Nonnative Fish Management Workshop
December 12-13, 2005
Grand Junction, Colorado

Summary Report

Upper Colorado River Endangered Fish Recovery Program
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EXECUTIVE SUMMARY

The Upper Colorado River Recovery Program (Recovery Program) held a workshop on December 12-13, 2005, in Grand Junction, Colorado, to focus on prevention and management strategies for control of northern pike (*Esox lucius*) and smallmouth bass (*Micropterus dolomieui*) in the Upper Colorado River Basin. Forty biologist and managers from seven state and federal agencies, one university, and one private firm attended the workshop. This was the third annual workshop held by the Recovery Program on nonnative fish control.

Eleven presentations were made on the prevention and management of smallmouth bass on the first day, and seven presentations were made on the prevention and management of northern pike on the second day. In addition, the results of a Smallmouth Bass Summit, held in November, 2005, were presented by the summit organizer and coordinator. A discussion by workshop participants was held at the end of each day for the respective species being addressed; i.e., smallmouth bass and northern pike. The four categories identified from the Smallmouth Bass Summit were used as the organizational framework for the workshop discussion—Prevention, Research, Mechanical, and Policy. Fifteen major recommendations were derived from the discussions held at the workshop and are presented in the body of the report.

Strategies within each of the four categories were discussed. Key issues for prevention of smallmouth bass and northern pike were escapement from floodplain ponds and reservoirs, and illicit stocking and translocation of fish. Recommended prevention measures including screening reservoir outlets and continued evaluation of unscreened ponds and reservoirs to determine where screening is needed. Key issues for research were a better understanding of sensitive life stages of nonnative fish, use of isotopic analysis to identify origins and sources of nonnative fish, the need for a defensible strategy to evaluate efficacy of nonnative fish control, and the need for a fish handling protocol. Recommendations included identification of sensitive life stages or the "Achilles Heel" to target removal efforts, focused use of isotopes to address specific questions, convene subcommittees to develop a defensible evaluation strategy and a fish handling protocol.

There was extensive discussion on mechanical removal and key issues were the need to focus removal efforts on target nonnative fish concentration areas, standardization of electrofishing, use of environmental cues to increase removal effectiveness, adaptive modifications of gears and techniques to follow fish responses, and local use of pisicides such as rotenone. The workshop served as a forum of communication among biologists and ideas on new and innovative strategies were shared for increasing effectiveness of nonnative fish removal efforts.

An over-riding and key policy issue was the recognition that information and education are interwoven into the Nonnative Species and Sportfishing element of the Recovery Program. Workshop participants discussed that one of the greatest challenges to controlling nonnative fish in the upper basin is public perception over the merits of

native fish conservation and maintenance of sport fishing. Designating important riverine reaches of critical habitat as "conservation areas" is important and would help to promote exclusion of nonnative fish from these areas and protection of native species. Other key policy issues included evaluating the flexibility of dam operations to manipulate flows and/or temperature to disadvantage nonnative fish, and the need for a more balanced approach to research (i.e., treatment reaches and mark-recapture population estimates) and more aggressive removal of nonnative fish. The need for ongoing communications among principal investigators and field biologists, a constant exchange of ideas, and the availability of mark and recapture datasets became evident as a necessary component of nonnative fish management in the Upper Colorado River Basin.

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1.0 INTRODUCTION

The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) convened a workshop to review results of nonnative fish management projects and develop recommended strategies for 2006 and beyond. The workshop was held on December 12-13, 2005, in Grand Junction, Colorado, with a focus on control of northern pike (*Esox lucius*) and smallmouth bass (*Micropterus dolomieui*). Forty biologist and managers attended the workshop (see Appendix A). The workshop agenda is provided in Appendix B; presentations are provided in Appendix C; and meeting notes are provided in Appendix D.

The theme of the workshop was "Integrated Management Techniques to Control Nonnative Fishes." Presentations and discussions were held on the techniques that may have merit for use in the Upper Colorado River Basin, and the advantages/disadvantages, risks/costs/benefits of each. The workshop also included discussions of techniques that can be eliminated from further use or consideration. Principal investigators working on nonnative fish control in the upper basin were asked to identify the factor(s) that are the most significant impediment to their ability to control nonnative fish.

The desired workshop products were ideas and solutions for improved prevention and management of smallmouth bass and northern pike within the upper basin. The outcome of this workshop was also used as guidance for the Biology Committee of the Recovery Program for the fiscal year 2006 work plan. It is emphasized that this report provides an assimilation of ideas and issues discussed at the workshop that will need to be formulated into recommendations before implemented. The intent of this report is to assimilate workshop discussions and help to formulate recommendations for implementation by the Recovery Program.

2.0 OVERVIEW OF RECOVERY PROGRAM ACTIVITIES

One of the six elements of the Recovery Program is Nonnative Species and Sportfishing, which implements actions to reduce the threat of certain nonnative fish species to endangered fish while maintaining sportfishing opportunities. For several years, the Recovery Program has worked cooperatively with state and federal partners to identify management actions to minimize the threat of nonnative fish to survival of endangered fish.

The Recovery Program has implemented several actions to reduce threats from nonnative fishes, including mechanical removal, screening off-river impoundments to prevent escapement of fish to the river, chemical removal of nonnative fish in small off-river impoundments, implementation of nonnative fish stocking procedures, and changes in state bag and possession limits. Scientific evidence demonstrates that northern pike, smallmouth bass, and channel catfish are nonnative fish species that pose significant threats to survival of endangered fish because they prey upon them and compete for food and space. In 2004, the Recovery Program revised its nonnative fish management program using what was learned in 2002 and 2003. Biologists from the states of Colorado and Utah, U.S. Fish and Wildlife Service, and Colorado State University conducted work in about 480 miles of the Colorado, Green, and Yampa rivers in Colorado and

Utah to reduce the abundance of northern pike and smallmouth bass. Efforts to manage channel catfish continued in Yampa Canyon, where effective removal has been demonstrated, but were postponed in other river reaches until methods to improve sampling efficiency are developed.

The following references help to define the problem and provide potential solutions: Dawson and Kolar (2003), Gabriel, et al. (2005), Hawkins and Nesler (1991), Introduced Fish Section (no date), Lentsch, et al. (1996), Meronek, et al. (1996), Nesler (2002), SWCA (2002), Tyus and Saunders (1996), Upper Colorado River Endangered Fish Recovery Program (2004). The following activities have been implemented by the Recovery Program or are being evaluated:

2.1 Institutional

- Nonnative Fish Stocking Procedures.—The Recovery Program has entered into agreements with the States of Colorado, Utah, and Wyoming to regulate stocking below 6,500 feet elevation and to restrict stocking into designated critical habitat.

- Nonnative Fish Management Policy.—In spring 2004, Recovery Program partners adopted a policy to identify and implement nonnative fish management actions needed to recover the endangered fishes. The policy was a landmark event demonstrating that these diverse organizations recognize that management of nonnative fish is essential to achieve and sustain recovery of the endangered fishes. The policy also recognizes the dual responsibilities of state and federal fish and wildlife agencies to conserve listed and other native fish species while providing recreational sportfishing opportunities.

- State Angling Regulations.—The States of Colorado and Utah have adjusted state angling regulations to encourage anglers to catch and keep greater numbers of nonnative fish in designated critical habitat waters.

- Information and Education.—Public relations have a vital role in controlling populations of nonnative fish from riverine habitats that are also sportfish in reservoirs. The Recovery Program I&E Committee works closely with biologists to help inform the public of efforts to control nonnative fish. The Recovery Program holds public meetings and produces a wide range of educational materials, including newsletters, fact sheets, interpretive exhibits, and a web site.

2.2 Physical Barriers (Prevention)

- Redlands and Grand Valley Project Selective Fish Passage Barriers.—Selective fish passage has been constructed on the Redlands Dam on the lower Gunnison River; and the Grand Valley Project on the Colorado River upstream of Grand Junction, Colorado. These fish passage facilities will allow native fish to pass upstream into historic habitat, and allow for selective removal of undesirable nonnative fishes.

- Highline Lake Fish Barrier Net.—A fish net barrier was installed in Highline Lake in 2001. Highline Lake is a small reservoir at the end of the Grand Valley Canal near Grand Junction that drains into Salt Wash and into the Colorado River. The net barrier reduces escapement of nonnative fish into critical habitat. The net is replaced about every 5 years, as a cost of about $100,000; annual operating and maintenance costs are about $2,000–8,000. The net was installed in compliance with nonnative fish stocking procedures. The net is made of Dynema material with 1/4" mesh; it is 363' wide x 19' deep, and weighs 1,400 lbs. A new net will be installed by April 2006.

- Elkhead Reservoir Outlet Screen.—Elkhead Reservoir, on a tributary of the Yampa River in northwest Colorado is being enlarged. The spillway will be 40' higher by fall 2006. The reservoir outlet is being screened to minimize escapement of nonnative fish. A temporary screen in spring 2005 failed and fish escaped into critical habitat in the Yampa River. About 540 cfs will be screened by 2006; ~1,000 cfs average peak. From fall 2005 through spring 2006, a conservation pool will be maintained at 1,250 acre feet via pumping and releases through the screened outlet. The Colorado Division of Wildlife (CDOW) and Colorado State University (CSU) sampled Elkhead Reservoir November 1–3, 2005, and will sample it again prior to spring runoff, 2006.

- Elder's Pond.—Elder's Pond is on the Ute Indian Reservation in northeastern Utah. It is a 3-acre pond 1 mile downstream from Bottle Hollow Reservoir (420-acre), 0.6 miles upstream from the Uintah River. The Uintah River flows into the Duchesne River at Randlett gage. A 1/4"-mesh screen was constructed at the outlet of Elder's Pond Screen in 2002 for $38K ($28K from Recovery Program). The goal of the project is to provide angling opportunities by stocking Elder's Pond with channel catfish, smallmouth bass, and male northern pike captured during nonnative fish removal from the Duchesne and/or White and Green rivers. As of 2005, sufficient numbers of fish had not been caught to make transport and stocking worthwhile. Utah has put some trout in Elder's Pond to provide put-and-take fishing, but the Ute Tribe has not stocked the pond. Sampling should be done in Elder's Pond to determine if fish are in the pond that may have escaped from Bottle Hollow.

- Pariette Draw Fish Fountain.—Pariette Wash drains a 9,000-acre wetland complex near Vernal, Utah. The wetlands support large numbers of nonnative fish that can escape into the Green River. A fountain type pipe and screen was installed at the outlet in 1999 for about $30,000 (cost-shared with BLM). The Pariette wetlands dried up in 2002, resulting in a complete fish kill, and the fountain has not been used since 2002. However, fish are beginning to re-invade from upstream and the fountain may be used in 2006 for draining the wetlands.

- Northern pike Spawning Barriers.—Spawning sites of northern pike along the Yampa River are being screened to prevent adults from accessing desirable spawning site.

- Other Methods.—Selective fish passage, barrier nets, and screens are the most common methods being employed in the upper basin to prevent escapement or passage of nonnative fish. Other methods should be explored to minimize passage of fish or escapement. In the case of selective fish passage systems installed in small dams and diversions, it is noted that passage is controlled upstream but not downstream. New and innovative ideas are needed to control movement of fish in a downstream direction. For example, recent studies at Grand Coulee Dam show that strobe lights alter fish behavior and may be used for preventing various fish species from exiting or entering areas (Johnson 2005).

2.3 Mechanical Removal (Prevention and Management)

- Increase Harvest.—The Recovery Program is implementing all possible means for increasing harvest and removal of nonnative fish from critical habitat of the four endangered fishes, including mechanical removal, revised bag and possession limits, and establishing "buffer zones."

- Mechanical Removal of Northern Pike.—Mechanical removal of northern pike is ongoing in 177 miles of the Yampa River, and 175 miles of the Green River.

- Mechanical Removal of Smallmouth Bass.—Mechanical removal of smallmouth bass is ongoing in 113 miles of the Colorado River, 175 miles of the Green River, 40 miles of the Duchesne River, and 63 miles of the Yampa River, for a total of 391 miles.

- State Bag and Possession Limits.—Bag and possession limits in the States of Colorado and Utah have been revised to increase harvest of nonnative fish.

- Buffer Zones.—The Recovery Program is considering establishment of "buffer zones" or "conservation areas" with the purpose: To establish river reaches free of northern pike and smallmouth bass, to prevent immigration into important nursery areas within critical habitat. If successful, it would still be necessary to manage pike and bass within critical areas. Prospective buffer zones include the Yampa River upstream of Craig; Duchesne River; Green River in Lodore Canyon and Desolation/Gray Canyons; Colorado River below Rifle.

- Other Strategies Considered.—The Recovery Program continues to investigate and evaluate control strategies from other regions of the country and the world.
    - Commercial fishery.—A commercial fishery for certain abundant and marketable species, such as channel catfish, has been considered, but is problematic because of the need to coordinate with transportation, distribution, and processing facilities, which are nonexistent in the Colorado River Basin. Eventual costs for marketing these fish could exceed current program removal costs. Markets for distribution of common carp from Utah Lake are being investigated and results of that study may help to better determine the feasibility of a commercial fishery for the upper basin.
    - Bounty.—It may be possible to establish a bounty of certain fish species in the upper basin, such as northern pike, smallmouth bass, and channel catfish. Bounties on undesirable fish have had varying success in other regions of the country. In 1990, the Bonneville Power Administration authorized a Northern Pikeminnow Sport Reward Fishery Program, in which anglers would be paid to catch and turn in pikeminnow. For every northern pikeminnow 9 inches or longer caught in the study area and returned to a registration station, anglers received $5-$8. The more fish an angler caught, the more each fish was worth; the first 100 fish caught in one season were worth $5 each; the next 300 fish were worth $6 each; additional fish turned in were worth $8 each. Specially tagged northern pikeminnow were worth $1,000. During 1990-2000, over 1.5 million northern pikeminnow have been removed from the Snake and Columbia rivers as a result of the sport reward program. Fishery managers estimate that the northern pikeminnow population has been reduced by 10-20%, and predation on juvenile salmonids has been reduced by 25 percent. Bounties risk generating a bi-catch of species intended for protection, and they tend to generate interest and demand in a resource that is intended to be depleted.
    - Fishing derbies.—Fishing derbies are generally most successful where popular fisheries exist, and may not receive much attention for rivers of the upper basin. Fishing derbies may create/promote/draw attention to fisheries that don't currently exist, and generate a dependency or demand among anglers. Fishing derbies exert little control over harvest and handling of fish, and considerable collateral mortality of native fish may result.

2.4 Chemical (Prevention)

- Toxicants.—Two chemical toxicants are currently approved by the FDA for use in controlling fish in public waters; rotenone and antimycin. Application of either requires an application certificate and an individual certified to apply the toxicant; all CDOW and Utah Division of Wildlife Resources (UDWR) fisheries biologists are certified. Rotenone was used in floodplain pond reclamation near Grand Junction, Colorado, and Old Charlie Wash, Utah, was rotenoned in April 2000 after young northern pike were observed from a 1999 spawn.

- Other Pisicides.—"The so called 'silver bullet' of selective piscicides does not presently exist for nuisance nonnative fishes in the southwestern United States, and the prospects for the development of such a tool are limited" (Dawson and Kolar 2003). "It is estimated that development and registration of a new toxicant would require 8 to 10 years and cost $35 to $50 million" (American Crop Protection Association 2001). It is estimated that development and registration of a new toxicant would require 8–10 years and cost about $35–50 million.

2.5 Biological Techniques

Biological techniques have not been attempted in the Upper Colorado River Basin. The following are techniques that are under investigation and evaluation in other waters of the world and may be of value in the upper basin.

- Pathogens.—Species-specific pathogens are being investigated, including viraemia virus, gill hyperplacia, motile aeromonas septicemia bacteria, and immuno-contractive control (SWCA 2002). Some of these are being test, evaluated, and applied on a very limited basis. These pathogens bear a risk in possible violation of species-specificity and invasion of other species, including native and sportfish.

