	4(66.7)	3(50)	2(33.3)	0(0)
Totals	**14(63.6)**	**19(86.4)**	**18(81.8)**	**6(27.3)**	**9(40.1)**	**5(22.7)**

Table 9. Mean volume of five invertebrate taxa and algae found in gut contents from 22 humpback chub from four sites in Grand Canyon, July 1994. N=number of fish pumped with food.

Site		Gammarus			Simulidae	Chironimade	Other Aquatic	Terrestrial	Cladophora glomerata	Total Vol.
		Adu	Imm	Tot						
Site 1	x	0	0	0	0	0.01	0	0	4.0	4.01
30-Mile	Range	-	-	-	-	-	-	-	-	-
N=1	SD	-	-	-	-	-	-	-	-	-
	% of Total Vol	0	0	0	0	<0.1	0	0	99.9	-
Site 2	x	0.08	0.04	0.12	0.34	0.02	0	<0.01	0.25	0.86
Above LCR	Range	0-0.44	0-0.14	0-0.46	0-0.53	0-0.04	-	0-0.01	0-1.0	0.09-1.95
N=8	SD	0.15	0.05	0.14	0.23	0.02	-	<0.01	0.46	0.77
	% of Total Vol	9.3	4.7	14.0	39.5	2.3	0	1.1	29.1	-
Site 3	x	0.25	0.03	0.28	0.45	0.01	0	<0.01	0.43	1.45
Below LCR	Range	0-0.57	0-0.12	0-0.65	0-1.03	0-0.03	-	0-0.01	0-2.0	0-4.12
N=7	SD	0.25	0.05	0.28	0.41	0.01	-	<0.01	0.79	1.47
	% of Total Vol	17.2	2.1	19.3	31.0	0.3	0	0.3	29.7	-
Site 4	x	0.01	0	0.1	0.37	0.01	<0.01	<0.01	0	0.42
MGG	Range	0-0.04	-	0-0.04	0-1.27	0-0.03	0-0.01	0-0.01	-	0.01-1.31
N=6	SD	0.02	-	0.02	0.47	<0.01	<0.01	<0.01	-	0.47
	% of Total Vol	2.4	0	2.4	88.1	2.4	<2.4	<2.4	0	
Totals	x	0.11	0.02	0.14	0.37	0.01	<0.01	<0.01	0.41	1.07
N=22	Range	0-0.57	0.014	0-0.65	0-1.27	0-0.04	0-0.01	0-0.01	0.20	0-4.12
	SD	0.18	0.04	0.20	0.35	0.01	<0..1	<0.01	0.94	1.18
	% of Total Vol	10.3	1.9	13.1	34.6	0.1	0.8	0.8	38.3	-

Table 10. Mean number of individuals of five invertebrate taxa found in gut contents from 22 humpback chub from four sites in Grand Canyon, July 1994.

Site		Gammarus			Simuliidae				Chironimidae				Other Aquatic	Terrestrial	Total No. Inverts
		Adu	Imm	Tot	Adu	Pup	Lar	Tot	Adu	Pup	Lar	Tot			
Site 1	x	0	0	0	0	0	0	0	1	3	0	4	0	0	4
30-Mile	Range	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N=1	SD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% of Total No.	0	0	0	0	0	0	0	25	75		100	0	0	
Site 2	x	1.9	1.9	3.8	7.9	52.6	23.6	84.1	0.4	6.4	1.4	8.1	0.25	0.5	96.8
Above LCR	Range	0-10	0-7	0-11	0-24	0-103	0-49	0-164	0-2	0-15	0-3	0-18	0-2	0-2	1-174
N=8	SD	3.4	2.6	3.7	9.1	38.1	16.9	55.8	0.7	6.3	1.3	7.4	0.7	0.8	60.0
	% of Total No.	1.9	1.9	3.9	8.1	54.3	24.4	86.9	<0.1	6.6	1.4	8.4	<0.1	<0.1	-
Site 3	x	5.7	1.6	7.3	4.0	74.1	30.4	109.0	0.3	2.4	2.3	5.0	0.7	0.7	122.0
Below LCR	Range	0-13	0.6	0-17	0-11	0-187	0-88	0-251	0-1	0-7	0-9	0-14	0-4	0.2	13-281
N=7	SD	5.7	2.4	7.2	4.2	69.9	30.8	101.0	0.5	2.8	3.5	5.9	1.5	0.8	108.0
	% of Total No.	4.6	1.3	6.0	3.3	60.7	24.9	89.3	<0.1	2.0	1.9	4.1	<0.1	<0.1	-
Site 4	x	0.3	0	0.3	5.8	9.5	76.0	91.3	0.3	2.0	1.3	3.7	2.7	0.5	98.5
MGG	Range	0-1	-	0-1	0-16	0-16	2-286	3-309	0-1	0-8	0-5	0-13	0-8	0-2	3-328
N=6	SD	0.5	-	0.5	6.7	7.1	107.0	114.0	0.5	3.0	2.0	4.8	3.5	0.8	120.0
	% of Total No.	<0.1	0	<0.1	5.9	9.6	77.2	92.7	<0.1	2.0	1.4	3.7	2.7	<0.1	-
Totals	x	2.6	1.2	3.8	5.7	45.3	39.0	90	0.4	3.8	1.6	5.7	1.1	0.6	101.0
N=22	Range	0-13	0.7	0-17	0-24	0-187	0-286	0-309	0.2	0-15	0-9	0-18	0.8	0.2	1-328
	SD	4.3	2.2	5.3	6.9	51.5	60.5	86.8	0.6	4.6	2.3	6.1	2.2	0.7	92.6
	% of Total No.	2.3	1.2	3.8	5.6	44.9	38.6	89.1	<0.1	3.8	1.6	5.6	1.1	0.1	-

Table 11. Summary of Asian tapeworm incidence in gut contents of humpback chub stomachs pumped during July 1994 from 4 sample reaches in Grand Canyon.

