APACHE TROUT (*Oncorhynchus apache)*

DRAFT RECOVERY PLAN

(Second Revision)
(Original Approved: August 20, 1979)
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An electronic version of this recovery plan will also be made available at:
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Cover artwork by Marco M. Mazzoni.

ABBREVIATIONS AND DEFINITIONS USED

AGFD =	Arizona Game and Fish Department
AMP =	Allotment Management Plan
ASNF =	Apache-Sitgreaves National Forest
AZFRO =	Arizona Fishery Resource Office, U.S. Fish and Wildlife Service
BIGB =	Big Bonito Creek system (Big Bonito, Hurricane, Hughey, and Pea Soup)
BVET =	Basinwide Visual Estimation Technique
CNF =	Coronado National Forest
ESA =	Endangered Species Act of 1973, as amended
EFLCR =	East Fork Little Colorado River
EFWR =	East Fork White River
FAIR =	Fort Apache Indian Reservation
GAWS =	General Aquatic Wildlife System
KNF =	Kaibab National Forest
LCR =	Little Colorado River
NEPA =	National Environmental Policy Act of 1969
OPTU =	Old Pueblo Chapter of Trout Unlimited, Tucson, Arizona
PFHC =	Pinetop Fish Health Center, U.S. Fish and Wildlife Service
SFLCR =	South Fork Little Colorado River
TNF =	Tonto National Forest
USBR =	United States Bureau of Reclamation, Department of the Interior
USFS =	United States Forest Service, Department of Agriculture
USFWS =	United States Fish and Wildlife Service, Department of the Interior
WCNFH =	Williams Creek National Fish Hatchery, U.S. Fish and Wildlife Service
WMAT =	White Mountain Apache Tribe
WFBR =	West Fork Black River
WFLCR =	West Fork Little Colorado River

Electrophoresis: A process where an electrical current is applied to DNA molecules to separate them by size and electrical charge.

Karotyping: An individual's chromosomal content, including abnormalities and number of chromosomes.

Mitochondrial DNA analysis: Analysis of the genetic material contained in mitochondria.

Pure: Apache trout that do not possess discernible genetic material from another non-native salmonid species (i.e., rainbow trout, cutthroat trout).

Relict population: One of 13 natural pure populations of Apache trout on the Fort Apache Indian Reservation: Big Bonito, Boggy/Lofer, Coyote, Crooked, Deep, East Fork White River, Elk Canyon, Firebox, Flash, Little Bonito, Ord, Smith, and Soldier creeks.

Replicated population: A population of Apache trout that has been established through

translocation of wild fish from a relict population stream, another replicated population stream, or hatchery stock derived from a relict population or replicated population stream.

Population: all individuals which occur in a specified area, have a common ancestry, or are potentially able to interbreed.

Self-sustaining population: A population that is characterized by presence of multiple age classes and evidence of periodic natural reproduction.

Established population: A population that is capable of persisting under the range of variation in habitat conditions that occur in the restoration stream (Propst and Stefferud 1997).

Secured stream or population: A population or stream where threats have been eliminated or reduced to the point that allows Apache trout to be self-sustaining.

Stream order: The smallest unbranched tributary is called a 1st order stream; the stream receiving 1st order streams is a 2nd order stream; the stream receiving 2nd order streams is a 3rd order stream, etc.

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Current and Former Recovery Team Members

Former Members	Years	Affiliates (grouped by agency)
Joseph L. Stone, AGFD	1975-1977	Chuck Benedict, AGFD
William Silvey, AGFD	1975-1980	Robert H. Bettaso, AGFD
John K. Adams, USFS	1975-1976	Scott D. Gurtin, AGFD
Ronald E. Gumtow, USFWS	1975-1976	Julie M. Meka, AGFD
Kevin Ryan, USFWS	1976-1978	Kelly Meyer, AGFD (formerly WMAT)
James McKibben, USFS	1976-1978	Tony Robinson, AGFD
Kenneth C. Harper, WMAT	1977-1978	Terry L. Myers, USFS
John Caid, WMAT	1979-1992	John N. Rinne, USFS
James N. Hanson, USFWS	1978-1995	Amy Unthank, USFS
Gary A. Davis, USFS	1978-1984	Bill Wall, USFS
James E Brooks, AGFD	1981-1985	Paul Barrett, USFWS
J. Robert Vahle, USFS	1984-1986	Gary J. Carmichael, USFWS
Leon Fager, USFS	1986-1992	Robert E. David, USFWS
Kelly Meyer, WMAT	1992-1998	George Divine, USFWS
Gary Bell, USFS	1992-1995	Leslie Hartsell, USFWS
Thomas Cain, USFS	1992-1997	Chuck Minckley, USFWS
Stuart C. Leon, USFWS	1995-1999	Jeremy Voeltz, USFWS
James R. Novy, AGFD (former Team leader)	1977-2001	Donald C. Morizot, Univ. of Texas
Mark Whitney, USFS	2000-2004	Tom Turner, Univ. of New Mexico
Alex Puglisi, WMAT	2003-2007	

Current Members (by starting year)

Scott J. Reger, AGFD	1992-
Kirk L. Young, AGFD	1993-
Jerry G. Ward, USFS	1995-
Tim Gatewood, WMAT	2000-
L. Stewart Jacks, USFWS	2000-
Robert W. Clarkson, USBR	2000-
Mike Lopez, AGFD	2002-
Lawrence M. Riley, AGFD (current Team leader)	2003-
Travis Clarkson, WMAT	2003-

EXECUTIVE SUMMARY

Current Species Status

Apache trout (*Oncorhynchus apache*, formerly called *Salmo apache* or Arizona trout*)* is one of two salmonid species native to Arizona (the other is Gila trout, *Oncorhynchus gilae*), and is currently listed as threatened (Federal Register 40 (137): 29863-29864). Once considered endangered, a re-analysis of species status led to its downlisting in 1975. Reclassification to threatened status included a 4(d) rule under the Endangered Species Act (ESA), allowing Arizona to regulate take of the species and to establish sport fishing opportunities. Currently, 25 pure Apache trout populations exist within historic range in Gila, Apache, and Greenlee counties of Arizona, on lands of the Fort Apache Indian Reservation (FAIR) and Apache-Sitgreaves National Forests (ASNF) (See Table 1). Also, several populations were introduced beyond what is now considered the species' historic range. Currently, four streams within historic range on ASNF (Boggy, Centerfire, Conklin, and Hannagan Creek) and six streams on FAIR (Coon, Little Diamond, Moon, Reservation, Rock, and Sun creeks) have been confirmed as having hybridized populations of Apache trout (e.g., crossed with rainbow trout [*Oncorhynchus mykiss*] or cutthroat trout [*Oncorhynchus clarki*]). Recovery and management efforts for Apache trout have been ongoing since the 1940s. Apache trout are raised in Federal and state hatcheries, and reared fish have been used to assist with recovery and to maintain populations for sportfishing in certain streams and reservoirs.

Habitat Requirements and Limiting Factors

Apache trout evolved in streams primarily above 1,800 m elevation, within mixed conifer and ponderosa pine forests. Apache trout generally require water temperatures below 25° C (77° F). Adequate stream flow and/or shading are generally required to prevent lethal temperatures and ample stream flow helps maintain pools that are used frequently during periods of drought and temperature extremes. Apache trout require clean coarse gravel substrates for spawning. Recovery streams that are subject to land-use practices such as timber harvest/thinning, prescribed fire, and livestock grazing should be managed to maintain healthy riparian corridors that promote sufficient habitat conditions to allow for all life functions including spawning, hatching, rearing, foraging, loafing, migrating, and over-wintering. Prey of Apache trout consists mostly of invertebrates, which are typically abundant in healthy streams. Apache trout often use cover in the form of woody debris, pools, rocks/boulders, undercut streambanks, or overhanging vegetation at stream margins. Recovery streams (or portions thereof) must have conditions favorable to persistence of Apache trout including minimization or elimination of threats from competitive brown trout or brook trout, and elimination of interbreeding rainbow or cutthroat trout.

Factors in the decline of Apache trout

Watershed alterations related primarily to forestry, livestock grazing, reservoir construction, agriculture, road construction, and mining have been identified as causes for reduction of Apache trout habitat in the White Mountains of Arizona (USFWS 1983). Such alterations damage riparian vegetation and streambank morphology and stability, which increases stream

erosion and can ultimately result in higher sediment loads. These effects increase susceptibility to habitat damage from floods, decrease quality and quantity of spawning and rearing areas, alter stream flow volume and temperatures, and alter stream productivity and food supply (e.g., stream dwelling insects). In addition, introductions of non-native trout [i.e., brook (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*)] have led to competition for resources and predation, or hybridization with congeneric rainbow trout or cutthroat trout. Collectively, these factors have varied in intensity, complexity, and damage depending on location, ultimately reducing the total occupied range and the ability of Apache trout to effectively persist at all life stages.

Strategy from the 1983 Recovery Plan

The recovery team prepared an initial recovery plan for Apache trout in 1979, which was updated in 1983 (USFWS 1979, 1983). Recovery actions have been guided by this document and have focused on 1) surveying and addressing the genetic status (purity) of existing populations and protecting those populations, 2) eliminating non-native trout species and subsequently reintroducing Apache trout in selected streams within historic Apache trout habitat, 3) surveying populations and habitat conditions, and developing and implementing habitat improvement measures, and 4) developing a hatchery broodstock and enhancing sport fisheries for the species. The main objective was to: "establish and/or maintain 30 self-sustaining discrete populations of Arizona trout throughout its historic range."

The 1983 Recovery Plan included several streams where Apache trout were introduced, eight of which are now considered outside historic range including Ash, Big, Deadman, Grant, and Marijilda creeks on the Coronado National Forest (CNF), Horton Creek (Tonto National Forest [TNF]), and Coleman and Grant creeks (ASNF; USFWS 1983).

Revised Strategy

The purpose of this revision is to include current information about the status of the species, additional information about the species gained through population surveys and genetic analysis, and to comprehensively address the five factors that are considered when listing a species under the ESA and how each factor will be addressed through the recovery criteria in this plan.

<u>Recovery Goal:</u> Implement necessary actions to delist Apache trout.

<u>Recovery Criterion:</u> Establish and maintain 30 self-sustaining populations that conserve, to the maximum extent practicable, the remaining genetic diversity of the species. A population is defined as all the individuals that occur in a specified area, have a common ancestry, or are potentially able to interbreed (Pianka 1978). A population will be considered self-sustaining by the presence of multiple age classes and evidence of periodic natural reproduction. A population will be considered established when it is capable of persisting under the range of variation in habitat conditions that occur in the restoration stream (Propst and Stefferud 1997).

<u>Recovery Objectives:</u> The basic strategy is to establish and maintain 30 self-sustaining populations to restore Apache trout to a non-threatened status and address/ameliorate the five listing factors.

Recovery efforts involve five objectives:

I. Assess, prepare, protect, and maintain habitats that are sufficient to allow for all life functions at all life stages, and establish and maintain 30 self-sustaining populations.

II. Implement appropriate laws and regulations to allow Apache trout populations to persist.

III. Monitor, prevent, and control disease and/or causative agents, parasites, and pathogens.

IV. Comply with Federal, state, and tribal regulatory processes.

V. Continually identify, assess, and ameliorate threats to Apache trout.

When the recovery criterion and objectives have been achieved, pure Apache trout will exist in at least 30 stream systems in approximately 300 kilometers (km) of secured stream habitat within the species' historical range (Table 1). The streams will be comprised of the following:

- Thirteen relict populations on FAIR: Big Bonito, Boggy/Lofer, Coyote, Crooked, Deep, Elk Canyon, Flash, Firebox, Little Bonito, Ord, Smith, and Soldier (partially on ASNF) creeks, and East Fork White River;

- Twelve streams with existing replicated populations: Bear Wallow (ASNF), Coyote/Mamie (ASNF), Fish (ASNF), Hayground (ASNF), Lee Valley Creek (ASNF), Mineral (ASNF), Paradise (FAIR), Squaw (FAIR), Thompson (FAIR), and Wohlenberg Draw (FAIR) creeks; and the East Fork Little Colorado (ASNF) and West Fork Black (ASNF) rivers;

- Six additional streams have been identified as potential recovery streams, all of which are on the ASNF: Conklin, Centerfire/Boggy/Wildcat, Snake, and Stinky creeks, and South Fork Little Colorado and West Fork Little Colorado rivers.

Conservation and management actions will continue beyond delisting to preserve or expand secured habitats, maintain adequate sportfishing opportunities, and monitor populations. All threats, including those that initiated protection through listing under the Endangered Species Act of 1973 (ESA 1973) must be continuously identified, monitored, and addressed.

All pure populations will require monitoring for persistence and sustainability. Non-native fishes present in recovery streams will be eliminated to prevent the potential for hybridization, competition, and/or predation. Similarly, populations in streams that contain a mix of Apache trout and/or hybrids (within historic Apache trout habitat) should be monitored to evaluate population levels as well as backcrossing and introgression (Hannagan Creek on ASNF; and Coon, Little Diamond, Reservation, Sun, and Moon creeks on FAIR).

With the exception of North Canyon Creek (KNF), which is outside the historical range of

Apache trout but is inhabited by a pure population of Apache trout from a relict lineage, the remaining populations established outside historical range are hybridized (Ash, Big, Grant, and Marijilda creeks [CNF]; Grant, Coleman, KP, and McKittrick creeks [ASNF]). Some of these streams are now considered within historical range for Gila trout and may be renovated and stocked with Gila trout in the future (Ash and Marijilda creeks [CNF]; Grant, Coleman, KP, and McKittrick creeks [ASNF]) (USFWS 2003). At present, selected small coldwater reservoirs currently managed for sport fishing on ASNF and FAIR may receive periodic stocking of hatchery-reared Apache trout (see Appendix 1). Although the North Canyon Creek population should be maintained, as it contains an important lineage of pure Apache trout, only a stream within the historical range of Apache trout will be considered one of the 30 streams necessary for recovery of the species.