- Genetic Bullets.—Recent technological advances have made use of genetics promising for control of undesirable species (Kapuscinski and Patronski 2005). Triploid sterilization and transgenic techniques are being developed, but approval and implementation could require 5-15 years and $30-$50 million.

- Pheromones.—Pheromones are natural chemicals secreted by fish as communication scents with other individuals. Several pheromones have been found to affect fish behavior. For example, "Schreckstoff" is a pheromonal alarm substance exuded from the skin of many cypriniform fishes when disturbed, and has been tested to affect behavior. Pheromonal attractants have also been suggested as a means of selectively removing unwanted fish by using sexual attractant pheromone baited traps.

2.6 Evaluation - Species Response

The Recovery Program is evaluating response of small-bodied prey-sized fish, native fish, and endangered fish to mechanical control programs. Metrics are being refined and evaluated to develop the most sensitive measure of response possible. Current metrics include:

- Number of Nonnative Fish Removed.—All investigators are currently keeping records of numbers of nonnative fish removed. This is an indicator of effort, but is not a good metric for success of mechanical removal, since populations of nonnative fish may be very large and response of native fish is not measured.

- Reduction in CPUE, Fish Size.—Many investigators are estimating relative abundance (CPUE) or absolute abundance (population estimates) of nonnative fish to track population response to mechanical removal. This metric provides an index of the effect of mechanical removal on the population, but does not provide a measure of the ability of the population to recover or a measure of the native fish populations.

- Evidence of Reproduction; YOY, etc.—Most investigators are able to capture young nonnative fish in mechanical removal efforts, and are capable of detecting dramatic changes or new occurrences of reproduction by nonnative fish. This measure is valuable for detecting new reproduction of nonnatives in given locations, but does not assess nonnative fish population strength or potential.

- Target Number per Mile.—Some investigators are comparing CPUE or numbers of fish per mile of nonnative fish with those of native fish as an index of success of mechanical removal. In 2004, the Biology Committee suggested that northern pike density should not be higher than Colorado pikeminnow density. As with other catch rate indicators, this metric provides an index of population trends and abundance relative to native species, but does not assess nonnative fish population size and reproductive/recruitment potential.

- "Break the Back of the Population" i.e., Reduce Recruitment.—Use of Ricker and Beverton and Holt stock recruitment models may be evaluated to identify population levels of nonnative fish at which the imposed adult mortality (removal) exceeds recruitment, and the population is expected to decline and remain at low levels with minimal effort. Schaefer yield curves may also be evaluated to identify the level of harvest that is feasible before a diminishing return is seen.

- Increased Numbers of Native Fishes.—This is the desired response, but may not be immediately measured because of a delayed response or because other environmental factors are influencing native fish populations.

3.0 NONNATIVE FISH MANAGEMENT STRATEGIES

Recommended strategies for control of smallmouth bass and northern pike were organized into four categories (i.e., prevention, research, mechanical, and policy) as identified in the Smallmouth Bass Summit. The following describes issues and strategies identified and discussed at the workshop for each of the four categories. Because the focus of this workshop was on prevention and management of smallmouth bass and northern pike, applicable sections of each strategy are identified by species. In some cases, the description applies to both species, as indicated. It should be noted that some strategies may not necessarily be consistent with other aspects of program recovery, and each strategy will have to be thoroughly evaluated by the Recovery Program before implementation.

3.1 Prevention

Preventing smallmouth bass and northern pike from invading critical habitat is important in controlling detrimental effects of nonnative fish on native and endangered fish populations. Four principal sources of invasion are identified (i.e., reservoirs, adjacent river reaches, illicit stocking of floodplain ponds, and illicit translocation and release) in which prevention measures may be used to minimize negative effects of these nonnative fish species. In addition to these four sources, selective fish passage was also identified as discussed as a strategy for preventing further invasion of species.

3.1.1 Reservoirs

SMALLMOUTH BASS

The smallmouth bass is currently considered by upper basin biologists as the most serious nonnative predator in the Yampa River. The sudden population increase in reaches of the upper basin is coincident with several years of drought condition. Some believe that low flows resulted in more suitable spawning and survival conditions with warmer water temperatures and more stable base flows.

A priority action identified by workshop participants was to constrain escapement of nonnative fish from reservoirs, especially smallmouth bass and northern pike. Smallmouth bass are currently in the following major reservoirs in the upper basin. A description is provided for each reservoir as well as past, ongoing, or planned Recovery Program activities to minimize escapement.

- Elkhead Reservoir.—Smallmouth bass were introduced into Elkhead Reservoir as sportfish by the CDOW. They escaped into Elkhead Creek and have become established in critical habitat in the Yampa River. Elkhead Reservoir is being enlarged in 2005 and 2006 with an increase of 40 feet in spillway elevation. Temporary screens erected to minimize escapement during construction failed in spring 2005, and increased numbers of nonnative fish were reported downstream, indicating that escapement had occurred. Work continues on screening and monitoring escapement of fish from Elkhead Reservoir.

- Rifle Gap Reservoir.—This reservoir is on Rifle Creek, a tributary of the upper Colorado River near Rifle, Colorado. The reservoir is used for irrigation and is drawn down to minimum pool annually. Rifle Gap Reservoir has a bottom release and apparently has never spilled. Escapement of smallmouth bass from Rifle Gap Reservoir is unknown and should be evaluated.

- Starvation Reservoir.—This reservoir is on the Strawberry River near Duchesne, Utah. The Strawberry River flows into the Duchesne River which flows into the middle Green River near Ouray, Utah. Smallmouth bass were introduced into Starvation Reservoir as a sportfish by the UDWR. Recent investigations by UDWR have documented some escapement, but it is also known that a reproducing population of smallmouth bass exists

in the Duchesne River. Escapement of smallmouth bass from Starvation Reservoir appears to be small and a fish screen at the reservoir outlet may not be worth the financial investment, unless the resident population of smallmouth bass in the Duchesne River can be controlled.

- Flaming Gorge Reservoir.—This reservoir is on the upper Green River on the Utah/Wyoming border. Smallmouth bass were introduced into Flaming Gorge Reservoir by the UDWR as a sportfish. Escapement of smallmouth bass through Flaming Gorge Dam is currently unknown, but escapement is identified as a concern in the Biological Opinion of the Flaming Gorge Dam EIS, and will be evaluated as part of NEPA compliance. Controlled releases of epilimnetic water through the temperature control device on the dam may help to provide more suitable warm temperatures for smallmouth bass in the Green River from Flaming Gorge Dam to the Yampa River confluence.

- McPhee Reservoir.—This reservoir is on the Dolores River in Colorado. Smallmouth bass have not been reported recently from this river. No action is currently recommended for this reservoir.

- White River Below Kinney Reservoir.—Kinney Reservoir is located on the White River in near Meeker, Colorado. Smallmouth bass have not been intentionally introduced into Kinney Reservoir, but they were reported from the White River downstream of the reservoir in 2005. The presence/absence of smallmouth bass in this reach of the White River can be assessed in spring 2006 during electrofishing mark-recapture sampling for Colorado pikeminnow. Further action may be necessary, depending on the numbers and distribution of smallmouth bass in that system.

- Lake Powell Reservoir.—This reservoir is on the upper Colorado River in southwestern Utah. Smallmouth bass were introduced as a sportfish by the UDWR. No smallmouth bass have been captured in Cataract Canyon immediately upstream of Lake Powell, indicating that escapement by swimming upstream is minimal or nonexistent. Escapement of smallmouth bass into upper basin critical habitat is not considered a problem.

NORTHERN PIKE

Like smallmouth bass, preventing northern pike from invading critical habitat is important in controlling detrimental effects on native and endangered fish populations. The northern pike is a large hunt and stalk predator that is one of the more serious nonnative predators in the upper basin, especially the Yampa River and middle Green River. Mechanical removal and translocation of northern pike has been ongoing for several years and the numbers of pike captured in certain river reaches has declined, indicating a depletion effect from removal efforts. Biologists have identified concentration areas and habitats used for spawning and nursing and are targeting these habitats for effective removal. Nevertheless, northern pike are appearing in new areas with evidence of reproduction (e.g., Brown's Park, Old Charlie Wash) and biologists will need to remain vigilant to re-expansion of populations. Northern pike are

currently in the following major reservoirs in the upper basin. A description is provided for each reservoir as well as past, ongoing, or planned Recovery Program activities to minimize escapement.

- Elkhead Reservoir.—Northern pike were introduced into Elkhead Reservoir as sportfish by the CDOW. They escaped into Elkhead Creek and have become established in critical habitat in the Yampa River. Elkhead Reservoir is being enlarged in 2005 and 2006 with an increase of 40 feet in spillway elevation. Temporary screens erected to minimize escapement during construction failed in spring 2005, and increased numbers of nonnative fish were reported downstream, indicating that escapement had occurred. Work continues on screening and monitoring escapement of fish from Elkhead Reservoir.

- Catamount and Stagecoach Reservoirs.—These reservoirs are on the Yampa River upstream of Steamboat Springs. Both have northern pike introduced as sportfish by the CDOW. Most large northern pike in Catamount Reservoir are tagged, but few of these marked fish are captured downstream in the Yampa River, indicating that escapement is minimal. Isotope analysis may be appropriate to determine escapement of young northern pike too small to tag in the reservoir. There is good evidence that northern pike spawn in the Yampa River between Catamount Dam and Craig, Colorado, and biologists believe that removal of northern pike from the Yampa River in the Steamboat Springs are is appropriate, especially in a 4-6 mile reach of public land. Appropriate coordination with the CDOW is necessary to implement this removal.

- Crawford and Paonia Reservoirs.—These reservoirs are on tributaries of the Gunnison River upstream of Delta, Colorado. Northern pike are found in both reservoirs but few pike have been found downstream in critical habitat, which is downstream of Delta. Biologists should continue to monitor the Gunnison River as part of other ongoing investigations in that system to insure that the northern pike does not become established in critical habitat.

- Rio Blanco Lake.—This reservoir is located next to the upper White River downstream of Meeker, Colorado. Northern pike were stocked into Rio Blanco Lake by the CDOW, and the reservoir is a receiving water for northern pike translocated from the Yampa River as part of the mechanical control program in that system. Northern pike cannot escape from Rio Blanco Lake.

3.1.2 Adjacent River Reaches

SMALLMOUTH BASS

- Yampa River Upstream of Craig, Colorado.—Critical habitat for Colorado pikeminnow on the Yampa River extends upstream as far as Craig, Colorado. Elkhead Reservoir releases into Elkhead Creek, a primary source of smallmouth bass into the Yampa River, with its confluence about 5 miles upstream of critical habitat. Movement of smallmouth bass into the reach adjacent to critical habitat is believed to be attributed primarily to

escapement from Elkhead Reservoir and possible reproduction in the river. Mechanical removal of smallmouth bass from the entire Yampa River is important to controlling the negative effects of this species on native fish.

- Duchesne River.—Smallmouth bass have been known from the Duchesne River for over 40 years. Until the late 1990's, smallmouth bass were never numerous in the Green River and seemed to be confined to the lower Duchesne River. Recent expansion of populations and increase in numbers of smallmouth bass may be related to several years of drought resulting in warmer, more suitable spawning, growth, and recruitment temperatures and conditions. Smallmouth bass populations will continue to be evaluated in the Duchesne River.

NORTHERN PIKE

- Yampa River Upstream of Craig, Colorado.—Critical habitat for Colorado pikeminnow on the Yampa River extends upstream as far as Craig, Colorado. Elkhead Reservoir releases into Elkhead Creek, a primary source of northern pike into the Yampa River, with its confluence about 5 miles upstream of critical habitat. Movement of northern pike into the reach adjacent to critical habitat is believed to be attributed primarily to escapement from Elkhead Reservoir and possible reproduction in the river. Mechanical removal of northern pike from the Hayden to Craig reach of the Yampa River would help to control this species closer to its source.

- Middle Green River Floodplains.—Inventories show that there are approximately 37 potential floodplain sites in the middle Green River between Split Mountain and Desolation Canyon, totaling about 11,400 acres (Valdez and Nelson 2004). Many of these floodplains connect to the river at high flows and may provide suitable spawning and nursery habitat for northern pike. Young northern pike were found in Old Charlie Wash in 2005, one such floodplain near Ouray, Utah. The Recovery Program cannot survey all inundated floodplains for invasion of northern pike, but ongoing investigations on several of these floodplains will help to monitor this species.

- Green River Upstream of Lodore Canyon.—Northern pike were found in the Brown's Park area in 2005. This reach of the Green River is upstream of critical habitat, which extends upstream to the confluence of the Yampa River. It is unknown if northern pike have become established in this reach of the Green River. Ongoing investigations in Lodore Canyon should continue to monitor the status of northern pike in this reach of the Green River in order to determine if mechanical removal is necessary.

3.1.3 Illicit Stocking of Floodplains Ponds

SMALLMOUTH BASS AND NORTHERN PIKE

The States of Colorado and Utah currently require pond stocking permits before any private landowner can stock fish into private ponds. Nevertheless, some pond owners may not

comply with, or may not be familiar with, these regulations and introduce fish into private ponds that may escape into a river system. State regulations for private parties importing fish are clear and require appropriate permits, but these laws may not adequately regulate aquaculturalists from especially out of state, who can sell and import fish without respective state permit requirements. States are encouraged to evaluate regulations regarding aquaculture sales and import of fish prohibited by states.

Most workshop participants believe that illicit stocking of ponds can be reduced with effective outreach and public relations programs that inform private landowners of the need to obtain a pond permit, the ecological liability, and of the penalty associated with violating such regulations. Most private pond owners in the Grand Valley have been contacted by the CDOW, and an I & E program can help to promote good relationships.

3.1.4 Illicit Translocation and Release

SMALLMOUTH BASS AND NORTHERN PIKE

Fish may be transported and released by anglers into waters other than the place of capture. These illicit translocations and releases can be very damaging to fish communities and costly to state and federal agencies having to control alien fish populations to protect sportfish or native fish. Some illicit introductions are by well-intentioned anglers wanting to introduce a favored species into waters they fish, or there may be "bait bucket releases" of highly competitive or predaceous bait fish. As with illicit stocking of ponds by private land owners, illicit releases of fish can be reduced through an effective outreach program that informs anglers of the liability of releasing nonnative fish into designated sportfish or native fish waters. Designation of "conservation areas" or "buffer zones" can help to convey the importance and designated use of such waters to the public.

3.1.5 Selective Fish Passage

SMALLMOUTH BASS AND NORTHERN PIKE

- Redland Diversion Dam.—A 107-m selective fish passage was built at the Redlands Diversion Dam on the lower Gunnison River in 1996, giving endangered and native fishes access to 92 km of historic habitat. The fish passage is operated annually by the U.S. Fish and Wildlife Service, and as of 2004, 67 Colorado pikeminnow, 9 razorback sucker, 1 bonytail, and more than 62,000 other native fish had passed through the facility, and thousands of nonnative fish had been selectively removed.

- Grand Valley Project Diversion Dam.—In 2005, a 4-m wide notch was cut in the concrete crest of the Grand Valley Project Diversion Dam to facilitate construction of a 113-m long selective fish passage. This fish passage will allow for passage of native fish into 90 km of historic habitat in the Upper Colorado River and selective removal of nonnative fish.

3.2 Research

Research is fundamental to understanding nonnative fish ecology and to developing effective control strategies.

3.2.1 Better Understand Life History and Ecology

SMALLMOUTH BASS

Understanding the life history and ecology of a nuisance fish species is vital for identifying the most sensitive life stage to target. Identifying this "Achilles Heel" helps to focus control measures at a particular time and place in order to make population control more effective and economical. Two aspects of smallmouth bass life history are identified as potential "Achilles Heels":

- Disturb Nesting Adults.—Smallmouth bass have very specific spawning requirements, that if violated, will cause the adults to abandon spawning efforts. Spawning occurs in late spring and summer, and electrofishing shorelines can disturb nesting adults, even if the fish are not captured. Spawning and nesting can also be disrupted through flow and temperature manipulation. Smallmouth bass will re-nest, but spawning success is reduced if initial spawning/nesting is disrupted.

