1.) "Observations on the effectiveness and maintenance of the Highline Lake fish barrier net."

Patrick J. Martinez[1] and Chris Foreman[2]
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ABSTRACT—A 363 foot wide x 19 foot deep x 0.25 inch aperture spillway barrier net fabricated of Dynema was installed in Highline Lake in August 1999 to control escapement of juvenile and adult nonnative fish. The net's placement met the screening requirement in the Procedures for Stocking Nonnative Fish Species in the Upper Colorado River Basin and allowed the stocking of bluegill and largemouth bass into Highline Lake in 1999 and 2000. Fish sampling and marking was performed in Highline Lake to evaluate fish escapement from the reservoir and downstream movement of nonnative fish toward the Colorado River. Fish were captured in June of both 1999 (1,091 fish=100% nonnative) and 2000 (1,420=99% nonnative), measured for total length, weighed and given a right pelvic fin clip (except trout) to denote their origin in the reservoir. Largemouth bass stocked into the reservoir in September of 1999 (7000 @ 4.2 in.) and 2000 (7000 @ 4.0 in.) were also marked with right pelvic fin clips. Monitoring of the net's performance included observations on 1) maintaining a seal between the net's bottom skirt and the lake bottom, 2) sand and gravel being wave-washed onto the net nearshore, and 3) the net's main float-line submerging during a period of high flow through the reservoir. Aspects of the net's maintenance discussed include 1) estimated vs. actual expenditures for inspections and cleaning in 2000, 2) the decision to leave the net in place over-winter vs. removing it, and 3) correcting the tendency for the net's top-skirt to sag and adjoin the net's main float line. Electrofishing was conducted at three sites, in Mack Wash below Highline Lake's dam, in Mack Wash near Root's Reservoir, and near Salt Creek's confluence with the Colorado River, in 1999 (July- November) and 2000 (May-November) to evaluate the net's effectiveness in controlling fish escapement from the reservoir. Following the net's installation, few marked fish were captured downstream of the reservoir in 1999 (4 of 714 = 0.5%) or 2000 (8 of 1565 = 0.5%). The number of largemouth bass captured in the reservoir nearly doubled from 1999 to 2000 (69 to 120) while the number of bass captured below the dam in 2000 was about half those captured in 1999 (230 to 127). The low number of marked fish captured below the dam, particularly stocked largemouth bass (3 @120-130 mm in 1999 and 7 @ 80-130 mm in 2000), suggests the net is highly effective in controlling escapement of fishes from the reservoir. Limnological sampling identified an opportunity to consider rescheduling annual maintenance releases from the reservoir's unscreened bottom outlet from early spring to mid-summer when low dissolved oxygen levels would preclude or minimize fish escapement.

2.) "Non-native fish control in backwater habitats in the Colorado River, Colorado"

Melissa Trammel, SWCA, Flagstaff AZ

ABSTRACT—Valdez, R.[1], L. Jonas[2], M. Trammell[2]. 2000. Non-Native Fish Control in Backwater Habitats in the Colorado River. Recovery Implementation Project No. 87b, [1] SWCA, Inc., 172 West 1275 South, Logan, UT 84321, [2] SWCA, Inc., 114 N. San Francisco Street, Flagstaff, AZ 86001

Predation and competition between small, non-native cyprinid species and young endangered fishes has been demonstrated in laboratory experiments (Ruppert et al. 1995; Muth and Beyers, unpublished data), and is perceived to be influential in limiting survival and recruitment of razorback sucker (*Xyrauchen texanus*) and Colorado pikeminnow *(Ptychocheilus lucius*) in the wild. Lentsch et al. (1996) recommended seining of select habitats as a viable mechanical control option for introduced cyprinids such as red shiner, fathead minnow, and sand shiner. The objectives of this study are to: 1) Significantly reduce the abundance of small non-native cyprinid and centrarchid fish species present in

backwaters within razorback sucker and Colorado pikeminnow critical habitat in the Colorado River on a per sampling trip and seasonal basis. 2) Significantly increase the survival and abundance of native and endangered fish species using backwater habitats in the Colorado River. 3) Evaluate backwater seining as an effective field method for controlling the abundance of small, non-native cyprinid and centrarchid fish species and for inducing a positive biological response within the native fish communities.

Depletion sampling was conducted on the Colorado River in the 15- and 18-mile reaches in June/July 1999 and March/April 2000. Four passes were made in 1999, and five passes were made in 2000. On each pass, all backwaters were seined and all fish were identified and counted. Non-native fishes were removed, while native fishes were released. In backwaters containing >50% native fish, all fish were released to avoid harm to the native fishes. In 1999, 8,863 non-native fish were removed from 65 backwaters. In 2000, 7,054 non-native fish were removed from 58 backwaters. In both reaches and years, catch rates of all fish initially declined after the first pass, but increased by the 4th pass in most cases. The effects of depletion by seining were thus temporary at best. Comparison of ISMP catch rates in 1998, prior to depletion efforts, and 1999, after the depletion effort, were inconclusive. Catch rates and relative percentage of native fishes did increase from 1998 to 1999, but catch rate of non-native fishes also increased. Catch rates of both native and non-native fish were not significantly different from mean catch rates seen from 1986 to 1998.

It is not anticipated that any control strategy implemented in the field will completely eliminate the prolific, non-native fish species in the 15- and 18- mile reaches. Instead, reducing the abundance of select non-native fishes, like the small cyprinids, on a temporary basis may create conditions favorable for reproductive and recruitment success of the endangered fishes. The initial study design called for depletion efforts to be carried out during pre-runoff conditions in March. We recommend that efforts in the final year of the study, 2001, be redirected towards alternate time periods just prior to spawning of native fishes; late April for razorback sucker, and June for Colorado pikeminnow.

