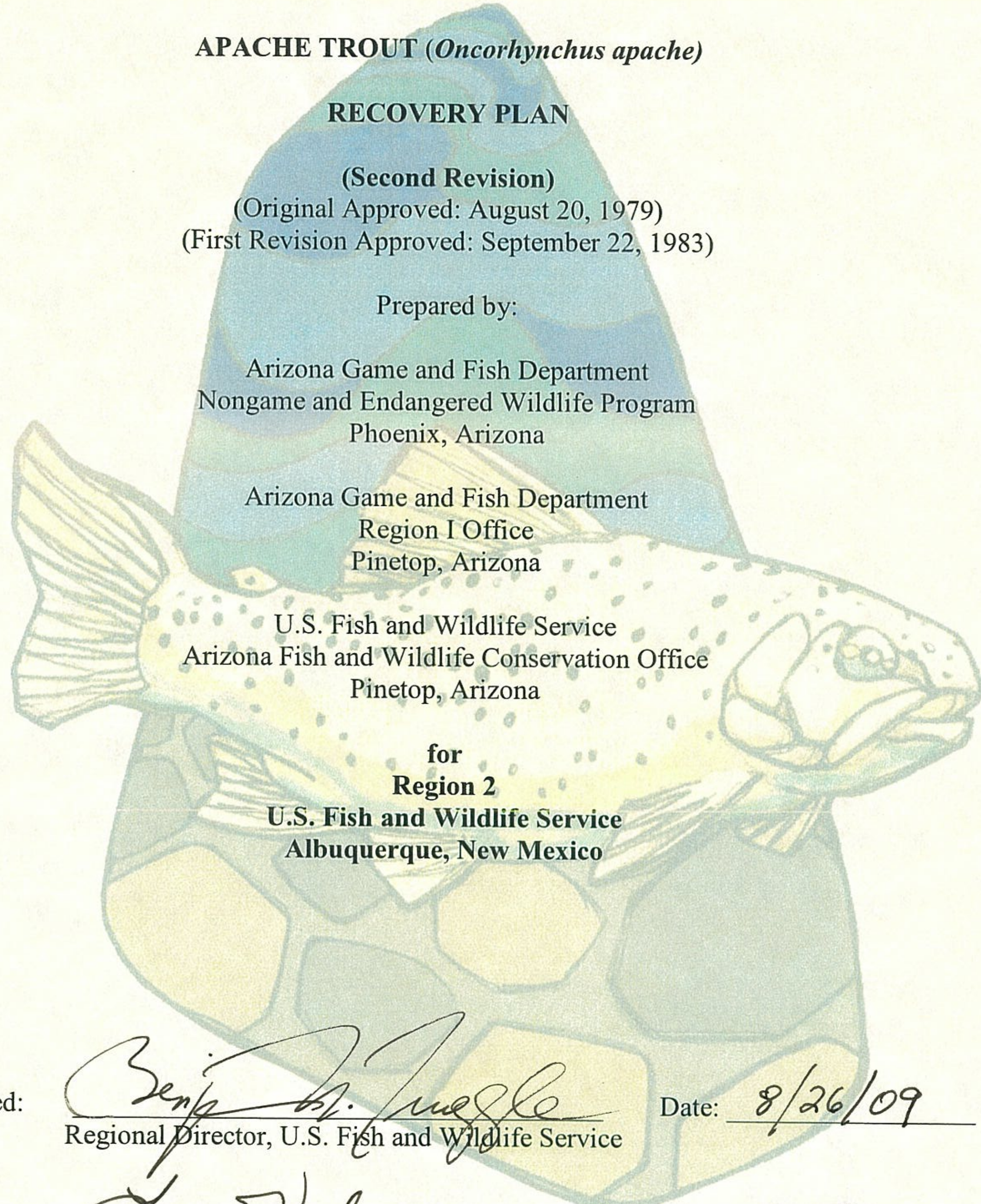

APACHE TROUT (*Oncorhynchus apache*)

RECOVERY PLAN

(Second Revision)
(Original Approved: August 20, 1979)
(First Revision Approved: September 22, 1983)

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Approved: ______________________ Date: 8/26/09
Regional Director, U.S. Fish and Wildlife Service

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Cover artwork by Marco M. Mazzoni.

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James McKibben, USFS	1976-1978	Tony Robinson, AGFD
Kenneth C. Harper, WMAT	1977-1978	Terry L. Myers, USFS, retired
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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, retired
Leon Fager, USFS	1986-1992	Robert E. David, USFWS, retired
Kelly Meyer, WMAT	1992-1998	George Divine, USFWS, retired
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Thomas Cain, USFS	1992-1997	Chuck Minckley, USFWS, retired
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Tim Gatewood, WMAT	2000-	
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Robert W. Clarkson, USBR	2000-	
Mike Lopez, AGFD	2002-	
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EXECUTIVE SUMMARY

Current Species Status

Apache trout (*Oncorhynchus apache*, formerly described as *Salmo apache* with the common name Arizona trout) is one of two salmonid species native to Arizona (the other is Gila trout, *O. gilae*), and is currently listed as threatened (Federal Register 1975). Originally listed as endangered (Federal Register 1967), a re-analysis of species status led to its downlisting in 1975 due to successful culturing in captivity and greater knowledge of existing populations. No critical habitat was designated for the Apache trout, as its listing and reclassification preceded the 1978 and 1982 amendments to the Endangered Species Act (ESA), which provided for critical habitat designation. Its 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 sportfishing opportunities (Federal Register 1975).

Historical and Current Range

Historically, Apache trout occupied streams and rivers in the upper White, Black, and Little Colorado River drainages in the White Mountains of east-central Arizona. Currently, 28 pure Apache trout populations exist within historical range in Gila, Apache, and Greenlee Counties of Arizona, on lands of the Fort Apache Indian Reservation (FAIR) and Apache-Sitgreaves National Forest (ASNF).

Habitat Requirements and Limiting Factors

Apache trout evolved in streams primarily above 1,800 m (6,000 ft) elevation, within mixed conifer and ponderosa pine forests. Apache trout generally require water temperatures below 25° C (77° F). Adequate stream flow and 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. Land-use practices such as timber harvest/thinning, prescribed fire, and livestock grazing can affect healthy riparian corridors that promote sufficient habitat conditions to allow for all life functions including spawning, hatching, rearing, foraging, loafing, 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 and boulders, undercut streambanks, or overhanging vegetation at stream margins. Recovery populations must have conditions favorable to persistence of Apache trout, which include minimizing or eliminating threats from competitive brown trout (*Salmo trutta*) or brook trout (*Salvelinus fontinalis*), and elimination of interbreeding rainbow trout (*Oncorhynchus mykiss*) or cutthroat trout (*Oncorhynchus clarki*).

Factors in the Decline of Apache Trout

Watershed alterations related primarily to forestry, livestock grazing, reservoir construction, agriculture, road construction, and mining were 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 and brown trout) have led to competition for resources and predation, or hybridization with 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 these documents and include: 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 historical 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 pure Arizona (=Apache) trout throughout its historic range" (USFWS 1983).

Revised Strategy

The purpose of this revision is to include current information about the status of the species, provide additional information about the species and its historical range 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.

Recovery Goal: Implement necessary actions to delist Apache trout.

Recovery Objective: Establish and/or maintain 30 self-sustaining discrete populations of pure Apache trout within its historical range.

Recovery Criteria: Apache trout should be considered for removal from the List of Threatened and Endangered Species (delisting) when the following criteria have been met:

- Habitat sufficient to provide for all life functions at all life stages of 30 self-sustaining discrete populations of pure Apache trout has been established and protected through plans and agreements with responsible land and resource management entities. These plans will address and serve to remedy current and future threats to Apache trout habitat.
- Thirty discrete populations of pure Apache trout have been established and determined to be self-sustaining. 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).
- Appropriate angling regulations are in place to protect Apache trout populations while complying with Federal, State, and Tribal regulatory processes.

- Agreements are in place with USFWS, AGFD, and WMAT to monitor, prevent, and control disease and/or causative agents, parasites, and pathogens that may threaten Apache trout.

Proposed Actions

- Complete any required regulatory compliance for fish stocking and stream improvements.
- Maintain existing fish barriers.
- Enhance or improve habitat for recovery populations as warranted.
- Remove or minimize undesirable fishes using piscicides or other feasible means in recovery populations.
- Maintain existing self-sustaining populations of pure Apache trout and establish new self-sustaining populations as necessary to meet the recovery objectives and criteria.
- 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, San Carlos Apache Tribe, Trout Unlimited, Federation of Fly Fishers, Wildlife Conservation Council, and National Fish and Wildlife Foundation are participants in planning and implementing recovery actions for Apache trout. Other participants are welcome to join in implementing recovery actions.

Estimated Cost of Recovery: Total estimated cost of recovery (in $1,000s). Cost is based on 2009 dollars.

Year	Recovery Action 1: Establish/maintain habitats and populations	Recovery Action 2: Implement laws and regulations to protect Apache trout populations	Recovery Action 3: Monitor, prevent, control disease	Total
Year 1 (2009)	1225	40	20	1285
Year 2 (2010)	530	40	20	590
Year 3 (2011)	215	40	20	275
Total	1970	120	60	2150

Date of Recovery: It is estimated that the actions necessary to prepare streams, establish and/or maintain 30 self-sustaining discrete populations of pure Apache trout within its historical range to restore Apache trout to a non-threatened status and address/ameliorate the five listing factors can be achieved by the end of 2011. It is estimated that the delisting package can be initiated in 2011.

CHAPTER 1: INTRODUCTION

Apache trout (*Oncorhynchus apache*) is endemic to high elevation streams in the upper Black, White, and Little Colorado River drainages in east-central Arizona. 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 (*O. gilae*), as well as Mexican golden trout (*O. chrysogaster*), represent the most divergent groups of inland trout, indicating the longest isolation from all evolutionary lines of rainbow trout (*O. mykiss*), 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 decreased to approximately 48 km (30 mi) by the mid 1900s from a total historical range estimated by Harper (1978) at 965 km (600 mi) and more recently estimated at 1,320 km (820 mi) based on Geographical Information System (GIS) mapping (Matt Alderson, Arizona Game and Fish Department [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 remaining populations existed on the Fort Apache Indian Reservation (FAIR). In 1955, WMAT closed most streams within the FAIR boundaries of the Mount Baldy Wilderness Area to fishing, while 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 U.S. Fish and Wildlife Service (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 reestablishment of Apache trout. WMAT subsequently 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 (FAIR). For their efforts, WMAT received the United States Department of Interior Conservation Service Award in 1969.

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

Apache trout was considered endangered under the Federal Endangered Species Preservation Act of 1966 (Federal Register 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 showed improved knowledge of existing populations which warranted a downlisting (Federal Register 1975). The downlisting with a 4(d) rule allowed AGFD and WMAT to selectively establish sportfishing opportunities. Recovery actions have been ongoing for over four decades, with delisting as the ultimate goal. Pure Apache trout are currently present in 28 populations within historical range across the FAIR and ASNF (Table 1). At the time of publication of the 1983 Apache Trout Recovery Plan (USFWS 1983), there were 14 known populations of Apache trout occupying less than 48 km (30 mi) of stream habitat.

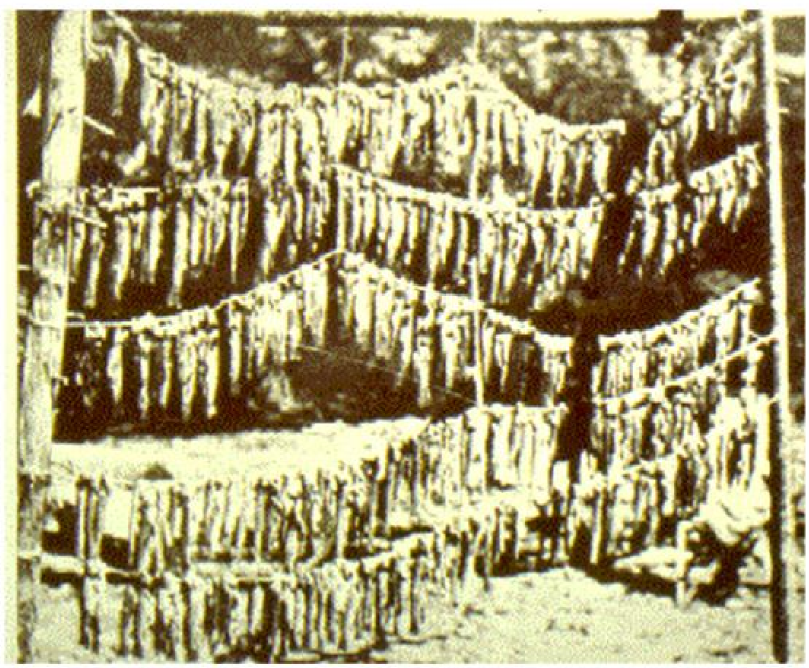


Figure 1. Photograph entitled “A Days Catch, White Mountains near Springerville, Arizona.” Date was thought to be pre 1900s, and the location was thought to be Becker Creek, Fort Apache Indian Reservation.

CHAPTER 2: SPECIES DESCRIPTION

Physical Characteristics

Distinguishing characteristics of Apache trout include a fusiform body and 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 (*O. clarki*), 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. Two black spots are located horizontally on the eye before and aft of the pupil, creating the image of a black band through the eye. A red or pink lateral band is usually absent (Miller 1972). 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 (Miller 1972, 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.

Taxonomy and Genetics

Taxonomy

Although native trout were known to science to occur in the White Mountains in Arizona since at least 1873, they were not described as a distinct species (*Salmo apache*) until 1972 (Miller 1972). Apache trout collections from the White River were first described as a variety of Colorado River cutthroat trout (*O. clarki 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).

The common name Arizona trout was originally linked to *Salmo apache*, although in 1980 the American Fisheries Society (AFS) accepted the species' common name change to Apache trout (Robins et al. 1980). The 1983 Recovery Plan retained the common name Arizona trout with a note to incorporate the new common name in future revisions (USFWS 1983). In 1991, the AFS Names Committee showed that the relationship between the cutthroat and rainbow series of trouts (including Apache trout) lie with *Oncorhynchus* rather than *Salmo*, hence the change to *Oncorhynchus apache* (Robins et al. 1991).

Apache trout is now recognized by AFS as a subspecies (*O. gilae apache*) of Gila trout due to their close relationship, while recognizing the need for further taxonomic work and the need for separate management of the two subspecies (Nelson et al. 2004). The USFWS will incorporate the change to a trinomial in a future Code of Federal Regulation publication.

Genetics

Both Apache and Gila trouts are more closely related to rainbow trout than cutthroat trout (Loudenslager et al. 1986, Dowling and Childs 1992), indicating Gila and Apache trouts may have derived from a common ancestral form that also gave rise to rainbow trout (Loudenslager et al. 1986, Behnke 1992).

Apache and Gila trout possess 56 diploid chromosomes with a total arm number of 106 (Miller 1972). This allows for distinction between 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 Gila and Apache trouts 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 *O. c. 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 and 1985). The index of genetic similarity between Apache trout and Gila trout was high at 0.93.

Evidence of hybridization has been detected among some populations consisting of Apache, cutthroat, and rainbow trouts, with introgression from rainbow trout most prevalent (Carmichael et al. 1993, Wares et al. 2004). The methods for analysis to detect hybridization of Apache trout have included the use of isozyme locus polymorphism (Carmichael et al. 1993) and microsatellite and mitochondrial DNA analyses (Wares et al. 2004). Isozyme locus polymorphisms were used to detect hybridization among Apache, cutthroat, and rainbow trouts in fish collected from 31 streams on FAIR and ASNF sampled between 1987 and 1989 (Carmichael et al. 1993). Pure populations of Apache trout were found in 11 streams including East Fork White River, and Boggy/Lofer, Coyote, Crooked, Deep, Elk Canyon, Firebox, Flash, Hurricane, Ord, and Soldier Springs Creeks (FAIR). Pure populations of Apache trout were also confirmed later in Big Bonito Creek (including its tributaries: Hurricane, Hughey, and Peasoup Creeks), Little Bonito Creek, and Smith Creek (FAIR). These pure populations comprise the 13 relict lineages of Apache trout known to exist on FAIR at present. In the majority of hybridized populations sampled by Carmichael et al. (1993), a trend of backcrossing toward Apache trout was evidenced and no pure rainbow trout or cutthroat trout were identified. On the ASNF, the genetic purity of Apache trout populations established through previous stockings was confirmed for Coyote, Hayground, Home, Mineral, Soldier, Stinky, and Wildcat Creeks, and the West Fork Black River (Wares et al. 2004). They found strong differentiation among lineages and high levels of genetic variation within populations.

Sun, Moon, Coon, Little Diamond, and Rock Creeks (FAIR) contain predominately pure individuals of Apache trout, based on an analysis by Carmichael et al. (1993). Because there is some evidence of hybridization, the populations are not counted towards recovery. However, there has been no influx of additional nonnative trout alleles since the 1960s, and Carmichael et al. (1993) recommended continued genetic monitoring of these populations since there was evidence of the hybrids back-crossing towards pure Apache trout. Samples were collected again in 2007 to reexamine the levels of hybridization in these populations. If the on-going analyses indicate purity with no evidence of hybridization, these populations may count towards recovery in the future.

Two streams outside historical range have pure replicate populations, North Canyon Creek (KNF; Ord Creek stock) and Coleman Creek (ASNF; Soldier Creek stock). 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 and North Canyon Creeks in 1996. Porath and Nielsen (2003) confirmed introgressed populations of Apache trout (with rainbow trout) in four Pinaleno Mountain streams (Ash, Big, Grant, and Marijilda Creeks) that were established from Ord Creek stock from 1965 to 1971 and are now considered outside of historical range for Apache trout. Additional streams outside Apache trout historical range that contain hybridized populations include Grant and KP Creeks on the ASNF.

