

I. Project Title: **Assessment of Endangered Fish Reproduction in Relation to Flaming Gorge Operations in the Middle Green and Lower Yampa Rivers.**

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III. Project Summary: The goal of the recently approved Flaming Gorge flow and temperature recommendations (Muth et al., 2000) was to improve the status and prospects for recovery of endangered fish populations in the Green River. A major emphasis of those recommendations was to enhance the reproductive and recruitment success of endangered fishes in the middle Green River, in particular razorback sucker and Colorado pikeminnow. The primary means to achieve enhanced populations will be to pattern flows after a more natural hydrograph, the timing and duration of which will be based on anticipated annual hydrologic conditions and the biology of the fish. Because of vagaries in timing and runoff patterns within and among various hydrologic scenarios, and uncertainties in anticipated effects of flow and temperature recommendations on endangered fishes, Muth et al. (2000) suggested that real-time data be gathered to guide and fine tune operation of Flaming Gorge dam each year. Two existing studies that have provided data to guide operations of Flaming Gorge Dam in the past are "Basin-wide Monitoring Program for Razorback Sucker" (Project 22C) and "Interagency Standardized Monitoring Program (ISMP) Assessment of Colorado Pikeminnow Reproduction and Larval Abundance in the Lower Yampa River, Colorado" (Project 22f). This study is an extension of portions of those previous studies and is intended to provide some of the necessary real-time data.

Larvae of razorback sucker *Xyrauchen texanus* and Colorado pikeminnow *Ptychocheilus lucius* (formerly, Colorado squawfish) were sampled in the Green River basin in

spring and summer 2002. Razorback sucker sampling was conducted with light traps primarily in the Green River between Jensen and Ouray and Colorado pikeminnow sampling was with drift nets in the lower Yampa River. Sampling was designed to provide a measure of timing of reproduction and a measure of annual reproductive success of each species. Diel variation in abundance of Colorado pikeminnow larvae in the drift was also assessed. This data will be used to assess effects of flow and temperature regimes on reproduction by razorback suckers and Colorado pikeminnow and to correlate abundance of larvae to abundance of juveniles in autumn.

- IV. Study Schedule: It is anticipated that this study will continue and will be a component of studies designed to evaluate operations of Flaming Gorge Reservoir.

- V. Relationship to RIPRAP: Reproduction and recruitment of early life stages are critical components of the life history of endangered razorback sucker and Colorado pikeminnow. Understanding trends in reproductive success may help define status of razorback sucker and Colorado pikeminnow in specific river reaches in the Colorado River Basin and should play a role in determining when recovery has been achieved.

Relationship to specific RIPRAP items:

Green River Action Plan: Mainstem

- I. Provide and protect instream flows--habitat management.
 - I.A. Green River above Duchesne River.
 - I.A.1. Initially identify year-round flows needed for recovery while providing experimental flows.
 - I.A.2.a. Summer/fall flow recommendations.
 - I.A.3. Deliver identified flows.
 - I.A.3.a. Operate Flaming Gorge pursuant to the Biological Opinion to provide summer and fall flows.
 - I.A.3.d. Operate Flaming Gorge Dam to provide winter and spring flows and revised summer/fall flows, if necessary.
 - I.B. Green River below the Duchesne River.
 - I.B.1. Initially identify year-round flows needed for recovery while providing experimental flows.
 - I.B.2. State acceptance of initial flow recommendations.
 - I.B.2.a. Review scientific basis.
- II. Restore habitat--habitat development and maintenance.
 - II.A. Restore and manage flooded bottomland habitat.
 - II.A.1. Conduct site restoration.
 - II.A.1.a. Old Charlie Wash.
 - II.A.1.a.(3) Monitor and evaluate success.

- II.C. Enhance water temperatures to benefit endangered fishes.
- II.C.1. Identify options to release warmer water from Flaming Gorge Reservoir to restore native fish habitat in the Green River.
- V. Monitor populations and habitat and conduct research to support recovery actions--research, monitoring, and data management.
- V.A. Conduct research to acquire life history information and enhance scientific techniques required to complete recovery actions.

Green River Action Plan: Yampa and Little Snake Rivers

- I. Provide and protect instream flows--habitat management.
- I.D. Yampa River below Little Snake River.
- I.D.1. Initially identify year-round flows needed for recovery.
- I.D.2. Evaluate need for instream flow water rights.
- I.D.2.a. Review scientific basis.