Sample Site	RM	# HB pumped	# Successful	# w/Tapeworms
30 Mile Area	30.7	5	3	0
Reach 1 - Above LCR	60.4-60.9	10	9	0
Reach 1 - Below LCR	61.7-65.3	17	12	3
Middle Granite Gorge	127.1	7	6	0
Totals		39	30	3

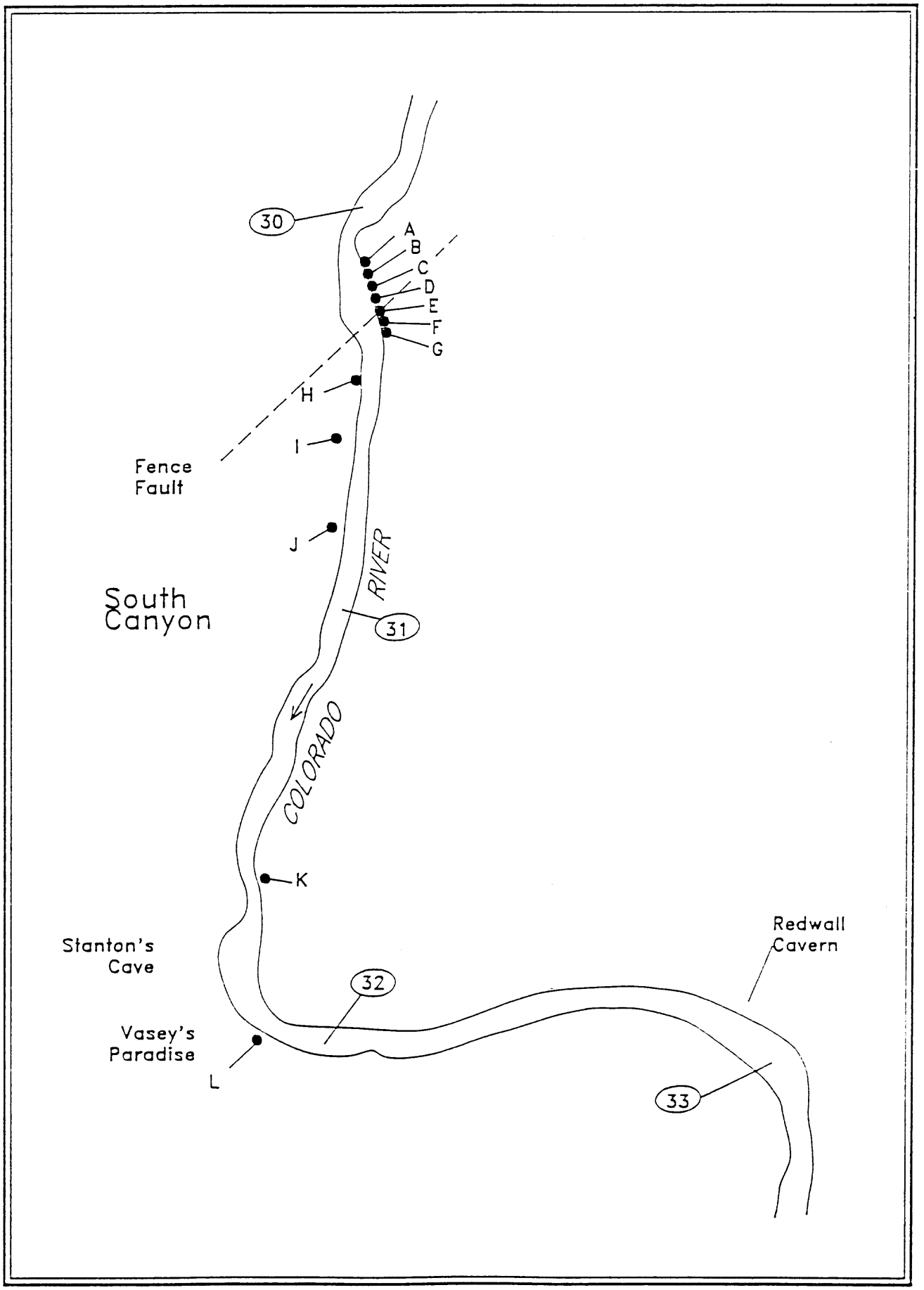


Figure 1. Locations of 12 springs (A-L) in the Fence Fault Area.

