Environmental Assessment

for

Northern Snakehead Eradication

and

Restoration of Native Fishery

to the

Piney Creek Drainage,

Lee County and Monroe County, Arkansas

22 August 2008

Prepared by:

U.S. Fish and Wildlife Service

Arkansas Game and Fish Commission

Table of Contents

1.0 Purpose of and Need for the Project

1.1 Introduction

The U.S. Fish and Wildlife Service (Service), in cooperation with the Arkansas Game and Fish Commission (AGFC), has prepared this Environmental Assessment (EA) to analyze potential effects that may result from the Service providing assistance to AGFC in the eradication of the northern snakehead. Specifically, the service will provide a helicopter and pilot to assist AGFC with aerial application of Rotenone within portions of the basin, and eight Marsh Masters™ and operators to transport personnel and assist in the ground-based application of the Rotenone and/or Antimycin A for the eradication of northern snakeheads in the Piney Creek drainage, in preparation of restoring the native fishery in the drainage. This EA will be used by the Service to decide whether or not assistance will be extended to the State of Arkansas, if the proposed Federal action requires refinement, or further analyses are needed through preparation of an environmental impact statement. If the proposed action is selected as described or with minimal changes and no further environmental analyses are needed, a Decision Notice and Finding of No Significant Impact will be prepared.

1.2 Project Background

The introduction of non-native northern snakeheads (*Channa argus*) (See Figure 1) into waterways of the United States has received a great deal of media, public, and political attention. While the northern snakehead is not a threat to human health or safety, it is a voracious predator that has the potential to prey on and compete with native fishes, amphibians, and aquatic invertebrates throughout the United States. It thrives in slow murky backwaters with vegetative cover, but can survive in many types of aquatic habitats. Left uncontrolled, this predatory invasive species is likely to expand its range and could permanently alter the balance of aquatic ecosystems throughout the Mississippi River basin, having significant negative economic impacts. The northern snakehead is a popular food fish in Asia that was imported into the United States for the live-food fish market until 2002, when the Service prohibited importation and interstate transport under the Lacey Act, 18 U.S.C. 42 (National Northern Snakehead Working Group (NSWG), 2007). Although the species was banned in Arkansas in 2002 and placed under the Federal importation and interstate transport ban the same year, AGFC fisheries biologists believe the species may have been brought to Arkansas before these regulations were passed.

Prior to 2002, the occurrence of northern snakeheads in the United States was fairly limited. In 2002, a self-sustaining population was discovered and later eradicated in a small pond in Maryland. A single specimen was identified from Pine Lake, Wheaton, Maryland on April 27, 2004. Twenty northern snakeheads were captured within a 23-km reach of the main-stem tidal freshwater Potomac River in Virginia and Maryland in May 2004 and over 300 individuals were captured in 2005. Occurrence in Maryland's Potomac River tributaries appeared to be on the rise during the spring of 2006. These fish are successfully foraging, using available habitat, and reproducing, and are now apparently self-sustaining in the Potomac River. In July 2004, northern snakeheads also were discovered in Meadow Lake in