- Displace Fry.—Smallmouth bass fry are very sensitive to displacement from warm, sheltered habitats. Efforts to capture fish in early summer and flow and temperature manipulation can displace fry and reduce their survival through starvation and/or predation. Hence, a sensitive time for smallmouth bass survival is during and shortly after spawning and nesting.

NORTHERN PIKE

Two aspects of northern pike life history are identified as potential "Achilles Heels":

- Block or Capture Adults During Spawning.—Northern pike have very specific spawning requirements. They require flooded vegetation on which they scatter their adhesive eggs. These floodplains are formed in a limited window of time when the river is at flood stage. Blocking adults from accessing these floodplains effectively excludes adults from these specific spawning sites and can cause females to reabsorb their eggs. Also, adults can be found in large concentrations in these floodplains and effectively captured and removed with electrofishing and large hoop nets. The key to this removal strategy is to understand the flow and/or temperature cue(s) that cause the fish to gather in these floodplains. These cues are not fully understood, and identifying them would enable field crews to target specific locations and times to remove the greatest numbers of adults with minimal investment in time and resources. Biologists are encouraged to better understand these cues and communicate this information to others.

- Kill YOY in Nurseries.—Young of year northern pike use sheltered floodplains as nurseries and are susceptible to being captured or killed in large numbers. Some biologists suggest that so few native fish share these floodplains with young northern pike that pisicide application (i.e., rotenone) is feasible with little collateral mortality. One such floodplain pond has been identified along the Yampa River, where YOY gather annually, and may be suitable for rotenone treatment. The appropriate permits and authorizations will need to be secured before such treatment can be implemented. Old Charlie Wash, a floodplain pond on the middle Green River near Ouray, Utah, was treated in this manner in 2005 after young northern pike were discovered.

3.2.2 Use Isotopes to Determine Fish Origins

SMALLMOUTH BASS

Most water bodies have unique water quality signatures expressed as different ratios of certain isotopes. These unique signatures are incorporated into the tissue of fish that reside in those waters. As a fish moves to a different water body, his tissue takes on the new signature of his new home. However, unique signatures are registered continuously in the otoliths (inner ear bones) that can be traced through extraction of material with laser ablation. These techniques are very valuable in determining fish origin, and can help biologists identify the most problematic sources of nonnative fish. Isotope analysis has application for identifying origin of specific fish; e.g., isotope analysis may help to ascertain the extent of escapement of smallmouth bass from Rifle Gap Reservoir.

NORTHERN PIKE

As with smallmouth bass, determining the origin of northern pike is important for controlling and preventing sources of invasion. Isotope analysis can be used to identify spawning and nursery sites of northern pike as a means of better targeting these areas for removal and possible application of pisicides. Origins of northern pike in Brown's Park should be determined with isotopes.

3.2.3 Develop Defensible Evaluation Strategy

SMALLMOUTH BASS AND NORTHERN PIKE

Reducing numbers of nonnative fish is intended to reduce predation and competition on native species and to help recovery of endangered fishes. The cause and effect relationships between nonnative and native fishes is evident from the life history of these fish, but may not be self-evident to the public concerned over removal of sportfish. A defensible evaluation strategy is needed to demonstrate to the public the benefits of targeted nonnative fish control for protecting native fish populations. Current and potential metrics, as described in Section 2.6, include:

- Number of Nonnative Fish Removed.
- Reduction in CPUE, Fish Size.
- Evidence of Reproduction; YOY, etc.
- Target Number per Mile.
- "Break the Back of the Population" i.e., Reduce Recruitment.
- Increased Numbers of Native Fishes.

3.2.4 Develop a Standardized Handling Protocol

SMALLMOUTH BASS AND NORTHERN PIKE

The amount of fish sampling in the Upper Colorado River Basin raises concerns for over-handling of fish and possible injury that could lead to direct or delayed mortality, decreased growth, and/or reduce reproductive potential. Biologists from the CDOW will coordinate development of a Standardized Handling Protocol for Native Fishes in the Upper Colorado River Basin. This protocol should also include handling and translocation protocols for sportfish, such as smallmouth bass and northern pike.

3.3 Mechanical

Mechanical removal is the most common method being used to control nonnative fish in the upper basin. Biological controls are not sufficiently developed for use in the wild, and chemical controls are generally used on a limited basis. Rotenone has been applied locally in floodplain ponds to eradicate suspected sources of problematic nonnative fish. A variety of mechanical control gears, methods, and strategies have been and are being employed involving seines, electrofishing, traps, and angling. The following describe the mechanical removal methods and strategies that are being shown to be most effective in the upper basin.

Biologists acknowledge that mechanical control is an interim solution and that other methods will need to be developed for future, more long-term and permanent control measures. Recovery Program participants may be willing to fund mechanical removal for only a period of time, and less costly and more effective control methods need to be developed. It should also be noted that focused mechanical removal of nonnative fish has been in effect only 2-3 years, and more time is needed to observe and evaluate effects.

3.3.1 Focus Efforts on Most Productive Areas

SMALLMOUTH BASS AND NORTHERN PIKE

Biologists in the upper basin recognize that the most effective strategy for removing nonnative fish is to focus efforts in those areas where the target species is most abundant or in areas used heavily for specific life history requirements. For smallmouth bass, some areas of the river have concentrations of fish, are nesting areas, or are nursery habitat. For northern pike, floodplains are recognized as principal spawning and nursery habitats. Focused sampling of these areas reduces time spent catching few fish in areas of low density, and this saves time and costs. Furthermore, removal is most effective if it affects population centers. Most productive areas for smallmouth bass have been largely identified and biologists are focused on removal in those areas. However, other areas of low density may have dramatic increases in numbers, and these areas have to be monitored as well. It may be useful to obtain a complete set of Yampa River aerial photos (1:12,000, 9" x 9") to get a better overview of the entire floodplain on both sides of the river to determine if there are more extensive floodplain complexes that could be sampled.

3.3.2 Target Large Adults

SMALLMOUTH BASS

Investigators are discovering that the largest female smallmouth bass have the highest fecundity, and removing these fish from the population can have the greatest reduction on reproductive potential. It must be recognized, however, that fish populations typically exhibit compensatory responses to removal of large fish. Smaller fish have more available resources and less predation, and can grow and reproduce rapidly to repopulate areas. Biologists need to be cognizant of these compensatory responses.

NORTHERN PIKE

As with smallmouth bass, the largest female northern pike generally have the highest fecundity. Hence, removing these fish from the population can dramatically affect reproductive potential. However, as with many fish species, removing large fish can result in compensatory responses by northern pike, including higher growth rates, and possibly high reproduction by small males and females previously excluded from reproduction by the larger, more aggressive fish.

3.3.3 Standardize Electrofishing Boats and Methods

SMALLMOUTH BASS AND NORTHERN PIKE

Most electrofishing systems in the upper basin used Coffelt products for many years. Coffelt Electronics recently discontinued their business, and electrofishing products in the west are now available primarily through Smith-Root. This has caused a switch in many electrofishing boats from Coffelt to Smith-Root electrofishing systems, and there is a need for all of these systems to become standardized with respect to power output (power transfer), voltages, amperages, and electrode configuration, as well as operations. Upper basin biologists have contacted an expert with electrofishing systems, and one or more workshops are planned to standardize electrofishing boats and methods. Biologists are referred to Snyder (2003) for insights into electrofishing in the upper basin.

Workshop participants agreed on the need to hold an electrofishing clinic for upper basin biologists. Pat Martinez, Pat Nelson, and Tom Czapla will work together to develop the plan for a clinic and protocol. Larry Kolz, former U.S. Fish and Wildlife Service electrofishing expert, will be asked to assist. A clinic would be held tentatively early in 2006—possibly at the Researcher's Meeting in January.

Workshop participants also agreed on the need to develop a fish-handling protocol (e.g., temperature threshold for moving fish, tank volume per numbers of fish, oxygen flow rate, etc.) for both native and sportfish. Smallmouth bass are very susceptible to handling stress (particularly hypoxia).

3.3.4 Implement Methodic and Deliberate Electrofishing Techniques

SMALLMOUTH BASS AND NORTHERN PIKE

Biologists have noted that many fish can be missed if electrofishing is not methodical and deliberate. Slow and deliberate electrofishing strategies are more effective than rapid moving systems. The most effective method is often location, time, and conditions specific, and all biologists should be aware of the best operating method for a given condition.

3.3.5 Electrofish Late in the Year at Low Water

SMALLMOUTH BASS AND NORTHERN PIKE

Electrofishing late in the year at low water levels can yield the highest catch rates. Water depths are low, water clarity is often high, and water temperatures are often cool to moderate fish escapement. Biologists should recognize those conditions that provide highest catch rates for their specific river reaches.

3.3.6 Apply Pisicides

SMALLMOUTH BASS AND NORTHERN PIKE

Rotenone has been applied locally to private floodplain ponds and may be useful in contained floodplains to eradicate concentrations of fish. The best opportunity to use pisicides is in spawning areas of northern pike or contained nursery areas. Similar opportunities may exist for poisoning young smallmouth bass if concentrations can be found in contained habitats, such as floodplain ponds. Target treatment areas should be checked to insure that collateral losses of native fish are minimal. Use of pisicides will require application permits, individuals trained and certified to apply pesticides, and appropriate modification of state and federal scientific collecting permits.

3.3.7 Use Environmental Cues to Initiate Sampling

SMALLMOUTH BASS AND NORTHERN PIKE

Several upper basin biologists have identified specific environmental cues when mechanical removal of nonnative fish is most effective in reducing overall population size. For example, smallmouth bass in the Yampa River spawn at specific temperatures of 55°F by May and river flows with spring peaks of <10,000 cfs. Monitoring river temperature and flow cue give crews to the most effective times of year to sample with the greatest cost saving for time and labor. Similarly, northern pike gather in large numbers in floodplain ponds during high river flows. The precise flows and temperatures at which spawning aggregations of northern pike occur need to be better defined. Sampling at high flows may require modification of gear types; e.g., 8' high trammel nets in deep backwaters may be more effective than the standard 6' nets.

3.3.8 Use Rapid Removal and Tandem Electrofishing

SMALLMOUTH BASS AND NORTHERN PIKE

A variety of strategies are being developed by field biologists to produce the highest catches possible. One possible approach is to intensively sample a small area repeatedly to insure removal of target nonnative fish, and then shift to another area. This strategy helps to insure reduced numbers of fish, but is labor-intensive and leaves adjoining reaches to repopulate. Clearly, a balance must be struck when determining extent of removal and intensity.

3.3.9 Strip Adults of Gametes During Mark-Recapture Studies

SMALLMOUTH BASS AND NORTHERN PIKE

Biologists believe that field crews can strip eggs from females handled during mark-recapture studies to negatively affect populations of smallmouth bass and northern pike. Records should be kept of any fish stripped to add to the database and assess if this activity is impacting populations.

3.3.10 Evaluate Decoy Spawning Sites for Northern Pike

Decoy spawning sites have been established to attract other species of fish into traps. Ponds at the Yampa State Wildlife Area and in Juniper Springs reach of the Yampa River are likely candidates for such decoy sites. These would be established by creating a channel and a control structure (both would need to be constructed) that would allow fish in but not out. The fish could then be removed mechanically, poisoned, or anglers could be allowed to take the fish. This strategy would involve unknown costs for construction and the efficacy is unknown.

3.4 Policy

Many biologists feel that the major impediments to nonnative fish removal in the upper basin are policy issues. Policy issues include institutional constraints on sampling that may be the result of certain state or federal regulations or policies, or certain public issues.

3.4.1 Remove Centrarcids Outside of Critical Habitat

SMALLMOUTH BASS AND NORTHERN PIKE

Members of the sunfish family of fishes (i.e., Centrarchids) can be highly piscivorous and competitive. Green sunfish, black crappie, bluegill, largemouth bass, and smallmouth bass can occur locally in large numbers, and recent isotope analyses indicate that some of these species are reproducing in riverine habitats, as well as floodplain ponds. Because river reaches that adjoin critical habitat can serve as sources of undesirable fish species, removal of problematic nonnatives should extend beyond critical habitat, where appropriate to reduce populations. Sources of problematic species are being identified, and all possible means should be used to implement removal of fish from these source areas.

3.4.2 Designate Conservation Areas

SMALLMOUTH BASS AND NORTHERN PIKE

Biologists from the CDOW are investigating the possibility of designating specific river reaches of importance of native and endangered fishes as “conservation areas” or “buffer zones.” These areas would be largely free of problematic nonnative fishes, such as smallmouth bass, northern pike, and channel catfish. These areas could be designated by the respective state game

commissions so that conservation areas carry the same weight of importance as "blue ribbon fisheries" or other designations that signify to the public specific importance and protection. This designation may help to reduce illicit translocations of fish by making it well known to the public in fishing proclamations that certain riverine areas are managed for native fish. Designating conservation areas will require a focused and well-structured I&E effort that convinces the public, commissioners, and administrators of the benefits of this concept.

3.4.3 Emphasize Danger of Certain Problematic Nonnative Species

SMALLMOUTH BASS AND NORTHERN PIKE

The danger of predaceous fish species, such as smallmouth bass and northern pike, may not be well understood by the public—and even some resource managers. When particularly dangerous aquatic predators or competitors are discovered in the upper basin, necessary actions should be evaluated and implemented, as necessary, to insure that the species does not become problematic. The Recovery Program should also establish communications with The 100th Meridian Initiative (U.S. Department of the Interior 2001) to be altered to new invasions of aquatic nuisance species into the west and possibly into the Colorado River basin.

3.4.4 Develop Subbasin Nonnative Fish Management Strategies

SMALLMOUTH BASS AND NORTHERN PIKE

The extent and manifestation of problematic nonnative fishes in different parts of the upper basin may vary. These species differences, and possible differences in control strategies, warrant subbasin nonnative fish management strategies. These strategies should be developed specific to, for example, the Upper Colorado River subbasin, and the Green River subbasin.

3.4.5 Make Smallmouth Bass and Northern Pike Database Available

Large numbers of smallmouth bass and northern pike have been, and will continue to be marked in rivers and reservoirs of the upper basin. Many of these marks are number or color-specific and can be used to trace fish origins or previous capture locations. Principal investigators request the availability of a computerized database available on an ongoing basis so that biologists can access prior capture information and incorporate their own data. The Recovery Program database may not be suitable for this need because principal investigators are not required to submit data until the completion of the study. State collecting permit reports may also not be suitable because data are not submitted until the end of the year. A readily accessible and upgraded database of smallmouth bass and northern pike will help biologists to better respond to identifying sources, movement, and escapement of fish.

3.4.6 Implement Outreach Program to Reduce Illicit Stocking

SMALLMOUTH BASS AND NORTHERN PIKE

The Information and Education Committee of the Recovery Program should design and implement an outreach program that will reduce illicit releases of fish in the upper basin. These include illicit stockings of private floodplain ponds, and illicit translocation and releases of fish into public waters, often by anglers. Information should be provided to the public to discourage releases of nonnative fishes, encourage protection of native fishes, and to inform the public of regulations and penalties associated with illicit stocking and translocation activities. The public is generally not aware of those activities that are illegal. For example, it is illegal in most western states to transport live fish, yet anglers often have live fish in live wells in boats, as shown from random road-block checks. The public should be made aware of this and other regulations that are designed to minimize displacement of fish from one water body to another.

3.4.7 Assign Priority to Nonnative Fish and Sportfishing

SMALLMOUTH BASS AND NORTHERN PIKE

The public should be continually informed that warm water reaches of the upper basin (below 6,500 feet elevation) are assigned priority for native fish management, and reservoirs are assigned priority for sportfish management. This provides a clear and distinct segregation of fish management priorities for the public and resource managers.

