

I. Project Title: **Middle Yampa River northern pike removal and evaluation**

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III. Project Summary:

In Colorado, the northern pike is one of 40 known, introduced fish species currently found in the Colorado River Basin (Nesler 2003). This species was first introduced to the Yampa River Basin of Colorado via Elkhead Reservoir in 1977 to reduce numbers of nonnative suckers (Roehm 2004). Movement of northern pike downstream was demonstrated by collection of this species in the Yampa River, as early as 1979 (Tyus and Beard 1990). This species has since become established as a self-sustaining population within the mainstem Yampa River.

Influences of such introductions on native fish fauna are cause for concern, especially in areas occupied by endangered species. The Yampa River downstream of Craig, Colorado, (middle Yampa River), has been designated by the U.S. Fish and Wildlife Service (USFWS) as critical habitat for the federal- and state-listed Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), bonytail (*Gila elegans*), and razorback sucker (*Xyrauchen texanus*). Primary threats to these native species include competition with, and predation by nonnative fish species (USFWS 2002). The northern pike has been identified as one of two principal, nonnative hazards to juvenile and adult Colorado pikeminnow (USFWS 2002). Northern pike and Colorado pikeminnow share similar habitat in the spring and early summer during the spawning season. Both species also rely on native sympatric species as prey, including the roundtail chub (*Gila robusta*), flannelmouth sucker (*Catostomus latipinnis*), bluehead sucker (*Catostomus discobolus*), and speckled dace (*Rhinichthys osculus yarrowi*) (Tyus and Beard 1990; Nesler 1995). Resource sharing may also increase the likelihood of northern pike predation on young and adult endangered fishes (Tyus and Beard 1990; Nesler 1995). Thus, northern pike may potentially influence native species through competition and/or predation.

Such negative interactions between introduced, nonnative sportfish and native fishes has prompted the development of management plans including control of nonnative fishes. A strategic plan for nonnative fish control was developed for the upper Colorado River Basin by 1997 (Tyus and Saunders 1996), and implemented by the Upper Colorado River Endangered Fish Recovery Program (Upper Colorado Recovery Program (USFWS 2002). The three basic strategies recommended for nonnative fish control within the plan are predation, removal, and exclusion. The Colorado Division of Wildlife (CDOW) developed an Aquatic Wildlife Management plan (CDOW 1998) specific to the Yampa Basin 1998 as part of the implementation process for recovery of endangered fishes. This plan includes reduction of northern pike abundance in riverine habitats, and evaluating such actions via monitoring for significant depletion of target species, temporally and spatially. The Upper Colorado Recovery Program adopted a Nonnative Fish Management Policy (UCRRIP 2004) in 2004. This policy indicates that the overall goals of nonnative fish management are to: 1) attain and maintain fish communities where populations of the endangered and other native fish species can persist and thrive, and 2) achieve recovery goals for the endangered species. Successful implementation of such nonnative fish management goals will benefit endangered fishes, as well as sympatric, native non-listed fish species.

This project is one of several designed for removal of northern pike and evaluation of such efforts within the upper Colorado River Basin. The two goals of this study are to: 1) reduce the number of northern pike occupying 54 river miles (RM) of critical habitat within the Yampa River downstream of Craig (RM 139 – RM 59), and 2) transport live northern pike collected from the study reach for release in Loudy Simpson ponds (Craig) and Rio Blanco Lake (White River Basin, near Meeker, Colorado), to increase angler opportunities to harvest northern pike. The objectives of this project were met; and include the following: 1) removal and translocation of as many northern pike as possible within the study area via three or more removal passes, 2) estimation of the number of northern pike occupying the study area by generating a population estimate for northern pike utilizing a mark-recapture methodology, and 3) calculation of the proportion of the estimated northern pike population that was removed. This study is scheduled to continue through 2007.

IV. Study Schedule:

Initial year: 2005 (CDOW assisted Colorado State University (CSU) in 2004)

Final year: 2007

V. Relationship to RIPRAP:

This study involved removing northern pike from the middle Yampa River, and evaluating the efficiency of that effort.

Green River Action Plan: Yampa and Little Snake rivers:

III. Reduce negative impacts of nonnative fishes and sportfish management activities (nonnative and sportfish management).

III.A.1. Implement Yampa Basin aquatic wildlife management plan in reaches of the Yampa River occupied by endangered fishes. Each control activity will be evaluated for effectiveness and then continue as needed.

III.A.1.b. Control northern pike.

III.A.1.b.(1) Remove and translocate northern pike and other sport fishes from the Yampa River.

VI. Accomplishment of FY 2005 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

A. FY 2005 Tasks and Deliverables

Task 1. Establish landowner contacts, and obtain permission to access riverside and backwater property for fish sampling.

Schedule: February and/or March, 2005

Deliverable: **Task completed.**

Task 2. Plan logistics, hire and train personnel, order and maintain equipment, and prepare for sampling.

Schedule: February-April, 2005

Deliverable: **Task completed.**

Task 3. Sample study area to capture, remove, and translocate northern pike. Limited data entry.

Schedule: First pass: April 25-May 6, 2005

Second pass: May 16-May 27, 2005

Third pass: June 6-June 17, 2005

Fourth pass: June 27-July 8, 2005

Deliverable: **Task completed.**

Task 4. Maintenance of equipment. Data entry, data analysis, and prepare final report. Present findings during the Annual Nonnative Fish Control Workshop, and at the Annual Recovery Program Researchers Meeting.

Schedule: August-December 2005, January 2006

Deliverable: **Task completed: preparation of final report suffices for the December 2005 Nonnative Fish Control Workshop and January 2006 Recovery Program Researchers Meeting.**

B. Discussion of Initial Findings and Shortcomings

Study Area

The initial project study area included a 54 mile stream reach of the Yampa River just downstream of Craig, Colorado, (RM 139) to Cross Mountain Canyon (RM 59). Slight modifications to the sample reaches were made to adjust for concurrent removal projects by other agencies (USFWS and CSU). The CDOW sampled a total of 47.3 river miles in this study. Five specific river segments were sampled (Figure 1; Table 1). On one occasion, a backwater at RM 58.5 was also sampled.

