December 3, 2019

Memorandum

To: Division Chief, Classification and Restoration, Fish and Wildlife Service, Albuquerque, New Mexico (Attn: A. Anders and M. Teugel)

From: Field Supervisor

Subject: Intra-Service Formal Consultation on the Proposed Issuance of a Section 10(a)(1)(A) Recovery Permit for the Northern Mexican Gartersnake for the Proposed Scientific and/or Enhancement of Propagation or Survival Activities

This transmits the U.S. Fish and Wildlife Service’s (FWS) opinion pursuant to Section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended (Act) for the issuance of a 10(a)(1)(A) Enhancement of Survival Permit (TE-62371D-0) authorizing incidental take of the Northern Mexican gartersnake (*Thamnophis eques megalops*: gartersnake). Salt River Project (SRP) will be responsible for implementing the proposed research described in their permit application package received on July 9, 2019.

This biological opinion analyzes the effects of the proposed issuance of the permit and implementation of the proposed research. We have determined that this action “may affect” the northern Mexican gartersnake.

At issue are effects that may result from the issuance of a 10(a)(1)(A) permit to SRP for 2019 to 2021 Roosevelt Reservoir research activities at Roosevelt Lake (Salt River and Tonto Creek confluence) and SRP properties located along the Gila and San Pedro rivers in Gila, Graham, and Pinal counties, Arizona.

We based this biological opinion on information provided in the permit application package, meetings, telephone conversations, field investigations, and other sources of information. Literature cited in this biological opinion is not a complete bibliography of all literature available on the species of concern and its effects, or on other subjects considered in this opinion. A complete administrative record of this consultation is on file at the Arizona Ecological Service Field Office.
Consultation History

- **July 9, 2019:** The FWS’s Albuquerque Regional Office received SRP’s permit package and formal consultation initiated.
- **September 13 and 26, 2019:** SRP provided Arizona Ecological Services Office with supplemental documentation on species accounts and project information.
- **October 7, 2019:** We sent a draft biological opinion to your office for review
- **October 23, 2019:** We sent a draft biological opinion to SRP for review.
- **November 5, 2019:** We received comments on the draft biological opinion.
BIOLICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Regulations implementing the Act (50 CFR 402.02) define “action” as “all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies of the United States or upon the high seas.”

The following is a summary of the proposed action and a detailed description can be found an attachment to the Section 10(a)(1)(A) Permit titled Research Plan – In Support of a Section 10(a)(1)(A) Permit - Operations of Roosevelt Lake.

The proposed action is the issuance of a recovery subpermit for take of the threatened northern Mexican gartersnake (gartersnake) by the FWS’s Albuquerque Regional Office under section 10(a)(1)(A) of the Act. We issue subpermits under the authority of the Endangered Species Blanket Permit No. 676811-11, which was issued to the FWS Regional Director, with subsequent amendments. Recovery permits and subpermits, hereafter simply referred to as recovery permits, allow permittees to undertake actions as specified in their permit, that may otherwise be prohibited by Section 9 of the Act, for scientific purposes or to enhance the propagation or survival of the affected species.

Recovery permits are issued to qualified individuals for research and population census purposes to benefit gartersnake recovery within its historical range. We summarize the specific studies proposed from 2019 through 2021 below. The main goals and objectives of the permit are to evaluate the following:

SRP seeks to examine how Roosevelt Dam and Reservoir operations and lake level changes influence the gartersnake and its habitat, by studying the ecological relationships between gartersnake habitat and fluctuating lake levels and interaction between gartersnakes, prey communities, and predatory non-native aquatic wildlife. SRP’s main goals and objectives, with work completed by SRP and/or its permitted representatives/contractors, are to study the following:

- Refining the understanding about existing or potentially occupied gartersnake habitat characteristics at Roosevelt and on conservation properties along the San Pedro and Gila Rivers.
- The recovery, establishment, and/or sustainability of gartersnake habitat due to lake level fluctuations over time.
- Non-native fish interactions with gartersnakes within the Roosevelt Lake conservation space.
- The impact of Roosevelt lake level fluctuations on predator and prey communities.
- Gartersnake and habitat occurrence at SRP conservation properties.

