National Fish and Wildlife Foundation

Business Plan for the Apache Trout

March 24, 2009

What Is a Business Plan?

A business plan serves two broad, primary functions. First, it provides specific information to those (e.g., prospective investors) not familiar with the proposed or existing business, including its goals and the management strategy and financial and other resources necessary to attain those goals. Second, a business plan provides internal guidance to those who are active in the operation of the business, allowing all individuals to understand where the business is headed and the means by which it will get there. The plan helps keep the business from drifting away from its goals and key actions through careful articulation of a strategy.

In the context of the National Fish and Wildlife Foundation's conservation efforts, business plans represent the strategies necessary to meet the conservation goals of Keystone and other initiatives. Each business plan emphasizes the type(s) and magnitude of the benefits that will be realized through the initiative, the monetary costs involved, and the potential obstacles (risks) to achieving those gains. Each of the Foundation's business plans has three core elements:

> **Conservation Outcomes**: A concrete description of the outcomes to which the Foundation and grantees will hold ourselves accountable.
>
> **Implementation Plan with Strategic Priorities and Performance Measures**: A description of the specific strategies that are needed to achieve our conservation outcome and the quantitative measures by which we will measure success and make it possible to adaptively revise strategies in the face of underperformance.
>
> **Funding and Resource Needs**: An analysis of the financial, human and organizational resources needed to carry out these activities.

The strategies and activities discussed in this plan do not represent solely the Foundation's view of the actions necessary to achieve the identified conservation goals. Rather, it reflects the consensus or majority view of the many federal, state, academic or organization experts that we consulted with during plan development.

In developing this business plan, the Foundation acknowledges that there are other ongoing and planned conservation activities that are aimed at, or indirectly benefit, keystone targets. This business plan is not meant to duplicate ongoing efforts but, rather, to strategically invest in areas where management, conservation, or funding gaps might exist in those broader conservation efforts. Hence, the aim of the business plan is to support the beneficial impacts brought about by the larger conservation community.

Summary

The Apache trout *(Oncorhynchus gilae apache)* is one of only two species of native trout in Arizona, historically occupying streams and rivers in the upper White, Black, and Little Colorado river drainages in the White Mountains of East-Central Arizona. Since the species was federally listed as Endangered under the Endangered Species Act of 1973, recovery efforts have achieved a downlisting to Threatened and restored Apache trout in more than twice the amount of streams that existed when it was listed. Despite aggressive recovery efforts, historical and present, there are still several ways to improve the present and future sustainability success of Apache trout that go beyond actions guided by the Apache Trout Recovery Plan. Three of the most significant threats to natural and reestablished Apache trout populations that exist today are:

- ☐ Non-native trout occupying historical Apache trout habitat.
- ☐ Marginal habitat in small recovery streams.
- ☐ Impacts of climate change on trout streams.

Four key strategies have been developed for this Keystone Initiative to address ongoing threats to the sustainability of Apache trout. If goals are achieved with this investment, not only would Apache trout abundance increase by an estimated 50 percent by 2017, but abundance would continue to increase, without financial investment, to an estimated 90 percent by 2020. In combination, actions guided by the Recovery Plan will result in recovery and a possible delisting proposal, and the Initiative will implement key actions that could reduce the effects of stochastic events, expand and improve habitat, and increase Apache trout abundance, ultimately ensuring their sustainability.

1. **Metapopulation creation.** The creation of three metapopulations will expand and connect isolated recovery streams, making populations less vulnerable to climatic changes, increase population numbers, and help maintain genetic diversity in populations.
2. **Habitat restoration**. Habitat restoration in meadow reaches of small recovery streams will break "invisible barriers," encouraging use of this habitat by trout and resulting in increased population sizes.
3. **Population and habitat assessment and monitoring.** A long-term monitoring plan to assess population and habitat conditions will be developed and implemented.
4. **Barrier maintenance and monitoring**. A long-term barrier maintenance and monitoring plan will be developed to ensure recovery streams are protected now and after delisting.

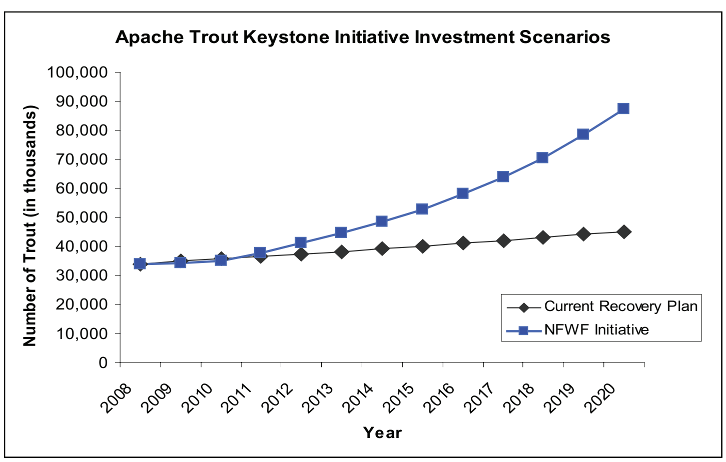

Figure 1. Apache trout Keystone Initiative levels of investment.

Key Partners: Arizona Game and Fish Department, US Fish and Wildlife Service, US Forest Service, White Mountain Apache Tribe, and Trout Unlimited

Timing: This project is a 10-year plan to secure Apache trout abundance and habitat.

Estimated Overall Cost of Apache Trout Keystone Initiative: $3,979,000

Contents

Conservation Need

The Apache trout *(Oncorhynchus gilae 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. g. 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, 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. 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 30 miles (48 km) by the mid 1900s compared to a total historical range estimated by Harper (1978) at 600 miles (965 km) and more recently estimated at 820 miles (1,320 km) based on Geographical Information System (GIS) mapping. Originally listed as Endangered under the Endangered Species Act (ESA) of 1973, a re-analysis of the species status led to its down-listing to Threatened in 1975 due to successful culturing in captivity and greater knowledge of existing populations (USFWS 1979).

Currently, pure Apache trout occupy 27 streams encompassing 118 miles (189 km) within its historical range, primarily due to recovery efforts that started in the 1950s and continue today. At present, the major threats to the persistence of Apache trout are:

- ☐ Non-native trout reinvasion of recovery streams because of barrier failure or illegal stocking.
- ☐ Marginal habitat in some streams, resulting in further fragmentation.
- ☐ Artificial fish barrier failure.
- ☐ Effects of climate change (e.g., drought, fire, post-fire flooding events, increasing water temperatures).

The Apache Trout Recovery Plan (Recovery Plan) was first published in 1979 and revised in 1983 and 2007 (USFWS 1979, 1983, 2007). The recovery strategy for Apache trout described in the Recovery Plan is to establish and/or maintain 30 self-sustaining populations of pure Apache trout within its historical range and to address and ameliorate the five Endangered Species Act listing factors. Currently, the Apache trout recovery program that is built among multiple agencies will likely be successful at meeting the 30 stream recovery criteria within the next several years. However, there is a great opportunity to take the recovery program beyond meeting recovery criteria identified in the Recovery Plan, and to take actions that focus on achieving the long-term sustainability of Apache trout. Combined, the actions guided by the Recovery Plan and the implementation of key strategies of this Keystone Initiative will help take Apache trout to recovery as well as ensure their persistence in the future. Partners who will implement the actions described in this business plan will include species leads with the Arizona Game and Fish Department (AGFD), U.S. Fish and Wildlife Service (USFWS), and U.S. Forest Service (USFS), Apache Sitgreaves National Forest (ASNF), White Mountain Apache Tribe (WMAT), the Apache Trout Recovery Team (Recovery Team), and individuals from various non-governmental organizations (these individuals collectively referred to as "Working Group").