3.) "Mechanical removal of nonnative cyprinids in the Lower Green and Colorado rivers, Utah."

Steve Meismer, Utah Division of Wildlife Resources, Moab.

ABSTRACT—The introduction of nonnative fish species in the upper Colorado River basin has resulted in an overwhelming majority of nonnative fishes relative to the abundance of native species, particularly small-bodied cyprinids. In an effort to combat the likely predation and competition between nonnative cyprinids and native larvae (Colorado pikeminnow *Ptychocheilus lucius* and razorback sucker *Xyrauchen texanus*), the Utah Division of Wildlife Resources (UDWR) has been mechanically removing nonnatives, primarily red shiner *Cyprinella lutrensis*, sand shiner *Notropis stramineus*, and fathead minnow *Pimephales promelas* from habitats used by native larvae as nursery areas. On the lower Green River, the removal efforts were concentrated between river miles (RM) 102 - 52. Sample areas on the Colorado River comprised three disjunct reaches, the Dewey Reach (RM 99-84), the Moab Reach (RM 66-54) and the Lathrop Reach (RM 32-18). On the lower Green River in 2000, seining of 118,000 m^2 resulted in removal of 47,000 nonnative cyprinids. Seining on the Colorado River resulted in removal of 42,000 nonnative cyprinids from 124,000 m^2. Year 2000 represents the culmination of three years of fieldwork to determine if mechanical removal of nonnative cyprinids from backwater and flooded tributary habitats on these sections of river is feasible.

4.) "Conceptual design of a spatially explicit individual-based model for Colorado pikeminnow in nursery habitats on the Green River*"

John W. Hayse[1], Steven F. Railsback[2], and Kirk E. LaGory[1]

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ABSTRACT—Conditions in nursery habitats, especially backwaters, have been hypothesized to play an important role in limiting the reproductive success of the endangered Colorado pikeminnow in the Upper Colorado River Basin. Because of the shallow and confined nature of the nursery areas, fish using them are likely to be most susceptible to adverse effects from changes in river flow. A spatially explicit model that links physical habitat simulation with an individual-based model is being developed to evaluate effects of changes in river flow on behavior, growth, condition, and survival of age-0 Colorado pikeminnow. The habitat simulation component will predict the spatial distribution of depth, velocity, and temperature at different flows for a hypothetical segment of river that approximates the conditions in the Ouray reach of the Green River. The hypothetical river segment will consist of a series of backwater areas connected by the main channel, and channel morphology of the segment will be based on existing information for the Ouray reach. The model will simulate entrainment of larvae into backwaters and subsequent foraging behavior, food consumption, energetic costs, growth, habitat selection, and mortality of individual age-0 fish. The overall response of the individual fish will be used to estimate population-level effects on abundance, age and size structure, and mortality rates. The spatially explicit nature of the model will permit the evaluation of behavioral responses of individual fish to temporary changes in habitat quality that are related to changes in river flow. A sub-daily time step will be used to evaluate potential effects of within-day changes in flow and stage throughout the nursery period. It is anticipated that the model will facilitate an understanding of the relationships between a variety of physical factors and biological interactions that may affect production, growth, and survival of the Colorado pikeminnow.

*Work supported by the U.S. Department of Energy, Western Area Power Administration, under Contract No. W-31-109-ENG-38

5.) "Historical observations of endangered fishes in the Green River subbasin."

Tim Modde, US Fish and Wildlife Service, Vernal , Utah

ABSTRACT—During the preimpoundment studies in the middle Green River, few Colorado pikeminnow were observed in vicinity of the proposed reservoir. Information presented in the preimpoundment study by McDonald and Dotson (1960) identified only two Colorado pikeminnow collected in the study area in the summer of 1959. However, in 1960 both Phil Dotson and Steve Radosevich (Utah Game and Fish Department) observed hundreds of Colorado pikeminnow concentrating downstream of the construction site diversion tunnel for Flaming Gorge Dam. The data from these collections has not surfaced but the concentration was described in writing by Phil Dotson and verbally by Steve Radosevich. The timing of the concentration occurred during the summer, most likely in mid-July which occurred during the descending limb of the hydrograph in 1960.

The concentration of large numbers of Colorado pikeminnow suggests that these fish were either engaged in either movement to or from a spawning area. The spawning pattern of the Colorado pikeminnow in the Green River subbasin is that individuals migrate to high-gradient reaches (canyon bound) where they spawn, and after which larvae emerge and drift downstream to nursery habitats in downstream alluvial reaches. Using this analogy together with observations of fish concentrations, it is possible that a historic spawning population may have existed above the Flaming Gorge Dam prior to

impoundment and that the alluvial reach of river in Browns Park may have an important nursery area for Colorado pikeminnow.

6.) "Establishing cause and effect in environmental studies."

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ABSTRACT—Assessing effects of stressors in aquatic systems involves two main emphases: 1) establishing a case for causation and 2) quantitative estimation of the magnitude of effect. Justification of a cause-and-effect relationship in environmental studies is complicated by inherent qualities of environmental data. Lack of randomization and replication invalidate the use of inferential statistics for demonstrating a causal link, and place special demands on descriptive-based arguments for causation. Assembly rules for causal arguments have been developed in epidemiology and provide a rigorous structure for descriptive-based analysis. Explicit use of assembly rules for making causal arguments allows investigators to efficiently organize, study, and present available evidence. Once a convincing case for causation has been established, results of quantitative assessments can be used to estimate biological significance of exposure. I illustrate how assembly rules can serve as a checklist for coordinated collection of data that satisfy both emphases of a scientific investigation.