SRP is planning to use the information from this study toward amending the Roosevelt Habitat Conservation Plan to include the gartersnake. Activities already permitted or not requiring a permit began in late 2019.
Study 1 - Identify Roosevelt Lake Gartersnake Occupied Habitat

Study 1 Objectives

Identify gartersnake occupied habitat characteristics at Roosevelt Lake and develop gartersnake habitat criteria based on existing studies, expert input, field data, and remote sensing that can be used to consistently delineate and map gartersnake habitat now and in the future (i.e., potentially occupied habitat) for the proposed Roosevelt Habitat Conservation Plan (RHCP) Amendment.

SRP will develop a mapping protocol; delineate and map potentially occupied gartersnake habitat in 2019 and 2020 within Roosevelt Lake conservation space (all areas below the 2151 feet, high water lake elevation); and conduct field surveys to verify the gartersnake presence and habitat quality and quantity by using gartersnake habitat results collected from Objective 1, remote sensing, and Geographic Information Systems (GIS) data.

Study 1 Site

Roosevelt Lake conservation space within the Tonto Creek and Salt River deltas (below 2,151 elevation) (Appendix A, Figure 1).

Study 1 Methods

To define, map, and verify gartersnake habitat, the following steps will occur:

- SRP will review Nowak et al. (2015, 2019), Emmons and Nowak (2016), and Sprague (2017), the key gartersnake habitat literature and FWS gartersnake listing references (USFWS 2014) for habitat characteristics that could be present at Roosevelt. SRP will solicit FWS, Arizona Game and Fish Department (AGFD), and Northern Arizona University (NAU) experts for habitat information and request FWS input for other expertise that may have relevant information. Recent (2015-2019) remote sensing and GIS data (e.g., aerial photography, satellite data, and Light Detection and Ranging (LiDAR) derived surface models will be used to relate gartersnake occupancy with landscape or environmental variables such as presence of water, density of vegetative cover, or floodplain topography, which have been found to be key gartersnake habitat features (Nowak et al. 2019).

- Based on data assimilated above, SRP will develop proposed criteria to define and delineate (map) gartersnake potentially occupied habitat at Roosevelt for use in the RHCP Amendment. SRP will collaborate with FWS to gain input and feedback to finalize the proposed criteria.

- Using habitat criteria identified above and remote sensing and GIS information from 2019 and 2020, SRP will delineate gartersnake potentially occupied habitat within the Roosevelt conservation space on Tonto Creek and the Salt River.

- Gartersnake presence/absence visual encounter surveys (VES) will occur in fall 2019 and summer 2020 and will evaluate habitat quality (based on criteria) in areas delineated as
having potentially occupied gartersnake habitat. VES will follow the methods described by Nowak et al. (2019) and Partners in Amphibian and Reptile Conservation Inventory and Monitoring Technical Publication IM-1 (Graeter et al. 2013). Random survey sites or subsample of areas not delineated as potentially occupied gartersnake habitat will aid in a qualitative assessment of the proposed criteria’s accuracy. The number of random survey sites sampled will be determined prior to fieldwork based on the number of gartersnake potentially occupied habitat areas.

- Field survey results will refine, if necessary, gartersnake habitat criteria.
- SRP will provide FWS a final report summarizing the results and conclusion of the analyses and fieldwork.

**Study 2 - Assess Roosevelt Reservoir Operation (Lake Level Fluctuations) Effects to Gartersnake Habitat**

*Study 2 Objective*

Evaluate how lake level fluctuations may affect the ecological process cycle and the creation, destruction, and permanence of gartersnake potentially occupied habitat. Using criteria developed in Study 1, develop and evaluate a conceptual model that outlines an “ecological process cycle” for gartersnake occupied habitat (i.e., habitat establishment, retention, and loss through varying water levels) within the Roosevelt Lake conservation space.

*Study 2 Site*

Roosevelt Lake conservation space within the Tonto Creek and Salt River deltas (below 2151 elevation) (Appendix A, Figure 1).