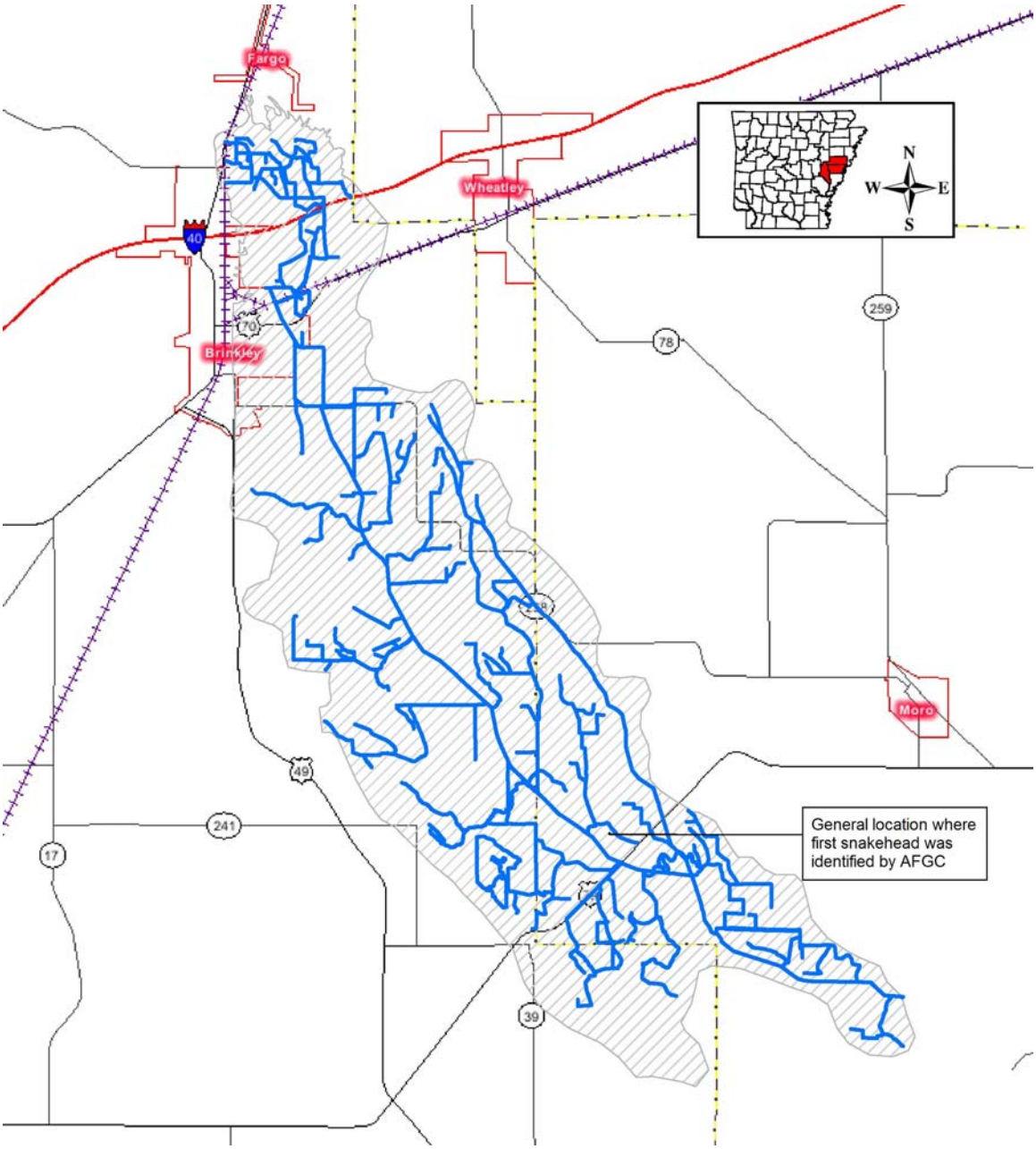
Figure 1. Northern Snakehead from the Piney Creek Basin. © Lindsey Lewis, USFWS

Philadelphia County, Pennsylvania. One northern snakehead was collected in Burnham Harbor, Lake Michigan in 2004. In June 2005, northern snakeheads were discovered in Meadow Lake in Queens, New York and in May 2006, were reported in a pond in Kenilworth Aquatic Gardens in Washington D.C. (NSWG, 2007). Recently, the AGFC identified a northern snakehead found on a farmer's road in mid-April 2008, and later confirmed a breeding population in the Big Piney Creek drainage in Lee County, Arkansas. In late May 2008, New York Department of Environmental Conservation verified the presence of northern snakeheads in Catlin Creek, Orange County, New York.

AGFC fisheries biologists confirmed a breeding population of the northern snakehead in Lee County, in eastern Arkansas on April 28, 2008. The population was discovered when a farmer found an unusual fish alive on a gravel farm road near a ditch and contacted the AGFC regional office in Brinkley, AR. AGFC Fisheries Management Biologist Lee Holt identified the fish as the invasive species that recently made national headlines. The specimen was later sent to Florida for confirmation. Since the confirmation, fisheries biologists have worked to establish how far the population has spread and to start control measures to contain the population. Initially, AGFC fisheries biologists applied the chemical piscicide (fish-killing), rotenone, in the ditches on the farm where the first fish was found and some of the waterways around the farm. They collected over 100 northern snakeheads of two or three age classes. In mid-June, 2008, AGFC coordinated a team of biologists from the Service, U.S. Geological Survey (USGS), and a few Universities on a week-long survey

program in waterways in Lee, Monroe, St. Francis, and Phillips counties. They searched for signs that the northern snakeheads had spread from the Piney Creek drainage area to nearby Big Creek or Cox Cypress Creek drainages. The biologists searched by electrofishing, netting, and rotenone application. Rotenone was by far the most efficient method of detecting northern snakeheads. Only small sections of the waterways were sampled during the survey. Northern snakeheads were only found in the Piney Creek drainage. However, there was evidence of five or six age classes, which showed that the fish have had a self-sustaining population for several years. See Figure 2 for map of the Piney Creek basin.

Figure 2. Map of Piney Creek basin



Therefore, AGFC is attempting to implement a rapid response action to attempt to protect native fish populations outside of Piney Creek and contain the spread of northern snakeheads. AGFC plans to treat approximately 195 miles (Big Piney Creek, Little Piney Creek, tributaries and irrigation ditches) of waterways and ponds (a total of about 4000 acres) with the piscicides rotenone and Antimycin A. After treatment, AGFC will monitor the results and restock Piney Creek with game fish species; other native species will gradually repatriate the drainage. AGFC has asked the Service to assist with the eradication of the northern snakeheads and the post-treatment monitoring of the fisheries in Piney Creek. The Service has available: a helicopter for aerially applying the rotenone over open water; a small number of Marsh Master™ vehicles to access hard to reach areas; and personnel to operate the equipment.