Green River Action Plan: Yampa and Little Snake Rivers

- V.A.1. Conduct standardized monitoring.
- V.B.2. Conduct appropriate studies to provide needed life history information.

VI. Accomplishment of FY 2002 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Project Objectives

- 1). To determine timing and duration of spawning by razorback suckers and presence and abundance of larvae in the system as measured by capture of larvae in light traps.
- 2). To determine timing and duration of spawning by Colorado pikeminnow and presence and abundance of larvae in the system as measured by capture of larvae downstream of spawning areas in the lower Yampa River.

Task Description (FY 2002)

- I). Collect light trap samples for razorback suckers. The CRFP office in Vernal was responsible for this task.
- II). Collect drift net samples for Colorado pikeminnow. The Larval Fish Laboratory was responsible for this task.
- III). Identify light trap and drift net samples. Preliminary identifications will be conducted by the responsible sampling entity, with assistance from the LFL, as samples are collected to provide real-time data. Final specimen identification and curation will be conducted by the LFL.

- IV). Summarize specimen data collection in an annual report.

Accomplishments by Task.

- I). Collect light trap samples for razorback suckers. Seine samples were also collected this year because of the paucity of locations to sample with light traps. Light trap and seine samples were collected from 14 May until 20 June 2002 by the Vernal CRFP.
- II). Collect drift net samples for Colorado pikeminnow. Drift net samples were collected daily from 18 June until 4 August 2002 by the Larval Fish Laboratory.
- III). Identify light trap and drift net samples. Ongoing.

Middle Green River light trap samples. A total of 95 light trap and seine samples were collected in 2002. Seine samples were collected this year because low water limited locations available for light trap sampling. Cliff Creek, Jensen Bridge, Greasewood Corral, Old Charlie Wash outlet, and Shepard Bottom outlet were among the sample sites in 2002.

The first catostomid larvae, a single *Catostomus latipinnis*, was collected on 15 May at Cliff Creek. The first razorback sucker larvae detected was on 20 May at that same location. Preliminary identifications have been made on about half of the samples; sample identification should be complete in early 2003.

Lower Yampa River drift net sampling. Samples were collected in the Yampa River about 0.8 km upstream from the Green River, the same site that samples were collected at from 1990 to 1996 (Bestgen et al. 1998) and in 1998 to 2001. A total of 207 samples were collected between 18 June and 4 August 2001. These included samples collected at dawn, noon, dusk, and midnight on approximately weekly intervals on seven occasions to detect diel variation in drift abundance.

Preliminary identification of samples has just begun so few results are available. We did detect drifting pikeminnow larvae as early as 26 June, well after planned high spring flow releases from Flaming Gorge Dam ceased.

Reproductive success of Colorado pikeminnow was considered moderate in 2001, and perhaps similar to 1999 and 1998, when 685 and 716 pikeminnow larvae were collected, respectively. The total number of fish captured in 1998 and 1999 were substantially higher than previous years from 1991 to 1997. In summer 2002, flows were very low and clear, conditions similar to 1994 when Colorado pikeminnow drift net captures were very low.

2001 light trap sampling data. Only preliminary data were available from 2001 light trap samples at the time of the December 2001 report deadline so we present that data now. A total of 4,046 specimens were captured in nine species in 2001 (Table 1). A total of 92 razorback sucker larvae (including 21 specimens classified as razorback sucker?) were captured and represented 2.3 % of all fish captured. Larvae were captured from 23 May to 18 June when average daily water temperatures was increasing slowly and in the 14 to 18°C range (Fig. 1). Larvae ranged in size from 11 to 16 mm TL; most were 11 to 12 mm TL (Fig. 2). The largest 15 and 16 mm TL larvae were captured later in the season on or after 29 May (Fig. 3). All larvae were captured after discharge in the Green River peaked on 18 May at 14,400 cfs.

The proportion of razorback suckers in 2001 middle Green River light trap samples compares favorably with proportions and catch rates from samples collected since 1993 (Bestgen et al. 2002). Only in 1994 (0.80 fish/hr) and 1996 (0.16 fish/hr) were catch rates of razorback sucker larvae higher than the 2001 rate of 0.13 fish/hr. The 2001 capture rate was also similar to the CPUE of 0.11 fish/hr found in the middle Green River in 2000 (N = 82 razorback larvae in 95 samples, 89 of which were collected after capture of the first native sucker larvae). A continued increase in capture rates of razorback sucker larvae over time may indicate increased reproduction by remaining wild and stocked razorback suckers in the Green River system. However, these data must be interpreted cautiously and only after several additional years of sampling because capture rates fluctuate dramatically over time.