7.) "Stable isotope signatures of native and non-native fishes in ponds and backwaters of the Upper Colorado River."

Patrick J. Martinez[1], Brett M. Johnson[2], and Joshua D. Hobgood[2];
[1]Aquatic Research, Colorado Division of Wildlife, Grand Junction, [2]Department of Fishery and Wildlife Biology, Colorado State University, Fort Collins

ABSTRACT—Floodplain ponds are considered to be potential sources of nonnative fish that prey upon or compete with native and endangered fishes in riverine habitats. Efforts to control the influx of nonnative fishes into rivers within the Critical Habitat of endangered fishes from floodplain ponds has largely followed a non-point approach, seeking to maximize reductions in the number of nonnative fish sources rather than identifying the worst point sources of nonnative fishes. This scenario is in part due to an inability to identify whether fish found in riverine habitats originated from reproduction and recruitment in the river or from specific floodplain ponds. Naturally-occurring stable isotopes of carbon (^{13}C) and nitrogen (^{15}N) were analyzed to address questions about trophic interactions among native and nonnative fishes in the upper Colorado River basin, and to begin to evaluate the discreteness of floodplain pond fish assemblages. Specifically, two hypotheses were evaluated: (1) can stable isotope analysis be used to establish trophic relationships among native and non-native fishes, and (2) can stable isotope signatures be used as a naturally-occurring marker to identify river fishes as having originated in the river or in floodplain ponds? Nitrogen isotopes showed that at a particular location, either in ponds or backwaters, centrarchids were usually the top predators in each system. In one backwater where taxonomic diversity of our samples was greatest, both $\delta^{15}N$ and $\delta^{13}C$ signatures of the fish assemblage ranged about 4‰. Thus, the number of trophic levels represented was limited to about two, and variation in energy (carbon) sources appeared to be great. The native flannelmouth sucker was most distinct with a relatively low $\delta^{15}N$ and high $\delta^{13}C$ signature. Stable isotope signatures appeared to have utility as a naturally occurring marker for tracking influx of non-native fishes to the Colorado River from ponds. While pond signatures were not consistently depleted or enriched relative to those from backwaters, average stable isotope signatures were more different among ponds than among backwater sites. Further, within particular species, some ponds have carbon or nitrogen signatures that were quite different from those at backwater sites. Stable isotope analysis appears to have promise for studying trophic relationships and movement patterns of native and non-native fishes in the upper Colorado River basin.

8.) "Survival and growth of razorback suckers introduced into floodplain depressions of the Green River, Utah."

Garn Birchell and Kevin Christopherson, Utah Division of Wildlife Resources, Vernal.

ABSTRACT—A total of 13,488 age I razorback suckers were stocked into The Stirrup, Baeser Bend and Above Brennan sites prior to runoff in 1999 and 2000. Each site received 1,985 fish in 1999 and 2,511 fish in 2000. The purpose of stocking these fish was to evaluate survival and growth in floodplain depression habitats; determine if razorback suckers would voluntarily leave the floodplain for river habitat during connection with the river; and determine what factors trigger movement from the floodplain. Age I razorback sucker survival rates following one full year in the sites were estimated between 49% and 72%. However, these rates were much reduced by the end of the summer 2000 because of the dry conditions that persisted through the summer. Razorback suckers stocked in 1999 averaged 1.3 - 1.5 mm/day growth during the first growing season. The same age class of fish stocked in spring of 2000 averaged 1.4 mm/day. Only 42 razorback suckers were captured leaving wetland sites during river-wetland connection in the spring of 2000. However, because of below average flows water connection was shallow and of short duration (2 - 10 days depending on the site).

9.) "Evaluation of trends in pH in the Yampa River, northwestern Colorado."

Dan Chafin, USGS, Colorado District, Denver, Colorado

ABSTRACT—In 1999 the U.S. Geological Survey, in cooperation with the National Park Service, began a study of pH trends in the Yampa River. The study was prompted by an apparent historical increase in measured pH at the Yampa River near Maybell, from an average of about 7.5 in the 1950's and 1960's to about 8.5 in the 1980's and 1990's. If real, further increase could adversely affect aquatic life in Dinosaur National Monument, about 42 miles downstream.

The significant historical increase in measured pH largely can be attributed to oxidation of organic matter in sample containers during shipping and holding prior to laboratory measurement during the 1950's and 1960's, especially in composited samples. Because of improved measuring protocol, pH measurements made onsite after September 1983 probably are the most reliable pH measurements in the record for Yampa River near Maybell.

At base flow, during August 16–19, 1999, late afternoon pH of the Yampa River ranged from 8.46 and 9.20. The highest pH (9.20) was measured at Yampa River above Elk River, about 1.8 miles downstream from the Steamboat Springs Regional Waste Water Treatment Plant outfall, where photosynthesis by algae dominated. Respiration plus oxidation of organic matter was dominant in Dinosaur National Monument, where daytime pH was 8.51 to 8.60. Diurnal measurement of pH in Dinosaur National Monument indicates that photosynthesis was minor and that pH was largely controlled by relatively high rates of respiration plus oxidation of organic matter.

