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Adult and Juvenile Humpback Chub Monitoring for the Yampa River Population, 2003-2004

August 2006

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by

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Key Words

Humpback chub, monitoring, *Gila cypha*, *Gila robusta*, Yampa Canyon, Whirlpool Canyon, Yampa River, Green River, electrofishing, trammel netting, seining

Executive Summary

The humpback chub (*Gila cypha*) is an endangered species native to the Colorado River Basin listed under the Endangered Species Act in 1967 (32 FR 4001). The "Yampa" population of humpback chub includes individuals that may be found in Yampa, Lodore, Whirlpool, and Split Mountain canyons and is one of the smallest existing populations of humpback chub (USFWS 2002). The objectives of this study are to define the distribution, length frequency and abundance of the adult Yampa humpback chub population and numbers of juveniles in the Yampa humpback chub population.

A two-year study began in 2003 that sampled adult humpback chub using trammel nets, boat electrofishing and angling. Juvenile fish were collected using backpack electrofishing and seining. All adult humpback chub were measured for total length (TL), weighed, scanned for the presence of passive integrated transponder (PIT) tags, tagged with PIT tags if none were found and immediately released. All juvenile samples were preserved for laboratory identification.

During the two-year study, 13 adult humpback chub were captured (10 in Yampa Canyon and 3 in Whirlpool Canyon) and three hundred and forty nine juvenile *Gila spp.* were collected of which 30 were questionably identified as *G. cypha*. Abundance estimates were not possible due to the low number of captures. Distribution was similar to historical ranges. Catch per effort of adult humpback chub dramatically decreased from other recently collected data.

Introduction

The humpback chub (*Gila cypha*) is an endangered species native to the Colorado River Basin that and was listed on the Endangered Species Act in 1967 (32 FR 4001). The fish evolved in swift water areas in narrow canyon bound reaches of the mainstem Colorado River and its major tributaries. Humpback chub are seldom locally abundant and typically occur intermittently (Douglas and Marsh 1996).

The Upper Colorado River Basin contains five geographically separate populations of humpback chub located in Yampa Canyon, Desolation/Gray Canyons, Westwater Canyon, Black Rocks Canyon, and Cataract Canyon (Haines and Modde 2002). The "Yampa" population of humpback chub includes fish that may be found in Yampa, Lodore, Whirlpool, and Split Mountain canyons and is one of the smallest existing populations of humpback chub (USFWS 2002).

Recent work has been done to study the abundance and distribution of the Yampa population (see Karp and Tyus 1990 and Haines and Modde 2002), both studies focusing primarily on the Yampa River itself. Karp and Tyus (1990) captured 109 unique humpback chub in Yampa Canyon and 3 in Whirlpool Canyon and 11 of 76 tagged fish were recaptured. Haines and Modde (2002) captured 83 adult humpback chub in Yampa Canyon and calculated a population estimate of 391, although the estimate was imprecise. Recent collections of humpback chub in Yampa Canyon were upstream of river kilometer (rkm) 17. A review of historic collections from the Yampa River indicate that humpback chub was previously abundant in Yampa Canyon (Tyus 1998).

Recovery goals for humpback chub require no net loss in the size of existing

humpback chub populations, measurable recruitment, and a monitoring program to measure the status of these populations (USFWS 2002), making abundance estimates important relative to monitoring recovery progress. This project was designed to study the entire Yampa population of humpback chub. The specific objectives of this study are to define the distribution, length frequency, relative numbers of juveniles, and adult abundance of the Yampa humpback chub population.

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Study Area

The study area for this project is the Yampa River in Yampa Canyon (River Kilometers "rkm" 0-87), and the Green River from Lodore Ranger Station to the bottom of Split Mountain Canyon (rkm 674-593). The study area lies entirely within the boundaries of Dinosaur National Monument in eastern Utah and western Colorado (Figure 1). Four distinct canyons (Yampa, Lodore, Split Mountain, and Whirlpool) and Island Park are contained within the study area.

The Yampa River originates on the west slope of the Rocky Mountains and flows 320 km to its confluence with the Green River. Most of the Yampa flows through low gradient agriculture lands upstream from Dinosaur National Monument. In Dinosaur National Monument, the river reaches Yampa Canyon where gradient increases and habitat changes. The Yampa River has an average annual discharge of about 61 m^3/s, with a average peak of 390 m^3/s in spring and an average base flow of about 15 m^3/s in late summer (USGS Provisional Data).