*Study 2 Methods*

SRP will develop an ecological process model and evaluate reservoir operations effects to gartersnake potentially occupied habitat

- SRP will review and assimilate gartersnake habitat and persistence criteria developed in Study 1 to vegetative and hydrogeomorphic features and processes that occur in dynamic floodplains and reservoir systems.

Woody riparian trees and shrubs (Fremont cottonwood, Gooddings willow, tamarisk spp., and velvet mesquite), presence of water, and obligate wetland plant species (cattails and sedges) may be important components of Roosevelt gartersnake habitat based on Nowak et al. (2015, 2019). Extensive research in the Southwest has addressed how hydrogeomorphic processes influence woody riparian plant establishment and community dynamics (Stromberg 1993; Poff et al. 1997). Limited research on inundation effects to various riparian and wetland plant species (Webb et al. 2012) and the processes supporting arid southwestern obligate wetland communities (Stromberg 2013) has occurred.
• SRP will develop, using the information assimilated above, an “ecological process cycle” for gartersnake potentially occupied habitat within Roosevelt’s conservation space. The model will focus on key habitat components response to inundation and desiccation over time.

• SRP will delineate gartersnake potentially occupied habitat between 2002 and 2019 (annually or a subset of representative years) by using habitat criteria defined in Study 1 and remote sensing and GIS data. SRP possesses over this period, due to its RHCP implementation, detailed remote sensing and imagery of very low and high lake levels. SRP will compare the mapped habitat to the ecological model, and refine the model, as necessary.

• SRP will map gartersnake potentially occupied habitat in spring or summer 2019, 2020, and 2021, after the winter runoff season.

• Field surveys will collect gartersnake presence/absence data and habitat variables to assess potentially occupied gartersnake habitat and its response to lake level fluctuations (rising, falling, or static levels) in late summer in 2019 (timing dependent upon habitat mapping) and in June 2020 and 2021 (approximately the driest time of the year).

SRP will estimate gartersnake potential occupied habitat (as described above) based upon VES survey data and evaluate vegetation response (germination, recruitment, inundation, or desiccation/die-back) to winter runoff, water deliveries, and corresponding changes to lake levels in potentially occupied habitat and in other areas within Roosevelt’s conservation space. SRP will develop a specific vegetation field sampling protocol prior to fieldwork, but anticipates that sites will be randomly selected or a stratified random set of samples will be chosen using the results of habitat mapping.

• The results from bullets 3 through 5 will refine the ecological process model, as necessary.

• SRP will provide FWS a final report summarizing the results and conclusion of the analyses and fieldwork.

Study 3 – Assess SRP Conservation Properties for Gartersnake Habitat

Study 3 Objective

SRP will assess and quantify gartersnake suitable habitat at its conservation properties (Appendix A, Figure 2) based on habitat criteria identified in Study 1.

Study 3 Sites

Biologists will perform gartersnake surveys on its conservation properties on the San Pedro River (five sites: 1,358 acres) and Gila River (five sites: 1,259 acres), and sample fish and collect prey observations on the Gila River conservation properties.

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1 Surveys conducted under Study 2 in 2019 and 2020 will take place concurrently with surveys conducted under Study 1 during the same period.
Gartersnakes were surveyed and detected at the Camp Verde Preserve (124 acres) in 2012 (Emmons and Nowak 2016) – no surveys are proposed for this site. The Rockhouse Demonstration Site on the Salt River delta at Roosevelt Lake will be surveyed during Study 1 or 2.

**Study 3 Methods**

Gartersnake presence/absence, habitat availability, and composition of predator and prey species on SRP’s conservation properties will be determined through the following steps:

- Recent remote sensing (aerial photographs) and GIS data will be used to create gartersnake habitat maps for each property. Targeted surveys will occur at areas identified by key gartersnake habitat components (e.g., streamside habitat, marshy areas, and backwaters).

- In late summer 2019 or summer 2020, field biologists will conduct VES in key habitat areas to help determine the gartersnake presence and evaluate the overall habitat quantity and quality at each conservation property. Habitat will be evaluated comparing aerial photographs and mapped habitat to field observations based on the criteria and literature reviewed in Study 1. Representative photographs will document habitat conditions. SRP acknowledges that gartersnakes are inherently fossorial and secretive, which results in low detectability, regardless of survey method or surveyor experience, but visual surveys can serve as an index to habitat occupancy.