During March 13–16, 2000, in response to late-winter melting of snow and ice at lower altitudes, streamflow and concentrations of dissolved nitrate were higher in the Yampa River than during August 1999. The effects of photosynthesis—higher pH and dissolved-oxygen concentration—were greater during March 2000 than during August 1999, probably because of (1) slower rates of exchange of CO_2 into and dissolved oxygen out of the river because of colder and deeper water and (2) slower rates of CO_2 production and oxygen consumption caused by slower rates of respiration in organisms and by slower rates of aerobic decomposition of organic matter in the colder river water and streambed sediment.

Hypothetical thermodynamic simulations were done for samples collected in the lower Yampa River Basin for this study to simulate the same degree of eutrophication that existed at Yampa River above Elk River. These simulations indicate that maximum potential pH would equal 9.1 to 9.2 during late-winter lowland runoff and late-summer base flow. Additional simulations with increased concentrations of major ions (especially alkalinity) indicate that drought conditions could cause slightly larger pH.

10.) "Recovery goals for the four endangered fishes of the Colorado River basin."

R.A. Valdez[1], T.E. Czapla[2], R.T. Muth[2], H.R. Maddux[2], and R.J. Ryel[3]
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ABSTRACT— We present recovery criteria for four endangered fishes of the Colorado River, including the Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), razorback sucker (*Xyrauchen texanus*), and bonytail (*Gila elegans*). Recovery criteria include site-specific management actions; objective, measurable recovery criteria; and estimated time to recovery, consistent with provisions specified under Section 4(b), Basis For Determinations, and Section 4(f)(1), Recovery Plans, of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 *et. seq.*). We address the five listing factors in reclassification of the species, including (A) the present or threatened destruction, modification, or curtailment of its habitat or range, (B) overutilization for commercial, recreational, scientific, or educational purposes, (C) disease or predation, (D) the inadequacy of existing regulatory mechanisms, and (E) other natural or manmade factors affecting its continued existence. Two recovery units are recognized; upper Colorado River basin and lower Colorado River basin. Recovery is defined as the process by which the decline of an endangered or threatened species is arrested or reversed, and threats to its survival are neutralized, so that its long-term survival in nature can be ensured. The goal of this process is the maintenance of secure, self-sustaining wild populations of the species with the minimum necessary investment of resources, such that protection of the ESA is no longer necessary. Four conditions are considered for recovery; genetics, demographics, population redundancy, and threats. Criteria for downlisting and delisting each species include numbers of populations, numbers of adults and demographic structure, and management actions to minimize or remove threats.

11.) Panel Discussion:

Where Do We Go From Here?
Biological Perspectives on the Future Direction of the Recovery Program.

Panel members: TBA, Colorado River Recovery Program Director's Staff
Tom Nesler, Colorado Division of Wildlife
TBA, Utah Division of Wildlife Resources
TBA, U.S. Fish and Wildlife Service
TBA, Bureau of Reclamation
TBA, Western Area Power Administration
Rich Valdez, SWCA, Inc.; and recovery goal co-author

Topic Guidance: In light of the development of recovery goals for the four species, programmatic biological opinions, and flow recommendations for the Green and Colorado Rivers, panel members will address what they see as the areas of emphasis for on-the-ground recovery actions within the Recovery Program.

12.) "Synthesis of four years of levee removal evaluation on the Green River: Where do we go from here?"

Kevin Christopherson[1], Garn J. Birchell[1], Tim Modde[2], Todd A .Crowl[3], and Pat Nelson[4];
[1]Utah Division of Wildlife Resources, Salt Lake City; [2]U.S. Fish and Wildlife Service, Vernal, Utah; [3]Utah State University, Logan; [4]U.S. Fish and Wildlife Service, Denver

ABSTRACT—Floodplains can provide nutrients but, the nursery habitat necessary for razorback sucker recovery is only relevant if they can recruit to the river. To do this razorback larvae must drift into and be entrained in the floodplain, survive predation, compete with non-native fish, grow large enough to survive the river environment, and leave the site entering the river. The project investigated if all of this was possible without an increase of riverine non-native fish. It would take a very unique convergence of condition to create the ideal site, and none of the sites investigate in this study fully met this criteria. Each element of the ideal site was evaluated and each site examined to see which one best met this criteria. The underlying objective was to define the best possible floodplain configuration thus providing guidance for acquiring or creating future sites. It is now clear that we need to carefully define our goals for floodplains and then select the best floodplain type. Based on this study the following recommendation are made. If a few days or weeks in a floodplain is adequate for razorback sucker larvae to grow to an adequate size for survival in the river, then terraces are the best, and sites like Baser-Chew should be the model. If the goal is mostly natural depressions that provide year round habitat for razorback suckers with minimal management, then Above Brennan is the model. If the goal is closely managed systems, then Stewart Lake should be the model.

13.)"Abundance estimates for Colorado pikeminnow in the middle Green, White, and Yampa rivers."

Kevin Christopherson[1], Garn Birchell[1], John Hawkins[3], Chris Kitcheyan[2], Bruce Haines[2], Tom Nesler[4], Gary White[3], and Kevin Bestgen[3];
[1]Utah Division of Wildlife Resources, Salt Lake City; [2]U.S. Fish and Wildlife Service, Vernal, Utah; [3]Colorado State University/Larval Fish Lab, Fort Collins, Colorado; [4]Colorado Division of Wildlife, Fort Collins

ABSTRACT—Sub-adult and adult Colorado pikeminnow *Ptychocheilus lucius* were sampled on at least three occasions in the middle Green, White, and Yampa rivers in spring 2000. The goal of that sampling was to generate estimates of abundance of Colorado pikeminnow that occupied each river system. The U. S. Fish and Wildlife sampled the White River, Utah Division of Wildlife Resources sampled the Green, Duchesne, and White rivers, and the Larval Fish Laboratory at Colorado State University sampled the Yampa River. Sampling occurred prior to and during spring runoff from mid-April through mid-June and ended before Colorado pikeminnow spawning migrations commenced.