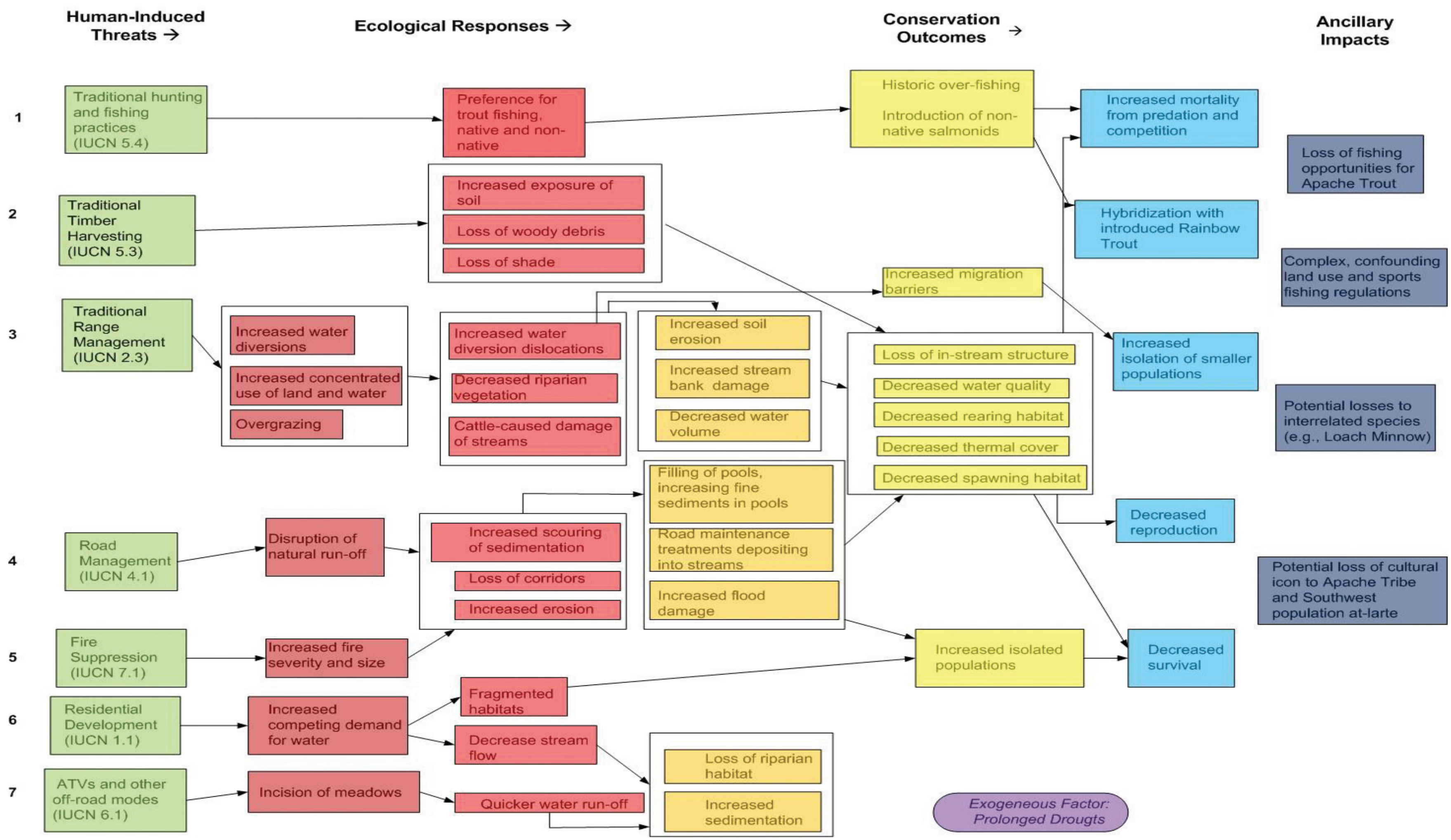

Figure 2. Logic framework including threats and ecological responses that have impacted Apache trout. A logic framework is a diagram of a set of relationships between certain factors believed to impact or lead to a conservation target (species representing Keystone Initiatives). Logic frameworks are typically composed of several chains of logic whose arrows are read as "if-then" statements to help better understand how threats contribute to conservation target declines. Logic frameworks are used to define the conservation problem, assess limiting factors, and prioritize key strategies.

Conservation Outcome

The goal of this Initiative is to increase the abundance and distribution of Apache trout to a level that would not be achieved otherwise. Specifically, the desired outcome is to gain a 50 percent increase in Apache trout abundance throughout a 10-year time period; this level of increase would not be achieved by implementing only the actions identified in the Recovery Plan that are required for recovery. For example, based on the current status of the Apache trout recovery strategy guided by the Recovery Plan, only 3 additional recovery streams are necessary to reach the 30-stream criteria identified in the plan. Under the current strategy, Apache trout abundance will increase slightly over time (Figures 1 and 3). To achieve the recovery goals identified in the Recovery Plan, it is estimated to cost $3,680,000 between 2008 and 2014 (recovery plans are required to provide an estimated cost of recovery over a seven year period). This funding comes from multiple agencies and non-governmental organizations, and is also sought after competitively from grant programs.

To achieve a 50 percent increase in Apache trout abundance, several population targets (outcomes) were established that reflect abundance expectations based upon various levels of funding that might be secured (Figures 1 and 3). Two approaches to achieving this outcome are considered and compared with the estimated trout abundance that results from applying actions guided in the Recovery Plan. Initiative 1 would implement 10 habitat restorations and create 3 metapopulations (cost $4,500,000); Initiative 2 would implement 6 habitat restorations and 3 metapopulations (cost $3,979,000). Initiative 2 presented below would be the most cost-effective plan to achieve a 50 percent increase in abundance after the 10th year of the project. Thus, Initiative 1 will not be considered for the remainder of the business plan. The baseline funding ($3,680,000) estimated to achieve the goals identified in the Recovery Plan does not include developing 3 additional metapopulations or restoring habitat in 6 streams — these activities are part of the NFWF Keystone Initiative and are *in addition to* recovery actions to be implemented as guided by the plan.