- Fish sampling on the Gila River conservation properties will follow similar methods (backpack electroshocking) as described in Study 4. Sampling will focus on key streamside, backwater, and marsh habitat areas located in the first bullet item. During fish and gartersnake sampling, record opportunistic observations of native prey species and relative abundance (low, medium, or high).

- Mapping and survey results will be compiled and synthesized in a report.

**Study 4 – Identify Non-native Fish and Prey Species Composition and Size Class within the Tonto Creek Delta at and above the Roosevelt Lake Prevailing Water Level**

**Study 4 Objective**

Sample for fish at the Tonto Creek delta over two consecutive years, starting in a high runoff year (2019), to determine if non-native fish capable of preying on gartersnake are present in gartersnake habitat. SRP will also record native prey species in various aquatic and semi-aquatic habitats.

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2 Sampling is not proposed on the San Pedro River conservation properties because the stream in this location is shallow and often intermittent and will not be expected to support large-bodied predatory non-native fish.
Study 4 Site

Tonto Creek between the existing water level and the 2,151-feet Roosevelt Lake high water mark.

Study 4 Hypothesis

Non-native fish species (gape size ≥ ½ inch) capable of preying on gartersnake will not persist in stream segments and isolated backwaters of Tonto Creek within the conservation space where gartersnake habitat exists.

Study 4 Methods

Using the methods described below, SRP (or its contractors) will sample fish in Tonto Creek between the existing high water level of the reservoir and an elevation of 2,151 feet in late summer 2019 and early and late summer 2020. Sampling areas occur in three sections based on locations and methodology: (1) fish sampling in marsh, backwater, and stream segments; (2) fish sampling in lake margins; and, (3) prey observations.

SRP will determine species composition, relative abundance, catch per unit effort (CPUE), and size structure of fish species for each sample location and by general habitat type (shoreline, backwater, marsh, pools, and stream segments). SRP will determine the presence of predatory non-native fish large enough to prey on gartersnakes for each of the water bodies sampled. SRP will summarize the results of stomach content analysis and the presence/absence of any snake species found. SRP will provide FWS electronic data files of sample data activities, and consider existing available AGFD data. SRP will provide FWS a final report summarizing fish community data and the potential for predation by fish on gartersnakes.

Marsh/Backwater/Stream Segments

- Using remote sensing imagery, ground or aerial field reconnaissance, and habitat mapping described in Studies 1 and 2, sample fish in isolated backwaters, pools, marshes, and other surface water associated with gartersnake occupied habitat.

As winter and spring seasonal flows recede in Tonto Creek, backwater/isolated pools that form within the stream floodplain could support non-native fish and allow habitat overlap with gartersnake. SRP intends to sample all isolated pools between the existing Roosevelt Lake water level and A-Cross Road (2,151 feet in elevation). If numerous pools exist, subsampling isolated pools will occur with a focus on gartersnake habitat overlap. Depending on seasonal flows, sampling or subsampling flowing water or pools near or adjacent to gartersnake habitat along the Tonto Creek main channel will occur. Unpredictable precipitation causing an unforeseen flow spike could delay sampling, or make it difficult/impossible.

- As noted above, fish sampling will be opportunistic depending on the presence and location of backwater/isolated pools, although late season persistent water will be identified using
aerial imagery and GIS to focus electrofishing efforts. A backpack electrofisher (Reynolds 1996) will be the primary method to sample isolated pools. Sampling will be qualitative and sufficient (one or two passes in isolated pools) to determine fish species composition and population size structure, especially targeting the capture of large-bodied predatory fish. Seining, as needed, may be appropriate for sampling in some habitat areas (e.g., stream reaches).

Biologists will search for gartersnake in pools and surrounding habitat prior to electroshocking fish to minimize the likelihood of shocking gartersnakes. Prior to electrodes entering the water, biologists will conduct VES. Biologists will properly sterilize all equipment (boots, waders, and electrodes) prior to entering any aquatic areas to minimize spread of disease.

