COLORADO RIVER RECOVERY PROGRAM Project Number: _125
FY 2012-2013 SCOPE OF WORK for:
Middle Yampa smallmouth bass and northern pike removal

Lead agency:
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(see last page for revision dates and notes)

Category:
_X Ongoing project
__ Ongoing-revised project
__ Requested new project
__ Unsolicited proposal

Expected Funding Source:
_X Annual funds
__ Capital funds
__ Other *[explain]*

I. Title of Proposal: **Evaluation of smallmouth bass and northern pike management in the middle Yampa River.**

II. Relationship to RIPRAP (3/25/2011 version):
Green River Action Plan: Yampa and Little Snake rivers

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

III.B. Implement CDOW Yampa Basin aquatic wildlife management plan and the Recovery Program's Yampa River Nonnative Fish Control Strategy. Each control activity will be evaluated for effectiveness and then continued as needed. See also III.A.2.c.1&2 under General Recovery program Support Action Plan.

III.B1.. Prevent nonnative fish introduction; reduce invasion and recruitment.

III.B.1(a). Evaluate nonnative fish escapement and control options at Elkhead Reservoir (during and after Elkhead expansion construction). See Miller et al. 2005.

III.B.1.(d)(2) Smallmouth bass

III.B.2. Control nonnative fishes via mechanical removal.

III.B.2.a. Estimate nonnative abundance, status, trends & distribution (YS I-3).

III.B.2.c.Identify and evaluate gear types and methods to control nonnative fishes(YS I-5)

III.B.2.d. Remove and translocate northern pike from the Yampa River. See Hawkins et al 2005. (YS J-1).

III.B.2.e. Remove (formerly "and translocate") smallmouth bass. (YS J-1).

See RIPRAP at http://www.coloradoriverrecovery.org/documents-publications/foundational-documents/recovery-action-plan.html*]*

III. Study Background/Rationale and Hypotheses

In the Yampa River, nonnative piscivorous smallmouth bass *Micropterus dolomieu* and northern pike *Esox lucius* are a predatory and competitive threat to native and endangered fishes. Northern pike have occupied the river for just over 25 years and smallmouth bass have occupied the river in significant numbers only since 1992. Northern pike were stocked into the tributary Elkhead Reservoir in the late 1970s, about the same time they first occurred in the Yampa River. In addition to Elkhead Reservoir, northern pike now occur throughout the Yampa River and portions of the middle Green River, both upstream and downstream of the Yampa River confluence, and in addition to Elkhead Reservoir they now have self-sustaining populations in Stagecoach and Catamount reservoirs where they were illegally introduced.

Smallmouth bass were extremely rare in the Yampa River until a rapid draw down of Elkhead Reservoir for dam maintenance in 1992 introduced a very large number of smallmouth bass into the Yampa River. Those fish established self-sustaining populations in the river and smallmouth bass are now abundant throughout the Yampa River downstream of Elkhead Creek. The loss of fish from the reservoir was so great in 1992 that local fishermen reported a significant decline in the smallmouth bass fishery in Elkhead Reservoir immediately after the draw down. Prior to that time it appeared that smallmouth bass rarely escaped from the reservoir. After the establishment of smallmouth bass the native fish community declined precipitously from 68% to only 3% of all fish captured in the Juniper Springs area from 1983 to 2007 (Wick et al.1985; Hawkins et al 2009a). During that same period, smallmouth bass increased from less than 1% to 57% of the fish community; the decline in native fish is attributed to predation by increased numbers of smallmouth bass. Smallmouth bass are also considered food-resource competitors with Colorado pikeminnow *Ptychocheilus lucius* due to their predation on small fish typically consumed by pikeminnow. The small-fish prey base has precipitously declined concurrently with the invasion of smallmouth bass and drought-related warmer water temperatures (Bestgen et al. 2007). Smallmouth bass have expanded their range downstream into Dinosaur National Monument and pose a great threat to young endangered fishes that reside there.

Both northern pike and smallmouth bass occupy reaches designated as critical habitat for the federally endangered Colorado pikeminnow, razorback sucker *Xyrauchen texanus*, humpback chub *Gila cypha*, and bonytail *G. elegans*. Northern pike are known predators of wild Colorado pikeminnow (Hawkins unpublished data) and stocked razorback sucker and are presumed predators of humpback chub and recently reintroduced bonytail. Northern pike also pose a significant predation threat to other native species such as roundtail chub *G. robusta*, flannelmouth sucker *Catostomus latipinnis*, and bluehead sucker *C. discobolus* (Martinez 1995). Northern pike were rated the 3rd greatest nonnative species of concern by experts in the Upper Colorado River Basin based on the potential effects of pike predation on endangered and other native fishes (Hawkins and Nesler 1991). Smallmouth bass were ranked low on the list of species of concern but the ranking questionnaire was completed before their 1992 invasion into the Yampa River. The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) determined that management actions to reduce abundance of nonnative piscivorous fish were necessary to recover endangered fishes in the Upper Basin. The Colorado Division of Wildlife (CDOW), a Recovery Program participant, developed an

Aquatic Wildlife Management Plan for the Yampa River Basin (Yampa Aquatic Plan) that recommended managing the reach downstream of Craig, Colorado, for native and endangered fishes by removing smallmouth bass, channel catfish *Ictalurus punctatus*, and northern pike and relocating some of those species to other waters within the Yampa Basin to provide continued sport-fishing opportunities (CDOW 2010). The Yampa Aquatic Plan also recommended lethal removal of white sucker *Catostomus commersonii* because of their potential for competition and hybridization with native and endangered suckers. Reducing the number of smallmouth bass and northern pike from critical habitat should reduce predation pressure, increase forage, and reduce the influx of both species downstream. The work described in this SOW focuses primarily on removal of smallmouth bass and northern pike and secondarily on removal of white sucker and common carp from two study sites in the Yampa River. The expected results of this work will be a reduction of smallmouth bass and northern pike and a reduction of spawning success of smallmouth bass in the study reaches. This work will also develop and identify effective and efficient techniques for reducing the targeted species. Results will be measured by a decline in the number or size distribution of the targeted species and a reduction in their colonization of downstream reaches. Successful reduction of targeted species will result in decreased predation and competition with endangered fishes.