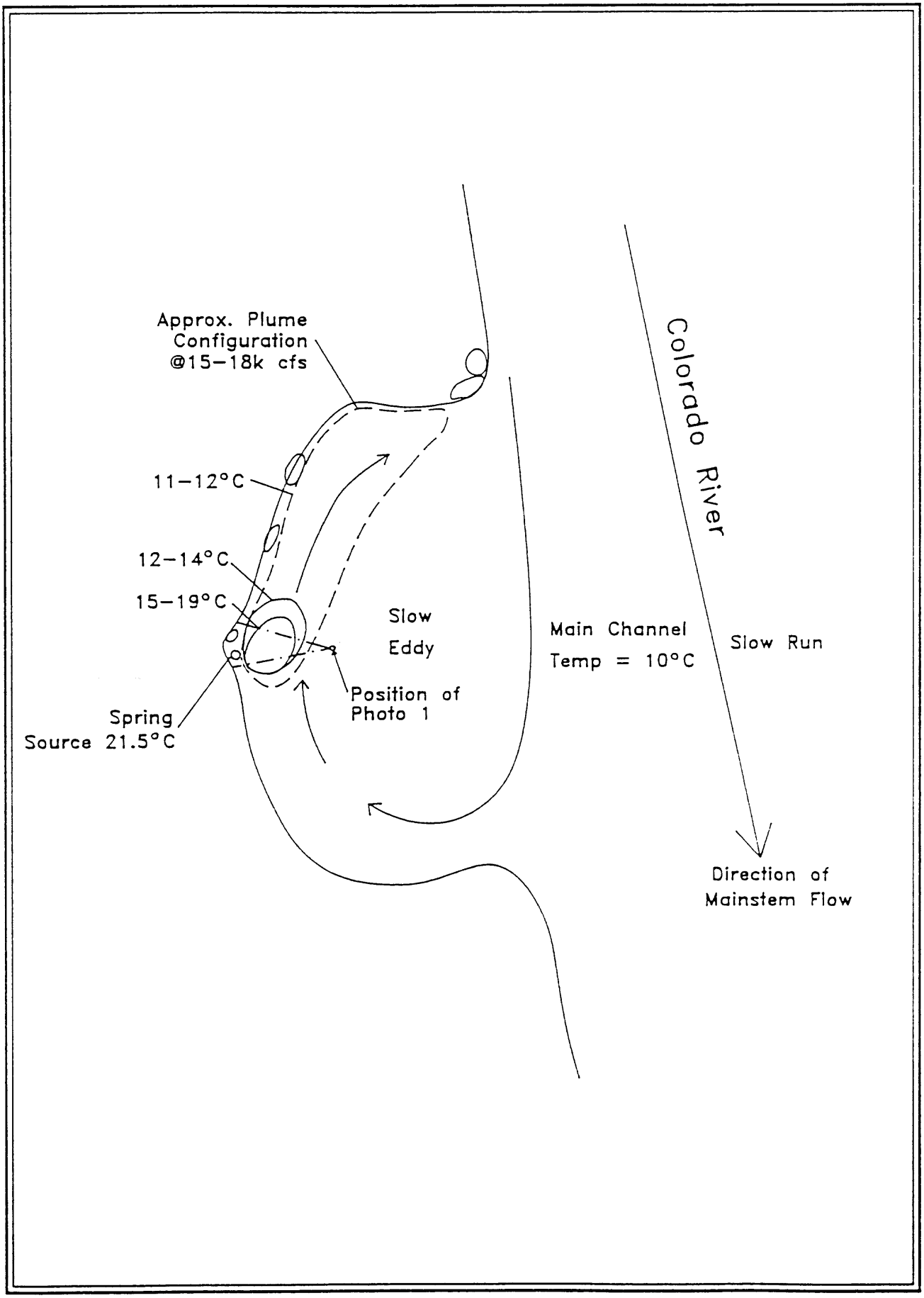
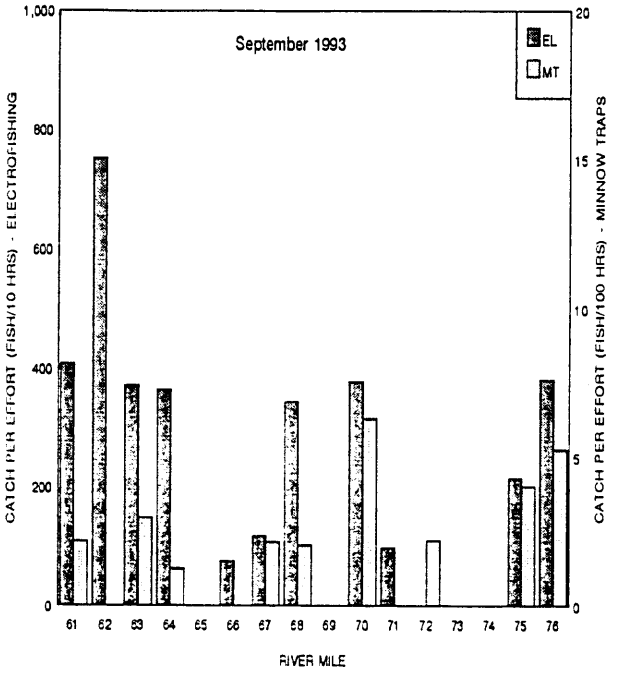
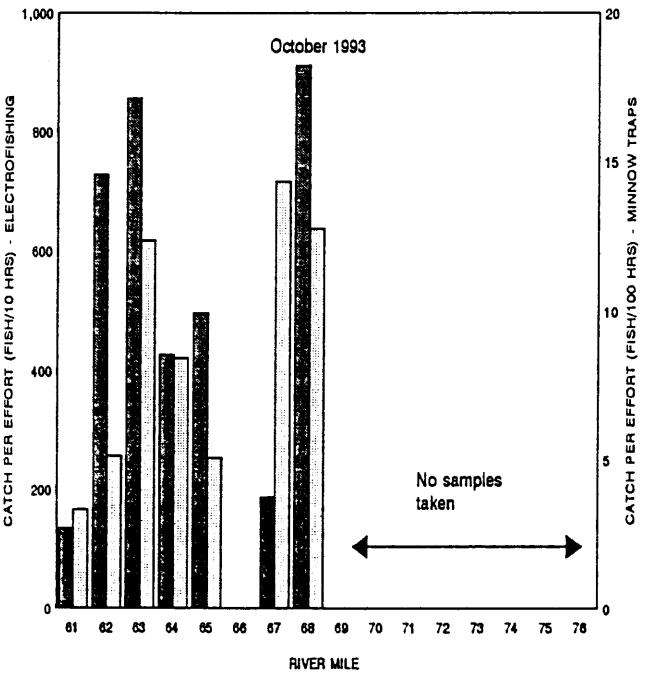
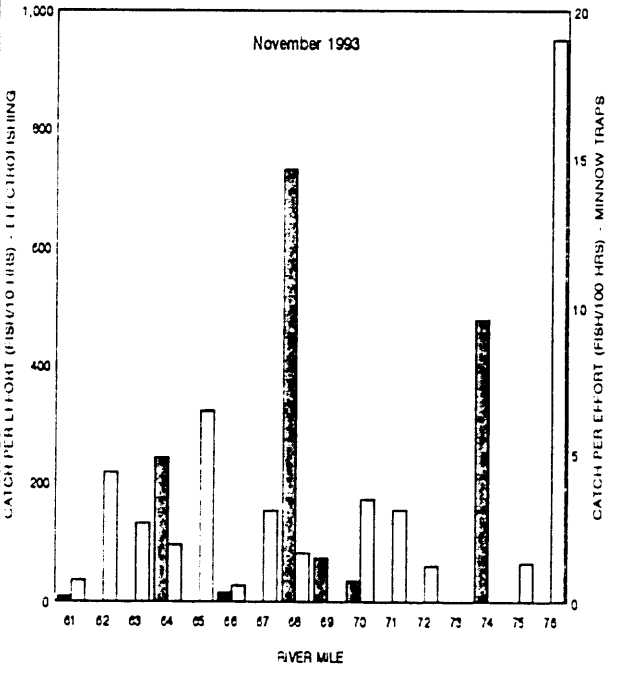


Figure 2. Approximate plume shape and thermal characteristics of Spring J at RM 30.8. Data collected July 14, 1994, with a Hydrolab Surveyor 3.







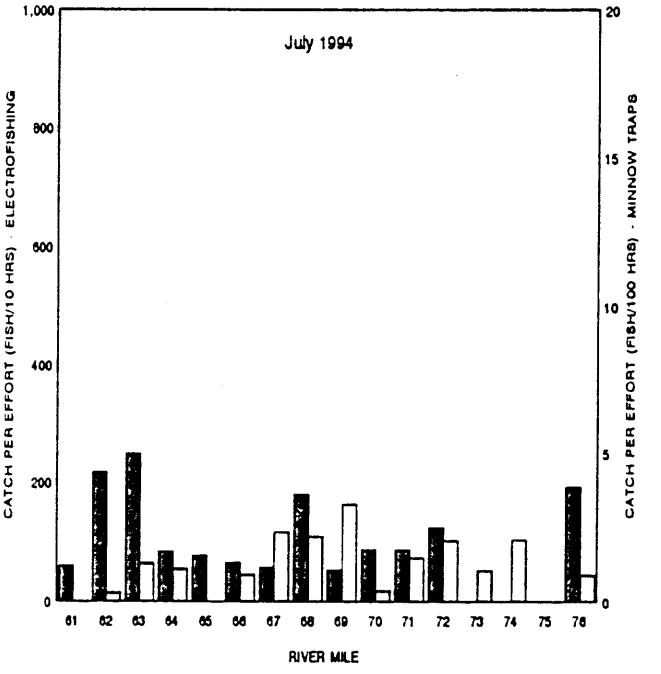


Figure 3. Longitudinal electrofishing and minnow trap catch rates (arithmetic mean CPE) by mile for Reach 1, below the confluence of the LCR, RM 61.3 to RM 76.5, for September through November 1993 and July 1994, in Grand Canyon, AZ.