CSU completed northern pike mark-removal passes in three reaches (Reach 6 through Reach 8 – 29 river miles). These reaches were not sampled by the CDOW. CSU designated 24 miles of river in Little Yampa Canyon, RM 124.0 to RM 100.0 (Round Bottom to upstream of Government Bridge) as part of their smallmouth bass study area. CSU established the upper 12 miles (Reach 6) as a smallmouth bass control area. The lower 12 miles (Reach 7) were selected as a smallmouth bass removal (treatment) area. CSU removed northern pike within these two reaches in conjunction with their smallmouth bass study. Smallmouth bass and northern pike were also removed by CSU from Lily Park, (Reach 8) downstream of Cross Mountain Canyon to near the confluence with the Little Snake River (RM 55.5 to RM 50.5). Reach 6 through Reach 8 have been included in previous northern pike removal projects. Additional, supplemental sampling through CDOW Reach 1 and CDOW Reach 2 was also performed by CSU. CSU supplemental sample reaches are referenced as Reach 9 and Reach 10, respectively. Information regarding CSU's sampling of Reach 6 through Reach 10 is presented in Table 2. Reach 6 through Reach 10 are described in Figure 1.

CSU northern pike data collected from Reach 6 through Reach 10 were combined with CDOW data for analysis. Data reported for other species in the following sections is based only on CDOW data. The 2005 Annual Report for Project #125 entitled "Middle Yampa smallmouth bass and northern pike removal" (Hawkins 2005) should be consulted for reference to all other species of interest collected by CSU.

CDOW Study Methods/Approach

Four total sampling passes (1 mark/release; 3 removal) were performed by the CDOW in Reach 1 through Reach 5, from April 26 through July 6, 2005. CSU completed multiple passes (1 mark/release; minimum 4 removal) in Reach 6 through Reach 8, from April 22 through July 21, 2005. CSU also completed two supplemental passes in Reach 9 (CDOW Reach 1), and one supplemental pass in Reach 10 (CDOW Reach 2), from May 20 through June 17, 2005.

Northern pike were captured utilizing Smith Root GPP 5.0 boat-mounted electrofishing gear. Electrofishing effort was recorded by reach sampled, and by date. “Block-and-shock” and “scare-and-snare” techniques were utilized with trammel nets at the mouths of backwaters. Water conductivity and temperatures were recorded at the beginning of each sampling day. All northern pike captured during the first pass were marked near the dorsal fin with a unique, numbered, yellow, t-bar FLOY tag (CDOW 2004-00000). These fish were returned to the river alive near the collection location. Northern pike captured on the three subsequent passes were removed from the river, marked, and transported alive to Loudy Simpson ponds or Rio Blanco Lake.

All northern pike, Colorado pikeminnow, and roundtail chub captured were measured for total length to the nearest millimeter (mm), and weighed to the nearest gram (g). Northern pike collected were examined for the presence of PIT (passive integrated transponder) tags, FLOY tags, and fin clips. Colorado pikeminnow and roundtail chub were also scanned for the presence of PIT tags. Individuals without PIT tags were implanted with a new PIT tag following the protocol of the Upper Colorado Recovery Program. All Colorado pikeminnow and roundtail chub captured were released back to the river immediately. Smallmouth bass with FLOY tags were measured for total length and weighed to the nearest gram. FLOY tag number and color were recorded. All smallmouth bass captured were released back to the river. Capture locations for all species were recorded to the nearest tenth of a river mile.

Incidental catch occurred with other nonnative species including rainbow trout, black bullhead, black crappie, brook stickleback, and bluegill. Fish species excluding rainbow trout were euthanized. In addition, thirty channel catfish were collected by the CDOW, and thirty four northern pike were collected by CSU. These fish were euthanized to assist in determination of age and bioenergetics analyses. All nonnative species euthanized were provided to Pat Martinez, CDOW Aquatic Researcher.

Determination of Population Estimates, Catch Per Unit Effort, and Movement

Population Estimates

Timing of CDOW Pass 1 and Pass 2 corresponded well to that of CSU Pass 1 and Pass 2. CDOW and CSU data for Pass 1 and Pass 2 were combined to produce northern pike population estimates for the middle Yampa River (approximately 84 river miles). Two population estimate techniques were utilized for comparison to 2004 northern pike population estimates. The Lincoln-Petersen formula and Program MARK Model (t) of Chao generated two northern pike population estimates for the middle Yampa River from downstream of Craig (RM 134.2) to near the confluence with the Little Snake River (RM 50.5). These analyses were based upon a single mark-release pass followed by a removal pass. Northern pike individuals captured that were less than 200 mm in length were excluded from the analysis. The few northern pike that were captured on May 24 and May 25, 2005, during backwater sampling in Reach 3 and Reach 4 were included with the Pass 2 data for Reach 3 and Reach 4, respectively. All fish collected in the first pass that had been previously marked by other investigators were also considered to be “marked” fish for purposes of determining population estimates. Duplicate catches of the same fish within the same pass by CSU and CDOW were only counted once.

Catch Per Unit Effort (CPUE)

Catch per unit effort (CPUE) was reported two ways, as the number of northern pike captured per hour by electrofishing boats, and number of northern pike captured per river mile sampled. All capture events were independent of one another, and all individuals that were recaptured on the same day or a different day, were included in total capture events. In several situations, electrofishing effort was recorded for one electrofishing boat on one river bank, but not the other electrofishing boat on the adjacent river bank. In these cases, electrofishing effort from the one electrofishing boat was doubled to account for the second electrofishing boat's effort. Thus, in several situations, CPUE values may underestimate or overestimate the actual combined electrofishing effort. Additionally, mechanical failure and high river discharge accounted for two incomplete sampling passes through Reach 3 and Reach 4 on May 24 and May 25, 2005. One electrofishing boat was utilized to primarily electrofish backwaters in Reach 3 and Reach 4 on both of these days. Electrofishing effort was not recorded on either day, and few northern pike were captured. Therefore, CPUE was not calculated for May 24 and May 25.

Movement

Two requirements had to be met before individuals were included in movement analysis. Individuals had to: 1) be captured more than once, and 2) be captured on different days; i.e., individuals recaptured on the same day were excluded. Individuals that moved one mile or less from the initial capture location upon recapture were also excluded. Movement analysis for individuals involved calculating the distance traveled by subtracting the furthest downstream river mile of capture from the furthest upstream river mile of capture. Distance traveled categories for individuals included the following: 1) <1.0 mile traveled, 2) >1.0 to 5.0 miles traveled, 3) >5.0 to 10.0 miles traveled, 4) >10.0 miles traveled, 5) >20.0 miles traveled, 6) >30.0 miles traveled, and 7) >40.0 miles traveled. Individual movement direction (upstream or downstream) was also identified. Direction was determined by comparing the first capture location to the second capture location. Several individuals were captured on three occasions. Movement direction for these individuals was determined by comparing the first capture location to the second capture location, and the second capture location to the third capture location. Movement direction categories for individuals included the following: 1) downstream movement, 2) upstream movement, 3) downstream movement then upstream movement, and 4) upstream movement then downstream movement.