IV. Study Goals, Objectives, End Product(s): *[Include measurable outcomes and their expected due dates.]*

We are implementing control measures for nonnative smallmouth bass and northern pike in the middle Yampa River and coordinating our sampling with CDOW and U.S. Fish and Wildlife Service (USFWS) who are responsible for removal of those species in other reaches. We (CSU) will be responsible for management and analysis of smallmouth bass data and CDOW will be responsible for management and analysis of northern pike data.

Smallmouth bass

The goal is to reduce the number of smallmouth bass and reduce their spawning success in two study sites in the Yampa River in order to benefit native fishes and assist in the recovery of endangered fishes.

Objectives:

1. Obtain an estimate of the number of smallmouth bass in Little Yampa Canyon, Lily Park, and if possible river-wide using a mark-recapture abundance estimator. Coordinate mark-recapture sampling with CDOW and USFWS to obtain the estimate of smallmouth bass, upstream of Yampa Canyon.
2. Conduct one marking pass and eight removal passes in Little Yampa Canyon and Lily Park study reaches.
3. Reduce the success of smallmouth bass spawning in the South Beach and Little Yampa Canyon reaches.
4. Calculate the proportion of juvenile and adult smallmouth bass removed from each study area based on initial population size.
5. Remove large numbers of age-0 and age-1 smallmouth bass from a 12-mile treatment reach (RM100-112) in Little Yampa Canyon and in Lily Park in coordination with Recovery Program Project 140 (Native fish response evaluation).

Northern pike

The goal is to reduce the number of northern pike from two study sites in the Yampa River in order to benefit native fishes and assist in the recovery of endangered fishes. Coordinate mark-recapture sampling with CDOW and USFWS to obtain a river-wide estimate of northern pike upstream of Yampa Canyon (Primarily accomplished by CDOW Project 98a and supplemented by this Project (#125).

Objective:

Conduct one marking pass and eight removal passes for northern pike from the Little Yampa Canyon and Lily Park study reaches to support Project 98a.

Other species

The goal is to reduce the number of other nonnative species from two study sites in the Yampa River in order to benefit native fishes and assist in the recovery of endangered fishes.

Objectives:

1. Remove centrarchid species, black bullhead, and brook stickleback *Culaea inconstans* on all sample occasions in all areas of the two study sites on the Yampa River.
2. Remove white sucker, white sucker hybrids, and common carp in Lily Park and the lower 12-miles of Little Yampa Canyon to develop baseline data on the effort required to reduce their numbers.
3. Evaluate whether there is a change in relative abundance of common carp, white sucker and white sucker hybrids over time and between control and treatment reaches by comparing CPUE of the two species from 1-mile fish-community samples in treatment and control reaches.

Results will be reported in Annual Reports and at Annual Nonnative and Researcher's meetings.

V. Study Area:

Our research will focus on two study reaches in the Yampa River, Colorado, a 24-mile reach in Little Yampa Canyon which is from Round Bottom (RM 124) to about 1-mile upstream of Government Bridge (RM 100) and an 8-mile reach at Lily Park from Cross Mountain Canyon (RM 55.5) to the boundary of Dinosaur National Monument (RM 47.5).

<u>Sampling Dates</u>

We will sample for smallmouth bass with boat electrofishing from April through July using a 10-days on and 4-days off rotation including eight consecutive sampling days. Both northern pike and smallmouth bass are susceptible to electrofishing when they occupy shallow shoreline and flooded off-channel habitats during runoff flows. Spring runoff sampling also allows for safer navigation with large electrofishing boats. As discharge declines and water clears, young smallmouth bass become more susceptible to capture. During base flow from mid-July through August, we will remove primarily age-0 bass from Lily Park and the lower 12-miles of the Little Yampa Canyon reach. Removing bass only in the 12-mile treatment reach in Little Yampa Canyon maintains the Control-Treatment study design originally designated in 2004 in support of the native fish response evaluation by Project 140.

VI. Study Methods/Approach:

Sampling protocol— Each year, we will remove smallmouth bass from each study site on multiple occasions in an attempt to reduce their number or size structure. Fish will be captured with boat electrofishing from April through mid-July when flow is sufficient (>1000 cfs) to navigate the river with 17-ft. aluminum, Jon-boats fitted with outboard jet motors. Both shorelines will be sampled concurrently with two electrofishing boats using pulsed –DC current. Sampling will occur in a downstream direction covering about 6 miles per day until the entire reach is sampled. Other sampling gear types such as backpack shocker, seine, trammel net, or fyke nets may also be used (Table 1). A third boat will be used to process, maintain, and transport live fish as needed. Each reach will be sampled on multiple occasions each year with an interval of 4–10 days between occasions. Fish ≥100 mm TL will be marked with a numbered Floy tag and released on one sample occasion each year to serve as a mark for annual abundance estimates. Prior to 2009, fish were marked on the first sample pass and removed on all subsequent passes. Starting in 2009, the marking pass may occur later in the year (around the third pass) in order to synchronize the marking pass with agencies working in other reaches. We will coordinate with CDOW and USFWS to determine when the marking pass will occur in all reaches. On all sample occasions prior to or after the marking pass, smallmouth bass and northern pike will be removed from the river. For a description of the sampling protocol used in previous years see Hawkins et al. (2009a).

We will process fish every ½-mile. Smallmouth bass or northern pike that are returned to the river will be Floy tagged and released within the ½-mile section from which they were captured. Backwater and flooded tributary mouth areas will be sampled by electrofishing boat, fyke net, or block-and-shock techniques described by Nesler (1995). To determine spawning locations and timing of smallmouth bass reproduction, we will note when we observe males moving off nests and reproductive condition of captured fish. Young bass will be removed from active nests and nest sites physically disrupted.