CHAPTER 3: HISTORICAL AND CURRENT DISTRIBUTION

Historical Distribution

Distribution of Apache trout and Gila trout prior to European colonization is not known with certainty. The historical 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 collected that exhibit physical characteristics of both Apache and Gila trouts may be indicative of an intermediate morphotype formed by hybridization of both species. Based on extensive sampling, analysis of physical characteristics and genetic material, and recent GIS mapping, it is generally accepted that Apache trout historically inhabited between approximately 965 km (600 mi) and 1,320 km (820 mi) of streams in east central Arizona's White Mountains above 1,800 meters (6,000 ft) elevation in the upper White, Black, 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 pure and hybrid populations and historical collections found in museum records (Rinne 1985, Loundenslager et al. 1986, Carmichael et al. 1993). Native trout historically found in the Blue River and San Francisco River drainages are now considered to be Gila trout based on early collection records, current distribution of relict lineages of Gila trout, and the distribution of Gila *x* rainbow trout hybrids (USFWS 2003).

Specimens collected from the headwaters of the Little Colorado River were referred to as *Salmo mykiss pleuriticus* (Jordan and Evermann 1896). Miller (1961) once believed that Apache trout gained access to the Little Colorado River (LCR) via a canal diverting water from the Black River drainage to Colter Reservoir (LCR drainage). However, the canal was completed in 1897 (Miller 1972) and Apache trout were collected in the LCR basin prior to 1896 (Jordan and Evermann 1896), indicating that Apache trout are native to the Little Colorado River drainage.

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.

Specimens collected in 1913 from Oak Creek (Verde River drainage) were identified as hybrid Gila *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 Gila *x* rainbow trout hybrids (Behnke and Zarn 1976). Thus, there is no decisive evidence to suggest that Apache trout did or did not historically occupy upper portions of the Verde and Agua Fria drainages.

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 or hybrid Gila *x* rainbow 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. Chamberlain in 1904 from KP Creek, a tributary of the Blue River (San Francisco River drainage), exhibited spotting patterns similar to Apache trout but showed “hybrid” influence (Miller 1972) and purportedly had a distinct red band rarely seen in 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 (David 1976), however recent mtDNA tests indicate that Spruce Creek fish are Gila trout, but distinct from other lineages of Gila trout (Riddle et al. 1998).

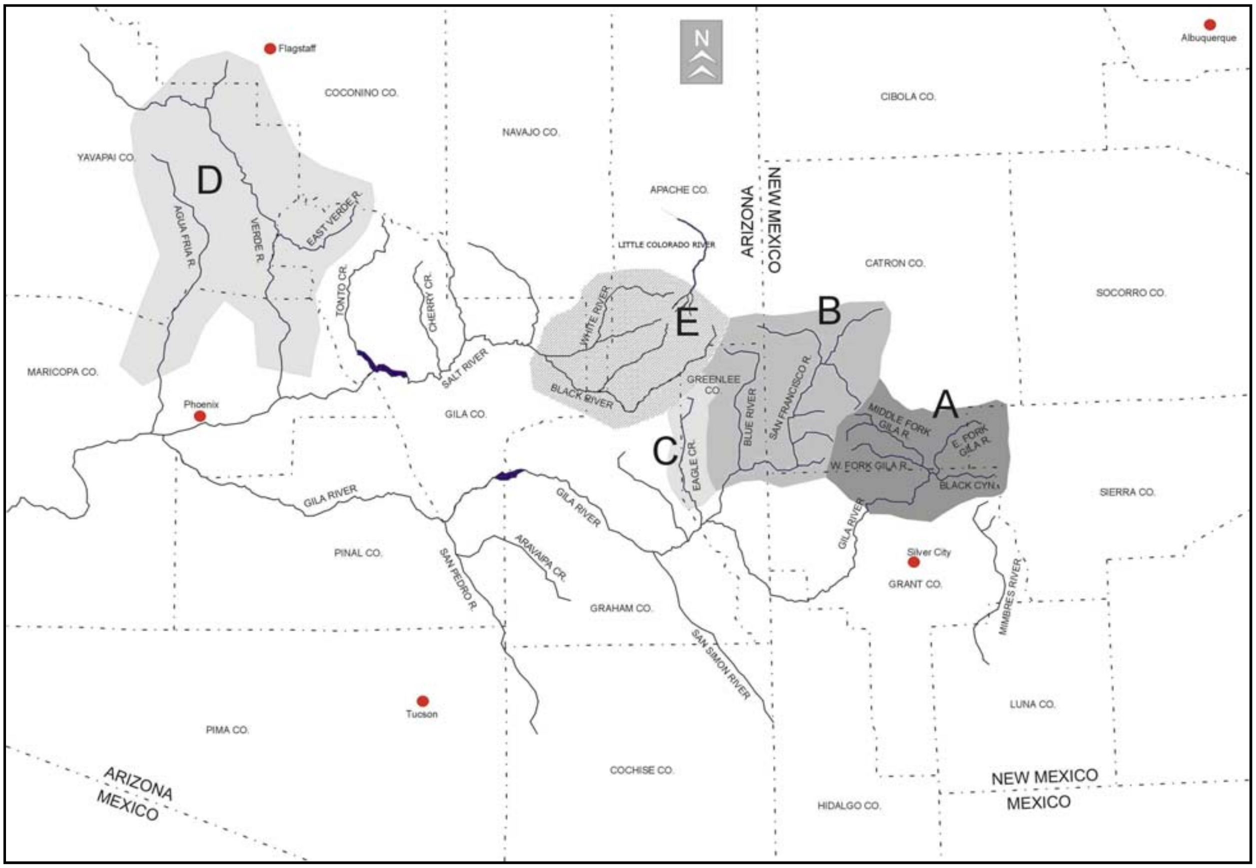


Figure 3. Historical distribution of Apache and Gila trout. The Apache trout (E) shares some characteristics with Gila trout of the San Francisco form/lineage (B) trout. Other forms of Gila trout include the Gila River form (A), Eagle Creek (C), and Verde River (D) forms (slightly revised from USFWS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

Current Distribution

The amount of habitat occupied by Apache trout was thought to have dropped to less than 48 km (30 mi) by 1976 (Harper 1976, USFWS 1983). The present distribution of relict and replicated Apache trout recovery populations occur in 28 populations within its historical range in approximately 199 km (119 mi) of stream (Table 1 and Appendix 5). At present, hatchery propagated Apache trout at the Williams Creek National Fish Hatchery (WCNFH) and AGFD Silver Creek Fish Hatchery (using eggs from WCNFH) are produced to stock streams and lakes on Tribal, State, and Federal lands for put-and-take and put-grow-take fisheries only; these waters do not count towards recovery (Appendix 3).

Salt River Watershed: Black River and White River Drainage

Recovery Populations

Natural Populations

The Big Bonito Creek system (including Big Bonito, Hurricane, Hughey, and Peasoup Creeks), 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, Smith Creek, and upper Soldier Springs Creek on the FAIR all contain relict populations of pure Apache trout. Lower Soldier Springs Creek on the ASNF contains a relict population of pure Apache trout.

Replicated Populations

Bear Wallow Creek (ASNF) was renovated in 1981, 2003, and 2005 to remove rainbow trout from above the rock-masonry barrier constructed in 1979 (repaired in 1984 and 2003-2005). In 1981, 1983, and 2005 pure Apache trout were stocked (Soldier Springs Creek lineage taken from Coleman and Soldier Springs Creeks). A new cyclopean concrete barrier was constructed in 2007 on lower Bear Wallow Creek on the San Carlos Apache Indian Reservation. Once the area between the upper and lower barriers is renovated, it will increase available habitat in Bear Wallow Creek by approximately two miles.

The Fish Creek system (ASNF; including Corduroy, Double Cienega, and Fish Creeks) was renovated in 2004 and 2005 to remove non-native trout and Apache trout hybrids from above the gabion barrier constructed in 1986 (repaired 2003-2004). The stream was stocked with pure Apache trout in 2006 and 2007 from the West Fork of the Black River.

Hayground Creek (ASNF) was renovated in 1989 and 2004 above the gabion barrier constructed in 1985 (repaired in 2004-2005). The stream was stocked with pure Apache trout (Ord Creek lineage from North Canyon Creek) in 2005. Surveys in 2007 found that non-native brown trout have compromised the stream due to a leaky barrier. The barrier needs to be repaired and the brown trout need to be removed.

Paradise Creek (FAIR) contained a hybrid population of Apache *x* rainbow trout in 1988 (Carmichael et al. 1993). In 1994 and 1995, Paradise Creek was renovated to remove hybrid trout, brown trout, and brook trout above a gabion barrier constructed in the mid 1980s. In 2000, the gabion barrier was repaired and capped with shotcrete and the stream was renovated again in 2001. In 2003, 30 Apache trout from Smith Creek were stocked into Paradise Creek. In 2007, only 27 Apache trout were collected; these fish were moved back to Smith Creek to augment the small natural population in Smith Creek and 124 Apache trout from Deep Creek were stocked in upper Paradise Creek in October 2007.

Squaw Creek (FAIR) was renovated in 1996 to remove brown trout above a barrier constructed in 1994. Following the renovation, Apache trout from Flash Creek were stocked in 1996. The results of this project are detailed in Kitcheyan (1999).

Stinky Creek (ASNF) was renovated in 1994 and 2007 above the gabion barrier constructed in 1991 (maintained 2004). The stream was subsequently stocked with pure Apache trout salvaged prior to the renovation in 2007 (originally stocked in 1995 from hatchery fish); however, brown trout were found in the stream in late 2007 due to a leaky barrier, so Stinky Creek will need to be renovated again following barrier repair.

The upper portion of Thompson Creek above a barrier on FAIR contains a replicated population of Apache trout from Firebox Creek in 1996.

The lower portions of Thompson Creek below the barrier, as well as the West Fork of the Black River above its upper constructed barrier (including Burro Creek [ASNF]) were renovated in 1996 to remove brown trout and brook trout. The West Fork Black River, lower Thompson Creek, and Burro Creek contain Apache trout from East Fork White River stock and are managed as part of the West Fork of the Black River metapopulation on ASNF due to its connected habitat.

Wohlenberg Draw Creek (FAIR) was renovated in 1999 to remove brown trout and brook trout above a timber barrier reconstructed in 1999. In 2003, Apache trout from Coyote Creek (FAIR) were stocked into Wohlenberg draw and subsequent surveys have document persistence and recruitment.

Hybrid Populations

The Boggy, Centerfire and Wildcat Creek system (ASNF) contained an Apache trout population with evidence of hybridization with rainbow trout (Carmichael et al. 1995). However, recent surveys have found very few trout due to severe drought conditions (AGFD unpublished). Hannagan Creek (ASNF) currently contains a hybridized population of Apache trout.

Sun, Moon, Coon, Little Diamond, and Rock Creeks (FAIR) contain predominately pure individuals of Apache trout, with some evidence of hybridization and therefore not counted towards recovery (Carmichael et al. 1993). Additional samples were collected again in 2007 to reexamine the levels of hybridization in these populations as Carmichael et al. (1993) noted that they were back-crossing towards pure Apache trout. If the analyses indicate purity with no evidence of hybridization, these populations may count towards recovery.

Little Colorado River (LCR) Drainage

Recovery Populations

Natural Populations

No natural populations of Apache trout remain in the Little Colorado River drainage.

Replicated Populations

Coyote and Mamie Creeks (ASNF) currently contain pure Apache trout (Ord Creek lineage) that were stocked into Mamie Creek in 1965. A rock-masonry/gabion barrier was constructed in 1994 to protect the population.

The upper East Fork LCR (ASNF) was renovated in 2004 and 2005, and was stocked with pure Apache trout in 2006 and 2007 from Soldier Springs Creek. Colter Dam protects this population from upstream movements of non-native trout.

Lee Valley Creek (ASNF), a tributary feeding Lee Valley Reservoir, was renovated in 1982 and 2003, and stocked with pure Apache trout (East Fork White River [EFWR] hatchery stock) in 2004 and augmented in 2007. Hatchery-reared Apache trout have been stocked in Lee Valley Reservoir to support a sport fishery since 1968 and a barrier was constructed on lower Lee Valley Creek (upstream of the reservoir) in 1979.

Mineral Creek (ASNF) was renovated in 1967 and 1968 and subsequently stocked with pure Apache trout (Ord Creek lineage); it currently supports a small population of pure Apache trout. A gabion barrier was built in 1982 to protect this population.

The South Fork LCR (ASNF) was renovated in 2007 and 2008 above two concrete barriers constructed in 2004. The stream was stocked with pure Apache trout from Big Bonito Creek (FAIR) in 2008.

The West Fork LCR (ASNF and FAIR) was renovated in 2006 above two gabion barriers constructed in 2004. The stream was stocked with pure Apache trout from the East Fork White River and West Fork Black River in 2007. In the fall of 2007, brown trout were collected between the barriers and above the upper barrier. It is suspected that the barriers were not completely sealed during construction. The barriers need to be repaired, and brown trout removed. The middle reaches of the creek near Sheep Crossing have been, and will continue to be, regularly stocked with hatchery Apache trout to maintain a popular sport fishery.

Populations Outside Historical Range

Ash, Grant, Big, and Marijilda Creeks in the Pinaleno Mountains (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 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 have been stocked into Bear Wallow Creek and the upper East Fork Little Colorado River and will continue to be stocked into other Apache trout recovery populations before Gila trout reestablishment 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 (KNF) 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 [TNF]) was stocked with hatchery Apache trout in 1971; 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 and would not contribute to recovery.

North Canyon Creek will be maintained as a refuge population of Apache trout and a source of fish for population establishment or augmentation. Coleman Creek will be used as a source population for establishing or augmenting other populations within the historical range of Apache trout. Once most of the fish are removed from Coleman Creek, it may be renovated and used for Gila trout recovery efforts, similar to other streams containing hybrid Apache trout that are within the historical range of Gila trout.

Table 1. Current distribution of Apache trout and potential recovery populations.

Relict Populations (FAIR/ASNF)				
Population	Habitat km (mi)	Barriers		
		Type	Artificial Material	Year Built & Maintenance
Big Bonito Creek System (Big Bonito, Hurricane, Hughey, and Pea Soup Creeks)	35.2 (21.8)	Natural	N/A	N/A
		Artificial	Gabion	1994, maintenance 1999
Boggy/Lofer Creeks	10.7 (6.6)	Natural	N/A	N/A
Coyote Creek	2.0 (1.2)	Artificial	Gabion	2002
Crooked Creek	7.6 (4.7)	Artificial	Gabion	1995, maintenance (fill and cloth) 1998
Deep Creek	11.0 (6.8)	Natural	N/A	N/A
East Fork White River	8.3 (5.2)	Natural	N/A	N/A
Elk Canyon Creek	4.2 (2.6)	Natural	N/A	N/A
Firebox Creek	4.3 (2.7)	Dewatered channel 6-km	N/A	N/A
Flash Creek	10.5 (6.5)	Natural	N/A	N/A
		Artificial	Gabion	1994, reinforced with Shot-Crete 1997
Little Bonito Creek	14.2 (8.8)	Artificial	Gabions (n=3)	1995, 1996, 1998
Ord Creek	9.8 (6.1)	Artificial	Gabion	1977, repaired 1998, reinforced with Shot-Crete 2000
Smith Creek	0.5 (0.3)	Natural	N/A	N/A
Soldier Springs Creek (FAIR/ASNF)	2.0 (1.2) FAIR 2.0 (1.2)ASNF	Natural	N/A	N/A

Table 1 (continued). Current distribution of Apache trout and potential recovery populations.

Reestablished Populations (Within Historical Range)					
Population	Habitat km (mi)	Lineage Stocked & Years	Barriers		
			Type	Artificial Material	Year Built & Maintenance
Bear Wallow Creek: Upper (ASNF)	16.9 (10.5)	Soldier Springs Creek 1981, (from Coleman Creek 1983, 2005)	Artificial	Rock-Masonry & Gabion	1979, repaired 1984, relined and splash pad 2003-2005
Coyote/Mamie Creeks (ASNF)	4.1 (2.5)	Ord Creek 1995	Artificial	Rock-masonry & Gabion	1994
East Fork Little Colorado River: Upper (ASNF)	6.9 (4.3)	Soldier Springs 2006, 2007	Artificial	Grate over Colter Dam	1998
Fish Creek System (ASNF): Ackre Lake, Fish, Corduroy, and Double Cienega Creeks	27.3 (16.9)	East Fork White River (from West Fork Black River) 2006, 2007	Artificial	Gabion	1986, additional gabions 1998 and 2003; concrete & plastic liner 2004
Hayground Creek (ASNF)	4.6 (2.9)	Ord Creek (from North Canyon Creek) 2005	Artificial	Gabion	1985, repaired 2004, 2005, needs maintenance
Lee Valley Creek (ASNF)	2.6 (1.6)	Soldier Springs Creek 1982, 1983; EFWR (from hatchery 1988, 2004, 2007)	Artificial	Concrete	1979, rebuilt 1987, repaired 2003, needs maintenance
Mineral Creek (ASNF)	4. 6 (2.9)	Ord Creek 1967, 1968	Artificial	Gabion	1982
Paradise Creek (FAIR)	6.5 (4.0)	Deep Creek 2007	Artificial	Gabion	1985, concrete covering 2000
South Fork Little Colorado River (ASNF)	9.4 (5.8)	Big Bonito Creek 2008	Artificial	Concrete (n=2)	2004
Squaw Creek (FAIR)	10.2 (6.3)	Flash Creek 1996	Artificial	Gabion	1994, repaired 1997-1999, sprayed with Shot-Crete 2001
Stinky Creek (FAIR/ASNF)	3.8 (2.4)	EFWR (from hatchery) 1995	Artificial	Gabion	1991, maintenance 2004, needs maintenance

Table 1 (continued). Current distribution of Apache trout and potential recovery populations.