The Green River originates in southwest Wyoming in the Wind River Mountain Range. Flaming Gorge Dam impounds the Green River at rkm 758, a short distance upstream of the Green River portion of the study reach. Spring releases from Flaming Gorge Dam are timed to peak when the Yampa River is peaking, but do not reach historical levels (Muth et al. 2000). Discharge from Flaming Gorge Dam (USGS Gauge #09234500) has averaged 27.8 m^3/s with spring peaks near 130.4 m^3/s during recent years.

Methods

Adult Sampling

Adult (> 200 mm TL) humpback chub were collected in the spring, summer, and autumn of 2003 and 2004 (Table 1) on the descending limb of the hydrograph and during base flows. Fish were sampled using raft-mounted pulsed DC Smith Root® electrofishing equipment throughout the study area and trammel nets (23m x 2m; 2.5 cm mesh) in Split Mountain and Whirlpool canyons. Habitats sampled included small rapids, pools, eddies and backwaters.

Electrofishing was accomplished with two boats each covering opposite banks of the river throughout Yampa, Lodore, Whirlpool and Split Mountain Canyons. Electrofishing was done entirely during daylight hours. Supplemental angling captures of humpback chub were used from Recovery Program Project No. 110 (catfish removal, volunteer angling).

Trammel nets were set approximately one hour before sunset and checked hourly until two hours after sunset. Trammel nets were set in areas of Whirlpool Canyon suspected to be occupied by humpback chub and in other deepwater areas in Whirlpool and Split Mountain Canyons.

All humpback chub were measured for total length, weighed, scanned for the presence of PIT tags, tagged (if necessary) with PIT tags and immediately released. Locations of the captures were recorded.

Juvenile Sampling

Juvenile chubs were collected in both Yampa Canyon and Island Park using seines (7.6 m x 1.5 m; 0.5 cm mesh) and pulsed DC backpack electrofishing in side channels, isolated pools, main channels, and backwaters (see Appendix). Juvenile sampling was conducted in September and October. All juvenile fish captured during the seining efforts were fixed in 10% buffered formalin and later transferred to 70% ethanol (Kelsch and Shields 1996).

Humpback Chub Identification

Adult chubs were identified using characteristics described in Douglas et al. (1989) and Muth (1990). Characters used for field identification were anal fin ray counts, caudle peduncle width and depth, angle of the anal fin in relation to the caudal fin, fin shape, head shape, presence of a nuchal hump, and mouth position. Juvenile chubs were identified under a dissecting microscope using similar characteristics as adults though the presence of a nuchal hump was never considered. Darrel Snyder and Kevin Bestgen (Colorado State University, Larval Fish Laboratory) assisted with verification of juvenile samples.

Data Analysis

Due to the few humpback chub collected, robust data analyses were not possible. Total catch per effort was calculated by comparing electrofishing time, trammel netting

time (hours that the nets fished), or angler hours and the number of humpback chub caught. These data were then expressed as humpback chub captured per hour. Data are presented in length frequency histograms, catch per unit of effort, tables of relative abundance, and by capture location.

Historical Data

Adult humpback chub data collected by previous investigators were used to supplement this study. These studies were Haines and Modde (2002) and Karp and Tyus (1990). Haines and Modde (2002) collected humpback chub in Yampa Canyon only using electrofishing and angling. Karp and Tyus (1990) used angling (primarily) and trammel netting to capture chubs or attempt to capture chubs throughout Dinosaur National Monument. Data were acquired exactly as published.

Results

Adult Fish

During the two-year study, 13 adult humpback chub were captured (12 potentially unique fish and 1 definitive recapture), two by trammel net, five by electrofishing, and six by supplemental angling data (Table 2). On release, all fish seemed fully recovered and swam away. Adult sampling effort during two years was 258 hours of electrofishing, 1,917 hours of angling, and 557 hours of trammel netting. Effort by time and gear varied by canyon reach (Table 1). Mean length of humpback chub from our study was 279 mm TL (Figure 2). This varied from the previous study of Haines and Modde (2002; 245 mm TL) but was similar to earlier collection data (Karp and Tyus 1990; 278 mm TL).

All adult fish were captured in Yampa Canyon or the upstream end of Whirlpool Canyon (Table 2) where previous investigators had captured humpback chub (See Miller et al. 1982, Karp and Tyus 1990, Modde and Haines 2002). Catch per unit of effort of adult humpback chub was dramatically lower than in previous years (Table 3). One possible humpback chub was captured between rkm 0 and 8 in Yampa Canyon, within the range of the population, however it was outside of recent capture locations. Trained staff did not have the opportunity to positively confirm the identity of this fish prior to its release, however it was within the current known population range.