Temperature monitoring. Temperature differences between the Green and Yampa rivers in Echo Park are potentially important because of potential for cold shock of Colorado pikeminnow larvae drifting from the Yampa into the normally colder Green River. Warmer water temperatures in the Green River also increase the likelihood of spawning by rare native fishes upstream of the Yampa River. Temperature data gathered in the Green and Yampa rivers in Echo Park were compared to determine if temperature differences fall within recommended constraints that the Green be no more than about 5°C colder than the Yampa River (Muth et al. 2000). In 2000 (Fig 4.), water temperatures in the Green were relatively cool and exceeded 20C for only a couple of days. Average water temperature in the Green River from 1 June to 30 September was 17.0°C compared to 19.7°C in the Yampa River for the same period (Table 2). In 2001 and 2002 (2002 through mid-July only), water temperatures in the Green River were considerably warmer and averaged 19°C in each year (Figs. 5 and 6). Water temperatures in the Yampa River in 2001 and 2002 (through mid-July) averaged 20.5 and 21.5°C, respectively. In only four instances (twice in 2000, once each in 2001 and 2002) did water temperatures exceed the recommended maximum summer difference of 5°C and none were within the period when Colorado pikeminnow were drifting downstream from the Yampa River. In 2002, summer water temperatures

in the Green River upstream of the Yampa River were likely the highest observed since Flaming Gorge Reservoir filled.

- VII. Recommendations: Continue to sample early life stages of razorback sucker and Colorado pikeminnow annually at these sites. This information is critical to establishment of long-term data that can guide informed management decisions regarding population viability and recovery. Data were also used to monitor effects of Flaming Gorge flows and water temperatures in relation to endangered fish reproduction in spring and summer. This information can also be used to make real-time recommendations for flow and temperature regimes for Flaming Gorge Dam during the critical time of reproduction for endangered Colorado pikeminnow. Sampling may also need to be expanded to assess reproduction by razorback suckers in the Yampa River.

Negotiations need to be finalized with the property owner at the Cliff Creek light trap sampling site. Owner allowed access in 2002 but stated that future access will be granted only for a fee. Initial contacts were made in summer 2002.

- VIII. Project Status: On track and ongoing. This project was approved for funding in 2003. That information, combined with more sophisticated water temperature data acquisition, should provide some tools for making flow and temperature recommendations to guide operation of Flaming Gorge Reservoir.

IX. FY 2002 Budget Status

- A. Funds Provided: \$87,000
- B. Funds Expended: \$72,000
- C. Difference: \$15,000 (all LFL), to be used for sample identification, verification, and curation and replacement of some sampling gear.
- D. Percent of the FY 2002 work completed, and projected costs to complete: Funds remaining should be sufficient to finish Yampa and Green River samples.
- E. Recovery Program funds spent for publication charges: NA

- X. Status of Data Submission (Where applicable): Data will be submitted when specimen identity is completed.