Electrofishing effort included 177 hours on the Green River, 127 hours on the White River, and 61 hours on the Yampa River. Electrofishing effort was greater on the Green and White rivers because two boats were used, one sampling each side of the river, while only one boat was used on the Yampa River. A substantial amount of effort was also devoted to fyke- and trammel-net sampling of backwaters in the Yampa River. A total of 1,151 Colorado pikeminnow captured in all passes; 738 were from the Green River, 320 were from the White River, and 93 were from the Yampa River. Total recaptures of Colorado pikeminnow from the Green, White, and Yampa were 254, 91, and 41, respectively. Those recaptures included fish captured during the same sampling pass, fish captured during previous passes in 2000, and fish captured in previous years. A total of 33 razorback sucker were captured from the Green River and 13 razorback sucker from the Duchesne River. Abundance estimates of Colorado pikeminnow will be presented.

14.)"Evaluation of stocked larval Colorado pikeminnow into the San Juan River 2000."

Julie Jackson, Utah Division of Wildlife Resources, Moab.

ABSTRACT—The stocking of Colorado pikeminnow *Ptychocheilus lucius* into the San Juan River was initiated in 1996 by the Utah Division of Wildlife Resources (UDWR) under the San Juan Recovery Implementation Program (SJRIP). Efforts for this initiative were begun due to the extremely low numbers of young-of-year (YOY) Colorado pikeminnow being collected by investigators since 1986, and the

apparent low availability of backwater habitat. A number of investigators have reported that YOY Colorado pikeminnow are more frequently found in backwaters than other types of habitats, yet are also found in low velocity areas such as shorelines, small channels and eddies. The objective of these stockings was to address possible habitat availability and use limitations in addition to the documentation of survival, growth and retention within low velocity and backwater habitats (nursery habitats). Fish that averaged 24 - 55 mm (larger than what is considered the larval stage) were stocked in 1996-1998. It was our goal in 1999 and 2000 to stock larval fish at approximately the same time a natural spawning event would typically occur. Larval stage fish were preferred in order for them to have the opportunity to drift before entering nursery habitats. High flows during 1999, following the stocking of 500,000 larval Colorado pikeminnow, are most likely the cause of none of the stocked fish being collected during the subsequent sampling trips. In an effort to repeat the experiment, approximately 105,000 larval Colorado pikeminnow were released in 2000. A repeat of last year's high flows was not seen and the stocked fish may have had a better chance to drift and eventually locate available nursery habitat. Low velocity and backwater habitats were sampled at a rate of two per mile in the days immediately following the stocking event and again four weeks later. Fish collected that were too small to identify in the field were preserved. Preserved samples have been processed and results will be presented.

15.)"Population estimate of humpback chub in Westwater Canyon, Colorado River, Utah, 1998-2000."

Michael Hudson, Utah Division of Wildlife Resources, Moab.

ABSTRACT—A three year effort (1998-2000) to determine a humpback chub *Gila cypha* population estimate in Westwater Canyon culminated in 2000. Three sampling passes were conducted over six weeks each of the three years to estimate the size of the humpback chub population in Westwater Canyon. All *Gila* spp. larger than 150 mm were PIT tagged. Sampling occurred exclusively with trammel nets to target the adult component of the Westwater chub populations. Sampling sites coincided with the annual monitoring sites in Westwater Canyon (RM 124.1, RM 121.5, RM 120.0). During each trip we sampled for two days at the Miner's Cabin site (RM 124.3 - 123.7), for two days at the Cougar Bar site (RM 122.1 - 121) and one day at the Hades Bar site (RM 120.0 - 119.8). Approximately seven to fourteen trammel nets were fished at each site beginning in the late afternoon, through the first few hours of darkness, and again during the pre-dawn and early morning hours. Results of the final analysis on humpback chub and roundtail chub *Gila robusta* will be presented.

16.) "Northern pike translocation on the Yampa River, 2000."

John Hawkins[1] , Jay Bundy[1], Brandon Mix[1], Cris Sodergren[1], Cameron Walford[1], Koreen Zelasko[1], and Tom Nesler[2] [1] CSU- Larval Fish Laboratory, [2] Colorado Division of Wildlife

ABSTRACT—Northern pike, *Esox lucius*, is a nonnative species introduced into the Yampa River system in the early 1980s. The species has established a reproducing population in the upper Yampa River and expanded their number and range within the Yampa and Green rivers. Pike are voracious predators and are considered a threat as competitors and predators to endangered and other native or game fishes in the Yampa River. We trapped and translocated northern pike from the Yampa River as recommended by the Colorado Division of Wildlife Aquatic Wildlife Management Plan for the Yampa River Basin. Pike were removed from the Yampa River between Milk Creek (river km 192) and Deerlodge Park (river km 74) during four sampling trips in Spring 2000, each about 10 days. Sample trips occurred on April 18-27, May 6-14, May 22-June 1, and June 20-24. Shoreline habitat was sampled with an electrofishing boat, eddies were sampled with trammel nets and backwaters were sampled with either fyke net or blocked with a trammel net and electrofished. On the first sampling occasion we did not have approval from the Division of Wildlife to move pike, so all pike were marked with a dorsal-fin hole-punch and returned to the river alive. On all other sampling occasions, all pike were tagged with a Floy tag and translocated to Rio Blanco Reservoir in Rio Blanco County in the White River Basin. A total of 446 northern pike were captured of which 86 were immediately returned alive to the Yampa River, 348 were translocated to Rio

Blanco Reservoir, and 12 either died during capture or were euthanized due to extreme injury. Average length of all pike caught was 51 cm. The largest pike moved to Rio Blanco was 102 cm and 7.8 kg. A total of 93 Colorado pikeminnow (*Ptychocheilus lucius*) was caught on all four trips. Suitability of the data for abundance estimates will be discussed and evidence provided of northern pike predation on native roundtail chub, *Gila robusta*, and flannelmouth sucker, *Catostomus latipinnis,* and northern pike predation attempts on Colorado pikeminnow.

