

**An Integrated Stocking Plan for Razorback sucker,
Bonytail, and Colorado pikeminnow for the
Upper Colorado River Endangered Fish Recovery Program**

Addendum to
State Stocking Plans

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1.0 INTRODUCTION

As a result of the August 28–29, 2002, workshop on “Designing methods to evaluate stocked fish in the Upper Colorado River, Green River, and San Juan River subbasins,” the current State stocking plans were recognized as being inconsistent regarding the number of fish to stock, how many years to stock, age of adult fish, and numbers of adult fish age classes to maintain. A recommendation from the workshop was to integrate the separate State stocking plans. This integrated stocking plan is intended to serve as an addendum to the previous stocking plans to ensure consistency throughout the Upper Colorado River Basin.

2.0 CURRENT STATE STOCKING PLANS

2.1 State of Colorado.—The building blocks for the State of Colorado’s stocking plan (Nesler 2001) were: recovery goal abundance plus a buffer; survivorship curves per species; abundance target composed of first three mature age groups; prioritized by species and river reach sites; and maintenance of 3-age group target for three years. The buffers were intended to compensate for annual adult mortality, i.e., stocking rates should reflect anticipated mortalities. Maintain 3 age-group targets for 3 years to the point where reproduction of stocked fish occurs (viable eggs and larvae). Stocking plan objectives are to restore populations to unoccupied reaches within the State of Colorado; augment very small populations; and establish populations of at least three adult age groups at recovery goal population abundance level. The benefits and benchmarks of the plan are identification of limiting factors pertaining to spawning, reproduction, survival and recruitment where low to non-existent population numbers exist and attempted spawning and reproduction of viable eggs and larvae constitute the first step in acquisition of natural function and self-sustaining status.

Razorback sucker is the highest priority (Priority 1). River reaches to stock razorback sucker in priority are: 1) Colorado River - Rifle to Debeque; 2) Gunnison River - Hartland to Redlands; and 3) Colorado River - Palisade to Stateline. All razorback sucker should be 300+ mm total length (TL), i.e., age 2+. Stocking should occur each fall for 5,480 razorback sucker per reach for 8 years.

Bonytail is the second highest priority (Priority 2). River reaches to stock bonytail in priority are: 1) Middle Green River/Yampa River - in Dinosaur National Monument; and 2) Colorado River - Palisade to Loma. All bonytail should be 200+ mm TL, i.e., age 2+. Stocking should occur each late summer/fall for 12,000 bonytail per reach for 7 years. By accepting the State of Colorado’s stocking plan the Program has deemed that stocking bonytail in the proximity of existing humpback chub populations is an “acceptable” risk regarding the potential of hybridization between the species.

Colorado pikeminnow is the last priority (Priority 3). River reaches to stock Colorado pikeminnow in priority are: 1) Colorado River - Rifle to Debeque; and 2) Gunnison River - Hartland to Redlands. All Colorado pikeminnow should be 150+ mm TL, i.e., age 3+. Stocking should occur each late summer/fall for 1,340 Colorado pikeminnow per reach for 9 years.

Humpback chub is not anticipated to be stocked. However, augmentation of existing small populations may become necessary. Stocking to expand population of humpback chub into the Yampa, Ladore, Whirlpool, and Split Mountain complex may be desirable in the future for meeting recovery goal criteria. [Supplemental stocking of humpback chub is an option to consider under Colorado's plan. Recovery goals do not assign specific numerical criteria to smaller populations (e.g., Yampa Canyon, Cataract Canyon). Supplemental stocking may be necessary to achieve numerical criteria in other reaches (e.g., Westwater, Black Rocks).]

2.2 State of Utah.—The State of Utah's stocking plan (Hudson 2001) was revised based on recovery goals. The plan calls for only stocking razorback sucker and bonytail. Utah is relying on other Program activities to continue: instream flow protection; habitat restoration; and research and monitoring.