Removal effort— We will attempt to maximize the number of removal occasions each year based on time and resources. Based on an average capture probability of 11% from 2004 to 2007 (Hawkins et al. 2009a) we estimate that it will require eight removal passes to remove 60% of the smallmouth bass in each study reach if we consider the population closed to immigration and recruitment. This estimate was derived from the formula,

$n = \log(1-R) / \log(1-p)$ where:

n = number of removal occasions
R = percent of fish removed (60%)
p = capture probability (11%, estimated from prior years).

Removal evaluation— Each year we will estimate the abundance and capture probability of smallmouth bass at each site and river-wide using mark-recapture methods. We will calculate catch per unit effort (CPUE) for adult smallmouth bass for each sample occasion and obtain an average CPUE for all sample occasions each year. We will determine removal effectiveness primarily by examining changes in annual abundance of juvenile (100-199mm TL) and adult (≥200 mm TL) smallmouth bass in each reach. We will calculate two other annual measures of removal effectiveness: removal rate and recapture rate. Removal rate measures the proportion of fish removed in relation to the abundance estimate and recapture rate measures the percent of

tagged fish recaptured during removal.

Intensive sampling during smallmouth bass spawning —We will use current knowledge about smallmouth bass spawning ecology to focus and increase removal of spawning smallmouth bass starting in 2010. Once temperatures reach 16° C, we will increase removal efforts in areas with known or potential spawning habitat by organizing and coordinating a multi-agency effort known as "The Surge". Our goal is to disrupt all stages of the spawning period, including pre-spawn nest building, spawning, and nest guarding. This activity will increase the catch and removal of adult fish, disrupt the spawning event, remove guarding males from active nests, and ultimately reduce the survival of young hatchlings. Removing spawning adults from nesting areas during the earlier nest building and spawning stages will create a sink in these areas for late spawners. Adult bass on nests are vulnerable to electrofishing gear because they are in shallow water and they have a tendency to remain and protect the nest rather than flee. Our plan is to remove spawning fish and create a void in desirable spawning habitat so that new bass can occupy those areas and be removed on subsequent sampling occasions. In that process, we will also be disrupting and decreasing the survival of eggs or young in nests. Sampling effort will be directed at river sections with concentrations of spawning bass. We will focus on the reaches between South Beach and Lower Juniper (RM 135–90), because those reaches have known spawning habitat. This sampling will be conducted with aluminum jon-boats during until base-flow and then we will switch to rafts. In 2012 we are requesting purchase of an electrofishing raft in case rafts are unavailable from other agencies.

Additional resources — Increased removal effort will require additional people and equipment; therefore, (CSU) will work closely with CDOW to coordinate removal passes and we will receive assistance from FWS crews from Vernal and Grand Junction. During intensive sampling CSU will contribute one additional boat and one additional field technician for a total of eight people and four boats. CDOW will increase sampling in South Beach, upper and lower Maybell, and Lower Juniper prior to spawning and will contribute a total of four people and three boats during intensive sampling. FWS- Grand Junction will assist with intensive sampling for 2 weeks and provide three people, two electrofishing jet boats or rafts, and two trucks. FWS- Vernal will assist for 2 weeks and provide two people and one truck with a fish hauler.

Effort required to complete one pass of the South Beach, Little Yampa Canyon, and lower Juniper reaches is about 7 days. With one extra crew (in addition to the CSU crew), we could sample all three reaches within 3-4 days. We will prioritize areas to sample on future passes based on results from the previous pass. We will allow about a 3-4-day reset period before returning to resample a reach to allow spawning habitat to reset with either displaced fish or new spawners.

Prediction of spawning period —CSU will measure water temperature daily and monitor temperatures at the Maybell gage and report when temperatures are expected to reach 16° C. Based on the past five years, this will occur between June 1st–30th. Spawning generally starts during the last part of the descending hydrograph and ends when young bass leave the nest about the time runoff drops to base flow. Bass nests are active for 10-20 days depending on temperatures and we plan to sample intensively enough that nests, no matter when started, would be disturbed 2-5 times. Intensive sampling should start within 5 days of temperatures reaching

16° C and continue for approximately 4 weeks or until water levels decline to a point that the river is un-navigable.

Spawning habitat probably occurs in all reaches but nests are often dispersed along the river and can vary in density. We propose sampling through all reaches at least once to discover and document either specific locations or sections of river where spawning areas are congregated. We will then target spawning concentrations or river sections with high densities of spawning habitat on future removal occasions. Some reaches have not been sampled during spawning and we recommend sampling those areas to determine whether spawning is occurring. We propose exploring those reaches after we have confirmed that spawning is occurring in known reaches. Areas that should be examined for potential spawning include the lower 5–10 miles of the Craig reach, the upper portion of South Beach, and the Maybell-Sunbeam reach.

During periods of low stream discharge in July and August, we will focus on removing young (age-0 and age-1) smallmouth bass from Lily Park and the lower 12-mile section of the Little Yampa Canyon study site (i.e. the original treatment reach designated in 2004). This reach is part of the control–treatment design of the native fish evaluation study (Bestgen et al. 2007). Young smallmouth bass will be captured with a 10 m-long electric seine powered by a 2000-watt generator. Other gear may include boat or backpack electrofisher, angling, seine, trap net, or cages with baited or scented attractants (Table 1). We will conduct at least three separate sampling occasions, in July and August, each about 10 days long and reaches will be sampled multiple times on each occasion. We will sample primarily shallow, low-velocity shorelines associated with backwaters, embayments, or boulders deposited from talus slopes and electrofishing effort will be recorded with a stop watch. All native and nonnative species will be handled as they are during boat electrofishing and as specified in Table 2 unless specified differently by the state collecting permit. A summary of collecting gear, fish handling, tagging, and disposition of each species is provided in Tables 1 and 2 for State of Colorado scientific collecting permit application.