Reestablished Populations (Within Historical Range), Continued					
Population	**Habitat km (mi)**	**Lineage Stocked & Years**	**Barriers**		
			Type	**Artificial Material**	**Year Built & Maintenance**
Thompson Creek: Upper (FAIR)	1.7 (1.1)	Firebox Creek 1996	Artificial	Culvert	Unknown
West Fork Black River, upper (including Burro Creek and lower Thompson Creek; ASNF/FAIR)	10.8 (6.7)	EFWR (from hatchery) 1997, 1998	Artificial	Gabions (n=2)	1996
Wohlenberg Draw (FAIR)	8.0 (5.0)	Coyote Creek 2003	Artificial	Timber	1982, reconstructed 1999
West Fork Little Colorado River (FAIR/ASNF)	16.5 (10.3)	EFWR (from EFWR) 2007 (upper on FAIR), EFWR (from West Fork Black River (lower on ASNF)	Artificial	Gabions (n=2)	2004, needs maintenance
Replicated Populations (Outside Historical Range)					
Coleman Creek (ASNF)	5.0 (3.1)	Soldier Springs Creek 1981, 1983	Natural	N/A	N/A
North Canyon Creek (KNF)	8.0 (5.0)	Ord Creek 1963, 1967	None	N/A	N/A

Table 1 (continued). Current distribution of Apache trout and potential recovery populations.

Additional Potential Recovery Populations					
Population	**Habitat km (mi)**	**Actions Needed**	**Barriers**		
			Type	**Artificial Material**	**Year Built & Maintenance**
Bear Wallow Creek: Lower (SCAT/ASNF)	3.0 (1.9)	Renovate and stock	Artificial	Concrete & Masonry	2007
Conklin Creek (ASNF)	8.4 (5.2)	Renovated, not yet stocked; barrier maintenance	Artificial	Culvert & Gabion	1988, enhanced grate over culvert 2006
Centerfire/Boggy Creeks (ASNF)	22.5 (14.0)	Monitor drought conditions, then renovate and stock	Artificial	Gabion	1984, reconstructed 2004
East Fork Little Colorado River: Lower (ASNF)	7.6 (4.7)	Renovate and stock	Artificial	Gabions (n=2)	2004
Marshall Butte Creek (FAIR)	3.2 (2.0)	Population discovered in 2007; genetic purity results pending	Natural	N/A	N/A
Snake Creek (ASNF)	3.4 (2.1)	Repair barrier, renovate, and stock	Artificial	Gabion	1987, grate installed 1998

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 to 9 cm (2 to 3 in) in length primarily fed on mayflies (Order Ephemeroptera), whereas fish 15 cm (6 in) and larger primarily consumed caddis flies (Harper 1978). Fish 5 to 17 cm (2 to 7 in) 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's 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 spawning during receding flows in the spring, at approximately 8 ^{o}C (46 ^{o}F) (Harper 1978). Redds were constructed primarily at downstream ends of pools in wide varieties of substrates (0.85 mm [0.03 in] to 32 mm [1.3 in] size), most frequently in water depths from 19 to 27 cm (7.5 to 11 in) in areas that received day-long illumination, with water velocities ranging between 1.42 to 3.11 cubic meters per second (cms) (50 to 110 cubic feet per second [cfs]) (Harper 1976). Spawning maturation is estimated to begin at 3 years of age, with eggs hatching in approximately 30 days after deposition, and emergence occurring about 60 days following 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 to 20 cm (5 to 8 in) produced between 72 and 240 eggs per female. Conversely, Apache trout from Christmas Tree Lake with lengths ranging from 30 to 35 cm (12 to 14 in) produced 646 to 1,083 eggs per female (Rosenlund 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. Because the fecundity of all fish examined was greater than the number of eggs found in redds, Harper suggested that each female may deposit eggs in several redds during a single spawning season.

Growth

Kitcheyan (1999) found that the average growth of pit-tagged Apache trout in Squaw and Flash Creeks ranged from 0.10 mm/day (0.003 in/day) in 1997 to 0.05 mm/day (0.002 in/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 to 22 mm (0.79 to 0.87

in) upon emergence, growing to between 31 to 51 mm (1.2 to 2 in) by the first annulus. Growth averaged 43 mm/year (1.7 in/year), 30 mm/year (1.2 in/year), and 25 mm/year (0.98 in/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 to 100 mm (3.5 to 4 in) by autumn of their first year, between 150 to 160 mm (6 to 6.3 in) by autumn of their second or third year, and between 190 to 200 mm (7.5 to 7.9 in) 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 (2^{nd} or 3^{rd} order) within the system may contain several thousand Apache trout, while populations in small (1^{st} 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 to 0.310 fish/m^2 (0.32 to 3.34 fish/ft^2) (Kitcheyan 1999). Harper (1978) reported densities in Big Bonito Creek ranged from 0.310 to 0.400 fish/m^2 (3.34 to 4.30 fish/ft^2) and averaged 0.340 fish/m^2 (3.66 fish/ft^2). Novy and Lopez (1991) reported Apache trout densities ranged from 0.005 to 0.570 fish/m^2 (0.05 to 6.13 fish/ft^2) in nine streams in the ASNF from 1988-1990.

Population estimates for Apache trout are widely variable and population size is 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-sized 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 replicated populations of Apache trout have persisted for longer than a decade, despite estimated population sizes of less than 1,000 total fish (i.e., Coleman, 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 (AGFD, unpublished). 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). The BVET sampling approach is habitat-based that divides each study area into habitat types and records visual observations of habitat characteristics and fish populations. Extrapolation error is minimized by calibrating visual observation and actual measurements at certain locations within the study area. This method is useful in characterizing habitat watershed-wide and can result in minimal extrapolation error but higher measurement error (McMahon et al. 1996). BVET has been used to evaluate the following Tribal streams: Big Bonito (1994), Boggy/Lofer (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). The GAWS sampling approach is transect-based, measuring habitat features in cross sections at stations along transects which produces information on how all resources interact within a transect. The GAWS method minimizes error of measured characteristics; however, extrapolation of fish population error can be high (McMahon et al. 1996). GAWS surveys have been used to evaluate 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).

Preliminary analyses have been conducted to estimate fish population abundances on recovery populations based on the surveys listed above; however, they are currently in draft form and will be included as an appendix to the Recovery Plan at a later date, included in the species status review, or included in a proposed rule to change the status of the species.

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 [5.1 in]) Apache trout used shallow water (< 20 cm [8 in]) most frequently while adults preferred water depth > 20 cm (8 in) (Kitcheyan 1999). Juvenile fish were closely associated with cover such as surface turbulence, overhanging vegetation, and objects less than 150 mm (6 in) 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 [0.38 in/sec]), depths were shallow (mean 3.31 cm [1.3 in]), and substrates tended to be composed of fines.

Wada (1991), Wada et al. (1995), and Kitcheyan (1999) reported that Apache trout spent a considerable portion of the day feeding and residing in portions of pools exposed to direct sunlight. Cantrell et al. (2005) reported that, in the absence of competition, 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).

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 [81^{o}F]). 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 2.1 km (1.3 mi) upstream and 2.4 km (1.48 mi) downstream; however, most fish were recaptured within 0.75 km (0.47 mi) of the initial capture site. Harper (1978) reported that 41 tagged adults in Big Bonito Creek were recaptured within 0.10 km (0.06 mi) of where they were marked. Movements of post-emergent fry in Big Bonito Creek were typically downstream, 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.

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

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

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 menziesii*) 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. 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. Box elder (*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 of Apache trout (or Gila trout), speckled dace (*Rhinichthys osculus*), desert sucker (previously referred to as Gila mountain sucker) (*Pantosteus clarki*), and bluehead sucker (*P. discobolus*) (Minckley 1973). Depending on the subdrainage and elevation, Apache trout co-occurred with roundtail chub (*Gila robusta*), or Gila chub (*G. intermedia*), Sonora sucker (*Catostomus insignis*) or flannelmouth sucker (*C. latipinnus*), loach minnow (*Tiaroga 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 nearly 100 years with non-native rainbow trout, cutthroat trout, brook trout, and/or brown trout. Hatchery and management records from WCNFH, the USFWS Arizona Fish and Wildlife Conservation Office (AZFWCO), 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 late 1800s (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 USFWS fish stocking actions are conducted under auspices of section 7 intra-Service consultations with compliance under applicable Federal laws (i.e., ESA, National Environmental Policy Act [NEPA]). Recovery populations for Apache trout must be protected by either natural or artificial barriers, or dewatered zones that provide 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 (Federal Register 1967). 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*" (Federal Register 1975). Below is a more detailed summary of the past and current threats to Apache trout.

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

This factor 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 vary in intensity, complexity, and damage depending on location, but ultimately reduce the ability of Apache trout to effectively persist at all life stages throughout its historical range.

Restrictions and/or changes to land-use practices (livestock grazing, logging, road construction, etc.) have been implemented to protect Apache trout habitat. For example, habitat was protected by installation of fencing along numerous streams on ASNF to exclude livestock along critical sections in order to improve riparian corridors (see Chapter 6). Allotment Management Plans 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. As long as the exclosure fences are regularly maintained and effective, these actions have been successful at protecting some streams from the impacts of livestock grazing. However, the natural recovery of impacted areas is slow and heavily impacted stream meadow reaches may need assistance to stabilize streambanks and restore vegetation.

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. Overutilization does not currently present a significant threat to Apache trout as fishing regulations are developed and enforced by AGFD and WMAT to maintain appropriate populations in recovery streams (including several streams that remain closed to fishing). The AGFD issues State Scientific Collecting permits for scientific and educational purposes, and the current levels of scientific and educational collection is not a significant threat to the species.

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 tested positive for the antigens 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.

Whirling disease has been introduced into Arizona (two known locations using private stockings of rainbow trout and one positive test from the Colorado River at Lee's Ferry), follow-up testing of fish at these two private ponds has not revealed the presence of myxospores, and continued tests of trout from the Grand Canyon are pending. Whirling disease 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, former USFWS Fish Health Specialist, personal communication). Wild fish health surveys are being conducted on Apache trout recovery populations, donor populations, and State and Federal hatchery facilities and to date disease does not appear to be a significant threat to Apache trout.

Non-native salmonids such as brown trout and brook trout were introduced into the range of Apache trout for fishing recreation starting in the 1940s (AGFD stocking records), and their introduction resulted in competition for resources or habitats and direct predation. This factor was identified as one of the primary causes leading to the listing of Apache trout. Non-native salmonids are no longer stocked by AGFD or USFWS in areas where they could negatively impact recovery populations of Apache trout.

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. Regulatory mechanisms are currently adequate to protect Apache trout.

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

Aquatic nuisance species such as northern crayfish (*Orconectes virilis*) 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.

Although not identified as a reason that led to listing in 1969, climate change may have an effect on Apache trout populations. Recent research by Seager et al. (2007) indicates that the baseline climatology for this region may be comparable to that of the mid-century drought and Dust Bowl era. Stochastic threats such as drought, wildfire, and post-fire flooding in native trout habitat appear to be on the rise, making these species especially vulnerable because small remaining populations are in areas most likely to be impacted by these climatic effects (Williams and Meka Carter 2009). Climate models for the southwest U.S. predict a continuing increase in drought and flood severity, warmer air and water temperatures, less precipitation, and more evapotranspiration (Hoerling and Eischeid 2007). Warming trends will alter seasonal river flows, making them higher during winter and lower during summer. Less snowfall and more rain during winter may result in earlier spring runoff, and drought subsequently may be more intense during summer low flows. It is suggested that such climate changes may further threaten native trout (Williams and Meka Carter 2009). Monitoring of habitat and populations will be needed to address potential threats.

CHAPTER 6: 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. The following actions have been implemented to address the factors that led to listing. 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 4: 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) which added livestock and/or elk exclosure fencing to many ASNF streams to restore riparian vegetation and improve the physical habitat conditions within streams (see below).

- Habitat was improved by installation of fencing along numerous 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 4).

- Allotment Management Plans have been modified to reduce deterioration of riparian and stream habitats by not permitting livestock use, limiting livestock utilization levels,

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

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 East Fork Little Colorado River (EFLCR) (to Colter Reservoir), Lee Valley, and West Fork Little Colorado River (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, Deep, EFWR, Elk Canyon, Firebox, Flash, and Smith Creeks on FAIR.

- 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 (2), Conklin (1), Coyote/Mamie (1), EFLCR (2), Fish (1), Hayground (1), Home (2), Lee Valley (1), Mineral (1), South Fork Little Colorado River (SFLCR) (2), Snake (1), Stinky (1), West Fork Black River (WFBR) (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 populations 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) and an additional 13 streams were treated with Fintrol (antimycin-A) from 1981 to 2008 (Bear Wallow, Conklin, EFLCR, Fish, Hayground, Home, Lee Valley, SFLCR, 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 populations.

- Stocking of non-native salmonids has been discontinued in habitat where predation and competition with non-native trout pose a threat to Apache trout.

- Hatchery produced Apache trout have been used to assist with recovery needs (e.g., stockings by AGFD at Sheep Crossing on the West Fork Little Colorado River and Lee Valley Creek; see Hatchery Considerations). The revised recovery strategy allows for the use of hatchery propagated Apache trout to stock a renovated and secured stream if such populations cannot be established by moving fish from a relict or replicated population. Thus, hatchery produced fish are available for recovery as necessary and to support recreational fishing opportunities. Providing fish for angling recreation has assisted with recovery by meeting public demand where rainbow trout were traditionally stocked, educating the public about Apache trout recovery, maintaining public support, and providing a buffer between non-native trout and recovery portions of streams.

- 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, including maintaining angling and access closures at relict populations.

- 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; these fisheries do not count towards recovery.

- 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 populations 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 USFWS fish stocking actions are conducted under auspices of section 7 intra-Service consultations with compliance to applicable Federal laws (i.e., ESA, NEPA).

- Unique Water designation affords additional protection for certain waters (see Background Law below, Appendix 4).

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

- Non-native salmonids have been removed from designated recovery populations by chemical renovation and/or electrofishing in order to prevent hybridization between non-native trout and Apache trout.

- Stocking of non-native salmonids has been discontinued in habitat where hybridization, poses a threat to Apache trout.

- Populations of Apache trout are present in 13 remaining natural populations, reestablished into 15 populations, and will be reestablished into at least two more populations throughout its historical 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.

- A partnership was developed to promote collaborative conservation among various government and non-government entities including the ASNF, AGFD, USFWS, Trout Unlimited, 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. The MOU expired in 2005 and is undergoing revision.

Delisting and Post-Recovery Management

When the recovery criteria and site-specific management actions described in this recovery plan have been met, at least 30 self-sustaining discrete populations of pure Apache trout within its historical range will exist in approximately 275 km (171 mi) of secured stream habitat. Conservation and other management actions for Apache trout will continue beyond delisting as components of the AGFD, WMAT, and USFS fish and wildlife programs.

<u>Post Delisting Management Plan</u>

AGFD, USFS, and WMAT, in cooperation with USFWS, will develop a post-delisting monitoring (PDM) plan for Apache trout in the recovery populations concurrent with a proposed delisting rule. The plan should address: habitat, population, and genetic management; monitoring distribution and population demographics; barrier integrity and maintenance; presence of non-native species; and agency roles, responsibilities, and timelines.

<u>Population Viability</u>

Although small populations of Apache trout have persisted in small streams over time, the future persistence of replicated populations of Apache trout in recovery populations is unknown. Recovery populations 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 action (action 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 (Ne) 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). Current research suggests 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.

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). The ability of populations to persist will vary with different evolutionary life histories and environmental and catastrophic factors that will influence individual streams. Thus, for small and large recovery populations, it is important to maintain habitat quality to maintain an adequate population size. To ensure habitat suitability for reestablished populations, only streams that supported healthy populations of non-native trout and/or Apache *x* rainbow trout hybrids were chosen for recovery. In addition, Apache trout recovery populations 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). Studies have suggested that fish in small, isolated streams are more at risk of extinction if habitat is insufficient (Fausch et al. 2006). Fortunately, several relict populations in Coyote, Smith, and Firebox Creeks and replicate populations in Coyote/Mamie and Mineral Creeks occur in headwater streams and have maintained small reproducing populations of pure Apache trout without management intervention.

There are few perennial stream networks that might function as recovery populations for inter-connecting populations. Currently, pure Apache trout exist in three stream systems including Big Bonito Creek and Fish Creek systems, and the upper West Fork Black River. The Big Bonito Creek system is comprised of over 35 km (22 mi) of stream including Big Bonito Creek and its tributaries Hurricane, Hughey, and Pea Soup Creeks. Fish Creek and the upper West Fork Black River systems each are comprised of three streams with a total of 27 km (17 mi) and 11 km (7 mi) of habitat, respectively. The lower mainstem of the West Fork Black River has been identified as a potential site for establishment of inter-connecting populations which would connect Hayground Creek, Stinky Creek, and the upper West Fork Black River including lower Thompson and Burro Creeks. Two recovery populations, Boggy/Lofer (10 km; 6 mi) and Coyote/Mamie (4 km; 2 mi), each have two inter-connecting streams occupied by Apache trout. The West (16 km; 10 mi) and South (9 km; 6 mi) Forks of the Little Colorado River each have tributaries that have previously supported non-native trout. Thus, Apache trout recovery populations are not limited to single channels per population as several of them contain more than two tributaries that will support trout populations.