3.4.8 Reduce Control-Treatment and Mark-Recapture Studies

SMALLMOUTH BASS AND NORTHERN PIKE

Nonnative fish control in the upper basin began as a series of studies to estimate abundances of nonnative fish species in order to establish a baseline for assessing success of removal. Biologists doing these studies have been faced with the dilemma of having to mark and release hundreds of nonnative fish for population estimates that should instead be removed from the system. Biologists are becoming increasingly familiar with nonnative fish population distributions and abundances, and are implementing mark-recapture studies on very limited river reaches. This allows for greater allocation of resources for removal of problematic fish.

Nevertheless, biologists also recognize the need to develop a metric by which to confidently measure success of nonnative fish removal, and mark-recapture population estimates are the most accurate and precise for determining population abundance. This dilemma of balancing mechanical removal of nonnative fish with population estimates needs to be resolved, as described in Section 2.6 of this report. Given the different and unique conditions in the basin for mechanical removal and population estimates, a subcommittee should be established to convene biologists and statisticians on an ongoing basis to establish baselines of nonnative fish abundance and metrics of success.

Workshop participants discussed the need for control efforts to move from control/treatment to more aggressive removal of nonnative fish on the Yampa River. However, biologists also recognize the need to demonstrate to the public that removal is effective for reducing nonnative fish populations and for increasing native fish populations. Hence, limited "treatments" should be continued to demonstrate these effects. Some biologists suggest that population estimates of smallmouth bass and northern pike should be conducted only once every 2 or 3 years. Biologists are encouraged to mark the smallest fish possible (smallmouth bass and northern pike) to better understand recruitment of these populations.

3.4.9 State Incompatibility of Nonnative Fish and Riverine Sport Fishery

SMALLMOUTH BASS AND NORTHERN PIKE

Many biologists in the upper basin believe that native fish conservation and sport fisheries in riverine critical habitat are incompatible. They believe that the best fish management strategy is to conserve native fish in riverine environments and promote sport fisheries in reservoirs. This concept is one of the most contentious and controversial issues in the upper basin. Some anglers have identified some riverine reaches as significant sport fisheries and are quite vocal about protecting and promoting this resource. The best example of this is angling for smallmouth bass and northern pike in the Yampa River. Some fishing guides have included the Yampa River as one angling opportunity for their clients.

3.4.10 Evaluate Dam Operations to Disadvantage Nonnative Fish

SMALLMOUTH BASS AND NORTHERN PIKE

Biologists in the upper basin recognize that certain life history events of most nonnative fishes are keyed to specific hydrologic and/or thermal events. These cues can be disrupted and spawning potential reduced with timely manipulation of flows and/or temperatures. Biologists encourage evaluation of reservoir operations to determine if there is sufficient flexibility in dam releases to manipulate flow and/or temperatures to disadvantage nonnative fishes. One example of flow management is to decrease river flows shortly after spawning to expose nests of smallmouth bass and vegetated spawning sites of northern pike.

3.4.11 Revise Yampa River Management Plan to Enhance Native Fish

SMALLMOUTH BASS AND NORTHERN PIKE

The Yampa River Management Plan contains provisions for nonnative fish control. This plan should be evaluated to insure that it is consistent with the current nature of the nonnative fish problem in the Yampa River.

3.4.12 Increase I&E Throughout Upper Colorado River Basin

SMALLMOUTH BASS AND NORTHERN PIKE

The I&E Committee of the Recovery Program has been instrumental in insuring good relationships between the public and nonnative fish control efforts. This I&E effort should continue, and increase where necessary, to insure good relationships with the public. Some biologists note a possible backlash from publicized removal of nonnative sportfish from the Yampa River. Fishing guides and anglers are promoting catch-and-release of smallmouth bass and northern pike to counter effects of removal.

Some workshop participants suggested that the public could be made aware of tradeoffs between continued water use and development in the upper basin and maintenance of riverine sport fisheries, such as smallmouth bass and northern pike; i.e., the Recovery Program and its activities play a significant role in continued water use and development in the upper basin. Program partners (e.g., water users, et al.) are encouraged to help communicate the importance of nonnative fish control to the public.

Some workshop participants stated that the numbers of anglers they see on the river during field work is small, and it appears that anglers promoting river sport fisheries in the upper basin are a small, but vocal group. At least one internet site exists (www.westernslopeanglers.com) that promotes such fisheries. Currently, a CDOW representative participates on this site to better inform the public, and this may be an opportunity for informing anglers of the merits of the nonnative species and sportfishing element of the Recovery Program. It was also suggested at the workshop that angler representatives should be invited to participate in meetings (e.g., Upper Basin Researchers Meeting) to better understand the Recovery Program mission, and for Recovery Program representatives to attend meetings of anglers.

3.4.13 Identify and Promote Alternative Fisheries

SMALLMOUTH BASS AND NORTHERN PIKE

Alternative fisheries should continue to be explored for anglers seeking additional opportunities. Translocation of northern pike to off-river ponds is an example of providing an alternative fishery. This program has been successful in gaining support for nonnative fish control efforts in the upper basin.

3.4.14 Adopt Adaptive Management Strategy

SMALLMOUTH BASS AND NORTHERN PIKE

Adaptive management should be the ongoing framework of nonnative fish management in the upper basin. As new information is revealed, biologist should make appropriate

adjustments. Exchange of information on best strategies should be ongoing among biologists so that adjustments can be made to improve results. An adaptive management strategy should be employed that is proactive instead of reactive. The Recovery Program should be prepared to respond to new species and expansions of existing species in areas that are sensitive to native and endangered fishes.

3.4.15 Seek Landowner Cooperation

SMALLMOUTH BASS AND NORTHERN PIKE

Landowners that own floodplain ponds should be contacted to establish good relations for working toward nonnative fish management. Many landowners in the Grand Valley have been contacted and many seem willing to work with state and federal resource agencies. Workshop participants suggested that scientific collecting permit requirements should require investigators to contact landowners potentially affected by their activities.

3.4.16 Discourage Angling For Nonnative Fish in Rivers

SMALLMOUTH BASS AND NORTHERN PIKE

Anglers should not be encouraged to fish for nonnative fish in rivers. Angling in warm river reaches of the upper basin is not very popular. The few anglers in the Upper Colorado River and Green River fish primarily for channel catfish. Anglers in the Yampa River target northern pike and smallmouth bass; these fishing activities should not be encouraged.

3.4.17 Focus Nonnative Fish Control in Problem Areas

SMALLMOUTH BASS AND NORTHERN PIKE

Control of problematic nonnative fish should be concentrated in those areas with highest populations and where effects on native fish are potentially greatest. This strategy can reduce costs, time spent afield, and increase chances of successful removal of problematic nonnative fish.

Biologist should also be aware of diminishing returns for constant effort, which indicates that numbers of target nonnative fish have declined to the point at which numbers of fish caught may not be worth the effort expended. Captures should be evaluated to determine if sampling is cost-effective and if it should continue in these areas or shifted to other areas with higher concentrations of target species.

Some biologists also suggest shifting crews from one area to another to target particularly problematic areas; e.g., UDWR crews on the middle Green River have reduced numbers of northern pike substantially and could shift their effort to more problematic reaches of the Yampa River in Colorado, such as Hayden to Craig.

4.0 WORKSHOP RESPONSES TO SPECIFIC ISSUES

Workshop participants were asked the following 13 questions to illicit responses to specific issues regarding nonnative fish control in the Upper Colorado River Basin.

1. Should we continue to work with isotopes to identify sources of NNF?

Workshop participants agreed that isotope analyses have been valuable for identifying sources and origins of nonnative fish in the upper basin. However, participants were in general agreement that isotope analysis should be used to address specific questions about the origin of particular fish and to assess the level of escapement from given source waters. The following two examples were identified and discussed: (1) The origin of northern pike found in the Brown's Park area in 2005 should be determined in order to assess the magnitude of the problem and design and implement control measures. (2) The numbers of smallmouth bass escaping from Rifle Gap Reservoir should be determined in order to assess the need for screening or other escapement prevention measures.

2. Should we investigate operations of Rifle Gap, Starvation, Flaming Gorge, Elkhead, and McPhee reservoirs as a strategy to prevent/minimize escapement of smallmouth bass?

Workshop participants were also in agreement that operations of key reservoirs should be evaluated to determine if flexibility exists to manage flows and/or temperature to disadvantage nonnative fishes. The following two examples were identified and discussed: (1) Smallmouth bass nest shortly after spring runoff and decreasing flows during and shortly after nesting can strand eggs and fry. (2) Northern pike spawn at particular flows and temperatures during spring runoff when flows can be manipulated to disrupt spawning and/or strand eggs and young.

3. Should we direct I&E Committee to reexamine and possible expand its program to provide information to the public?

Workshop participants unanimously believe that additional information and education is needed to better inform the public of the Recovery Program's Nonnative Fish and Sportfish Element. Issues of greatest concern were (1) Inform the public of state fishing regulations and penalties, (2) Inform the public of regulations and drawbacks of illicit stocking of private ponds, (3) Inform the public of regulations and drawbacks of illicit transportation and release of nonnative fish, (4) Establish and maintain a consistent message delivered by all Recovery Program partners; e.g., smallmouth bass are a serious problem, (5) Establish and maintain communications with owners of private ponds, (6) Advise the public of the nonnative fish stocking policy, (7) Send a positive message to the public regarding native fish and benefits of removing nonnatives, and (8) Emphasize that native fish recovery benefits water use and development, and this involves tradeoffs between native fish and sportfish.

4. Should we investigate smallmouth bass in White River below Kenney Reservoir and implement immediate removal?

Workshop participants agreed that smallmouth bass presence, relative abundance, and extent of distribution in the White River should be evaluated in 2006. Participants agreed that the most cost-effective means is to monitor smallmouth bass captured during the river-wide, mark-recapture efforts for Colorado pikeminnow population estimates in spring 2006. Field crews will not be able to target removal of smallmouth bass at that time, but the extent of the problem should be assessed and subsequent action decided by the Biology Committee. Removal of fish during mark-recapture sampling should be coordinated with the Colorado Division of Wildlife.

5. Should we shift effort/gears to target smaller fish as we see shift in size with initial removal of smallmouth bass?

Workshop participants had differing opinions on this issue. To some, it seemed that shifting to a smaller size fish was a good adaptive management strategy (if large fish disappearing and small fish are persisting). There is considerable biological basis for shifting efforts from large to small bass in order to affect recruitment. Small fish are the most sensitive life stage and can be affected with targeted tactics. However, some sampling conditions preclude being able to target certain size fish, and biologist felt a need to better assess this strategy for their particular situation.

Some workshop participants asked if it was necessary to identify triggers that would shift control efforts from one life stage to another. These triggers may not necessarily be numbers of fish caught, but may be environmental cues. Early warm temperatures result in long a growing season and high young survival, and hence a need to target small fish. Some participants suggested that all field crews should be equipped with electric seines to target small fishes, as needed. It was pointed out that significant changes to sampling could require modifications to scopes of work and to scientific collecting permits. Principal investigators should be aware of these possible requirements before changing sampling protocol.

6. How do we establish criteria for levels of NNF removal?

Workshop participants agreed that this is a major issue that could not be resolved in the time and context of the ongoing workshop. Participants agreed that establishing criteria for levels of nonnative fish removal was important for two reasons: (1) to assess progress and success for a given scope of work, and (2) to demonstrate to the public the efficacy of the nonnative fish control program. It was suggested, and workshop participants agreed, that a subcommittee should be established to bring together principal investigators and statisticians to establish criteria for nonnative fish removal.

7. Should we focus removal of smallmouth bass on concentration/productive areas? Do we have enough information to know this? What are the tradeoffs? Establish "buffer zones" or predator free zones?

Workshop participants agreed that removal of smallmouth bass and northern pike should focus on areas of highest fish concentration. The tradeoffs are that some fish will be missed from not sampling certain areas, as well as areas with rapidly expanding populations. Some participants suggested that principal investigators focus on concentration areas, but also conduct periodic surveys of other areas to insure that comprehensive monitoring of the presence, and approximate distribution and abundance of nonnative fish populations.

8. Should we continue smallmouth bass mark-recapture population estimates or implement alternative methods?

Workshop participants generally agreed that greater emphasis should be placed on removal of target nonnative fish and less emphasis on experimental treatment sections and mark-recapture population estimates of nonnative species. It was recognized that a large response is desirable and measurable, and that removal should focus for 1 or 2 years followed by mark-recapture estimates using short-interval sampling occasions. In cases where numbers of target nonnative fish have been reduced to substantially diminish catch with effort, population estimates may not be necessary; lower Green River in Utah. Participants noted that periodic population estimates should not drive management objectives of reducing nonnative fish numbers. Some participants advocated development of river or subbasin-specific nonnative fish management plans because of the unique and different circumstances associated with each subbasin.

9. Should we move away from control/treatment approach to more widespread removal of smallmouth bass?

Some workshop participants expressed a desire to move away from the control/treatment approach to more widespread removal of smallmouth bass; others expressed the desire to maintain some control/treatment areas and the most reliable and precise way to assess efficacy of removal. There was no consensus to move completely away from the control/treatment approach, but there was general agreement to maintain sufficient control/treatment studies, while increasing removal efforts. This issue was not resolved, and will need to be addressed by the subcommittee identified above in issue #6.

10. Should we test pheromones as attractants for trapping NNF?

Workshop participants agreed that use of pheromones as attractants to trap large numbers of nonnative fish was a technique deserving further investigation and evaluation. It was discussed that sex hormones of certain fish species in Great Britain have been used to attract fish, and that ripe male brook trout have been held in pens in the western U.S. to attract females.

11. Should we propose to establish "native fish conservation areas" and what would this mean to management?

Workshop participants agreed that establishing "native fish conservation areas" was a good idea. Designation of these areas may need approval from respective game commissions, but such designations could help to ally the public to native fish management. Individuals from CDOW are assessing the prospect of this concept with that agency.

12. Should we design our ongoing investigations with the ability to monitor native/NNF population changes with end of low water years?

Workshop participants agreed that native and nonnative fish may respond if the annual hydrograph is dramatically changed with an increase in snow pack and a higher runoff following several years of low runoff or "drought." However, most believed that ongoing investigations should have sufficient sensitivity to detect major population changes and community shifts.

13. Should the 45 mile reach of the Yampa River from Craig to the control treatment section be included in smallmouth bass removal?

Workshop participants agreed that smallmouth bass should be removed from concentration areas of the Yampa River. The 45-mile reach from Craig downstream includes one reach of about 10 miles where removal of fish should be increased. A small group of biologists convened during the workshop to discuss the best manner to best sample this reach of the Yampa River and provide comprehensive removal of smallmouth bass. Biologists agreed to coordinate their efforts with the CDOW to insure compliance with scientific collecting permits.

5.0 RECOMMENDATIONS

The following is a list of recommendations assimilated from the workshop. These recommendations were derived from the discussions held during the 2-day workshop. They are organized by the four categories, but are not listed in any order of priority. A brief description or explanation of each is provided:

5.1 Prevention

1. Expand I&E Program to inform the public of: (1) regulations and penalties for illicit stocking and fish transport, and (2) nonnative fish stocking procedures.

2. Use isotope analysis to identify sources and origins of specific fish species in addressing specific questions about escapement.

5.2 Research

3. Conduct population estimates of target nonnative fish (e.g., smallmouth bass, northern pike) every 2-3 years following intensive removal efforts to assess effects.

4. Develop defensible metrics for assessing effects of removal on nonnative fish and for assessing response by native and endangered fishes.

5. Establish criteria for necessary levels of nonnative fish removal.

6. Develop and implement standardized protocol for handling native and endangered fish, as well as for translocating sportfish.

5.3 Mechanical

7. Focus removal efforts on concentration areas of target nonnative fish, but maintain comprehensive surveys of all river reaches to insure that sudden appearances or increases in numbers of nonnative fish are detected.

8. Use environmental cues (flows, temperature, season, and habitat availability) to target removal of and disadvantage nonnative fish, particularly on sensitive life stages.

9. Employ adaptive management to shift gears and strategies for increasing removal of nonnative fish, as necessary; e.g., shift capture strategies to capture small fish when large fish are depleted.