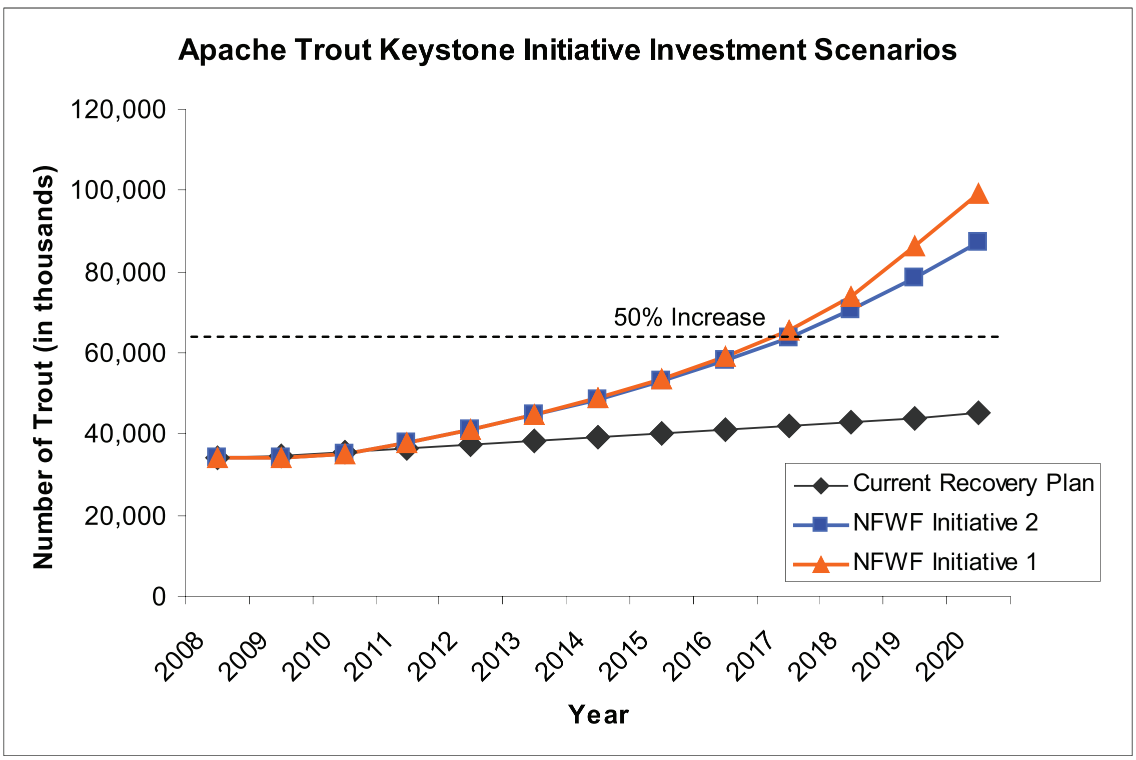

Figure 3. Expected changes in Apache trout population size with three levels of targeted financial investment throughout a 10-year period.

Implementation Plan

Within the current recovery strategy identified in the Recovery Plan, Apache trout populations are limited mainly by:

1. The lack of diverse habitat combining mainstem and tributary habitats within recovery streams.
2. Poor habitat quality in meadow reaches of small recovery streams.
3. Varying methods population and habitat assessments.
4. Barrier failures.

Consequently, our implementation strategies for Apache trout are aimed at increasing the amount and quality of available habitat, resulting in a large increase in population size throughout time. In addition, the population, habitat, and barrier monitoring plans will improve knowledge of Apache trout population dynamics and persistence as well as maintain and ensure barrier integrity.

We propose four key strategies as core conservation efforts necessary to address the limiting factors. Within each strategy, we established actions that will help contribute to population goals. Key strategies 1, 2, and 4 have a relatively high chance of significantly contributing to population goals. Key strategy 3 has a direct and important link to population goals but is not expected to have the same level of benefit as key strategies 1, 2, and 4. Nonetheless, all strategies are necessary to achieve the desired population outcome.

The following results chain outlines the hypothesized relationships among restoration actions, conservation outcomes, and measures of success — primarily to realize the desired population increase of at least 50 percent by 2017, a 10-year timeframe (Figure 4).

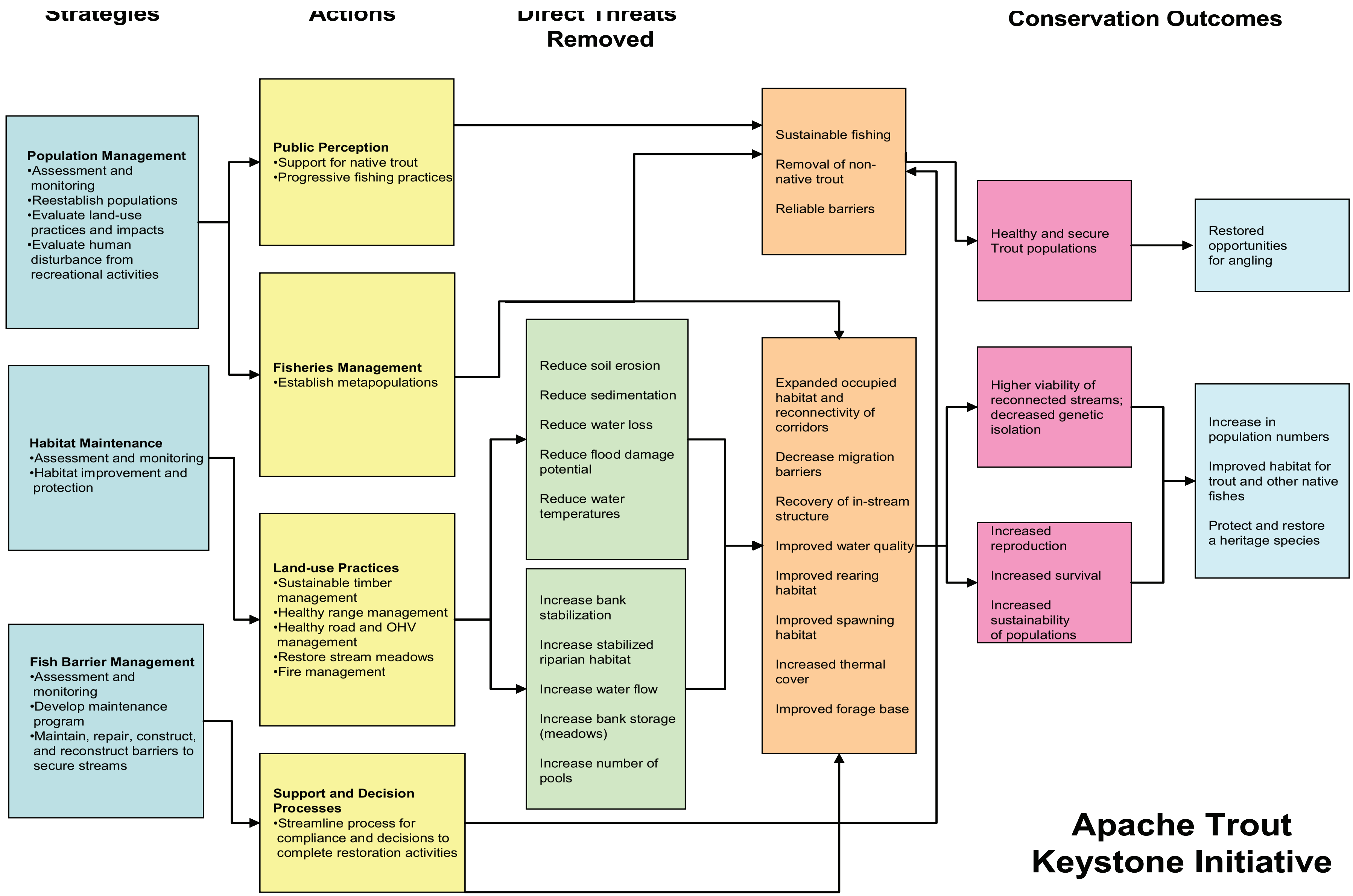

Figure 4. Results Chain. A results chain is a chain of logic that illustrates how a specific strategy is presumed to reach a particular conservation outcome. Results chains are used to develop a suite of indicators to show progress at different stages in the initiative.