Fish handling — Fish captured with boat electrofishing will be placed in a live well, measured to the nearest mm TL, and weighed to the nearest 50 gr with 5- or 10-kg, Pesola® spring scale. Fish captured with electric seine will be weighed to the nearest 0.1 gr with an electronic scale. Fish handling time will be reduced by subsampling lengths and weights of fish, except for tagged or recaptured fish, which we will measure and weigh. All fish will be examined for tags, fin clips, pike bites, gametes, and abrasions along the ventral medial fins indicating nest cleaning. Smallmouth bass $\geq$100 mm TL will be tagged during the marking pass so that recaptured fish can provide information about abundance, movement, and potential escapement from translocated waters. During removal passes starting in 2011, all smallmouth bass will be euthanized with an overdose of Tricaine methanesulfonate (MS-222). Northern pike $\geq$ 500 mm TL will be translocated to Yampa State Park Headquarters' pond as directed by CDOW. Northern pike smaller than 500 mm will be euthanized. See Table 2 for sizes of each species that will be tagged, euthanized, or translocated. If not previously tagged, smallmouth bass and northern pike released on the marking pass will be tagged with a numbered, Floy® t-bar anchor tag (model FD-94) inserted through the left musculature between pterygiophores near the posterior base of the dorsal fin. Fish that are translocated will be transported in an oxygenated live well. Tag colors and numbers will be coordinated with other agencies each year.

Endangered fishes and roundtail chub will be handled per guidelines and permits of the CDOW and the USFWS. All Colorado pikeminnow and roundtail chub will be captured, PIT tagged per Recovery Program protocol, their location recorded within 0.1 mile, and UTM coordinates recorded. We will record tag data for all recaptured fish originally tagged by other agencies. All trout species and channel catfish will be measured and released in the river. Other nonnative species captured that will be euthanized include centrarchids, black bullhead *Ameiurus exile*, walleye *Stizostedion vitreum*, brook stickleback, common carp *Cyprinus carpio*, white sucker, and white sucker hybrids. Handling protocol is described in Table 2. Centrarchids, black bullhead, and stickleback will be removed on all sample occasions from both study sites. Stickleback and common carp are on the state of Colorado's prohibited species list and any other species captured that is on the Colorado prohibited species list will be removed and euthanized (Table 3). Starting in 2009, we will initiate a pilot program to determine the effort involved to remove common carp, white suckers, and white sucker hybrids using electrofishing boat and electric seine. Removal of these species will occur concurrently with removal of smallmouth bass and northern pike and will be temporarily suspended if it compromises removal of smallmouth bass or northern pike. Carp and white sucker will be removed from Lily Park and a treatment reach in the lower 12-miles of Little Yampa Canyon. Fish that are euthanized will be provided to CDOW researchers, kept as a voucher specimen and cataloged in the LFL collection, or disposed of per state collecting permit requirements. We will evaluate if we are having a removal effect on white sucker and common carp by comparing their CPUE and relative abundance in the 1-mile community sampling sites in the upper 12-miles (control reach) with the lower 12 miles (treatment reach) of Little Yampa Canyon.

Fish Community (1-mile) sampling— We will monitor relative abundance of the fish community at four, 1–mile sites in Little Yampa Canyon and one, 1–mile site at Lily Park. These locations include RM 118.0–119.0 near Milk Creek, RM 112.5–113.5 near Sand Spring Gulch, RM 108.0–109.0 near Duffy Tunnel inlet, RM 104–103 near Morgan Gulch and RM 52.0–53.0 near Lily Park Bridge. Each site will be sampled at least monthly with boat electrofishing concurrently with smallmouth bass sampling. At each site we will net, count, and measure lengths and weights of all fish species.

Assessment of spawning success by smallmouth bass— To assess the success of spawning disruption from intensive removal of spawning adult smallmouth bass and to look for high density areas of YOY smallmouth bass that indicate nearby areas of high spawning density, we will sample the middle Yampa River longitudinally from Elkhead Creek to Dinosaur National Monument (RM 147–46) including both Juniper Canyon (2 miles) and Cross Mountain Canyon (3 miles). Sampling will occur in August when YOY smallmouth bass are relatively small but large enough to be susceptible to the sampling gear. Sampling gear will include seine, dipnet, backpack electrofisher, and electric seine. We will estimate YOY smallmouth bass abundance by their relative abundance to other species and their catch per unit effort (CPUE).

We will spend a total of three weeks sampling all reaches by spending one week in Craig and South Beach reaches, one week in Little Yampa Canyon, Lower Juniper, and Juniper Canyon, and one week in Maybell, Cross Mountain Canyon, and Lily Park. Sampling in Craig, South Beach, and Maybell will be coordinated with and may be assisted by the CDOW Area aquatic

biologist and his technicians. Sampling in Little Yampa Canyon and Lily Park will coordinate and may co-occur with ongoing YOY smallmouth bass removal sampling in those two reaches. Fish will be identified in the field when possible and fish that cannot be identified in the field and voucher specimens will be euthanized and preserved for lab verification.

Smallmouth bass spawning ecology in the Yampa River

Nest location—In other river systems, smallmouth bass nests are often adjacent to some type of large cover such as a log or boulder, but nests in the Yampa River are usually exposed and not associated with large cover except when they occur near steep-cut banks. In the Yampa River, smallmouth bass nests are located in either backwaters or in other quiet (zero velocity) waters usually near shore or downstream from an obstruction that breaks the current. Nests in the Yampa River are typically about 1-m deep, but the literature reports typical depths of 0.6–1.5 m (2-5 ft). Nests are typically circular, 25–50 cm (10 to 20 in) in diameter, with predominately small-gravel substrates which, when visible, are often darker and stand out from the surrounding, silted bottom. In portions of the Yampa River we have identified several backwaters that contain congregations of nesting smallmouth bass and several sections of river that contain high densities of nesting bass opportunistically dispersed along the shoreline among suitable habitat. Some reaches, such as lower Craig and Maybell to Sunbeam, have not been sampled recently during the spawning period and the status of nest concentration in those areas is unknown. Often, water clarity is too poor during nesting in the Yampa River to visually detect nests. If nests are not visible, then we will determine spawning activity and nest location by observing gonad development via dissection, monitoring bass for abrasions on the anal or caudal fin indicating nest clearing, and monitoring bass capture locations that contain depth, velocity, and substrate typical of spawning habitat.