Results and Discussion

Nine different fish species were collected within Reach 1 through Reach 5, across four passes by the CDOW. This summary information along with northern pike data collected for Reach 6 through Reach 10 is presented in Table 3.

Northern Pike

Overview

Overall, the CDOW and CSU captured 526 individual northern pike; this number included 17 fish that were too small to uniquely mark. A total of 637 northern pike capture and recapture events occurred. Four hundred and ten (410) northern pike were removed, 78% of the northern pike individuals handled (Table 4). Three hundred and fifty (350) northern pike were translocated to Loudy Simpson ponds, while 17 northern pike were translocated to Rio Blanco Lake. Nine (9) northern pike mortalities occurred. Thirty four (34) northern pike were euthanized, and provided to Pat Martinez, CDOW Aquatic Researcher.

One northern pike (total length of 681 mm/ 26.8 inches) captured had a distended abdomen, from the consumption of a roundtail chub (estimated total length of 335 mm/13.2 inches). A PIT tag was not detected in the roundtail chub mortality. The northern pike was translocated to Loudy Simpson ponds after removal of the roundtail chub.

One northern pike was recaptured in the river after being translocated to Loudy Simpson ponds. CSU initially removed this fish (785 mm) on May 10, 2005, at RM 54.5 in Lily Park. The USFWS recaptured this northern pike, verified by total length and PIT tag, on June 8, 2005, between RM 145 and 143 upstream of Craig. The fish was removed by the USFWS, and translocated to the Yampa State Wildlife area ponds.

Population Structure and Estimates

One hundred and ninety five (195) northern pike were marked, and released on the first pass. One hundred and fifty six (156) of these fish were marked by the CDOW and CSU in 2005, while the remaining 39 had been marked in previous studies by the USFWS, Chris Hill, and CSU. Forty two (42) of the 195 northern pike (22%) were recaptured on the second pass. An additional 41 first pass northern pike were recaptured across all subsequent passes. Thus, only 43% of the northern pike initially marked during the first pass were recaptured; 57% of the northern pike handled and released on the first pass were never recaptured. Eighty-six (86) marked northern pike were handled twice, while 11 marked fish were handled on three occasions.

Dates of sampling and number of passes completed by CDOW and CSU within Reach 1 through Reach 10 varied, with the exception of Pass 1 and Pass 2. Thus, specific northern pike data are presented in Table 5 according to the pass number completed by each agency.

Recaptured northern pike were categorized into six groups (Table 4 and Table 5). These included the following: 1) CDOW 2005 marked fish, 2) CSU 2005 marked fish, 3) CSU prior year(s) to 2005 marked fish, 4) USFWS marked fish, 5) fish marked by Chris Hill, and 6) fish that were marked, but the tag descriptor was missing. Twenty four (24) CDOW 2005 marked fish, and 38 CSU 2005 marked fish were recaptured.

Two of Chris Hill's (former CSU graduate student) northern pike were recaptured. Fish number 36 was captured and marked by Hill on April 25, 2002, at RM 163.3 (Total Length=576 mm). This fish was captured twice in 2005 by CSU. Number 36 was captured on CSU Pass 1 on May 8 at RM 114 (Total Length=628 mm). The second capture was on CSU Pass 3 on May 24 at RM 103.4. Fish number 53 was captured and marked by Hill on April 26, 2002, at RM 163.3 (Total Length=315 mm). This northern pike was captured by the CDOW on Pass 1 on May 17 at RM 133 (Total Length=785 mm).

Northern pike total length frequency histograms for three major sections of the river from South Beach to Lily Park are presented in Figure 2 through Figure 4. Hawkins (2004) divided the middle Yampa River into three sections: 1) the Juniper Springs section (Reach 1, Reach 2, Reach 6, Reach 7, Reach 9 and Reach 10); 2) the Maybell section (Reach 3 through Reach 5); and 3) the Lily Park section (Reach 8). Collation of 2005 northern pike capture data into these same categories allowed comparison with 2004 length frequency histograms for the same sections. In 2005, 407 northern pike were captured in the Juniper Springs section compared to 583 northern pike captured in the same section in 2004 (Figure 2). The mean total length for 2005 fish captured in the Juniper Springs section was 495 mm. In 2005, 94 northern pike were captured in the Maybell section compared to 181 northern pike captured in the same section in 2004 (Figure 3). The mean total length for 2005 fish captured in the Maybell section was 572 mm. In 2005, 25 northern pike were captured in the Lily Park section compared to 55 northern pike captured in the same section in 2004 (Figure 4). The mean total length for 2005 fish captured in the Lily Park section was 654 mm. The number of northern pike captured decreased in 2005 compared to 2004 for all three study sections. In addition, the average total length of northern pike captured in 2005 increased in a downstream direction.

The influence of multiple passes on the average size of northern pike captured was not consistent. A distinct pattern between northern pike mean total length and pass number could not be determined for Reach 1 (Reach 9), Reach 3, Reach 4, Reach 6, and Reach 8. Mean total length of northern pike in Reach 2 (Reach 10), Reach 5, and Reach 7 did tend to decrease over time. In Reach 2 (Reach 10), average total length of northern pike was 504 mm on the first pass, and 335 mm on the fifth and final pass. Mean total length of northern pike in Reach 5 decreased from 785 mm on Pass 2 to 366 mm on the fourth and final pass. The most dramatic change was seen in Reach 7, where nine passes were completed by CSU. Average total length of northern pike in Reach 7 from Pass 1 through Pass 9, varied as follows in a downward direction: 446 mm, 506 mm, 496 mm, 468 mm, 566 mm, 556 mm, 412 mm, 320 mm, and 221 mm.

Total number of northern pike capture events in 2005 (637) decreased from the total number of northern pike capture events in 2004 (825). This decrease may be attributable to increased sampling effort by agencies involved in northern pike removal within all stretches of the Yampa River. However, this downward trend may suggest that a depletion of northern pike may be occurring within the middle Yampa River study reach.

Two population estimates were determined for northern pike in the middle Yampa River in 2005 (Table 6). The Program MARK model M(t) of Chao population estimate of northern pike was 701 (573-891 95% C.I.; SE=80.3; CV=0.115; p-hat=0.22). The Lincoln-Petersen point estimate of northern pike was 719 (556-882 95% CI; SE=83.1; CV=0.116; p-hat=0.22). The 2004 point estimate for northern pike in the middle Yampa River derived from the model M(t) of Chao was 974 (769-1279 95% CI; SE=128.5; CV=0.132; p-hat=0.23) (Hawkins 2004). In 2005, 59% of the northern pike population (estimate of 701) was removed (410 individuals). In 2004, 68% of the northern pike population (estimate of 974) was removed (660) (Hawkins 2004).