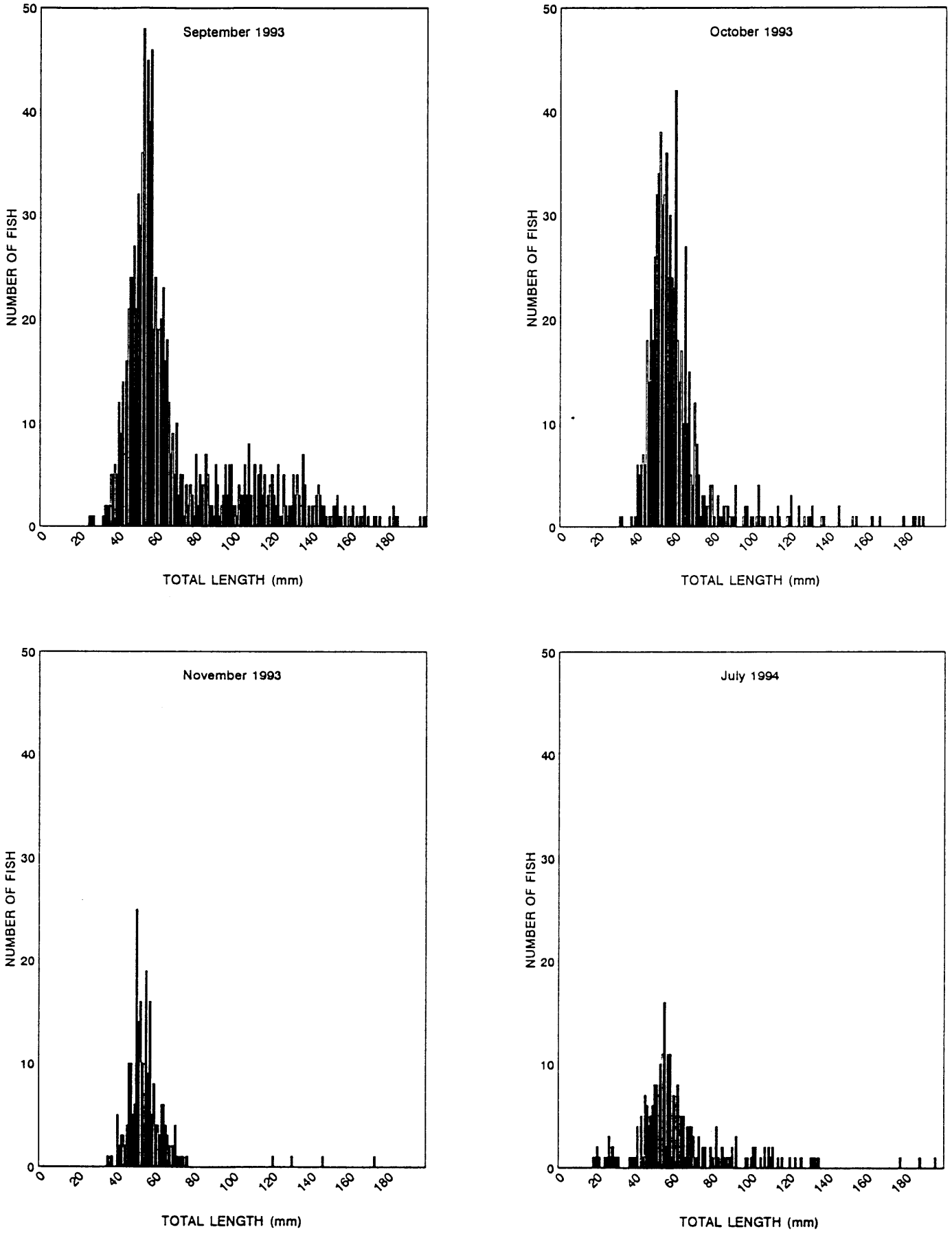


Figure 4. Length frequency histograms, by 1 mm increments for humpback chub captured in Reach 1, below the LCR, RM 61.3 to RM 76.5, for September through November 1993 and July 1994, in Grand Canyon, AZ.