The razorback sucker goal is to achieve 5,800 by year 10. This is expected to be accomplished by stocking each year 18,500 razorback sucker for five years. The razorback sucker stocked will be >300 mm TL and is based on the 25 x 25 breeding matrix. The plan assumes 0.5, 0.6, and 0.7 survival for age-3, age-4, and age-5 razorback sucker respectively.

The bonytail goal is to achieve 4,500 by year 10. This is expected to be accomplished by stocking each year 5,427 bonytail for five years. The bonytail stocked will average 200 mm TL. The plan assumes 0.3, 0.5, 0.6, and 0.7 survival for age-2, age-3, age-4, and age-5 bonytail respectively.

3.0 INTEGRATED STOCKING PLAN

A combination of ideas was used to develop this integrated plan to give consistency throughout the Upper Colorado River Basin, such as multiple adult age groups and age at adult stage. In the comparison of plans (Tables 1–4) the increase of multiple adult age groups from 3 to 4 results in the decrease of fish needed to be initially stocked on an annual basis.

3.1 Inconsistencies Among State Stocking Plans.—As stated in the introduction, inconsistencies occurred between the state stocking plans. The age of adult razorback sucker, bonytail and Colorado pikeminnow has been identified in the recovery goals as age 4+, age 4+ and age 7+, respectively. The number of adult age classes to maintain varied among the two plans and by species; this plan recommends maintaining 4 adult age classes, which would require stocking razorback sucker and bonytail for six years and Colorado pikeminnow for eight years. Adult survival estimates used were similar across the plans; Colorado used a mixed survival of adult bonytail to buffer the stocking numbers. Thus buffers were slightly different among the plans. This plan recommends a 20% buffer for Colorado pikeminnow which represents the average annual adult mortality for ages 7–10. Table 1 provides a list of differences among the State stocking plans and this integrated plan.

Table 1. Differences among plans by species and issue.

Species	Issue	Colorado Plan	Utah Plan	Integrated Plan
Razorback sucker	Age of adult	4+	6+	4+
	Number of adult age classes	3	5	4
	Survival of adults	0.70	0.70	0.70
	Buffer used	30%	30%	30%
Bonytail	Age of adult	4+	4+	4+
	Number of adult age classes	3	7	4
	Survival of adults	0.60–0.70	0.70	0.70
	Buffer used	30–40%	30%	30%
Colorado pikeminnow	Age of adult	7+		7+
	Number of adult age classes	3		4
	Survival of adults	0.70–0.85		0.70–0.85
	Buffer used	15%		20%

Table 2. Comparison of razorback sucker plans to achieve 7,540 target of adults per population (shaded cells indicate adult fish).

Age	Survival rate	Numbers of Fish		
		Colorado Plan	Utah Plan	Integrated Plan
2	0.50	16,440	18,500	9,930
3	0.60	8,220	9,250	4,965
4	0.70	4,932	5,550	2,979
5	0.70	3,452	3,885	2,085
6	0.70	2,417	2,720	1,460
7	0.70	1,692	1,904	1,022
8	0.70		1,333	
9	0.70		933	
10	0.70		653	
Total Adults		7,561	7,541	7,546

Table 3. Comparison of bonytail plans to achieve 6,160 target of adults per population (shaded cells indicate adult fish). In the Colorado Plan, parenthetical numbers are those originally reported, but were miscalculated.

Age	Survival rate	Numbers of Fish		
		Colorado Plan	Utah Plan	Integrated Plan
2	0.30	12,000	16,280	17,750
3	0.50	3,600	4,884	5,325
4	0.60	1,800 (2,830)	2,442	2,663
5	0.70	1,080 (1,700)	1,465	1,598
6	0.70	756 (1,190)	1,026	1,118
7	0.70		718	783
8	0.70		503	
9	0.70		352	
10	0.70		246	
Total Adults		3,636 (5,720)	6,751	6,161
Target		5,720	6,756	6,160

Table 4. Comparison of Colorado pikeminnow plans to achieve target of adults per population (shaded cells indicate adult fish). Colorado Plan target was 1,150; integrated plan target is 1,200.