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. Most recovery populations are headwater streams that can be isolated from non-native trout reinvasion with a barrier. Choosing headwater streams because of their isolation is practiced elsewhere for native trout recovery for many other western species (Fausch et al. 2006) and isolated streams above barriers have ensured the persistence of many other wild salmonid populations (see for example Northcote and Hartman 1988). This has resulted in artificially fragmented stream segments that do not promote inter-connecting above barriers and may affect the migratory life history of some freshwater salmonids. However, these headwater habitats are the highest quality habitat for trout because they have been minimally impacted by land-use practices and their remoteness provides protection for recovery populations. Because isolated headwater streams may be more vulnerable to catastrophic and stochastic events (Fausch et al. 2006), Tribal, State, and Federal biologists regularly monitor these populations in case intervention (e.g., supplemental stockings, removal due to severe drought) is necessary.

Hatchery Considerations

Currently, Apache trout are reared by USFWS at WCNFH, and by AGFD at Tonto Creek and Silver Creek State Fish Hatcheries using eggs produced and fertilized at WCNFH. Fish were captured in 1983 and 1984 from East Fork White River (FAIR) and were spawned on-site; embryos were transferred to 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 originating from the East Fork White River population.

Hatchery produced fish have been used to support recreational needs on state, forest, and tribal lands, and have been used in the past to establish new populations for recovery on ASNF in the West Fork Black River and Hayground, Lee Valley, and Stinky Creeks. Populations of pure Apache trout originally stocked from hatchery produced fish are established in Coleman, Stinky, and the West Fork Black River. Similarly, wild fish from Ord Creek were propagated in the early 1960s at Sterling Springs State Fish Hatchery and were stocked into CNF streams (Ash, Big, Grant, Deadman, and Marijilda Creeks) and still persist as hybrid populations.

Current hatchery production at WCNFH is for producing fish for recreational needs only, 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. There may be other options for using hatcheries in future conservation efforts including providing temporary refuges, rearing wild-spawned fish, and offsetting risks to nearby recovery populations by providing recreational opportunities where angler use is high.

For recovery purposes, wild fish will be used first if they are available. For reestablishing new recovery populations, it is preferred to use wild Apache trout populations if they are large enough to support removal of fish to allow for reestablishment in other streams. 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 reestablishment or augmentation would be to use hatchery stock from state hatcheries, as fish produced at WCNFH are used for recreational needs on the FAIR.

<u>Regulation of Harvest</u>

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. The downlisting with a 4(d) rule allowed AGFD and WMAT to selectively establish sportfishing opportunities (via cooperative agreement pursuant to section 6 of the ESA). AGFD and WMAT 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 populations, angling regulations will be assessed on a case-by-case basis so that mortality associated with sportfishing does not threaten the continued existence of any population.

Summary

Based on the above considerations and current status of threats to the species, recovery of Apache trout will endeavor to establish and/or maintain 30 self-sustaining discrete populations of pure Apache trout within its historical range. The species evolved to withstand the environmental conditions within its 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 reestablishment 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 and in the development of the PDM plan.

CHAPTER 7: 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 main focus in the 1983 plan was to 1) establish and/or maintain 30 self-sustaining discrete populations of pure Arizona (=Apache) trout throughout its historic range, with additional objectives to: 2) survey and manage Apache trout populations presently existing in waters outside the historical 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 needed to be updated to include current information about the status of the species, changes in the knowledge of historical range, 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 1983 Recovery Plan identified many streams where Apache trout were introduced, several of which are now considered outside historical range: Ash, Big, Deadman, and Marijilda, Horton, Coleman, and Grant (ASNF) Creeks. The recovery strategy in this revision only includes streams within historical Apache trout habitat and retains the 1983 objective to establish and/or maintain 30 self-sustaining discrete populations of pure Apache trout within its historical range. It also includes additional criteria to ameliorate threats relative to the five listing factors (see previous section on “Reasons for Listing”). In addition, the revised recovery strategy allows for the use of hatchery propagated Apache trout to stock a renovated and secured stream if such populations cannot be established by moving fish from a relict or replicated wild population. At present, hatchery propagated Apache trout at the WCNFH are produced and stocked into streams and lakes for put-and-take and put-grow-take fisheries on Tribal lands; these waters do not count towards recovery. Apache trout produced at WCNFH are also distributed as fertilized eggs to state hatcheries and primarily grown to catchable size and stocked into non-recovery waters. Two exceptions include hatchery fish stocked by AGFD to supplement the popular sport fishery at Sheep Crossing on the West Fork Little Colorado River and to augment the population of Apache trout in Lee Valley Creek (same genetic lineage as the recreationally managed Apache trout fishery in Lee Valley Lake). A PDM plan will incorporate genetic considerations such as recommendations to conserve remaining genetic potential by establishing new populations and augmenting existing populations.

The following section presents a strategy to recover the species, including objective and measurable recovery criteria; as well as 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 addresses the five statutory listing/recovery factors (section 4(a)(1) of the ESA) to demonstrate how the recovery objective, criteria, and actions will lead to removal of the Apache trout from the lists of Threatened and Endangered Species.

Recovery Strategy: Hybridization with non-native rainbow and cutthroat trouts is one of the most serious threats to Apache trout. Other non-native trouts such as brown trout and brook trout can compete with Apache trout for food and cover and competition with these trouts has been identified as a cause of the decline of Apache trout (Rinne and Minckley 1985). All AGFD and USFWS fish stocking actions are conducted under auspices of section 7 intra-Service consultations with compliance under applicable Federal laws (i.e., ESA, NEPA). The removal of rainbow and cutthroat trouts from Apache trout recovery populations is an essential component of the recovery strategy to prevent hybridization with Apache trout, as is reducing or eliminating other nonnative fishes which will reduce competition and predation for limited resources by other salmonid species. Re-invasion of Apache trout recovery populations by non-native trout will be prevented by using streams for recovery that are protected by natural barriers (including dewatered stretches of stream that prevent upstream movement of nonnative fishes) or by the construction and maintenance 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 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 4). 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 populations will require 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. The frequency of monitoring recommended in the 1983 Apache Trout Recovery Plan was at least every three years to determine if non-native trout had reinvaded the stream and monitor population abundance. This monitoring strategy will continue, with more frequent monitoring necessary with new populations to document establishment. Because the majority of Apache trout streams is isolated by natural or man-made barriers to protect the populations from existing threats and some 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 populations that decrease with significant flow fluctuations triggered by drought may need to be supplemented with fish from the appropriate source streams (see Recovery Actions 1.0 and 1.4).

Recovery Goal: Implement necessary actions to delist Apache trout.

Recovery Objective: Establish and/or maintain 30 self-sustaining discrete populations of pure Apache trout within its historical range. A population is defined as all individuals that occur in a specified geographic area, such as a stream above a natural or manmade barrier (including significant stretches of waterless stream channel). 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 Criteria: The recovery criteria are designed to address the threats to Apache trout so that the species no longer requires the protection of the ESA. These criteria address the biodiversity principles of representation, resiliency and redundancy (Schaffer and Stein 2000); as well as Tear's et al. (2005) recommendation for a fourth "R" – restoration, to further achieve levels of representation, resiliency, and redundancy. Representation involves conserving the breadth of the genetic makeup of the species to conserve its adaptive capabilities. Resiliency involves ensuring that each population is sufficiently large to withstand stochastic events. Redundancy involves ensuring a sufficient number of populations to provide a margin of safety for the species to withstand catastrophic events. The listing factors addressed by each criterion are shown below in abbreviated form. For a complete description of the listing factors, please refer to Chapter 6, pages 25-29 of this plan.

Apache trout should be considered for removal from the List of Threatened and Endangered Species (delisting) when the following criteria have been met:

- Habitat sufficient to provide for all life functions at all life stages of 30 self-sustaining discrete populations of pure Apache trout has been established and protected through plans and agreements with responsible land and resource management entities. These plans will address current and future threats to Apache trout habitat (Factor A: habitat destruction; Factor C: disease or predation; Factor E: other factors)

- Thirty discrete populations of pure Apache trout have been established and determined to be self-sustaining. 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) (Demographic criterion not specific to any one listing factor, but related to all five).

- Appropriate angling regulations are in place to protect Apache trout populations while complying with Federal, State, and Tribal regulatory processes (Factor B: overutilization; Factor D: Inadequate regulatory mechanisms).

- Agreements are in place with USFWS, AGFD, and WMAT to monitor, prevent, and control disease and/or causative agents, parasites, and pathogens that may threaten Apache trout (Factor C: disease or predation).

When the recovery actions have been achieved, pure Apache trout will exist in 30 discrete populations in approximately 275 km (171 mi) of secured stream habitat within the species' historical range. The populations will be comprised of the following:

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

- Fifteen replicated populations: Bear Wallow (ASNF), Coyote/Mamie (ASNF), Fish Creek system (including Corduroy and Double Cienega Creeks ASNF), Hayground (ASNF), Lee Valley (ASNF), Mineral (ASNF), Paradise (FAIR), Squaw (FAIR), Stinky (ASNF), Thompson (FAIR), and Wohlenberg Draw (FAIR) Creeks; and the East Fork Little Colorado River (ASNF), South Fork Little Colorado River (ASNF), West Fork Black River system (including lower Thompson and Burro Creeks) (ASNF and FAIR), and West Fork Little Colorado River (ASNF);

- Additional habitats have been identified to support potential recovery populations, all of which are on the ASNF: Conklin, Centerfire/Boggy/Wildcat, and Snake Creeks. Additional streams identified for range expansion include lower Bear Wallow Creek (ASNF and SCAT), and the lower East Fork Little Colorado River. Additional streams within the historical range of Apache trout may be used for further conservation of the species if they meet the criteria for recovery populations in the future.

Recovery populations were selected by the Recovery Team if they either contained a remaining natural population of Apache trout or were within the historical range of Apache trout (including representative populations in three sub-basins: White, Black, and Little Colorado Rivers), contained suitable habitat for all life stages of Apache trout, and were realistically feasible to be isolated from nonnative trouts (either by natural or artificial barriers). There are few perennial stream networks that might function as recovery streams for inter-connecting populations within the historical range of Apache trout, mainly because water impoundments, reservoirs, and rural communities have been developed in the mainstream habitats. Unless natural fish barriers are present, the installation of artificial barriers is a necessary component of Apache trout recovery to maintain isolation from nonnative trout to prevent hybridization and competition/predation. Thirty populations were identified as the recommended threshold for recovery by applying Shaffer and Stein's (2000) three principles of conservation biology; representation, resiliency, and redundancy; and Tear's et al. (2005) fourth "R" – restoration, to further achieve levels of representation, resiliency, and redundancy.

Representation – The 30 populations of pure Apache trout will be derived from the remaining natural populations (n=13) plus suitable replicate populations (n=17) within its historic range to conserve a variety of the remaining genetic makeup of the species. Currently, eight of the 13 natural populations have been replicated at least once (Big Bonito, Coyote, Deep, Firebox, Flash, Ord, and Soldier Springs Creeks, and East Fork White River).

Resiliency – The 30 populations are located in streams that contain a diversity of habitat that allows for the populations of sufficient size to persist and maintain viability under varying habitat conditions and population dynamics. In order for a stream to be considered as a potential recovery stream, it must be within historical range of Apache trout and have all of the following characteristics: 1) perennial water that is capable of supporting all life stages of Apache trout 2) the historical presence of trout (native or non-native) as an indication of perennial water and habitat suitability; 3) streams are above reservoirs, unless reservoirs contain Apache trout as the only salmonid; and 4) streams are above and isolated from areas that receive intense angling pressure.

Redundancy – The 30 populations within the historic range of the species in three sub-basins (White, Black, and Little Colorado Rivers) provide a margin of safety such that the species will not be likely to become endangered (or extinct) throughout all or a significant portion of its range due to a catastrophic event.

Restoration – The 30 populations within its historical range would be more than double the number of populations at the time of listing and the 275 km (171 mi) of occupied stream habitat within the 30 populations would be close to six times greater than the amount of habitat occupied when the species was listed.

Conservation and management actions should 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. Threats from non-native fishes present in recovery populations will be reduced or eliminated to prevent the potential for hybridization, competition, and/or predation. Similarly, populations in hybrid streams that contain a mix of Apache trout and hybrids (within historical Apache trout habitat) should be monitored to evaluate population levels as well as backcrossing and introgression.

With the exception of North Canyon (KNF) and Coleman (ASNF) Creeks, which are outside the historical range of Apache trout but inhabited by pure Apache trout, the remaining populations established outside historical range are hybridized (Ash, Big, Grant, and Marijilda Creeks [CNF]; Grant, and KP Creeks [ASNF]). Some of these streams are now considered within historical range of Gila trout and may be renovated and stocked with Gila trout in the future. Although the North Canyon Creek population should be maintained, as it contains an important lineage of pure Apache trout (Ord Creek) that has been, and should continue to be, used as a source of fish for recovery efforts, only streams within the historical range of Apache trout will be considered one of the 30 populations necessary for recovery of the species.

Recovery Action Outline:

- 1.0: Assess, prepare, protect, and maintain habitats sufficient to establish and/or maintain 30 self-sustaining discrete populations of pure Apache trout within its historical range
  - 1.1: Complete any necessary Federal, State, and Tribal regulatory compliance for recovery actions
  - 1.2: Construct and maintain artificial fish barriers if natural barriers are not present
  - 1.3: Reduce or eliminate threats from non-native trout and other non-native fishes within recovery portions of streams using chemical piscicides or other effective techniques (upstream of fish barriers)
  - 1.4: Stock streams with pure Apache trout
  - 1.5: Salvage and provide refuges for populations of Apache trout that are affected by wildfire, drought, barrier failures, or other natural or human induced threats
  - 1.6: Conduct population and habitat surveys
- 2.0: Implement appropriate laws and regulations to protect Apache trout populations while complying with Federal, State, and Tribal regulatory processes
  - 2.1: Develop, implement, enforce, and evaluate regulations as necessary to prevent extirpation of recovery populations
  - 2.2: Identify regulatory mechanisms, laws, and policies that are insufficient to fulfill all recovery criteria and protect Apache trout
- 3.0: Monitor, prevent, and control disease and/or causative agents, parasites, and pathogens
  - 3.1: Implement fish disease prevention protocols for professionals, and communicate best practices to anglers and other outdoor enthusiasts
  - 3.2: Monitor for presence of diseases and/or causative agents, parasites, and pathogens through wild fish health surveys

Recovery Action Narrative: The following site specific actions to implement the recovery strategy are described below in each of the criteria in the narrative. The listing factors that each action addresses are included.

<u>**Action 1.0**</u> **Assess, prepare, protect, and maintain habitats sufficient to establish and/or maintain 30 self-sustaining discrete populations of pure Apache trout within its historical range.** (Factor A: habitat destruction;

Factor C: disease or predation; Factor E: other factors). 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).

Recovery populations 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 NEPA, Clean Water Act, ESA, or other applicable statutes, policies, or procedures.

Site-specific actions needed:

- Comply with applicable regulations for all recovery activities

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.

Site-specific actions needed:

- Maintain all artificial barriers
- Repair barriers on West Fork LCR and Conklin, Hayground, Stinky, and Snake Creeks

1.3 Reduce or eliminate threats from non-native trout and other non-native fishes within recovery portions of streams using chemical piscicides or other effective techniques (upstream of fish barriers). Brown trout can prey on Apache trout, and brown and brook trout can out-compete Apache trout for resources. Rainbow trout and cutthroat trout can hybridize with Apache trout.

Site-specific actions needed:

- Remove non-native trout from the West Fork LCR, Hayground, Stinky, and Snake Creeks once barriers are repaired
- Continue mechanical removal efforts where currently ongoing (Crooked, Squaw, and Little Bonito Creeks)

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 secure 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 hatcheries to establish new populations.

It is recommended to use donor 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.

Site-specific actions needed:

- Stock Conklin Creek with pure Apache trout
- Augment recently stocked populations, if needed to minimize the risk of inbreeding and maintain genetic variation over time
- Stock Hayground, Snake, and Stinky Creeks following renovation

1.5 **Salvage and provide refuges 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 with suitable isolation facilities until they can be returned to the wild. The *Emergency Evacuation Procedures for Gila trout* (Brooks 2004) will be used as a guide for Apache trout.

Site-specific actions needed:

- Implement evacuation plan as needed

1.6 **Conduct population and habitat surveys.** Survey recovery populations to determine population persistence, overall population status, and document reproduction, and detect the presence of non-native trout, hybrid Apache trout, and crayfish before population declines occur. Habitat surveys will be conducted to monitor habitat changes over time and implement adaptive management programs and habitat restoration where needed. If non-native trout are found, implement recovery action 1.3.

Because the remaining three populations 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 succeed after the non-native trout are removed and pure Apache trout are stocked. Future monitoring (using a variety of techniques including visual, snorkeling, and electrofishing) will be conducted to ensure that these populations are self-sustaining.

Site-specific actions needed:

- Conduct population and habitat surveys on all populations; at least once every three years

Action 2.0 **Implement appropriate laws and regulations to protect Apache trout populations while complying with Federal, State, and Tribal regulatory processes.** (Factor B: overutilization; Factor D: inadequacy of regulatory mechanisms).

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 maintaining existing stream closures, implementing new closures, closed or restricted seasons, harvest limits, length limits, or restricting gear types.

Site-specific actions needed:

- AGFD and WMAT will continue to implement fishing regulations to protect recovery populations.

2.2 **Identify regulatory mechanisms, laws, and policies that are insufficient to fulfill all recovery criteria 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 any State or Tribal regulations, NEPA, Clean Water Act, ESA section 7 consultations, or other applicable statutes, policies, or procedures.

Site-specific actions needed:

- Take corrective action if any populations are adversely impacted due to insufficient or inadequately enforced laws or policies.

Action 3.0 **Monitor, prevent, and control disease and/or causative agents, parasites, and pathogens.** (Factor C: Disease or predation; these actions address disease, predation on Apache trout is addressed by action 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.

Site-specific actions needed:

- Continue education and outreach activities regarding the potential spread of disease through unintentional angler transport.

3.2 Monitor for presence of diseases and/or causative agents, parasites, and pathogens through wild fish health surveys. Recreational trout fisheries should be occasionally monitored, as well as recovery populations.