XI. Signed: Kevin R. Bestgen 5 December 2002
Principal Investigator Date

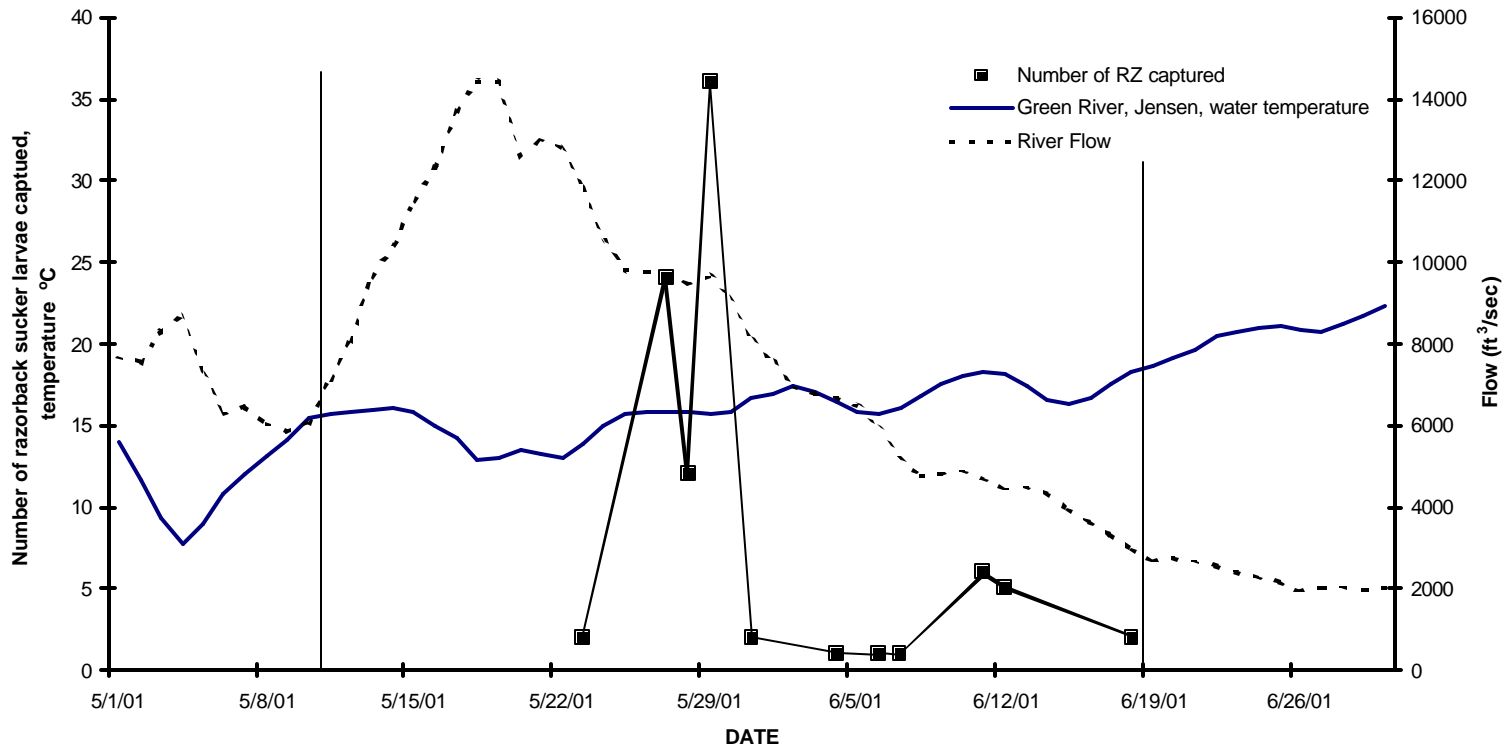


Figure 1. Number and timing of razorback sucker larvae captured in light traps in the middle Green River, Utah, 2001 overlaid on flow and temperature regimes (Jensen gage). Solid vertical lines depict the first and last dates of sampling.