If a gartersnake is shocked, biologists will deactivate electrodes, cease shocking, and attempt to hand-capture the snake and relocate it into thermal cover a sufficient distance away from the sampled waterbody. If the gartersnake is able to flee, biologists will follow the snake to ensure that it is a safe distance from the water before resuming shocking. If the gartersnake is nonresponsive, biologists will remove it from the water by hand and place it away from the pool where adequate cover exists so that it may escape when active. Biologists will record specific settings used for the backpack shockers to provide information on electrical current levels that could have adverse effects to gartersnakes.

- Biologists will identify, measure, count, and release collected fish back to the sampling location. Fish estimated to be large enough (gape size \( \geq \frac{1}{2} \) inch) greater than 8 inches) to prey on gartersnakes will have stomach contents collected with gastric lavage to determine the general categories of prey items (Foster 1977) and gartersnake presence/absence.

Reservoir Margin Sampling

Biologists will sample along the shoreline of the Tonto Creek delta at Roosevelt Lake in late summer 2019 and early and late summer 2020 (any work initiated prior to permit issuance will be conducted by AGFD under an existing permit). Prior to initiating fieldwork, the proposed sampling protocol, as described below, SRP will solicit AGFD’s input on gear types, locations, and other methodology to maximize effectiveness and efficiency of capturing target larger-bodied non-native fish species.

- Biologists will sample lake margin habitat by electrofishing from a boat; electrofishing provides effective sampling of juvenile and adult fish. Biologists will operate the electrofisher continuously along shoreline habitat from one side of the lake to the other, bracketing the Tonto Creek delta area. Sampling will target habitat up to 5 feet deep. Biologists will attempt to sample in and adjacent to flooded vegetation that fish use as cover, however shallow water and thick vegetation could preclude sampling because of difficult access.

- Biologists will identify, measure, count, and release collected fish back to the sampling location. Fish estimated to be large enough (gape size \( \geq \frac{1}{2} \) inch) to prey on gartersnakes or
their prey will have stomach contents collected with gastric lavage to determine the general categories of prey items (Foster 1977) and gartersnake presence/absence. Sampling may be limited due to shallow water conditions and overgrown vegetation. Biologists will divide shallow water habitat into approximately 1500-foot-long segments and sample a random number of sites (to be determined). All fish will be weighed (grams), measured (millimeters), and released. Biologists will record effort for each gear type to estimate CPUE.

To minimize effects to gartersnakes during fish sampling, biologists will search pools and surrounding abutting habitat for gartersnakes to reduce the likelihood of shocking a snake. Biologists will properly sterilize all equipment (boots, waders, and electrodes) prior to entering any aquatic areas to minimize spread of disease.

- If a gartersnake is shocked, biologists will deactivate electrodes, cease shocking, and attempt to hand-capture the snake and relocate it into thermal cover a sufficient distance away from the sampled waterbody. If the gartersnake is able to flee, biologists will follow the snake to ensure that it is a safe distance from the water before resuming shocking. If the gartersnake is nonresponsive, biologists will remove it from the water by hand and place it away from the pool where adequate cover exists so that it may escape when active. Specific settings used for the backpack shockers will be recorded to provide information on electrical current levels that could have potentially significant adverse effects to gartersnakes.

Gartersnake Prey Observations

- Using visual observations during fish sampling and while assessing potential habitat in Studies 1 and 2, biologists will record the presence and relative abundance (low, medium, or high) of prey species (small fish and amphibians of all life stages).

- SRP will digitize and incorporate data with the physical habitat characteristics identified in Study 1.

Conservation Measures

SRP will implement the following gartersnake conservation measures with the intent to avoid and minimize adverse effects resulting from the proposed action:

- Biologists will search for gartersnakes prior to electroshocking fish in pools and surrounding habitat to reduce the likelihood of shocking a snake. Biologists will conduct VES immediately prior to electrodes entering the water body.
  