Proposed Actions

- Complete any required regulatory compliance.
- Construct new fish barriers and maintain existing fish barriers.
- Habitat enhancement or improvement in recovery streams as warranted.
- Remove or minimize undesirable fishes using piscicides or other feasible means in all or portions of recovery streams.
- Establish and maintain 30 self-sustaining populations of pure Apache trout.
- Monitor all populations.

Implementation Participants

The U.S. Fish and Wildlife Service, U.S. Forest Service, Arizona Game and Fish Department, White Mountain Apache Tribe, Trout Unlimited, Federation of Fly Fishers, and Wildlife Conservation Council are participants in planning and implementing recovery actions for Apache trout.

A partnership was developed to promote collaborative conservation among various government and non-government entities including the ASNF, AGFD, the USFWS, Trout Unlimited, the Wildlife Conservation Council, and Federation of Fly Fishers. A Memorandum of Understanding (MOU: AZ A.G. Contract No., KR001230-EQS, Forest Service Agreement No. 00-MU-11030121-005) was implemented in 2000 for the recovery of the endangered Gila trout and threatened Apache trout, as well as the recovery of the watersheds they inhabit on the ASNF. More specifically, the MOU provides a formal agreement that established the framework for cooperative management activities and research necessary to facilitate recovery and conservation of native fish communities. The partnership has fostered greater public involvement in proposed recovery actions. Partners have donated funds, volunteered time to accomplish field activities, provided expertise, and drafted grant proposals to fund recovery efforts.

Estimated Cost of Recovery and Future Post-Delisting Management: Total estimated cost of recovery and management (in $1,000s). Cost is based on 2007 dollars.

Year	Objective 1: Establish/maintain habitats and populations	Objective 2: Implement laws and regulations for populations to persist	Objective 3: Monitor, prevent, control disease	Objective 4: Determine adequacy of regulatory processes	Objective 5: Identify and ameliorate threats	Total
Year 1 (2007)	415	40	20	40	20	535
Year 2 (2008)	230	40	20	40	20	350
Year 3 (2009)	170	20	20	20	20	250
Year 4 (2010)	155	20	20	20	20	235
Year 5 (2011)	155	20	20	20	20	235
Year 6 (2012)	100	20	20	20	20	180
Year 7 (2013)	100	20	20	20	20	180
Total	1325	180	140	180	140	1965

Date of Recovery: It is estimated that the actions necessary to prepare streams, establish, and maintain 30 populations to restore Apache trout to a non-threatened status and address/ameliorate the five listing factors can be achieved by the end of 2007. It is estimated that delisting can be initiated in 2008.

CHAPTER 1: INTRODUCTION

Apache trout are endemic to high elevation streams in the upper Black, White, and Little Colorado River drainages in east-central Arizona. Apache trout were collected from headwaters of the Little Colorado River in the middle 1870s. However, it was not recognized as a distinct species until 1972, by which time its distribution had been dramatically reduced (Miller 1972). Apache trout and Gila trout, as well as Mexican golden trout (*Oncorhynchus chrysogaster*) represent the most divergent groups of inland trout, indicating the longest isolation from all evolutionary lines of rainbow trout, perhaps dating from the early to mid-Pleistocene (Behnke 1992).

In the late 1800s, substantial harvest of trout was documented in the areas historically occupied by Apache trout (Figure 1). Introduction of non-native trout species and degradation of habitat associated with modern day settlement rapidly eliminated or reduced most populations of Apache trout in a span of about 50 years (Behnke and Zarn 1976; Harper 1978). Habitat alterations were associated principally with timber harvest, grazing of domestic livestock, road construction, water diversions, reservoir construction, and to a lesser extent mining (sand and gravel operations). Consequently, their range was thought to have decreased to approximately 48 stream km by the mid 1900s from a total historic range estimated by Harper (1978) at 965 km and more recently estimated at 1,320 km based on Geographical Information System (GIS) mapping (Matt Alderson, AGFD personal communication).

Conservation of Apache trout was first attempted by the White Mountain Apache Tribe (WMAT) in the late 1940s and 1950s when the only known populations existed on the FAIR. In 1955, WMAT closed most streams within the FAIR boundaries of the Mount Baldy Wilderness Area to fishing (other FAIR streams deemed important to Apache trout conservation were closed to fishing in the early 1990s). Interest in Apache trout continued and substantially increased during the early 1960s, resulting in fishery surveys carried out by the USFWS and AGFD in cooperation with WMAT to determine species status. In conjunction with these surveys, AGFD, again in cooperation with WMAT and USFWS, entered into a controlled propagation program. As part of the Federal and State Apache trout recovery effort, stocking of Apache trout into streams began in 1963.

In a WMAT resolution dated November 10, 1964, the Tribe adopted a management plan proposed by USFWS that called for the construction of fish barriers and chemical renovation of streams for the reintroduction of Apache trout. As part of this plan, WMAT renovated Sun and Moon creeks and constructed an impoundment (Christmas Tree Lake) at their confluence. In 1965 the WMAT, by resolution, closed Ord Creek, the upper reaches of East Fork White River, and Paradise Creek (including tributaries) to fishing. Christmas Tree Lake filled in the spring of 1967, and Apache trout were stocked from Ord, Firebox, and Deep creeks. For their efforts, WMAT received the United States Department of Interior (USDI) Conservation Service Award in 1969.

Apache trout was considered endangered under the Federal Endangered Species Preservation Act of 1966 (USFWS 1967), and the species became federally protected with passage of the

ESA in 1973. A recovery team was formed, and in 1975 Apache trout was one of the first species to be downlisted from endangered to threatened after re-evaluation of its status. The downlisting with a 4(d) rule allowed AGFD and WMAT to selectively establish sport fishing opportunities. Recovery actions have been ongoing for over four decades, with delisting as the ultimate goal. Pure populations of Apache trout are currently present in at least 25 streams within historical range across the FAIR and ASNF (Table 1).

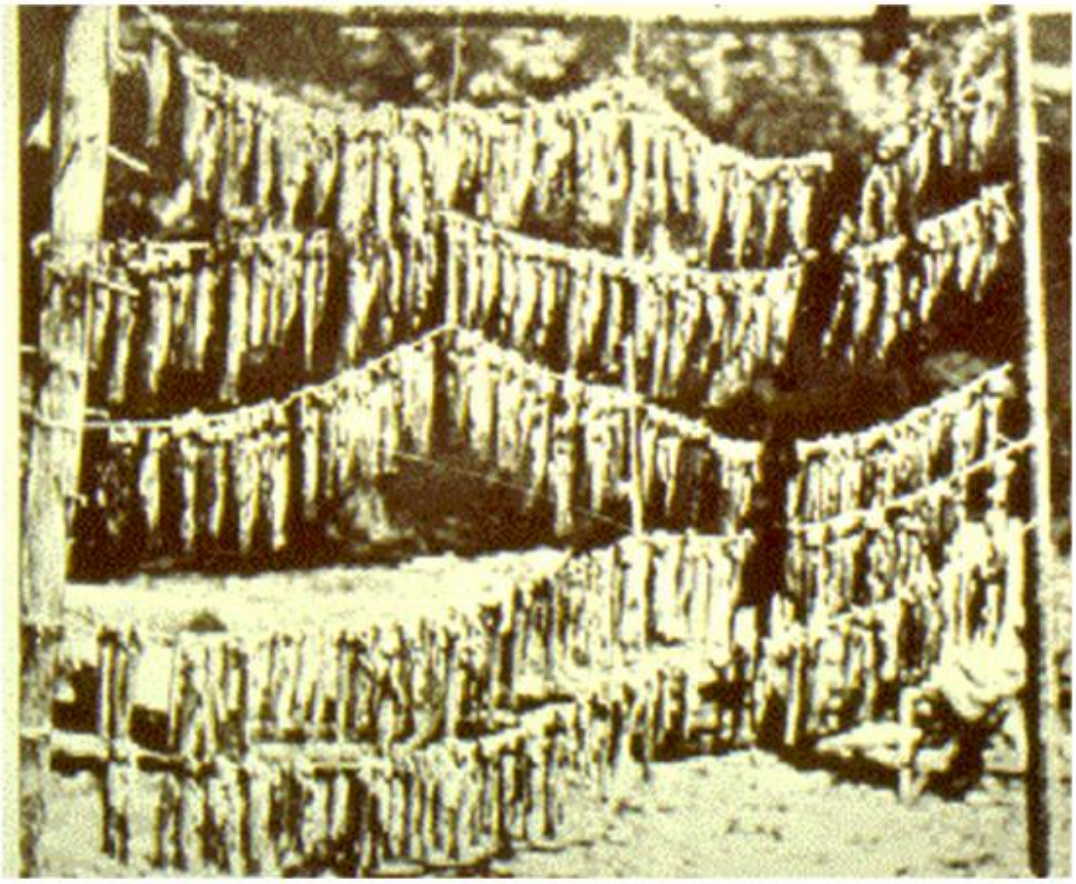

Figure 1. Photograph entitled “A Days Catch, White Mountains near Springerville, Arizona”. Date was thought to be pre 1900s, and the location was thought to be Becker Creek, Fort Apache Indian Reservation.

CHAPTER 2: SPECIES DESCRIPTION

Physical Characteristics

Distinguishing characteristics of Apache trout include a deep and laterally compressed body, a large dorsal fin, with spots on the body pronounced and often uniformly spaced both above and below the lateral line (Figure 2). Spots are circular in outline, medium-sized and appear slightly smaller than most interior subspecies of cutthroat trout, but more like typical cutthroat trout than Gila trout (Miller 1972). Yellow or yellow-olive colors predominate, with tints of purple and pink observable on live specimens. A red or pink lateral band is typically absent (Miller 1972). However, a single specimen obtained from the renovation of Ord Creek in 1977 (Rob Clarkson, USBR personal communication) and specimens captured during renovation of Hurricane Creek and Hurricane Lake on the FAIR in 1987 included fish with a red or pink lateral band. Biochemical genetic analyses of the latter specimens revealed they were indistinguishable from Apache trout (G. J. Carmichael, personal communication). Dorsal, pelvic, and anal fins have conspicuous cream or yellowish tips. A yellow cutthroat mark is usually present and basibranchial teeth are occasionally present (Miller 1972). Vertebrae number 58-61; pyloric caecae number 21-41; scales number 133-172 in lateral line series (2 rows above lateral line), and scales above the lateral line (origin of dorsal fin to lateral line) number 32-40 (Behnke 1974; Behnke and Zarn 1976).

Rinne (1985) and Rinne and Minckley (1985) completed the first comprehensive inventory of Apache trout populations in Arizona. Between 1977 and 1982, trout were collected from 46 streams and analyzed to describe and characterize meristic (numbers of vertebrae, pyloric caecae, and scales above the lateral line) and morphometric variation (snout length, length of dorsal fin base, depressed length of dorsal fin, length of anal finbase, depressed length of anal fin, and depressed length of adipose fin). Results indicated a wide range of morphometric characters for native trout, and that initial descriptions (Miller 1972) did not account for the total physical variation in Apache trout.

Figure 2 Drawing of Apache trout by Randy Babb, Arizona Game and Fish Department.

Genetics

The Apache trout is recognized by the American Fisheries Society as a subspecies of Gila trout due to their close relationship (Nelson et al. 2004). Both species are more closely related to rainbow trout than cutthroat trout (Loudenslager et al. 1986; Dowling and Childs 1992). This suggests that Gila and Apache trout derived from a common ancestral form that also gave rise to rainbow trout (Loudenslager et al. 1986; Behnke 1992). Apache trout (and Gila trout) possess 56 diploid chromosomes with a total arm number of 106 (Miller 1972). This allows for distinction with cutthroat trout that possess 64-68 chromosomes, as well as rainbow trout with 58-64 chromosomes and 104 chromosomal arms (Behnke 1992).

Behnke (1992) recognized the Gila and Apache trout as two subspecies based on karyotyping, electrophoresis, and mitochondrial DNA comparisons, all of which have substantiated the taxonomic relationship of the two trout. Loudenslager et al. (1986) presented data from electrophoretic analysis of 36 gene loci for four populations of Gila trout and five populations of Apache trout that were compared with Rio Mayo (Mexican) trout (*Oncorhynchus spp.*), two populations of hatchery rainbow trout, and three subspecies of cutthroat trout (Lahontan *Oncorhynchus clarki henshawi*, Yellowstone *O. c. bouvieri*, and Colorado River *O. c. pleuriticus*). Data were compared to previous morphological analyses of these trout (David 1976; Rinne 1978, 1985). The index of genetic similarity between Apache trout and Gila trout was high at 0.93.

Thirty-one populations of Apache trout on FAIR and ASNF were sampled between 1987 and 1989 to detect hybridization among Apache, cutthroat, and rainbow trout (Carmichael et al. 1993). Unhybridized populations of Apache trout were found in 11 populations including White River and Hurricane (Big Bonito system), Flash, Crooked, Deep, Boggy, Firebox, Elk Canyon, Soldier, Lofer, and Coyote creeks, 10 of which accounted for one of the 13 Apache trout lineages (Boggy and Lofer Creek strains were the same). Unhybridized populations of Apache trout were also confirmed as part of this effort including Big Bonito/Hughey/Peasoup, Little Bonito, and Smith creeks, all of which account for the remaining three lineages. Additional pure populations of Apache trout on ASNF were confirmed including Coyote, Hayground, Home, Mineral, Soldier, Stinky, and Wildcat creeks, and West Fork Black River (Wares et al. 2004), two of which are presently scheduled for renovation due to presence of non-native trout (Stinky and Wildcat creeks). They found strong differentiation among lineages, and high levels of genetic variation within and among populations.

Evidence of hybridization has been detected among some populations consisting of Apache, cutthroat, and rainbow trout, with introgression from rainbow trout most prevalent (Carmichael et al. 1993; Wares et al. 2004). Hybrid Apache trout were originally identified based on physical (meristic and morphometric) characteristics described in the previous section (Rinne 1985; Rinne and Minckley 1985). Modern genetic techniques included the use of isozyme locus polymorphisms that are, in aggregate, diagnostic for discrimination of Apache trout, rainbow trout, and cutthroat trout (Carmichael et al. 1993). They can be used to assess extent and directionality of inter-specific hybridization and were used to test 645 individuals from 31 wild populations within the historical range of Apache trout (Carmichael et al. 1993). Additional

genetic analysis techniques have been used to detect hybridization including microsatellite and mitochondrial DNA analyses (Wares et al. 2004). In the majority of hybridized populations sampled, a trend of backcrossing toward Apache trout was evidenced and no pure rainbow trout or cutthroat trout were identified (Carmichael et al. 1993).