Environmental factors and timing—Spawning activity begins when temperatures reach about 16–18° C (60–65° F) which in the Yampa River can range from early to late June. Bestgen presented back-calculated hatching dates based on otolith increments at the 2009 Nonnative Workshop that support a start of spawning at 16° C which can vary depending on discharge volume and timing (Figure 1). Hatching date ranges from two to nine days after spawning, depending on temperatures. Optimum incubation and hatching temperatures range from 19–22°C (66 --72 °F) and shorten hatching time. After hatching, larvae drop into the gravel nest and they eventually emerge and remain in the nest for an additional 6–15 days. Males will often remain in the area and guard the slowly dispersing young for as long as 28 days.

Reproductive strategy—Male smallmouth bass build a nest over a period of 4–48 hours, starting primarily in the morning. There may be multiple spawning events over a single nest for several hours. Eggs are demersal and adhesive. Females may spawn over several time periods before being spent because their eggs mature at different rates. The literature reports that only about 25% of mature males nest in any given year and larger males nest earlier and often have more successful nests than smaller males. Larger males also tend to be more protective and aggressive in defense of the nest than smaller males. Males actively guard the nest and young from time of egg deposition to fry dispersal. Removing the male from a nest (typically reported in the literature by angling) often results in large losses of eggs or larvae due to predation on the young or abandonment of the nest by the male if released back to the water. However, we have observed males return to a nest after being chased away by electrofishing.

VII. Task Description and Schedule:

Task 1 Oct-Jan	Prepare and present results at three annual Recovery Program meetings: nonnative workshop, nonnative summit workshop, and Researcher's Meeting.
Task 2 Feb- Mar	Contact landowners and obtain permission for private property access for sampling. Attend agency and public meetings. Hire and train field crew; purchase, prepare, and fabricate equipment.
Task 3 Apr - Jul	Yampa River sampling in Critical Habitat. capture, remove and translocate smallmouth bass and northern pike.
Task 4 Jun-Jul	Coordinate and conduct smallmouth bass removal and spawning disruption during the spawning period through the base flow period.
Task 4.1	Purchase, assemble, and wire raft and trailer for base-flow electrofishing during spawning.
Task 4.2	Purchase MBS Electrofishing ETS control box and generator for use in electrofishing raft.
Task 5 Jul- Aug	Capture and remove YOY and yearling smallmouth bass from treatment sites
Task 6 Aug	Evaluate success of the Surge by identifying distribution and relative abundance of YOYsmallmouth in the Yampa River. bass through middle Yampa River.
Task 7 Aug - Oct	Equipment maintenance. Data entry and analysis. Interaction and data sharing with DOW aquatic researchers. Prepare Recovery Program annual progress report.

VIII. Deliverables, Due Dates, and Budget by Fiscal Year:

FY 2012
**Deliverables
Recovery Program Annual Report Nov 11, 2012

FY 2013
**Deliverables
Recovery Program Annual Report Nov 11, 2013

FY 2012 Costs	**CSU- LFL**	Task Sub-total
Task 1		
Labor-Biologist Researcher IV ($1500/week – 4 weeks)	6,000	
Labor-Biologist Researcher II ($1100/week – 4 weeks)	4,400	
Travel-Lodging ($80/night-2 nights/trip x 2 people x 3 trips)	480	
Travel-per Diem ($46/day x 3 days/trip x 2 people x 3 trips)	828	
Travel- Truck mileage ($0.40/mile x 500 miles/trip x 3 trips)	600	
Task subtotal		12,308

Task 2		
Labor-Biologist Researcher IV ($1500/week – 1 week)	1500	
Labor-Biologist Researcher II ($1100/week – 1 weeks)	1100	
Travel-Lodging ($80/night-2 nights/trip x 2 people x 3 trips)	480	
Travel-per Diem ($46/day x 4 days x 2 people)	368	
Travel- Truck mileage ($0.40/mile x 750 miles)	300	
Task subtotal		3,748
Task 3		
Labor-Biologist Researcher IV ($1500/week – 15 weeks)	22,500	
Labor-Biologist Researcher II (2 x $1100/week – 14 weeks)	30,800	
Labor- Biological Technicians (4 techs x $750/week x 16 weeks)	48,000	
Travel-Lodging rental house ($1000/ month x 4 months)	4,000	
Travel-per Diem ($20/day x 10 days/trip x 6 trips x 7 people)	8,400	
Travel- Truck Insurance and motor pool fees ($380/yr x 4 trucks)	1,520	
Travel- Truck mileage ¾ ton people hauler ($0.40/mile x 900 miles/trip x 6 trips)	2,160	
Travel- Truck mileage 1-ton fish hauler ($0.45/mile x 500 miles/trip x 6 trips)	1,350	
Travel- Truck mileage 1-ton people hauler ($0.$0.82 /mile x 900 miles/trip x 6 trips)	4,428	
Travel- Truck mileage gas hauler ($0.87/mile x 200 miles/trip x 6 trips)	1,044	
Supplies- Boat Gas (3 boats x $3.85/gal x 15 gal/day x 8 days/trip x 6 trips)	8,316	
Supplies-Field supplies (nests, booms, boots, first aid, electrical safety gloves, tools, batteries)	1,200	
Supplies- Boat 2-cycle oil ($27/gal x 3 gallons/boat/trip x 3 boats x 6 trips)	1,701	
Service- Annual boat engine service at dealer ($400/boat x 4 boats)	1,600	
Service- Boat repair and maintenance- Welding , rigging and field equipment repair	500	
Supplies- Fish transport supplies (O2 bottle, salts)	480	
Service- Wireless broadband modem for work related email	828	
Task subtotal		138,827
Task 4		
Labor-Biologist Researcher IV ($1500/week – 2 weeks)	3,000	
Labor-Biologist Researcher II (2 x $1100/week – 2 weeks)	4,400	
Labor- Biological Technicians (4 techs x $750/week x 2 weeks)	6,000	
Travel-per Diem ($20/day x 10 days/trip x 2 trips x 7 people)	2,800	
Travel- Truck mileage ¾ ton people hauler ($0.40/mile x 900 miles/trip x 2 trips)	720	
Travel- Truck mileage 1-ton	810	