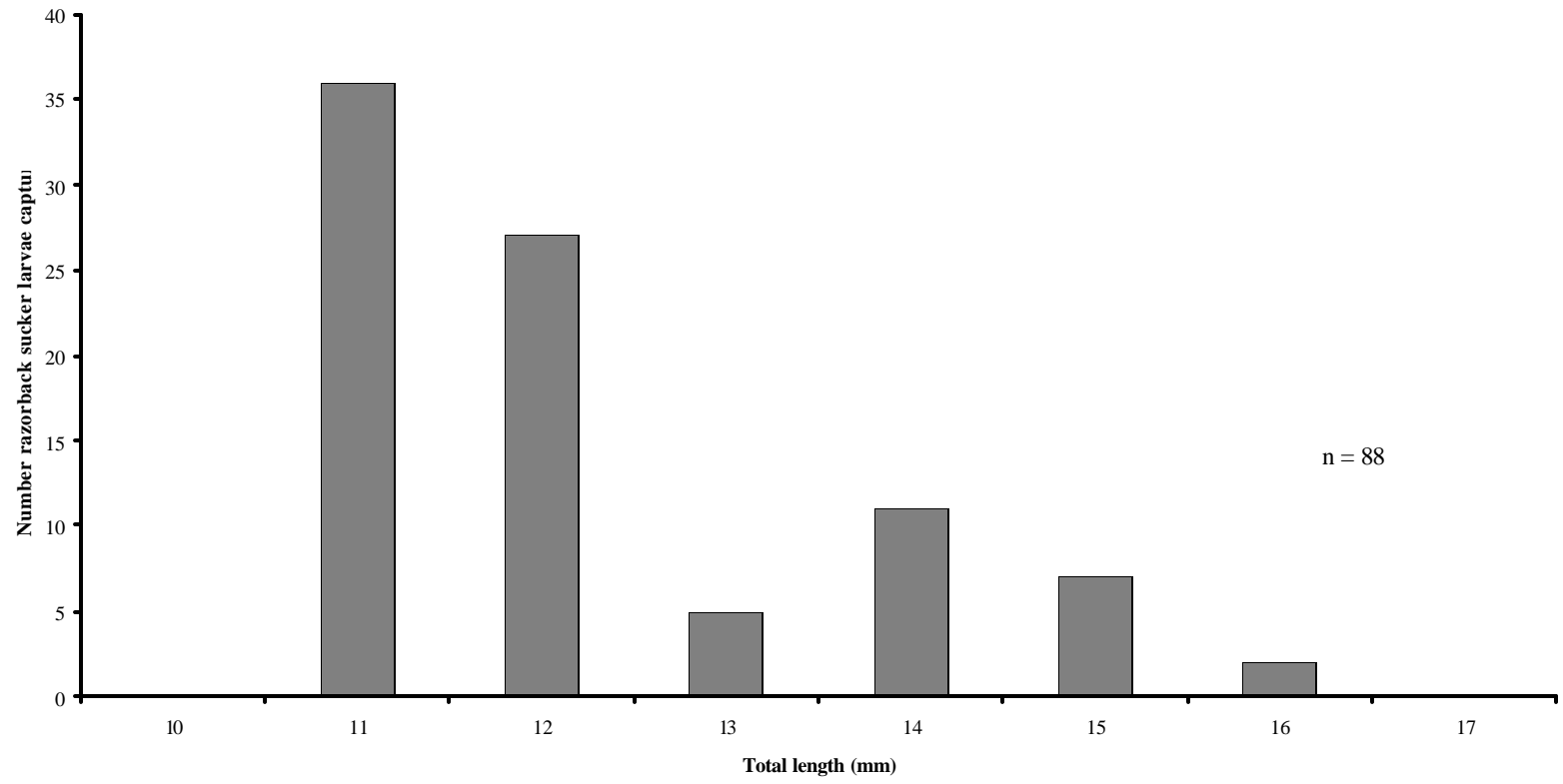


Fig. 2. Length-frequency histogram of lengths (TL, mm) of razorback sucker larvae captured in light traps in the middle Green River, Utah, 2001.