Two streams outside historical range have pure replicate populations, North Canyon Creek (Ord Creek stock) and Coleman Creek (Soldier Creek). North Canyon Creek received Ord Creek stock in the early 1960s. The Ord Creek population was subsequently compromised by brook trout and was eventually re-renovated and replaced with stock from Coyote (ASNF) and North Canyon (KNF) creeks in 1996. Porath and Nielsen (2003) confirmed introgressed populations of Apache trout (with rainbow trout) in four Pinaleno Mountain (CNF) streams (Ash, Big, Grant, and Marijilda creeks) that were established from Ord Creek stock from 1965 to 1971. Additional streams outside Apache trout historical range that contain hybridized populations include Grant and KP creeks (ASNF).

CHAPTER 3: HISTORIC AND CURRENT DISTRIBUTION

Historic Distribution

Distribution of Apache trout (and Gila trout) prior to European colonization is not known with absolute certainty. The original distribution of Apache trout was described as upper Salt River drainage (Black and White rivers), San Francisco River drainage (Blue River), and headwaters of Little Colorado River, Arizona (Miller 1972). Experts have struggled with the question of what prevented Apache trout from becoming established in the Verde and Agua Fria drainages, tributaries to the Salt River that are now considered historical habitat of Gila trout. For example, the “Verde trout”, named for specimens collected from Oak Creek in the late 1800s, closely resembled Gila trout but also possessed Apache trout characteristics (Behnke 2002). Specimens that have been collected that exhibit physical characteristics of both Apache and Gila trout may be indicative of an intermediate species formed by hybridization of both species. Many streams in the White Mountains support populations that display both Apache and rainbow trout characteristics (hybrids; Carmichael et al. 1993). Based on extensive sampling, analysis of physical characteristics and genetic material, and recent GIS mapping, it is generally accepted that Apache trout historically inhabited approximately 1,320 km (820 miles) of streams in east central Arizona's White Mountains above 1,800 meters (6,000 feet) elevation in the upper White and Black rivers and Little Colorado River basins (Figure 3). Routine monitoring surveys and further genetic testing may reveal information that could result in a more comprehensive understanding of the distribution of Apache trout and Gila trout populations.

The distribution of Apache trout in the Black, White, and Little Colorado River drainages is confirmed by present hybrid populations and documented collections (Rinne 1985; Loundenslager et al. 1986; Carmichael et al. 1993). Many early White Mountain area settlers reported the presence of native trout, which they referred to as yellow-bellied, speckled trout (USFWS 1983). Brown (2003) conducted research on historic newspaper articles and found several that reported fishing opportunities for wild trout, and quoted an article from the *Phoenix Herald* from January 26, 1878:

> "The main upper branches of the Salt River, the White and Black rivers, are both swift running streams, and rise in the White Mountains. They are well stocked with the real speckled mountain trout, affording rare sport to followers and devotees of Izaak Walton."

Apache trout collections from the White River were first described as a variety of Colorado River cutthroat trout (*Salmo pleuriticus)* (Cope and Yarrow 1875). Specimens collected from the headwaters of the Little Colorado River were referred to as *Salmo mykiss pleuriticus* (Jordan and Evermann 1896). Subsequent authors referred to native trout of the White Mountains as *Salmo gilae* until the 1970s. Miller (1972) once believed that Apache trout gained access to the Little Colorado River (LCR) via human activities. Further research indicated the species was collected in the LCR basin prior to 1896 (Jordan and Everman 1896). A canal diverting water from the Black River drainage to Colter Reservoir (LCR drainage) was not completed until 1897, after Apache trout were collected in the LCR. Thus, Apache trout were believed to have migrated naturally between the LCR, White, and Black River drainages during periods of extreme spring snow melt or precipitation.

The amount of habitat occupied by Apache trout was thought to have dropped to a low of about 48 km by 1976 (Harper 1976). Based on recent GIS analyses (Matt Alderson, AGFD personal communication), perennial streams above 1800 m elevation encompass approximately 1,320 km of habitat that was likely suitable for Apache trout. Excluding hatchery populations currently managed for sportfishing, the present distribution of relict and replicated Apache trout populations occur in 25 stream systems within its historic range in approximately 190 km of stream. Additional hybridized populations occur within ten stream systems.

<u>Salt River Watershed: Verde River and Agua Fria River Drainage</u>

As mentioned above, the former distribution of Apache trout has been confused with that of Gila trout. Specimens collected in 1913 from Oak Creek (Verde River drainage) were identified as hybrid Gila trout x rainbow trout by Miller (1972). Those specimens exhibited morphological characteristics of Apache trout but spotting patterns of Gila trout, suggesting a possible intergrade of the two species. Additional samples of trout from Sycamore Creek (Agua Fria River drainage) were identified as hybrids (Gila trout x rainbow trout; Behnke and Zarn 1976). Thus, there is no decisive evidence to suggest that Apache trout occupied upper portions of the Verde and Agua Fria drainages.

<u>Gila River Watershed: San Francisco River and Blue River Drainage</u>

All specimens of native trout collected from the Gila River drainage (excluding the Salt River drainage above barrier falls in Salt River canyon) have been identified as Gila trout. This includes a 1973 collection (currently lost) from Chitty Creek (tributary to Eagle Creek), tentatively identified as hybrid Gila trout x rainbow trout (W.L. Minckley and R. Miller, personal communication). Kynard (1976) disagreed with this identification and suggested the Chitty Creek population was a subspecies of Apache trout. Re-sampling and genetic testing of the Chitty Creek population has been conducted since then, and Dowling and Childs (1992) and

Genetic Analysis Incorporated Laboratories (1994) have identified fish currently inhabiting Chitty Creek as rainbow trout.

Specimens collected by F.W. Chamberlin in 1904 from K.P. Creek, a tributary of the Blue River (San Francisco River drainage), exhibited spotting patterns similar to Apache trout but showed "hybrid" influence (Miller 1972). However, those fish were reported to have a distinct red band that is more characteristic of Gila trout than Apache trout.

A taxonomic analysis of southwestern New Mexico trout included a population of Gila trout from Spruce Creek, tributary to Dry Creek, which is a tributary of the San Francisco River (David 1976). Several characteristics of Spruce Creek specimens suggested that they might represent an intergrade between Gila and Apache trout:

> "Morphometric and meristic characters intermediate between these species included predorsal lengths (dorsal origin to snout tip), head lengths, and vertebrae counts. Characters closely aligned with Apache trout included scales in lateral series, scales above lateral line, adipose fin length, presence of basibranchial teeth, and spotting pattern. The spotting pattern in Spruce Creek specimens is similar to that described for Apache trout. Mean spots per square centimeter for Spruce Creek is 11.9, while the mean for Main Diamond Creek (type locality for Gila trout) is 22.2. Spots on Spruce Creek trout, particularly those on the predorsal area, are surrounded by a light circle, similar to the "halo-effect" described by Miller (1972) for the Apache trout."

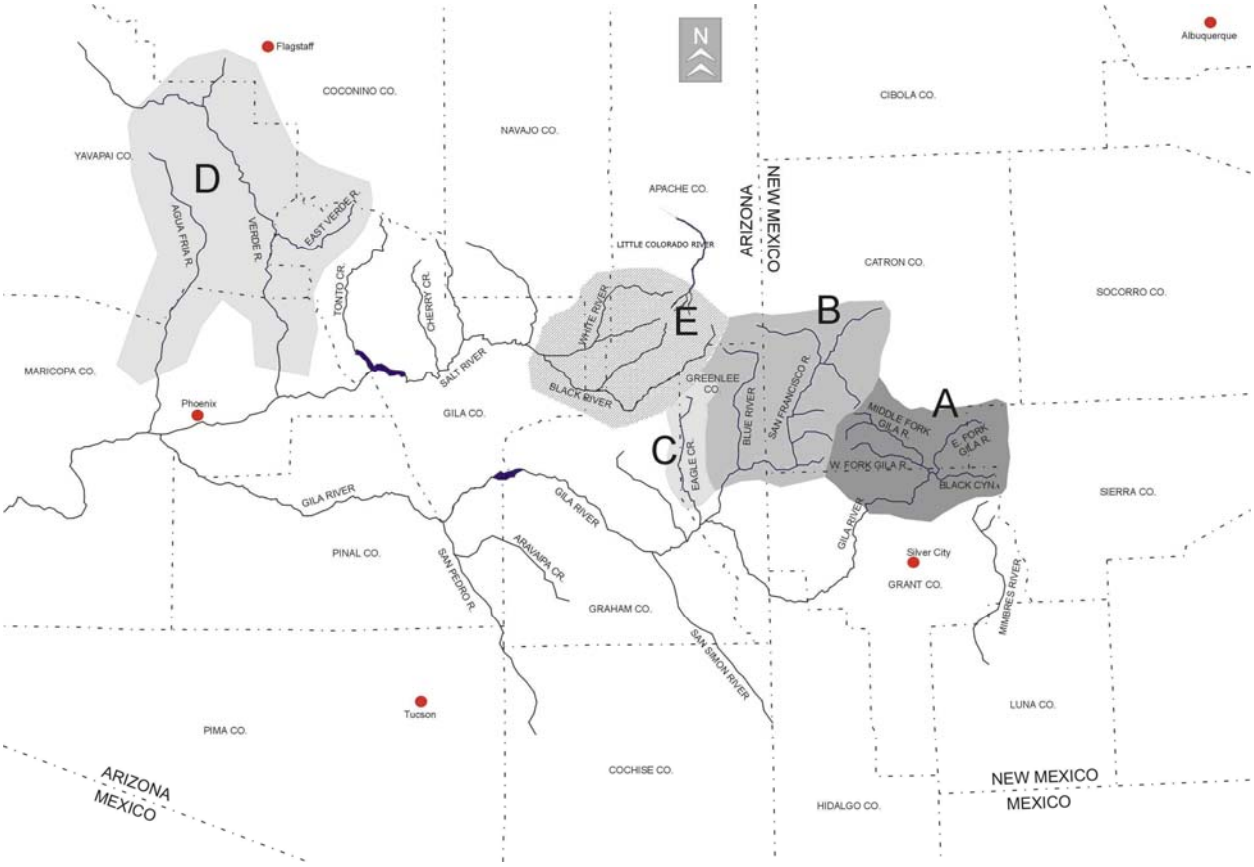

Figure 3. Historical distribution of Apache and Gila trout. The Apache trout (E) shares some characteristics with Gila trout of the San Francisco form/lineage (B) trout. Other forms of Gila trout include the Gila River form (A), Eagle Creek (C), and Verde River (D) forms (slightly revised from USFWS 2003, with permission).

Current Distribution

<u>Salt River Watershed: Black River and White River Drainage (non-Tribal lands)</u>

Recovery streams

Bear Wallow Creek (ASNF) was renovated to remove rainbow trout in 1981, 2003, and 2005. It was repatriated with pure Apache trout (Coleman and Soldier creeks stock) in 1981, 1983, and 2005 (Table 1). Conklin Creek (ASNF) was renovated in 2006 to remove non-native trout and Apache trout hybrids. However, the renovation was unsuccessful and it will be re-renovated and repatriated with pure Apache trout in 2007. The Fish Creek complex (ASNF; including Corduroy, Double Cienega and Fish creeks) was renovated in 2004 and 2005 to remove non-native trout and Apache trout hybrids and was repatriated with pure Apache trout in 2006. Hayground Creek (ASNF) was renovated in 1989 and 2004, and repatriated with pure Apache trout (Ord Creek lineage from North Canyon Creek) in 2005. Home Creek (ASNF) was renovated in 1987 and repatriated with pure Apache trout (East Fork White River [EFWR] stock) in 1988; however, low water conditions during periods of drought may have extirpated the

populations as no fish have been found in recent surveys; thus, Home Creek is not considered a recovery stream. Snake Creek (ASNF) was renovated in 2003 and will be repatriated with pure Apache trout in 2007. Soldier Creek originates on the FAIR (upper 0.6 km) and the remainder is on ASNF. Soldier Creek currently supports a relict population of pure Apache trout. Stinky Creek (ASNF) was renovated in 1994 and subsequently repatriated with pure Apache trout; however, the stream will be renovated again to remove brown trout and restocked with Apache trout in 2007. The West Fork Black River and Burro and Thompson creeks (ASNF and FAIR) were renovated in 1996 and subsequently repatriated with pure Apache trout (EFWR and Firebox Creek lineages) in 1997 and 1998. The area between the upper and lower barriers will be renovated in 2007 to remove brown trout.

Hybrid streams

The Boggy, Centerfire and Wildcat Creek complex (ASNF) currently contains a naturally occurring Apache trout population with evidence of hybridization with rainbow trout (Carmichael et al. 1995). The stream complex will be renovated and repatriated with pure Apache trout in 2008 or 2009. Hannagan Creek (ASNF) currently contains a hybridized population of Apache trout.

Salt River Watershed: Black River and White River Drainage (Tribal lands)

The Big Bonito Creek system, Boggy and Lofer creeks, Coyote Creek, Crooked Creek, Deep Creek, East Fork White River, Elk Canyon Creek, Firebox Creek, Flash Creek, Little Bonito Creek, Ord Creek, and Smith Creek all contain relict populations of pure Apache trout. Squaw Creek contains a replicated population of pure Apache trout from the Flash Creek lineage. Wohlenberg Draw Creek currently contains a replicated population of pure Apache trout from the Coyote Creek lineage. Crooked, Flash, Little Bonito, Ord, Paradise, Squaw, Thompson, and Wohlenberg creeks and the West Fork Black River were renovated to remove non-native trout and subsequently stocked with pure Apache trout. Sun, Moon, Coon, Little Diamond, and Rock creeks contain predominately pure populations of Apache trout (some evidence of hybridization and therefore not counted towards recovery). Soldier Creek, Thompson Creek, and the West Fork Black River are on both FAIR and ASNF and the details are listed above under "Recovery Streams". The upper portion of Thompson Creek above a natural barrier on FAIR contains a small replicated population of Apache trout from Firebox Creek (translocated in 1996); the lower portion of Thompson Creek below the barrier contains Apache trout from EFWR stock.