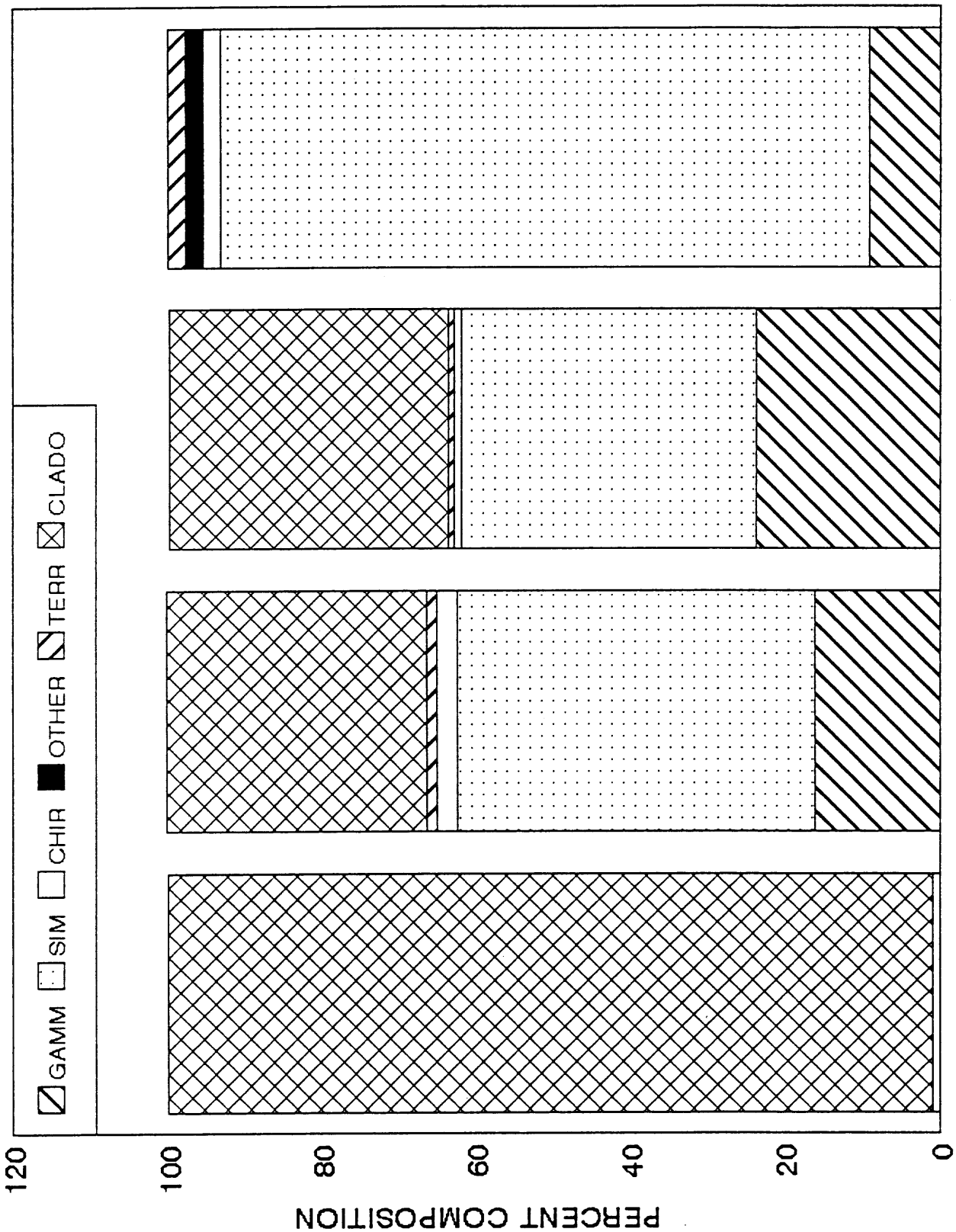


Figure 5. Percent composition of volume of food items found in 22 humpback chub at four sites during July 1994 in Grand Canyon. Site 1, N=1; Site 2, N=8; Site 3, N=7; Site 4, N=6.

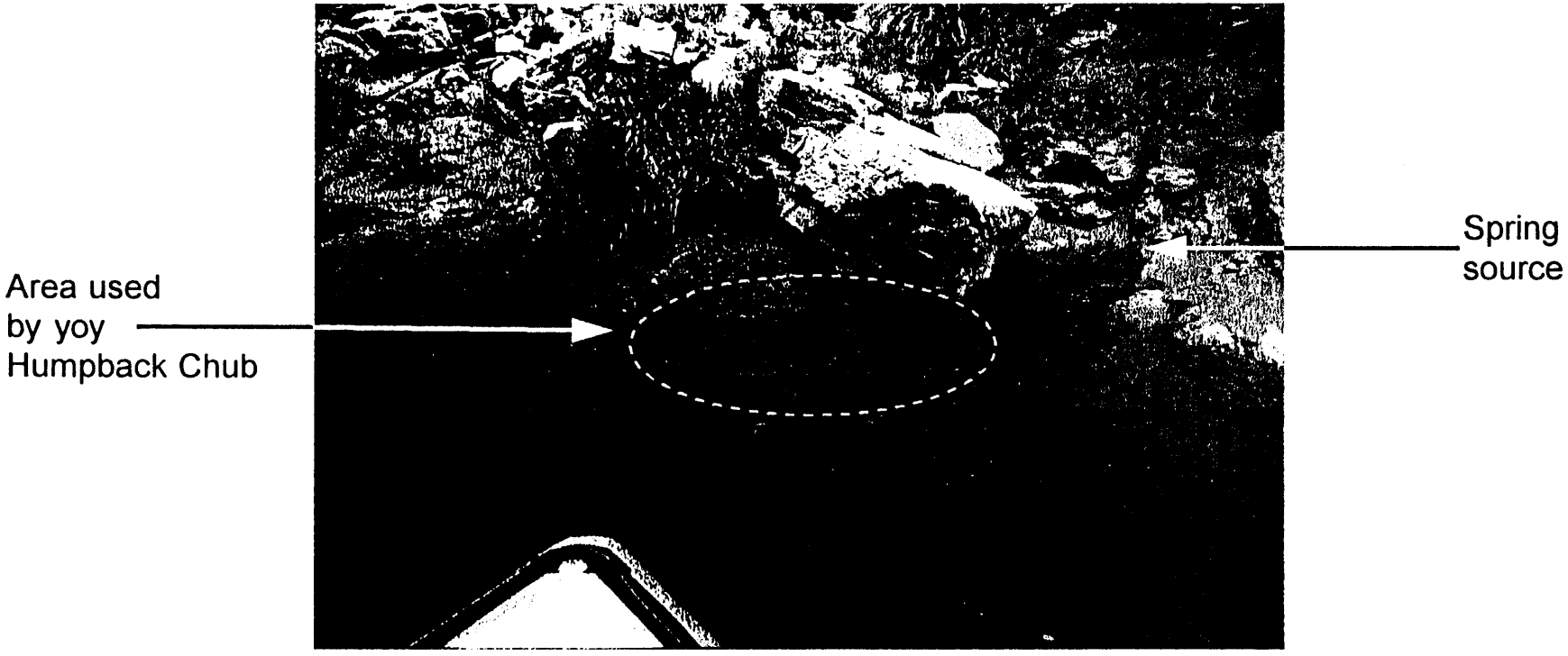


Photo 1. Photograph of Spring J at RM 30.7, Grand Canyon. Approximately 100 YOY humpback chub were observed in the mouth of the spring at the time of the photograph on July 14, 1994. See Figure 2 for location and angle of this photo.

LITERATURE CITED

Blinn, D.W., L.E. Stevens, and J.P. Shannon. 1992. The effects of Glen Canyon Dam on the aquatic food base in the Colorado River Corridor in Grand Canyon, Arizona. Glen Canyon Environmental Study-11-02.