17.)"Abundance and size structure of channel catfish in Yampa River (rm 45-10)"

Mark Fuller, U.S. Fish and Wildlife Service, Vernal, Utah.

ABSTRACT—Channel Catfish have been identified as principal competitors/predators to native and endangered fishes in the upper Colorado River basin, a region where controlling problematic nonnative fishes is necessary for the recovery of four endangered fish species. The lower Yampa River, a tributary important to these endangered fishes, provides: 1) critical habitat for humpback chub *(Gila cypha)* and Colorado pikeminnow *(Ptychocheilus lucius)*; 2) spawning habitat for razorback suckers *(Xyrauchen texanus)*; and 3) recent re-introductions of bonytail chub *(Gila elegans)*. Removal of nonnative channel catfish from the lower Yampa River (rm 45-10) began in 1998-99. Significant reductions in channel catfish populations from four test reaches indicate that mechanical control in Yampa Canyon is feasible. Information specific to the Yampa River channel catfish population (abundance, size structure etc.) and their vulnerability to removal efforts will be examined to determine applicability to larger scale removal efforts.

18.) "Evaluation of the Interagency Standardized Monitoring Program sampling technique in backwaters of the Colorado River in the Grand Valley, Colorado."

K. R. Bestgen[1], J. M. Bundy[1], and P. J. Martinez[2];
[1]CSU- Larval Fish Laboratory, [2]Colorado Division of Wildlife

ABSTRACT—The main goal of this study was to estimate the level of bias and precision of the ISMP sampling program to detect presence and estimate abundance of centrarchid fishes in backwaters of the Colorado River. This was accomplished by comparing the density estimates of fishes generated by the ISMP methodology and comparing those with density estimates based on three-pass removal or capture-recapture population estimates. Overall, the ISMP sampling approach underestimated how many backwaters were occupied by largemouth bass and green sunfish by about 50 %. In other words, ISMP detected those centrarchid species in only every other backwater in which they occurred. When ISMP sampling detected largemouth bass and green sunfish in Colorado River backwaters, abundance estimates for those taxa were only about 30% of the level estimated by more reliable removal or capture-recapture sampling. Although detection and abundance estimation of centrarchids was not an original goal of ISMP backwater sampling, managers needed to understand whether this approach could be useful for such. The results gathered in this study should be used to guide decisions about whether to continue ISMP in its present form, to alter it to change the reliability of the parameters being estimated, or to change the goals of the sampling.

19.)"Temporal and spatial use of Lodore Canyon by the Colorado pikeminnow."

D. Chris Kitcheyan, U.S. Fish and Wildlife Service, Vernal, Utah

ABSTRACT—After the closure of Flaming Gorge Dam in 1962, water released from the dam consisted of cold hypolimnetic water that converted the Green River through Lodore Canyon from a turbid, warm river to a clear, cold river occupied by salmonids. From 1963 to early 1978, biologist concluded that higher, colder water releases undoubtedly altered the native fish fauna and eliminated the reproduction of warm

water fishes between the dam and confluence with the Yampa River. However, two major dam-related events occurred which affected the physical habitat and help to re-establish the native fish fauna. First, multi-level penstocks were installed to discharge warmer surface water from the reservoir (1978). Second, flows were re-regulated from the dam to increase spring flows and reduce summer flows to enhance the physical habitat, the result of the interim Biological Opinion (1992). As a result, the abundance and distribution of native fishes, especially Colorado pikeminnow, increased within Lodore Canyon.

Beginning in 1999, Lodore Canyon was sampled using electrofishing rafts or hard bottom boats, and angling to collected and implant adult Colorado pikeminnow to determine: 1) if pikeminnow occupy the Lodore Canyon throughout the year (i.e. do fish overwinter in the canyon?); and 2) if pikeminnow spawn in the canyon and document these new spawning locations or migrate to a documented spawning site (Yampa or middle Green rivers). No pikeminnow were captured in 1999. But in 2000, using the same capture techniques as in 1999, nine pikeminnow were captured of which only seven were implanted with a transmitter. A data logger, established above the Yampa River confluence, indicated Colorado pikeminnow began dispersing in and out of the canyon from August to November 2000. On the 17 November 2000, an aerial survey concluded all pikeminnow from Lodore Canyon emigrated out of the canyon. The pikeminnow implanted in Lodore Canyon seem to resemble the behavior and movement patterns of pikeminnow implanted in the Duchesne River. As temperatures in the Duchesne River decreased, pikeminnow left the Duchesne and returned to the Green River (main channel). However temperatures in Lodore Canyon were only monitored until August in 2000.

20.)"Genetic variation in speckled dace (*Rhinichthys osculus*) from the Virgin River basin (UT, AZ, NV)."