Little Colorado River (LCR) Drainage

Coyote and Mamie creeks (ASNF) currently contain pure Apache trout (Ord Creek lineage) that were introduced into Mamie Creek in 1965. The upper East Fork LCR (ASNF) was renovated in 2004 and 2005, and was repatriated with pure Apache trout in 2006. The lower East Fork LCR will be renovated and repatriated with pure Apache trout in 2008. Mineral Creek (ASNF) was renovated in 1967 and 1968 and subsequently repatriated with pure Apache trout (Ord Creek lineage); it currently supports a small population of pure Apache trout. The South Fork LCR will be renovated and repatriated with pure Apache trout in 2007. The West Fork LCR was renovated in 2006 and will be repatriated with pure Apache trout (hatchery EFWR stock) in

2007. The middle reaches of the creek near Sheep Crossing will be regularly stocked with hatchery Apache trout to maintain a sport fishery. Hatchery-reared Apache trout have been stocked in Lee Valley Reservoir as needed to support a sport fishery since 1968. Lee Valley Creek, a tributary feeding Lee Valley Reservoir, was renovated in 1982 and 2003, and repatriated with pure Apache trout (EFWR stock) in 2004. Lee Valley Creek is considered an Apache trout recovery stream.

Streams Outside Historic Range

Ash, Grant, Big, and Marijilda creeks in the Pinaleno Mountains on the Coronado National Forest (CNF) currently contain hybridized populations of Apache trout. Grant and Big creeks drain into the Willcox Playa, which is a closed basin (Minckley 1973); Ash and Marijilda creeks are tributaries to the Gila River and now considered within historical range of Gila trout (USFWS 2003). Deadman Creek (CNF) was stocked with Apache trout in 1968 and 1969, and it is uncertain if hybridized Apache trout (with rainbow trout) still persist; Deadman Creek is now considered within historical range of Gila trout. Coleman Creek (ASNF) is a tributary to Campbell Blue Creek, which flows into the Blue River. At present, Coleman Creek supports pure Apache trout (Soldier Creek stock, 1981 and 1983); however, it is now considered a candidate stream for Gila trout recovery. Apache trout from Coleman Creek will be removed and reintroduced into another Apache trout recovery stream before Gila trout reintroduction is initiated. KP and Grant creeks (ASNF), tributaries to the Blue River, currently contain hybridized populations of Apache trout and are now considered within historical range of Gila trout (USFWS 2003). North Canyon Creek (Kaibab National Forest) is a tributary to the Colorado River and supports a pure Apache trout population (Ord Creek lineage). Apache trout from North Canyon Creek were used to reintroduce trout back into Ord Creek in 1996 and into Hayground Creek in 2005. Horton Creek (Tonto National Forest) was stocked with hatchery Apache trout in 1971 (n=23); however, at the time the stream also had rainbow, brook, and brown trout populations. It is likely that any remaining Apache trout would be hybridized.

Table 1. Current distribution of Apache trout and potential recovery streams. Populations include: relict, replicated, hybridized, and those considered outside of historical range. Additional information includes location (ASNF=Apache Sitgreaves National Forest; CNF=Coronado National Forest; KNF=Kaibab National Forest; FAIR=Fort Apache Indian Reservation), amount of occupied habitat (km), lineage and year(s) established, and if streams contain manmade (type, year built, maintenance activity) or natural barriers.

Stream (Location)	Habitat (km)	Existing lineage, year(s) established	Barriers
Relict Lineages (FAIR)			
Big Bonito System (Big Bonito, Hurricane, Hughey, and Pea Soup)	3.94	Pure	Gabion 1994; repairs 1999, 2000
			Natural
Boggy/Lofer	10.72	Pure	Natural
Coyote	1.97	Pure	Rock-masonry 1994
Crooked	7.6	Pure	Manmade 1995; repaired with sand, gravel and filter cloth 1998
Deep	11.04	Pure	Natural
East Fork White River (EFWR)	8.25	Pure	Natural
Elk Canyon	4.95	Pure	Natural
Firebox	4	Pure	None
Flash	10.49	Pure	Gabion 1994; repaired 1997, reinforced with extra layer of gabion and sprayed with Shot-Crete
			Natural
Little Bonito	14.18	Pure	Gabion (3) 1995, 1996, 1998

Table 1 (continued). Current Distribution of Apache Trout.

Stream (Location)	Habitat (km)	Existing lineage, year(s) established	Barriers
Relict Lineages (FAIR) -- continued			
Ord	9.75	Pure 1996; Ord Creek fish in Coyote (ASNF) and North Canyon creeks repatriated into Ord 1999	Timber 1964 Gabion 1977; repaired 1998, added new set of baskets and concrete covering 2000
Smith	0.47	Pure	Natural
Soldier (FAIR/ASNF)	1.96 FAIR 2.02 ASNF	Pure	Natural
Existing Replicates (within historic range)			
Bear Wallow (ASNF)	16.93	Soldier 1981, 1983 Coleman (Soldier) and Soldier 2005	Rock-masonry 1979, repaired with rock gabions 1984, maintenance with gabions 2003, liner installation 2004, splash pad installation 2005
Coyote/Mamie (ASNF)	4.13	Ord 1995	Rock-masonry/gabion 1994
East Fork Little Colorado: Upper (ASNF)	14.31	Coleman (Soldier stock) 2006	Colter Reservoir; manmade grate over jump pool at outlet of Colter Dam 1998
Fish Creek System (ASNF): Fish, Ackre Lake, Corduroy, and Double Cienega	27.31	West Fork Black (EFWR) 2006	Gabion 1986; gabions added to stream banks 1998; rock gabions added to spillway and barrier wings 2003, concrete and plastic liner installation 2004
Hayground (ASNF)	4.64	North Canyon (Ord) 2005	Gabion 1985; reconstruction 2004, 2005
Lee Valley (ASNF)	2.6	Soldier 1982, 1983 EFWR 1988, 2004	Concrete block 1979; rebuilt 1987, repaired 2003

Table 1 (continued). Current Distribution of Apache Trout.

Stream (Location)	Habitat (km)	Existing lineage, year(s) established	Barriers
Existing Replicates (within historic range) -- continued			
Mineral (ASNF)	4.58	Ord 1967, 1968	Gabion 1982
Paradise (FAIR)	6.5	Smith 2003	Gabion mid 1980s; added new baskets and concrete covering 2000
Squaw (FAIR)	10.2	Flash 1996	Gabion 1994; repaired 1997, 1998, 1999, added extra layer of gabion and sprayed with Shot-Crete 2001
Thompson (FAIR/ASNF)	1.7	Firebox: Upper 1996	Culvert
		EFWR: Lower 1997, 1998	
West Fork Black River, upper (ASNF/FAIR)	10.77	EFWR 1997, 1998	Rock and masonry gabions (2) 1996
Wohlenberg Draw (FAIR)	8	Coyote 2003	Timber early 1980s; reconstructed 1999
Existing Replicates (outside historic range)			
Ash (CNF)	2.5	Introgressed (Ord) 1965	
Big (CNF)	1.2	Introgressed (Ord) 1965	
Coleman (ASNF)	4.98	Pure (Soldier) 1981, 1983	Natural
Grant (CNF)	2.8	Introgressed (Ord) 1965	
Grant (ASNF)	4.8	Suspect Introgressed (Ord) 1969	Natural
KP (ASNF)	18.6	Introgressed (Ord) 1969	Natural
Marijilda (CNF)	1.6	Introgressed (Ord) 1969	
North Canyon (KNF)	8	Pure (Ord) 1963, 1967	

Table 1 (continued). Current Distribution of Apache Trout.

Stream (Location)	Habitat (km)	Existing lineage, year(s) established	Barriers
Existing hybrid populations			
Coon (FAIR)	3.6	Introgressed	Natural
Hannagan (ASNF)	6.72	Introgressed	Culvert
Little Diamond (FAIR)	29	Introgressed (Crooked)	Gabion 2002
Reservation (FAIR/ASNF)	22.5	Introgressed	
Rock (FAIR)	18.6	Introgressed	
Sun/Moon (FAIR)	19.3	Introgressed (Ord) 1967	Christmas Tree Lake
Renovated, not yet stocked			
Snake (ASNF)	3.38		Gabion 1987; modification and grate installation 1998
West Fork Little Colorado (ASNF)	16.46	EFWR 1999	Gabion (2) 2004
Additional Potential Recovery Streams			
Centerfire/Boggy (ASNF)	22.51		Manmade 1984
			Natural enhanced with rock gabions 1984; reconstruction 2004
Conklin (ASNF)	8.38		Culvert, concrete splashpad, gabion 1988; maintenance and metal grate installation 1998; enhanced gabions and grate 2006
East Fork Little Colorado: Lower (ASNF)	14.31		Gabion (2) 2004
South Fork Little Colorado (ASNF)	9.38		Concrete 2004

Table 1 (continued). Current Distribution of Apache Trout.

Stream (Location)	Habitat (km)	Existing lineage, year(s) established	Barriers
Additional Potential Recovery Streams -- continued			
Stinky (FAIR/ASNF)	3.84	EFWR 1995	Gabion 1991; maintenance 2004
West Fork Black, lower (FAIR, ASNF)	33.8		
Wildcat (ASNF)	5.41	EFWR 1990-1992	Jersey structures (2) 1989
			Natural

CHAPTER 4: LIFE HISTORY AND HABITAT CHARACTERISTICS

Feeding habits

The Apache trout is a largely opportunistic feeder that eats a variety of aquatic and terrestrial organisms, the utilization of which can vary with the season and fish size. The food habits of Apache trout in Big Bonito Creek (FAIR) varied with fish size; fish 6-9 centimeters (cm) in length primarily feed on mayflies (Order Ephemeroptera), whereas fish 15 cm and larger primarily consumed caddisflies (Order Trichoptera; Harper 1978). Fish 5-17 cm in length captured from Mamie Creek on the ASNF exhibited similar feeding habits; however, mayflies were more prevalent in the diet of larger specimens (AGFD, unpublished data). Clarkson and Dreyer (1996) found that Apache trout stocked in Lee Valley Reservoir fed on organisms found at both the lake surface and bottom including both aquatic and terrestrial insects, zooplankton, crustaceans, snails, leeches, nematodes, and fish. Robinson and Tash (1979) reported that Apache trout fed at higher light intensities than brown trout, which were predominately nocturnal feeders.

Reproduction

Trout spawning in White Mountain streams occurs from March through mid-June, and varies with stream elevation. Apache trout begin redd construction and associated spawning during receding flows in the spring, at approximately 8°C (Harper 1978). Redds were constructed primarily at downstream ends of pools in wide varieties of substrates (0.85 mm to 32 mm size), most frequently in water depths from 19 to 27 cm in areas that received day-long illumination, with water velocities ranging between 50-110 cfs (Harper 1976). Spawning maturation is estimated to begin at 3 years of age, with eggs hatching in approximately 30 days, and emergence occurring about 60 days after deposition (Harper 1978).

Egg production in Apache trout is positively related to fish size. For example, Apache trout from Big Bonito Creek with lengths ranging from 13-20 cm TL produced between 72 and 240 eggs per female. Conversely, Apache trout from Christmas Tree Lake with lengths ranging from 30-35 cm TL produced 646-1,083 eggs per female (Roselund 1974). Fish collected from Ord Creek in 1962 and held by AGFD yielded an average of 72 eggs per female. Five years later the same fish produced an average of 4,315 eggs per female. Two redds examined by Harper (1978) contained 43 and 67 eggs. The fecundity of all fish examined was greater than the number of eggs found in redds, thus Harper suggested that each may deposit eggs in several redds during a single spawning season.

Growth

Kitcheyan (1999) found that pit-tagged Apache trout in Squaw and Flash creeks averaged about 0.10 mm/day in 1997 and 0.05 mm/day in 1998. Harper (1976) reported that juvenile Apache trout in Big Bonito Creek grew slowly from emergence until the first annulus was formed. Apache trout fry were 20-22 mm TL upon emergence, growing to between 31-51 mm TL by the

first annulus. Growth averaged 43 mm/year, 30 mm/year, and 25 mm/year for the second, third, and fourth years of life, respectively (Harper 1976). Propst and Stefferud (1997) reported that the closely related Gila trout were about 90-100 mm by autumn of their first year, between 150-160 mm by autumn of their second or third year, and between 190-200 mm by their fourth or fifth year.

Population Estimates and Densities

The headwaters of the White and Black rivers on the FAIR contain the largest concentrations of Apache trout. Larger streams (2nd or 3rd order) within the system may contain several thousand Apache trout, while populations in small (1st order) tributary streams may be less than 100 individuals at certain times.

Average population densities of Apache trout in Flash Creek ranged from 0.030 fish/m^2 to 0.310 fish/m^2 (Kitcheyan 1999). Harper (1978) reported densities in Big Bonito Creek ranged from 0.310-0.400 fish/m^2 and averaged 0.340 fish/m^2. Novy and Lopez (1991) reported Apache trout densities ranged from 0.005-0.570 fish/m^2 in nine streams in the ASNF from 1988-1990.

Population estimates for Apache trout are widely variable and dependent upon stream size/length, habitat quality, stream discharge, species assemblage, food availability, and other natural environmental fluctuations. For the closely related Gila trout, Propst and Stefferud (1997) reported that no single measure or statistic should prompt a conclusion on the status of any population, but rather should be considered in the context of other environmental or biological influences. Moreover, Gila trout in McKnight Creek were reduced by >90% in 1988 due to floods, but in 1992 the population was not considered different by any measured attribute from other intermediate-stream populations, thus indicating a tremendous resiliency. Until the 1980s, few population surveys were conducted to determine population estimates. Most surveys were initiated to determine species presence or to gather genetic material.