Site-specific actions needed:

- Conduct fish health surveys as necessary, using existing national protocols (Puzach 2006).

IMPLEMENTATION SCHEDULE

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 criteria.

Priority Number	Action Number	Action Description	Recovery Action Number	Action Duration (Years)	Responsibility		Total Cost ($1,000s)	Cost Estimate by FY ($1,000)		
					Parties	Is FWS Lead?		FY09	FY10	FY11
2	1	Complete any necessary Federal, State, and Tribal regulatory compliance for recovery actions.	1.1	Continual	AGFD, FWS-FWCO, FWS-ES, USFS, WMAT	No	160	75	75	10
1	2	Construct and maintain artificial fish barriers if natural barriers are not present.	1.2	Periodic	AGFD, FWS-FWCO, USFS, WMAT	No	450	250	150	50
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-FWCO, USFS, WMAT	No	350	150	150	50
2	4	Stock streams with pure Apache trout.	1.4	Periodic	AGFD, FWS-FWCO, USFS, WMAT	No	110	50	30	30
2	5	Salvage and provide refuges 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-FWCO, USFS, WMAT	No	650	600	25	25
3	6	Conduct population and habitat surveys.	1.6	Periodic	AGFD, FWS-FWCO, USFS, WMAT	No	250	100	100	50
3	7	Develop, implement, enforce, and evaluate regulations as necessary to prevent extirpation of recovery populations	2.1	Continual	AGFD, FWS-FWCO, USFS, WMAT	No	60	20	20	20
2	8	Identify regulatory mechanisms, laws, and policies that are insufficient to fulfill all recovery criteria and protect Apache trout	2.2	Continual	AGFD, FWS-FWCO, FWS-ES, USFS, WMAT	No	60	20	20	20
3	9	Implement fish disease prevention protocols for professionals, and communicate best practices to anglers and other outdoor enthusiasts	3.1	Continual	AGFD, FWS-FWCO, USFS, WMAT	No	30	10	10	10
3	10	Monitor for presence of diseases and/or causative agents, parasites, and pathogens through wild fish health surveys	3.2	Periodic	AGFD, FWS-FWCO, USFS, WMAT	No	30	10	10	10

LITERATURE CITED

Alcorn, S.R. 1976. Temperature tolerances and upper lethal limits of *Salmo apache*. Transactions of the American Fisheries Society 105(2):19.

Allendorf, F.W., D. Bayles, D.L. Bottom, K.P. Currens, C.A. Frissell, D. Hankin, J.A. Lichatowich, W. Nehlsen, P.C. Trotter, and T.H. Williams. 1997. Prioritizing pacific salmon stocks for conservation. Conservation Biology 11:140-152.

Behnke, R.J. 1974. Status of Apache trout. Written for USFS, Denver Conservation Library, Denver, CO, 6 pp.

Behnke, R.J. 1992. Native trout of western North America. American Fisheries Society Monograph 6. 275 pp.

Behnke, R.J. and M. Zarn. 1976. Biology and management of threatened and endangered western trouts. U.S. Department of Agriculture, Forest Service Technical Report RM-28, 1-45. Rocky Mountain Forest and Range Experimental Station, Fort Collins, CO.

Behnke, R.J. 2002. Trout and salmon of North America. The Free Press, New York, NY. 359 pp.

Beissinger, S.R., and M.I. Westphal. 1998. On the use of demographic models of population viability in endangered species management. Journal of Wildlife Management 62:821-841.

Brooks, J. 2004. Emergency evacuation procedures for Gila trout. U.S. Fish and Wildlife Service, New Mexico Fishery Resources Office, Albuquerque, NM.

Brown, D.E. 2003. Fishing for speckled mountain beauties in old newspapers and journals. Arizona Wildlife Views 46:12-17.

Cantrell, C.J., A.T. Robinson, and L.D. Avenetti. 2005. Habitat selection by Apache trout in six east-central Arizona streams. Transactions of the American Fisheries Society 134:1382-1388.

Carmichael, G.J., J.N. Hanson, M.E. Schmidt, and D.C. Morizot. 1993. Introgression among Apache, cutthroat, and rainbow trout in Arizona. Transactions of the American Fisheries Society 122:121-130.

Carmichael, G.J., J.N. Hanson, J.R. Novy, K.J. Meyer, and D.C. Morizot. 1995. Apache trout management: cultured fish, genetics, habitat improvements, and regulations. American Fisheries Society Symposium 15:112-121.

Clarkson, R.W., and J.R. Wilson. 1995. Evaluation of the U.S. Forest USFWS Fish Habitat Relationship System in east-central Arizona trout streams. Arizona Game and Fish Department, Technical Report No. 8, Research Branch, Phoenix, AZ, 74 pp.

Clarkson, R.W. and R.J. Dreyer. 1996. Investigation of techniques to establish and maintain Arctic grayling and Apache trout lake fisheries. Arizona Game and Fish Department, Technical Report No. 12, Research Branch, Phoenix, AZ, 71 pp.

Cope, E.D. and H.C. Yarrow. 1875. Report upon the collection of fishes made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona, during the years 1871, 1872, 1873, and 1874. Report Geography Geology Exploration Survey W. 100th Meridian (Wheeler Survey), 5:635-703.

David, R.E. 1976. Taxonomic analysis of Gila and Gila x rainbow trout in southwestern New Mexico. Master's thesis, New Mexico State University, Las Cruces, NM, 36 pp.

Dolloff, C.A., D.G. Hankin, and G.H. Reeves. 1993. Basinwide estimation of habitat and fish populations in streams. General Technical Report SE-83. Ashville, North Carolina: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 25 pp.

Doremus, H., and J.E. Pagel. 2001. Why listing may be forever: Perspectives on delisting under the U.S. Endangered Species Act. Conservation Biology 15:1258-1268.

Dowling, T.E., and M.R. Childs. 1992. Impact of hybridization on a threatened trout of the southwestern United States. Conservation Biology 6(3):355-364.

Dunham, J., M. Peacock, C.R. Tracy, J. Nielsen, and G. Vinyard. 1999. Assessing extinction risk: integrating genetic information. Conservation Ecology [online] 3(1):2. Available from Internet. URL:http://www.consecol.org/vol3/iss1/art2.

Endangered Species Act (ESA). 1973. 16 US Congress, 1988 Amendments.

Fausch, K.D., B.E. Rieman, M.K. Young, and J.B. Dunham. 2006. Strategies for conserving native salmonid populations at risk from non-native fish invasions: tradeoffs in using barriers to upstream movement. General Technical Report RMRS-GTR-174. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 44 p.

Federal Register. 1976. Native fish and wildlife, endangered species. FR 32:4001.

Federal Register. 1975. Threatened status for three species of trout. FR 40 (137):29863-64.

Fenneman, N.M. 1931. Physiography of the western United States. McGraw-Hill Book Co., Inc., New York, NY. 534 pp.

Franklin, I.A. 1980. Evolutionary changes in small populations. Pages 135-150 in M. Soule and B.A. Wilcox, editors. Conservation Biology: an evolutionary-ecological perspective. Sinauer Associates, Sunderland, Massachusetts.

Genetic Analysis, Incorporated. 1994. Unpublished data. Starchart Corporation, Smithville, TX.

Hankin, D.G., and G.H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Canadian Journal of Fisheries and Aquatic Sciences, 45:834-844.

Harper, K.C. 1976. On the biology of *Salmo apache* and its management implications. MS Thesis, University of Arizona, Tucson.

Harper, K.C. 1978. Biology of a southwestern salmonid, *Salmo apache* (Miller 1972). Pages 99-111 in J.R. Moring, editor. Proceedings of the wild trout-catchable trout symposium. Oregon Department of Fish and Wildlife, Research and Development Section, Eugene, Oregon.

Hoerling, M., and J. Eischeid. 2007. Past peak water in the southwest. Southwest Hydrology 6(1):18-19, 35.

Jordan, D.S., and B.W. Evermann. 1896. The fishes of north and middle America. Bulletin of the United States Natural History Museum, Part 1, 47:i-ix - 1-1240.

Kitcheyan, D.C. 1999. Population structure of Apache trout (*Oncorhynchus apache*) in Flash and Squaw Creeks of the FAIR. MS Thesis, University of Arizona, Tucson.

Kynard, B.E. 1976. A study of the pollution sources and their effect on the aquatic habitat of Eagle Creek watershed, Apache-Sitgreaves National Forest Cooperative Agreement No. 16-514-CA. U. S. Forest Service Experimental Station, Tempe, AZ, 82 pp.

Lee, R.M., and J.N. Rinne. 1980. Critical thermal maxima of five trout species in the southwestern United States. Transactions of the American Fisheries Society 109:632-635.

Loudenslager, E.J., J.N. Rinne, G.A.E. Gall, and R.E. David. 1986. Biochemical genetic studies of native Arizona and New Mexico trout. Southwestern Naturalist 31:221-234.

Mann, C.C., and M.L. Plummer. 1999. A species' fate, by the numbers. Science 284:36-37.

McMahon, T.E., A.V. Zale, and D.J. Orth. 1996. Aquatic Habitat Measurements. Pages 83-120 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Merrill, R.K., and T.L. Pewe. 1977. Late Cenozoic geology of the White Mountains Arizona. State of Arizona Bureau of Geology and Mineral Technology Special Paper No. 1. 65 pp.

Mesick, C.F. 1988. Effects of food and cover on numbers of Apache and brown trout establishing residency in artificial stream channels. Transactions of the American Fisheries Society. 117:421–431.

Miller, R.R. 1961. Man and the changing fish fauna of the American Southwest. Papers of the Michigan Academy of Sciences, Arts and Letters. 45:365-404.

Miller, R.R. 1972. Classification of the native trouts of Arizona with the description of a new species, *Salmo apache*. Copeia 1972:401-422.

Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, AZ. 293 pp.

Minckley, W.L., and D.E. Brown. 1982. Wetlands. Pp. 223-300 *In*: D.E. Brown, editor. Biotic Communities of the American Southwest - United States and Mexico.

Morris, W.F., P.L. Bloch, B.R. Hudgens, L.C. Moyle, and J.R. Stinchcombe. 2002. Population viability analysis in endangered species recovery plans: past use and future improvements. Ecological Applications 12:708-712.

Nelson J.S., E.J. Crossman, H. Espinosa-Pérez, L.T. Findley, C.R. Gilbert, R.N. Lea, and J.D. Williams. 2004. Common and Scientific Names of Fishes from the United States, Canada, and Mexico, Sixth Edition. American Fisheries Society, Bethesda, Maryland.

Northcote, T.G., and G.F. Hartman. 1988. The biology and significance of stream trout populations (*Salmo* spp.) living above and below waterfalls. Polish Archives of Hydrobiology 35:409-442.

Novy, J., and M. Lopez. 1991. Statewide fisheries investigations survey of aquatic resources federal aid project F-7-M-33: Fish Management Reports. Arizona Game and Fish Department, Pinetop, Arizona.

Pianka, E.R. 1978. Evolutionary ecology, 2nd ed. Harper and Row, New York. 397pp.

Porath, M.T., and J.L. Nielsen. 2003. Evidence of sexually dimorphic introgression in Pinaleno Mountain Apache trout. North American Journal of Fisheries Management 23:172-180.

Propst, D.L. and J.A. Stefferud. 1997. Population dynamics of Gila trout in the Gila River drainage of the south-western United States. Journal of Fish Biology 51:1137-1154.

Puzach, C. (Editor). 2006. National Wild Fish Health Survey – Laboratory Procedures Manual. 4.0 edition. U.S. Fish and Wildlife Service, Onalaska, Wisconsin.

Reiman, B.E., and F.W. Allendorf. 2001. Effective population size and genetic conservation criteria for bull trout. North American Journal of Fisheries Management 21:756-764.

Riddle, B.R., D.L. Propst, and T.L. Yates. 1998. Mitochondrial DNA variation in Gila trout, *Oncorhynchus gilae*: implications for management of an endangered species. Copeia 1998:31-39.

Rinne, J.N. 1978. Distribution of pure populations of the native Arizona trout, *Salmo apache* Miller -- A report to aid in the management and recovery of threatened species of fish. Final Report to the USFWS, Albuquerque, New Mexico. USFS, Rocky Mountain Forest and Range Experimental Station, Tempe, AZ, 1-60.

Rinne, J.N. 1982. Movements, home range, and growth of a rare southwestern trout in improved and unimproved habitat. North American Journal of Fisheries Management 2:150-157.

Rinne, J.N. 1985. Variation in Apache trout populations in the White Mountains Arizona. North American Journal of Fisheries Management 5:1465-1458.

Rinne, J.N., and W.L. Minckley. 1985. Patterns of variation and distribution in Apache trout (*Salmo apache*) relative to co-occurrence with introduced salmonids. Copeia 1985:285-292.

Robins, R.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1980. A list of common and scientific names of fishes from the United States and Canada, Fourth Edition. American Fisheries Society, Bethesda, Maryland.

Robins, R.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1991. Common and Scientific Names of Fishes from the United States and Canada, Fifth Edition. American Fisheries Society, Bethesda, Maryland.

Robinson, R.W., and J.C. Tash . 1979. Feeding by Arizona trout (*Salmo apache*) and brown trout (*Salmo trutta*) at different light intensities. Environmental Biology of Fishes. Volume 4:363-368.

Rosenlund, B.D. 1974. Apache trout disease check. Memorandum, U.S. Fish and Wildlife Service, Pinetop, AZ, 2 pp.

Seager, R., M. Ting, I. Held, Y. Kushnir, J. Lu, G. Vecchi, H. Huang, N. Harnik, A. Leetmaa, N. Lau, C. Li, J. Velez, and N. Naik. 2007. Model projections of an imminent transition to a more arid climate in southwestern North America. Science 316:1181-1184.

Shaffer, M.L., and B. Stein. 2000. Safeguarding our precious heritage. Pages 301-322 in B.A. Stein, L.S. Kutner, and J.S. Adams, eds. *Precious heritage: the status of biodiversity in the United States*. The Nature Conservancy and Association for Biodiversity Information. Oxford University Press, New York, New York.

Tear, T., P. Kareiva, P. Angermeier, P. Comer, B. Czech, R. Kautz, L. Landon, D. Mehlman, K. Murphy, M. Ruckelshaus, J.M. Scott, and G. Wilhere. 2005. How much is enough? The recurrent problem of setting measurable objectives in conservation. BioScience 55(10):835-849.

USFS (U.S. Forest Service). 1985. Fisheries Habitat Survey Handbook. USFS, Region 4-2609.23.

USFS. 1989. Apache-Sitgreaves National Forests Plan. Amendment No. 1. USFS, Southwestern Region, Albuquerque, NM.

USFS. 1993a. Decision notice and finding of no significant impact, revised allotment management plan (West Fork Allotment) Apache County Arizona. USFS, ASNF, Alpine Ranger District, Alpine, AZ.

USFS. 1993b. Decision notice and finding of no significant impact, West Fork of the Black River watershed and fisheries restoration projects and Burro Creek, Hayground, Reservation allotments, allotment management plans, Apache County, AZ. USFS, ASNF, Springerville Ranger District, Springerville, AZ.

USFS. 1994. Environmental Analysis for an Apache trout habitat improvement project. USFS, Southwestern Region, Springerville, AZ.

USFS. 1995. Decision notice and finding of no significant impact, Apache trout habitat improvement project, Apache and Greenlee Counties, AZ. USFS, Apache-Sitgreaves National Forest, Supervisors Office, Springerville, AZ.

USFWS (U.S. Fish and Wildlife Service). 1979. Recovery plan for Arizona trout, *Salmo apache*, Miller, 1972. Apache Trout Recovery Team. USFWS, Albuquerque, NM, 36 pp.

USFWS. 1983. Recovery plan for Arizona trout, *Salmo apache*, Miller, 1972. Apache Trout Recovery Team. USFWS, Albuquerque, NM, 38 pp.

USFWS. 2003. Gila trout recovery plan (third revision). Albuquerque, NM. i-vii + 78 pp.

Wada, L.L.L. 1991. Summer habitat use by Apache trout (*Oncorhynchus Apache*) in five streams on the FAIR. MS thesis, University of Arizona, Tucson, AZ.

Wada, L.L.L., O.E. Maughan, and S.C. Leon. 1995. Habitat use by Apache trout (*Oncorhynchus Apache*) on the Fort Apache Indian Reservation, Arizona. Pages 191-195 in R. Barnhart, B. Shake, and R.H. Harnes, editors, Symposium Proceedings of Wild Trout V: Wild Trout in the 21st Century, Bozeman, Montana.

Wares, J.P., D. Alò, and T. Turner. 2004. A genetic perspective on management and recovery of federally endangered trout (*Oncorhynchus gilae*) in the American Southwest. Canadian Journal of Fisheries and Aquatic Sciences 61:1890-1899.

Williams, J.E., and J. Meka Carter. 2009. Managing native trout past peak water. Southwest Hydrology 8(2): 26-27, 34.

APPENDIX 1: Abbreviations and Acronyms Used

AGFD =	Arizona Game and Fish Department
AMP =	Allotment Management Plan
ASNF =	Apache-Sitgreaves National Forest, U.S. Forest Service
AZFWCO =	Arizona Fish and Wildlife Conservation Office, U.S. Fish and Wildlife Service
BKD=	Bacteria kidney disease
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
MtDNA =	Mitochondrial DNA
NEPA =	National Environmental Policy Act of 1969
PDM=	Post-delisting monitoring; as required under section 4(g) of ESA
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

APPENDIX 2: Definitions Used

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

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).

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

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

Population: all individuals which occur in a specified geographic area, such as a stream above a natural or manmade barrier (including significant stretches of unwatered stream channel).

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 system (including Hurricane, Hughey, and Peasoup Creeks), 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.