Marlis and Michael E. Douglas, Department of Biology and Museum, Arizona State University, Tempe, AZ

ABSTRACT—The Virgin River has been subjected to water removal for agricultural purposes since mid-1800's. Of late, regional urbanization and tourism have also absorbed much of the basin's water. These conditions, coupled with introductions of nonnative fishes, have seriously impacted endemic fishes. Several are now listed as endangered, while others are "of concern."

The speckled dace (Rhinichthys osculus) is widespread throughout western North America, and concomitantly in the Virgin River basin. Interestingly, it is neither endangered nor "of concern" to resource agencies. The basin-wide distribution of genetic diversity in this fish could be a model for other species in the basin, especially those now greatly restricted in range and abundance. To accomplish this, 10 individuals were sampled from each of the following 13 sites (east to west): North fork of Virgin River, La Verkin Creek, above Washington Field's diversion, at mouth of Santa Clara River, Santa Clara below Gunlock Reservoir, Santa Clara at Veyo, Moody Wash, Virgin River at Littlefield (AZ), Beaver Dam Wash above confluence (AZ), Beaver Dam Wash above Montoqua (UT), Virgin River at Mesquite (NV), Meadow Valley Wash (NV), and Condor CN (NV). MtDNA was isolated from muscle and 2 regions of the molecule (ATPase 8 and 6) were amplified and sequenced. Preliminary results indicate considerable variability within and among populations, and suggest differentiation between several tributaries vs mainstem, and in the mainstem above vs below the Virgin River narrows. Management implications are discussed.

21.)"Phylogeography of the Sonoran sucker (*Catostomus insignis*)."

Michael E. and Marlis Douglas, Department of Biology and Museum, Arizona State University, Tempe, AZ.

ABSTRACT—Native fish research in western North America has focused primarily upon federally threatened and endangered (i.e., T&E) species because a sense of urgency is usually implicit, and

monies are often available to complete these projects in a short period of time. However, research endeavors to conserve and adaptively manage those species not as yet pushed to the brink of extinction should also be a major imperative. This is because these forms are in a slow (and possibly irreversible) decline throughout their ranges. 'Species of concern' often inhabit smaller tributaries with limited distributions. The Sonora sucker (Catostomus insignis), with a distribution limited primarily to Arizona, falls into this category. Its conservation genetics are of particular interest, for this species is severely impacted by introduced nonnative fishes, habitat degradation, and stream diversion/fragmentation.

In this study, 213 individual C. insignis were examined from 18 populations distributed across the range of the species. Three mitochondrial DNA (MtDNA) genes (ATPase-8, ATPase-6, and ND2) were assayed for each individual, and thirty-nine haplotypes recovered from the combined 1,231 base pairs. Twenty of the 39 (51%) represent transitions at but a single base pair. The molecular variability in C. insignis displayed scant geographic structure. However, the Santa Maria and Bill Williams rivers did cluster together as a single group (at 56% bootstrap support), and an undescribed "Sonora-like" sucker was found in Tularosa Creek (NM) of the Gila River. Haplotypes of this undescribed form are also found in the Virgin and San Juan rivers, which are outside the distribution of C. insignis.

22.)"The propagation and stocking of the endangered fishes in the Upper Basin: a progress report."

Tom Czapla, U.S. Fish and Wildlife Service, Denver.

ABSTRACT—Since 1996, experimental and augmentation stockings have been occurring with predominantly razorback sucker and bonytail in the Upper Colorado River and Green River subbasins. Over the past few years, hatcheries have been able to produce sufficient numbers of fish to stock. In addition, river and wetland acclamations have provided better survival of smaller fish. One of the greatest successes to date has been the appearance of hatchery-stocked razorback sucker, in a reproductive state, to the spawning bar in the middle Green River.

23.) "Selenium accumulation in razorback suckers (*Xyrauchen texanus*) held in Stewart Lake for 34 days during the summer of 2000."

Nathan Darnall, U. S. Fish and Wildlife Service, Salt Lake City, Utah

ABSTRACT—On June 9, 2000 personnel from Ouray National Fish Hatchery stocked 145 razorback suckers (*Xyrauchen texanus*) (1998 year class, $\bar{x}$ = 300 mm, 291 g) into Stewart Lake, near Jensen, Utah. Elevated selenium concentrations have been documented at Stewart Lake, and concerns were expressed regarding potential selenium accumulation and its effects upon these fish. Waddell and May (1995) developed a non-lethal technique to analyze selenium concentrations in endangered fish, which involved collection of a small sample of muscle tissue (muscle plug) using a 4 mm biopsy punch, with subsequent analysis via neutron activation.

Prior to stocking, muscle plugs were collected from five randomly selected fish. Selenium concentrations in these five fish ($\bar{x}$ = 0.92 ± 0.03 (*s*) μg/g, dry weight) provide information about ambient selenium concentrations in the hatchery, as well as baseline data from which to evaluate selenium accumulation in fish held in Stewart Lake. Selenium concentrations in these fish closely resembled selenium concentrations from hatchery fish recently released into the Green River during 1999 ($\bar{x}$ = 0.76 ± 0.25 (*s*) μg/g, *n* = 9).

Four days after stocking (June 13, 2000), three razorback suckers were recaptured in Stewart Lake. Weights and lengths were recorded, but muscle plugs were not collected. Nineteen days after stocking, 4 additional razorback suckers were recaptured, and again 34 days after stocking, 4 more razorback suckers were recaptured. Fish were weighed, measured for total length, and muscle plugs were collected. Stewart Lake was then drained and the fish were released to the Green River (July 12, 2000).