Certain stream populations of Apache trout have persisted for at least a decade, despite estimated population sizes of less than 1,000 total fish (i.e., Coleman, Lee Valley, Mineral, and Coyote creeks). Unfortunately, population estimates were not available for relict streams on the FAIR until recently, as most prior surveys were conducted to determine presence/absence or perform genetic testing. Surveys conducted on ASNF from the late 1980s to present indicate that several populations of Apache trout and non-native trout have declined in numbers. This was likely due in part to the dramatic decrease in annual precipitation levels from the mid to late 1980s. Severe drought was recorded for Arizona in 2002 (National Oceanic and Atmospheric Administration, National Climate Data Center, Climate of 2002 Annual Review), and is essentially part of a longer-term dry spell that has affected Arizona since the mid 1990s.

One method currently used to analyze Apache trout populations by habitat type is a modified survey based on the Basinwide Visual Estimation Technique (BVET), and is detailed in Hankin and Reeves (1988) and Dolloff et al. (1993). This method is used on all Tribal streams. The BVET provides a “statistically valid, accurate, and cost-effective” method for estimating habitat and the inventory of fish populations (Dolloff et al. 1993). BVET has been conducted on the

following Tribal streams: Big Bonito (1994), Boggy/Loffer (2001, 2002), Coyote (1998, 2001), Crooked (2001, 2002, 2004), Deep (2002), East Fork White River (2002), Elk Canyon (2001, 2004), Firebox (2001), Flash (2003), Little Bonito (2001), Ord (1989, 2001), Rock (2003), Smith (2002), Soldier (2001, 2002), and Thompson (2002). BVET was also conducted on the upper West Fork Black River on ASNF (2003).

Another method commonly used to measure habitat conditions and estimate fish population abundances is the General Aquatic Wildlife System (GAWS; USFS 1985). This method has been used on all non-Tribal streams. GAWS surveys have been conducted on the following non-Tribal streams: Boggy (1988, 1994, 1997), Bear Wallow (1990, 1996, 2001), Centerfire (1988, 1993, 1994, 1997), Coleman (1988, 1995, 2001), Corduroy (1987, 1995, 1997, 2001), Coyote/Mamie (1990, 1995, 2002), Double Cienega (1987, 1995, 2003), East Fork LCR (1987, 1993, 2001), Fish (1987, 1995, 2003), Hannagan (1990, 1997), Hayground (1988, 1994, 2001), Home (1989, 1994, 2003), KP (1995), Lee Valley Creek (1990, 1995, 2001), Mineral (1986, 1991, 1996, 2001, 2003), South Fork LCR (1991), Snake (1990, 1996), Soldier (1989, 1996, 2001-2003), Stinky (1989, 1994, 2001), West Fork LCR (1993), West Fork Black River (1989, 1990, 1996, 2002, 2005, 2006), and Wildcat (1988, 1993).

Habitat Use, Dispersal, and Movement

Information concerning specific stream habitat requirements for all life stages of Apache trout is limited. Apache trout currently exist mainly in headwater areas upstream from natural and artificial barriers. This environment is subject to extreme variations in both temperature and flow.

In Squaw and Flash creeks, juvenile (< 130 mm TL) Apache trout used shallow water (< 20 cm) most frequently while adults preferred water depth > 20 cm (Kitcheyan 1999). Juvenile fish were closely associated with cover such as surface turbulence, overhanging vegetation, and objects less than 150 mm in diameter, while adults used cover less frequently (Kitcheyan 1999). In general, juveniles preferred faster moving water than adults. Juveniles and adults used substrates in proportion to their availability (Kitcheyan 1999). Nursery areas for fry were miniature pools in runs or shallow areas on the edges of pools in Firebox and Sun creeks (Wada 1991). Current velocities in nursery areas were low (mean of 0.96 cm/sec), depths were shallow (mean 3.31 cm), and substrates tended to be composed of fines.

Apache trout were predominantly captured in areas exposed to direct sunlight (Kitcheyan 1999). Similarly, Wada et al. (1995) reported that Apache trout spent a considerable portion of the day feeding and residing in portions of pools exposed to direct sunlight. Wada (1991) reported that instream cover and bank cuts are important variables defining Apache trout habitat. In general, Apache trout selected areas with the greatest depths and cover in the absence of non-native trout.

Alcorn (1976) and Lee and Rinne (1980) studied temperature tolerances of Apache trout and found that critical upper limits were similar to data reported for other species of trout (~ 27° C). During winter, formation of anchor ice and ice bridges is common (Harper 1978) within many Apache trout streams. Streams examined by Harper (1978) had low pool-riffle ratios and stream

widths greatly exceeded depths. The majority of the habitats containing Apache trout consisted of riffles and runs.

Kitcheyan (1999) reported that maximum movements of tagged Apache trout were 2,100 m upstream and 2,385 m downstream; however, most fish were recaptured within 750 m of the initial capture site. Harper (1978) reported that 41 tagged adults in Big Bonito Creek were recaptured within 100 m of where they were marked. Movements of post-emergent fry in Big Bonito Creek were typically downstream oriented, generally taking place at night from August into October. Rinne (1982) reported similar results for the closely related Gila trout, and reported they were relatively sedentary under normal population levels and moved little even with high population densities.

Cantrell et al. (2005) reported results similar to Kitcheyan (1999) and Wada (1991) in that Apache trout select pools with slower current and abundant cover. Apache trout also appear to select pools with greater width, lower width to depth ratios, and more eddy flows (Cantrell et al. 2005).

Physical Habitats

Clarkson and Wilson (1995) described the area geography, which includes watersheds occupied by Apache trout:

> "…streams straddle the zone separating the Colorado Plateau and Basin and Range Physiographic Provinces in the White Mountains area, east-central Arizona (Fenneman 1931). They drain the White Mountains Volcanic Field and adjacent areas in the Little Colorado and Gila River basins, the latter consisting of tributaries in the White, Black, and Blue* sub-basins (Fig. 1). The area is characterized by volcanic, volcaniclastic, alluvial, lacustrine, colluvial, and glacial late Tertiary and Quaternary deposits (Merrill and Pewe 1977). Mount Baldy and Mount Ord, remnants of the Mount Baldy Volcano of middle Tertiary age, represent the highest elevations of the area, rising to 3475 and 3461 m above sea level, respectively."
>
> "Riparian habitats typically are located within ponderosa pine (*Pinus ponderosa*) and mixed conifer forests. Shrub willows (*Salix scouleriana, S.bebbiana, S. exigua, S. laevigata,* and *S. lasiolepis*) and other shrubs such as red-osier dogwood (*Cornus stolonifera*), shrubby cinquefoil (*Potentilla fruiticosa*), and thinleaf alder (*Alnus tenuifolia*) dominate the riparian scrublands. Aspen (*Populus tremuloides*) and conifer species including ponderosa pine, Douglas-fir (*Pseudotsuga menziesi*) and white fir (*Abies concolor*) are occasionally present, but distinctive riparian tree forms are typically absent. Subalpine wet meadows also occur along high elevation watercourses, and are dominated by grasses such as *Poa pratensis, Muhlenbergia wrightii, Carex* spp. and *Juncus* spp. Willow communities may also be present in these meadows (Minckley and Brown 1982). Some lower elevation riparian habitats consist of mixed broadleaf and cottonwood-willow gallery forest communities.

* The Blue River drainage is now considered historical habitat for Gila trout.

Diverse mixtures of tree species such as Arizona sycamore (*Platanus wrightii*), velvet ash (*Fraxinus pennsylvanica* var. *velutina*), Fremont cottonwood (*Populus fremontii*), Arizona alder (*Alnus oblongifolia*), Arizona walnut (*Juglans major*), and several species of willow, such as *Salix gooddingii*, are present. Boxelder (*Acer negundo*), narrowleaf cottonwood (*P. angustifolia*), and bigtooth maple (*Acer grandidentata*) may also be present."

Interactions with other species

Native fish fauna of high elevation streams in east central Arizona included allopatric or sympatric populations composed of Apache trout (or Gila trout), speckled dace (*Rhinichthys osculus*), desert sucker (also referred to as Gila mountain sucker) (*Pantosteus clarki*), and bluehead sucker (*P. discobolus*) (Minckley 1973). Depending on the subdrainage and elevation, Apache trout likely co-occurred with roundtail chub (*Gila robusta*), or Gila chub (*G. intermedia*), Sonora sucker (*Catostomus insignis*) or flannelmouth sucker (*C. latipinnus*), loach minnow (*Rhinichthys cobitis*), and Little Colorado spinedace (*Lepidomeda vittata)* (Minckley 1973). In 1873, Spencer Baird and Charles Girard observed predation by roundtail chub on Apache trout in the White River and reported that in the presence of roundtail chub, trout and other species were displaced to the shallow and rapid parts of the stream (Cope and Yarrow 1875; Miller 1972).

Many watersheds formerly inhabited by Apache trout have been routinely stocked for more than 50 years with non-native rainbow trout, cutthroat trout, brook trout, and/or brown trout. Hatchery and management records from Williams Creek National Fish Hatchery (WCNFH), the USFWS Arizona Fishery Resources Office (AZFRO), and AGFD indicate that cutthroat trout were stocked from at least 1920 to 1942. Cutthroat trout are believed to have also been stocked by mule train in the late1800s (USFWS 1983).

Apache trout have been found to hybridize with rainbow trout and cutthroat trout in several streams in eastern Arizona (Loudenslager et al. 1986; Dowling and Childs 1992; Carmichael et al. 1993; Porath and Nielsen 2003). Although non-native salmonids were dispersed extensively by stocking over the entire range of Apache trout, natural fish barriers prevented mixing in some locations. Isolation of Apache trout above natural barriers may have prevented species extinction.

In addition to hybridization, non-native salmonids tend to be predatory and out-compete Apache trout for food and space. Such competition with brown trout and brook trout has been identified as a cause of the decline of Apache trout (Rinne and Minckley 1985). Wada (1991) suggested that if there is a selective advantage of more permanent use of cover, Apache trout may be at a competitive disadvantage because brown trout use cover more frequently than Apache trout. Apache trout co-occurred with brown trout in pools with cover only when they were larger than brown trout. Thus, brown trout may not completely eliminate adult Apache trout because habitat use is not identical (Wada 1991), but they would likely influence factors such as recruitment, population structure, and condition. Similarly, Mesick (1988) found that Apache trout were displaced from cover slightly easier than brown trout within artificial streams when starved.

Non-native trout stocking still occurs today, although most often in reservoirs or small lakes. All AGFD and FWS fish stocking actions are conducted under auspices of Section 7 intra-Service consultation with consideration of applicable Federal laws (i.e., ESA, NEPA). Recovery streams for Apache trout must be protected by either natural or artificial barriers, or dewatered zones that provide variable levels of protection against immigration by non-native trout.

CHAPTER 5: REASONS FOR LISTING

Under the Endangered Species Act, the Secretary of the Department of Interior shall determine whether any species is endangered or threatened because of any of the following five factors (50 CFR part 424):

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;
E. Other natural or manmade factors affecting its continued existence.

Apache trout, along with Lahontan cutthroat trout and Paiute cutthroat trout, were listed as endangered under the Endangered Species Conservation Act of 1967 due to "*destruction, drastic modification, or severe curtailment of their habitat*," and hybridization with introduced trout species (32 FR 4001). In 1975, the USFWS recommended a reclassification to threatened status because: "*all three species have been cultured extensively and reintroduced successfully into areas where they were extirpated: efforts at eliminating introduced trout with which they hybridize are succeeding: and none are in danger of extinction throughout all or a significant portion of their ranges*" (40 FR 29863-29864). Below is a more detailed summary of the threats to Apache trout.

A. **The present or threatened destruction, modification, or curtailment of its habitat or range;**

This factor was mentioned in preceding sections, and was identified in the original listing of the species. Apache trout distribution and population levels decreased primarily because of habitat alterations and negative interactions with non-native salmonids. Land use practices including logging, livestock grazing, reservoir construction, agriculture, and road construction caused damage to Apache trout habitat (USFWS 1983). Effects were multi-faceted and included: changes to riparian corridors (vegetation) and streambank morphology; increased erosion potential and greater susceptibility of streams to damage from floods (particularly high intensity, short duration events); reduced quantity and quality of spawning and rearing areas; altered stream flow volume and temperature; and negative influences to stream productivity and food supply (e.g., stream dwelling insects). Threats varied in intensity, complexity, and damage depending on location, but ultimately reduced the ability of Apache trout to effectively persist at all life stages throughout its historic range.

B. **Overutilization for commercial, recreational, scientific, or educational purposes;**

Although not identified as a reason that led to listing in 1969, unregulated harvest of Apache trout was another factor that contributed to the species decline from the late 1800s to 1950s (see Figure 1). Curtailment and control of harvest was initiated via the establishment of game laws by AGFD in 1929, and active enforcement was implemented accordingly. In 1955, WMAT closed most Apache trout streams within the FAIR boundaries of Mount Baldy Wilderness Area to fishing.

C. **Disease or predation;**

Disease has not been considered a factor in the decline of Apache trout and was not identified as such at the time of listing. However, the closely related Gila trout has been found to harbor the carrier (gram-positive bacterium *Renibacterium salmoninarum*) for Bacterial Kidney Disease (BKD) in low amounts in populations of the upper West Fork Gila River, including Whiskey Creek (USFWS 2003). There is no evidence of the carrier in Apache trout populations.

Although whirling disease has been introduced into Arizona (two known locations using private stockings of rainbow trout), follow-up testing of fish at these two private ponds has not revealed the presence of myxospores and it is not known to be present in any wild or hatchery population of Apache trout. However, preliminary results from controlled laboratory testing confirmed that Apache trout (and Gila trout) are highly vulnerable to whirling disease (Jim Thompson, USFWS Fish Health Specialist, personal communication). Wild fish healthy surveys are being conducted on Apache trout recovery streams, donor populations, and State and Federal hatchery facilities.

D. **The inadequacy of existing regulatory mechanisms;**

Prior to the listing as an endangered species in 1969, Apache trout had no Federal protection. Federal listing provided protection from take which is defined as: harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or to attempt to engage in any such conduct. The establishment and implementation of game laws by AGFD began in 1929. AGFD currently regulates take for Apache trout on non-Tribal lands through the 4(d) rule under the Endangered Species Act and Title 17 of the A.R.S. WMAT regulates take for Apache trout on lands administered by the FAIR through the 4(d) rule and WMAT Tribal Code.