Juvenile Fish

A total of 47 juvenile samples were collected during the study, 12 in 2003 and 35 in 2004. A total of 13,379 fish were collected in these samples. Three hundred and

forty-nine *Gila* spp. were collected, of which 30 were questionably identified as *G. cypha* (Snyder et al. 2006). *Gila spp*. comprised 2.6% of the juvenile fish collected (Table 4).

Mean length of the questionably identified juvenile *Gila cypha* was 47.9 mm TL and *Gila robusta* was 43.9 mm TL (Figure 3). The length frequency data show two year classes, having only one fish in the age-1 class. These length distributions are similar to the two year classes (age-0 <70mm TL and age-1, 70-130 mm TL) identified for *Gila spp.* in the Yampa River (Steve Ross, University of Southern Mississippi, personal communication) and those identified from Westwater Canyon (Chart and Lentsch 1999).

Juvenile *G. robusta* were found in two samples from Island Park and *G. robusta* and *G. cypha* were found in mid and lower Yampa Canyon (rkm 18.5-37; Figure 4). Juvenile humpback chub are distributed further downstream than the adult population. Juvenile *Gila spp.* have been previously found in Island Park and in the alluvial reaches of the Middle Green River (USFWS, Vernal, Utah, unpublished data).

Discussion

Adult Fish

Due to the low number of captures and only one recapture, the population estimate objective of the study was not met. Haines and Modde (2002) were able to estimate population size, but with very low precision. Catch per unit of effort of humpback chub has steadily declined from all previous studies (Table 3). The low number of captures (n=13) and decrease in catch per unit of effort indicates a population in decline. This is similar to the Desolation/Gray Canyon population (Jackson and Hudson 2003) and the Westwater Canyon population (Hudson and Jackson 2005). It appears that a population estimate will not be possible until this population contains more individuals.

No gear seemed more effective than another at capturing humpback chub and none alone caught 50%. Electrofishing captured a large proportion of our fish but may be harmful to individuals in the population (Snyder 2003). Trammel netting was effective at sampling the deepwater habitats of Whirlpool Canyon but has been previously abandoned in Yampa Canyon due to high stress on chubs (Karp and Tyus 1990). Angling was effective in localized areas but is a known source of mortality in other fishes (i. e. Lindsay et al. 2004, Dubois and Dubrelzig 2004) and was labor intensive and is therefore not feasible for capturing the large numbers of humpback chub needed for a population estimate. Also, use of untrained volunteers in capturing humpback chub makes this method questionable and should probably be avoided, or at minimum, all fish captured in this manner should be scanned for PIT tags. Previous investigators have had poor

success with other gears (i.e. hoop nets) for capturing humpback chub in the Yampa population (T. Modde, pers. comm.).

Humpback chub were captured within their recent distribution ranges within Dinosaur National Monument. Early records, greater than 50 years old, indicate a more widespread distribution and higher abundance (Tyus 1998). Historical records indicate the presence of humpback chub in Lodore Canyon, and upstream areas such as Red Canyon and Flaming Gorge (Dotson 1959).

Our objective was to describe the distribution of the humpback chub population within the boundaries of Dinosaur National Monument; however, other nearby areas may contain humpback chub. Two humpback chub radio-tagged in the Little Snake River, a tributary of the Yampa upstream of Yampa Canyon, moved and were relocated in Yampa Canyon, (Hawkins et al. 2001). Habitats that may contain humpback chub also exist in Cross Mountain Canyon, a high gradient, difficult to sample stretch of the Yampa River upstream of the Little Snake River confluence. No sampling to establish their presence in Cross Mountain Canyon or the Little Snake River was done in this study.

Proliferation of non native fishes and altered hydrologic and thermal regimes has been implicated in the decline of native fishes in the Green River upstream of the Yampa River confluence (Bestgen and Crist 2000) and in Yampa Canyon (Miller et al. 1982). Direct predation on humpback chub by non native fishes has been documented in the Little Colorado River (Marsh and Douglas 1997) and is suspected in Dinosaur National Monument. Smallmouth bass have become abundant in the rivers of Dinosaur National Monument since previous data on humpback chub were systematically collected. Smallmouth bass were rare in Yampa Canyon in 1997 and have increased to 18.4% of the

adult fish composition in 2004, all concurrent with a decline in native species composition of 84.3% in 1997 to 45.4% in 2004 (Modde et al. 2006)

The Yampa population of humpback chub has declined dramatically in recent decades. Tyus (1998) indicated much higher abundance and distribution of humpback chub in Yampa Canyon in the 1940's than those reported by Karp and Tyus (1990) between 1987-1989. The 1998-2000 population estimate by Haines and Modde (2002) reported further declines in catch rates. Of note however, is the fact that the Karp and Tyus (1990) and Haines and Modde (2002) sampling was done following wet years in the Yampa River Basin as opposed to the current study. In 2003-2004 catch rates have declined from those reported from 1998-2000 and the population appears near extirpation.