1.3 Proposed Federal Action

The AGFC is moving forward with the rapid response planning for the eradication of northern snakeheads in Big Piney Creek using chemical piscicides and the restoration of native game fishes shortly after treatment. The AGFC is moving rapidly on the project so that the northern snakeheads do not move out of the drainage during higher water in the winter and spring.

The proposed Federal action would be the Service providing resources to the State of Arkansas to protect native fishes downstream of Big Piney Creek, and assisting in the eradication of northern snakeheads in the Piney Creek drainage. The Service would provide an equivalent of up to $150,000, in the form of eight Marsh Masters™ and operators, and one helicopter and pilot to assist in the application of rotenone. The helicopter would aerially apply rotenone to about 10% of the waterways. Aerial application would occur only in ditches, tributaries, ponds and lakes that are free of significant canopy cover. The Marsh Masters™ would be used to apply rotenone to the waterways where the helicopter and boats cannot reach. Marsh Masters™ are low-impact, tracked, amphibious vehicles that would be used in areas where application by truck, ATV, or foot is not feasible. Additional Service resources, such as boats, ATVs, and personnel may also be provided, as needed.

1.4 Purpose and Need

The purpose of the proposed Federal action is to enhance the State of Arkansas' likelihood of success in the restoration of the Piney Creek watershed fisheries. The project would move forward, with or without the Service's available resources. The State of Arkansas could contract elsewhere for a helicopter and Marsh Masters™ to assist in the project; however, this may delay the work due to contracting mechanisms and seeking additional funding. The need for the proposed Federal action is providing services to the State of Arkansas to aid in their rapid response to the restoration of native fishery in the Piney Creek watershed. This watershed has been found to be inhabited by the non-native invasive northern snakehead which may decimate native species in the waterway, and adjoining watersheds. The Service is particularly interested in keeping the northern snakehead out of the White River National Wildlife Refuge downstream of the Piney Creek drainage. However, left uncontrolled, this invasive predatory species has open access to, and is likely to expand its range and could

permanently alter the balance of aquatic ecosystems in the Mississippi River basin. Access to the Mississippi River drainages could have significant negative economic impacts and possibly force the Service and other States to take on larger, more comprehensive and complex snakehead control and native fish restoration projects.

1.5 Decision to be Made

The Regional Director, U.S. Fish and Wildlife Service Region 4, will decide whether or not to extend the resources available within the Service to the State of Arkansas, as outlined in this EA. After a public comment period, the Regional Director will assess the proposed action and any comments received, and reach a determination as to whether or not the project will have significant impact on the human environment.

2.0 Public Involvement

This project is a rapid response to the discovery of northern snakehead inhabiting the Piney Creek watershed. Service policy is to seek public comment on environmental assessments. A public meeting to assist the Service team in evaluating the effects of the proposed Federal action is scheduled. The Service will hold a public meeting on September 18, 2008 to take comments on the proposed Federal action. This will be a joint meeting with the State of Arkansas where the project will be explained; there will be a question and answer period; and, during a formal comment session, public comments will be recorded for our consideration.

3.0 Issues

With or without the Service's resources, the State of Arkansas will move forward with their eradication and restoration efforts. Federal involvement would enhance the State's effort.

Four species listed as Threatened and Endangered under the Endangered Species Act occur in Arkansas within the general area associated with this project: Ivory-billed Woodpecker (*Campephilus principalis*); Interior Least Tern (*Sterna antillarum*); Pink Mucket (*Lampsilus abrupta*); and, Fat Pocketbook (*Potamilus capax*). No affect to these species are expected as a result of this project.

4.0 Alternatives Considered but Eliminated from Detailed Evaluation

The urgency of this rapid response project dictated that only technologies that are readily available be considered as alternatives. Two possible alternatives were considered but eliminated from detailed evaluation. Both alternatives would not require Service resources for implementation. One alternative consisted of constructing a barrier across Piney Creek to preclude snakehead movement out of the basin. The second alternative was to use non-chemical eradication techniques to eliminate the northern snakeheads.

4.1 Barriers

Various types of fish barriers were considered, but it was decided that they would not be effective in the long-term. The types of barriers considered consisted of nets, stone berms, bubble curtains, and electrical fields across the mouth of creeks and tributaries. The barriers would be effective as long as the waters remained within the banks of the creek. However, if overbank flooding occurs which it does periodically, the barriers would be ineffective in containing the northern snakehead.

4.2 Non-Chemical Removal Techniques

Unlimited angling, repeated electrofishing, and use of nets were considered as alternative means of removing the northern snakehead from the Piney Creek drainage. All of these methods would result in decreased densities of the northern snakehead; however, they would not result in the total elimination of this non-native invasive species. Electrofishing has limitations on both depth and area of influence. Some fish are able to sense the electrical field and avoid capture. Use of the nets is limited by the substrate, aquatic plants and debris, and the ability to deploy nets in strategic sites. Use of these technologies would not prevent the snakehead from spreading out of the waters the Piney Creek basin.