E. **Other natural or manmade factors affecting its continued existence.**

Non-native salmonids such as rainbow trout, cutthroat trout, brown trout, and brook trout were introduced throughout the range of Apache trout for fishing recreation, and their introduction resulted in competition for resources or habitats, direct predation, and hybridization (with rainbow and cutthroat trout). This factor was identified as one of the primary causes leading to the listing of Apache trout. Other aquatic nuisance species such as crayfish have become established in some Apache trout streams. Although the specific magnitude of the impact of crayfish to Apache trout has yet to be assessed, control of crayfish populations is being researched.

CHAPTER 6: RECOVERY OF APACHE TROUT

The previous Apache Trout Recovery Plan, first released in 1979 and revised in 1983 (USFWS 1983), outlined a multi-step plan to recover the species. The first recovery criterion in the 1983 plan was to 1) establish and/or maintain 30 self-sustaining discrete populations of pure Arizona (Apache) trout throughout its historical range, with additional objectives to: 2) survey and manage Apache trout populations presently existing in waters outside the historic range; 3) provide habitat protection through implementation of land management practices, programs, and acquisitions; 4) provide adequate enforcement of all Federal, state, and tribal laws and regulations to ensure protection of Apache trout; and 5) develop public support of the Apache trout program through an information and education campaign.

The 1983 Recovery Plan included several streams where Apache trout were introduced, several of which are now considered outside historic range: Ash (CNF), Big (CNF), Coleman (ASNF), Deadman (CNF), Horton (Tonto National Forest), Grant (ASNF), Grant (CNF), and Marijilda (CNF) creeks. The recovery strategy in this revision only includes streams within historical Apache trout habitat and retains the 1983 criterion to establish and maintain 30 self-sustaining populations. It also includes additional objectives to ameliorate threats relative to the five listing factors (see previous section on "Reasons for Listing"). However, the revised recovery strategy allows for the use of hatchery propagated Apache trout to repatriate a renovated and secured stream if such populations cannot be established by moving fish from a relict or replicated population. A post-delisting management plan will incorporate genetic considerations such as recommendations to conserve remaining genetic potential by establishing new populations, augmenting existing populations, and using wild gametes to invigorate brood stocks.

The 1983 Recovery Plan needed to be updated to include current information about the status of the species, additional information about the species gained through population surveys and genetic analysis, and to comprehensively address the five listing factors and how each factor will be addressed through the site-specific management actions in this plan.

The following section presents a strategy to recover the species, including an objective and measurable recovery criterion and site-specific management actions to monitor and reduce or remove threats to the Apache trout, as required under section 4 of the ESA. The Recovery Plan also addresses the five statutory listing/recovery factors (section 4(a)(1) of the ESA) to demonstrate how the recovery criterion and actions will lead to removal of the Apache trout from the lists of Threatened and Endangered Species.

Recovery Goal: Implement necessary actions to delist Apache trout.

Recovery Criterion: Establish and maintain 30 self-sustaining populations that conserve, to the maximum extent practicable, the remaining genetic diversity of the species. A population is defined as all the individuals that occur in a specified area, have a common ancestry, or are potentially able to interbreed (Pianka 1978). A population will be considered self-sustaining by the presence of multiple age classes and evidence of periodic natural reproduction. A population will be considered established when it is capable of persisting under the range of variation in

habitat conditions that occur in the restoration stream (Propst and Stefferud 1997).

Recovery Strategy: Hybridization with non-native trout (primarily rainbow trout), is one of the most serious threats to Apache trout. Other non-native trout such as brown trout can out-compete Apache trout for food and cover, thus limiting the species potential to thrive in certain waters. Such competition with brown trout and brook trout has been identified as a cause of the decline of Apache trout (Rinne and Minckley 1985). Non-native trout stocking still occurs in Arizona, although most often in reservoirs or small lakes. All AGFD and FWS fish stocking actions are conducted under auspices of Section 7 intra-service consultation with consideration of applicable Federal laws (i.e., ESA, NEPA). Nonetheless, removal of non-native salmonids from Apache trout recovery streams is an essential component of the recovery strategy to prevent hybridization and competition for limited resources by other salmonid species, and to ensure the persistence of Apache trout. Re-invasion of Apache trout recovery streams by non-native trout will be prevented by utilizing headwater streams for recovery that are protected by natural barriers or by the construction of artificial barriers.

In addition to decreases in Apache trout distribution and population levels by negative interactions with non-native salmonids, land use practices including logging, livestock grazing, reservoir construction, agriculture, and road construction caused significant damage to Apache trout habitat (USFWS 1983). These impacts will continue to be addressed in several ways, including the addition of instream structures such as fencing to exclude livestock along critical sections to improve riparian corridors. Forest Management Plans have incorporated minimal stream standards for Apache trout and other salmonids (see section on Background Law, Appendix A). Allotment Management Plans (AMPs) have been modified to reduce deterioration of riparian and stream habitats by not permitting livestock use, limiting livestock utilization levels, constructing fence exclosures and/or conventional livestock/elk fencing, and other means such as rotational deferred grazing and rest-rotation grazing. Habitat protection will continuously be afforded through implementation of land management practices, programs, and acquisitions in cooperation with all Federal, state, and tribal partners.

Recovery streams will require continuous monitoring to estimate population abundance and abundance trends, and to document recruitment, age and size structure of the population over time to determine the risk or persistence the specific population is experiencing over time. Because the majority of Apache trout streams are isolated by natural or man-made barriers to protect the populations from existing threats and many populations are small, managers should be cognizant that small populations may require more aggressive management to ensure long-term survival. For example, streams with small populations or for populations that decrease with significant flow fluctuations triggered by drought may need to be supplemented with fish from the appropriate source streams (see Objectives 1.0 and 1.4).

Recovery Objectives: The recovery strategy involves five objectives:

1. Assess, prepare, protect, and maintain habitats that are sufficient to allow for all life functions at all life stages, and establish and maintain 30 self-sustaining populations.

2. Implement appropriate laws and regulations to allow Apache trout populations to persist.

3. Monitor, prevent, and control disease and/or causative agents, parasites, and pathogens.

4. Comply with Federal, state, and tribal regulatory processes.

5. Continually identify, assess, and ameliorate threats to Apache trout.

When the recovery criterion and objectives have been achieved, pure Apache trout will exist in at least 30 stream systems in approximately 300 kilometers (km) of secured stream habitat within the species' historical range (Table 1). The streams will be comprised of the following:

- Thirteen relict populations on FAIR: Big Bonito, Boggy/Lofer, Coyote, Crooked, Deep, Elk Canyon, Flash, Firebox, Little Bonito, Ord, Smith, and Soldier (partially on ASNF) creeks, and East Fork White River;

- Twelve streams with existing replicated populations: Bear Wallow (ASNF), Coyote/Mamie (ASNF), Fish (ASNF), Hayground (ASNF), Lee Valley Creek (ASNF), Mineral (ASNF), Paradise (FAIR), Squaw (FAIR), Thompson (FAIR), Wohlenberg Draw (FAIR), and the East Fork Little Colorado (ASNF) and upper West Fork Black (ASNF) rivers;

- Six additional streams have been identified as potential recovery streams, all of which are on the ASNF: Conklin, Centerfire/Boggy/Wildcat, Snake, and Stinky creeks, and South Fork Little Colorado and West Fork Little Colorado rivers.

Conservation and management actions will continue beyond delisting to preserve or expand secured habitats, maintain adequate sportfishing opportunities, and monitor populations. All threats, including those that initiated protection through listing under the Endangered Species Act of 1973 (ESA 1973) must be continuously identified, monitored, and addressed.

All pure populations will require monitoring for persistence and sustainability. Non-native fishes present in recovery streams will be eliminated to prevent the potential for hybridization, competition, and/or predation. Similarly, populations in streams that contain a mix of Apache trout and/or hybrids (within historic Apache trout habitat) should be monitored to evaluate population levels as well as backcrossing and introgression (Hannagan Creek on ASNF; and Coon, Little Diamond, Reservation, Sun, and Moon creeks on FAIR).

With the exception of North Canyon Creek (KNF), which is outside the historical range of Apache trout but is inhabited by a pure population of Apache trout from a relict lineage, the remaining populations established outside historical range are hybridized (Ash, Big, Grant, and Marijilda creeks [CNF]; Grant, Coleman, KP, and McKittrick creeks [ASNF]). Some of these

streams are now considered within historical range for Gila trout and may be renovated and stocked with Gila trout in the future (Ash and Marijilda creeks [CNF]; Grant, Coleman, KP, and McKittrick creeks [ASNF])(USFWS 2003). At present, selected small coldwater reservoirs currently managed for sport fishing on ASNF and FAIR may receive periodic stocking of hatchery-reared Apache trout (see Appendix 1). Although the North Canyon Creek population should be maintained, as it contains an important lineage of pure Apache trout, only a stream within the historical range of Apache trout will be considered one of the 30 streams necessary for recovery of the species.

Recovery Goal: Implement necessary actions to delist Apache trout.

As of June 2007, Apache trout are present in 25 recovery streams. Three streams are ready to receive fish (Conklin Creek, Snake Creek, and upper West Fork of the Little Colorado River) and will be stocked in 2007. Two additional streams will be renovated in 2007 (Stinky Creek and the South Fork of the Little Colorado River) and stocked with pure Apache trout.

Narrative Outline of Recovery Actions: The following site specific actions to implement the recovery strategy are described below each objective:

Objective 1.0 **Assess, prepare, protect, and maintain habitats sufficient to establish and maintain 30 self-sustaining populations.** This objective addresses listing factor A: The present or threatened destruction, modification, or curtailment of its habitat or range. A population will be considered established when it is self-sustaining, capable of persisting under the range of variation in habitat conditions that occur in the restoration stream (Propst and Stefferud 1997), and when the population is protected from immigration of non-native trout (USFWS 2003).

Recovery streams that are subject to multiple land-use practices, such as timber harvest/thinning, prescribed fire, livestock grazing, and intensive recreation, should be managed to maintain healthy riparian corridors that promote sufficient habitat conditions for all Apache trout life functions. Occupied streams that have unstable or declining conditions should be the focus of remedial actions. Routine monitoring should be used to assess stream conditions.

1.1 **Complete any necessary Federal, state, and tribal regulatory compliance for recovery actions.** Prepare appropriate documentation requisite to compliance with the National Environmental Policy Act (NEPA), Clean Water Act, Section 7 consultation, or other applicable statutes, policies, or procedures.

1.2 **Construct and maintain artificial fish barriers if natural barriers are not present.** Barriers are necessary to protect Apache trout populations by preventing upstream migration by non-native fishes. Routine barrier

maintenance on all artificial barriers is vital to maintaining secure populations of Apache trout.

1.3 Reduce or eliminate threats from non-native trout and other non-native fishes within recovery portions of streams (upstream of fish barriers). Brown trout often prey on Apache trout, and brown and brook trout tend to out-compete Apache trout for resources. Rainbow trout and cutthroat trout often inter-breed with Apache trout.

1.4 Stock streams with pure Apache trout. New populations of Apache trout will be established by using a tiered process. The first alternative is to use fish from relict populations. If fish are not available from relict populations (for biological, political, logistical, or other reasons), the second alternative is to use fish from replicated populations. If fish are not available from relict or replicated populations the last alternative would be to use hatchery fish from state or Federal hatcheries to establish new populations.

It is recommended to use relict or replicated streams that contain more than 500 individuals, to ensure that the removal of fish for repatriation will not deplete the source population. Supplemental stockings to augment and enhance small populations will follow the same guidelines.

1.5 Salvage and provide refugia for populations of Apache trout that are affected by wildfire, drought, barrier failures, or other natural or human induced threats. Wildfire, drought, and barrier failure can destroy habitat and threaten or extirpate populations. If a population is threatened with extirpation, Apache trout should be salvaged (if possible) and moved to other streams or into hatcheries until they can be repatriated to the wild. The *Emergency Evacuation Procedures for Gila trout* (Brooks 2004) will be used as a guide for Apache trout.

1.6 Conduct population and habitat surveys. Survey recovery streams to determine population persistence, overall population status, and presence of non-native trout, hybrid Apache trout, and crayfish.

Populations established in 2007 will be surveyed to determine persistence of fish and to look for evidence of reproduction. Because the remaining five streams needed to reach 30 populations previously contained (or currently contain) self-sustaining populations of non-native trout (AGFD, unpublished), we believe that habitat will allow for the new populations of Apache trout to be self-sustaining. Additionally, previous efforts at restocking streams of comparable quality with Apache trout have resulted in self-sustaining populations. Future monitoring (using a variety of techniques including visual, snorkeling, and electrofishing) will be

conducted to ensure that these populations are self-sustaining.

Objective 2.0 **Implement appropriate laws and regulations to allow Apache trout populations to persist.** This objective addresses listing factor B: Overutilization for commercial, recreational, scientific, or educational purposes.

2.1 **Develop, implement, enforce, and evaluate regulations as necessary to prevent extirpation of recovery populations.** This can be accomplished through various means, such as stream closures, closed seasons, harvest limits, length limits, or restricting gear types.

Objective 3.0 **Monitor, prevent, and control disease and/or causative agents, parasites, and pathogens.** This objective addresses listing factor C: Disease or predation (predation on Apache trout is addressed by Objectives 1.2 and 1.3).

3.1 **Implement fish disease prevention protocols for professionals, and communicate best practices to anglers and other outdoor enthusiasts.** Employ available quality assurance and quality control management safeguards for hatchery operations, and disseminate appropriate information to anglers and recreationists through outreach.

3.2 **Monitor for presence of diseases and/or causative agents, parasites, and pathogens through wild fish health surveys.** Popular nearby recreational trout streams should be occasionally monitored, as well as recovery streams.

Objective 4.0 **Determine adequacy of Federal, state, and tribal regulatory processes.** This objective will address listing factor D: Inadequacy of existing regulatory mechanisms.