  - If a gartersnake is shocked, biologists will deactivate electrodes, cease shocking, and attempt to hand-capture the snake and relocate it into thermal cover a sufficient distance away from the sampled waterbody. If the snake is able to flee, biologists will follow the snake to ensure that it is a safe distance from the water.

  If the gartersnake is nonresponsive due to electroshocking, biologists will remove
it from the water by hand and place it away from the pool where adequate cover exists so that it may escape when active.

- Biologists will handle gartersnakes according to the Protocol for Surveys and Monitoring developed by Nowak (2013). Biologists will place gartersnakes in the shade if being handled, for photographs and measurement. Biologists that opportunistically have the opportunity to handle gartersnakes will investigate for passive integrated transponder (PIT) tags placed during previous survey efforts.

- No gartersnake marking, PIT-tagging, or other invasive measures would be conducted on snakes for this project.

- Biologists will properly sterilize all equipment (boots, waders, and electrodes) prior to entering any aquatic areas to minimize spread of disease.

**Action Area**

The action area is defined at (50 CFR 402.02) as “all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action.”

We have determined that action for the portion of the project under formal consultation addressing the northern Mexican gartersnake (Appendix A: Figure 1) is smaller than the entire proposed project area, which includes SRP’s conservation properties (Figure 1 and 2). The action area is the Roosevelt Lake conservation space up to elevation 2,151 feet, including the Salt and Tonto creek deltas (Appendix A: Figure 1). Below in the Environmental Baseline’s “Activities/effects addressed by existing permitted actions” section, we describe how existing permitted actions refined and clarified the Action Area.

**STATUS OF THE SPECIES AND CRITICAL HABITAT**

The information in this section summarizes the rangewide status of each species that is considered in this biological opinion. Further information on the status of these species can be found in the administrative record for this project, documents on our web page (Arizona Ecological Services Office Documents by Species), and in other references cited in each summary below.

**Northern Mexican Gartersnake**

*Description*

The northern Mexican gartersnake, which reaches up to 44 inches total length, ranges in color from olive to olive-brown or olive-gray with three lighter-colored stripes that run the length of the body, the middle of which darkens towards the tail. It may occur with other native gartersnake species and can be difficult for people without specific expertise to identify because of its similarity of appearance to other native gartersnake species.
Listing and Proposed Critical Habitat
The northern Mexican gartersnake was designated a threatened species on July 8, 2014 (USFWS 2014, 79 FR 38678). Please refer to this rule for more in-depth information on the ecology and threats to the species, including references. Critical habitat was proposed on July 10, 2013 (USFWS 2013, 78 FR 41500), and has not yet been designated. Please refer to these documents for more in-depth information on the ecology and threats to the species and critical habitat, including references. We are incorporating the final and proposed rules herein by reference. Proposed northern Mexican gartersnake critical habitat occurs in 14 sub-basin and national wildlife refuge units in Arizona and New Mexico, totaling 421,423 acres (USFWS 2013). In Arizona, proposed critical habitat is located in portions of the Verde, Agua Fria, Bill Williams, Upper Salt, San Pedro, Babocomari, Upper Santa Cruz and Upper Gila rivers; Tonto and Cienega Creeks; Redrock Canyon; and Buenos Aires and San Bernardino National Wildlife Refuges. In New Mexico, proposed critical habitat is located in portions of Mule Creek and the Upper Gila River.

The primary constituent elements (PCEs) of the physical and biological features essential to northern Mexican gartersnake conservation are:

- **PCE 1: Aquatic or riparian habitat that includes:**
  - Perennial or spatially intermittent streams of low to moderate gradient that possess appropriate amounts of in-channel pools, off-channel pools, or backwater habitat, and that possess a natural, unregulated flow regime that allows for periodic flooding or, if flows are modified or regulated, a flow regime that allows for adequate river functions, such as flows capable of processing sediment loads; or
  - Lentic wetlands such as livestock tanks, springs, and cienegas; and,
  - Shoreline habitat with adequate organic and inorganic structural complexity to allow for thermoregulation, gestation, shelter, protection from predators, and foraging opportunities (e.g., boulders, rocks, organic debris such as downed trees or logs, debris jams, small mammal burrows, or leaf litter); and,
  - Aquatic habitat with characteristics that support a native amphibian prey base, such as salinities less than 5 parts per thousand, pH greater than or equal to 5.6, and pollutants absent or minimally present at levels that do not affect survival of any age class of the northern Mexican gartersnake or the maintenance of prey populations.