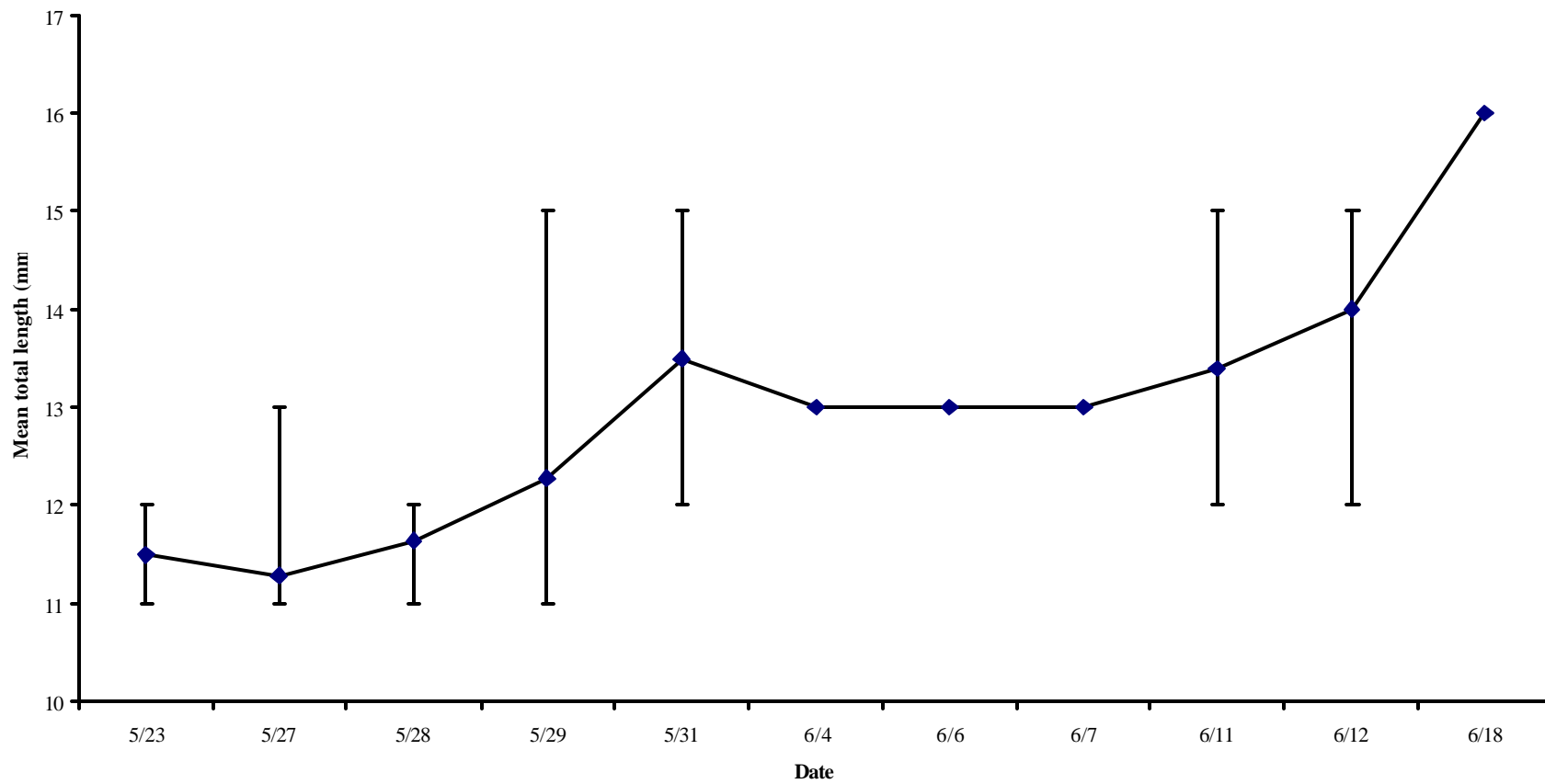


Fig. 3. Mean total length (mm) of razorback sucker larvae captured in light traps in the middle Green River, Utah, 2001. Vertical bars are the range of lengths.



Fig. 4. Water temperatures of the Green River and the Yampa River, in Echo Park, Dinosaur National Monument, Colorado, summer 2000. Vertical lines depict the period when Colorado pikeminnow larvae are drifting from the Yampa River into the Green River.