4.1 **Identify regulatory mechanisms, laws, and policies that are insufficient to fulfill all recovery objectives and protect Apache trout.** Mechanisms, laws, policies that are insufficient or inadequately enforced will be brought to the attention of the appropriate management authorities. This includes but is not limited to National Environmental Policy Act (NEPA), Clean Water Act, Section 7 consultation, or other applicable statutes, policies, or procedures.

Objective 5.0 **Identify, assess, and ameliorate threats to Apache trout.** This objective addresses listing factor E: Other natural or manmade factors affecting its continued existence. As threats are identified, they should be priority-ranked with respect to severity and significance, and addressed according to priority.

CHAPTER 7: RECOVERY ACTIONS AND CONSERVATION MEASURES IMPLEMENTED TO DATE

Since the time of original listing and during implementation of the 1983 Recovery Plan, several site-specific management actions and conservation measures have addressed and ameliorated the most significant remaining threats. From a general perspective, the following actions have been implemented to address the factors that led to listing. Once the final actions suggested in this revised plan are completed, delisting of Apache trout will be proposed. Recovery and site-specific conservation actions implemented to date to address the five factors are listed below. Additional conservation measures that would remain in place following delisting of Apache trout are found in Appendix 1: Background Law.

A. **The present or threatened destruction, modification, or curtailment of its habitat or range;**

- Fish surveys, in addition to surveys of associated stream and riparian habitat, have been conducted to assess the biological communities and overall habitat conditions, and identify if and where potential problems exist. This led to development of an Apache Trout Habitat Improvement Project (USFS 1994).

- Habitat has been improved by the addition of instream structures. Fencing has been installed along several streams on ASNF to exclude livestock along critical sections in order to improve riparian corridors in Bear Wallow, Boggy/Centerfire, Conklin, Corduroy*, Coyote, Double Cienega*, Fish*, Hannagan, Hayground, Home, Mineral, and Stinky creeks. Similarly, fencing installed along FAIR streams now protects portions of Soldier and Boggy/Lofer creeks.

- Forest Management Plans have incorporated minimal stream standards for Apache trout and other salmonids (see section on Background Law, Appendix A).

- Allotment Management Plans (AMPs) have been modified to reduce deterioration of riparian and stream habitats by not permitting livestock use, limiting livestock utilization levels, constructing fence exclosures and/or conventional livestock/elk fencing, and other means such as rotational deferred grazing and rest-rotation grazing. Livestock use has been excluded from Bear Wallow, Centerfire (Alpine District), Fish/Corduroy/Double Cienega, Conklin, Home, Snake, upper EFLCR (to Colter Reservoir), Lee Valley, and WFLCR (from headwaters to Greer).

- Natural fish barriers and/or dewatered zones serve as protection measures that isolate Apache trout in the following streams: Soldier Creek on ASNF; and upper Big Bonito, Boggy/Lofer, Coon, Deep, EFWR, Elk Canyon, Firebox, Flash, and Smith creeks on FAIR.

* Temporary electric fencing failed, thus, livestock grazing was then discontinued in these areas.

- In streams without natural fish barriers, artificial barriers have been installed to isolate/protect Apache trout from existing non-native fishes or those considered a threat to the population(s). Artificial barriers have been constructed in the following ASNF streams: Bear Wallow (2), Boggy/Centerfire/Wildcat (1), Conklin (1), Coyote/Mamie (1), EFLCR (2), Fish (1), Hayground (1), Home (2), Lee Valley (1), Mineral (1), SFLCR (2), Snake (1), Stinky (1), West Fork Black River (2), and WFLCR (2). Similarly, fish barriers on FAIR have been constructed in Big Bonito (1), Crooked (1), Flash (1), Little Bonito (2), Little Diamond (1), Ord (2), Paradise (1), Squaw (1), Thompson (1), and Wohlenberg (1) creeks.

- Non-native trout have been removed from several recovery streams in order to re-establish pure Apache trout. At least seven USFS streams were chemically treated with rotenone from 1962 to 1969 (Ash, Grant, and Marijilda creeks [CNF]; Grant and Mineral creeks [ASNF]; North Canyon Creek [KNF]) and an additional 12 streams were treated with Fintrol (antimycin-A) from 1981 to 2006 (Bear Wallow, Conklin, EFLCR, Fish, Hayground, Home, Lee Valley, Snake, Stinky, WFBR, WFLCR, and Wildcat creeks). Nine streams on FAIR have been chemically renovated from 1977 to 1999 (Crooked, Flash, Little Bonito, Ord, Paradise, Squaw, Thompson, WFBR, and Wohlenberg creeks). Mechanical removal of brown trout is an additional method used by FAIR in Apache trout recovery streams.

- Hatchery produced Apache trout have been used to assist with recovery needs. Fish will continue to be used for recovery and to support recreational fishing opportunities and associated demands. Providing fish for angling recreation has assisted with recovery by meeting public demand, maintaining public support, and providing a buffer between non-native trout and recovery portions of streams.

- Apache trout recovery streams that possess crayfish have been identified. Crayfish harvest is permitted as a control measure on most Federal, state, and tribal lands per AGFD Commission Rule R12-4-313, and by WMAT Wildlife and Outdoor Recreation Division regulations. Transport of live crayfish is prohibited in the majority of Arizona per existing State (R12-4-316F) and tribal regulations. Improved control methods will be used as they become available.

B. **Overutilization for commercial, recreational, scientific, or educational purposes;**

- Streams on FAIR that contain relict lineages of Apache trout have been closed to fishing since 1955.

- Angling opportunities, methods of take, and harvest of Apache trout on USFS streams has been addressed by AGFD by imposing and enforcing restrictive regulations via Arizona Revised Statute (A.R.S.) Title 17. Similar restrictions have been developed and enforced by WMAT Wildlife and Outdoor Recreation Division for FAIR streams.

- AGFD and WMAT have established several Apache trout sport fisheries in streams and reservoirs using hatchery-reared fish (from State and Federal hatcheries) and angling regulations that are enforced.

- AGFD and USFWS monitor and manage collection permits so damage to populations is prevented or minimized. AGFD issues Scientific Collection Permits via AGFD Commission Rule R12-4-418, and the U.S. Fish and Wildlife Service issues permits under Section 10 of the Endangered Species Act.

C. **Disease or predation;**

- Populations are monitored for disease and/or causative agents, parasites, and pathogens.

- AGFD requires fish health certification (AGFD Commission Rule R12-4-410- D) for imports of fishes. An aquatic wildlife stocking permit is also required for import, possession, transport and stocking of restricted live wildlife. Inspections and certification of aquaculture facilities is controlled through the state Department of Agriculture (A.R.S. 3-2905).

- Non-native salmonids are removed from designated recovery streams by chemical renovation and/or electrofishing in order to prevent competition for resources and/or predation upon Apache trout.

- Through published fishing regulations, anglers are encouraged to clean waders after fishing to minimize risk of transporting disease.

D. **The inadequacy of existing regulatory mechanisms;**

- Strict regulatory compliance (e.g., Endangered Species Act of 1973 and National Environmental Policy Act 1969) has provided protection for Apache trout and their environments.

- The National Forest Management Act, Forest Plan(s), and AMPs for Forest activities have addressed habitat conditions as well as multiple land-use issues that are considered detrimental to Apache trout or other listed or candidate species.

- Protection of Apache trout has also been addressed by imposing and enforcing restrictive state angling regulations on USFS by AGFD under A.R.S. Title 17 authority, and by WMAT on FAIR lands.

- All AGFD and FWS fish stocking actions are conducted under auspices of Section 7 intra-Service consultation with consideration of applicable Federal laws (i.e., ESA, NEPA).

- Unique Water designation affords additional protection for certain waters (see Background Law below, Appendix I).

E. **Other natural or manmade factors affecting its continued existence.**

- Stocking of non-native salmonids has largely been discontinued in habitat where hybridization, predation, and/or competition pose a threat to Apache trout.

- Populations of Apache trout have been protected in 13 remaining natural streams, reestablished into 12 streams, and will be reestablished into at least five more streams throughout home range.

- Apache trout are produced in hatcheries and have been used in past recovery efforts as well as to meet the recreational demand for sportfishing.

- Increased public awareness of regulations and strategies for recovery have been and will continue to be addressed through an aggressive outreach campaign with television segments (e.g., Arizona Wildlife Views, ESPN Cumberland Stories), Department/Agency news releases, public meetings, recovery-themed posters, fish-shaped bookmarks, magazine and newspaper articles, and periodic presentations to angler groups and other stakeholders.

Delisting and Post-Recovery Management

When the recovery criterion and site-specific management actions described in this recovery plan have been met, pure Apache trout will exist in at least 30 stream systems in approximately 300 km of secured stream habitat. Conservation and other management actions for Apache trout will continue beyond delisting as components of the AGFD and WMAT fish and wildlife programs. AGFD and WMAT in cooperation with FWS and USFS should develop post-delisting monitoring and management plans for Apache trout in the recovery streams concurrent with a proposed delisting rule. The plan(s) should address: habitat, population, and genetic management, monitoring distribution and population demographics, barrier integrity and maintenance, presence of non-native species, and agency roles and responsibilities.

Population Viability

Although small populations of Apache trout have persisted in small streams over time, the future persistence of replicated populations of Apache trout in recovery streams is unknown. Recovery streams will require continuous monitoring to estimate population abundance and abundance trends, and to document recruitment, age and size structure of the population over time to determine the risk or persistence the specific population is experiencing over time. Risk assessment models such as population viability analysis (PVA) are sometimes used to predict a population's survival (Mann and Plummer 1999), particularly for threatened or endangered species. However, the models are data intensive and even the simplest PVA approach (stochastic single-population models) requires time series data on current population abundance

and trends, knowledge of age and size structure, fecundity and recruitment estimates for each age class, and estimated carrying capacity over time for parameter estimation (Beissinger and Westphal 1998; Morris et al. 2002). Without these data or with only partial data available for certain populations, extinction risk estimates from PVA models would be largely variable and unreliable. The lack of long term population-level data for relict and replicated Apache trout populations indicates the use of PVA at this stage in recovery is premature. However, continuous monitoring of Apache trout populations is a recovery objective (Objective 1 and sub-objective 1.6), thus, it may be possible to use PVA models to estimate risk of extinction for some populations after sufficient data are collected.

Effective Population Size (N_e) and Inter-mixing Populations

Many studies indicate small populations are subjected to increased risk of extinction (e.g., Franklin 1980; Allendorf et al. 1997; Dunham et al. 1999; Fausch et al. 2006). Effective population size (N_e), which measures genetic drift and addresses the loss of genetic diversity and amount of inbreeding in a population, has been considered important in the conservation and management of fishes from a genetic perspective (Rieman and Allendorf 2001). It is recommended that a minimum N_e of 50 individuals in a population is required to prevent short-term effects of inbreeding and 500 individuals to maintain genetic variation over time (Franklin 1980; Rieman and Allendorf 2001). Reiman and Allendorf (2001) estimated N_e for bull trout (*Salvelinus confluentus*) using models based on life history and population parameters (e.g., age at maturity, survival, fecundity). Based on their simulation results, a minimum of 100 spawning adults each year would minimize inbreeding risks and 1,000 spawning adults would maintain genetic variation over time. However, because it is rare for bull trout populations to average 1,000 or more spawning adults each year, a fact also true for Apache trout and other native trout populations, the authors recommended the importance of preserving inter-connected populations in order to meet this minimum.

It has been demonstrated that Apache trout populations can successfully be established with a relatively "small" number of wild trout. Kitcheyan (1999) documented reestablishment of an Apache trout population in Squaw Creek (FAIR) with a one-time stocking of approximately 120 individuals collected from Flash Creek (FAIR). In addition, an Apache trout population was reestablished in Ord Creek (FAIR) with approximately 150 individuals in the 1960s (USFWS unpublished data). Preliminary results from research on Lahontan cutthroat trout indicated that populations can survive extreme bottlenecks (i.e., < 50 individuals) without losing genetic integrity, assuming populations rebound in a timely fashion (Mary Peacock, University of Nevada, personal communication). Because the ability of populations to persist will vary with different evolutionary life histories and environmental and catastrophic factors influencing individual streams, and because of our limited knowledge of the genetic variability in relatively small repatriated Apache trout populations, it is important to try to maintain high numbers of individuals per stream and maintain or improve habitat condition to support all life stages as best as possible (Fausch et al. 2006).

There are few perennial stream networks that might function as recovery streams for inter-connecting populations. The West Fork Black River has been identified as a potential site for

establishment of inter-connecting populations. Many recovery streams were chosen based on characteristics such as suitable habitat and stream size, and their remoteness in order to prevent certain threats to Apache trout persistence (e.g., invasion by non-native trout). These types of threats exist throughout historic Apache trout habitat, thus limiting the amount of historic habitat suitable for recovery streams. Unless natural fish barriers are present, the installation of artificial barriers is a necessary component of Apache trout recovery to maintain isolation from non-native salmonids. Choosing headwater streams isolated from non-native salmonid populations has also been common in native trout recovery for many other western species (Fausch et al. 2006). This has resulted in artificially fragmented systems that do not promote inter-connecting above barriers. Because the majority of Apache trout streams are isolated by natural or man-made barriers to protect the populations from existing threats and many populations are small, managers should be cognizant that small populations may require more aggressive management to ensure long-term survival.

Hatchery Considerations

Historically, AGFD created hatchery broodfish populations at Sterling Springs State Fish Hatchery from Apache trout taken from Ord Creek and Crooked Creek in 1963. A number of waters were stocked throughout Arizona for both restoration and sport fishing from this initial hatchery program. Apache trout were stocked into Christmas Tree Lake, Bear Canyon, Becker Lake, and Lee Valley Reservoir. In addition, populations were established in Coyote/Mamie and Mineral Creeks on ASNF, North Canyon Creek (KNF), Ash, Big, Grant, Deadman and Marijilda creeks on Coronado National Forest (CNF), Grant Creek (ASNF), and Sun and Moon Creeks on FAIR as a direct result of these pre-ESA efforts.