Age	Survival Rate	Numbers of Fish	
		Colorado Plan	Integrated Plan
3	0.50	2,680	2,250
4	0.60	1,340	1,125
5	0.70	804	675
6	0.80	563	473
7	0.85	450	378
8	0.85	383	321
9	0.85	325	273
10	0.85		232
Total Adults		1,158	1,205

3.2 *Razorback sucker*.—Razorback sucker should be stocked at sizes greater than or equal to 300 mm TL, primarily in the fall (Table 5). Smaller fish should over winter until reaching the stocking size and then be culled from grow-out ponds for release in the spring and summer. This will allow the smaller fish more space to grow to the stocking size required. The production of fish is discussed below. The effort is to establish populations in the Upper Colorado River and Green River subbasins. A redundant population is called for in the Lower Green River in case of a catastrophic event.

3.3 *Bonytail*.—Bonytail should be stocked at sizes greater than or equal to 200 mm TL, primarily in the fall (Table 6). Smaller fish should over winter until reaching the stocking size and then be culled from ponds for release in the spring and summer. This will allow the smaller fish more space to grow to the stocking size required. The production of fish is discussed below. The effort is to establish populations in the Colorado and Green rivers. A redundant population is called for in the Lower Green River because of the uncertainty of the life-history and habitat requirements for this species. Shared stocking by the States of Colorado and Utah will be done to achieve one population each in the Middle Green and Colorado rivers.

3.4 *Colorado pikeminnow*.—Colorado pikeminnow should be stocked at sizes greater than or equal to 150 mm TL, primarily in the fall (Table 7). The production of fish is discussed below. The effort is establish Colorado pikeminnow into reaches that no longer produce juvenile fish in Upper Colorado River Subbasin. If stocked Colorado pikeminnow are not retained within those river reaches stocked, this stocking effort will be re-evaluated.

Table 5. Integrated stocking plan for razorback sucker, first priority species. The priority by river reach is identified for each state (C=Colorado; U=Utah).

Priority by State and River Reaches	Fish age and Size (mm TL)	Season stocked ¹	Numbers of fish stocked per year	Number of years stocked
1C: Colorado River: Rifle to Debeque Canyon	Age 2+ 300	1° Fall 2° Spring–Summer	3,310 ²	6
2C: Gunnison River: Hartland to Redland dams	Age 2+ 300	1° Fall 2° Spring–Summer	3,310 ²	6
3C: Colorado River: Palisade to Stateline	Age 2+ 300	1° Fall 2° Spring–Summer	3,310 ²	6
1U: Middle Green River: (RM 302–249)	Age 2+ 300	1° Fall 2° Spring–Summer	9,930	6
2U: Lower Green River: (RM 120–249)	Age 2+ 300	1° Fall 2° Spring–Summer	9,930 ³	6

¹ 1° refers to the primary season; 2° refers to secondary season to cull fish and allow smaller individuals to achieve stocking size by the next fall.

² Represents one population in the Upper Colorado and Gunnison rivers.

³ Represents an additional population in case of a catastrophic event.

Table 6. Integrated stocking plan for bonytail, second priority species. The priority by river reach is identified for each state (C=Colorado; U=Utah).

River Reaches	Fish age and Size (mm TL)	Season stocked ¹	Numbers of fish stocked per year	Number of years stocked
1C: Middle Green–Yampa Rivers: Dinosaur National Monument	Age 2+ 200	1° Fall 2° Spring–Summer	2,665 ²	6
2C: Colorado River: Palisade to Loma	Age 2+ 200	1° Fall 2° Spring–Summer	2,665 ³	6
1U: Middle Green River: (RM 302–249)	Age 2+ 200	1° Fall 2° Spring–Summer	2,665 ²	6
2U: Lower Green River: (RM 120–249)	Age 2+ 200	1° Fall 2° Spring–Summer	5,330 ⁴	6
3U: Colorado River: (RM 110.5)	Age 2+ 200	1° Fall 2° Spring–Summer	2,665 ³	6

¹ 1° refers to the primary season; 2° refers to secondary season to cull fish and allow smaller individuals to achieve stocking size by the next fall.