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

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. When two 1st order streams meet, the resulting channel is a 2nd order stream; where two 2nd order streams meet, a 3rd order stream results, and so on.

APPENDIX 3: Waters Managed For Recreation Apache Trout Fisheries

The following waters are stocked for with Apache trout for recreational opportunities by State and Federal Hatcheries:

Land Management: Apache-Sitgreaves National Forest/Arizona Game and Fish Commission:
Ackre Lake
Becker Lake[2]
Big Lake[2]
Black River (East Fork)[1]
Black River (West Fork below fish barriers)[1]
Lee Valley Lake
Little Colorado River (West Fork above fish barriers)[1]
Little Colorado River (in Greer)[2]
Long Lake
Silver Creek

Land Management: Fort Apache Indian Reservation:
A1 Lake
Big Bear Lake
Bog Tank
Christmas Tree Lake[1]
Cibecue Creek[1]
Cyclone Lake
Diamond Creek[1]
Earl Park Lake
Hawley Lake
Horseshoe Cienega Lake
Hurricane Lake[1]
Little Bear Lake
Pacheta Lake
Paradise Creek (lower) [1]
Sunrise Lake
Tonto Lake
White River (lower East Fork) [1]
White River (North Fork) [1]

[1] = Apache trout are the only species stocked at these locations; however, locations may contain populations of other native/non-native fishes

[2] = Apache trout stockings vary, depending on hatchery supply, angler demand, and/or other fish species availability

APPENDIX 4: 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 20^{o}C (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 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.

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 require 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 are within historical range of 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;

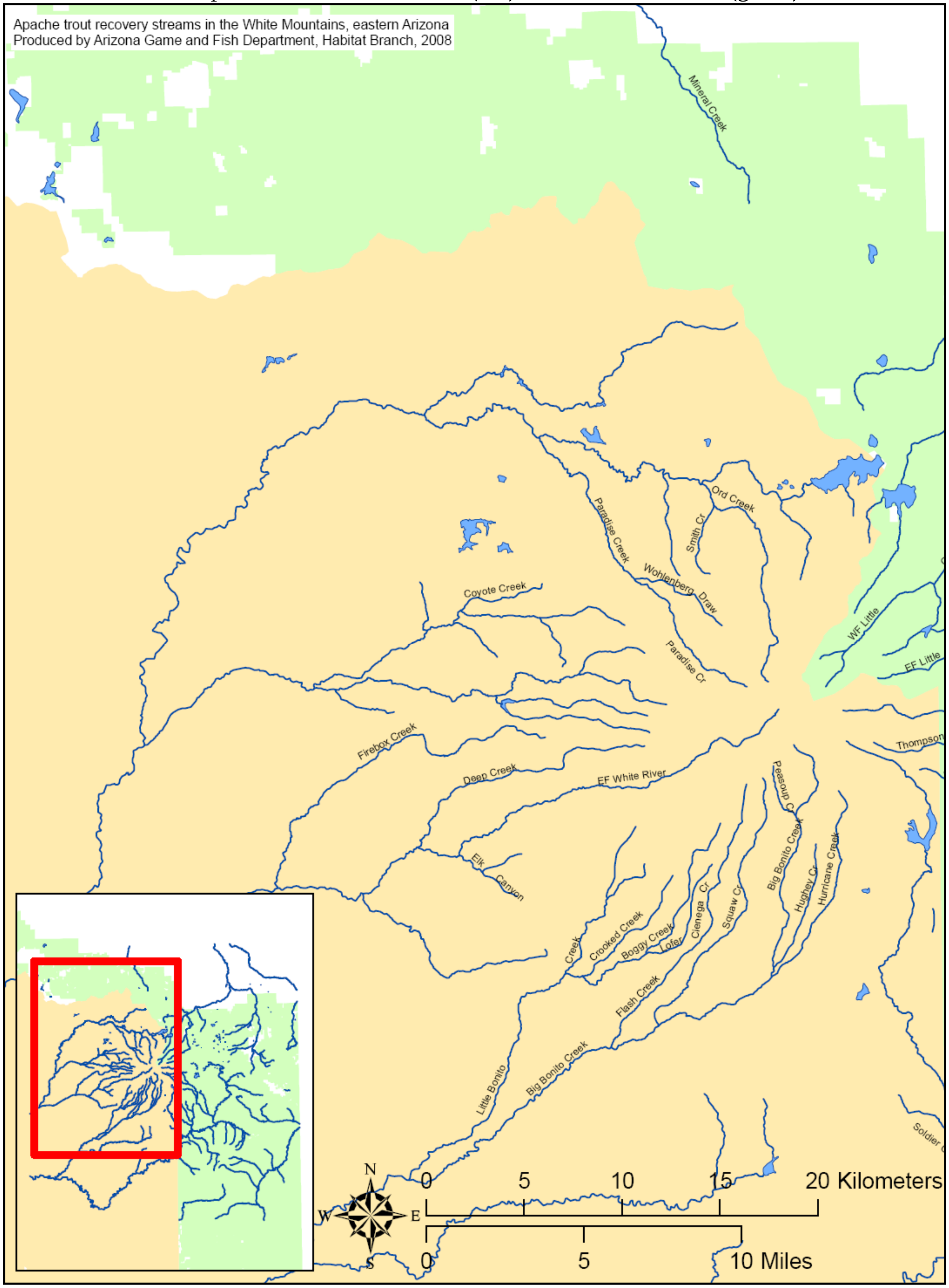
- North Fork of Bear Wallow Creek, from its headwaters to Bear Wallow Creek;
- South Fork of Bear Wallow Creek, from its headwaters to Bear Wallow Creek;
- Snake Creek, from its headwaters to its confluence with Black River;
- Hayground Creek, from its headwaters to its confluence with the West Fork Black River;
- Stinky Creek, from the Fort Apache Indian Reservation boundary to its confluence with the West Fork Black River; and

Tribal Water Quality Standards

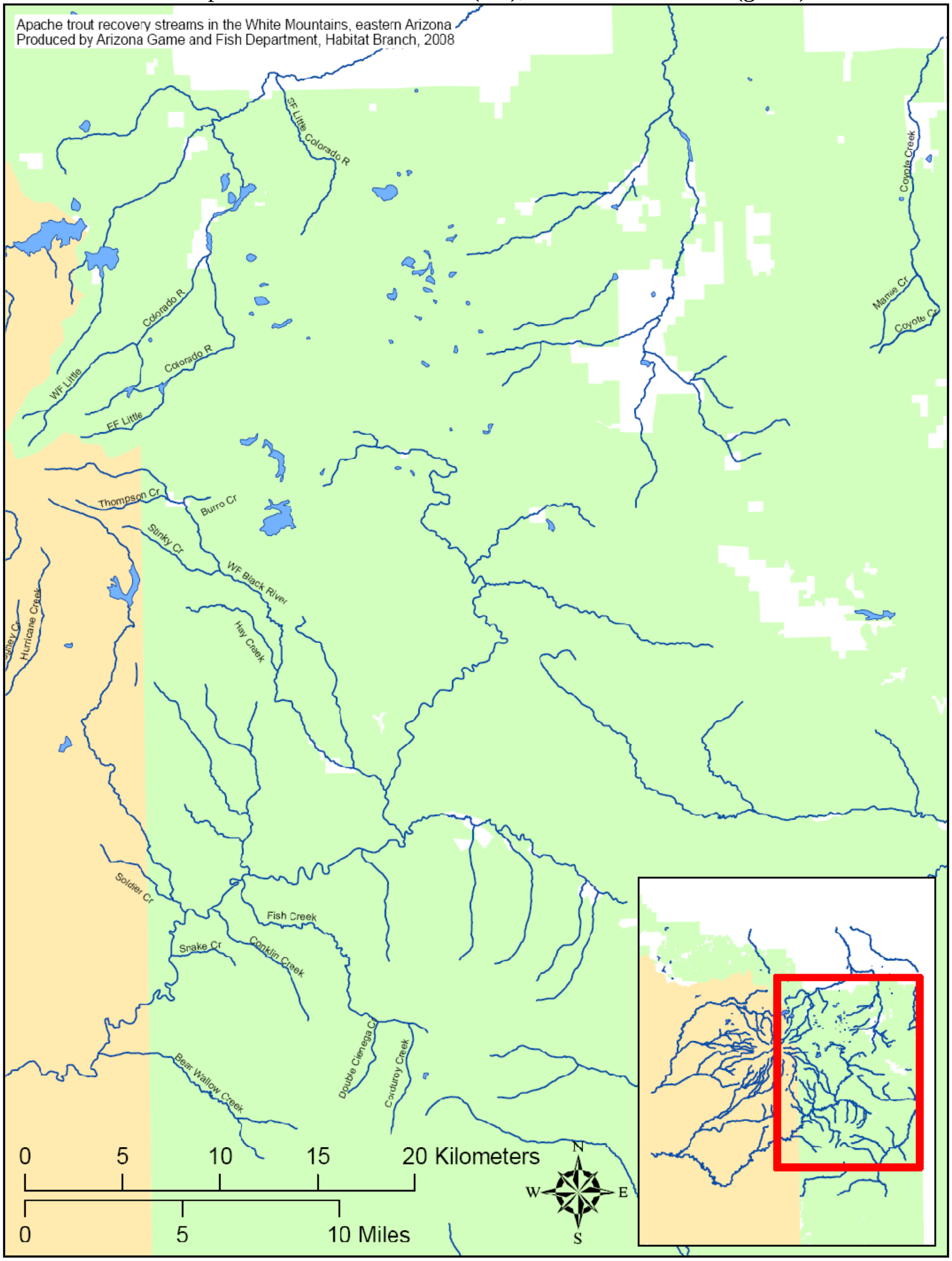
For waters that contain Apache trout on Tribal lands, there are general water quality standards for all streams that apply regardless of “designated” or "non-designated" uses. In addition, there are specific standards that apply to individual stream segments based on their use designation, and those 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*).

APPENDIX 5: Apache Trout Distribution Maps (page 1 of 2)

Fort Apache Indian Reservation (tan), U.S. Forest Service (green)



APPENDIX 5: Apache Trout Distribution Maps (page 2 of 2)
Fort Apache Indian Reservation (tan), U.S. Forest Service (green)



APPENDIX 6: Public and Peer Review Comments

INDEX TO PUBLIC COMMENT LETTERS

1 Joseph McGurrin, Jeff Collins, Fred Fillmore – Trout Unlimited, 17 September 2007
2 Robert W. Clarkson, 18 September 2007
3 Dr. Paul C. Marsh, Arizona State University, 19 September 2007
4 Jerry G. Ward, 25 September 2007

INDEX TO PEER REVIEW COMMENT LETTERS

A Dr. Michael K. Young, U.S. Forest Service, Rocky Mountain Research Station, 16 August 2007
B Doug Krieger, Colorado Division of Wildlife, 20 August 2007
C Dr. Thomas F. Turner, University of New Mexico, 11 September 2007
D Dr. David L. Propst, New Mexico Department of Game and Fish, 18 September 2007
E Dr. Thomas E. Dowling, Arizona State University, 20 September 2007

INDEX TO AGENCY COMMENT LETTERS

I Harv Forsgren, U.S. Forest Service, Southwest Region, 25 September 2007

Apache Trout Recovery Plan 2nd Revision
Response to Issues from Public & Peer Review Comments

Issue	Response	Letter No.
Minor editorial, grammatical, and formatting changes	Thank you for your level of detailed review. Changes were made to the recovery plan as appropriate.	3, 4, D
No justification is provided anywhere for the recovery criterion of 30 self-sustaining populations. It is impossible to determine from the information provided whether 30 is too small, too large, or about right. It may be worthwhile to justify why 30 populations—as opposed to 20 or 40—is regarded as a threshold for delisting.	The " 30 populations" was retained from the 1979 and 1983 Apache Trout Recovery Plans and was chosen by the recovery team based on the following criteria: 1) within the historical range, 2) suitable habitat for all life stage of Apache trout, and 3) realistically feasible to isolate from nonnative trouts, either through natural or artificial barriers. Additional justification is provided in text on pages 35-38.	1, 3, A, D, E
How does one define "maximum extent practicable?" What are the criteria used to determine what is practicable?	The phrase has no legal definition and does not add to the criteria of this plan. The references to "maximum extent practicable" have been removed.	1, 4, E
While genetics are mentioned in the recovery criterion, there is no real consideration of genetics in the management plan. What is the remaining genetic diversity in the species and how is it distributed within and among populations? The study by Wares et al. was specifically designed to assess population structure; however, samples are very limited and not sufficient to provide an accurate picture of levels and distribution of genetic diversity. How will existing population structure be taken into account when establishing these 30 populations? While the study by Wares et al. was limited, it did indicate that there is significant genetic structure among populations and drainages that needs to be considered.	On pages 4 and 5 of the plan, we discuss the Wares et al. publication and its findings that they found strong differentiation among lineages and high levels of genetic variation within populations, albeit with limited sample sizes. In addition, on page 37, we discuss representation, redundancy, and resiliency and how the 30 populations will consist of the remaining natural populations plus reestablished populations replicated from natural populations or suitable hatchery stock. Although it is not part of the recovery criteria to replicate each and every lineage, currently eight of the 13 remaining natural lineages have been replicated at least once in the wild.	1, A, D, E
As mentioned in the Draft Recovery Plan, we are a formal partner with federal, state, and tribal agencies in implementing recovery actions. Over the past five years, we have invested over $500,000 in cash and in-kind services toward species recovery.	Thank you for your continued commitment to conserving Apache trout and other native trout species across the United States. We look forward to continuing the partnership with Trout Unlimited.	1
While we have problems with some of the information and conclusions in the current document, we have even greater concerns about what is missing. The inclusion of just a single, vague plan criterion to measure what is needed to delist the species under the Act is a clear indication of the failure of the FWS to take a comprehensive approach to planning for recovery.	We have modified the criteria in the final plan to be more discrete and measurable. The demographic goal of establishing and/or maintaining 30 self-sustaining discrete populations of pure Apache trout within its historical range is consistent with the previous (1979 and 1983) recovery plans. We have articulated three additional criteria to specifically address threats through habitat, regulatory, and monitoring and management actions.	1
Recovery Criterion – The plan states the Recovery Criterion as "Establish and maintain 30 self sustaining populations that conserve,	Please see our response immediately above regarding modification to the criteria in the Final Plan. In addition, Pages 35 through 42	1

to the maximum extent practicable, the remaining genetic diversity of the species." The identification of 30 self-sustaining populations is a measurable criterion, but additional criteria need to be established for genetic diversity, habitat, and other targets that relate to the five factors that are identified in the Act.	describe how the criteria and recovery actions address the five listing factors identified in the Act.	
The plan clearly ignores the importance of establishing populations in larger river systems for the species long term survival. Segments of mainstem rivers such as the White, Black, and Little Colorado are not targeted for Apache trout recovery under the new plan, but those reaches represented a major component of the ecosystem in which Apache trout evolved and adapted. These mainstem rivers undoubtedly functioned as metapopulation centers from where the species expanded during favorable conditions (e.g., wet, cool periods) and contracted during unfavorable conditions (e.g., drought, extreme temperatures). The Plan does not attempt to conserve even parts of these rivers, and therefore it cannot conserve the species. Restricting, as the current Plan does, the range of Apache trout to mostly extreme headwater streams whose habitat suitability are susceptible to climatic fluctuations and whose small populations will be at greatest risk of extinction events from natural events such as floods and fire will not ensure the long-term survival of those populations and the species.	The plan discusses inter-connecting populations, or metapopulations, on pages 30 and 31. The plan states that there are few perennial networks that might function as recovery populations for inter-connecting populations. The lower West Fork Black River has been identified as one possibility for the establishment of an inter-connecting population after the construction of a barrier in the lower watershed that would enable connectivity among the mainstem and tributary recovery populations (mainstem WFBR, Hayground, Stinky, and Thompson Creeks). Several other recovery populations have tributary streams that support, or will support once established, Apache trout populations and enable some level of genetic variation within a population as fish naturally disperse throughout the available habitats. For example, the Big Bonito Creek system includes four streams that all support Apache trout in over 35 km of habitat. The Fish Creek system (27 km; 17 mi) includes two tributary streams that supported rainbow trout prior to the reestablishment of Apache trout. Two recovery populations, Boggy/Lofer and Coyote/Mamie, each have two inter-connecting streams occupied by Apache trout. The West (16 km; 10 mi) and South (9 km; 6 mi) Forks of the Little Colorado River each have tributaries that have previously supported nonnative trout. Thus, Apache trout recovery populations are not limited to single channels per stream as several of them contain more than two tributaries that will support trout populations, thus meeting the definition of a metapopulation. Recovery populations for Apache trout were chosen because the habitat was suitable to support trout, they were remote enough to prevent certain threats to Apache trout persistence (illegal stocking), they had a suitable location to construct a barrier (if a natural barrier was not present), and it was feasible to remove the nonnative trouts. Most of these streams are fragmented due to barriers constructed to prevent non-native trout invasion. Choosing headwater streams for recovery populations is also common for many other western species	1, 2

	of trout (Fausch et al. 2006). Segments of the mainstem White, Black, and Little Colorado rivers are not targeted for recovery due to the existence of unmanageable threats and unattainable course of actions that would need to occur to manage the threats. Constructing barriers and applying chemicals in these larger systems to remove nonnative trouts is not feasible (biologically, politically, socially, and economically) at this time.	
There are no meaningful plan criterion that address the evaluation of riparian and in-stream conditions for Apache trout streams. Data sources on habitat are mentioned, but no targets for desired future conditions of habitat are identified.	Recovery Action 1 (page 38 and 39) states that "recovery populations 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." The goal is to maintain the streams to "promote sufficient habitat conditions for all Apache trout life functions." Targets for desired future conditions have been described in Environmental Assessments (Appendix 4).	1,2