10. Use pisicides locally, judiciously, and where feasible to remove large concentrations of nonnative fish.

11. Develop and implement standardized protocol for fish capture methods, especially electrofishing systems, to minimize harm to native fishes.

5.4 Policy

12. Expand I&E Program to inform the public of: (1) benefits of establishing conservation areas, (2) mission of Recovery Program to proceed with water use and development, and (3) to involve representatives of angler groups in Recovery Program meetings and activities.

13. Evaluate the feasibility of establishing “native fish conservation areas” or “buffer zones” that promote maintenance of native and endangered fish populations and reduced nonnative and sportfish populations.

14. Evaluate dam operations to determine flexibility for managing flows and/or temperatures to disadvantage nonnative fish, particularly during sensitive life stages.

15. Continue to investigate all possible control methods and coordinate with other programs to insure use of most current and effective control techniques.

REFERENCES

CDOW. 2005. 2005 Fishing: Colorado regulations and property directory. CDOW, Denver, Colorado.

CDOW, UDWR, WGFD, and USFWS. 1996. Procedures for Stocking Nonnative Fish Species in the Upper Colorado River Basin. U.S.D.I. Fish and Wildlife Service, Denver, Colorado.

CDOW's Aquatic Wildlife Management Plans for the Colorado (2003), Gunnison (2003), Yampa (1998), and San Juan (2003) river basins.

Dawson, V.K., and C.S. Kolar (eds.) 2003. Integrated management techniques to control nonnative fishes. U.S. Geological Survey, La Crosse, Wisconsin.

Dowling et al. 1990. Assembling an electric seine: a technical reference. Illinois Natural History Survey.

Gabriel, O., K. Lange, E. Dahm, and T. Wendt. 2005. Von Brandt's fish catching methods of the world. Blackwell Publishing, Oxford, United Kingdom.

Hawkins, J.A., and T.P. Nesler. 1991. Nonnative fishes of the Upper Colorado River Basin: An issue paper. Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Hawkins, J., C. Walford, and T. Sorensen. 2005. Northern pike management studies in the Yampa River, Colorado,1999–2002. Final Report of Colorado State University to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Introduced Fish Section, American Fisheries Society, Bethesda, MD.

Jackson, J.A., and P.V. Badame. 2002. Centrarchid and channel catfish control in the middle and lower Green River; 1997 and 1998. Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Johnson, R.L., M. A. Simmons, C. A. McKinstry, C. S. Simmons, C. B. Cook, R. S. Brown, D. K. Tano, S. L. Thorsten, D. M. Faber, R. LeCaire, and S. Francis. 2005. Strobe light deterrent efficacy test and fish behavior determination at Grand Coulee Dam Third Powerplant Forebay. Prepared for the Bonneville Power Administration, U.S. Department of Energy under Contract DE-AC05-76RL01830

Kapuscinski, A.R., and T.J. Patronski. 2005. Genetic methods for biological control of non-native fish in the Gila River basin: Development and testing of methods, potential environmental risks, regulatory requirements, multi-stakeholder deliberation, and cost estimates. Contract report to the U.S. Fish and Wildlife Service (USFWS agreement number 201813N762). University of Minnesota, Institute for Social, Economic, and Ecological Sustainability, St. Paul, Minnesota. Minnesota Sea Grant Publication F20.

Lentsch, L.D., R.T. Muth, P.D. Thompson, B.G. Hoskins, and T.A. Crowl. 1996. Options for selective control of nonnative fishes in the Upper Colorado River Basin. Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Martinez, A. 2004. An evaluation of nonnative fish control treatments in ponds along the Colorado and Gunnison rivers, 1996–2002. Final Report of Colorado Division of Wildlife to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Martinez, A., J. Romatzke, and D. Powell. N.D. 2004. Proposed redirection of the nonnative fish control program in Colorado from pond reclamation/isolation to intensive control of nonnative fish in one area of the Colorado River that is considered a “hot spot” for centrarchids. Proposal to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Martinez, P.J., and N.P. Nibbelink. 2004. Colorado nonnative fish stocking regulation evaluation. Final Report of Colorado Division of Wildlife to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Meronek, T.G., P.M. Bouchard, E.R. Buckner, T.M. Burri, K.K. Demmerly, D.C. Hatleli, R.A. Klumb, S.H. Schmidt, and D.W. Coble. 1996. A review of fish control projects. North American Journal of Fisheries Management 16:63–74.

Modde, T., and M. Fuller. 2002. Feasibility of channel catfish reduction in the lower Yampa River. Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Nesler, T.P. 2002. Interactions between endangered fishes and introduced gamefishes in the Colorado River, Colorado, 1986–1991. Final Report of Colorado Division of Wildlife to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Osmundson, D. B. 2003. Removal of non-native centrarchids from upper Colorado River backwaters, 1999–2001: Summary of results. Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Snyder, D.E. 2003. Electrofishing and its harmful effects on fish, Information and Technology Report USGS/BRD/ITR—2003-0002: U.S. Government Printing Office, Denver, CO, 149 p.

SWCA. 2002. Nonnative fish control feasibility study to benefit June Sucker in Utah Lake. Final Report to June Sucker Recovery Implementation Program, Utah Department of Natural Resources, Salt Lake City, UT.

Trammell, M., R. Valdez, H. Johnstone, and L. Jonas. 2002. Non-native fish control in backwater habitats in the Colorado River. Final Report of SWCA to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Trammell, M., S. Meismer, and D. Speas. 2004. Nonnative cyprinid removal in the lower Green and Colorado rivers, Utah. Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Tyus, H.M., and J.F. Saunders. 1996. Nonnative fishes in the Upper Colorado River Basin and a strategic plan for their control. Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Upper Colorado River Endangered Fish Recovery Program. 2004. Nonnative fish management policy. Final Adopted by the Implementation Committee of the Recovery Program on February 4, 2004.

U.S. Department of the Interior. 2001. The 100th Meridian Initiative: A strategic approach to prevent the westward spread of zebra mussels and other aquatic nuisance species. Washington, D.C.

APPENDIX A: Workshop Attendees

Billy Atkinson ..... Colorado Division of Wildlife
Paul Badame ..... Utah Division of Wildlife Resources
Kevin Bestgen ..... Larval Fish Laboratory, Colorado State University
Bob Burdick ..... U.S. Fish and Wildlife Service
Gary Burton ..... Western Area Power Administration
Tom Chart ..... U.S. Fish and Wildlife Service
Kevin Christopherson ..... Utah Division of Wildlife Resources
Larry Crist ..... U.S. Fish and Wildlife Service
Dean Ellis ..... Colorado Division of Wildlife
Bill Elmblad ..... Colorado Division of Wildlife
Sam Finney ..... U.S. Fish and Wildlife Service
Mark Fuller ..... U.S. Fish and Wildlife Service
Kevin Gelwig ..... Wyoming Game and Fish Department
Patti Gillette ..... U.S. Fish and Wildlife Service
Patrick Goddard ..... Utah Division of Wildlife Resources
Julie Jackson ..... Utah Division of Wildlife Resources
John Hawkins ..... Larval Fish Laboratory, Colorado State University
Sherm Hebein ..... Colorado Division of Wildlife
Trina Hedrick ..... Utah Division of Wildlife Resources
Angela Kantola ..... Recovery Program, U.S. Fish and Wildlife Service
Larry Kolz ..... Independent Electrofishing Expert
Lori Martin ..... Colorado Division of Wildlife
Anita Martinez ..... Colorado Division of Wildlife
Patrick Martinez ..... Colorado Division of Wildlife
Chuck McAda ..... U.S. Fish and Wildlife Service
Bob Muth ..... Recovery Program, U.S. Fish and Wildlife Service
Pat Nelson ..... Recovery Program, U.S. Fish and Wildlife Service
Doug Osmundson ..... U.S. Fish and Wildlife Service
Al Pfister ..... U.S. Fish and Wildlife Service
Dave Speas ..... Bureau of Reclamation
Melissa Trammell ..... National Park Service
Rich Valdez ..... SWCA, Inc.
Cameron Walford ..... Larval Fish Laboratory, Colorado State University
Dana Winkleman ..... Colorado State University
Steve Yamashita ..... Colorado Division of Wildlife
Susan ? ..... Colorado Division of Wildlife
Aaron? (summer temp for Lori Martin) ..... Colorado Division of Wildlife
Guy with Blue cap next to D. Osmundson ..... U.S. Fish and Wildlife Service

APPENDIX B: Workshop Agenda

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

Nonnative Fish Management Workshop

December 12–13, 2005

Holiday Inn
755 Horizon Drive
Grand Junction, Colorado
(970) 243-6790

Nonnative Fish Management Project Leaders - Tom Nesler (Colorado Division of Wildlife), Kevin Christopherson (Utah Division of Wildlife Resources), Patrick Goddard (Utah Division of Wildlife Resources), Dave Irving (U.S. Fish and Wildlife Service), Chuck McAda (U.S. Fish and Wildlife Service), John Hawkins (Colorado State University), Kevin Bestgen (Colorado State University)

Nonnative Fish Management Coordinator - Pat Nelson (Recovery Program Director's Office)

Workshop Moderator - Tom Nesler (Colorado Division of Wildlife)
Workshop Facilitator - Rich Valdez (SWCA Environmental Consultants)
Workshop Sergeant at Arms - Pat Martinez (Colorado Division of Wildlife)
Workshop Time Keeper - Dave Speas (Bureau of Reclamation)
Workshop Recorder - Angela Kantola (Recovery Program Director's Office)

Purpose of Workshop - To review results of nonnative fish management projects and develop recommended strategies for 2006 and beyond.

Focus/Theme - "Integrated Management Techniques to Control Nonnative Fishes." Which techniques may have merit for use in the upper Colorado River basin? What are advantages/disadvantages, risks/costs/benefits for each? Are there techniques that can be eliminated from further consideration? For each PI: What factor is the most significant impediment to your ability to control nonnative fishes?

Desired Workshop Products - Recommendations for improving prevention and management of smallmouth bass and northern pike within the Upper Basin, and specific recommendations for FY 06.

Rules for Presenters - Most presentations will be limited to 10 minutes, with 5 minutes for questions and comments. When showing a slide, try to identify potential practical applications of information presented (i.e., how the information can be used to help manage targeted species).

Rules for workshop participants/audience - If you have a question or comment, raise your hand to be called upon by the workshop facilitator. During presentations, jot down any questions/comments and/or ideas/solutions for the discussion periods. If/when identifying a problem, please also try to offer realistic, workable solutions. Any comments that cannot be addressed during the workshop will be recorded for future reference.

Monday, December 12 (10:00–5:00)

10:00 am	**Introduction** (Rich Valdez) -Workshop purpose and desired outcome -Workshop structure, process, rules -Workshop participant roles/responsibilities
10:15 am	**Smallmouth Bass Summit Results** (Pat Martinez)
10:45 am	**Prevention and Management Techniques, and Examples of What the Recovery Program has Done to Date** (Pat Nelson)
11:15 am	**Smallmouth Bass Prevention** (i.e., identifying and managing sources of smallmouth bass, and preventing their invasion into critical habitat)
11:15 am	Floodplain Pond Rehabilitation (Anita Martinez)
11:30 am	Floodplain Pond Outlet Screens (Anita Martinez)
11:45 am	Evaluation of Colorado Nonnative Fish Stocking Regulations (Pat Martinez)
12:00 pm	**Lunch**
1:00 pm	Colorado River Isotope Study (Pat Martinez)
1:15 pm	Starvation Reservoir escapement study (Kevin Christopherson)
1:30 pm	Duchesne River buffer zone (Mark Fuller)

1:45 pm **Smallmouth Bass Management** (i.e., removal of smallmouth bass from critical habitat)

1:45 pm Middle Yampa River smallmouth bass and northern pike removal and translocation (John Hawkins)

2:00 pm Lower Yampa River smallmouth bass and channel catfish removal (Mark Fuller)

2:15 pm Green River smallmouth bass removal buffer zone within critical habitat (Mark Fuller)

2:30 pm Green River smallmouth bass removal (Kevin Christopherson)

2:45 pm Colorado River centrarchid removal (Bob Burdick)

3:00 pm **Break**

3:15 pm **How Many Fish Need to be Removed?** (Rich Valdez)

3:30 pm **Smallmouth Bass Group Discussion** on identification of sources and preventing invasion of smallmouth bass into critical habitat; and on management within critical habitat. Objectives: To generate a list of specific recommendations for FY 06; and general recommendations for future direction/strategy.

5:00 pm **Adjourn**

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Tuesday, December 13 (8:00–5:00)

8:00 am **Recap of Day #1 and Introduction to Day #2**

8:30 am **Northern Pike Prevention** (i.e., identifying and managing sources of northern pike, and preventing their invasion into critical habitat)

8:30 am Yampa River isotope study (Dana Winkelman)

8:45 am Yampa River northern pike tagging (98c), and Upper Yampa northern pike buffer zone (98b; Sam Finney)

9:00 am **Northern Pike Management** (i.e., removal of northern pike from critical habitat)

9:00 am Middle Yampa River northern pike removal and translocation (Lori Martin)

9:15 am Green River northern pike removal (Kevin Christopherson)

9:30 am	Northern pike in Lodore Canyon and Brown's Park (Kevin Bestgen)
9:45 am	**Break**
10:00 am	**Northern Pike Group Discussion** on identification of sources and preventing invasion of northern pike into critical habitat; and on management within critical habitat. Objectives: To generate a list of specific recommendations for FY 06; and general recommendations for future direction/overall strategy.
12:00 pm	**Lunch**
1:00 pm	**Native and endangered (and small-bodied) fish response to management and prevention efforts**
1:00 pm	Green River small-bodied (and native) fish response to nonnative fish management activities (Kevin Christopherson)
1:15 pm	Yampa River small-bodied (and native) fish response to nonnative fish management activities (Kevin Bestgen)
1:30 pm	**Species Response Group Discussion** (i.e., species response to nonnative fish management/prevention). Objectives: To identify species-response metrics as indicators of success/failure; to generate a list of specific recommendations for FY 06; and general recommendations for future direction/overall strategy.
3:30 pm	**Group Discussion** to refine/clarify specific recommendations for FY 06 (5 minutes); and general recommendations for future direction/overall strategy (55 minutes).
4:30 pm	**Adjourn**

APPENDIX C: Workshop Presentations

The Nonnative Fish Workshop was divided into two major sessions, each lasting one day. Smallmouth bass were addressed on the first day and northern pike on the second. Eleven presentations were made on prevention and management of smallmouth bass on the first day, and seven presentations were made on the prevention and management of northern pike on the second day. In addition, the results of a Smallmouth Bass Summit, held in the last week on November, 2005, were presented by the summit organizer and coordinator. A group discussion was held at the end of each day for the respective species being addressed; i.e., smallmouth bass and northern pike. The workshop was concluded with an open discussion of all issues and is presented in Section 3.0 of this report.