Juvenile Fish

Sampling for juvenile chubs with seines is an effective technique for capturing *Gila spp.* and monitoring juvenile success (Chart and Lentsch 1999). Identification of this life stage is the major drawback to these monitoring techniques due to a lack of character distinction in the population (Snyder et al. 2006). Sampling juvenile *Gila spp.* in more individual sample years is an alternative to the current approach. Annual sampling of juvenile *Gila spp* would facilitate better monitoring of abundance and distribution.

The presence of juvenile *Gila spp.* indicates some reproduction is occurring. The high incidence of these juvenile *Gila spp.* in given areas may lend some clues into

important nursery areas and should be further examined. Again, the difficulties in distinguishing *G. cypha* from *G. robusta* need to be addressed.

Conclusion and Recommendations

Due to low numbers of adult captures and poor juvenile identification, meeting study objectives proved difficult. In light of historic and current study data distribution of the population has been defined in Dinosaur National Monument, but humpback chub may be present in other nearby areas. Length frequency, while quantified, is weak considering the low number of juveniles. Similarly, a low number of captures made adult abundance estimates impossible. The ability to differentiate juvenile *G. cypha* from *G. robusta* in this population limited the ability to draw inference from these data.

The Yampa population of humpback chub has declined and is nearly extirpated. The low number of individuals makes a population estimate impossible. However, some level of monitoring should be continued to determine if the population has increased enough to support a population estimate. If humpback chub in Yampa Canyon prove to be genetically unique, their genetic diversity should be preserved by moving fish to a refuge. Recommendations are as follows:

1) Eliminate Lodore Canyon and Split Mountain Canyon from further attempts to study the Yampa population. If incidental capture of humpback chub occur in the future in these areas, effort should be expanded.

2) Annually monitor *Gila spp.*nursery areas in Yampa Canyon, Whirlpool Canyon, and Island Park.

3) Sample Cross Mountain Canyon and the Little Snake River for the presence of humpback chub.

4) Fish should be immediately removed from the canyon to refugia to preserve genetic material.

5) The population estimation element of recovery for this population should be suspended until more individuals are available for sampling.

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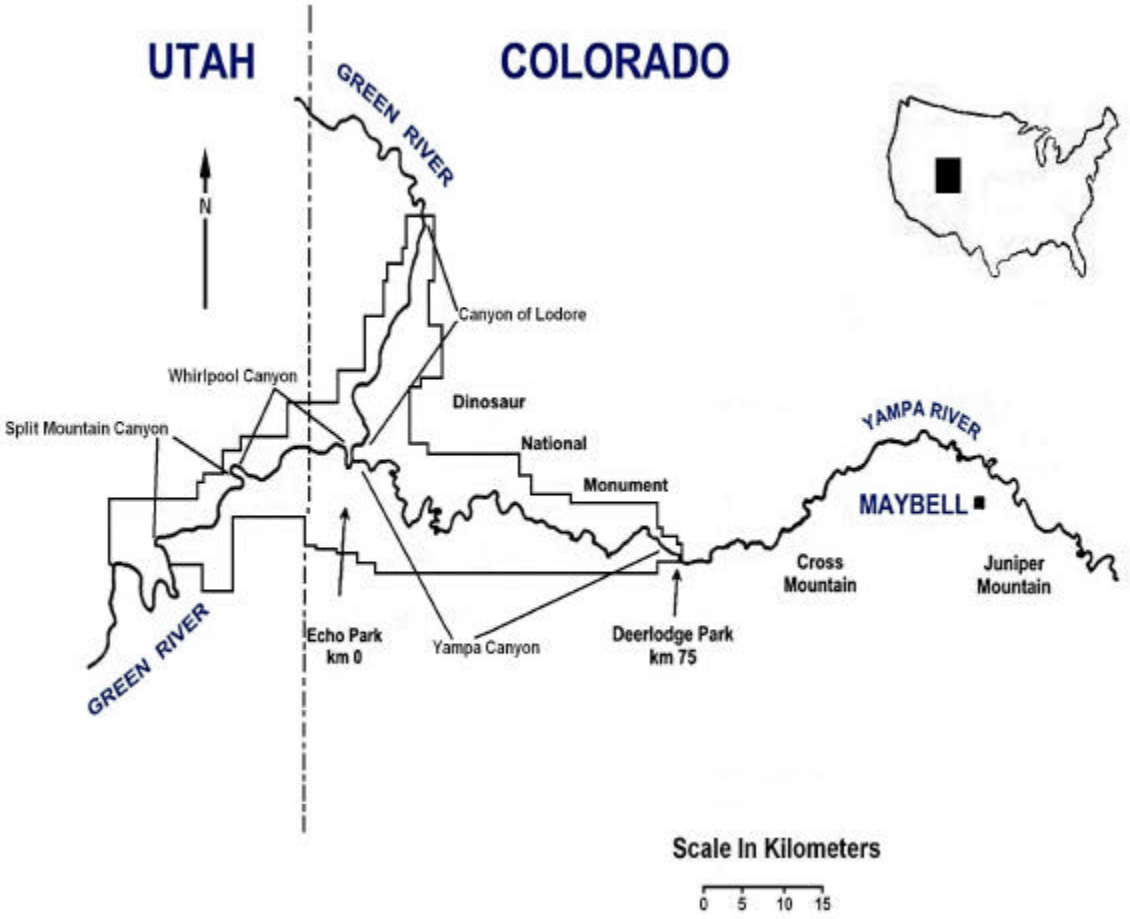