² Represents one population in the Middle Green River.

³ Represents one population in the Upper Colorado River.

⁴ Represents an additional population in case of a catastrophic event.

Table 7. Integrated stocking plan for Colorado pikeminnow, third priority species. The priority by river reach is identified by number.

River Reaches	Fish age and Size (mm TL)	Season stocked ¹	Numbers of fish stocked per year	Number of years stocked
1: Colorado River: Rifle to Debeque Canyon	Age 3+ 150	1° Fall 2° Spring–Summer	1,125 ²	8
2: Gunnison River: Hartland to Redland dams	Age 3+ 150	1° Fall 2° Spring–Summer	1,125 ²	8

¹ 1° refers to the primary season; 2° refers to secondary season to cull fish and allow smaller individuals to achieve stocking size by the next fall.

² Represents one population in the Upper Colorado and Gunnison rivers.

4.0 FISH PRODUCTION AND FACILITIES

4.1 Razorback sucker.—The Program has two facilities dedicated to the production of razorback sucker, Grand Junction Endangered Fish Facility (Grand Junction) and Ouray National Fish Hatchery (Ouray). Grand Junction will produce 14,895 razorback sucker ≥ 300 mm TL annually for 6 years (9,930 for Colorado waters and 4,965 for Lower Green River, Utah). Ouray will produce 14,895 razorback sucker ≥ 300 mm TL annually for 6 years (9,930 for Middle Green River and 4,965 for Lower Green River). See Table 8 below. Although, previously it was determined that brood from Ouray would be used to stock the Green River, more recent information of a fish released in the Gunnison moving downstream to the Green River, then upstream to Green River, Utah, suggests, as fish are distributed throughout the basin they will eventually mix among the river reaches.

4.2 Bonytail.—The Program has two facilities dedicated to the production of bonytail, the Wahweap State Fish Hatchery (Wahweap) and the Mumma Native Aquatic Species Restoration Facility, Alamosa, CO (Mumma). Wahweap will produce all the bonytail destined for Utah waters, a total of 10,660 bonytail ≥ 200 mm TL annually for 6 years. Mumma will produce all bonytail destined for Colorado waters, a total of 5,330 bonytail ≥ 200 mm TL annually for 6 years.

4.3 Colorado pikeminnow.—The Mumma facility will produce all the Colorado pikeminnow required in the Program stocking plan, a total of 2,250 fish ≥ 150 mm TL annually for 8 years.

4.4 Stocking Sites.—Stocking sites will be determined on an annual basis for each river reach. Acclimation has the highest potential of increasing survival of stocked fish. Razorback sucker and bonytail should be stocked in floodplain areas that can overwinter fish or in side channels that may be netted for a short period of time prior to access of the main flow of the river. Colorado pikeminnow should be stocked into backwaters along the river.

4.5 Excess Fish.—Excess fish are defined as those in addition to the needs of production to meet the stocking plan. A disposition policy was approved by the Recovery Program in 1995 (see Appendix A; Stemple and Wydoski 1995). Alternatives to the policy may include:

- 1) Excess larvae produced as a result of too many spawned individuals or overly successful hatch should be distributed to riverside ponds that are not expected to connect with the river except under very high flows. These can later be captured for marking with coded wire tags or passive integrated transponder (PIT) tags (size dependent) and released to the river.
- 2) Excess juveniles produced as a result of under estimated survival should be tagged and released into floodplain wetlands.
- 3) Excess razorback sucker and Colorado pikeminnow at time of stocking should be made available to the San Juan Program. Excess bonytail at time of stocking should be stocked in the Upper Colorado River Basin and distributed evenly among the 3 populations.