Population estimates for northern pike included uncertainty. Confidence intervals were wide, a result of the low recapture rate of marked fish on Pass 2. Mark-recaptures studies assume closed systems, and therefore, do not account for immigration, emigration, mortality, or recruitment into the population. The middle Yampa River is not a closed system, and northern pike have been shown to move great distances inside and outside of the study area (see *Movement* section below). Further, recapture passes in this study extended over a two month time period.

Catch Per Unit Effort (CPUE)

CPUE was calculated by pass for each agency, and expressed as the number of northern pike captured per hour (# of NPK/hour), and the number of northern pike captured per river mile (# of NPK/RM) (Table 7). CDOW and CSU data were analyzed separately. A significant reduction was not found in CPUE (# of NPK/hour) for CDOW Pass 1 through Pass 4 in Reach 1 through Reach 5 (d.f. 2, F=3.57, R²=0.64, p=0.20) (Figure 5), although CPUE (# of NPK/RM) slightly declined. Reduction in CPUE (# of NPK/hour) for CSU Pass 1 through Pass 4 in Reach 6 through Reach 8 also was not statistically significant (d.f. 2, F=9.75, R²=0.83, p=0.09) (Figure 6). Reach 6 through Reach 8 were sampled a minimum of 4 occasions. Only CSU Pass 1 through Pass 4 were comparable to each other because more passes were completed in Reach 7 than in Reach 6 and Reach 8. NPK/hour and NPK/RM estimates declined between CSU Pass 1 and Pass 2, and between CSU Pass 2 and Pass 3.

CSU completed supplemental sampling in Reach 9 (CDOW Reach 1) and Reach 10 (CDOW Reach 2). This sampling increased the number of northern pike removed in Reach 1 by 35%. An additional 19% of northern pike were removed in Reach 2 by CSU's additional pass.

Combined CDOW and CSU electrofishing effort of 415 hours in 2005 compared well with the 2004 electrofishing effort of 388 hours reported by Hawkins (2004). A total of 405 river miles were sampled in 2005 compared to 410 river miles sampled in 2004 (Hawkins 2004). Similar effort across nearly the same stretches of river, however, resulted in different numbers of northern pike capture events. A total of 825 northern pike capture events occurred in 2004 (Hawkins 2004). A total of 637 northern pike capture events occurred in 2005. Such difference in northern pike capture events between years may be partially attributable to depletion from removal efforts within the Yampa River Basin.

Conclusions regarding CPUE should be conservative due to confounding variables that may influence results. For example, river discharge may influence catch rates. Elevated discharge increases habitat availability for northern pike, but can also create difficulty in capturing these fish. On May 24 and May 25, 2005, a CDOW crew electrofished backwaters in Reach 3 and Reach 4. Trammel nets were set at the mouths of the backwater areas, and "block-and-shock" and "scare- and-snare" techniques were used. Only five northern pike were captured on these occasions. The Yampa River near Maybell peaked at 12,500 cubic feet per second (cfs) on these dates (Figure 7). Previous sampling occurrences in these backwater areas at less than peak discharge resulted in collection of high numbers of northern pike captured in the reach. On May 5, 2005, nine northern pike were captured in Spring Creek, RM 81.6. Mean discharge of the Yampa River near Maybell was 2,980 cfs on this date. Turbidity, conductivity, and temperature may also impact CPUE. Other factors to consider include mechanical malfunctions and crew capability.

Movement

Ninety seven (97) northern pike individuals were utilized in movement analyses (Table 8 and Table 9). Twenty three individuals (24%) traveled one river mile or less, while 42% of fish (41) moved up to 10 river miles. Thirty one fish (32%) moved between 10 and 40 river miles. Two (2) fish traveled more than 40 river miles. No correlation was observed between distance traveled and size of northern pike.

Direction of movement for northern pike was also determined (Table 9). Twenty three (23) of the 97 northern pike considered were excluded in the movement analysis as these fish did not move greater than one river mile. Ninety three (93%) of 74 northern pike moved in one direction, downstream.

Smallmouth Bass

All smallmouth bass captured by the CDOW had been previously marked in studies conducted by other agencies, i.e. CSU and the USFWS. Overall, 46 smallmouth bass marked individuals were captured (Table 10). Recaptures included: 4 USFWS Red tags, 13 CSU Blue tags, 27 CSU Yellow tags, and 2 Unknown tag identifications. All four FWS fish were captured in Reach 1. Thirty four (34) smallmouth bass individuals were captured in Reach 1, compared to none in Reach 5 (Figure 8). A total length frequency histogram was developed for all smallmouth bass captured by pass (Figure 9). The mean total length of smallmouth bass captured was 354 mm.

Colorado Pikeminnow

Overall, 22 Colorado pikeminnow individuals were captured by the CDOW (Table 11). Thirteen (13) Colorado pikeminnow were captured on Pass 1 while none were captured on Pass 4. An equal number of fish previously marked with PIT tags (11) were captured, compared to 11 individuals captured without marks. Nineteen (19) Colorado pikeminnow were captured in Reach 2 through Reach 4 (Figure 10). Two fish were recaptured on three occasions; one Colorado pikeminnow was captured on Pass 1 at RM 82.0, on Pass 2 at RM 74.7, and on Pass 3 at RM 72.9; the second Colorado pikeminnow was captured in the same location (RM 81.6) twice on Pass 2, and once on Pass 3. A total length frequency histogram was developed for all individual Colorado pikeminnow captured by pass (Figure 11). The mean total length of Colorado pikeminnow captured was 604 mm. Thirteen (13) Colorado pikeminnow were captured in the main channel, while nine (9) were captured in backwaters/tributary streams. Five (5) Colorado pikeminnow were captured during peak river discharge on May 24 and May 25, 2005. On May 24, one Colorado pikeminnow captured was a mortality. Five (5) Colorado pikeminnow displayed evidence of presumed northern pike attacks that had healed.