Figure 1. Map of the study area Dinosaur National Monument, Colorado and Utah.

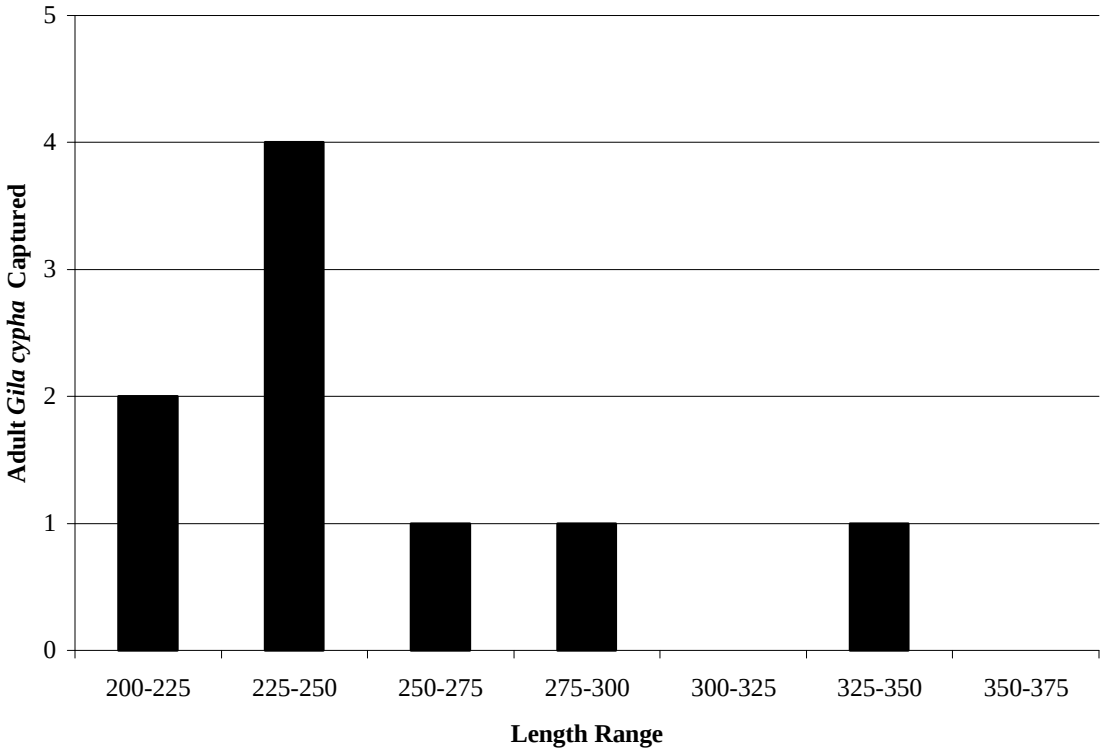

Figure 2. Length frequency of nine adult humpback chubs captured in the Yampa and Green rivers within the boundaries of Dinosaur National Monument, autumn 2003-2004. Four humpback chub captured by angling were not measured.