The Federal Register announcement that accompanied the new plan notes that critical habitat for Apache trout has never been designated. The plan doesn't address this shortcoming or discuss its implications for future recovery.	The Apache trout was originally recognized as endangered under the Federal Endangered Species Preservation Act of 1966 (March 11, 1967; 32 FR 4001), prior to critical habitat being formalized in the 1978 and 1982 amendments to the Act. One of the applicability provisions in the 1982 amendments to the Act indicates that the provision for designating critical habitat, section 4(a)(3)(A) of the Act, shall not apply with respect to any species which was listed as an endangered species or a threatened species before November 10, 1978 (section 4(b)(6)(A)(i)(II) of the Endangered Species Act of 1973, as amended, (16 U.S.C. 1533(b)(6)(A)(i)(II)), Pub. L. 95-632, at 2(2), 92 Stat. 3751 (November 10, 1978), and Pub. L. 97-304, at 2(b)(2), 2(b)(4), 96 Stat. 1411, 1416 (October 13, 1982). Therefore, we are not required to designate critical habitat for the Apache trout. Further, we do not believe it is necessary to designate critical habitat for the Apache trout due to the progress being made towards species recovery. Considerable gains have been made in habitat and population restoration and protection through the cooperation of many partners, without the designation of critical habitat. We anticipate that with the implementation of the new recovery plan, we will achieve full recovery in the near future without the need to invest resources in critical habitat designation.	1
According to data in the Plan, Apache trout will occupy only approximately 25% of its historic range even after the species meets the recovery criterion of occupying 30 streams. Occupation of this proportion of historical habitat is simply too small to ensure that the species is adequately protected from significant threats to its persistence, and it inarguably would be in danger of extirpation throughout a significant portion of its range and thus meet the definition of threatened or endangered as provide by the Endangered Species Act.	By the early 1900s, the range of Apache trout was reduced to approximately 48 km (30 mi). When the actions identified in the plan are completed, Apache trout will occupy at least 30 populations consisting of approximately 275 (171 mi) of streams. This will be close to six times greater than the amount of habitat occupied at the time of listing. We have added further discussion and justification on pages 35-37 for our recovery approach using Shaffer and Stein's (2000) principles of conservation biology (representation, resiliency, redundancy). When the actions outlined in the plan are completed, the Service may begin a rule making process using the criteria in section 4 of the Act to determine whether or not the species should be removed from the list of threatened and endangered species, based on the five factor threat analysis.	1, 2, 3
Recent literature that is reviewed in the Plan states that in order to ensure long-term persistence of a population, effective population sizes for trouts should average 1000 spawning adults per year	On pages 30 and 31 we discuss population viability and effective population size with regard to our approach for Apache trout recovery, using the same citations and studies you provide. The	1, 2, A, D

(Reiman and Allendorf 2001), or total population sizes of approximately 2,500 individuals (Allendorf et al. 1997). Where local conditions do not exhibit adequate stream lengths and thus cannot support large population sizes, establishment of interconnected stream populations should be made to meet those minima (Hilderbrand and Kershner 2000). The Plan documents the fact that such Apache trout population sizes are likely unattainable in most of the identified recovery locations based on stream size, habitat limitations and existing population estimates, yet it proposes management actions to delist the species regardless. By ignoring such considerations, Apache trout populations will continue to be highly vulnerable to local extinction.	studies focus primarily on bull trout in the Pacific Northwest. Habitats for bull trout are often significantly larger than that of habitats for Southwestern trout such as Apache trout, and other related species such as Lahontan cutthroat trout. As discussed on page 30, research indicates that Lahontan cutthroat trout can survive bottlenecks down to 50 individuals without losing genetic integrity, if populations rebound in a timely fashion. There has been no effective population size of population viability analysis done for Apache trout, so we must base our management on the best information available. Kitcheyan documented the establishment of an Apache trout population with a one-time stocking of 120 fish (page 30 of this plan). In addition, smaller isolated populations may have a higher risk for localized extinction due to stochastic factors; however, conversely, smaller isolated populations have a lower risk of non-native contamination, illegal angler over-harvest, and disease (all identified as threats).	
Recovery Time Estimates – One of the most alarming aspects of the new plan is an FWS estimate that Apache trout can be restored by the end of 2007 and that de-listing can be initiated in 2008. While we are aware that FWS began a status review in 2006, we are unsure how FWS was able to make these estimates. The FWS attempt to do an Act species status review at the same time that it is conducting a major recovery plan revision is a difficult way to conduct an objective evaluation process. It's hard to understand how FWS estimated that it will decide to delist the species when the scientific plan that is the basis of those decisions doesn't contain the technical criteria to make such a decision and has yet to be reviewed and adopted.	All recovery plans require the Service to estimate a date of recovery and a cost associated with the specific actions required to meet the criteria in the plan. At the time of publication of the draft plan, it was estimated that recovery actions could be completed by the end of 2007, with a delisting package set to begin development in 2008. However, due to unforeseen circumstances, the estimated date of recovery has been pushed back. An estimated date of recovery in a recovery plan does not usurp the Service process for delisting, which includes a proposed rule that includes a thorough status review, a public comment period, and a final rule. In addition, all species listed under the Act are required to undergo 5-year status reviews. The Apache trout review began in 2006. Five-year reviews are independent of recovery planning and a delisting rule making process. A major component of the 5-year review is the adequacy of the species existing recovery plan. The 1983 plan, while it still has value, lacks current information and a clear tie between the recovery criteria and the five listing factors in the Act. The new plan has that clear tie, and the 5-year review will not be completed until the revised plan is completed.	1
Despite our concerns about the plan and status review process, TU remains optimistic about the prospects for Apache trout recovery.	Thank you for your comment. We agree that the partnership with TU and other governmental and non-governmental organizations is a	1

The investments TU has made in Apache trout recovery are just a portion of a larger public/private partnership involved in Apache trout restoration that has greatly accelerated recovery actions over the past few years. So we believe that we are making progress and that the public support needed to bring back the species remains strong.	large reason why progress is being made to recover Apache trout.	
Now is not the time for shortcuts. TU has worked hard with government agencies and the private sector to restore this fish and does not want these efforts to be undercut by an inadequate plan followed by a rush to enact a premature delisting. TU remains very concerned by a FWS precedent that would delist a species without a scientifically sound recovery plan. TU will surely support a de-listing action when it is warranted, but it will be impossible to determine whether a de-listing will ever be warranted if the current plan is used for guiding and evaluating our efforts.	The Service will continue to monitor the status of Apache trout and when the Service believes that Apache trout no longer warrants federal protection as a threatened or endangered species, a proposed delisting rule will be developed. As stated previously, an estimated date of recovery in a recovery plan in no way usurps the Service's rule making process which includes a public comment period.	1
The definition in the recovery criterion of a population as "all of the individuals that … are potentially able to interbreed (Pianca 1978)" is problematic. According to the definition as constructed here, Apache trout are one population that occurs in many places (presumably, Apache trout from any stream are able to breed with those in any other stream). Thus, reference to individual "populations" here in the criterion, and extensively elsewhere throughout the document, is inappropriate. This problem may require extensive revision to clarify and resolve the text of the Plan.	Thank you for identifying this problematic definition. The term "population" with regard to Apache trout is meant to include all individuals which occur in a specified area above a natural or manmade barrier (including significant stretches of unwatered stream channel). The definition has been changed in Appendix 2 and where referenced elsewhere in the document.	3
What is meant by "self-sustaining?" This is a very nebulous term that could be interpreted in many different ways, some of which do not require long term persistence. Implementation of such a definition requires establishment of some specific quantitative criteria that support classification of a population as self-sustaining. Such quantitative criteria could be derived from studies of age structure of healthy populations of related species (e.g., rainbow or cutthroat trout) in similar environments. It may be implied that "self-sustaining" is perpetual, but without making this temporal quantification it would be possible to misinterpret the criterion and inappropriately determine a population to be self-sustaining when it simply has multiple age classes and periodic reproduction.	As defined in Appendix 2, self-sustaining means that the Apache trout population is characterized by presence of multiple age classes and evidence of periodic natural reproduction. Further, the population is capable of persisting under the range of variation in habitat conditions that occur in the restoration stream (Propst and Stefferud 1997).	3, 4, E

Where isolated populations were once connected, it will be important to periodically move individuals among these populations to maintain previous evolutionary processes. If genetic exchange is deemed necessary, how do managers determine which fish to move among which streams, how many fish, and how often? These questions are critical to the future well-being of Apache trout, are important aspects of the Plan, and cannot be dismissed until a later time, as provided on page 23 of the Plan and in the Federal Register Notice, i.e., "A post-delisting management plan will incorporate genetic considerations."	Future genetic management will be addressed as post-delisting monitoring plans are developed. As discussed on pages 4, 5, and 10, genetic management of Apache trout has focused on maintaining pure populations of Apache trout (no detectable introgression with rainbow or cutthroat trouts).	3, A, E
The organization of the historic and current distribution section is confusing and should be reevaluated. Start by reiterating the definition of "recovery streams" then itemize by persistent (= non-renovated) pure populations, then replicated pure, then hybrid (as in Table 1). Segregating by tribal vs. non-tribal is artificial and divisive.	Thank you for your suggestion. The section on historical and current distribution on pages 6 through 12 has been changed to more clearly discuss historical and current distribution using a watershed-level approach rather than a land management authority approach.	3
What does the term "maintain" mean as it is used in the criterion? If Apache trout populations are to be self-sustaining, as stated in the criterion, then there is no need for the term "maintain." Or does "maintain" imply some kind of management, in which case the populations would not be self sustaining. This confusion needs to be removed and the criterion clarified.	We do not believe that "maintain" and "self-sustaining" are contradictory. Actions may need to be taken to maintain the habitat to allow for it to support a self-sustaining population of Apache trout. For example, erecting fence around an important segment of stream to impede access by livestock or elk has been, and may need to be in the future, an action taken in order for the stream to maintain suitable habitat to support a self-sustaining population of Apache trout.	3
We would encourage the renewal of the Memorandum of Understanding (MOU) established in 2000 between the Apache-Sitgreaves National Forests, Arizona Game and Fish Department, U.S. Fish and Wildlife Service, Trout Unlimited, the Wildlife Conservation Council, and the Federation of Flyfishers. The formal agreement provided a framework that fostered greater public involvement in recovery actions, which remains critical to recovery of Apache trout. The MOU could also be used to establish a more formal escalation path for the agency stakeholders to bring forth key issues and concerns, which will insure continued effective implementation of the recovery plan.	We agree. The MOU expired in 2000 and the Arizona Game and Fish Department is leading the effort to expand the partners in the MOU and seek renewal amongst the signatories to the 2000 MOU. Page 29 of the plan has been changed to clarify the intent to renew the MOU.	4, I
Table 1 should contain additional information that would provide the reader with a full understanding of the populations. At a minimum,	At this time the data collected during the GAWS and BVET surveys has not been statistically analyzed. We will continue to work with	4, B

the table (or another appendix) should include the most recent (or average for multiple years) population estimate, density and biomass. You state in on page 17 that population sampling has been conducted at ASNF since the 1980's and has been conducted "recently" at FAIR. It should also describe the acreage of stream habitat available for each of the population stream segments, or perhaps an average stream width. It might also be helpful to see the elevation of lower and upper terminus of inhabited segments for each stream.	our partners to analyze and report the data. At that time, the data can be included: 1) in a plan update, 2) species status review, and/or 3) proposed rule to change the status of the species.	
"Population" as defined does not appear to be consistent with section 4(a) of the Act (61 FR 4722-4725, February 7, 1996).	The policy (61 FR 4722-4725) refers to the Service's policy regarding the recognition of distinct population segments (DPS) under the Endangered Species Act. Apache trout was listed as a species and has never had DPS designated.	4
The terms "Self-sustaining population", "established population", and "secured stream or population" are nothing more than colloquialisms that provide no meaningful or measurable standard by which any reasonable person could determine if they have been reached.	All three terms are defined in Appendix 2 of the plan. It is the role of the Service to determine if Apache trout are recovered using an analysis of the five listing factors in section 4 of the Act. A recovery plan is a guidance document that provides a road map to achieve recovery.	4
Page ix states "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 Act and how each factor will be addressed through the recovery criteria in this plan." This document fails to meet any of these purposes, especially in a comprehensive manner.	Without specific comments as to how the "document fails to meet any of these purposes" we cannot make any changes to the plan based on this comment.	4
The plan fails to establish in any meaningful or scientific way how the single "recovery criterion" addresses all of these threats and provides for recovery of the species.	Pages 38 through 42 of the plan describe how each recovery action addresses the five factors that are considered when listing and recovering a species under the Act.	4
The use of "30 stream systems" is incorrect and deliberately misleading, headwater streams with constructed "barriers" are not stream systems.	We have removed the word "systems" (where appropriate) to avoid any confusion as to the multiple possible definitions of "systems."	4
The 300 km figure provided is ridiculous, the document needs to provide what data were used and the basis and assumptions used to make this determination.	Stream kilometers were determined using Geographical Information System (GIS) digitations from United States Geological Survey maps and topographical software.	4
Page x states "Non-native fishes present in recovery streams will be eliminated to prevent the potential for hybridization, competition, and/or predation." Other discussion in the document states that	The removal of nonnative trout in recovery populations is conducted using chemicals on streams on the National Forest and formerly on Fort Apache Indian Reservation (FAIR) streams. However, the	4

complete elimination is not necessary, no rationale is provided for this inconsistency.	Tribal Council does not currently approve the use of chemicals for nonnative trout removal. The only nonnative trout in Apache trout recovery populations on FAIR are brown trout, which do not pose a hybridization risk to Apache trout populations. Mechanical removal is an acceptable alternative to remove brown trout if conditions preclude the use of piscicides.	
Barriers and populations have been compromised repeatedly, this process will continue; and the document fails to address this or provide any reasoning or rationale as to how this will be prevented in the future.	Recovery Action 1.2 on page 39 states the importance of maintaining barriers: "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."	4, B
Page xii contains a table with costs associated with the various recovery objectives. It is nonsensical in that costs for recovery actions associated with recovery objectives are provided for 2007 through 2013. It would be helpful and very informative to the reader if the specific actions associated with the costs were disclosed for each objective. Not only would this clarify the various agency and cooperators roles and potential contributions, it would also provide some insight as to how the recovery objectives are being implemented and the specific actions proposed to address the associated threats; as this is not contained within the document.	As identified in section 4(f)(1)(B)(iii) of the Act, "Each plan must include, to the maximum extent practicable, estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal." We provide this information in the cost estimate table on page viii, with further explanations of the actions needed to recover the species in the step-down outline and narrative on pages 38 through 42, and the implementation schedule on page 43.	4
Page 2 states "Pure populations of Apache trout are currently present in at least 25 streams within historical range across the Fair and ASNF Table 1)." Referring to streams that have recently been chemically treated as "pure populations" is irresponsible, misleading, and not using the best available scientific and commercial data.	All stockings of Apache trout are conducted using fish from a known "pure" source. We do not agree that referring to these streams as "pure populations" is irresponsible and misleading. If a stream is stocked with Apache trout from a pure source, the new stream contains a pure population.	4
Pages 4 and 5 discuss genetic monitoring that has occurred over the last 20 years. Most of the existing genetic information is approximately twenty years. The document needs to discuss and disclose the limitations (e.g., inadequate sample sizes) and uncertainty (e.g., age and timeliness) associated with the information that has been collected, and how this will be addressed with future monitoring and when will this occur.	The Service has conducted genetic analysis of populations on the Fort Apache Indian Reservation between 1994 and 2000 (USFWS, unpublished), with additional samples collected for genetic purity analysis in 2007 (undergoing analysis by the University of Arizona). Therefore, this information is not 20 years old.	4
Page 6 states "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." It is unclear as to what is the relevance and significance of this statement.	The relevance of this statement is that Apache trout were found in the Little Colorado River prior to the inter-basin water diversions between the LCR and Black river drainages that could have explained how Apache trout were brought to the LCR drainage.	4