Key Strategy 1 — Metapopulation creation: Apache trout appear to be limited mainly the lack of diverse habitat, including access to both mainstem and tributary habitats. As a result, correcting this problem by creating metapopulations is a promising conservation strategy.

There are few perennial stream networks that might function as recovery streams for interconnecting populations within the historical range of Apache trout, mainly because water impoundments, reservoirs, and rural communities have been developed in the mainstem habitats. 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 trout. Choosing headwater streams isolated from non-native trout populations is common for native trout recovery for many other western species; isolated streams above barriers have ensured the persistence of many native trout populations. However, this has resulted in artificially fragmented stream segments that do not promote interconnection above barriers. Out of the 27 Apache trout recovery streams that currently exist, five stream systems, each with multiple tributaries and mainstem habitat, have metapopulation characteristics. To significantly increase the numbers of individuals and provide more protection to isolated populations that are vulnerable to stochastic events such as drought, fire, and post-fire floods, more stream systems for Apache trout need to be established by expanding some of the existing recovery streams and creating metapopulations (See Table 1.). Metapopulations would connect isolated recovery streams with mainstem habitats that would promote gene exchange, genetic diversity, and prevent genetic bottlenecks. In addition, the inclusion of mainstem habitat would greatly increase Apache trout abundance.

Our success to develop three metapopulations will depend on the cooperation and support of the land-management agencies (USFS and WMAT). We will minimize the risk associated with this factor by maintaining a positive working relationship with the land-management agencies and to work with concerns as they arise. Cooperation will include support of barrier construction and/or modification and chemical renovation of selected streams.

Table 1. Key projects to create metapopulations by expanding three existing Apache trout recovery streams. Projects include: barrier construction and/or reconstruction, removal of non-native trout, and stocking new Apache trout or distributing existing Apache trout within the new habitat.

Stream	Key Partners	Indicators of Progress
West Fork Black River (ASNF)	AGFD, USFWS, USFS, TU	• Construction of two barriers. • Mainstem and tributary connectivity. • Removal of non-native trout. • Redistribution of trout; increase in abundance.
Bonito Creek Drainage (WMAT)	AGFD, USFWS, WMAT, TU	• Barrier maintenance and/or reconstruction. • Mainstem and tributary connectivity. • Removal of non-native trout. • Redistribution of trout; increase in abundance.
Other (WMAT)	AGFD, USFWS, WMAT, TU	• Mainstem and tributary connectivity. • Removal of non-native trout. • Redistribution of trout; increase in abundance.

Key Strategy 2 — Habitat restoration: The meadow reaches of many small recovery streams have become marginal for trout due to past land-use practices. Restoring habitat in meadow reaches will encourage use of this habitat by trout, resulting in increased population sizes.

Apache trout distribution and population levels decreased prior to federal ESA listing primarily because of habitat alterations and negative interactions with non-native trout. Habitat alterations were related to land-use practices such as forestry, livestock grazing, reservoir construction, road construction, and mining. To mitigate for these effects in reestablished Apache trout recovery streams, riparian habitat has been improved on many streams by the installation of fencing to exclude grazing ungulates along critical sections of some recovery streams, particularly the smaller streams on Forest and Tribal lands. However, many recovery streams with impacted meadow reaches need habitat restoration beyond fencing and changes in livestock grazing schedules. The smaller streams all contain meadow reaches, are more vulnerable to drought, and have the smallest numbers of trout compared with other recovery streams. They are important for recovery, and many contain natural lineages or reestablished populations that have persisted since the 1960s. At present, many meadow reaches within recovery streams serve as "invisible barriers" and do not promote the seasonal and life history migratory behavior of trout. Habitat restoration such as revegetation, elk exclosure fencing, installation of instream structures to diversify homogenous meadow habitat, and potential stream channel realignment will greatly benefit up to six streams on Forest and Tribal lands (see Table 2). Habitat restoration of meadow reaches ultimately will result in connecting isolated portions of habitat within streams, which will increase the amount of suitable trout habitat and population numbers.

Our success on habitat restoration projects will depend on the cooperation and support of the land-management agencies (USFS and WMAT). We will minimize the risk associated with this factor by maintaining a positive working relationship with the land-management agencies and to work with concerns as they arise. An interdisciplinary approach will be necessary and will provide collaboration among members of the recovery team and various experts in hydrology, engineering, fisheries, range, and botany to identify the methods that have the best chance of success.

Table 2. Key projects for habitat restoration of meadow reaches in small Apache trout recovery streams.

<table>
<tr><th>Stream</th><th>Key Partners</th><th>Indicators of Progress</th></tr>
<tr><td>West Fork Black River (ASNF)</td><td>AGFD, USFWS, USFS, Trout Unlimited (TU)</td><td rowspan="2">• Increase in trout abundance.
• Increase in bank stability.
• Increase in vegetation cover.</td></tr>
<tr><td>Coyote/Mamie, Mineral (ASNF); Firebox, Thompson, and/or others (WMAT)</td><td>AGFD, USFWS, USFS, TU, WMAT</td></tr>
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Key Strategy 3 — Population and habitat assessment and monitoring: We need to know how many fish there are in each recovery stream and how successfully they are reproducing and surviving to be able to measure the success of our conservation efforts and adapt ongoing efforts to maximize conservation benefits. We need to monitor changes in habitat because habitat quality and population abundance have a direct link.

Assessment and monitoring form the backbone of any successful conservation program. Population and habitat surveys conducted by the AGFD on Forest streams and by the USFWS and WMAT on Tribal streams have used two different survey methods since surveys began. Although the results of these surveys have provided the scientific baseline for information included in the Recovery Plan and this business plan, the survey methods are substantially different, and surveys have not been consistent over time. Continued monitoring of stocking success, reproductive success, and habitat conditions will be vital for measuring the effectiveness of the conservation actions implemented through the monitoring plan, the Recovery Plan, and this Initiative (Table 3). The monitoring plan will evaluate the most affordable and accurate survey method and require concurrence of State, Federal and Tribal agencies to adopt the recommended method for evaluating Apache trout recovery streams. A long-term monitoring plan is also required with a delisting proposal, thus the opportunity to create and implement this plan now will aid the recovery program when recovery criteria are met and a delisting proposal is considered in the future.

Our success with population and habitat assessment will require the personnel and resources support of AGFD, USFWS, USFS, and WMAT. Collectively these agencies must consider developing monitoring protocols as an essential aspect of this Initiative as well as for the long-term persistence of the species. There is a risk that not all parties will agree on the monitoring protocols or their importance, thus impacting their implementation. To mitigate this risk, the Apache Trout Recovery Team will assign a Working Group with representatives from each agency and from non-governmental organizations that will develop these protocols together. This key strategy is a real-time assessment opportunity to determine if the other 3 key strategies are increasing Apache trout abundance and allowing for potential adaptive management strategies to be evaluated in a timely manner.

Table 3. Key projects for assessing habitat, population size, reproduction, and survival of Apache trout and monitoring those trends through time.