($0.45/mile x 900 miles/trip x 2 trips)		
Task subtotal		17,730
Task 4.1- Purchase, assemble and rig electrofishing raft for low-flow electrofishing. (FY-2012 only)		
Labor-Biologist Researcher IV ($1500/week – 0.7 weeks)	1,000	
NRS Raft, 16 ft, Expedition model E-160 + $250 freight	5,000	
Custom frame with Safety Cage and motor mount	3,000	
Oars, oar blades, straps, repair kit, & rigging	1,000	
Outboard Motor Lift	500	
Electrofishing cables, rigging, and safety equipment	1,000	
Raft Trailer- heavy duty with added rollers and tilt	3,500	
Task subtotal		15,000
Task 4.2 Purchase Electrofishing unit. (FY 2012 only)		
ETS Electrofishing, LLC, Model MBS-1DP-COS, 5-kw electrofishing control box as specified by Program + shipping.	5435	
Honda 5500 watt generator	2,100	
Task subtotal		7,535
Task 5		
Labor-Biologist Researcher IV ($1500/week – 4 weeks)	6,000	
Labor-Biologist Researcher II (2 x $1100/week – 4 weeks)	8,800	
Labor- Biological Technicians (3 techs x $750/week x 4 weeks)	9,000	
Travel-Lodging rental house ($1000/ month x 1 months)	1,000	
Travel-per Diem ($20/day x 10 days/trip x 4 trips x 5 people)	4,000	
Travel- Truck mileage ¾ ton people hauler ($0.40/mile x 900 miles/trip x 4 trips)	1,440	
Travel- Truck mileage 1-ton ($0.45/mile x 900 miles/trip x 4 trips)	1,600	
Supplies- Electric seine repair and maintenance	520	
Task subtotal		32,360
Task 6		
Labor-Biologist Researcher IV ($1500/week – 4 weeks)	6,000	
Labor- Biological Technicians ($750/week x 4 weeks)	3,000	
Travel-per Diem ($20/day x 10 days/trip x 4 trips x 2 people)	1,600	
Travel- Truck mileage 1-ton ($0.45/mile x 900 miles/trip x 4 trips)	1,600	
Supplies-Field supplies (nests, booms, boots, first aid, electrical safety gloves, tools, batteries)	800	
Task subtotal		13,000

Task 7		
Labor-Biologist Researcher IV ($1500/week – 6 weeks)	9,000	
Labor- Biological Technicians ($750/week x 8 weeks)	6,000	
Supplies-computer software for tag data analysis	400	
Task subtotal		15,400
Sub Total all Tasks		255,908
CSU overhead BOR rate 17.5%		44,784
Total- CSU LFL		300,692

Budget for assisting agencies

Task 4 FWS – Grand Junction, CO-2012	**FWS**	
Labor- Fish Biologist (1-GS12@ $57.96/hr x 40 hrs)	2,318	
Labor- Admin. Officer (GS-9 @ $39.63/hr x 21 hrs)	832	
Labor- Bio Tech (2 GS-5 @ $17.45 / hr x 64 hrs)	2,234	
Labor- Bio Tech (2 GS-5 @ $26.18 / hr [Overtime] x 25 hrs)	1,309	
Travel- Lodging 8 nights x $77 /day x 3 people	1,848	
Travel – M&IE: $46/day x 8 days x 3 people	1,104	
Travel- Truck GSA Lease ($334/month x 0.5 months x 2 trucks)	334	
Travel- Mileage 500 miles/week x 1.8 weeks x $0.30/mile	540	
Supplies- Boat gas 26 gal/day x 2 boats x $4.00/gal x 8 days	1,664	
Supplies- Boat parts, oil	223	
Service- Boat and equipment maintenance	200	
Task subtotal		12,606

Task 4 FWS – Vernal, UT 2012

Need to get cost break down		
Task Subtotal		8,160

FY 2013 Costs	**CSU- LFL**	Task Sub-total
Task 1		
Labor-Biologist Researcher IV ($1500/week – 4 weeks)	6,000	
Labor-Biologist Researcher II ($1100/week – 4 weeks)	4,400	
Travel-Lodging ($80/night-2 nights/trip x 2 people x 3 trips)	480	
Travel-per Diem ($46/day x 3 days/trip x 2 people x 3 trips)	828	
Travel- Truck mileage ($0.40/mile x 500 miles/trip x 3 trips)	600	
Task subtotal		12,308
Task 2		
Labor-Biologist Researcher IV ($1500/week – 1 week)	1500	
Labor-Biologist Researcher II ($1100/week – 1 weeks)	1100	