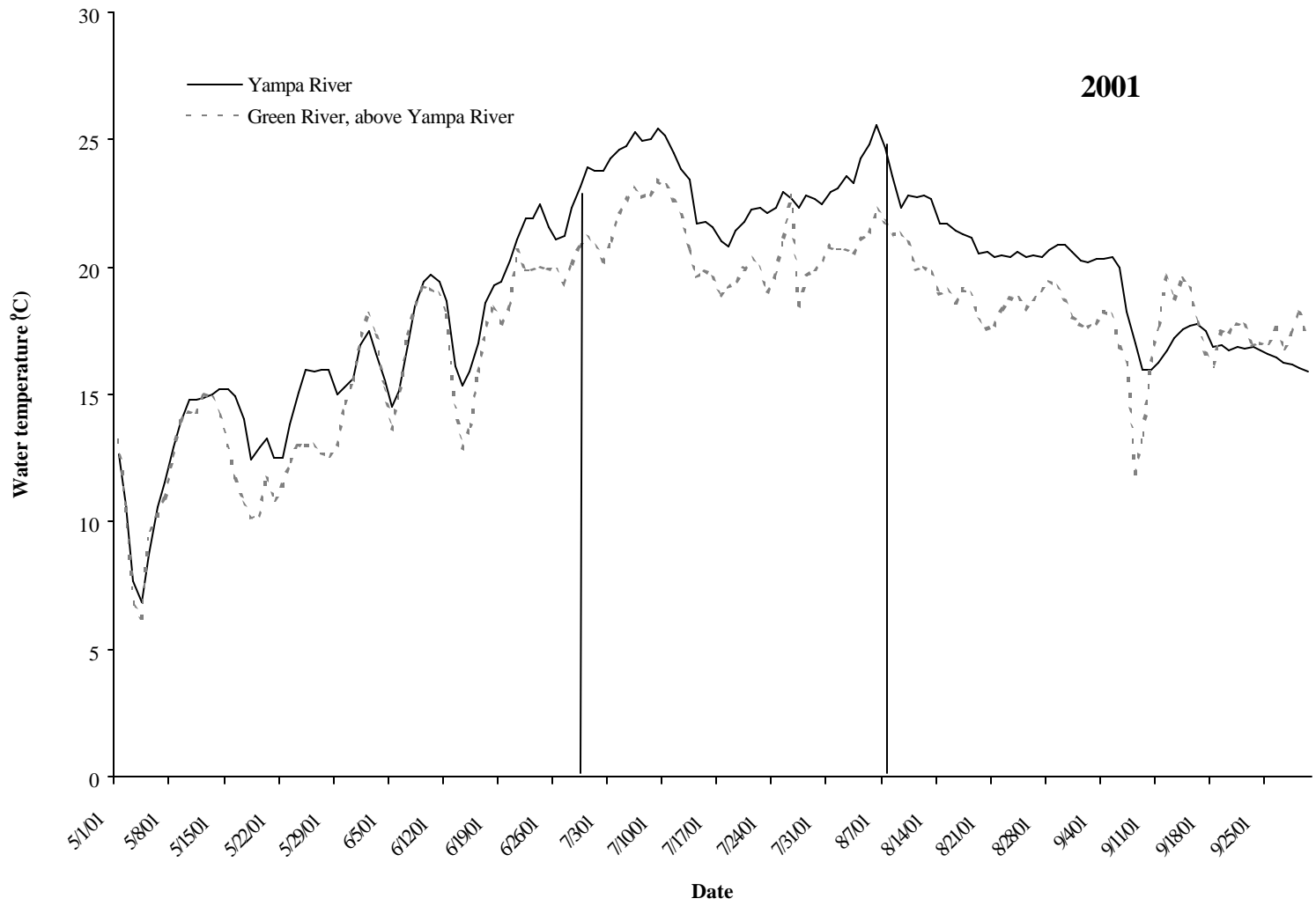


Fig. 5. Water temperatures of the Green River and the Yampa River, in Echo Park, Dinosaur National Monument, Colorado, summer 2001. Vertical lines depict the period when Colorado pikeminnow larvae are drifting from the Yampa River into the Green River.