Project	Key Partners	Indicators of Progress
Population and habitat assessment	AGFD, USFS, USFWS, WMAT	• Development of long-term habitat and population monitoring protocols. • Accuracy and statistical power of habitat monitoring. • More reliable population estimates based on data base creation and analysis of population data. • Changes in sampling protocol based on more accurate and precise population estimates (adaptive management principles).
Genetics analysis	AGFD, USFWS, WMAT, University of Arizona	
Data base to house AGFD and WMAT data	AGFD, USFWS, WMAT	
Develop long-term monitoring plan	AGFD, USFS, USFWS, WMAT	
Research	AGFD, USFS, USFWS, Universities	

Key Strategy 4 — Barrier maintenance and monitoring: Fish barriers are the main defense to keep non-native trout out of Apache trout recovery streams, and the development of maintenance and monitoring plans will ensure recovery streams are protected now and after delisting.

Fish barriers are the main defense to prevent non-native trout from moving upstream into Apache trout recovery streams. Gabion barriers come with an unofficial life expectancy of approximately 25 years and require frequent maintenance. Other types of barriers, such as concrete, modified culvert barriers, and masonry structures purportedly last longer. Regardless of the type of fish barrier, maintenance is critical to ensuring the effectiveness and structural integrity of each barrier, especially the first several years following initial construction and following high discharge events. For this key strategy, we will evaluate each barrier and conduct the necessary maintenance to maintain efficacy. We will also develop maintenance and monitoring plans that recommend when maintenance and inspections should be conducted (See Table 4.). Typically, yearly maintenance will include armoring and backfilling areas with additional rock where erosion is occurring and filling and repairing holes and areas of heavy seepage with additional material and erosion cloth. We also are seeking more permanent sealing methods with help from AGFD, USFS, and Natural Channel Design (NCD) engineers. A greater effort will need to be undertaken so inspections are a high priority and conducted at a minimum of twice yearly to ensure integrity of the barriers.

One risk involved in barrier maintenance is the substantial level of funding it takes to construct, reconstruct, and conduct maintenance on barriers. These are expenses above and beyond the current level of funding that agencies direct toward Apache trout. In general, barriers can become compromised for reasons such as atypical high flows and flood events, natural changes in the alluvium, or the barrier lifespan reaching its expectancy. The key strategy of focusing on maintaining barriers and developing a monitoring plan will greatly reduce these risks.

Table 4. Projects for maintaining and monitoring the effectiveness of fish barriers on Apache trout recovery streams.

Project	Key Partners	Indicators of Progress
Barrier effectiveness evaluations on Tribal barriers	AGFD, USFWS, WMAT, NCD	• Development of long-term barrier maintenance, monitoring, and inspection protocols. • Development of agreement among partners for barrier responsibility. • Functioning barriers = lack of non-native trout in recovery streams.
Complete necessary maintenance and/or reconstruction to secure recovery streams	AGFD, USFWS, USFS, WMAT, NCD	
Develop maintenance and monitoring plan for barriers	AGFD, USFWS, USFS, WMAT, NCD	
Develop environmental compliance document for maintenance on all Forest Service barriers	AGFD, USFS, NCD	

Table 5. Gantt chart including four key strategies for Apache trout conservation, the timeline for implementation (Federal Fiscal Year), and the total cost per year during the 10-year funding period. The total overall cost is $3,979,000 (see Table 6). Environmental compliance to meet National Environmental Protection Act (NEPA) standards will be necessary for each metapopulation, habitat restoration, and barrier project.

Action	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
METAPOPULATIONS										
Metapopulation 1		Design	NEPA	Construction (barrier 1)	Construction (barrier 2)	Non-native trout removal; monitoring	Non-native trout removal; monitoring	Non-native trout removal; monitoring		
Metapopulation 2		Feasibility	Design	NEPA	NEPA	Reconstruction	Non-native trout removal; monitoring	Non-native trout removal; monitoring	Non-native trout removal; monitoring	
Metapopulation 3		Feasibility	Design	NEPA	NEPA		Construction	Non-native trout removal; monitoring	Non-native trout removal; monitoring	Non-native trout removal; monitoring
HABITAT RESTORATION										
Habitat restoration 1			Evaluate	NEPA	NEPA		Restoration	Monitoring	Monitoring	
Habitat restoration 2			Evaluate	NEPA	NEPA			Restoration	Monitoring	Monitoring
Habitat restoration 3			Evaluate	NEPA	NEPA				Restoration	Monitoring
Habitat restoration 4		Evaluate	NEPA	NEPA		Restoration	Monitoring	Monitoring		
Habitat restoration 5		Evaluate	NEPA	NEPA			Restoration	Monitoring	Monitoring	
Habitat restoration 6		Evaluate	NEPA	NEPA				Restoration	Monitoring	Monitoring
MONITORING										
Population/habitat	Survey	Survey	Survey	Survey			Survey			Survey
Genetics	Genetics	Genetics	Genetics	Genetics					Genetics	
Research		Electrofishing effects	Electrofishing effects	Electrofishing effects	Reestablish-ment success	Reestablish-ment success	Reestablish-ment success			
BARRIERS										
Barrier evaluations	FS & Tribal streams	Tribal streams	Tribal streams	Monitoring	Monitoring	Monitoring	Monitoring	Monitoring	Monitoring	Monitoring
Barrier maintenance (as needed)	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance
Non-native trout removal	Non-native trout removal	Non-native trout removal	Non-native trout removal	Non-native trout removal	Non-native trout removal	Non-native trout removal	Non-native trout removal	Non-native trout removal	Non-native trout removal	Non-native trout removal
TOTAL COST per year (in thousands)	**450**	**404**	**515**	**515**	**485**	**550**	**605**	**240**	**110**	**105**

Funding Needs

Changes in Apache trout population sizes that are likely to occur through implementation of the described actions are dependent on the level of financial investment (Figure 2). This business plan is built on the assumption that adequate funds can be raised on an annual basis effect a 50 percent increase in Apache trout abundance during a 10-year period. If goals are achieved with this investment, not only would Apache trout abundance increase by an estimated 50 percent by 2017, but abundance would continue to increase, without financial investment, to an estimated 90 percent by 2020. The sum, representing additional funding above that currently directed toward Apache trout, is equivalent to an estimated $3,979,000 during the 10-year period and can be broken down into the budget categories identified in Table 6. The levels of funding are highest in years 1-5 when NEPA is conducted; the increase in Apache trout abundance is greatest in years 6-10, when actions have been implemented (see Figure 2). The current cost estimate to recover Apache trout to the 30 self-sustaining population level is $3,680,000 throughout a seven-year period, as identified in the Recovery Plan. The Initiative cost estimate is above and beyond that level of funding.

Table 6. Budget estimates for the first 10 years of the Apache trout Initiative. Cost estimates depict the total cost for each budget category by years 1-5 and years 6-10 for the recommended investment scenario to create 3 metapopulations, conduct habitat restoration on 6 streams, population and habitat assessment and monitoring, and barrier assessment and monitoring. Actual budgets will be based on the previous year's results and any strategic changes in approaches to Apache trout conservation. See Figures 1 and 2 for estimated levels of Apache trout abundance depending on investment level.