5.0 Alternatives Considered in Detail

The use of chemical-based fish management substances is the only method, other than completely draining the watershed, which will eliminate entire populations of fishes. Dewatering is not a viable option in a watershed of this size.

5.1 No Action Alternative

The no action alternative applies only to the Service actions. The State of Arkansas will move forward with the eradication of the northern snakehead and the restoration of the native fishery in the Piney Creek drainage with or without Service involvement. The no action alterative considers the Service not assisting the State with the proposed action. The State's action would follow its proposed action plan, but where it refers to the Service resources (helicopter, Marsh Masters™, and operators), the State would have to contract for those resources from other outside vendors.

5.2 Service Support of the State's Proposal, Preferred Alternative

The State's planned action will be conducted in three phases: 1) Treatment, 2) Short-Term Assessment with Re-Treatment and 3) Re-Stocking and Long-Term Assessment. The proposed Federal action would be to provide Marsh Masters™ and operators, and a helicopter and pilot for applying rotenone to the Piney Creek waterways during Phase I of the State's plan. Additional Service resources, such as boats, ATVs, and personnel may also be provided.

Phase I: Treatment

Treatment will be conducted between the dates of September 29th and October 18th 2008. Actual beginning and ending schedule of this phase would depend on weather and field conditions. Treatment would not be conducted when Big Piney Creek flow exceeds 50 cfs measured at the Buckhorn County Road Bridge.

Treatment will consist of applying up to 24,000 lbs of powdered rotenone and 3,000 gallons of liquid rotenone to Big Piney Creek, Little Piney Creek and associated unnamed tributaries and ditches that contain water at the time of treatment. The AGFC is also looking into the use of Antimycin A as an alternative piscicide for use in ponds and lakes. The Service will not be dispensing any of the Antimycin A. The final decision about the use of Antimycin A will be made at a later date by the State. Estimated treatment coverage is up to 4,000 acres. Actual areas treated will depend on the presence of water in the creeks, tributaries and ditches at the time of treatment.

All of the powdered rotenone, the Antimycin A, and a portion of the liquid rotenone would be applied using 2-3 man ground crews. Up to 16 crews may be deployed during the treatment operation. All crews would be led by an AGFC employee certified by the Arkansas State Plant Board in the application of rotenone. Powdered rotenone would be mixed with water to create a "mud" or "paste" consistency as directed by the product's label. The prepared rotenone would be applied by hand at a rate up to 3 lbs of dry product per acre-ft of water to achieve an overall treatment concentration of 1.5-4.0 ppm in the treated water area. Ground crews would apply liquid rotenone at a rate up to 0.5 gals per acre-ft of water to achieve a similar treatment concentration. Ground transportation in the treatment area would consist of Marsh Masters™ (provided by the Service), ATVs, pickup trucks, and on foot.

Aerial application would consist of liquid rotenone only. Aerial application would occur only in ditches, tributaries, ponds and lakes that are free of significant canopy cover. All aerial application would be conducted by a Service helicopter and crew. The helicopter will apply liquid rotenone at a rate up to 0.5 gal per acre-ft of water to achieve the treatment concentration. The Service pilot would be certified by the Arkansas State Plant Board in the application of rotenone.

Treatment would begin at or near the mouth of Big Piney Creek and proceed upstream until the confluence of Little Piney Creek is reached. Treatment efforts would split at that point and proceed up Big Piney Creek and Little Piney Creek simultaneously. Treatment would proceed upstream until the headwaters of Big Piney Creek north of I-40 and Pleasant Valley Road on Little Piney Creek is reached. The treatment area would be zoned based on the expected area to be treated each day. Zones will facilitate the coordination of ground and aerial application efforts. Treatment zones will vary in size depending on terrain conditions and estimated rate of coverage by ground crews. Treatment zones would be adjusted daily during the treatment period as actual treatment rates achieved by ground and aerial crews are determined.

Water leaving the treated basin containing rotenone would be neutralized so that no effect to downstream organisms would occur. Potassium permanganate ($KMnO_4$) is the most commonly used chemical to neutralize rotenone. $KMnO_4$ is a strong oxidizer that rapidly breaks rotenone down into potassium, manganese, and water. All are common in nature and have no deleterious environmental effects at the concentrations normally associated with the neutralizing processes (Finlayson et al. 2000). Any residual rotenone leaving Big Piney Creek and flowing into Big Creek would be neutralized by applying sufficient quantities of $KMnO_4$.

Phase II: Short-Term Assessment and Re-Treatment

The purpose of this phase would be to rapidly assess the success of the treatment on the northern snakehead and conduct limited re-treatment in areas where incomplete kills of the fish community are suspected. This phase would begin immediately following the treatment phase and would conclude by November 1, 2008. Assessment crews would qualitatively determine the success of the treatment by sampling for the presence or absence of fish life and would determine the presence of northern snakeheads in the treatment area. Areas containing live fish may be re-treated with liquid or powdered rotenone at the application rate described above. Assessment crew leaders would make the decision in the field on whether re-treatment of an area is warranted. Assessments would be conducted in at least three zones representing the upper, middle, and lower sections of the basin.