Roundtail Chub

Overall, 71 roundtail chub individuals were captured by the CDOW (Table 12). Sixty (60) roundtail chub individuals were captured on Pass 1 and Pass 2. Seventy (70) fish were PIT tagged, and five (5) of these fish were recaptured. Four of these recaptures were collected on all occasions in Reach 5. One individual was collected in Reach 4 on both occasions. No roundtail chub were captured in Reach 1, while 40 roundtail chub were captured in Reach 5 (Figure 12). A total length frequency histogram was developed for all roundtail chub individuals captured by pass (Figure 13). The mean total length of roundtail chub captured was 400 mm. Four (4) roundtail chub exhibited evidence of presumed northern pike attacks.

Incidental Nonnative Species

Incidental contact occurred with other non-targeted, nonnative species. Three (3) black bullhead, 77 black crappie, 68 bluegill, and one (1) brook stickleback were captured and euthanized. Ten inch and larger rainbow trout were observed across all reaches. Thirty (30) channel catfish were targeted, removed from Reach 2 through Reach 5, and euthanized. Black crappie and bluegill were collected across all five reaches. Total length frequency histograms for black bullhead, black crappie, bluegill, and channel catfish captured are presented in Figure 14.

VII. Recommendations:

- A. Continue northern pike removal efforts.
- B. Standardize electrofishing equipment and operating protocol within and between agencies.
- C. Explore depletion estimator rather than mark-recapture estimator, as well as other potential metrics for assessment of NPK population.
- D. Increase number of removal passes.
- E. Increase backwater sampling effort; may need to reschedule cycle of days on the river to not miss peak opportunities (consider sampling backwaters more frequently than every two weeks).
- F. Prioritize focus areas; eliminate or reduce effort in several reaches.
- G. Explore baiting, trapping, chumming options for northern pike.
- H. Continue marking and documentation of roundtail chub and Colorado pikeminnow; PIs need to be consistent regarding model of PIT tag used.
- I. Consider Lily Park as Yampa River sanctuary for native fishes; focus intensive removal efforts for northern pike and smallmouth bass in this reach.
- J. Develop centralized northern pike database for use by PIs.
- K. Continue coordination with CSU and FWS regarding sampling logistics; recommend standardizing FLOY tags.
- L. Continue contacts with Yampa River landowners and stakeholders before, after and during study; provide Fact Sheet of Study Objectives, Goals and Schedule, as well as Study Findings to all landowners contacted.

VIII. Acknowledgments: The author appreciates the assistance of numerous CDOW personnel and volunteers who assisted during the field season. The author also recognizes Sam Finney and John Hawkins for sharing and exchanging data.

IX. Project Status: This project is considered on track, with minor revisions to be considered. Study direction and sampling design for 2006 may be adjusted per results from the 2005 Nonnative Fish Control Workshop in December.

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XIV. Appendix:

- A. 12 tables attached
- B. 14 figures attached

APPENDIX

Table 1. Yampa River reaches sampled for northern pike downstream of Craig in 2005 by the Colorado Division of Wildlife (CDOW).

<u>River Reach</u>	<u>Reach Description</u>	<u>River Miles</u>	<u>Date Sampled</u>	<u>DOW Pass #</u>	<u>Overall Pass #</u>	<u>Release/Removal Pass</u>
1	South Beach launch to Round Bottom	134.2-124.0	April 26*, 27	1	1	Release
2	Ups. Government bridge to mouth of Juniper Canyon	100.0-91.0		April 28	1	1 Release
3	Dwn. Juniper Canyon to Old Maybell launch	88.7-79.2	May 5	1	1	Release
4	Old Maybell launch to Sunbeam launch	79.2-71.0	May 3, 4	1	1	Release
5	Sunbeam launch to ups. Cross Mountain launch	71.0-60.6	May 4, 6	1	1	Release
1	South Beach launch to Round Bottom	134.2-124.0	May 17	2	2	Removal
2	Ups. Government bridge to mouth of Juniper Canyon	100.0-91.0		May 18	2	2 Removal
3	Dwn. Juniper Canyon to Old Maybell launch	88.7-79.2	May 24**, June 8	2	2	Removal
4	Old Maybell launch to Sunbeam launch	79.2-71.0	May 19, 25**	2	2	Removal
5	Sunbeam launch to ups. Cross Mountain launch	71.0-60.6 (58.5)	June 7, 10		2 2	Removal
1	South Beach launch to Round Bottom	134.2-124.0	June 9	3	4***	Removal
2	Ups. Government bridge to mouth of Juniper Canyon	100.0-91.0		June 16	3	4*** Removal
3	Dwn. Juniper Canyon to Old Maybell launch	88.7-79.2	June 15	3	3	Removal
4	Old Maybell launch to Sunbeam launch	79.2-71.0	June 14	3	3	Removal
5	Sunbeam launch to ups. Cross Mountain launch	71.0-60.6	June 17	3	3	Removal
1	South Beach launch to Round Bottom	134.2-124.0	June 28	4	6***	Removal
2	Ups. Government bridge to mouth of Juniper Canyon	100.0-91.0		June 30	4	5*** Removal
3	Dwn. Juniper Canyon to Old Maybell launch	88.7-79.2	July 6	4	3	Removal
4	Old Maybell launch to Sunbeam launch	79.2-71.0	June 29	4	3	Removal
5	Sunbeam launch to ups. Cross Mountain launch	71.0-60.6	July 5	4	3	Removal

*April 26, 27: A 5.0 river mile stretch (RM 139.2-134.2) was only sampled on April 26. Data from this 5.0 mile section is not included as the CDOW learned that the FWS was covering this stretch as part of the study.

** May 24 and May 25 data collected were analyzed with June 8th and May 19th data, respectively

*** CSU completed supplemental sampling between CDOW's Pass 3 and Pass 4 for Reach 1 (CSU Reach 9) and Reach 2 (Reach 10), and after CDOW's Pass 4 for Reach 1 (CSU Reach 9); Reach 9 was sampled twice by CSU and Reach 10 was sampled once by CSU

Table 2. Yampa River reaches sampled for northern pike downstream of Craig in 2005 by Colorado State University Larval Fish Laboratory (CSU).