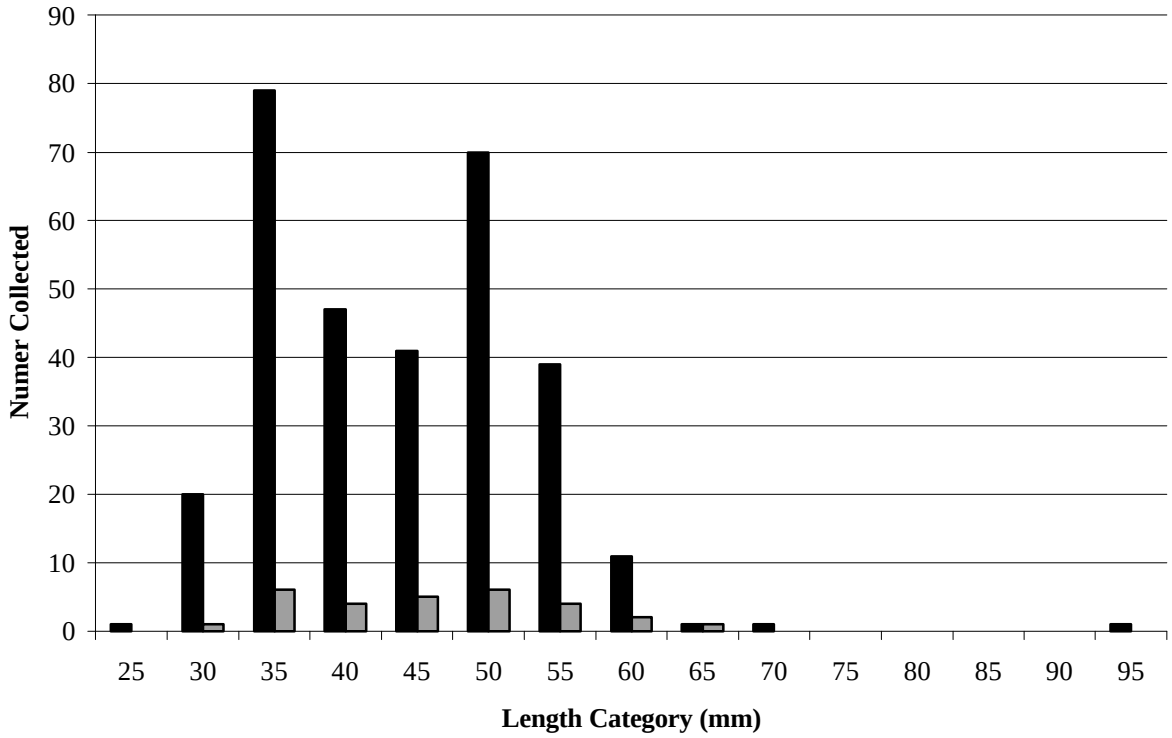

Figure 3. Length frequency of juvenile roundtail chub (solid bars) and tentatively identified humpback chub (dashed bars) captured in the Yampa and Green rivers with the boundaries of Dinosaur National Monument, Fall 2003-2004. N=339.