Phase III: Re-Stocking and Long Term Assessment

Big Piney and Little Piney Creeks would be re-stocked with largemouth bass, bluegill, and channel catfish at rates of 100, 400, and 50 fish per acre of surface area, respectfully. Largemouth bass and bluegill would be young-of-year a minimum of 75 mm in total length. Channel catfish would be a combination of yearling (175-200 mm) and adult (250 mm plus) fish. Stocking may begin immediately following Phase II in early November and proceed through summer 2009. Stocking locations will be determined by availability of access, but attempts will be made to stock fish throughout the treatment area.

Long Term Assessment would be conducted to monitor the Big Piney Creek drainage for the presence of the northern snakehead and the re-colonization of the treatment area with fish and other aquatic life. Long term monitoring would begin in 2009 and continue until such a time that monitoring activities are no longer deemed necessary. The AGFC would coordinate monitoring activities with the Service's Region 4 Fisheries Program.

6.0 Mitigation and Monitoring

There are limited direct effects associated with the proposed Federal action. With or without the above mentioned Service resources, it is likely that the State of Arkansas would move forward with the eradication and restoration efforts. Service involvement would enhance the State's efforts. Therefore, mitigation would not be needed for the Federal action. The State is planning on restoring the native fishes in the Piney Creek drainage, after monitoring the success of the eradication of the northern snakehead and possibly retreating some areas.

7.0 Affected Environment

Monroe and Lee Counties receive an average of 50 inches of rain annually, creating a wet environment relative to the US average of 37 inches. The climate is also warmer than the national average, with a mean July high of 92 degrees and January low of 31 degrees.

The Piney Creek watershed is located in the part of the Mississippi Alluvial Plain (Ecoregion 73) classified as Western Lowland Pleistocene Valley Trains (73g) (Woods et al. 2004). This landscape is composed of glacial outwash sediments transported to Arkansas by the Mississippi River, creating elevated terraces outside of the areas inundated by streams. Elevated areas exhibit plant communities characteristic of areas not frequently inundated, including species such as post oak and loblolly pine, while lower areas are dominated by overcup oak, water hickory, willow oak, and pin oak.

Natural stream courses in this area meandered greatly, but have been highly altered and redirected to allow for a long history of agriculture. Current day crops are primarily rice, cotton, and soybeans, and aquaculture of bait fish, catfish, and crayfish is common. The area also provides significant waterfowl habitat, and water levels are managed in some places to enhance duck hunting opportunities. See Figures 3 and 4.

Figure 3. Typical Aerial view of Piney Creek Basin. Note the somewhat braided channel, wooded riparian zone, irrigation and drainage ditches, heavy emergent vegetation on edges of channels, and flooded rice fields. ©Lindsey Lewis, USFWS

Figure 4. Typical Drainage Ditch in Piney Creek Basin. Note heavy emergent vegetation, water under vegetation is 4 to 6 feet deep. ©Lindsey Lewis, USFWS

The Piney Creek basin is a tributary to Big Creek, which in turn flows into the White River. Streams in the Mississippi Alluvial Plain that fall in the White River Basin are some of the most productive and species rich, low-gradient streams in the state. These streams have sand and silt substrates and abundant cover in the form of large woody debris. They characteristically have high total dissolved solids and moderate salinity. Habitat quality of streams in this area has been reduced in some places due to channel alteration and riparian deforestation. The White River Basin portion of the Mississippi Alluvial Plain is dominated by cropland (68%), while forest areas are much reduced (23%).

While the White River Basin portion of the Mississippi Alluvial Plain is home to many species of conservation concern, such is not the case in the Piney Creek Basin or the Big Creek Basin that it is included within. Collections within the Big Creek Basin, inclusive of Piney Creek, have documented 45 native fish species. They have also included three non-native introduced species – grass carp, common carp, and northern snakehead. The only reported crayfish collections from the Big Creek Basin were made in the 1960's and documented five crayfish species, none of which are of conservation concern. Extremely limited surveys and professional judgment predict no species of conservation concern among freshwater mussels, or any reptiles or amphibians of conservation concern that would be affected by fish toxicants.

Figure 3 illustrates the agrarian environment in which the eradication/restoration will take place. The area does not have a high concentration of people relative to an environment such as Little Rock, nor are there many towns or communities in the affected area.

8.0 Environmental Consequences

8.1 Timeliness

The northern snakeheads are known to inhabit parts of the Piney Creek drainage. They have not been detected outside of the drainage, either in Big Creek or Cox Cypress Creek. Left uncontrolled, this predatory invasive species is likely to expand its range and could permanently alter the balance of aquatic ecosystems throughout the Mississippi River Basin, having significant negative economic impacts. Once outside of the Piney Creek basin, the probability of eradicating the northern snakehead would be nearly impossible. The aerial extent and huge volume of water will make any attempt far more complex and expensive.