<u>River Reach</u>	<u>Reach Description</u>	<u>River Miles</u>	<u>Date Sampled</u>	<u>CSU Pass #</u>	<u>Overall Pass #</u>	<u>Release/Removal Pass</u>
6	Little Yampa Canyon-Smallmouth Bass Control	124.0-112.0	May 7, 8	1	1	Release
7	Little Yampa Canyon-Smallmouth Bass Treatment	112.0-100.0	April 22, 23 April 26, 27 May 5, 6	1	1	Release
8	Lily Park-Smallmouth Bass Treatment	55.5-50.5	May 4	1	1	Release
6	Little Yampa Canyon-Smallmouth Bass Control	124.0-112.0	May 19, 20	2	2	Removal
7	Little Yampa Canyon-Smallmouth Bass Treatment	112.0-100.0	May 17, 18	2	2	Removal
8	Lily Park-Smallmouth Bass Treatment	55.5-50.5	May 10	2	2	Removal
6	Little Yampa Canyon-Smallmouth Bass Control	124.0-112.0	June 3, 5	3	3	Removal
7	Little Yampa Canyon-Smallmouth Bass Treatment	112.0-100.0	May 23-24	3	3	Removal
8	Lily Park-Smallmouth Bass Treatment	55.5-50.5	June 6	3	3	Removal
6	Little Yampa Canyon-Smallmouth Bass Control	124.0-112.0	July 8, 9	4	4	Removal
7	Little Yampa Canyon-Smallmouth Bass Treatment	112.0-100.0	May 31, June 6	4	4	Removal
8	Lily Park-Smallmouth Bass Treatment	55.5-50.5	June 16	4	4	Removal
7	Little Yampa Canyon-Smallmouth Bass Treatment	112.0-100.0	June 14, 15	5	5	Removal
8	Lily Park-Smallmouth Bass Treatment	55.5-50.5	June 21	5	5	Removal
7	Little Yampa Canyon-Smallmouth Bass Treatment	112.0-100.0	June 19, 20	6	6	Removal
8	Lily Park-Smallmouth Bass Treatment	55.5-50.5	July 19	6	6	Removal
7	Little Yampa Canyon-Smallmouth Bass Treatment	112.0-100.0	July 6, 7	7	7	Removal
7	Little Yampa Canyon-Smallmouth Bass Treatment	112.0-100.0	July 11, 12	8	8	Removal
7	Little Yampa Canyon-Smallmouth Bass Treatment	112.0-100.0	July 20, 21	9	9	Removal
9	Ups. South Beach launch to Round Bottom	134.6-124.0	May 20	1	3*	Removal
10	Ups. Government bridge to Juniper Hot Springs launch	100.0-92.0	June 2	1	3*	Removal
9	Ups. South Beach launch to Round Bottom	134.6-124.0	June 17	2	5*	Removal

* CSU completed supplemental sampling between CDOW's Pass 3 and Pass 4 for Reach 1 (CSU Reach 9) and Reach 2 (Reach 10), and after CDOW's Pass 4 for Reach 1 (CSU Reach 9); Reach 9 was sampled twice by CSU and Reach 10 was sampled once by CSU

Table 3. Number of individuals captured by species and across passes for reaches of the Yampa River downstream of Craig in 2005. Data are included for: 1) Colorado Division of Wildlife Pass 1 through Pass 4 in Reach 1 through Reach 5, and 2) Colorado State University Larval Fish Laboratory northern pike information for Pass 1 through Pass 4 in Reach 6, Pass 1 through Pass 9 in Reach 7, Pass 1 through Pass 6 in Reach 8, supplemental Pass 1 through Pass 2 in Reach 9, and supplemental Pass 1 in Reach 10. NPK=northern pike; SMB=smallmouth bass; CPM=Colorado pikeminnow; RTC=roundtail chub; BBH=black bullhead; BCR=black crappie; BGL=bluegill; BST=brook stickleback; CCF=channel catfish

<u>River Reach</u>	<u>#NPK*</u>	<u>#SMB*</u>	<u>#CPM*</u>	<u>#RTC*</u>	<u>#BBH</u>	<u>#BCR</u>	<u>#BGL</u>	<u>#BST</u>	<u>#CC</u>
1, 9	60, 24	34, JH** 1, JH	0, JH	1, JH	30, JH	21, JH	1, JH	0, JH	
2, 10	54, 10	6, JH	6, JH	14, JH	0, JH	10, JH	17, JH	0, JH	8, JH
3	83	6	8	2	0	21	16	0	8
4	25	2	5	15	2	10	10	0	3
5	8	0	2	40	0	6	4	0	11
6	163	JH	JH	JH	JH	JH	JH	JH	JH
7	167	JH	JH	JH	JH	JH	JH	JH	JH
8	27	JH	JH	JH	JH	JH	JH	JH	JH
Total	621*	48*	23*	76*	3	77	68	1	30

* Numbers represent some individuals that may be accounted for more than once across different reaches

**Reference John Hawkins 2005 Annual Report #125 for this information

Table 4. Overall number of northern pike (NPK) capture events, number of NPK individuals captured, number of NPK marked by CDOW and CSU, number of NPK not marked (too small), number of Colorado Division of Wildlife (CDOW) 2005 NPK recaptures, number of Colorado State University Larval Fish Laboratory (CSU) 2005 NPK recaptures, number of foreign NPK recaptures: [(CSUP05)=CSU recaptures from previous years, (FWSRW)=U.S. Fish and Wildlife Service red and white tag recaptures, (HILL)=Chris Hill recaptures, (UNK)=unknown tag identification], number of NPK released; number of NPK removed and final disposition: [(LS)=Loudy Simpson, (RB)=Rio Blanco Lake, (PM)=Provided to Pat Martinez, CDOW Aquatic Researcher], and number of NPK mortalities for the Yampa River downstream of Craig in 2005. Data included are the sum of CDOW and CSU NPK information, accounting for individual fish across Pass 1 through 9. Passes for both agencies did not occur over the same time periods, although both agencies completed four passes in Reach 1 through Reach 8. CSU completed more than four passes in Reach 7 and Reach 8, and supplemental passes in Reach 9 (CDOW Reach 1) and Reach 10 (CDOW Reach 2). * #NPK Marked are only those fish marked by the CDOW and CSU; fish that were previously marked by others are included as recaptures.

# NPK Capture Events	# NPK Individuals Captured	# NPK * Marked	# NPK Not Marked	CDOW 2005 NPK Recaptures	CSU 2005 NPK Recaptures	NPK Foreign Recaptures				Released	# NPK Removed			# NPK Mort
						CSUP05	FWSRW	HILL	UNK		LS	RB	PM	
637	526	421	17	24	38	38	47	2	1	120	350	17	34	9

Table 5. Number of northern pike (NPK) capture events, number of NPK marked, number of NPK not marked (too small), number of Colorado Division of Wildlife (CDOW) 2005 NPK recaptures, number of Colorado State University Larval Fish Laboratory (CSU) 2005 NPK recaptures, number of foreign NPK recaptures: [(CSUP05)=CSU recaptures from previous years, (FWSRW)=U.S. Fish and Wildlife Service red and white tag recaptures, (HILL)=Chris Hill recaptures, (UNK)=unknown tag identification, number of NPK released, number of NPK removed, and number of NPK mortalities for the Yampa River downstream of Craig in 2005. Data included are for: 1) CDOW Pass 1 through Pass 4 in Reach 1 through Reach 5, and 2) CSU multiple, varying passes in Reach 6 through Reach 8. Data from CSU supplemental passes in Reach 9 and 10 are included in parentheses () during CSU Pass 1 and CSU Pass 2. **Some columns are not additive; see Table 4 for totals.** * #NPK Marked are only those fish marked by the CDOW and CSU; fish that were previously marked by others are included as recaptures.