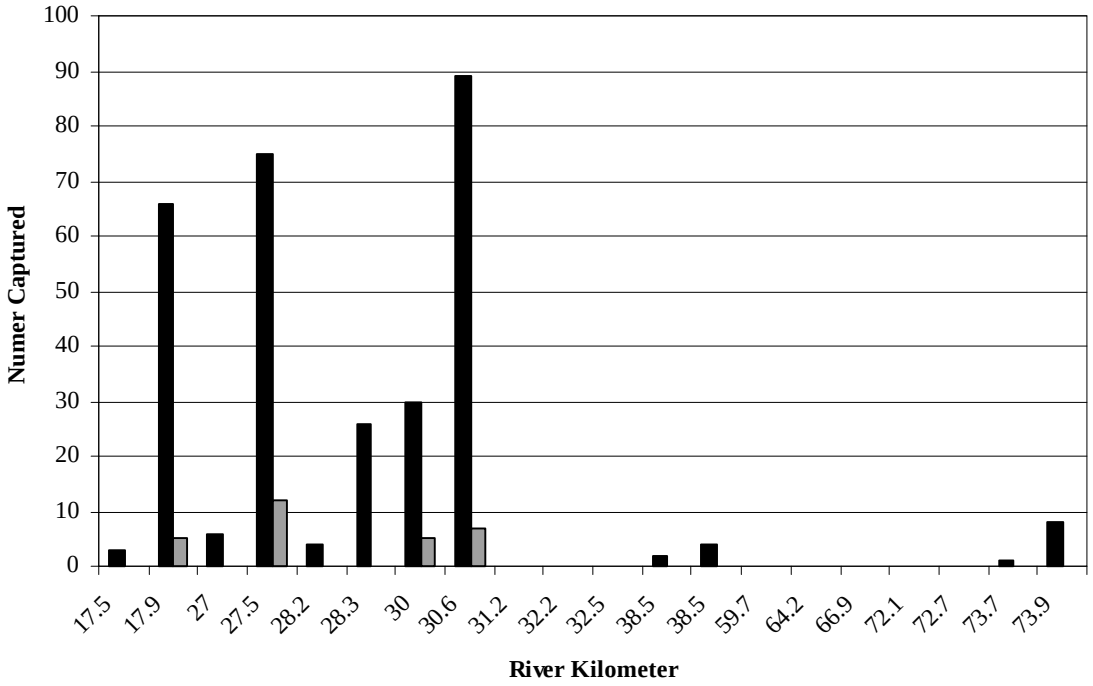

Figure 4. Locations of juvenile roundtail chubs (solid bars) and humpback chub (dashed bars) captured in Yampa Canyon, Fall 2003-2004. N=339.

Table 1. Adult humpback chub sampling dates, locations (canyon), effort, and gear for the 2003-2004 sampling period. AN= angling, EF=electrofishing, TN=trammel netting. Humpback chub captured by angling in Yampa Canyon were collected in study #110.

2003	Gear	Total Effort (h)
Yampa		
6/23-6/26, 7/7-7/10	EF	58.3
7/14-7/18, 7/21-7/25	AN	521
Lodore		
7/21-7/24, 9/15-9/18	EF	28.5
Split Mountain/Whirlpool		
9/15-9/19	TN	309
9/15-9/19	AN	70
10/6-10/9, 10/13-10/16	TN	17.4
2004		
Yampa		
4/14-4/17, 6/1-6/4, 6/7-6/10	EF	125.3
6/21-6/24, 7/19-7/22	AN	1326.6
Lodore		
7/26-7/29, 9/20-9/23	EF	28.5
Split Mountain/Whirlpool		
8/3-8/5, 8/16-8/18, 9/7-9/9, 9/13-9/16	TN	248.1

Table 2. Summary of capture data for the thirteen humpback chub captured or recaptured in the Yampa and Green Rivers during the 2003-2004 sampling period.

Date	Total Length	Weight	Recapture	Canyon	River Kilometer	Gear
07/08/03	250	145	N	Yampa	45.1-52.1	EF
07/15/03	N/A	N/A	N/A	Yampa	52.1-59.5	AN*
10/07/03	252	N/A	N	Whirlpool	550.1	TN
10/22/03	252	134	N	Whirlpool	550.7	TN
10/29/03	253	120	Y	Whirlpool	545.6	TN
04/14/04	250	114	N	Yampa	61.6	EF
04/15/04	320	284	N	Yampa	39.3	EF
06/08/04	264	144	N	Yampa	39.4	EF
06/16/04	260	140	N	Yampa	24.3	EF
06/21/04	289	N/A	N/A	Yampa	65.8-59.5	AN*
06/23/04	373	N/A	N/A	Yampa	45.1-39.4	AN*
06/23/04	N/A	N/A	N/A	Yampa	59.5-52.1	AN*
06/23/04	N/A	N/A	N/A	Yampa	6.9-0	AN*

*Supplemental captures from non native fish removal project. Identification is unsure and mileage not exact. Confirmation of the presence of PIT tags was not confirmed. Some data are missing because field equipment was physically separated from volunteer anglers who are instructed to immediately release fish.

Table 3. Catch per unit of effort of humpback chub captured by angling (AN), electrofishing (EF), and trammel netting (TN) for multiple years in Dinosaur National Monument. Total captures (n) of humpback chub are listed in parentheses. Data from 1987-1989 are from Karp and Tyus (1990) and data from 1998-2000 are from Haines and Modde (2002).

	Yampa Canyon		Lodore Canyon	Whirlpool Canyon			Split Mountain Canyon		
	AN	EF	EF	AN	EF	TN	EF	TN	AN
Year									
1987-1989	0.65 (51)	1.03 (58)	0.00	0.23 (2)	0.00	N/A	0.00	N/A	N/A
1998-2000	0.04 (77)	0.80 (69)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2003-2004	0.004 (6)	0.03 (5)	0.00	0.00	0.00	0.009	0.00	0.00	0.00

Table 4. Relative percentage of juvenile fish in the entire 2003-2004 juvenile fish sample collected in the Fall of 2003 and 2004. N=13,379.