The State of Arkansas believes that it must initiate eradication to stem the spread of this non-native invasive species and to restore native fishes. In the Piney Creek basin, water levels and flows would be low during the estimated time of rotenone application; this would permit the application of the rotenone to be systematic in application and to be incorporated into the water column more efficiently. Water temperatures would continue to be elevated from the warm summer months, decreasing the potency of rotenone in the waters.

8.1.1 Effects on Timeliness

<u>No Action</u>
The Service selection of the no action alternative, may present confounding problems for the State to implement its plan in the opportune time. It may be difficult for the State to contract with vendors for the Marsh Masters™ and a helicopter. As with the Service, many vendors lease their Marsh Masters™ and helicopters for firefighting purposes. If the State cannot get the equipment in a timely manner, it may be forced to delay the project, thus losing the optimal water levels, flows, and temperatures needed for a successful restoration project.

<u>Proposed Federal Action</u>
The resources identified from the Service are available during early to mid-October. At this time, the Marsh Masters™ and helicopter can be cleared for the project timeframe because they do not have higher priority scheduled conflicts. Many of the Marsh Masters™ and the helicopter that the Service operates in Region 4 are used in firefighting, both prescribed and wildland fires. October is the beginning of fire season in the southeast, so the planned activity will be between the summer field season and the fall fire season. Service equipment and personnel will be affective tools in support of the planned rapid response. However, the State will proceed with the effort with or without the Service.

8.2 Water Quality

8.2.1 Effects on Water Quality

<u>No Action and Proposed Federal Action</u>

There will be limited direct effects associated with the proposed Federal action. With or without the Service's resources, the State will move forward with its eradication of the northern snakehead and native fish restoration.

Rotenone is a naturally occurring substance derived from the roots of tropical plants in the bean family. Rotenone does not suffocate fish or interfere with the uptake of oxygen in the blood, as is believed by some. Instead, it inhibits a biochemical process at the cellular level making it impossible for fish to use the oxygen absorbed in the blood and needed in the release of energy during respiration (Oberg 1967a, 1967b as cited in Finlayson et al. 2000). Rotenone acts through uncoupling oxidative phosphorylation within cell mitochondria by blocking electron transport at complex I. It is a piscicide that is applied directly to the water to manage fish populations in lakes, ponds, reservoirs, rivers, streams, and in aquaculture. Use of rotenone enables fisheries managers to eradicate entire populations of fish with minimum impact to nontarget wildlife. The chemical can be applied to an entire water body to achieve a "complete kill" or to a portion of a water body to achieve a "partial kill." Complete kills are used to eliminate all fish in the treatment area; partial kills are used to reduce or sample fish populations in the treatment area (EPA, 2007).

Under typical piscicide use conditions, rotenone is relatively short-lived. The degradation appears due to a combination of both abiotic (aqueous photolysis and hydrolysis) and biotic (microbial degradation) factors and is highly dependent on temperature (EPA, 2007). Based on aquatic field dissipation studies, rotenone neutralizes under cold water conditions in 20 days and under warm water conditions in 1.5 days. Due to the water temperatures in the Piney Creek drainage during early October, the activity of rotenone is expected to be about two to three days. It is also expected that all fish species will be eradicated. Most dead fish will sink to the bottom in a few days, decompose, and release nutrients back into the water. These nutrients will directly stimulate phytoplankton production and indirectly stimulate insect and zooplankton production, the basis of a good fishery. During the decaying of the fish, the biological oxygen demand will increase in the waters of the Piney Creek basin; this may have an effect on other aquatic species that are not directly affected by rotenone by decreasing the dissolved oxygen available to other aquatic species.

Fish-eating birds and mammals are not expected to be affected, since they have natural enzymes in the digestive tract that neutralizes rotenone, and gastrointestinal absorption of rotenone is inefficient. Other aquatic species may be affected; some amphibians and aquatic invertebrates are more susceptible because rotenone is readily absorbed directly into their blood through their gills. Studies have shown that amphibians and invertebrates will repopulate an area when rotenone neutralizes (Finlayson et al. 2000). AGFC will apply potassium permanganate at the outfall of Big Piney Creek into Big Creek to neutralize rotenone moving downstream into Big Creek.

Rotenone is not expected to affect humans; the U.S. EPA concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment, when used according to the label instructions (EPA, 2007). All application of rotenone will be according to label instructions during this project. The ability of rotenone to move through soil is moderate. Rotenone binds strongly with organic matter in soil and

continues to degrade, so it is unlikely that rotenone will enter groundwater (Dawson et al. 1991, as cited in Finlayson et al. 2000, and EPA, 2007). After the application of the rotenone, the AGFC will search for live snakeheads and spot treat areas where they are found. Once spot treatment is complete and the rotenone is neutralized, the AGFC will begin to restock the Piney Creek basin with largemouth bass, bluegill, and channel catfish.