SMALLMOUTH BASS SESSION

1. **Smallmouth Bass Summit Results (Pat Martinez)**

2. **Prevention and Management Techniques, and Examples of What the Recovery Program has Done to Date (Pat Nelson)**

3. **Floodplain Pond Rehabilitation and Floodplain Pond Outlet Screens (Anita Martinez)**

4. **Colorado Nonnative Fish Stocking Regulations (Pat Martinez)**

5. **Electric Seines - An Effective Tool for Sampling Small Bodied Fishes at Low Flows (Cameron Walford)**

6. **Colorado River Isotope Study (Pat Martinez)**

7. **Starvation Reservoir Escapement Study (Trina Hedrick)**

8. **Duchesne River buffer zone (Sam Finney)**

9. **Middle Yampa River Smallmouth Bass and Northern Pike Removal and Translocation (John Hawkins)**

10. **Lower Yampa River Smallmouth Bass and Channel Catfish Removal (Mark Fuller)**

11. **Green River (Echo Park to Split Mountain, including Lodore and Whirlpool canyons) Smallmouth Bass Removal Buffer Zone Within Critical Habitat (Mark Fuller)**

12. **Green River smallmouth bass removal (Paul Badame)**

13. **Colorado River Centrarchid Removal (Bob Burdick)**

14. How Many Fish Need to be Removed? (Rich Valdez)

NORTHERN PIKE SESSION

1. Yampa River isotope study (Dana Winkelman)

2. Yampa River northern pike tagging (98c), and Upper Yampa northern pike buffer zone (98b; Sam Finney)

3. Middle Yampa River northern pike removal and translocation (Lori Martin)

4. Green River northern pike removal (Kevin Christopherson)

5. Northern pike in Lodore Canyon and Brown's Park (Kevin Bestgen)

6. Green River small-bodied (and native) fish response to nonnative fish management activities (Kevin Christopherson)

7. Yampa River small-bodied (and native) fish response to nonnative fish management activities (Kevin Bestgen)

APPENDIX D: Workshop Notes

UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

Nonnative Fish Management Workshop
Summary
December 12–13, 2005

Holiday Inn
755 Horizon Drive
Grand Junction, Colorado
(970) 243-6790

Nonnative Fish Management Project Leaders - Tom Nesler (Colorado Division of Wildlife), Kevin Christopherson (Utah Division of Wildlife Resources), Patrick Goddard (Utah Division of Wildlife Resources), Dave Irving (U.S. Fish and Wildlife Service), Chuck McAda (U.S. Fish and Wildlife Service), John Hawkins (Colorado State University), Kevin Bestgen (Colorado State University)

Nonnative Fish Management Coordinator - Pat Nelson (Recovery Program Director's Office)

Workshop Moderator & **Sergeant at Arms**- Pat Martinez (Colorado Division of Wildlife)
Workshop Facilitator - Rich Valdez (SWCA Environmental Consultants)
Workshop Time Keeper - Dave Speas (Bureau of Reclamation)
Workshop Recorder - Angela Kantola (Recovery Program Director's Office)

Purpose of Workshop - To review results of nonnative fish management projects and develop recommended strategies for 2006 and beyond. Focus on northern pike and smallmouth bass.

Focus/Theme - "Integrated Management Techniques to Control Nonnative Fishes." Which techniques may have merit for use in the upper Colorado River basin? What are advantages/disadvantages, risks/costs/benefits for each? Are there techniques that can be eliminated from further consideration? For each PI: What factor is the most significant impediment to your ability to control nonnative fishes?

Desired Workshop Products - Ideas for and concerns regarding improving prevention and management of smallmouth bass and northern pike within the Upper Basin, and specific recommendations for the FY 06 work plan.

Monday, December 12 (10:00–5:00)

10:00 am **Introduction** (Rich Valdez)

-Workshop purpose and desired outcome
-Workshop structure, process, rules
-Workshop participant roles/responsibilities

10:15 am **Smallmouth Bass Summit (Nov. 28-29, 2005) Results** (Pat Martinez, see handout)
- Largest males tend to produce most of the YOY.
- ~70% of critical habitat in UCRB is in Utah. SMB present in 89% of CH in Colorado, and in 36% of CH in Utah.
- SMB have exploded very quickly (escaped from Flaming Gorge, Elkhead Reservoir, Starvation Reservoir, and Rifle Gap Reservoir).
- SMB predation in Yampa exceeds 100% of small fish (exploiting ~30% of crayfish).
- Categories of control: policy, mechanical, research, prevention. Summit participants ranked policy most highly.

10:45 am **Prevention and Management Techniques, and Examples of What the Recovery Program has Done to Date** (Pat Nelson)

Prevention and management techniques
- *Institutional*
- *Physical*
- *Chemical*
- *Biological*

What the Recovery Program has done to date

Institutional

Nonnative fish stocking procedures
CO & UT nonnative fish stocking regulations
Aquatic wildlife management plans
Nonnative fish management policy
I&E and PR (*Role of I&E in nonnative fish prevention/management, see handout);*
>please submit additional ideas to Pat Nelson.

Prevention

Agreements to regulate stocking

- Nonnative Fish Stocking Procedures (Colorado, Utah, Wyoming, USFWS)
- Colorado and Utah nonnative fish stocking regulations (Pat Martinez; Kevin Christopherson)

Physical Barriers (Prevention):
- C4b Redlands and Grand Valley Project selective fish passage barriers

- C20 Highline Lake fish barrier net (~$100K every 5 years; ~$2–8K O&M per year). In compliance with nonnative fish stocking procedures. Dynema 363' wide x 19' deep, 1,400 lbs, 1/4" mesh. A new net will be installed by April 2006.

- Elkhead Reservoir outlet screens (540 cfs screened by 2006; ~1,000 cfs average peak). Spillway will be 40' higher by fall 2006. From fall 2005 through spring 2006 conservation pool will be maintained at 1,250 acre feet via pumping and releases through screened outlet. CDOW/CSU sampled Elkhead 11/1–3/05; will sample again prior to spring runoff 2006. (See handout for sampling results.)

- Elder's Pond. A 3-acre pond 1 mile downstream from 420-acre Bottle Hollow Reservoir, 0.6 miles upstream from the Uintah River. Screen 1/4"-mesh constructed in 2002 for $38K ($28K from RP). Uintah into Duchesne at Randlett gage. Goal was to stock catfish, smallmouth bass, and male northern pike captured during nonnative fish removal from the Duchesne and/or White and Green rivers. So far, crews have not caught enough fish to make transport and stocking worthwhile. Utah has put some trout in there to provide put-and-take fishing. The Ute Tribe has not done any stocking. May want to sample pond to see if any fish are in the pond that may have escaped from Bottle Hollow.

- Pariette Draw fabulous fish fountain (for draining 9,000-acre Pariette wetlands), construction completed in 1999 for ~$30K (cost-shared with BLM). Pariette wetlands dried up in 2002, resulting in a complete fish kill. Fountain has not been used since. Fish are beginning to re-invade from upstream, however, so fountain may be used in 2006 for draining the wetlands (Tim Farecloth, BLM, Vernal, UT).
- C31 northern pike spawning barriers
Hill, C.G. 2004. Dynamics of northern pike spawning and nursery habitat in the Yampa River, Colorado. Final Report of Colorado State University to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Mechanical Removal (Prevention and Management):

- Increase harvest

- Buffer zones (Yampa upstream of Craig; Duchesne; Green in Lodore and Deso/Gray; Colorado below Rifle). Purpose: To establish pike-free and bass-free zones, to prevent immigration into important nursery areas within critical habitat. If successful, then will still need to manage pike and bass within critical areas.

*- Removing **northern pike** from Yampa River (177 miles) and Green River (175 miles)*

*- Removing **smallmouth bass** from Colorado River (113 miles), Green River (175 miles), Duchesne River (40 miles), and Yampa River (63 miles); total = 391 miles.*

- Changes to State bag and possession limits to increase harvest.

Chemical (Prevention)
Toxicants:
Pond Reclamation - Anita Martinez will give presentation
Old Charlie Wash - Rotenoned in April 2000 after pike had spawned in 1999.

Biological Techniques
- Pathogens
- Pheromone bait
- Genetic bullets (triploid sterilization, transgenics) (development, approval, and implementation could require 5-15 years and $30-$50M)

Evaluation - species response
- small-bodied prey-sized fishes
- native fishes
- endangered fish

11:15 am **Smallmouth Bass Prevention** (i.e., identifying and managing sources of smallmouth bass, and preventing their invasion into critical habitat)

11:15 am Floodplain Pond Rehabilitation and Floodplain Pond Outlet Screens(Anita Martinez)

1996-2002
- Intensive I&E efforts
- Identified 729 potentional ponds on CO & GU rivers; investigated 329; 191 contained fish; 86 ponds (374 acres) received nnfc treatments (reclamation, screens, drying out, etc.)
- Paid $39,200 to access 363 SA ($108/acre) (didn't guarantee permission to control nonnative fish.

- Most common landowner misconception was that discovery of T&E fish = loss of landowner rights
- Total cost $310K ($830/acre); O&M landowner responsibility.

<u>If we wanted to reclaim all ponds in CH</u>
- Rotenone for potentially 551 ponds and ~1400 acres ~5' depth = 7,080 =~$220K
- $KMnO_4$ detoxification $234K
- Labor ~$2.2M
- Access fees for ~1/3 of landowners $67K
- TOTAL est. ~$2.7M

<u>Additional sources of nonnative fishes</u>
- ponds outside/above CH,
- ditches/washes (some in GV primarily nonnative, some primarily native fishes)
- bait buckets
- stocking,
- reproduction
- re-invasion of reclaimed ponds (at least 65%)

<u>Summary</u>: other nnfc techniques may be more cost effective and longer lasting. E.g., *promote wetlands for waterfowl (without fish); *dry out ponds annually to control mosquitoes.

Anita doing literature review on available *screens

Q: *Could other fish be made available to landowners? Possibly.

Martinez, A. 2004. An evaluation of nonnative fish control treatments in ponds along the Colorado and Gunnison rivers, 1996–2002. Final Report of Colorado Division of Wildlife to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Martinez, A., J. Romatzke, and D. Powell. N.D. Proposed redirection of the nonnative fish control program in Colorado from pond reclamation/isolation to intensive control of nonnative fish in one area of the Colorado River that is considered a "hot spot" for centrarchids. Proposal to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

11:45 am Colorado Nonnative Fish Stocking Regulations (Pat Martinez)

-*How many standing waters are there on the western slope?* 3,616 (Martinez & Nibbelink 2004/ 21,300 (CDOW-GIS 2005) *How many below 6,500'?* 1104 (M&N)/1,300 (CDOW-GIS)

-*Are there waters above 6,500' where problematic species have access to critical habitat?*

Catamount (6,900')and Statgecoach (7,000'); private ponds: unknown
Gunnison: Crawford (6,600'), Paonia?

-How many standing waters are there where we do not know fish species composition, potential for escapement, and potential for access to critical habitat?

-How many miles of streams/rivers within the basin but outside of critical habitat?
For Western Colorado only: ~18.2K mi. (362 in CH)

-Is there a way to ensure that all stocking within Colorado is reported to CDOW?
Yes: for CDOW stocking in public and private waters.
Yes: FWS trout stocking in public waters.
Yes: RIP Stocking endandered fish.
No: commercial aq stocking in private waters
- permit required for purchaser, not vendor (so can be circumvented) (*Q: Could vendors be required to check permit?)
- out-of-state sources, internet or mail order

No: Private individual stocking in private/public waters.
- illicit transplants
- private aq. releases

-Is there a way to enforce stocking regulations?
Increased publicity of need for stocking permits? Has been tried, but not everyone gets the message.
Permit required in advance of stocking above 6,500'?
Other strategies?

-What are the bag limits on pike, bass, catfish, etc., within critical habitat?
CO 2005 fishing regulations:
COR, GRR, GUR,WHR, YAR: No bag possession or size limit for channel catfish, largemouth bass, smallmouth bass, northern pike, walleye, green sunfish, bluegill, bullhead, and crappie. Are we inadvertently promoting a sportfishery?

-Can a regulation be added to prevent release of fish captured by angling?
*Campaign to dissuade & prosecute illicit stocking?
*Technology to facilitate prosecution
*Increased awareness and penalties for illicit stocking?
Other strategies?
*Yellowstone Lake example

*Perhaps incentives like Operation Game Thief or Samson Award to discourage illicit stocking

Martinez, P.J., and N.P. Nibbelink. 2004. Colorado nonnative fish stocking regulation evaluation. Final Report of Colorado Division of Wildlife to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

CDOW. 2005. 2005 Fishing: Colorado regulations and property directory. CDOW, Denver, Colorado.

CDOW, UDWR, WGFD, and USFWS. 1996. Procedures for Stocking Nonnative Fish Species in the Upper Colorado River Basin. U.S.D.I. Fish and Wildlife Service, Denver, Colorado.

CDOW's Aquatic Wildlife Management Plans for the Colorado (2003), Gunnison (2003), Yampa (1998), and San Juan (2003) river basins.

Electric Seines - *An effective tool for sampling small bodied fishes at low flows (Cameron Walford)

What is it? Two probes & a 10m floated wire with 11 droppers (alternating anodes and cathodes); powered by a compact 2,000 watt generator (AC current). Mostly copper tubing. Used out of a canoe or from shore.

How is it used? Most efficient with a crew of 5. Works best sampling upstream. Use habitat features to corner fish into backwaters, embayments, alluvial fans and eddies.

Effectiveness: most effective at low flows, depths of less than one meter , clear to low turbidity, and slow velocities. Catch rate up to 380 SMB/hour under optimal conditions. SMB recruited to this gear at 25mm.

Cost ~$1,500, parts easy to obtain, construction time ~40 hours (first one difficult, easy after you work out the bugs).

Positives: samples complex habitats, allows opportunity to shock at low flows, smaller age classes and small bodied fishes vulnerable, width of seine allows wide coverage. and entrapment, very mobile, low cost and easy-to-find parts, reliable, works in high conductivities.

Negatives: turbidity can lower catch rates and availability of habitat; requires a minimum crew of four.

Recommendations: investigate DC compatibility, ?

Dowling et al. 1990. Assembling an electric seine: a technical reference. Illinois Natural History Survey.

12:00 pm **Lunch**

1:00 pm Colorado River Isotope Study (Pat Martinez)
-*What percentage of largemouth bass were produced in the river* (71%) *versus percentage that were produced elsewhere* **(19%)** *and subsequently invaded the river?*

-Other species? Centrarchids (e.g., bluegill, green sunfish, black crappie, smallmouth bass)? Ictalurids?
-Of 368 centrarchids, 22% from ponds, 59% from river, 19% undetermined origin.
*Efforts to control LMB, GSF & BGL should focus on backwaters & beaver ponds w/ structure.
*Efforts to control centrarchid escapement from ponds should be focused below Gunnison R. confluence.*Focus exerimental control of LMB in ponds <2 parts per thousand salinity and for BCR in ponds >2 parts per thousand salinity.
More older fish had pond otolith signature: artifact of interannual variation in hydrology? Decreased river-pond connectivity during dry-drought years? Increased river-pond connectivity during wetter years?

1:15 pm Starvation Reservoir escapement study (Trina Hedrick)

Managed as a walleye, smallmouth bass and brown trout fishery. Yellow perch, Utah chub, etc. also present.

-Preliminary results of spillway escapement (species, numbers, sizes)
Walleye and smallmouth bass are escaping, though not at high rates. Outlet: mostly brown trout and mtn whitefish, a few smb and walleye.

-How much would it cost to screen the spillway and outlet?

-Species composition of escapees versus species composition in Duchesne River?

-What's the likelihood of problematic nonnatives accessing critical habitat?

-Are smallmouth bass self-sustaining in the Duchesne River? Stilling basins?

-Can walleye and yellow perch persist in river environments (i.e., Duchesne and Green rivers)?

-No bass, perch, sunfish, or walleye were captured in the Strawberry River in 2002. Do you think they move down the Duchesne and into the Green?

-How many reservoirs are in the Green River basin? Species composition of each? Potential for escapement? Access to Green River?

-How many tributaries in the Green River basin? Species composition of each?

*Screening may not be most beneficial use of Program funds. Riverine populations of smallmouth bass and potentially brown trout would have to be addressed simultaneously?

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1:30 pm Duchesne River buffer zone (Sam Finney)

-A total of six miles of river were sampled during each pass; a total of 18 miles (of 41-mile reach) were sampled during the 3-pass study (11.47 hours electrofishing). Was each reach different during the three passes?

-Species composition in Duchesne River?
-Any walleye, yellow perch, largemouth bass captured over the years?

-Number of targeted species captured, by pass? Length/frequency, by pass? Versus 2004?

-Are bass and catfish self-sustaining in the Duchesne? Or are they moving in from upstream?

-Critical habitat for razorback sucker from river mile 0–2.5. Most of reach a buffer zone.

-Any recaptures of tagged fishes from outside of reach?

-Any obvious concentration areas?

-Any recommendations for improving both total catch and catch rate?

-Need to compare 2005 results with previous years results.

-No mark/recapture; no population estimates.