Travel-Lodging ($80/night-2 nights/trip x 2 people x 3 trips)	480	
Travel-per Diem ($46/day x 4 days x 2 people)	368	
Travel- Truck mileage ($0.40/mile x 750 miles)	300	
Task subtotal		3,748
Task 3		
Labor-Biologist Researcher IV ($1500/week – 15 weeks)	22,500	
Labor-Biologist Researcher II (2 x $1100/week – 14 weeks)	30,800	
Labor- Biological Technicians (4 techs x $750/week x 16 weeks)	48,000	
Travel-Lodging rental house ($1000/ month x 4 months)	4,000	
Travel-per Diem ($20/day x 10 days/trip x 6 trips x 7 people)	8,400	
Travel- Truck Insurance and motor pool fees ($380/yr x 4 trucks)	1,520	
Travel- Truck mileage ¾ ton people hauler ($0.40/mile x 900 miles/trip x 6 trips)	2,160	
Travel- Truck mileage 1-ton fish hauler ($0.45/mile x 500 miles/trip x 6 trips)	1,350	
Travel- Truck mileage 1-ton people hauler ($0.$0.82 /mile x 900 miles/trip x 6 trips)	4,428	
Travel- Truck mileage gas hauler ($0.87/mile x 200 miles/trip x 6 trips)	1,044	
Supplies- Boat Gas (3 boats x $3.85/gal x 15 gal/day x 8 days/trip x 6 trips)	8,316	
Supplies-Field supplies (nests, booms, boots, first aid, electrical safety gloves, tools, batteries)	1,200	
Supplies- Boat 2-cycle oil ($27/gal x 3 gallons/boat/trip x 3 boats x 6 trips)	1,701	
Service- Annual boat engine service at dealer ($400/boat x 4 boats)	1,600	
Service- Boat repair and maintenance- Welding , rigging and field equipment repair	500	
Supplies- Fish transport supplies (O2 bottle, salts)	480	
Service- Wireless broadband modem for work related email	828	
Task subtotal		138,827
Task 4		
Labor-Biologist Researcher IV ($1500/week – 2 weeks)	3,000	
Labor-Biologist Researcher II (2 x $1100/week – 2 weeks)	4,400	
Labor- Biological Technicians (4 techs x $750/week x 2 weeks)	6,000	
Travel-per Diem ($20/day x 10 days/trip x 2 trips x 7 people)	2,800	
Travel- Truck mileage ¾ ton people hauler ($0.40/mile x 900 miles/trip x 2 trips)	720	
Travel- Truck mileage 1-ton ($0.45/mile x 900 miles/trip x 2 trips)	810	
Task subtotal		17,730

Task 5		
Labor-Biologist Researcher IV ($1500/week – 4 weeks)	6,000	
Labor-Biologist Researcher II (2 x $1100/week – 4 weeks)	8,800	
Labor- Biological Technicians (3 techs x $750/week x 4 weeks)	9,000	
Travel-Lodging rental house ($1000/ month x 1 months)	1,000	
Travel-per Diem ($20/day x 10 days/trip x 4 trips x 5 people)	4,000	
Travel- Truck mileage ¾ ton people hauler ($0.40/mile x 900 miles/trip x 4 trips)	1,440	
Travel- Truck mileage 1-ton ($0.45/mile x 900 miles/trip x 4 trips)	1,600	
Supplies- Electric seine repair and maintenance	520	
Task subtotal		32,360
Task 6		
Labor-Biologist Researcher IV ($1500/week – 4 weeks)	6,000	
Labor- Biological Technicians ($750/week x 4 weeks)	3,000	
Travel-per Diem ($20/day x 10 days/trip x 4 trips x 2 people)	1,600	
Travel- Truck mileage 1-ton ($0.45/mile x 900 miles/trip x 4 trips)	1,600	
Supplies-Field supplies (nests, booms, boots, first aid, electrical safety gloves, tools, batteries)	800	
Task subtotal		13,000
Task 7		
Labor-Biologist Researcher IV ($1500/week – 6 weeks)	9,000	
Labor- Biological Technicians ($750/week x 8 weeks)	6,000	
Supplies-computer software for tag data analysis	400	
Task subtotal		15,400
Sub Total all Tasks		233,373
CSU overhead BOR rate 17.5%		40840
Total- CSU LFL		274,213

Budget for assisting agencies

Task 4 FWS – Grand Junction, CO -2013	**FWS**
Labor- Fish Biologist (1-GS12@ $59.65/hr x 40 hrs)	2,386
Labor- Admin. Officer (GS-9 @ $40.78/hr x 21 hrs)	856
Labor- Bio Tech (2 GS-5 @ $17.95 / hr x 64 hrs)	2,298
Labor- Bio Tech (2 GS-5 @ $26.93 / hr [Overtime] x 25 hrs)	1347
Travel- Lodging 8 nights x $77 /day x 3 people	1,848
Travel – M&IE: $46/day x 8 days x 3 people	1,104
Travel- Truck GSA Lease ($334/month x 0.5 months x 2 trucks)	334
Travel- Mileage 2 trucks x 500 miles/week x 1.8 weeks x	540

$0.30/mile		
Supplies- Boat gas 26 gal/day x 2 boats x $4.00/gal x 8 days	1,664	
Supplies- Boat parts, oil	100	
Service- Boat and equipment maintenance	129	
Task subtotal		12,606

Task 4 FWS – Vernal, UT 2013

Need to get cost break down	
Task Subtotal	8,160

IX. Budget Summary: Includes CSU and assisting agencies

	CSU-LFL	FWS- Grand Junction	FWS- Vernal	Total
FY-2012	300,692	12,606	8,160	321,458
FY-2013	274,213	12,606	8,160	294,979

X. Reviewers: P. Martinez

Revisions: 5/26/11- Revised text based on P. Martinez review, corrected FWS budget amounts. 2/2/12--Revised to include purchase of electrofishing raft (FY2012 Task 4.1) and electrofishing control box (FY2012 Task 4.2) as directed by Biology Committee.

XI. References:

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White, G. C., D. A. Anderson, K. P. Burnham, and D. L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory,

LA-8787-NERP, Los Alamos, New Mexico.

Table 1—Sampling gear that may be used by CSU on the Yampa River.

Electrofishing: boat, bank, backpack, or seine.
Nets: Gill, trammel, dip, hoop, fyke, or trap; cages (i.e. minnow traps) - various lengths and mesh sizes.
Seines: various lengths and meshes.
Angling: with bait, lures or artificial flies.
Suction devices to collect larvae or young.
All gear may be baited or scented with attractants.

Table 2—Summary of handling, tagging, and disposition requirements for fish captured by CSU researchers in the Yampa River, 2009.