Effects on water quality will be the same for the No Action and the Proposed Federal Activity, since equal amounts of rotenone will be applied whether the Service assists the State or not.

8.3 Aquatic Biota

While the White River Basin portion of the Mississippi Alluvial Plain is home to many species of conservation concern, such is not the case in the Piney Creek Basin or the Big Creek Basin that it is included within. Extremely limited surveys and professional judgment predict no species of conservation concern among freshwater mussels, or any reptiles or amphibians of conservation concern that would be affected by fish toxicants.

8.3.1 Effects on Aquatic Biota

No Action and Proposed Federal Action

Rotenone does not affect all aquatic animals the same. Fish, aquatic invertebrates, and some forms of amphibians are more susceptible because rotenone is readily absorbed directly into their blood through their gills. Other ingredients in the liquid rotenone formulation impart no toxicity to fish, insects, birds or mammals (CDFG, 1994 as cited in Finlayson et al. 2000). Rotenone residues in dead fish are generally very low (<0.1 ppm), unstable like those in the water, and not readily absorbed through the gut of the animal eating fish. All animals, including fish, insects, birds, and mammals have natural enzymes in the digestive tract that neutralize rotenone, and the gastrointestinal absorption of rotenone is inefficient. Therefore, any aquatic or terrestrial animals that eat the dead fish and drink treated water will not be affected (Finlayson, 2000). Extremely limited surveys and professional judgment predict no species of conservation concern among fish, freshwater mussels, or any reptiles or amphibians that would be affected by fish toxicants. As the fish that are eradicated by the rotenone are decaying, there will be an increase in the biological oxygen demand, decreasing the dissolved oxygen in the water for some period of time. Aquatic species that are not directly affected by rotenone may be affected by decreased oxygen in the water. Some species are adapted to low oxygen levels and others are able to migrate out of the low oxygen zones. However, the system as a whole will be “sterile” for a few weeks, before oxygen levels increase and aquatic species move back into the basin.

Effects on aquatic biota will be the same for the No Action and the Proposed Federal Activity, since equal amounts of rotenone will be applied whether the Service assists the State or not.

8.4 Recreation

The basin is not known for its recreational fishing, but fishing opportunities are still available for suckers (buffalo), catfish (bullhead, channel), and sunfish (sunfish, bluegill, crappie, and largemouth bass). Other recreational opportunities, such as swimming, canoeing, and kayaking are possible, but not popular in the Piney Creek basin. Hunting opportunities are located within the basin. Waterfowl hunting is probably the most common, especially on flooded rice fields.

8.4.1 Effects on Recreation

No Action and Proposed Federal Action

During the period of application of rotenone, no recreational activities should occur in or on the Piney Creek waterways. The State of Arkansas is in the process of informing landowners and local residents of the upcoming work and the fact that they should stay away from the application activities, but that there is no danger to them other than the equipment that is being used (helicopter, Marsh Masters™, ATVs, boats, etc.). State Wildlife Officers will be on duty in the area while work is ongoing, to inform people that are attempting to use the waterways. Once the rotenone application is complete, there should be no restrictions on the use of the Piney Creek waterways. Once the rotenone is applied, the fishing opportunities will be eliminated, until the AGFC starts to restock largemouth bass, bluegill, and channel catfish. Other recreational opportunities will still exist, but the presence of dead fish may deter anyone from participating in any recreational activity on the waterways for a week or two.

Effects on recreation will be the same for the No Action and the Proposed Federal Activity, since the entire fisheries in Piney Creek drainage will be eradicated whether the Service assists the State or not.

8.5 Aesthetics

Streams in the Mississippi Alluvial Plain that fall in the White River Basin are some of the most productive and low-gradient streams in the state. These streams have sand and silt substrates and abundant cover in the form of large woody debris and emergent plants. Natural stream courses in this area meandered greatly, but have been highly altered and redirected to allow for a long history of agriculture. Canoeing and kayaking would be slow, but visually pleasing. Elevated areas exhibit plant communities characteristic of areas not frequently inundated, including species such as post oak and loblolly pine, while lower areas are dominated by overcup oak, water hickory, willow oak, and pin oak. During cooler months, the area also provides significant waterfowl habitat. Occasionally, anoxic sediment may be disturbed, releasing hydrogen sulfide gases (rotten egg smell), but odors would quickly dissipate with any wind.

8.5.1 Effects on Aesthetics

No Action and Proposed Federal Action

The actions involved in applying rotenone will have minor effects on the habitat, some disturbance of the vegetation will occur as the equipment runs up and down the riparian areas.(Marsh Masters™ and ATVs). Liquid rotenone contains organic solvents that may have the odor of mothballs. The odor will dissipate shortly after application, especially into the warm waters of Piney Creek. Once the rotenone is applied, dead fish may be seen along the banks of the waterways for a period of several days. Along with the visual intrusion of the dead fish, the odor of decaying fish will be around for several days as well.