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APPENDIX A

Summary of humpback chub handled during July, 1994

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
1	940712	TK	1F20242479	N		451	784	F	RS	30.70	N
2	940712	TK	1F20051329	Y	PITTAG	414	489	F	RS	30.70	N
3	940714	TK	7F7F284922	Y	PITTAG	428	667	U	RS	30.70	N
4	940714	TK	1F204D373D	N		352	379	M	RS	30.70	N
5	940714	TK	1F20170C1E	N		367	464	F	RS	30.70	N
6	940714	DN		N		27	0	U	RA	30.70	N
7	940714	DN		N		21	0	U	RA	30.70	N
8	940714	DN		N		19	0	U	RA	30.70	N
9	940714	DN		N		25	0	U	RA	30.70	N
10	940714	DN		N		20	0	U	DP	30.70	N
11	940714	DN		N		26	0	U	DP	30.70	N
12	940714	DN		N		26	0	U	RA	30.70	N
13	940714	DN		N		31	0	U	DP	30.70	N
14	940714	DN		N		26	0	U	DP	30.70	N
15	940714	DN		N		18	0	U	DP	30.70	N
16	940714	DN		N		24	0	U	RA	30.70	N
17	940714	DN		N		29	0	U	RA	30.70	N
18	940714	DN		N		28	0	U	RA	30.70	N
19	940714	DN		N		20	0	U	RA	30.70	N
20	940715	TK		N		201	83		DP	60.40	N
21	940715	TK	7F7F183777	Y	PITTAG	195	73	U	RA	60.75	N
22	940715	TK	7F7D18052F	Y	PITTAG	297	208	M	RS	60.75	N

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
23	940715	TK	7F7D1A483C	Y	PITTAG	338	305	F	RS	60.75	N
24	940715	TK	7F7D080274	Y	PITTAG	375	396	M	RS	60.75	N
25	940715	TK	7F7D173645	Y	PITTAG	320	306	F	RA	60.75	N
26	940715	TK	7F7F1F137B	N		235	120	F	RA	60.90	N
27	940715	TK	7F7F3F4B64	Y	PITTAG	364	338	M	RS	60.90	N
28	940715	TK	7F7D1B6D44	Y	PITTAG	331	312	F	RS	60.90	N
29	940715	TK	7F7F3E2619	Y	PITTAG	382	495	U	RS	60.40	N
30	940715	TK	7F7D170E4B	Y	PITTAG	284	190	M	RS	60.40	N
31	940715	TK	7F7B182E37	Y	PITTAG	329	329	F	RS	60.40	N
32	940715	TK	7F7F05026E	Y	PITTAG	362	435	M	RS	60.40	N
33	940715	TN	7F7D180120	Y	PITTAG	302	370	F	RS	60.90	N
34	940716	EL		N		86	4	U	RA	62.00	N
35	940716	EL		N		70	2	U	RA	62.00	N
36	940716	EL		N		53	1	U	RA	62.35	N
37	940716	EL		N		79	4	U	RA	62.65	N
38	940716	EL		N		55	1	U	RA	62.65	N
39	940716	EL		N		62	2	U	RA	62.65	N
40	940716	EL		N		58	1	U	RA	62.65	N
41	940716	EL		N		48	1	U	RA	62.65	N
42	940716	EL		N		57	2	U	RA	62.75	N
43	940716	EL		N		55	1	U	RA	62.75	N
44	940716	EL		N		50	2	U	RA	62.75	N

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
45	940716	EL		N		49	1	U	RA	62.75	N
46	940716	EL		N		100	10	U	RA	62.75	N
47	940716	EL		N		40	1	U	RA	63.20	N
48	940716	EL		N		45	1	U	RA	63.20	N
49	940716	EL		N		41	1	U	RA	63.20	N
50	940716	EL		N		49	1	U	RA	63.20	N
51	940716	EL		N		53	1	U	RA	63.20	N
52	940716	EL		N		98	8	U	RA	63.20	N
53	940716	EL		N		46	1	U	RA	63.20	N
54	940716	EL		N		52	1	U	RA	63.20	N
55	940716	EL		N		67	2	U	RA	63.20	N
56	940716	EL		N		45	1	U	RA	63.20	N
57	940716	EL		N		53	1	U	RA	63.20	N
58	940716	EL		N		92	6	U	RA	63.20	N
59	940716	EL		N		62	1	U	RA	63.20	N
60	940716	EL		N		69	3	U	RA	63.20	N
61	940716	EL		N		47	1	U	RA	63.20	N
62	940716	EL		N		47	1	U	RA	63.20	N
63	940716	EL		N		28	1	U	RA	63.20	N
64	940716	EL		N		85	5	U	RA	63.20	N
65	940716	EL		N		54	1	U	RA	63.20	N
66	940716	EL		N		53	1	U	RA	63.20	N

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
67	940716	TK	7F7F396025	Y	PITTAG	276	179	F	RS	61.95	N
68	940716	TK	7F7F196E07	Y	PITTAG	237	115	M	RA	61.95	N
69	940716	TK	1F1F786664	N		399	481	M	RS	61.85	N
70	940716	TK	1F20510967	N		406	523	M	RS	61.85	N
71	940716	TK	7F7D152D77	Y	PITTAG	363	370	F	RS	61.85	N
72	940716	TK	7F7D401470	Y	PITTAG	412	566	M	RS	61.85	N
73	940716	TK	1F0F754A13	Y	PITTAG	349	286	M	RS	61.85	N
74	940716	TK	7F7D2C1657	Y	PITTAG	384	424	M	RS	61.85	N
75	940716	TK	7F7D2B256C	Y	PITTAG	273	136	M	RS	62.10	N
76	940716	TK	7F7D225674	Y	PITTAG	349	315	M	RS	62.10	N
77	940716	TK	7F7F476C10	Y	PITTAG	330	285	F	RS	62.10	N
78	940716	TN	7F7F480E1B	Y	PITTAG	335	293	M	RS	61.70	N
79	940716	TN	1F20404A47	N		359	344	M	RA	61.70	N
80	940717	EL		N		92	5	U	RA	63.30	N
81	940717	EL		N		97	5	U	RA	63.30	N
82	940717	EL		N		83	4	U	RA	63.30	N
83	940717	EL		N		82	4	U	RA	63.30	N
84	940717	EL		N		89	5	U	RA	63.30	N
85	940717	EL		N		88	4	U	RA	63.30	N
86	940717	EL		N		75	0	U	RA	63.50	N
87	940717	EL		N		57	0	U	RA	63.50	N
88	940717	EL		N		50	0	U	RA	63.50	N