4.6 *Fish Health*.—Fish health concerns, particularly the transportation of fish into Utah, will require the necessary diagnostic testing for diseases. This will require a small number of fish to be sacrificed, so numbers of fish above the stocking plan will need to be raised to meet this requirement. The most obvious need will be razorback sucker brought in from Colorado to meet the Lower Green River stocking number. Bonytail raised in Colorado will be stocked into Colorado waters, but will undergo the necessary treatment for Asian tapeworm.

Table 8. Production of endangered fish for Upper Colorado River Endangered Fish Recovery Program.

Year	Razorback sucker			Bonytail			Colorado pikeminnow	
	Survival	Grand Junction	Ouray	Survival	Mumma	Wahweap	Survival	Mumma
0	0.75	28,371	28,371	0.75	7,896	15,793	0.75	5,333
1	0.70	21,279	21,279	0.90	5,922	11,844	0.75	4,000
2		14,895	14,895		5,330	10,660	0.75	3,000
3								2,250

5.0 EVALUATION OF STOCKING SUCCESS

At least for the first couple of years, the evaluation of stocked fish will be conducted through other projects under population estimates and nonnative fish control. It is recognized, that at a later time, spawning success and recruitment of subadults to adults will be required.

6.0 LITERATURE CITED

- Hudson, J.M. 2001. State of Utah stocking plan for endangered fish species of the Upper Colorado River Basin, revised plan. Utah Division of Wildlife Resources, Salt Lake City, Utah.
- Nesler, T.P. 2001. Stocking plan for endangered Colorado River fish species in Colorado. Colorado Division of Wildlife, Denver, Colorado.
- Nickum, J.G. 1988. Guidelines for use of fishes in field research. *Fisheries* (Bethesda, Maryland) 13: 16–23.
- Stemple, M., and R. Wydoski. 1995. Final environmental assessment: disposition of captive-reared endangered Colorado River fish. U.S. Fish and Wildlife Service, Denver, Colorado.

APPENDIX A

GUIDELINES FOR DISPOSITION OF CAPTIVE-REARED ENDANGERED FISH

- A. Background. Many propagation activities may produce more fish than are needed to meet specified requirements. This additional production allows the hatchery manager to compensate for unknown or unpredictable attrition rates to ensure that specified requirements are met. These guidelines provide the protocol for disposition of such fish.

Planned captive propagation minimizes the production of endangered fish that will be excess to Recovery Implementation Program (Program) needs and reduces demands on resources (i.e., people, funds, and space). The number of endangered fish that are reared for Program needs depends upon:

1. Captive propagation goals and objectives
2. Breeding strategy or mating system used
3. Fecundity of the endangered fish
4. Anticipated mortality during culture
5. Method used to culture endangered fish
6. Uncertainty of production during captive culture, and
7. Availability of culture facilities

“Stocking plans” and annual “Scopes of Work” that are required by the Program should be prepared well in advance of projected field or laboratory studies so that endangered fish needs can be incorporated into planned production. This is especially important if large or mature endangered fishes are needed for the studies. For example, approximately 5 years are needed to produce mature bonytail and humpback chubs and 7 years are needed to produce adult razorback sucker and Colorado squawfish.

All endangered fish propagation will be done in accordance with Program “Genetics Management Guideline” (i.e., philosophy, goals, and general procedures for maintaining genetic diversity similar to wild stocks), “Genetics Management Plan (i.e., classification of endangered fish species or stocks and establishing priorities using information on status and trends), and “Stocking Plans” (i.e., specific details on species, specific stocks of fish, numbers of fish size[s], time of stocking, and method[s] to evaluate stocking).

All wild endangered fish used to develop broodstocks for captive propagation will be released back into the wild when pedigreed family lots of their progeny have been established.