Smb catch rates higher at lower flows
more smb in upstream reaches
smb catch rates were very low
cc catch rates were low
abundant carb and whit sucker
7.3% native composition

*Recommendation: major reevaluation of project in order (in light of very low catch rates).
Electric seine
Regular seine? Hoop nets? Fyke nets?
Compare 2005 & 2006 results.

Mark Fuller - nonnative populations may be building. Larry Crist - may become more impt. source of nonnative fishes with more stable base flows. Are techniques comparable to what Modde did a few years ago (when native fish dominated)?

1:45 pm **Smallmouth Bass Management** (i.e., removal of smallmouth bass from critical habitat)

For all fish removal projects, each presentation needs to address:
-Population estimate (2005 vs 2004), if possible
-Number marked and number recaptured for each pass
-Number caught during each pass, and total caught for all passes (2005 vs 2004)
-Catch rate during each pass
-Obvious concentration areas, if present and identifiable (spawning areas, nursery areas)
-Length/frequency for each pass (2005 vs 2004) and for all passes combined (2005 vs 2004)
-Recaps from outside reach (from where?) (2004 vs 2005)
-Recommendations for improving both total catch and catch rate
-For each slide, what is the practical application (i.e., How can we use info to improve catch)?

1:45 pm Middle Yampa River smallmouth bass and northern pike removal and translocation (John Hawkins)

-To what degree has immigration of smallmouth bass and northern pike into your reach from outside sources hampered your ability to reduce their abundance (i.e., percent that reproduce and recruit within the reach versus percent that move into the reach from other areas)?

Need to determine if est. is accurate, how fish are moving, diffc. among years.
Come back to capture probabilities.

Hawkins, J., C. Walford, and T. Sorensen. 2005. Northern pike management studies in the Yampa River, Colorado,1999–2002. Final Report of Colorado State University to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

2:00 pm Lower Yampa River smallmouth bass and channel catfish removal (Mark Fuller)

Highest smb depletion 14% (2004) May have depleted larger bass in 2005. Some fish may be being displaced downstream with flow.

High smb production in years with: spring peak flows <10,000 cfs; temps reached 55 F by May; runoff and warming were gradual into late aug & sept; summer flows stayed above 20 cfs.

-9 yellow-tagged bass captured between June 13–30 (from Hawkins' reach; none from Elkhead).

-Any obvious concentration areas, or are they everywhere?

-Any observed spawning or nursery sites?

*Alternative methods: temperature, flows, biological/chemial.

Modde, T., and M. Fuller. 2002. Feasibility of channel catfish reduction in the lower Yampa River. Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

2:15 pm Green River (Echo Park to Split Mountain, including Lodore and Whirlpool canyons) smallmouth bass removal buffer zone within critical habitat (Mark Fuller)

Highest smb depletion 30.5% (2004)

-RM 318–345

-8 yellow-tagged bass captured in August (from Hawkins' reach). Any from Elkhead?

-Any concentration areas? Spawning areas?

*Recommendations
Define success
Apply effort to highest priority sites
Define environmental requirements for a successful growing season and key on removing age 0-1 the following fall & spring
Interrupt nesting & renesting by staggering flows
Continue to explore and use a comb of approaches
Explore biological and chemical control options (e.g., chemical sterilization)
Chemically sterilized fish still exhibit spawning behavior

2:30 pm Green River smallmouth bass removal (Paul Badame)
Total captures & CPUE declined from 2004

-RM 168–318

-Any idea why RM 307 to RM 315 is a concentration area? Any nearby bass sources?

-No tagged bass from other reaches captured in this area (downstream from Split Mountain).

-No recaptures of tagged bass; therefore, population estimate not possible.

-Streamer tags and flag tags don't seem to work very well.

-Any thoughts on why bass are only found in the upper 55 miles of Desolation Canyon?

Unknown.
-*Why does RM 210 to 215 seem to be a concentration area for bass?*
Better flow, woody debris.

-*I like Badame's % frequency by river mile bar graph. How should it be interpreted?*

More passes for significant reduction.

Jackson, J.A., and P.V. Badame. 2002. Centrarchid and channel catfish control in the middle and lower Green River; 1997 and 1998. Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

2:45 pm Colorado River centrarchid removal (Bob Burdick)
CPUE & total numbers up from 2004 (except for lower Gunnison R.)
Very high concentrations up around Rifle, esp. where Pioneer Irrig. Ditch dumps out. (?)
*Need to investigate possibility of smallmouth bass escapement from Rifle Gap Reservoir

-*No mark/recapture; therefore, no population estimates.*

-*Best way(s) to determine sources of centrarchids (i.e., produced in river or coming in from ponds/reservoirs and/or upstream reaches)?*

-*Control over flow regime limited.*

Osmundson, D. B. 2003. Removal of non-native centrarchids from upper Colorado River backwaters, 1999–2001: Summary of results. Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Trammell, M., R. Valdez, H. Johnstone, and L. Jonas. 2002. Non-native fish control in backwater habitats in the Colorado River. Final Report of SWCA to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Trammell, M., S. Meismer, and D. Speas. 2004. Nonnative cyprinid removal in the lower Green and Colorado rivers, Utah. Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

3:00 pm **Break**

3:15 pm **How Many Fish Need to be Removed?** (Rich Valdez)

Metrics
nna fish removed
reduction in CPUE, fish size
evidence of repro; YOY, etc
target #/mile
"Break the back of the population," i.e., nullify recruitment
increased # of native fishes (ultimate effect we're looking for)

Stock recruitment curve (rel. of the parents [all the mature fish]) to single cohort which is the recruitable size fish). How many recruits are needed to replace and sustain the population? We want to drive population down so mortality exceeds replacement. However, can needed decrease be reached in light of diminishing returns?

See handout for references.

3:30 pm **Smallmouth Bass Group Discussion** on identification of sources and preventing invasion of smallmouth bass into critical habitat; and on management within critical habitat. Objectives: To generate a list of specific recommendations for FY 06; and general recommendations for future direction/strategy.

See smallmouth ideas.wpd

Potential solutions that may have merit for adding to Integrated Nonnative Fish Prevention and Management Approach

-Flow fluctuations during egg stage of bass spawning (Green River)?
-Fishing regulations: Make it illegal to release smallmouth bass and northern pike?
-Low flow electrofishing rigs (Mark Fuller)
-Electric seines (John Hawkins and Kevin Bestgen)
-Aerial photos (Yampa River) to identify potential source habitats and expand removal coverage?
-Fish at dawn, dusk, night?
-Spot treatment of concentration areas with rotenone?
-Remove northern pike on first pass (i.e., no population estimate)?
-Remove smallmouth bass on first pass (i.e., no population estimate)?
-Radio-tag smallmouth bass and northern pike to describe seasonal movement, possibly identify spawning concentrations or other concentration areas?
-Use FG releases in Jul/Aug to flush young bass <1" from Lodore/Whirlpool and young pike from Brown's Park?
-Need to compile lake management plans, stocking histories, and species composition and relative abundance for all reservoirs within the Colorado River sub-basin.
-Translocate pike to Loudy-Simpson as soon as flow projections predict YSWA connection?
-Other?

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5:00 pm **Adjourn**

Tuesday, December 13 (8:00–4:30)

8:00 am **Recap of Day #1 and Introduction to Day #2**

1. Continue to work w/ isotopes? Is ongoing work adequate (e.g. Rifle Gap)? Yes, helps answer specific question (e.g., is their escapement from Rifle Gap)? Tells where they came from (but can't say if that's a problem). Not useful to determine illicit stocking as long as penalties are minimal. Not useful if relative contribution of riverine population is high (e.g., 90%), but this varies from year to year. So, yes, to answer a specific question.

2. Investigate operations of Rifle, Starvation, Flaming Gorge, Elkhead, McPhee as a strategy to prevent/minimize escapement? Isotope work could indicate sources and feed into changed operational strategies. Definite opportunity to minimize escapement (take water earlier, if that would fit with water demands). Manage flows to impact nnf populations downstream - flow recommendations technical work group needs to begin discussing. Need to understand more about smb ecology: if can determine spawning window, minor change in hydrograph could significantly impact nesting.

3. Direct I&E committee to reexamine and possibly expand program to provide information to public? E.g., illicit stocking, contacts with private pond owners, stocking ponds consistent with nnf stocking policy. Many people are unaware of the regulations. Differences between CO and UT need to be recognized. CO has put announcements in newspapers to alert landowners re stocking regulations; included phone number for who to contact to CDOW. Need consistent message delivered by all Program partners that SMB are the key problem. NNF policy. Include aquaculturists and try to get them to support our efforts (note: regulated by agriculture, not DOW). Need to send a positive message, not just tell folks what they can't do. E.g., emphasize increased trout in Yampa when we have data to show that. Emphasize that recovery benefits water use/development, may have to tradeoff some sportfisheries to get there.

4. Investigate smb in White River below Kenney and implement immediate smb removal? Possibly report on presence/absence/abundance during CPM pop estimates. Yes, however, shocking for CPM est. is usually done faster, rather than slow removal shocking. Elmblad thinks need to check Kenney Reservoir again. CDOW plans spring sampling for Kenney. >CDOW (Sherm Hebein), please

coordinate with Mark Fuller and let him know what they find. CPM pop. est. is done on the whole river. Group recommends removing any and all SMB captured as part of CPM pop. est.; >CDOW needs to discuss.

5. Shift effort/gear to target certain life stages (e.g., large adults on nesting areas, smaller fish as see shift in size after initial removal)? E.g., incorporate electric seine, where appropriate. Seems to be good adaptive management (if large fish disappearing and small fish persisting). There's considerable biological basis for shifting efforts to large bass. Small fish are the most sensitive life stage, perhaps we should let natural mortality target this. On Yampa, can't target large fish during the low-flow periods. Need to identify triggers that would shift our target from one life stage to another. Temperature should be a trigger: early warm temperatures will result in long growing season, thus a need to target small fish. Perhaps everyone should be equipped with electric seines to be prepared to target small fishes, if needed. However, reducing earlier passes to include later sampling for small fishes would be a significant change to a scope of work. Needs to be clearly identified in permit. Could permit address a range of conditions? CDOW would prefer to have more specific permit and amend as needed. Need to identify institutional contraints (gear, personnel, permits). Need to standardize electrofishing boats to keep power output (power transfer) the same. >Hold clinic early this year (maybe even at researcher's meeting), enlist Larry Kolz or someone like that to lead. Recent literature also addresses how to optimize boats to protect fish. >Also need to develop a fish-handling protocol (e.g., temperature threshold for moving fish, tank volume per numbers of fish, oxygen flow rate, etc.). SMB very susceptible to handling stress (particularly hypoxia). Dave Ward developed a fish-handling protocol for Grand Canyon. >Pat Nelson, Pat Martinez and Tom Czapla will work together to develop plan for clinic and protocol. (Pat Martinez handed out articles; Larry Kolz stopped by and described course. Re-writing the chapter in the Fisheries Techniques manual; out in about a year.)

6. How do we establish criteria for levels of nna removal? (Discuss later)

7. Focus smb removal on concentration/productive areas? Do we have enough information? What are tradeoffs? Establish predator-free buffer zones? Yes, focus on concentration areas (tradeoff is that some fish will be missed, also could miss where fish are exploding). Don't sample areas where few or no fish found year after year.

8. Continue smb mark-recapture population estimates or implement alternative methods (e.g., target large bass nesting areas)? Where is this feasible and what are tradeoffs? What other metrics could we employ to assess depletion and species response? If could focus only on concentration areas for one year, could really help. Perhaps an estimate only every other year? Need a large response, so perhaps focus for a year or two on removal, then do mark-recapture to see if

we've had an effect. Or measure relative abundance (native to nonnative fish). Consider just doing removal (no estimate) on lower Green River; continue mark-recapture on Yampa. Perhaps develop river-specific control plans, since each river is different (this would be broader than just whether to continue pop. ests.; consider other control methods, etc.). Depletion approach could be considered (e.g., exhaustive tandem electrofishing) (Kevin B. said this won't work since we can't remove 30-50% of the fish per pass.) BC should consider. May need subcommittee of investigators and a statistician. Keep in mind need for periodic pop. ests., but don't let that drive the management objective of reducing nnf numbers.

9. Should we move away from control/treatment to more widespread smb removal? Depends on the river reach.

10. Test pheremones as attractants for trapping nonnative fish? >Determine legality and mechanism of using this (developed in Britain, available on internet). Mike Young (Rocky Mtn. Forest Exper. Station) apparently used it. Chelated rotenone-laced bait also being used on carp (affects only the fish that eat it).

11. Propose to establish native fish conservation areas and what would this mean to management?

12. Design ongoing investigations with ability to monitor native/nnf pop changnes with end of low water years? Are we prepared to address fish response to high flows? Difficult to significantly change crews and timing, but need to monitory flows and be prepared to make possible adjustments as needed.

13. Should the 45-mile reach of the Yampa from Craig to the control treatment section be included in smb removal?

8:30 am **Northern Pike Prevention** (i.e., identifying and managing sources of northern pike, and preventing their invasion into critical habitat)

8:30 am Yampa River isotope study (Dana Winkelman)

-Status update on what has been accomplished to date versus what remains to be done.

8:45 am Yampa River northern pike tagging (98c), and Upper Yampa northern pike buffer zone (98b; Sam Finney)

-How many northern pike have been tagged in the Yampa above Hayden (303 in 2005; ? In 2004)?
-How many tagged pike have been recaptured in critical habitat? 1in 2005? In 2004?
-Two pike tagged in this reach were recaptured in Lodore Canyon (125 miles downstream).

98c: ‘04 N=616, ‘05 N=722; 1 fish moved into CH, 24 moved into Hayden to Craig reach.
98b (Hayden to Craig): ‘04 ~5% of fish caught were juv.; 05 almost 30% juv (most from one backwater). Evidence of Elkhead escapement (drop in number of fish caught between 04 and 05 above Elkhead, same or increase between 04 and 05 below Elkhead.
‘05 Adult N=1748 (wide conf. intervals); 813 adults plus 284 juveniles removed.
*Recs 98c: remove NP from Steamboat area to mitigate for Elkhead impacts; continue to collect and monitor 98c fish in downstream reaches.
*Recs 98b: continue as in ‘05, 7 passes; compile and anal movement data for all NP in the Yampa.

Only 34 smb encountered in ‘05 (11 from Elkhead); 322 crappie; 422 bluegill, 1 LMB, 4 green sunfish, 3 bullheads.
137 mountain whitefish counted on passes 6 & 7.

What changed when Elkhead net failed? Started downstream near Elkhead instead of further up, 2 passes, then switched to concentration passes with emphasis below Elkhead. Consider spot rotenone treatment in the backwater concentration area.

9:00 am **Northern Pike Management** (i.e., removal of northern pike from critical habitat)

9:00 am Middle Yampa River northern pike removal and translocation (Lori Martin)

‘05 526 caught, 410 removed. 57% of pike handled on first pass not handled again (on up to 8 subsequent passes in certain reaches).
‘04 est. 974; ‘05 est. 701 (sampling effort almost identical).
Would like to increase CPUE
Fish moved great distances; 93% moved downstream.
#’s decreased from 04 to 05; pop est. declined. Mean tL increased in a downstream direction

*Recs: continue removal; explore depletion estimator rather than mark-recapture (as well as other potential metrics), ...

Need to use Chuck McAda’s database to ?

9:15 am Green River northern pike removal (Kevin Christopherson)
-No mark/recapture; therefore, no population estimate.
-No sampling passes; known concentration areas were targeted.
-Why collect cleithra for age analyses? Why collect/analyze stomach samples? How much of the $30.9K is used for these collections and analyses? How will the data help us manage pike?

Yr	# fish removed
96	52
97	48
98	92
99	202
01	248
02	42
03	22
04	27
05	37 (25 caught o northern pike control trips)

Difficult to "break the back" of the population. If one pair spawns, we have a problem. *Therefore, don't believe we can ever quit removing northern pike (Old Charlie Wash example).

Few crappie and bluegill seen in river, but numerous in the floodplain.