Fish lengths and weights increased during the 34 days fish were held in Stewart Lake. During the same time period, selenium concentrations also increased ten-fold ($\bar{x}$ = 9.0 ± 0.61 (*s*) μg/g, dry weight), and the increase was closely correlated with time (R^2 = 0.90). Relative body condition (*Rn*) was calculated for each fish and plotted against selenium concentrations by sample period. Fish collected during the last sampling period had the highest weights, and highest selenium concentrations, but slightly lower, though not significant, *Rn* than fish collected 13 days prior. While sample size was small, this data may indicate that selenium concentrations were beginning to impact physiological functions in these fish. It is speculated that, had fish remained in Stewart Lake, they would have continued to accumulate selenium, and that physiological functions would likely have been impaired.

24.) "The effects of stage fluctuations induced by hydropower operations on overwinter survival of young Colorado pikeminnow."

Bruce Haines, U.S. Fish and Wildlife Service, Vernal, Utah

ABSTRACT—This study uses mark-recapture procedures to estimate over-winter survival and movement of age-0 Colorado pikeminnow and relates the observed responses to stage fluctuations in the Green River induced by hydropower operations at Flaming Gorge Dam. FY 2000 was the first of three field seasons for this project. During the winter of 1999-2000, daily stage changes at Jensen of approximately 0.3 feet resulted in little detectable backwater habitat changes in the Ouray nursery area. An ice-jam at the Ouray bridge during early January, however, changed backwater habitats to flow-through areas for a few days (5-10). Surprisingly, many young Colorado pikeminnow remained over-winter in these habitats, although a few fish moved over 2 miles. If ice-jams are common occurrences in the nursery area, their effects on stage changes dwarfs that of flow releases from Flaming Gorge Dam. Construction of a bioenergetics model for age-0 Colorado pikeminnow in winter conditions is proceeding as planned at the Larval Fish Laboratory, Colorado State University.

25.) "Population dynamics of Colorado pikeminnow in the upper Colorado River."

Doug Osmundson, U.S. Fish and Wildlife Service, Grand Junction.

ABSTRACT—In 1991, the U. S. Fish and Wildlife Service initiated a four-year mark-recapture effort to estimate the size of the subadult and adult population of Colorado pikeminnow in the mainstem Colorado River. Strong year classes in 1985 and 1986 recruited to the adult population during the 1991-1994 study, allowing researchers the opportunity to observe the large effect that a couple of strong year classes can have on adult population size. In the first year of the study (1991) most adults were found concentrated in the upper reach of the river (upstream of Westwater Canyon) and this population consisted of only about 200 individuals. By 1994, catch rates there had doubled. The 1994 point estimate for the upper reach was about 330 fish; though not double, it was substantially higher than that estimated three years prior. Also, an additional 300 or so young or soon-to-be adult fish were estimated to reside in the lower reach (downstream of Westwater Canyon). Thus, in four years the river-wide population of individuals > 450 mm TL increased from somewhere around 200-250 fish to around 465 fish.

Recaptures of many young adults indicated that many young fish tagged in the lower reach dispersed upstream to the upper reach. Based on body condition in the lower reach that declined as the fish grew and later improved upon arrival in the upper reach, along with differences in forage between the two reaches, investigators concluded that these upstream movements were related to an inadequate supply of food for adult pikeminnow in the lower reach.

In 1998, a second mark-recapture study was begun to monitor the status of this dynamic population - this time a three-year effort was conducted instead of a four-year effort. In 1998-2000, the same protocol was used as before.

Point estimates and length frequency analysis indicate that the whole-river population of fish age-7 and older (> 450 mm TL) increased from about 465 in the early 1990's to 664 in the late 1990's, an increase of 43%. As the 1985-86 cohort ages, the dominant length class increases. During the past three years, the dominant size class has been 600-650 mm TL. Higher numbers and larger average size should provide greater egg production increasing the potential for greater reproductive output. If proper environmental conditions are provided strong year classes may result in coming years.

In the upper reach, where most fish are adults, the population estimates and netting catch rates suggest that, beginning in 1992, adult numbers continued to increase, peaked in 1998, and perhaps declined somewhat in 1999. Body condition was relatively stable during the 1991-1994 period (averaging 98.8 for adults 500-599 mm) but declined significantly by 1998 (averaging 92.8 for 1998-2000). A preliminary interpretation of declining condition concurrent with increased population size is that food is in short supply and that carrying capacity of the Colorado River may have been exceeded despite the fact that overall population size is small. If subsequent data collection and other studies bear this out, it will have important implications for the potential viability of this population and management activities will need to be directed toward increasing the extent of adult range and the food supply in this river so that this population has the capacity to expand to a more viable population size.

26.) "Temporal changes in periphyton and aquatic macroinvertebrate communities in the '15-Mile Reach' of the Colorado River, Colorado."

David E. Rees, William J. Miller, and Jonathan A. Ptacek; Miller Ecological Consultants, 1113 Stoney Hill Drive, Suite A, Fort Collins, Colorado.

ABSTRACT— Periphyton and aquatic macroinvertebrate communities were sampled on a monthly basis from May through October during 1999 and 2000. Two sampling sites were established based on physical characteristics in order to determine the effects of seasonal flow variation on aquatic biota in riffle and run habitat. During August 2000 fish sampling was conducted to determine population estimates for these specific habitats. Preliminary results suggest that habitat type and portions of the flow regime resulting from runoff and summer rainstorm events affected aquatic biota distribution and abundance.