Species		Percentage
Red Shiner	(*Cyprinella lutrensis*)	45.41
Redside Shiner	(*Richardsonius balteatus*)	2.19
Sand Shiner	(*Notropis stramineus*)	41.1
Fathead Minnow	(*Pimephales promelas*)	5.79
Bullhead	(*Ameirus melas*)	<1
Smallmouth Bass	(*Micropterus dolomieu*)	<1
Gila spp.		2.6
Flannelmouth Sucker	(*Catostomus latipinnis*)	1.83
Common Carp	(*Cyprinus carpio*)	<1
Killifish	(*Fundulus kansae*)	<1
Channel Catfish	(*Ictalurus puntatus*)	<1
Speckled Dace	(*Rhynichthys oculus*)	<1
Green Sunfish	(*Lepomis cyanellus*)	<1
Bluehead Sucker	(*Catostomus discobulus*)	<1
Bluegill	(*Lepomis macrochirus*)	<1
Flannelmouth Sucker x Bluehead Sucker		<1

Appendix. Date, locality, gear and effort of all juvenile samples taken during the 2003-2004 sampling period for humpback chub in Dinosaur National Monument. EF=electrofishing, SN= Seining

Year	Date	Location	Gear	Effort
2003	11/05	Yampa (45.2)	EF	N/A
2003	11/05	Yampa (44.8)	EF	N/A
2003	11/06	Yampa (20.2)	SN	1 haul
2003	11/06	Yampa (20.0)	SN	1 haul
2003	10/20	Green (332.3)	SN	1 haul
2003	10/20	Green (330.9)	SN	1 haul
2003	10/20	Green (328)	SN	1 haul
2003	10/20	Green (331)	SN	1 haul
2003	10/20	Green (330.3)	SN	1 haul
2003	10/20	Green (331)	SN	1 haul
2003	10/20	Green (330)	SN	1 haul
2003	10/20	Green (335.5)	SN	1 haul
2004	10/26	Yampa (41.6)	SN	3 hauls
2004	10/27	Yampa (19.4)	SN	3 hauls
2004	10/22	Yampa (20.2)	SN	2 hauls
2004	10/28	Yampa (11.1)	SN	1 haul
2004	10/27	Yampa (17.1)	SN	3 hauls
2004	10/28	Yampa (10.9)	SN	1 haul
2004	10/27	Yampa (18.6)	SN	2 hauls
2004	10/28	Yampa (16.8)	SN	2 hauls
2004	10/27	Yampa (18.6)	SN	1 haul
2004	10/28	Yampa (15.3)	SN	1 haul
2004	10/28	Yampa (15.3)	SN	1 haul
2004	10/26	Yampa (13.9)	SN	3 hauls
2004	10/26	Yampa (39.9)	SN	3 hauls
2004	10/26	Yampa (37.1)	SN	1 haul
2004	10/27	Yampa (23.9)	SN	2 hauls
2004	10/26	Yampa (37.1)	SN	1 haul
2004	10/28	Yampa (11.1)	SN	1 haul
2004	10/27	Yampa (19.0)	SN	3 hauls
2004	10/27	Yampa (23.9)	SN	4 hauls
2004	10/28	Yampa (11.1)	SN	1 haul
2004	10/28	Yampa (17.5)	SN	2 hauls
2004	10/28	Yampa (17.1)	SN	1 haul
2004	10/27	Yampa (19.0)	SN	1 haul
2004	10/27	Yampa (19.0)	SN	4 hauls
2004	10/27	Yampa (17.6)	SN	2 hauls
2004	10/27	Yampa (18.6)	SN	1 haul

2004	10/14	Green (331.0)	SN	1 haul
2004	10/14	Green (331.0)	SN	1 haul
2004	10/14	Green (331.0)	SN	1 haul
2004	10/14	Green (333.2)	SN	1 haul
2004	10/14	Green (332.8)	SN	1 haul
2004	10/14	Green (333.2)	SN	1 haul
2004	10/14	Green (328.9)	SN	1 haul
2004	10/14	Green (328.8)	SN	1 haul
2004	10/14	Green (331.7)	SN	1 haul

Cover Photo: Humpback Chub, Whirlpool Canyon, Dinosaur National Monument

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