- B. Procedures for Disposition of Captive-Reared Endangered Fish. Production targets are based on the numbers of fish that were identified for specific Program needs. Under normal operating procedures, unfit fish (e.g., hybrids, genetically deformed, those with untreatable contagious diseases, etc.) will be euthanized following accepted protocol of the fisheries profession. Fish identified as surplus to Program requirements should be

reported at any time to the Propagation and Nonnative Fish Coordinator who will notify appropriate persons of their availability. Relevant information should be provided to the Coordinator such as numbers of fish that are available, size and/or age, specific stock, breeding strategy used, etc.

At a minimum all captive-reared endangered fish in Program propagation facilities will be summarized in an Annual Operation Plan. In this annual plan, all fish that are no longer needed for specific Program purposes will be identified as surplus to Program requirements.

Disposition of such fish will be done by priority:

1. Captive-reared endangered fish will be used to meet Program needs for genetic refugia, broodstock development, approved Program laboratory/field experiments, and planned augmentation or restoration stocking.
2. Provide fish for other research studies that were not identified in annual Program Statements-of-Work or in Table 1 of the Annual Propagation Operation Plan.
3. Provide fish to agencies in the Lower Colorado River Basin for use in research and augmentation or restoration stocking.
4. Provide fish for information and education programs as well as public display:

NOTE: Appropriate Federal and State permits must be obtained before such fish are transferred. Contact the appropriate State Supervisor, Ecological Services, U.S. Fish and Wildlife Service for information related to Federal permits: Colorado - 303-231-5280; North Dakota - 701-250-4402; Utah - 801-524-5001; Wyoming - 406-449-5225; or Chief of Endangered Species in the Regional Office in Denver, Colorado - 303-236-7398.

5. Maintain fish for possible future use if space is available and the cost is not prohibitive.

NOTE: Documentation of Priorities 1 through 5 will be made before the disposition described in priorities 6 and 7 are pursued. The Regional Director of the U.S. Fish and Wildlife Service will seek review and input from the Management Committee on any action involving the disposition of captive-reared endangered fish. The Regional Director is responsible for actions related to endangered species in this Region and must approve Priority 6 and 7 actions.

6. If fish are not used for purposes described in Items 1 through 5, they will be euthanized following accepted protocol of the fisheries profession (Nickum 1988).

These specimens will be provided as reference fish collections for museums or as teaching collections in colleges or universities.

7. If fish are not needed for uses identified in Items 1 through 6, they will be euthanized following the accepted protocol of the fisheries profession (Nickum 1988).
 - (A) These fish may be used to obtain tissues or organs for determining levels of contaminants, age determination from otoliths, or other studies.
 - (B) If the fish are not needed for any of the uses described, they will be discarded using appropriate methods.
 - (C) For instructions on correct procedures, contact Assistant Regional Director - Law Enforcement, U.S. Fish and Wildlife Service, P.O. Box 25486 - Denver Federal Center, Denver, Colorado 80225. The telephone number of that office is 303-236-7540 and FAX number is 303-236-7901.
 8. The disposition of wild or captive-reared endangered fish that have died while in captivity will follow the guidance provided in Section 7 (A), (B), and (C).
- C. Euthanasia Protocol. Euthanasia of excess fish will follow recommendations in the “Guidelines for Use of Fishes in Field Research” that were developed jointly by the American Fisheries Society, American Society of Ichthyologists and Herpetologists, and American Institute of Fisheries Research Biologists (Nickum 1988).
- D. Appropriate Procedures for Disposition of Surplus Captive-Reared Endangered Fish. All actions involving the disposition of captive-reared endangered fish must be covered by appropriate Federal and State permits.

For instructions on correct procedures, contact the Assistant Regional Director - Law Enforcement, U.S. Fish and Wildlife Service, P.O. Box 25486 - Denver Federal Center, Denver, Colorado 80225. The telephone number of that office is 303-236-7540 and FAX number is 303-236-7901.

Also, check with the appropriate State Fish and Wildlife Agency regarding State permit requirements.