Effects on aesthetics will be the same for the No Action and the Proposed Federal Activity, since the same activities will be accomplished whether the Service assists the State or not.

8.6 Direct, Indirect and Cumulative Effects

8.6.1 Direct Effects

The proposed Federal action and the resulting state restoration of the Piney Creek watershed are discussed in detail in preceding sections of this document. Only those direct effects on the human environment where there is some uncertainty or where there may be questions by the public are addressed (see sections 7 and 8).

8.6.2 Indirect Effects

Indirect effects are defined as those effects caused by the project, but occurring later in time or farther removed in distance than direct impacts. No indirect effects are anticipated with the proposed action. The use of Federal equipment and personnel would only occur during the treatment of the watershed with rotenone. The effects of the rotenone are short-term and would have no lasting effect on the human environment beyond the removal of all fish species from the treated waterways. The state has a restoration plan that includes stocking game fish in the watershed once removal of the snakehead has been achieved. Non-game species would recolonize the watershed. No effects are anticipated beyond the treated waterways. The use of potassium permanganate would neutralize the rotenone before it leaves the treated watershed.

8.6.3 Cumulative Effects

Cumulative effects are the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. We do not anticipate cumulative impacts on the human environment due to the proposed Federal action. The use of rotenone would occur during a limited time period, the month of October 2008, there would be no long term effects. The proposed action would have no effect or synergistic effect on the human environment as a result other actions reasonably foreseeable to occur in the restored or adjacent watershed.

The direct, indirect and cumulative effects associated with the use of rotenone are discussed in greater detail by Phillips et al. 2005, in the EPA publication, Environmental Fate and Ecological Risk Assessment for the Registration of Rotenone

9.0 Comparison of Alternatives

Table 1 summarizes the two federal action alternatives and the primary environmental consequences of each as a basis for comparison.

Table 1. Summary of Environmental Consequences by Alternative

Resource Objective or Issue	**Alternative**	
	No Action	Proposed Federal Action
Timeliness	May delay State Action	Maintain Schedule
Water Quality	Short-term minor impacts from rotenone application and decaying biota	Short-term minor impacts from rotenone application and decaying biota
Aquatic Biota	Minor impacts due to elimination of all fish and most other aquatic animal species, aquatic plant species will not be affected.	Minor impacts due to elimination of all fish and most other aquatic animal species, aquatic plant species will not be affected.
Recreation	Minor impacts due to temporary loss of one to two months for sport fishing	Minor impacts due to temporary loss of one to two months for sport fishing
Aesthetics	Minor impacts due to a potential for temporary odors and view of decaying fish	Minor impacts due to a potential for temporary odors and view of decaying fish

10.0 List of Preparers

Mark Sattelberg, U.S. Fish and Wildlife Service
Jay Troxel, U.S. Fish and Wildlife Service
Michael Armstrong, Arkansas Game and Fish Commission
Brian Wagner, Arkansas Game and Fish Commission

11.0 Literature Cited

CDFG (California Department of Fish and Game). 1994. Rotenone use for fisheries management - final programmatic environmental impact report (SCH 92073015). CDFG, Environmental Services Division, Sacramento.

Dawson, V. K., W. H. Gingerich, R. A. Davis, and P. A. Gilderhus. 1991. Rotenone persistence in freshwater ponds: effects of temperature and sediment adsorption. North American Journal of Fisheries Management 11:226-231.

Environmental Protection Agency. March 2007. Reregistration Eligibility Decision for Rotenone. Office of Prevention, Pesticides and Toxic Substances. EPA 738-R-07-005. pp. 44.

Finlayson, B. J., R. A. Schnick, R. L. Cailteux, L. DeMong, W. D. Horton, W. McClay, C. W. Thompson, and G. J. Tichacek. 2000. Rotenone use in fisheries management: administrative and technical guidelines manual. American Fisheries Society, Bethesda, Maryland.

Northern Snakehead Working Group (NSWG). 2007. National Control and Management Plan for the Northern Snakehead (*Channa argus*). U.S. Department of the Interior. pp. 38.

Oberg, K. 1967a. On the principal way of attack of rotenone in fish. Archives for Zoology 18:217-220.

Oberg, K. 1967b. The reversibility of the respiration inhibition in gills and the ultrastructural changes in chloride cells from rotenone-poisoned marine teleost, *Gaduscallarius*. Experimental Cellular Research 45:590-602.

Phillips, T., T. Steeger, and R.D. Jones. 2005. Environmental Fate and Ecological Risk Assessment for the Registration of Rotenone. U.S. Environmental Protection Agency. Office of Pesticide Programs, Environmental Fate and Effects Division, Washington, D.C. pp. 197.

Woods A.J., Foti, T.L., Chapman, S.S., Omernik, J.M., Wise, J.A., Murray, E.O., Prior, W.L., Pagan, J.B., Jr., Comstock, J.A., and Radford, M., 2004, Ecoregions of Arkansas (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,000,000).