Agency Pass #	# NPK Capture Events	# NPK * Marked	# NPK Not Marked	CDOW 2005 NPK Recaptures	CSU 2005 NPK Recaptures	NPK Foreign Recaptures				# NPK Released	# NPK Removed	# NPK Mortality
						CSUP05	FWSRW	HILL	UNK			
CDOW1	69	53	1	0*	2	6	5	0	0	68	0	0
CDOW2	70	36	3	8	9	10	1	0	0	70	0	
CDOW3	64	45	1	6	2	5	4	0	1	0	64	3
CDOW4	28	18	2	4	3	0	1	0	0	0	28	0
CSU1	154 (19)	103 (11)	1 (0)	6 (1)**	0* (0)*	8 (0)	20 (4)	2 (0)	0 (0)	140 (0)	0 (19)	0 (0)
CSU2	89 (15)	51 (13)	1 (0)	3 (0)	13 (0)	8 (1)	12 (1)	0 (0)	0 (0)	3 (0)	86 (15)	2 (0)
CSU3	29	20	0	0	6	2	0	1	0	0	29	1
CSU4	38	27	1	1	3	3	3	0	0	1	37	0
CSU5	17	10	0	1	4	1	1	0	0	0	17	0
CSU6	11	10	0	0	0	1	0	0	0	0	11	0
CSU7	12	8	3	0	0	1	0	0	0	0	12	0
CSU8	14	10	3	0	1	0	0	0	0	0	14	1
CSU9	8	7	1	0	0	0	0	0	0	0	8	2

* Numbers do not include same day/same agency pass recaptures; ** One of the 6 NPK captured in the 1st Pass is the same fish () captured in Reach 9 and Reach 10

Table 6. 2005 northern pike (NPK) population estimates for the Yampa River downstream of Craig as a result of two different statistical analyses. Numbers based upon a two pass (one mark, one removal) effort, with fish <200 millimeters (mm) in total length excluded. Data included are for CDOW and CSU Pass 1 and Pass 2 combined. Duplicate catches of the same fish within the same pass by CDOW and CSU were counted once. * NPK Marked (M) on Pass 1 includes all fish that CDOW and CSU marked, as well as those previously marked by other investigators.

<u>Analysis</u>	<u># NPK * Marked (M) on Pass 1</u>	<u># NPK Recaptured on Pass 2 (R)</u>	<u># NPK Not Marked and Captured on Pass 2 (C)</u>	<u>Point Estimate (N-hat)</u>	<u>95% Confidence Interval</u>	<u>Standard Error</u>	<u>Coefficient of Variation</u>	<u>Capture Probability (p-hat)</u>
Lincoln- Petersen	195	42	153	719	556-882	83.1	0.116	0.22
MARK Model (t) of Chao	195	42	153	701	573-891	80.3	0.115	0.22

Table 7. Number of northern pike (NPK) capture events, electrofishing effort (hours for two boats), number of river miles (RM) sampled, and catch per unit effort (CPUE) expressed as number of NPK/hour and number of NPK/mile for reaches of the Yampa River downstream of Craig in 2005. Data included are for: 1) CDOW Pass 1 through Pass 4 in Reach 1 through Reach 5, and 2) CSU multiple, varying passes in Reach 6 through Reach 8. Data from CSU supplemental passes in Reach 9 and Reach 10 are included in parentheses () during CSU Pass 1 and CSU Pass 2.

<u>Agency Pass #</u>	<u># of NPK Capture Events</u>	<u>Electrofishing Effort (hours)</u>	<u># of RM Sampled</u>	<u>CPUE (# NPK/hour)</u>	<u>CPUE (# NPK/RM)</u>
CDOW1	68	39.8	47.3	1.709	1.438
CDOW2	65*	40.2	47.4**	1.617	1.371
CDOW3	64	38.6	47.3	1.658	1.353
CDOW4	28	37.7	47.3	0.743	0.592
CSU1	154 (19)	46.5 (15.0)	29.0 (18.6)	3.312 (1.267)	5.310 (1.022)
CSU2	89 (15)	38.8 (9.7)	29.0 (10.6)	2.294 (0.515)	3.069 (1.415)
CSU3	29	35.2	29.0	0.824	1.000
CSU4	38	36.0	29.0	1.056	1.310
CSU5	17	21.4	17.0	0.794	1.000
CSU6	11	20.3	17.0	0.542	0.647
CSU7	12	15.6	12.0	0.769	1.000
CSU8	14	15.2	12.0	0.263	1.167
CSU9	8	5.4	12.0	1.481	0.667
Total	631	415.4	404.5	1.519	1.560

* Number does not include five NPK that were collected during high flow; electrofishing effort was not recorded for these five NPK, so these fish are not included in capture events

** Includes one additional backwater sampled at RM 58.5 (approximately 0.1 of a river mile in length)

Table 8. Distance traveled (calculated by subtracting the furthest downstream river mile (RM) of capture from the furthest upstream river mile of capture) for northern pike collected in the Yampa River downstream of Craig in 2005, as a result of certain criteria. Individuals had to: 1) be captured more than once, and 2) be captured on different days, i.e. individuals recaptured on the same day were excluded. Data included are the sum of CDOW and CSU northern pike information.

<u># NPK Individuals</u>	<u>Distance Traveled</u>						
	<u>< 1.0 RM</u>	<u>> 1.0 to 5.0 RMs</u>	<u>> 5.0 to 10.0 RMs</u>	<u>> 10.0 RMs</u>	<u>> 20.0 RMs</u>	<u>> 30.0 RMs</u>	<u>> 40.0 RMs</u>
97	23	21	20	18	9	4	2

Table 9. Direction of movement for northern pike (NPK) collected in the Yampa River downstream of Craig in 2005, as a result of certain criteria. Individuals had to: 1) be captured more than once, 2) be captured on different days, i.e. individuals recaptured on the same day were excluded, and 3) have moved greater than one river mile (RM) from the initial capture location upon recapture. Several individuals were captured on three occasions. Movement direction for these individuals was determined by comparing the first capture location to the second capture location, and the second capture location to the third capture location. Data included are the sum of CDOW and CSU NPK information.