Budget Category	**Initiative: 3 metapopulations, 6 habitat restorations YEARS 1-5 (Total costs)**	**Initiative: 3 metapopulations, 6 habitat restorations YEARS 6-10 (Total costs)**	**Total Costs**
Metapopulation Creation	$684,000	$510,000	$1,194,000
Habitat Restoration	$390,000	$550,000	$940,000
Population and Habitat Assessment and Monitoring	$695,000	$300,000	$995,000
Barrier Assessment and Monitoring	$600,000	$250,000	$850,000
Total Cost	**$2,369,000**	**$1,610,000**	**$3,979,000**

Evaluating Success

Timely success of this Initiative requires dedication to an evaluation process that focuses on individual projects, each of the four strategies, and the collective outcomes across all projects. At each level, we will determine if the planned actions are achieving the desired results. In addition, two meetings will be held each year to evaluate progress of the Initiative and associated key strategies. To evaluate the success of a project in most situations, indicators associated with potential population change will be used (Tables 1 and 2). However, we will not see substantial increases in population abundance until five or six years into the Initiative. Thus, it will be crucial to monitor the progress of project preparation and logistics, environmental compliance, project completion, and timelines to ensure population abundance gains are achieved.

Individual projects funded by NFWF will be evaluated based upon the anticipated outcomes identified in the full proposal. Typically, individual grantees will provide a summary of results and outcomes directly to NFWF as part of each grant agreement. However, periodically, individual projects will be evaluated by NFWF or independent third-party evaluators. Achieving the stated outcomes is obviously the desired result of these projects but, in cases in which outcomes were not realized, it is equally important to identify the reasons behind the discrepancy between expected and observed outcomes.

Collaborative implementation of the key strategies is intended to produce a positive trajectory in the abundance of Apache trout. This will be evaluated systematically through range-wide population surveys every three years. Between those surveys, however, periodic population, habitat, and fish barrier assessments should provide a comprehensive understanding of the types and magnitudes of factors limiting populations, and the relative population benefits offered by each of the key strategies.

Projects under each of the four key strategies are intended to collectively produce results that are meaningful and measurable regardless of whether the projects were directly or indirectly intended to result in an increase in Apache trout numbers. Certainly, not all individual projects will produce the intended results. The collaborative nature of this Initiative will readily allow for periodic evaluations of the effectiveness of each key strategy and its contribution to the overall desired outcome. It will also allow for using adaptive management principles by the evaluation of changes or additions to each strategy each year to ensure that Apache trout population numbers continue to increase.

Exit Strategy

The adaptive nature of this initiative will allow NFWF and partners to regularly evaluate the strategies behind our objectives, make necessary course corrections or additions, and even know when additional investments are unlikely to be productive in the context of the intended outcome (which could warrant reduced participation by NFWF). Although a formal population viability analysis of Apache trout has not been completed, experts are in general agreement that a 30-to-50-percent increase in Apache trout numbers will improve the long-term prospects substantially for this species. Our business plan lays out a strategy to increase Apache trout abundance by an estimated 50 percent by the 10th year of this project if goals are achieved and an additional 40 percent following completion of the project. If this goal is met, mainly by the creation of metapopulations and restoring habitat in marginal streams, the exponential growth of Apache trout numbers will continue, and it is estimated that by 2020, population numbers would be more than 90 percent higher than numbers without the Initiative project. Thus, even after NFWF funding ends, the numbers of Apache trout are expected to increase until a natural carrying capacity in the expanded streams is reached.

Most projects will be initially implemented by 2015, and actions conducted in the final two years of the Initiative, 2016 and 2017, will be predominately focused on population abundance and habitat monitoring. To help ensure that the population gains made in 10 years won't be "given back" after the exit of NFWF funding, the partnership must seek development of funding solutions that are sustainable in the long-term, cost-effective, and can be maintained at lower levels of funding in the future. Therefore, part of the evaluation of this Initiative will address that staying power and the likelihood that successful strategies will remain successful at lower management intensity and financial investment. These topics will be continuously addressed throughout the Initiative at the biannual Working Group meetings.

Long-term Foundation Support:

This business plan lays out a strategy to achieve clear outcomes that benefit wildlife over a 10-year period. At that time, it is expected that the conservation actions partners have taken will have brought about new institutional and societal standards and environmental changes that will have set the population in a positive direction such that maintaining those successes or continuing them will be possible without further (or greatly reduced) NFWF funding. To help ensure that the population and other gains made in 10 years won't be lost after the exit of NFWF funding, the partnership must seek development of solutions that are long-lasting, cost-effective, and can be maintained at lower levels of funding in the future. Therefore, part of the evaluations of this initiative will address that staying power and the likelihood that successful strategies will remain successful at lower management intensity and financial investment.

The adaptive nature of this initiative will also allow NFWF and partners to regularly evaluate the strategies behind our objectives, make necessary course corrections or addition within the 10 year frame of this business plan. In some cases these corrections and additions may warrant increased investment by NFWF and other partners. However, it is also possible that NFWF would reduce or eliminate support for this initiative if periodic evaluation indicates that further investments are unlikely to be productive in the context of the intended outcomes.

Literature Cited

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.

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.

Kanda, N., and F. W. Allendorf. 2001. Genetic population structure of bull trout from the Flathead River basin as shown by microsatellites and mitochondrial DNA markers. Transactions of the American Fisheries Society 130:92-106.

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

Rieman, B. E., and J. D. McIntyre. 1995. Occurrence of bull trout in naturally fragmented habitat patches of varied size. Transactions of the American Fisheries Society 124:285-296.

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

USFWS (U.S. Fish and Wildlife Service). 1983. Recovery plan for Arizona trout, *Salmo apache*, Miller, 1972. Apache Trout Recovery Team. Albuquerque, NM, 38 pp.

USFWS ((U.S. Fish and Wildlife Service). 2007. Recovery plan for Arizona trout, *Oncorhynchus gilae apache*, Second Revision. Apache Trout Recovery Team. Albuquerque, NM, 49 pp.

Map of Apache Trout Range (1)