Species	**Tag type**	**Disposition**
Native-Colorado pikeminnow	RFID-PIT	measured, marked, and released at capture site
Native-roundtail chub	RFID-PIT	measured, marked and released at capture site
Native-Other species, bluehead sucker flannelmouth sucker hybrid native suckers mountain whitefish speckled dace mottled sculpin	None	measured and released at capture site
Nonnative-northern pike	Grey Floy tag	Mark Pass: All sizes measured, marked and released on first pass Removal Passes: If ≥ 500 mm then then measured, marked and moved to Yampa State Park Headquarters' pond as directed by CDOW. Fish < 500 mm euthanized. During low-flow sampling, euthanize all sizes if transportation is not feasible. Northern pike recaptured with Orange Floy tags that indicate escapees from Catamount Reservoir will be euthanized and held as requested by CDOW biologist B. Atkinson.
Nonnative-smallmouth bass	Grey Floy tag	Mark Pass: If <100 mm TL then euthanized, if ≥100 mm TL then measured, marked and released. Removal Passes: All sizes euthanized.
Nonnatives: bluegill black crappie green sunfish largemouth bass pumpkinseed yellow perch walleye black bullhead common and grass carp burbot	None	Common carp, white sucker, and white sucker hybrids will only be removed from the treatment reaches which include the lower 12 miles of Little Yampa Canyon and Lily Park. All other species will be measured, euthanized, and either buried or provided to other researchers.

gizzard shad white sucker white sucker hybrids stickleback spp.		

Nonnatives: salmonids (trout) channel catfish	none	measure and release at capture site
Nonnative-Prohibited fish species per Colorado Revised Statutes-see list below.	none	measured, euthanized, and preserved

Table 3—List of Prohibited Aquatic species per Colorado Revised Statutes, Title 33, Article VII, 12, adopted by the Wildlife Commission on 01/11/07: http://wildlife.state.co.us/RulesRegs/Regulations/

1. Bowfins: Amiidae.
2. Carp of the following genera: Aristichthys; Catla; Catlocarpio; Carrassius; Cirrinus; Cyprinus; Hypophthalmichthys; Labeo; Mylopharyngodon; and Tor.
3. Catfish, Walking: *Clarias batrachus.*
4. Crayfish, Rusty: *Orconectest rusticus.*
5. Eel, Asian Swamp: *Monopterus albus.*
6. Frog, Green: *Rana clamitans.*
7. Gars: Lepistosteidae -- All species.
8. Gobies: Gobiidae.
9. Mussel, Quagga: .*Dreissena bugensis*.
10. Mussel, Zebra: *Dreissena polymorpha*.
11. New Zealand mudsnail: *Potamopyrgus antipodarum*.
12. Perch, White: *Morone americana.*
13. Piranha: Including members of the genera Serrasalmus and Pygocentrus.
14. Rudd: *Scardinius erythropthalmus.*
15. Ruffe, Eurasian: *Gymnocephalus cernuus*.
16. Snakeheads or murrels: Members of the genera Channa, Parachanna and Ophiocephalus.
17. Sticklebacks: Members of the genera Apeltes, Aulorhynchus, Gasterosteus and Pungitus.
18. Tilapia: All species.
19. Trahira: *Hoplias malabaricus*.
20. Water Fleas, Fish Hook and Spiny: *Cercopagis pengoi*, *Bythotrephes lomgimanus*, and *Daphnia lumholtzii*.

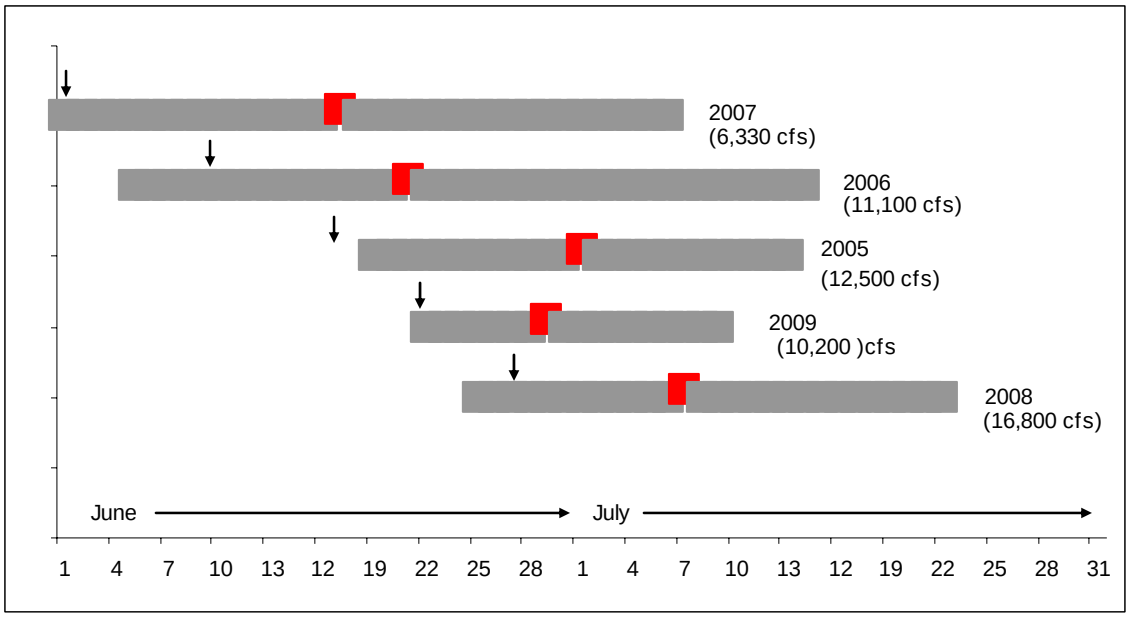

Figure 1—Estimated spawning dates for smallmouth bass in the Yampa River based on daily otolith increments. First and last dates of spawning shown by grey bars and average spawning date shown with raised dark block (in red). First occurrence of 16^0 C marked by arrow and maximum daily peak discharge for each year in parentheses. Data for 2005–2008 from Bestgen and Hill 2009 nonnative workshop presentation for Project 140. Spawning dates estimated based on 8 days prior to hatch. Dates for 2009 estimated from field observations.