<u># NPK Individuals</u>	<u>Downstream Movement</u>	<u>Upstream Movement</u>	<u>Downstream Movement Followed by Upstream Movement</u>	<u>Upstream Movement Followed by Downstream Movement</u>
97 (23 excluded)	69	2	3	0

Table 10. Number of smallmouth bass (SMB) capture events, number of SMB foreign recaptures by agency and tag color: [(CSUB)=Colorado State University Blue tag, (CSUY)=Colorado State University Yellow tag, (FWSB)=U.S. Fish and Wildlife Service Blue tag, (FWSR)=U.S. Fish and Wildlife Service Red tag, (UNK)=Unknown tag identification], number of SMB released, number of SMB removed, and number of SMB mortalities for Yampa River Reach 1 through Reach 5 downstream of Craig across Pass 1 through Pass 4 in 2005 by the Colorado Division of Wildlife (CDOW).

CDOW Pass #	# SMB Capture Events	<u>Recaptures by Agency</u>				# of SMB Released	# SMB Removed	# SMB Mortalities
		CSUB	CSUY	FWSR	UNK			
1	11*	5*	6	0	0	11	0	0
2	12	3	5	3	1	12	0	0
3	6	2	3	0	1	6	0	0
4	19*	4*	14*	1	0	19	0	0
Total	48**	14**	28**	4	2	48	0	0

* Number reflects 2 SMB that were captured twice (see below); each fish accounted for on each capture pass

** Number reflects number of SMB captured overall (capture events); accounts for two fish previously marked that were captured twice

- 2 SMB individuals captured twice: CSU Blue Tag # 2070: captured 1st Pass (5/5/05) at River Mile 81.1 (Reach 3)
captured 4th Pass (7/6/05) at River Mile 87.3 (Reach 3)

CSU Yellow Tag # 5728: captured 4th Pass (6/30/05) at River Mile 95.7 (Reach 2)
captured 4th Pass (7/6/05) at River Mile 80.5 (Reach 3)
- All 4 SMB FWS fish captured in Reach 1
- 34 SMB captured in Reach 1; 6 SMB captured in Reach 2; 6 SMB captured in Reach 3; 2 SMB captured in Reach 4; 0 SMB captured in Reach 5 (numbers represent capture events, i.e. some individuals may be accounted for more than once across different reaches)

Table 11. Number of Colorado pikeminnow (CPM) capture events, number of CPM marked, number of CPM recaptures, number of CPM released, number of CPM removed, and number of CPM mortalities for Yampa River Reach 1 through Reach 5 downstream of Craig across Pass 1 through Pass 4 in 2005 by the Colorado Division of Wildlife (CDOW). * CPM Recaptures are individuals with the presence of a PIT tag.

<u>CDOW Pass #</u>	<u># CPM Capture Events</u>	<u># CPM Marked</u>	<u># CPM * Recaptures</u>	<u># CPM Released</u>	<u># CPM Removed</u>	<u># CPM Mortalities</u>
1	2*	0	2*	2	0	0
2	15*	8	6*	14	1	1
3	9*	2	7*	9	0	0
4	0	0	0	0	0	0
Total	26**	10	15**	25	1 (mortality)	1 (removal)

* Number reflects 2 CPM that were captured three times (see below); each fish accounted for on each capture pass

** Number reflects number of CPM captured overall (capture events); accounts for two fish previously marked that were captured on three occasions

- 2 CPM individuals captured on three occasions:
 - #FC65: captured 1st Pass (5/5/05) at River Mile 82.0 (Reach 5)
 captured 2nd Pass (5/25/05) at River Mile 74.7 (Reach 4)
 captured 3rd Pass (6/14/05) at River Mile 72.9 (Reach 4)
 - #405E: captured 2nd Pass (5/24/05) at River Mile 81.6 (Reach 3)
 captured 2nd Pass (6/8/05) at River Mile 81.6 (Reach 3)
 captured 3rd Pass (6/15/05) at River Mile 81.6 (Reach 3)
- 1 CPM captured in Reach 1; 6 CPM captured in Reach 2; 10 CPM captured in Reach 3; 7 CPM captured in Reach 4; 2 CPM captured in Reach 5 (numbers represent capture events, i.e. some individuals may be accounted for more than once across different reaches)

Table 12 . Number of roundtail chub (RTC) capture events, number of RTC marked, number of RTC recaptures, number of RTC released, number of RTC removed, and number of RTC mortalities for Yampa River Reach 1 through reach 5 downstream of Craig across Pass 1 through Pass 4 in 2005 by the Colorado Division of Wildlife (CDOW). * # RTC Recaptures are individuals with the presence of a PIT tag that were marked in 2005 by the CDOW.

CDOW Pass #	# RTC Capture Events	# RTC Marked	# RTC * Recaptures	# RTC Released	# RTC Removed	# RTC Mortalities
1	22	21	0	22	0	0
2	40*	38	2	40	0	0
3	5*	4	1	5	0	0
4	9*	7	2	9	0	0
Total	76**	70	5	76	0	0

* Number reflects 5 RTC that were captured twice (see below); each fish accounted for on each capture pass

** Number reflects number of RTC captured overall (capture events); accounts for five fish that were recaptured

- 5 RTC individuals captured twice:
 - #3CF2: captured 1st Pass (5/4/05) at River Mile 69.7 (Reach 5)
captured 2nd Pass (6/7/05) at River Mile 66.8 (Reach 5)
 - #2758: captured 1st Pass (5/4/05) at River Mile 68.9 (Reach 5)
captured 2nd Pass (6/7/05) at River Mile 68.7 (Reach 5)
 - #7070: captured 2nd Pass (6/7/05) at River Mile 69.7 (Reach 5)
captured 3rd Pass (6/17/05) at River Mile 70.0 (Reach 5)
 - #1072: captured 2nd Pass (6/7/05) at River Mile 67.8 (Reach 5)
captured 4th Pass (7/5/05) at River Mile 66.0 (Reach 5)
 - #3A30: captured 1st Pass (5/3/05) at River Mile 74.5 (Reach 4)
captured 4th Pass (6/29/05) at River Mile 77.4 (Reach 4)
- 0 RTC captured in Reach 1; 14 RTC captured in Reach 2; 2 RTC captured in Reach 3; 16 RTC captured in Reach 4; 44 RTC captured in Reach 5 (numbers represent capture events, i.e. some individuals may be accounted for more than once across different reaches)