Is Stewart Lake a threat (a la the Old Charlie Wash example)? All middle Green floodplain sites bear this risk.

9:30 am Northern pike in Lodore Canyon and Brown's Park (Kevin Bestgen)

-Any ideas where they came from?

Predator fish abundance in Lodore '02-'05.
NP #'s increased; 10 in Brown's Park for the first time in '05. Are FG operations creating habitat? What is their provenance?
recently established and expanding smb pop (lower # in '05); expanding upstream
Channel cat established
Brown trout the most abundant predacious fish (did not remove).
Drift net captures may offer good control technique
Found evidence of SMB predation on stocked bonytail in '04 & '05.
*Recs: continue to remove predator fishes; continue to monitor fish community response, including predators, to fish removal and flow and temp. mgmt.

Given the very few brown trout anglers in Lodore Canyon, should we consider removing brown trout?

Considerable white sucker hybrids in Lodore, so high potential to affect razorbacks.

11:30 am **Lunch**

1:00 pm **Native and endangered (and small-bodied) fish response to management and prevention efforts**

1:00 pm Green River small-bodied (and native) fish response to nonnative fish management activities (Kevin Christopherson)

-To the extent data have been analyzed, abundance estimates for all species of small-bodied fishes, and size structure of native and endangered fishes.

Developing a baseline.
Tacked onto CPM YOY backwater sampling.
Good number of native fishes. Many red and sand shiners, but other nonnatives in fairly low numbers.

1:15 pm Yampa River small-bodied (and native) fish response to nonnative fish management activities (Kevin Bestgen)

-To the extent data have been analyzed, comparisons between treatment and control, spring versus fall, and 2005 versus 2004, of size structure, abundance (or density) estimates (for all species, including nonnative fish predators).
-Any ideas on best metrics for declaring success or failure of nonnative fish management?

Used electric seine exclusively this year.
Substantial treatment effect on in '04 & '05 on smallmouth bass (though still abundand).
Didn't detect native fish response to smallmouth bass reduction (very low numbers of native fish overall), but other small-bodied (nonnative) fish responded
More native fish captured in one isolated pool. May indicate a substantial mainstem predation effict.
Few large-bodied native fishes remain; perhaps insufficient to repopulate study area.
*Continue '05 sampling regime in '06.

1:30 pm **Northern Pike Group Discussion** on identification of sources and preventing invasion of northern pike into critical habitat; and on management within critical habitat. Objectives: To generate a list of specific recommendations for FY 06; and general recommendations for future direction/overall strategy.

Upstream removal on Yampa? Probably don't need another populations estimate. Perhaps expand/continue pike sources investigations (reservoirs).

Species Response Group Discussion (i.e., species response to nonnative fish management/prevention). Objectives: To identify species-response metrics as indicators of success/failure; to generate a list of specific recommendations for FY 06; and general recommendations for future direction/overall strategy.

3:30 pm **Group Discussion** to refine/clarify specific recommendations for FY 06 (5 minutes); and general recommendations for future direction/overall strategy (55 minutes).

4:30 pm **Adjourn**

Attachment 1

Bibliography (defining the problems and identifying potential solutions)

Dawson, V.K., and C.S. Kolar (eds.) 2003. Integrated management techniques to control nonnative fishes. U.S. Geological Survey, La Crosse, Wisconsin.

Gabriel, O., K. Lange, E. Dahm, and T. Wendt. 2005. Von Brandt's fish catching methods of the world. Blackwell Publishing, Oxford, United Kingdom.

Hawkins, J.A., and T.P. Nesler. 1991. Nonnative fishes of the upper Colorado River basin: An issue paper. Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Introduced Fish Section, American Fisheries Society, Bethesda, MD.

Lentsch, L.D., R.T. Muth, P.D. Thompson, B.G. Hoskins, and T.A. Crowl. 1996. Options for selective control of nonnative fishes in the upper Colorado River basin. Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Meronek, T.G., P.M. Bouchard, E.R. Buckner, T.M. Burri, K.K. Demmerly, D.C. Hatleli, R.A. Klumb, S.H. Schmidt, and D.W. Coble. 1996. A review of fish control projects. North American Journal of Fisheries Management 16:63–74.

Nesler, T.P. 2002. Interactions between endangered fishes and introduced gamefishes in the Colorado River, Colorado, 1986–1991. Final Report of Colorado Division of Wildlife to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

SWCA, Inc. 2002. Nonnative fish control feasibility study to benefit June Sucker in Utah Lake. SWCA, Inc., Environmental Consultants, Salt Lake City, Utah.

Tyus, H.M., and J.F. Saunders. 1996. Nonnative fishes in the upper Colorado River basin and a strategic plan for their control. Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Upper Colorado River Endangered Fish Recovery Program. 2004. Nonnative fish management policy. Final Adopted by the Implementation Committee of the Recovery Program on February 4, 2004.

Attachment 2

Prevention and Management Techniques

Physical

Manage Flows:
+High flows may flush bass fry from nests, reduce water temperature and delaying spawning, increase turbidity less favorable to bass (sight feeders).
-Floodplain landowners have become dependant upon flood prevention, water and power users will lose water and power, tail-water trout fishermen will oppose, mosquitos, weeds

Flow fluctuations:
+Flood/dewater northern pike and smallmouth bass nests.
Differential effects on native versus nonnative species unknown.
Stage fluctuations dampened as function of distance downstream from dam.

Manage Temperature:
Realistically can only be manipulated via flow releases and expensive TCD. See Flows.

Manage Turbidity:
Realistically can only be manipulated via flow releases. See Flows.

Install Barriers:

In mainstem:
Selective upstream passage (e.g., Redlands, GVP)
Selective downstream passage may be unrealistic.

For floodplain and backwater nursery habitats:
Has been attempted in the lower Green River, upper Yampa River.
High cost, labor-intensive O&M.
May prevent recovery of razorback sucker, possibly bonytail.
May as well use predator-free grow-out ponds or hatchery ponds/tanks.

For reservoirs, floodplain ponds, gravel pits, irrigation canals/ditches, off-channel habitats, reservoirs:
Expensive to buy and install.
High cost, labor-intensive O&M.

Control/Prevent Stocking:
-NNF Stocking Procedures. Monitoring and enforcement could be improved.

Increase Harvest:

Commercial fishing:
-Targeted overharvest
-Would need to identify/create a market.
-Would be difficult to use typical commercial gear types in Upper Basin rivers (rocky substrate, debris, root wads, trees, etc.).
-Would be difficult to avoid/prevent native and endangered fish by-catch/mortality.
Are their any commercial fisheries in rivers like those in the Upper Basin? Any in the west?

Bounties:
-May create/promote/draw attention to fisheries that don't currently exist.
-May create dependancy among anglers.
-Little control over harvest/handling. Native fish mortality may result.
-How to determine where fish were captured (e.g., from Elkhead)?

Fishing derbies:
-May create/promote/draw attention to fisheries that don't currently exist.
-May create dependancy/demand among anglers.
-Little control over harvest/handling. Native fish mortality may result.

-Fishing contests/lottery
Implant bass/pike with Grand Prize tag: Must cut open fish to determine if winner.

Fishing pressure:
-Bag limits already removed.
-Add regulation making it illegal to release captured fish?

Mechanical Removal:
-Electrofishing
-Nets
-Angling

Chemical

Toxicants:
Would kill everything, including native and endangered fishes.
Cannot be 100 percent effective.
Re-invasion rates (would re-invade over time)?
Would need to remove natives and hold in refugia, then re-stock after treatment.
Would stir up a lot of controversy, press coverage.
Cost would likely be several million dollars.
Critical Habitat (Gunnison 52 miles; Colorado 241 + 47; Green 343; Yampa 141; White 122) = 946 miles.
729 floodplain ponds (Rifle RM 241 to State Line RM 132 and Austin RM 60 to Colorado River RM 0; A. Martinez 2004). Cannot access, sample, and/or poison ponds without landowner permission.
3,616 standing waters in Colorado west of Continental Divide; 1,104 below 6,500' elevation (P. Martinez 2004).
72 ponds along the Yampa River thought to be potential sources of northern pike (Hill 2004). Cannot access, sample, and/or poison ponds without landowner permission.
May/may not be able to develop species-specific toxicants.
"The so called 'silver bullet' of selective piscicides does not presently exist for nuisance nonnative fishes in the southwestern United States, and the prospects for the development of such a tool are limited" (Dawson and Kolar 2003). "It is estimated that development and registration of a new toxicant would require 8 to 10 years and cost $35 to $50 million" (American Crop Protection Association 2001).
To develop/register new toxicant: ~8–10 years and ~$35–50M.
Spot treatments of concentration areas, obvious sources? ID concentration areas/sources.

Chemical sterilization:
Adult male sea lampreys sterilized and released to compete with fertile males during spawning (bisazir, radiation).

Water quality:
Difficult, maybe impossible to manipulate to favor native and endangered fishes.

Pheromones (attractants and repellants):
May have merit.
Regulations on release?
Time/cost to develop/isolate?

Biological

Pathogens/viruses:
-Must be species specific. May take years to identify, isolate, and or develop. Costly. Risky.
-Subject to regulations before they can be released into the environment.

Parasites:
-Examples: bass tapeworm; CCAT virus
-Subject to regulations before they can be released into the environment.

Genetic bullets:
-Includes fatality and sterility genes, immuno-contraceptive agents, chromosomal manipulations, gynogenesis, transgenics.
-Would take years to develop. Costly. Risky.
-Regulations on release?

Attachment 3

Recommendations from FY 05 Nonnative Fish Management Annual Reports

Prevention (i.e., identifying and managing sources of smallmouth bass, and preventing their invasion into critical habitat)

Project #C-18/19: Isotope study to determine centrarchid origin in Colorado River

-Complete and submit draft manuscript, Whitledge, G. W., B. M. Johnson, P. J. Martinez, and A. Martinez. Provenance of non-native fishes in the upper Colorado River revealed by stable isotope and microchemical analyses of otoliths, for peer-review publication.
-Efforts to control abundance of centrarchids (except black crappie and smallmouth bass) in critical habitat for native threatened and endangered fishes should emphasize backwaters and beaver ponds that contain abundant structure irrespective of presence or absence of direct tributaries rather than focusing on those with inflowing washes or ditches.
-Any efforts to control centrarchid escapement from ponds to the Colorado River should focus on the reach below the Gunnison River confluence, although such actions should be secondary to management activities in riverine habitats given that the majority of centrarchids examined in this study exhibited riverine otolith core dD signatures.
-If additional control measures were deemed necessary to control movement of largemouth bass from ponds, such efforts could be applied on ponds with a salinity < 1.8 o/oo, thus narrowing the number of candidate ponds for treatment.
-Management of black crappie abundance, in particular, within critical habitat would require an emphasis on restricting escapement from ponds; however, black crappie are the least numerous of the five centrarchids present in our study area.
-Although results of this project indicate that centrarchid control efforts in the upper Colorado River should focus on riverine habitats when hydrologic conditions are similar to those during this study, reevaluation of relative proportions of riverine-dwelling centrarchids with pond and riverine otolith core signatures is recommended during and immediately following years of above average precipitation and river discharge. Such a follow-up study would be useful for assessing whether management of centrarchid abundance in critical habitat should always be focused within riverine habitats themselves or if additional emphasis should be placed on controlling centrarchid escapement from ponds to curtail immigration to riverine habitats during high-water years.

Project #119: Evaluation of Nonnative Fish Escapement from Starvation Reservoir

-Continue project as identified in approved scope of work.

Project #124: Nonnative fish removal in the Duchesne River (buffer zone upstream from critical habitat)

-Continue nonnative removal efforts of channel catfish and smallmouth bass in the Duchesne River in 2006 for comparison to 2005 results.
-Reevaluate necessity or value of nonnative fish removal from the Duchesne River after 2006.

Project #98c: Upper Yampa River northern pike tagging (upstream from Hayden)

-Continue to follow movement of fish marked in previous years
-Mitigate for impacts associated with the escapement of pike from Elkhead by removing pike from the public land areas of the study reach.

Project #98b: Upper Yampa River northern pike translocation (Craig to Hayden)

-Collect angler tag returns 3 times a week.
-Continue with 7 passes.
-Continue monitoring the native fish community.
-Compile and analyze movement data from all Yampa River northern pike in order to more accurately determine seasonal and size dependent movement in the entire river system.

Management (i.e., removal of targeted species from critical habitat)

Project #110: Development of a smallmouth bass and channel catfish control program in the lower Yampa River (Yampa Canyon).

-We recommend that removal efforts of smallmouth bass and channel catfish from the Yampa River in DNM be continued.
-Because electrofishing continues to be the best known sampling method, we recommend it's continuance which would include low water level shocking techniques i.e. catarafts and electric seines.
-We recommend collecting and processing all fish in several one-mile reaches to determine fish composition and the native fish response to mechanical removal.

Project #123: Smallmouth bass control in the middle Green River

-Based on the tag retention study, we recommend that the larger Floy-tags used in the upper reach be used to tag smallmouth bass and that streamer type tags be avoided.
-To improve total catch and catch rate of smallmouth bass, more time should be spent in the areas the fish concentrate. In general, the smallmouth seems to be found most in rocky and brushy areas. Electrofishing in areas and habitats of known concentration and skipping over sandy stretches would improve the catch rate and the total catch.
-Evaluate additional capture techniques (e.g., electric seining) in appropriate habitats.
-Continue to evaluate removal of smallmouth bass in the Green River using annual mark-recapture estimates.

Project #109: Green River northern pike removal

-Continue with northern pike control in the middle Green River.
-Continue age analysis using cleithra to track potential changes in the composition of the middle Green River northern pike population.
-Continue collection of data on other sympatric species encountered while conducting removal efforts.

Project #126: Colorado River centrarchid removal

-Continue to collect and lethally remove all centrarchids from the Colorado and Gunnison rivers during all station sampling studies which includes sampling on the Colorado and Gunnison rivers during 2006.
-Suspend all electrofishing operations when it is determined that Colorado pikeminnow show signs of preparing to spawn, e.g., mid- to late-June. Electrofishing will be suspended during this period to eliminate the likelihood of harassment, interference, and injury to spawning Colorado pikeminnow.
-Electrofishing should commence following cessation of spawning of Colorado pikeminnow which should be sometime in mid- to late-July.
-Increase the number of electrofishing passes in river segments that have higher concentrations of smallmouth bass, if possible, in 2006. This should maximize catches of centrarchids fishes while at the same time minimizing harassment and negative impacts to native fishes in reaches where centrarchid abundance is low. Concomitantly, decrease electrofishing effort in river reaches of low smallmouth bass densities.
-Target specific in-river features that provide habitat for centrarchid fishes. These include but are not limited to beaver lodges, tree stumps and logs, rock piles, and concrete rip-rap. Sampling these features with electrofishing may increase catches of centrarchid fishes.
-Continue sampling the Upper Colorado reaches from the Rifle Bridge to Beavertail Mountain in Debeque Canyon. This is necessary to 1) build upon the existing fishery community database and monitor abundance of nonnative centrarchid fishes in these reaches which is within critical habitat for Colorado pikeminnow and razorback sucker, and 2) particularly determine if smallmouth bass continue to proliferate in the river reach

from Rifle to Rulison. Include fish sampling the Colorado River in Garfield County upstream through designated critical habitat to the bridge at Rifle, Colorado, in the 2006 Colorado scientific collection permit.
-Investigate the possibility of smallmouth bass escapement from Rifle Gap Reservoir into the Colorado River.

Species Response (i.e., response of small-bodied, native, and endangered fishes to nonnative fish prevention and management activities)

Project #140: Yampa River species response

-Test additional gear types (e.g., electric seine) to increase sampling efficiency.
-Continue emphasis on small-bodied fishes because this is where we expect most of the fish response to occur, if any.
-Plan some sampling for large-bodied species to assess predator removal effects since springtime removals and to ensure that native fishes for which a response is being estimated, still occur in the study reach.
-Continue additional smallmouth bass removal from the treatment reach.