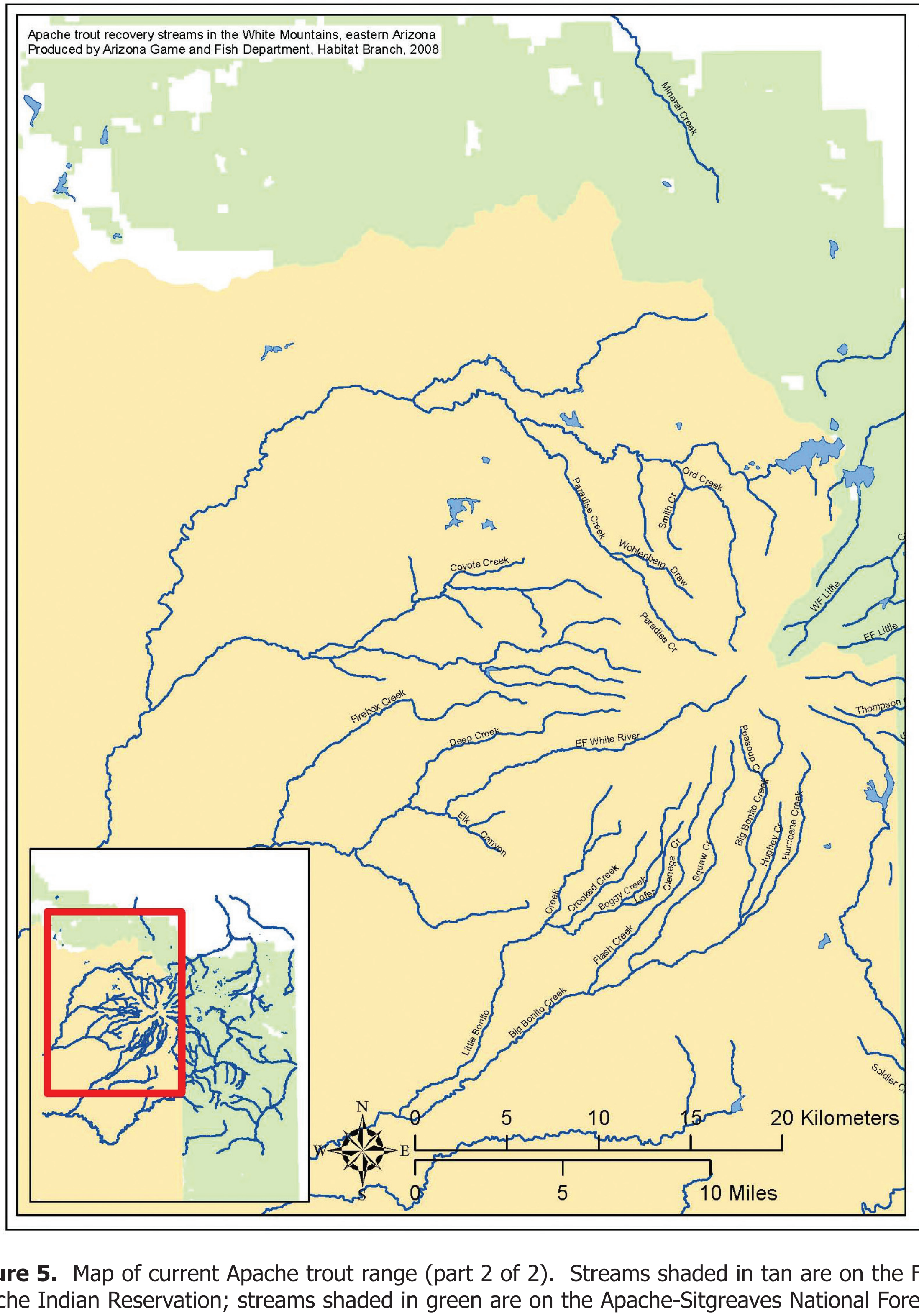

Figure 5. Map of current Apache trout range (part 2 of 2). Streams shaded in tan are on the Fort Apache Indian Reservation; streams shaded in green are on the Apache-Sitgreaves National Forest.

Map of Apache Trout Range (2)

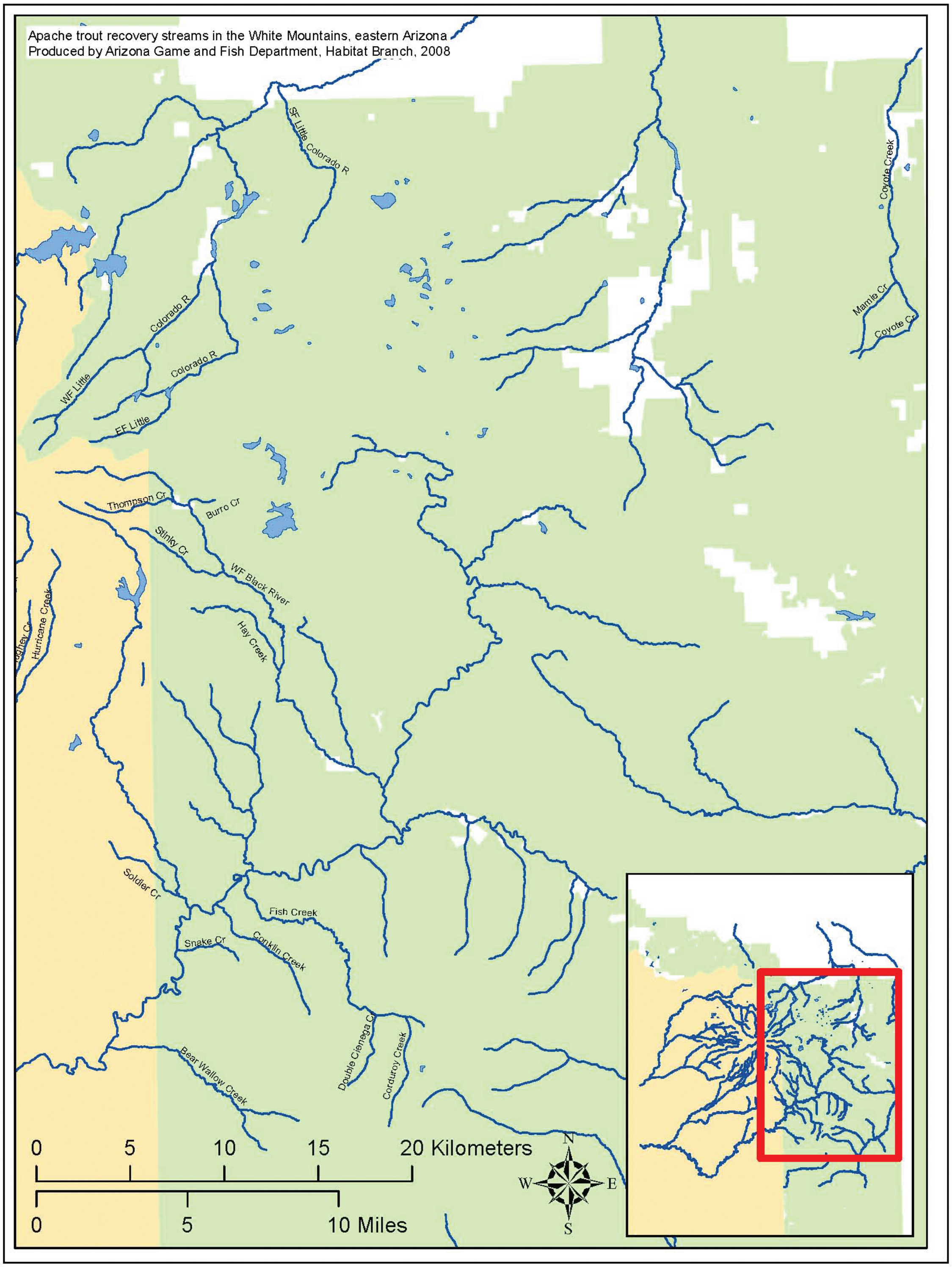

Figure 6. Map of current Apache trout range (part 2 of 2). Streams shaded in tan are on the Fort Apache Indian Reservation; streams shaded in green are on the Apache-Sitgreaves National Forest.

Metapopulation Description

The figure below is of the West Fork Black River, which has two fish barriers downstream of Burro Creek and each of three tributaries that have one barrier near the confluence with West Fork Black River. One of the proposed metapopulation projects is to build two barriers in the lower West Fork Black River (in red) and chemically treat the mainstem to remove all non-native trout. This would expand Apache trout habitat from isolated headwater streams to mainstem habitat and would promote mixing of populations that are now isolated by barriers. In the future fish barriers on the tributaries may be considered for removal; however, mixing of populations with barriers intact is also possible through fishery management intervention and the potential for trout to spill over barriers during high flows.

Choosing headwater streams isolated from non-native trout populations is common for native trout recovery in many western states. This has resulted in artificially fragmented stream segments that do not promote inter-connecting above barriers and restrict trout to areas more vulnerable to stochastic events. Metapopulation theory is based on the concept that fragmented populations are more vulnerable to localized extinctions and stochastic events, and that habitat connectivity increases evolutionarily important variables such as genetic diversity, gene flow, and preventing genetic bottlenecks (Rieman and McIntyre 1995; Kanda and Allendorf 2001).