If it is retained in the document it should be supported with a literature citation.	Miller (1972) discusses this, and the citation has been added to page 6.	
Page 6 states "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." As stated above this is an irresponsible and inaccurate representation of this species distribution on the Forests. Again, the revised recovery should disclose and discuss the true assumptions and conditions that are being used to characterize and describe the individual populations.	The present distribution of Apache trout is not represented by populations on the "the Forests," as you state. Populations of Apache trout (both relict and reestablished) are present on both the FAIR and ASNF.	4
Page 9 states, "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." It is my understanding that both brown trout and brook trout have been found above the upper barrier since 1998. The document fails to mention or discuss this situation and the threat it presents to this population.	At this time, the extent of non-native trout in the West Fork of the Black River is unknown. Future surveys will be conducted and actions will be taken if necessary to ensure that non-native fishes are not a threat to Apache trout in the West Fork of the Black River.	4
Page 10 states, "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." It is my understanding that repatriation efforts in 2004 were unsuccessful. It should also be noted that this barrier has structurally failed, and this issue should be addressed. It is my opinion that the amount and condition of the habitat within Lee Valley Creek is not capable of providing a recovery population of Apache trout.	The barrier on Lee Valley Creek may not be functional any longer. However, there are no fish present in Lee Valley Lake other than Apache trout and Arctic grayling (which do not pose a hybridization threat to Apache trout); and Arctic grayling have not been collected from Lee Valley Creek. Therefore, while the barrier may or may not be currently functional, the threat to Apache trout in Lee Valley Creek from nonnative fishes is not there. Future monitoring will determine if the creek is capable of supporting a population of Apache trout.	4
Page 17 states, Surveys conducted on ASNF from the late 1980s to present indicate that several populations of Apache trout non-native trout have declined in numbers." It is my understanding that all of the populations have undergone declines in numbers. Which streams have declined and how are they different than the ones that have not? Which ones have maintained or increased their numbers and why? It should also be noted that habitat conditions have declined as well, if this were discussed it may provide some insight as to why populations have changed!	The Little Colorado River and Salt River watersheds are considered to be in a long-term severe drought status (Arizona Drought Monitor Report 2007). We do not have comprehensive data to determine that all recovery populations have undergone declines in numbers as you suggest. The Service will continue to use the best available information during the recovery process for Apache trout.	4
Page 21 states, "Recovery streams for Apache trout must be	The term "…variable levels of…" is a nebulous term and has been	4

protected by either natural or artificial barriers, or dewatered zones that provide variable levels of protection against immigration by non-native trout." To understand and comprehensively address the threats from non-native salmonids, these "variable levels of protection" need to be disclosed, described, and discussed; along with how they will be addressed to provide for recovery.	removed from the draft plan.	
Page 24 states, "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." Fencing is not an instream structure.	Thank you for recognizing this error. We have modified this statement on page 34.	4
Numerous Apache trout stream reaches are not recovering their riparian vegetation due to continued impacts associated with elk; and this issue needs to be addressed.	Elk impacts on some stream reaches is significant and we are working with our partners to develop projects and solutions to minimize elk impact and improve impacted meadows (e.g., Boggy/Lofer cienega, upper West Fork Black River, etc.).	4
Page 29 discusses actions that have occurred on the Forests. The discussion is vague, misleading, and inaccurate. Actions that have been accomplished need to be quantified and disclosed, and accurately described to the reader.	Chapter 6 of the plan provides a brief synopsis of recovery actions that have occurred to date on the FAIR and ASNF.	4
Page 31 states, "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." This statement is nonsensical. Of the three items mentioned, only AMPs have any influence on ongoing management activities being implemented by the Forests. The Forests has conducted numerous section 7 formal consultation on livestock grazing actions that have had adverse impacts to apache trout and their habitat.	This draft plan was reviewed by multiple individuals employed by the Forest Service and we did not receive any information from these reviews on the issue raised in the comment.	4
The "Delisting and Post-Recovery Management" and "Summary" information that occurs on Pages 32 though 35 and Page 36 respectively, appears to do nothing more than make an case/argument as to the adequacy (and inadequacy) of the previous information included within the document. This information should be included in discussion on threats, species status, etc. in previous sections of the document.	The inclusion of this information in the "Delisting and Post-Recovery Management" and "Summary" sections is not recovery criteria, but management considerations or research needs post-recovery.	4
The information provided on Pages 44 and 45 is misleading and inaccurate. The implication that viability as defined by the National Forest Management Act will provide for the recovery of Apache trout is unfounded, and shows a lack of understanding of this law	This draft plan was reviewed by multiple individuals employed by the Forest Service and we never received any information from these reviews on the issue raised in the comment. Without providing specific information as to how the statements are "misleading or	4

and its implementation. Additionally, there is an assumption and conclusion that the Forest Plan and Allotment Management Plans will provide for the recovery of Apache trout, and this is also unfounded and without supporting documentation.	inaccurate," we cannot evaluate the need for changes in the Recovery Plan.	
The statement that Apache trout will be provided further protection under the Act due to several other listed species is incorrect and misleading. How is this possible under the Act? None of the species listed are currently known to occur within any Apache trout recovery stream, and only the Mexican spotted owl occurs within their watersheds.	Thank you for identifying this error in the plan. The section referring to co-occurring species in Appendix 4 has been removed.	4
In regard to the use of appropriate fish stocks for recovery into National Forest System (NFS) streams, our preference agrees with that stated in the draft plan of starting with wild fish, followed by replicated populations, with the least favorable alternative being the use of hatchery stock. We would encourage further development of a Broodstock Plan that includes involvement of key stakeholders. This could be a valuable tool for Apache trout recovery, given the particular situation of currently available Apache trout lineages. The long-term implications of using one hatchery stock (for purposes other than established recreational fisheries) that has been in captivity for over 20 years should be discussed with greater clarity in the recovery plan.	The discussion regarding the use of hatchery fish in recovery actions has been discussed further with changes/additions on pages 31 and 32.	A, B, C, D, I
It would seem appropriate to consider climate change under this heading. Because recent research (Seager et al. 2007) indicates that the baseline climatology for this region may be comparable to that of the mid-century drought and Dust Bowl era, climate change may play a key role in the persistence of this species.	Pages 24 and 25 have been changed to include information from Seager et al. 2007 and Williams and Meka Carter 2009.	A
Pg. 24, Pg. 26 - Objective 1.0, and elsewhere– "*Recovery streams will require continuous monitoring*" Monitoring of stream fish populations is a nontrivial task, and it is not apparent in the draft recovery plan how monitoring will be performed to achieve the objectives noted above. The recovery plan draft does not specify the frequency that populations will be monitored, the technique that will be used (other than to say that an array of detection methods will be used; page 27, para. 6), the fish population estimation model to be employed (mark-recapture, removal), or the spatial distribution of sampling within a stream.	Development of a specific monitoring plan is not required during the recovery planning process. Rather, section 4(g)(1) of the Act, added in the 1988 reauthorization, requires the Service to implement a system, in cooperation with the States, to monitor for no fewer than 5 years the status of all species that have recovered and been removed from the List of Threatened and Endangered Wildlife and Plants (50 CFR 17.11, 17.12, 224.101, and 227.4). The purpose of the post-delisting monitoring is to verify that a species delisted due to recovery remains secure from risk of extinction after it has been removed from the protections of the Act.	A, C

Page 27, para. 3: *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.* The 50-500 rule for retaining genetic diversity is based on reproducing adults. You may have considerably more latitude for transplanting if only juvenile fish are used.	The goal is to use fish from wild streams to start new populations in new streams, without adversely affecting the donor population; hence our recommendation to use donor streams that have populations of greater than 500 fish.	A
Page ix, Recovery Criteria: The recovery criteria for "self-sustaining" and "established" may be criticized for lack of quantification (effective population size, and viability thresholds). However, your arguments against using rigid criteria for effective population size (p.33) or viability models (p.32) are persuasive. Some have found fault with recovery and conservation plans for not assuring population size sufficient to assure persistence for 50-100 years under the misunderstood assumption that these populations will not be constantly monitored and managed. You commit to several strategies (population, genetic, and habitat monitoring; regulatory; stocking) that can successfully maintain a trout population, in the face of any destabilizing factors. I would agree that there is also value in smaller isolated populations. Although I would agree that those populations have a higher risk of genetic inbreeding or moving towards homozygosity, they also have a lower risk of disease, non-native contamination, and even angler harvest.	The overall goal for Apache trout recovery is to establish and/or maintain 30 self-sustaining populations of pure Apache trout within its historical range, understanding the need for long-term commitment to maintaining barriers, monitoring populations, augmenting stocks as necessary, and continuing to increase the range of the species into the future.	B
Page ix, Recovery Objectives: You may want to consider some factor in your objectives related to distribution of recovery populations across its range. For instance, it may be appropriate to include in the recovery objectives a requirement that (for example) at least 3 populations exist in each of some geographically significant unit (USGS hydrounits, sub-drainages, or another meaningful unit). This would help to assure that the species has some protection from localized threats (fire, whirling disease, drought, non-natives, etc) that would be mitigated by a broad distribution.	Even though the historical range of Apache trout includes headwaters from 3 distinct drainages (Little Colorado, White, and Black rivers), our approach does not require a spatial recovery component as you suggest because we are limited by the habitats available in the drainages. However, when the proposed actions are complete; Apache trout will be found in at least 15 populations in the White, 9 in the Black, and 6 in the Little Colorado river drainage to provide a level of redundancy to assure that the species has protection from localized threats.	B
Page 4, Genetics:	Yes. Several studies have been conducted to detect hybridization	B

Have Apache and Gila trout been subjected to genetic testing which is diagnostic for the two species? Because of the close proximity of their ranges, and possibly their genetic fingerprints, it may be advantageous to assure their lineage. Recent testing of cutthroats in Colorado using microsatellites and AFLP suggests (publication pending) the ability to distinguish between greenback, Rio Grande and Colorado River subspecies of cutthroat trout. Preliminary findings suggest that early (1890-1920) stocking may have resulted in misplaced populations (greenback on west slope of Colorado, and Colorado River cutthroat on the east slope). At the very least, our early assumptions that cutthroat subspecies always align with their historical range have become suspect. That same level of genetic resolution is suggested to further investigate the distribution of Apache trout in relation to its nearby Gila trout neighbors.	between rainbow trout and Apache and/or Gila trouts, and/or to differentiate between Apache and Gila trouts. See Loudenslager et al. (1986), Behnke (1992), Dowling and Childs (1992), Carmichael et al. (1993), Hendrickson et al. (2003), Porath and Nielsen (2003), Wares et al. (2004), and the discussion of genetics on pages 4 and 5 of this plan.	
I found no information in the draft plan about the level of introgression on the hybridized Apache populations. Ten streams were identified (page viii of the executive summary) however no other details on these populations was provided. The Utah (Hudson 2000) paper representing the Interstate Inland Cutthroat Group presented a recommended protocol for the quantification of introgression that was developed by the Ad-hoc Intercross Technical Committee. This group was charged with developing a standard approach to quantifying the degree of introgression in cutthroat trout populations. That discussion led to a general acceptance of <10% introgression for conservation populations. Furthermore, a recent court ruling on the petition to list Westslope cutthroat trout has resulted in a reliance on morphology to determine the acceptability of populations under the Act. Please include introgression levels, if available, for all populations tested, the genetic test conducted, and which populations (if any) have not been tested.	The levels of introgression are published in Carmichael et al. (1993) and Wares et al. (2004). The methods for analysis to detect hybridization of Apache trout have included the use of isozyme locus polymorphism (Carmichael et al. 1993) and microsatellite and mitochondrial DNA analyses (Wares et al. 2004), as discussed on page 4 of this plan. We understand the results of the Ad Hoc Committee and their acceptance of <10% introgression as acceptable for conservation of cutthroat trouts, however, the Apache trout recovery team and previous recovery plans (USFWS 1979 and 1983) for Apache trout have concluded that all recovery populations for Apache trout must contain pure Apache trout populations. The streams discussed in recovery plan that currently have some level of hybridization are not counted towards recovery.	B
<u>Page 11, Table 1:</u> Of the 13 relic streams, it appears that only some of them (Big Bonito, Ord, Flash, EFWR, Firebox, Soldier, Smith and Coyote) have been replicated (translocated or hatchery production) to other streams. Are there plans to replicate the remaining streams (Boggy/Lofer, Crooked, Deep, Elk Canyon, and Little Bonito)?	The recovery approach identified in the plan does not require replication of all remaining lineages in order for recovery to be achieved. The Service must recover a species as it was listed. In the case of Apache trout, the entire species was listed, not distinct population segments. Therefore, recovery of Apache trout focuses on the species level. Managing the genetic variation of Apache trout will continue to be an important consideration and will evolve, as the science of conservation genetics continues to evolve. For the	B

	purposes of recovery under the Endangered Species Act, Apache trout may be considered for delisting when 30 pure populations of Apache trout are established within its historic range.	
Page 26, Objective 1.0: I did not see any discussion about upper level temperature requirements for Apache trout in the draft plan, and particularly reference to upper elevational constraints. Without being familiar with Apache trout streams and habitat I do not know if populations are limited (primarily due to inadequate temperature degree-days for successful egg maturation) at high elevations exposed to low summertime/fall water temperature.	Upper elevational limits relating to temperature for Apache trout have not been identified as a limiting factor in recovery efforts for the species.	B
The draft states, "*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*." It is unclear what the non-native species are and why they would not be considered a threat. I would assume that the non-native component will be removed and that once that is accomplished that the habitat has been documented as adequate for Apache trout development.	Yes, this statement refers to the fact that streams presently containing nonnative trout (brown, brook, and/or rainbow) will be suitable for Apache trout, once the nonnative trout are removed.	B
"Objective 3.0 -- Monitor, prevent, and control disease and/or causative agents, parasites, and pathogens." The authors may want to elaborate here on strategies that are likely already in place. For instance, annual requirements for hatchery testing and certification as disease free, testing of progeny prior to stocking, or disinfection requirements for biologists sampling within Apache trout habitat. Also is there a regular monitoring regime in place to test recovery populations (or downstream non-native salmonid surrogates) for diseases (primarily WD, BKD or VHS)?	State and federal trout hatcheries in Arizona undergo annual disease testing for a variety of diseases including whirling disease, bacterial kidney disease, virology, and external parasites. Existing wild Apache trout populations have been occasionally tested, and potential recovery populations are tested prior to renovations to determine baseline conditions of any potential parasites/pathogens in the existing trout populations. Because disease testing requires at least 60 fish to be killed, it is not prudent to conduct annual disease monitoring of Apache trout wild populations due to potential impacts on wild populations. Rather, protocols are in place to test populations when recommended by federal and state fish health specialists. In addition, biologists follow existing HACCP (Hazard Analysis of Critical Control Point) protocols to eliminate or mitigate the likelihood of transporting parasites and/or pathogens between sites. These HACCP plans include recognizing potential vectors and taking actions at control points (such as disinfecting sampling gear,	B, C

	stocking vehicles, and transport containers, etc.).	
The revised draft of the Apache trout recovery plan does not acknowledge that genetically distinct populations exist, despite the findings of Wares et al. 2004. Furthermore, the plan does not provide for additional genetic study to uncover other potentially distinct populations that are likely to exist in other parts of the range. This is a major flaw in this draft because recovery activities such as translocating fish from donor to recipient populations and/or hatchery rearing and population supplementation require knowledge of underlying genetic structure to maximize probability of successful recovery of the species. Specifically, recovery activities should be conducted such that they maintain genetic diversity within and among lineages of Apache trout, in accordance with best conservation practices.	We acknowledge the levels of variation found by Wares et al. (2004) on page 4 and 5 of the plan. As stated in the plan, a thorough examination of the genetic diversity among remnant populations has not been conducted. Rather, most genetic analyses have focused on detection of hybridization with other *Oncorhynchus* species. Although the replication of each remnant lineage is not considered in this plan or the 1983 plan as a specific criterion, eight of the 13 remnant lineages have been replicated on Tribal or National Forest lands.	C, D
Page 4: sentence beginning: “Thirty one populations of Apache trout were sampled…to detect hybridization” is a confusing and run-on paragraph.	We agree that this section is confusing. That paragraph on pages 4 and 5 has been modified to read clearer.	D
The draft plan is rather vague on how potential contamination of extant populations by stocking nonnative trout in the vicinity of Apache trout populations will be precluded. Granted, barriers prevent movement by fish, but humans have a habit of stocking where they should not.	The plan states that all fish stockings by AGFD and FWS are conducted under section 7 of the Act to avoid, minimize, and/or mitigate impacts to listed species. Through the section 7 process, the agencies may not stock nonnative trout if there is an adverse affect to Apache trout at that location. An illegal stocking by individual(s), is just that (illegal), and is difficult to enforce, but if it occurs, the nonnative trouts will be removed as described in recovery action 1.3.	D
Throughout the draft plan, recreational fishing is promoted as a ‘recovery’ activity. While recreational angling for Apache trout is certainly a positive by-product of recovery, it is not, or at least should not, be viewed as an action that contributes to recovery.	We do not believe the draft plan promotes recreational fishing as a recovery activity. None of the recovery criteria have a required recreational fishing component. In fact, replicated streams on National Forest lands are closed to fishing by the Arizona Game and Fish Department until these recovery populations reach a level where angling opportunities may be explored.	D
For the five streams to be stocked with Apache trout, each will be considered as having an established population as soon as it receives trout. Is that correct? If so, believe it is a very risky assumption. While most stockings are successful, some are not, particularly those in small headwaters where stochastic natural events can easily eliminate the few stocked fish.	Each stream will be considered as having an established population after the verification of multiple age classes to indicate successful reproduction through monitoring.	D
The Southwestern Regional Office submits the following comments for consideration during the public review period for the draft	Recovery Plans are developed using the best information available at the time of the development of the plan. We agree that as recovery	I

revised Recovery Plan for Apache Trout. Upon consideration of the draft plan and based on Forest Service (FS) participation in recovery efforts, we encourage a final recovery plan that can provide for appropriate adjustments to actions as new information becomes available during the life of the plan. In particular, this could apply to timeframes for repatriation into marginal habitats, more specific descriptions of a range of options to obtain non-hatchery stock, and further consideration of the role of hatcheries in supplementing wild stocks or creating replicated populations.	moves forward, plan updates should occur. The current recovery guidelines define an update as: "specific actions that have been initiated since the plan was completed, as well as changes in species status or background information that do not alter the overall direction of the recovery effort." These changes cannot represent a major change in the direction of recovery, and do not require a public comment period.	
Compared to the relatively recent Recovery Plan for Paiute cutthroat trout (2004), the draft Apache trout recovery plan provides no specific habitat information, yet included in the plan is a list of 22 FS streams that have been analyzed with the General Aquatic Wildlife System (GAWS). The 65 surveys conducted through time on those 22 streams could provide valuable information for managing the habitat of Apache trout. We recommend that the recovery plan parties work together to complete analysis of the habitat data. As stated in the draft recovery plan, one purpose of the plan is to include current information on species status and to "assess, prepare, protect, and maintain habitats sufficient for all life functions." In addition to the GAWS data, there is the continuously recorded thermograph information collected by Trout Unlimited. These data could be used by all parties to help manage Apache trout in the future.	The plan cites studies by Kitcheyan, Wada, Alcorn, Lee and Rinne, Harper, and Cantrell et al. that describe habitat conditions for Apache trout. A recovery plan is an advisory document with specific actions that must be taken in order to recover a species. With that being said, we agree that the data gathered during GAWS surveys on Forest Service streams should be analyzed. The Service would welcome working with the Forest Service and other partners to analyze the data, and make plan updates as necessary.	I