Currently, Apache trout are reared by USFWS at Alchesay and Williams Creek National Fish Hatcheries (A/WCNFH), and by AGFD at Tonto Creek and Silver Creek State Fish Hatcheries using eggs produced and fertilized at A/WCNFH. Fish were captured in 1983 and 1984 from East White River (FAIR) and were spawned on-site; embryos were transferred to A/WCNFH. These collections of Apache trout resulted in 944 fish being reared to maturity and available for use as initial broodfish. Fish culture facilities have been established and the technology has been developed for successful production of large numbers of hatchery-reared Apache trout. Current levels of hatchery production should be maintained or expanded to provide additional sport fishing opportunity for Apache trout.

Hatchery produced fish have been used to support recreational needs on state, forest, and tribal lands, and to establish new populations for recovery on ASNF in Coleman, Hayground, Home, Lee Valley, Stinky, West Fork Black River, and Wildcat creeks. Similarly, wild fish from Ord Creek were propagated in the early 1960s at Sterling Springs State Fish Hatchery and were stocked into CNF streams including Ash, Big, Grant, Deadman, and Marijilda creeks.

Current hatchery production is focused on producing fish for recreational needs and accordingly, the fish have been selected for early spawning and rapid growth traits. Although hatchery fish do not pose a hybridization threat to extant populations, there has been no incorporation of new genetic material from wild stocks since 1984 (6 generations). Milt from male Apache trout was

collected from the East Fork of the White River in May 2007 to reinvigorate the genetic stock of Apache trout maintained in the hatchery. A broodstock management plan has been drafted that addresses genetic integrity while maintaining spawning and growth traits (Kincaid, in progress). There are other options for using hatcheries in recovery efforts including providing temporary refugia, rearing wild-spawned fish, and offsetting risks to nearby recovery streams by providing buffer zones where angler use is high.

For recovery purposes, wild fish will be used first if they are available. For reestablishing populations into new recovery streams, it is preferred to use wild Apache trout populations if they are large enough to support removal for repatriations. In the event that fish from all extant populations or extant populations with enough individuals to support a removal are not available, new Apache trout populations could be established from a replicated population. It is recommended to remove fish from relict or replicated streams that contain more than 500 individuals (Franklin 1980), to ensure that the removal of fish for repatriation will not deplete the source population or reduce genetic variability. The last alternative for repatriation or enhancement would be to use hatchery stock to establish new recovery populations. As discussed previously, hatchery reared fish have previously been used successfully to establish populations in the wild. In summary, hatcheries will continue to provide fish for recreational use, enhancement of extant populations, and for the establishment of new populations when necessary.

Regulation of Harvest

The AGFD manages wildlife pursuant to Arizona Revised Statute (A.R.S.) Title 17. The laws relating to wildlife are administered by the AGFD under the control of the Game and Fish Commission. The AGFD is responsible for managing Arizona's wildlife populations on non-Tribal lands, and accordingly the AGFD works to ensure that the diversity of wildlife that resides in Arizona is maintained and protected. This includes working to reintroduce once extirpated species as well as threatened and endangered species that are present. Under Article IV, Section 1 (f), (h), (i), and (q) of the Constitution of the WMAT, the Tribal Council of the WMAT, enacted a Game and Fish Code that authorizes the WMAT Game and Fish Department to administer the laws of the Tribe relating to conservation and management of wildlife and recreation resources.

In 1975 Apache trout was one of the first species to be downlisted from endangered to threatened after re-evaluation of its status. The downlisting with a 4(d) rule allowed AGFD to selectively establish sport fishing opportunities (via cooperative agreement pursuant to Section 6 of the ESA). AGFD and WMAT (on FAIR lands) can regulate methods of take (via angling), possession limits, open and close seasons, and close specific areas to fishing. Once populations are re-established in recovery streams, angling regulations will be assessed on a case-by-case basis so that mortality associated with sport fishing does not threaten the continued existence of any population.

All 13 known relict populations of Apache trout currently reside on lands of the FAIR (portions of Soldier Creek are also on ASNF), and all are currently closed to fishing.

Summary

Based on the above considerations and current status of threats to the species, recovery of Apache trout will endeavor to establish and maintain 30 pure populations. The species evolved to withstand the environmental conditions within their range, and small populations have persisted throughout history in several small headwater streams where they are isolated from non-native trout. Those populations may be subject to risk of extirpation from stochastic events such as drought, fire, and periodic flooding. Closely monitoring relict and replicated Apache trout streams will provide scientists and managers with more information on life history characteristics and reintroduction success, allowing a greater understanding of population-level effects that can be managed accordingly. Increasing the number or size of protected stream reaches and establishment of intermixing populations has been proposed as a means of bolstering population numbers for other salmonids, including Gila trout. Apache trout recovery will endeavor to, where feasible, utilize the largest habitats available. Existing information (mostly from the 1990s to present) on Apache trout population numbers will be used as baseline information for future population monitoring purposes.

IMPLEMENTATION SCHEDULE

Table 2. Implementation schedule for Apache trout recovery. Costs for employee labor were based on a full time employee (FTE) at a Federal GS-12, step 5, plus 25 % employee-related expenses ($75,000 annually). Allocation refers to the amount of time spent annually on the task. For example, one FTE at 50 % allocation is $38,000 (i.e. $37,500 rounded up). Priority 1: Actions necessary to prevent extinction or irreversible decline in the species in the foreseeable future. Priority 2: Actions necessary to prevent a significant decline in species population/habitat quality, or some other significant negative impact, short of extinction. Priority 3: All other actions necessary to meet recovery objectives.

Priority Number	Action Number	Action Description	Recovery Criterion Number	Action Duration (Years)	Responsibility		Total Cost ($1,000s)	Cost Estimate by FY ($1,000)							Comments
								Recovery		Post-delisting management					
					Parties	Is FWS Lead?		FY07	FY08	FY09	FY10	FY11	FY12	FY13	
2	1	Complete any necessary Federal, state, and tribal regulatory compliance for recovery actions.	1.1	Continual	AGFD, FWS-FRO, FWS-ES, USFS, WMAT	No	65	25	10	10	10	10	0	0	
1	2	Construct and maintain artificial fish barriers if natural barriers are not present.	1.2	Periodic	AGFD, FWS-FRO, USFS, WMAT	No	400	150	50	50	50	50	25	25	As needed
1	3	Reduce or eliminate threats from non-native trout and other non-native fishes within recovery portions of streams	1.3	Continual	AGFD, FWS-FRO, USFS, WMAT	No	400	150	100	50	25	25	25	25	
2	4	Stock streams with pure Apache trout.	1.4	Periodic	AGFD, FWS-FRO, USFS, WMAT	No	170	30	30	30	30	30	10	10	As needed
2	5	Salvage and provide refugia for populations of Apache trout that are affected by wildfire, drought, barrier failures, or other natural or human induced threats.	1.5	Unknown	AGFD, FWS-FRO, USFS, WMAT	No	70	10	10	10	10	10	10	10	Unknown
3	6	Conduct population and habitat surveys.	1.6	Periodic	AGFD, FWS-FRO, USFS, WMAT	No	230	50	30	30	30	30	30	30	Every other year
3	7	Develop, implement, enforce, and evaluate regulations as necessary to prevent extirpation of recovery populations	2.1	Continual	AGFD, FWS-FRO, USFS, WMAT	No	180	40	40	20	20	20	20	20	
3	8	Implement fish disease prevention protocols for professionals, and communicate best practices to anglers and other outdoor enthusiasts	3.1	Continual	AGFD, FWS-FRO, USFS, WMAT	No	70	10	10	10	10	10	10	10	
3	9	Monitor for presence of diseases and/or causative agents, parasites, and pathogens through wild fish health surveys	3.2	Periodic	AGFD, FWS-FRO, USFS, WMAT	No	70	10	10	10	10	10	10	10	As needed
3	10	Identify regulatory mechanisms, laws, and policies that are insufficient to fulfill all recovery objectives and protect Apache trout	4.1	Continual	AGFD, FWS-FRO, FWS-ES, USFS, WMAT	Yes	180	40	40	20	20	20	20	20	
2	11	Identify, assess, and ameliorate threats to Apache trout	5.0	Continual	AGFD, FWS-FRO, FWS-ES, USFS, WMAT	No	140	20	20	20	20	20	20	20	

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APPENDIX 1: BACKGROUND LAW

Doremus and Pagel (2001) contend that recovery planning must include careful consideration of availability and effectiveness of conservation measures beyond the ESA (once delisting occurs), which they term 'background law'. The following are conservation measures that would remain in place following delisting of Apache trout.

National Forest Management Act

The National Forest Management Act (NFMA) sets out direction to develop and revise land and resource management plans (LRMP or "forest plan") under the principles of the Multiple Use Sustained Yield (MUSY) Act of 1960. Language in NFMA states that economic and environmental aspects of various systems of renewable resource management provide for outdoor recreation (including wilderness), range, timber, watershed, wildlife, and fish on National Forest System lands. NFMA also states that protection be provided for streams, streambanks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperature, blockages of water courses, and deposits of sediment, where [timber] harvests are likely to seriously and adversely affect water conditions or fish habitat. NFMA also establishes that diversity of plant and animal communities be based on the suitability and capability of the specific land area.

The implementing regulations for NFMA (36 CFR 219) address diversity and viability of plant and animal communities and species within the area covered by a land and resource management plan. Forest plans "to the extent practicable, shall preserve and enhance the diversity of plant and animal communities, including endemic and desirable naturalized plant and animal species". Furthermore, the 1982 implementing regulations for NFMA (36 CFR 219.19) state:

> "*Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area*".

Forest Plan and Allotment Management Plans

Amendment Number One to the 1987 ASNF Forests Plan increased emphasis on fish, recreation, and wildlife resources on the forests (USFS 1989). Allotments with threatened and endangered species were prioritized for allotment management plan review. Among the numerous guidelines were specifications for all applicable analysis areas including:

1) Manage waters to perpetuate Apache trout in order that this species can be delisted from the endangered category (p 206a);
2) To manage for and maintain at least 80% of streambank total linear distance in stable condition (p.158a);
3) Prevent siltation not to exceed 20% of fines (< 0.855 mm) in riffle areas (page 158a);
4) Maintain at least 80% spawning gravel surface free of organic sediment (p 158a);

5) Forage utilization standards will use a baseline of 45% for riparian areas in unsatisfactory condition and 55% for areas in satisfactory condition (p 155a);
6) Manage for stream temperatures not to exceed 68° F unless not technically feasible (p 158a);
7) Maintain at least a 80 Biotic Condition Index on all perennial streams (p 158a);
8) Manage for or maintain at least 60% of potential habitat capability for trout, Loach minnow, and Little Colorado spinedace (p158a).

All Apache trout streams on the ASNF have been analyzed during the last fifteen years through project level National Environmental Policy Act (NEPA) for range, restoration, or other USFS activities. Two Decision Notices detailing habitat actions affecting six Apache trout streams were issued in 1993 (USFS 1993 a and b). A third Decision Notice affecting the remaining Apache trout streams on ASNF was issued in 1995 (USFS 1995). Habitat protection measures detailed in these Decisions have been implemented, or grazing of domestic livestock has been deferred in affected areas. Monitoring of fish populations and habitat in these streams will continue through repetition of earlier surveys.

ESA, NEPA, and TPPR Considerations for Co-occurring Listed/Proposed Species

Further protection of Apache trout will be afforded under the ESA due to several listed species that reside in or near areas where Apache trout occur. Those species include Little Colorado spinedace (*Lepidomeda vittata*), loach minnow (*Tiaroga cobitis*) and its critical habitat, Chiricahua leopard frog (*Rana chiricahuensis*), bald eagle (*Haliaeetus leucocephalus*), southwestern willow flycatcher (*Empidonax traillii extimus*), and Mexican spotted owl (*Strix occidentalis lucidia*). Regulatory compliance (NEPA) must include analysis of Federal actions on listed and/or proposed species.

Similar to NEPA, regulatory requirements are also implemented on Tribal lands via the Tribal Plan and Policy Review (TPPR) process. All projects including timber sales that could affect tribal natural/economic/cultural resources undergo review to identify and mitigate potential concerns.

Unique Waters Designation

Under Arizona Administrative Code, Department of Environmental Quality (Article 1. Water Quality Standards for Surface Waters), "Unique water" means a surface water that is classified as an outstanding state resource water by the Director under R18-11-112. The Director shall not allow limited degradation of a unique water under subsection (C). Criteria for Unique Water designation requires the surface water meets one or both of the following conditions:

I. The surface water is of exceptional recreational or ecological significance because of its unique attributes, including but not limited to, attributes related to the geology, flora, fauna, water quality, aesthetic values, or the wilderness characteristics of the surface water.

II. Threatened or endangered species are known to be associated with the surface water and the existing water quality is essential to the maintenance and propagation of a threatened or endangered species or the surface water provides critical habitat for a threatened or endangered species. Endangered or threatened species are identified in Endangered and Threatened Wildlife and Plants, 50 CFR § 17.11 and § 17.12 (revised as of October 1, 2000) which is incorporated by reference and on file with the Department and the Office of the

Secretary of State. This incorporation by reference contains no future editions or amendments.

The following surface waters are classified as unique waters and also contain Apache trout:

- The West Fork Little Colorado River, above Government Springs;
- Lee Valley Creek, from its headwaters to Lee Valley Reservoir;
- Bear Wallow Creek, from its headwaters to the boundary of the San Carlos Indian Reservation;
- North Fork of Bear Wallow Creek, from its headwaters to Bear Wallow Creek;
- South Fork of Bear Wallow Creek, from its headwaters to Bear Wallow Creek;
- Snake Creek, from its headwaters to its confluence with Black River;
- Hay (Hayground) Creek, from its headwaters to its confluence with the West Fork Black River;
- Stinky Creek, from the Fort Apache Indian Reservation boundary to its confluence with the West Fork Black River; and
- KP Creek, from its headwaters to its confluence with the Blue River.

Tribal Water Quality Standards

For waters that contain Apache trout on Tribal lands, there are general water quality standards for all streams that apply regardless of “designated” or "non-designated" uses. In addition, there are specific standards that apply to individual stream segments based on their use designation, and those standards undergo a triennial review and update (if necessary) per requirements of the Federal Clean Water Act, Section 303(c). The ordinance (and standards) are presently undergoing review (*Water Quality Protection Ordinance of the White Mountain Apache Tribe*)