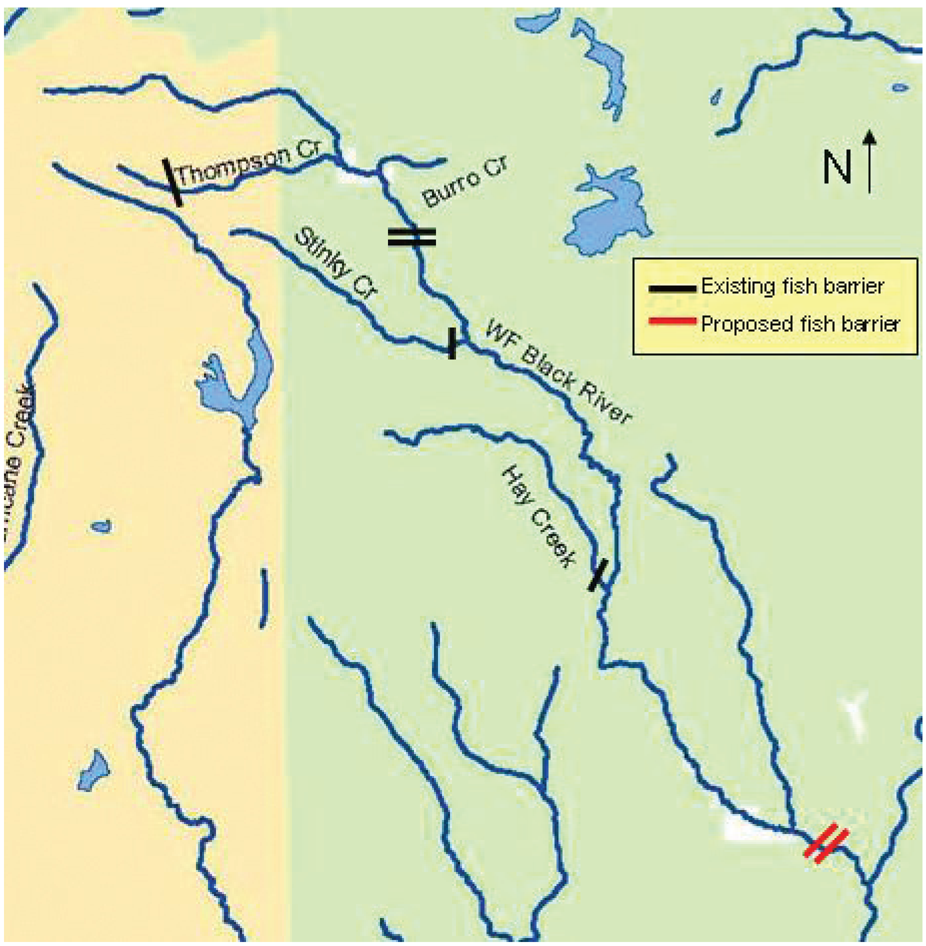

Figure 7. Diagram of potential metapopulation in West Fork Black River.

Ancillary Benefits

Measurable benefits are likely to accrue to other native fish species through strategies and actions directed at Apache trout as described above. The benefits will be greatest for species whose distribution and abundance have been impacted by the introduction of non-native trout, particularly by predatory brown trout. Ideally, benefits accrued to these species (Table 7) should be measured (along with benefits directed toward Apache trout), but that will require individual assessment and monitoring plans. Abundance of these species can be measured during regular population estimate surveys conducted for Apache trout.

In addition, ancillary benefits overall may include improving the species status that would benefit a possible delisting proposal when recovery criteria are met and populations are well established. The expansion of habitat by creating metapopulations may result in increased fishing opportunities when populations are well established, and angling is approved. Apache trout were not historically used by the White Mountain Apache Tribe as a form of subsistence; however, the Tribe continues to value their uniqueness as a cultural icon as well as a sportfish that attracts anglers from around the country. In fact, the Tribe championed the effort to begin recovery actions to preserve Apache trout populations in the 1950s. This Initiative will also benefit the Tribe by preserving a unique trout species found only in the White Mountains, at the heart of their legacy.

Table 7. Ancillary benefits resulting from actions directed towards Apache trout. The magnitude of benefits is described in general terms as having low, medium, or high positive impacts during a 10-year period.

Ancillary Benefits	Metapopulation Creation	Habitat Restoration	Population and Habitat Assessment and Monitoring	Barrier Assessment and Monitoring
Species				
Speckled Dace	Low	Low	Low	
Bluehead Sucker	Low	Low	Low	
Sonoran Sucker	Low	Low	Low	
Delisting Potential	High	High	High	High
Sportfishing Opportunities	High	Low	High	Medium
Preserving Cultural Icon	High	Medium	Medium	Medium

Authors: Apache Trout Species Leads from Arizona Game and Fish Department, U.S. Fish and Wildlife Service, U.S. Forest Service, and the Apache Trout Recovery Team

Photo credit: John Rinne (formerly with the U.S. Forest Service)

Acknowledgements

This business plan was drafted during fall 2008 with the extensive technical expertise of the species leads with the Arizona Game and Fish Department, U.S. Fish and Wildlife Service, and U.S. Forest Service, the Apache Trout Recovery Team, and the conservation vision of the National Fish and Wildlife Foundation (NFWF). The document represents a first generation attempt to expand on the current recovery strategy identified in the Draft Apache Trout Recovery Plan, 2nd Revision (USFWS 2007) to create metapopulations, restore heavily impacted meadows along recovery streams, and create and implement a long-term population and barrier maintenance program for the Apache trout. The business plan represents an initial accomplishment in a timely partnership between the Working Group, which had the foresight to coordinate and synergize the diverse talents and interests of its individual member organizations, and the NFWF, which was seeking ambitious and rigorously developed conservation programs in which to invest.

The Apache Trout Recovery Team was formed in 1975, and in the same year Apache trout was one of the first species to be downlisted from Endangered to Threatened under ESA after re-evaluation of its status showed improved knowledge of existing populations (USFWS 1979). Its membership, an appointed group of participants from State, Federal, and Tribal government agencies, meets biannually to discuss and strategize about conservation and research topics and coordinate monitoring efforts. These meetings have stimulated many accomplishments, including completion of the Apache Trout Recovery Plan in 1983 and a second revision in 2007 (USFWS 1983; USFWS 2007) and the creation of a Memorandum of Understanding for collaboration on Apache trout recovery efforts among agencies and several non-governmental organizations. To prepare, plan, and implement the key strategies of this Initiative, a Working Group will be created that will include the Apache Trout Recovery Team and affiliates, government agency and Tribal personnel, and individuals representing non-governmental organizations. The Working Group will host biannual meetings in conjunction with the Recovery Team meetings to evaluate the progress of projects supported by this Initiative.

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About NFWF — The National Fish and Wildlife Foundation is a 501(c)(3) organization dedicated to funding sustainable conservation initiatives. Chartered by the United States Congress in 1984, NFWF leverages federal grants and private support to achieve maximum conservation impact. Recently, the Foundation — through its Keystone Initiatives — strategically repositioned itself to more effectively capture conservation gains by directing a substantial portion of its investments towards programs that had the greatest chance of successfully securing the long-term future of imperiled species. By leveraging innovative program design from scientific experts, the Foundation is able to structure conservation programs that consistently achieve measurable and meaningful outcomes. [www.nfwf.org]