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
89	940717	EL		N		50	0	U	RA	63.50	N
90	940717	EL		N		50	0	U	RA	63.50	N
91	940717	EL		N		101	0	U	RA	63.55	N
92	940717	EL		N		50	0	U	RA	63.55	N
93	940717	EL	1F1F6E4C08	N		177	35	U	RA	64.90	N
94	940717	EL		N		39	0	U	RA	64.90	N
95	940717	MT		N		61	0	U	RA	63.75	N
96	940717	MT		N		105	0	U	RA	63.50	N
97	940717	MT		N		109	0	U	RA	63.50	N
98	940717	MT		N		82	0	U	RA	63.45	N
99	940717	MT		N		64	0	U	RA	63.45	N
100	940717	TK	7F7F3E410F	Y	PITTAG	228	110	M	RA	64.80	N
101	940717	TK	1F1E490B6F	N		248	130	M	RA	64.80	N
102	940717	TK	7F7B023022	Y	PITTAG	379	406	M	RS	64.80	N
103	940717	TK	1F2031612F	N		386	396	M	RS	64.80	N
104	940717	TK	7F7F395960	Y	PITTAG	359	398	M	RS	64.80	N
105	940717	TK	7F7F051102	Y	PITTAG	391	514	F	RS	65.30	N
106	940717	TK	1F201B3A6C	Y	PITTAG	363	396	M	RS	65.30	N
107	940718	EL		N		114	19	U	RA	64.61	N
108	940718	EL		N		111	10	U	RA	64.61	N
109	940718	EL		N		111	10	U	RA	64.61	N
110	940718	EL		N		57	0	U	RA	63.70	N

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
111	940718	EL		N		73	3	U	RA	63.70	N
112	940718	EL		N		60	3	U	RA	63.70	N
113	940718	EL		N		48	0	U	RA	63.70	N
114	940718	EL		N		52	0	U	RA	63.70	N
115	940718	EL		N		54	0	U	RA	63.70	N
116	940718	EL		N		45	0	U	RA	63.70	N
117	940718	EL		N		45	0	U	RA	63.70	N
118	940718	EL		N		46	0	U	RA	63.70	N
119	940718	EL		N		133	19	U	RA	63.65	N
120	940718	EL		N		49	0	U	RA	63.65	N
121	940718	EL		N		41	0	U	RA	63.65	N
122	940718	EL		N		51	0	U	RA	63.65	N
123	940718	EL		N		51	0	U	RA	63.65	N
124	940718	EL		N		41	0	U	RA	63.65	N
125	940718	EL		N		90	6	U	RA	63.65	N
126	940718	EL		N		73	4	U	RA	63.65	N
127	940718	EL		N		76	4	U	RA	63.65	N
128	940718	EL		N		67	0	U	RA	63.65	N
129	940718	EL		N		63	3	U	RA	63.65	N
130	940718	EL		N		43	0	U	RA	63.65	N
131	940718	EL		N		49	0	U	RA	63.65	N
132	940718	EL		N		131	17	U	RA	63.65	N

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
133	940718	EL		N		120	11	U	RA	63.65	N
134	940718	EL		N		109	12	U	RA	63.65	N
135	940718	EL		N		107	12	U	RA	63.65	N
136	940718	EL		N		102	11	U	RA	63.65	N
137	940718	EL		N		90	7	U	RA	63.65	N
138	940718	EL		N		102	8	U	RA	63.65	N
139	940718	MT		N		57	0	U	RA	64.20	N
140	940718	MT		N		68	0	U	RA	64.25	N
141	940718	MT		N		57	0	U	RA	64.25	N
142	940718	MT		N		51	0	U	RA	64.85	N
143	940718	MT		N		48	0	U	RA	64.85	N
144	940718	TK	7F7F47342F	Y	PITTAG	205	91	U	RA	64.80	N
145	940718	TK	7F7D2B147F	Y	PITTAG	378	391	U	RS	65.30	N
146	940719	EL		N		82	3	U	RA	67.20	N
147	940719	EL		N		58	0	U	RA	67.20	N
148	940719	EL		N		55	0	U	RA	67.20	N
149	940719	EL		N		55	0	U	RA	67.20	N
150	940719	EL		N		55	0	U	RA	67.20	N
151	940719	EL		N		54	0	U	RA	67.20	N
152	940719	EL		N		65	0	U	RA	67.20	N
153	940719	EL		N		57	1	U	RA	63.54	N
154	940719	EL		N		107	10	U	RA	67.20	N

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
155	940719	EL		N		110	9	U	RA	67.20	N
156	940719	EL		N		92	7	U	RA	67.20	N
157	940719	EL		N		85	5	U	RA	67.20	N
158	940719	EL		N		87	5	U	RA	67.20	N
159	940719	EL		N		79	3	U	RA	67.20	N
160	940719	MT		N		46	0	I	RA	66.90	N
161	940719	MT		N		49	0	I	RA	66.90	N
162	940719	MT		N		71	0	U	RA	67.80	N
163	940719	MT		N		68	0	U	RA	68.20	N
164	940719	MT		N		65	0	U	RA	68.20	N
165	940719	MT		N		57	0	U	RA	67.80	N
166	940719	MT		N		75	0	U	RA	67.80	N
167	940720	EL		N		54	0	U	RA	67.90	N
168	940720	EL		N		54	0	U	RA	67.90	N
169	940720	EL		N		43	0	U	RA	67.90	N
170	940720	EL		N		132	21	U	RA	67.95	N
171	940720	EL		N		60	0	U	RA	68.10	N
172	940720	EL		N		52	0	U	RA	68.10	N
173	940720	EL		N		58	0	U	RA	68.20	N
174	940720	EL		N		64	0	U	RA	68.20	N
175	940720	EL		N		56	0	U	RA	68.20	N
176	940720	EL		N		51	0	U	RA	68.20	N

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
177	940720	EL		N		37	0	U	RA	68.20	N
178	940720	EL		N		60	0	U	RA	68.20	N
179	940720	EL		N		47	0	U	RA	68.20	N
180	940720	EL		N		58	0	U	RA	68.20	N
181	940720	EL		N		44	0	U	RA	68.20	N
182	940720	EL		N		50	0	U	RA	68.20	N
183	940720	EL		N		63	0	U	RA	68.20	N
184	940720	EL		N		55	0	U	RA	68.20	N
185	940720	EL		N		53	0	U	RA	68.20	N
186	940720	EL		N		63	0	U	RA	68.20	N
187	940720	EL		N		60	0	U	RA	68.20	N
188	940720	EL		N		72	0	U	RA	68.20	N
189	940720	EL		N		80	0	U	RA	68.20	N
190	940720	EL		N		63	0	U	RA	68.20	N
191	940720	EL		N		58	0	U	RA	68.20	N
192	940720	EL		N		48	0	U	RA	67.75	N
193	940720	EL		N		52	0	U	RA	67.75	N
194	940720	EL		N		67	0	U	RA	68.20	N
195	940720	EL		N		69	0	U	RA	68.20	N
196	940720	EL		N		76	0	U	RA	68.20	N
197	940720	EL		N		54	0	U	RA	68.20	N
198	940720	EL		N		67	0	U	RA	68.20	N