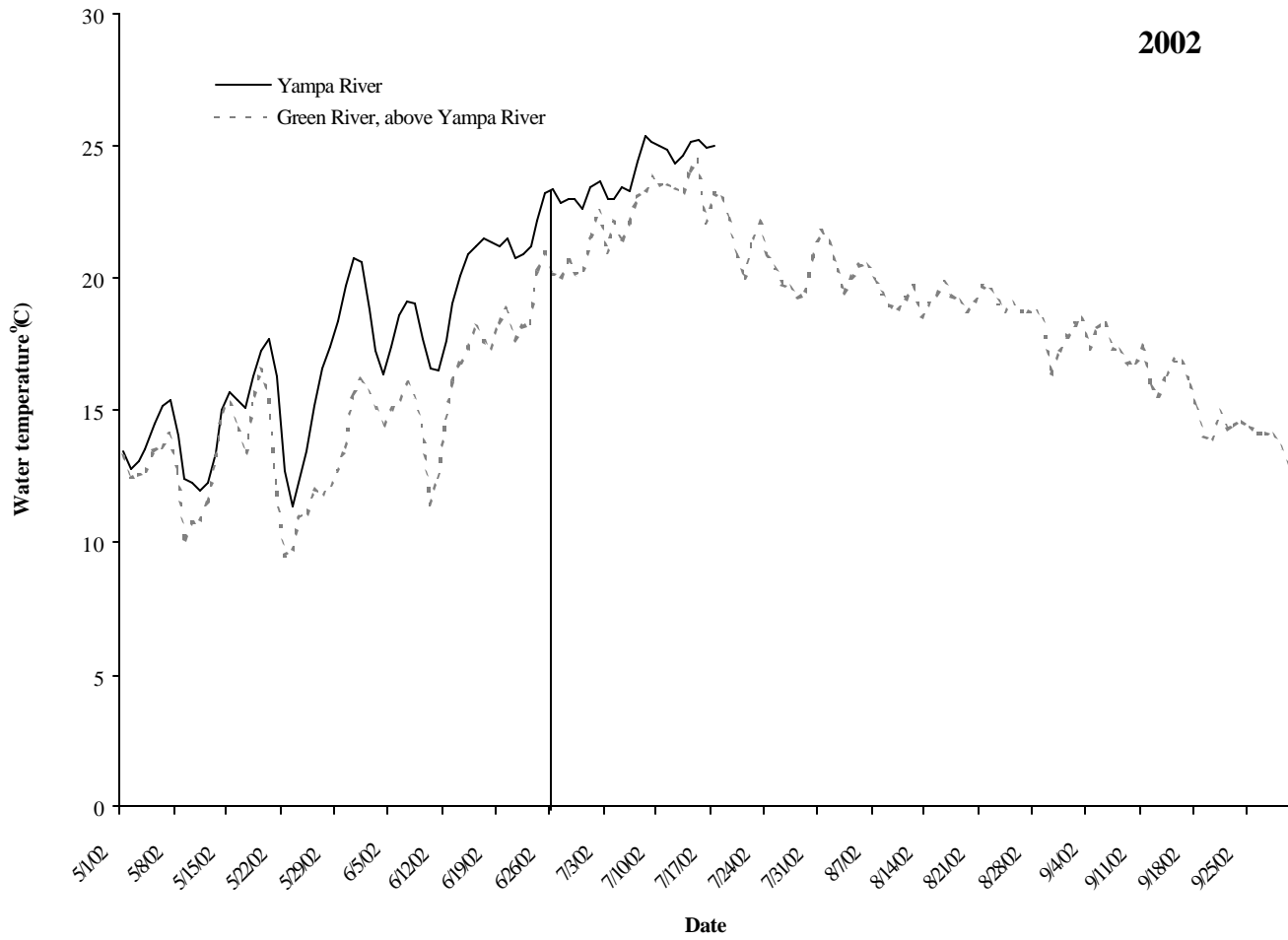


Fig. 6. Water temperatures of the Green River and the Yampa River, in Echo Park, Dinosaur National Monument, Colorado, summer 2002. Only a partial year of data was available for the Yampa River. The vertical line depicts the beginning of the period when Colorado pikeminnow larvae are drifting from the Yampa River into the Green River; sample data are not yet available for the remainder of the year.

Table 1. Frequency of occurrence in samples (number and %) and number and percent of all fish collected in 91 light trap samples in the middle Green River, Utah, 2001. The NNC are unidentified non-native cyprinids, US is unidentified suckers.

| Taxon | Frequency in samples (N) | Frequency in samples (%) | Number collected | Percent of all fish collected |
|---------------------|-----------------------------|-----------------------------|---------------------|----------------------------------|
| common carp | 6 | 6.6 | 9 | 0.2 |
| red shiner | 41 | 45.1 | 964 | 23.8 |
| fathead minnow | 21 | 23.1 | 506 | 12.5 |
| sand shiner | 24 | 26.4 | 125 | 3.1 |
| speckled dace | 2 | 2.2 | 3 | 0.1 |
| NNC | 13 | 14.3 | 80 | 2.0 |
| white sucker | 12 | 13.2 | 26 | 0.6 |
| bluehead sucker | 25 | 27.5 | 717 | 17.7 |
| flannelmouth sucker | 53 | 58.2 | 1513 | 37.4 |
| razorback sucker | 35 | 38.5 | 92 | 2.3 |
| US | 7 | 7.7 | 11 | 0.3 |
| | | | Total | 4046 |

Table 2. Average daily summer water temperature (maximum) of the Green and Yampa rivers, Echo Park, Dinosaur National Park, Colorado, 2000 to 2002 (2002 through mid-July only). Number of days where temperature of the Green River was 5°C or more cooler than the Yampa River is also shown; none of those days were in the period when Colorado pikeminnow larvae were drifting from the Yampa River.

| Year | <u>Mean summer water temp C (maximum)</u> | | Number of days difference exceeded 5°C |
|------|---|-------------|--|
| | Green River | Yampa River | |
| 2000 | 17.0 (20.7) | 19.7 (24.1) | 2 |
| 2001 | 19.0 (23.4) | 20.5 (25.6) | 1 |
| 2002 | 19.0 (24.5) | 21.5 (25.3) | 1 |