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
199	940720	MT		N		65	0	U	RA	67.20	N
200	940720	MT		N		61	0	U	RA	67.20	N
201	940720	MT		N		62	0	U	RA	67.20	N
202	940720	MT		N		55	0	U	RA	67.05	N
203	940720	MT		N		45	0	U	DP	67.05	N
204	940720	MT		N		53	0	U	RA	67.05	N
205	940720	MT		N		55	0	U	RA	67.05	N
206	940720	MT		N		58	0	U	RA	67.80	N
207	940720	MT		N		57	0	U	RA	67.80	N
208	940720	MT		N		70	0	U	RA	67.20	N
209	940720	MT		N		62	0	U	RA	67.20	N
210	940720	MT		N		63	0	U	RA	67.20	N
211	940720	MT		N		69	0	U	RA	67.20	N
212	940720	MT		N		64	0	U	RA	68.20	N
213	940720	MT		N		54	0	U	RA	68.20	N
214	940720	MT		N		53	0	U	RA	68.20	N
215	940721	EL		N		135	25	U	RA	69.90	N
216	940721	EL		N		68	0	U	RA	69.90	N
217	940721	EL		N		62	0	U	RA	69.90	N
218	940721	EL		N		62	0	U	RA	70.10	N
219	940721	EL		N		55	0	U	RA	70.10	N
220	940721	EL		N		58	0	U	RA	70.10	N

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
221	940721	EL		N		66	0	U	RA	70.10	N
222	940721	EL		N		53	0	U	RA	72.35	N
223	940721	EL		N		65	0	U	RA	72.35	N
224	940721	EL		N		47	0	U	RA	72.40	N
225	940721	EL		N		57	0	U	RA	72.40	N
226	940721	EL		N		58	0	U	RA	72.40	N
227	940721	EL		N		51	0	U	RA	72.40	N
228	940721	EL		N		55	0	U	RA	72.40	N
229	940721	EL		N		50	0	U	RA	72.40	N
230	940721	EL		N		43	0	U	RA	72.40	N
231	940721	EL		N		43	0	U	RA	71.75	N
232	940721	EL		N		58	0	U	RA	71.75	N
233	940721	EL		N		58	0	U	RA	71.75	N
234	940721	EL		N		45	0	U	RA	71.75	N
235	940721	MT		N		49	0	U	RA	69.90	N
236	940721	MT		N		55	0	U	RA	69.90	N
237	940721	MT		N		61	0	U	RA	69.90	N
238	940721	MT		N		70	0	U	RA	70.85	N
239	940722	EL		N		55	0	U	RA	71.10	N
240	940722	EL		N		64	0	U	RA	71.10	N
241	940722	EL		N		101	8	U	RA	71.30	N
242	940722	EL		N		58	0	U	RA	71.45	N

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
243	940722	EL		N		51	0	U	RA	71.45	N
244	940722	EL		N		50	0	U	RA	71.45	N
245	940722	EL		N		59	0	U	RA	71.45	N
246	940722	EL		N		45	0	U	RA	71.45	N
247	940722	EL		N		46	0	U	RA	71.45	N
248	940722	EL		N		38	0	U	RA	71.45	N
249	940722	EL		N		60	0	U	RA	71.45	N
250	940722	EL		N		73	0	U	RA	70.60	N
251	940722	EL		N		62	0	U	RA	70.60	N
252	940722	MT		N		60	0	I	RA	71.45	N
253	940722	MT		N		53	0	I	RA	71.45	N
254	940722	MT		N		65	0	U	RA	72.35	N
255	940722	MT		N		64	0	U	RA	72.35	N
256	940722	MT		N		57	0	U	RA	72.35	N
257	940722	MT		N		123	16	U	RA	72.35	N
258	940722	MT		N		61	0	U	RA	72.25	N
259	940722	MT		N		53	0	U	RA	72.25	N
260	940722	MT		N		54	0	U	RA	72.20	N
261	940722	MT		N		54	0	U	RA	71.80	N
262	940722	MT		N		54	0	U	RA	71.80	N
263	940722	MT		N		57	0	U	RA	71.45	N
264	940723	EL		N		126	20	I	RA	76.20	N

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
265	940723	EL		N		82	5	I	RA	76.40	N
266	940723	EL		N		55	5	I	RA	76.40	N
267	940723	EL		N		61	5	I	RA	76.40	N
268	940723	EL		N		30	5	I	RA	76.40	N
269	940723	EL		N		43	0	U	RA	76.40	N
270	940723	EL		N		41	0	U	RA	76.40	N
271	940723	EL		N		52	0	U	RA	76.40	N
272	940723	MT		N		62	0	U	RA	75.85	N
273	940723	MT		N		61	0	U	RA	76.35	N
274	940723	MT		N		55	0	U	RA	76.35	N
275	940723	MT		N		60	0	U	RA	76.35	N
276	940723	MT		N		69	0	U	RA	76.05	N
277	940723	MT		N		52	0	U	RA	76.05	N
278	940723	MT		N		51	0	U	RA	76.05	N
279	940723	MT		N		51	0	U	RA	75.85	N
280	940724	EL		N		46	0	U	RA	76.50	N
281	940724	EL		N		55	0	U	RA	76.50	N
282	940724	EL		N		116	13	U	RA	125.80	N
283	940724	EL	1F1E43146C	N		187	60	U	RA	126.29	N
284	940724	EL		N		46	0	U	RA	76.50	N
285	940724	EL		N		55	0	U	RA	76.50	N
286	940724	EL		N		54	0	U	RA	76.50	N

N	Date	Gear	PIT Tag	Recap	Old Tag	TL	WT	Sex	Disp	RM Capture	Radio
287	940724	EL		N		68	0	U	RA	76.50	N
288	940724	EL		N		56	0	U	RA	76.50	N
289	940724	EL		N		48	0	U	RA	76.50	N
290	940724	MT		N		52	0	U	RA	62.50	N
291	940725	TK	1F20077743	Y	PITTAG	241	137	M	RA	127.10	N
292	940725	TK	1F200F6F43	N		204	92	U	RA	127.10	N
293	940725	TK	1F20376426	N		361	570	F	RS	127.10	N
294	940725	TK	1F1F677269	N		346	490	M	RS	127.10	N
295	940725	TK	1F1F6D0154	N		294	238	M	RS	127.10	N
296	940725	TK	1F201E356E	N		241	141	M	RA	127.10	N
297	940725	TK	1F1F5F756E	N		279	201	F	RS	127.10	N
298	940725	TK	7F7D087B21	Y	PITTAG	312	291	F	RS	127.10	N
299	940725	TK	7F7D090828	Y	PITTAG	352	517	F	RS	127.10	N
300	940726	TK	1F20350705	N		216	101	F	RS	127.10	N