- **PCE 2: Adequate terrestrial space (600 feet lateral extent to either side of bankfull stage) adjacent to designated stream systems with sufficient structural characteristics to support life history functions such as gestation, immigration, emigration, and brumation (extended inactivity).**

- **PCE 3: A prey base consisting of viable populations of native amphibian and native fish species.**

- **PCE 4: An absence of non-native fish species of the families Centrarchidae and Ictaluridae, bullfrogs, and/or crayfish (*O. virilis, P. clarki*, etc.), or occurrence of these
non-native species at low enough levels such that recruitment of northern Mexican gartersnakes and maintenance of viable native fish or soft-rayed, non-native fish populations (prey) is still occurring.

**Distribution**
The northern Mexican gartersnake historically occurred in every Arizona county and nearly every sub-basin, from perennial or intermittent creeks, streams, and rivers as well as lentic wetlands such as cienegas, ponds, or stock tanks (Rosen *et al.* 2001; Holycross *et al.* 2006a, b; Cotton *et al.* 2013). In New Mexico, the gartersnake had a limited distribution that consisted of scattered locations throughout the Upper Gila River watershed in Grant and western Hidalgo Counties (Price 1980, Fitzgerald 1986, Degenhardt *et al.* 1996, Holycross *et al.* 2006a, b). Within Mexico, northern Mexican gartersnakes historically occurred within the Sierra Madre Occidental and the Mexican Plateau, comprising approximately 85% of the total range-wide distribution of the subspecies (Rossman *et al.* 1996).

Known viable and reliably detected northern Mexican gartersnake populations in the United States include: 1) the Page Springs and Bubbling Ponds State Fish Hatcheries along Oak Creek; 2) lower Tonto Creek; 3) the upper Santa Cruz River in the San Rafael Valley; 4) the Bill Williams River; and 5) the middle/upper Verde River. In New Mexico and elsewhere in Arizona, the northern Mexican gartersnake may occur in extremely low population densities within its historical distribution; limited survey effort is inconclusive to determine extirpation of this highly secretive species. We do not have good information regarding the status of the northern Mexican gartersnake on tribal lands, such as the White Mountain Apache or San Carlos Apache Tribes. We know less about the current distribution of the northern Mexican gartersnake in Mexico due to limited surveys and limited access to information on survey efforts and field data.

Sampling data indicate that only four populations of northern Mexican gartersnakes in the United States are relatively dense and where the species remains somewhat reliably detected. These populations are: 1) upper Santa Cruz River in the San Rafael Valley, 2) lower Tonto Creek, 3) Verde Valley, and 4) the Aquatic Research and Conservation Center (formally known as the Page Springs and Bubbling Ponds State Fish Hatcheries) adjacent to Oak Creek.

Areas with protected backwaters, braided side channels and beaver ponds, isolated pools near the river mainstem, and edges of dense emergent vegetation that offer cover and foraging opportunities are important for acquisition of prey that includes native fish and amphibians.

**Life History and Habitat**
The northern Mexican gartersnake is an active predator of both vertebrate and invertebrate species. Northern Mexican gartersnakes forage along vegetated stream banks, and search for prey in water and on land using different strategies (Alfaro 2002). Its diet primarily consists of amphibians and fishes, such as adult and larval (tadpoles) native leopard frogs, as well as juvenile and adult native fish (Rosen and Schwalbe 1988). In situations where native prey species are rare or absent, this gartersnake’s diet may include non-native species, including larval and juvenile bullfrogs, western mosquitofish (Holycross *et al.* 2006a, b; Emmons and Nowak 2013), or other non-native fishes.
Throughout its range-wide distribution, the northern Mexican gartersnake occurs at elevations from 130 to 8,497 feet (Rossman et al. 1996). Within Arizona and New Mexico, records generally come from elevations ranging from 130 to 6,200 feet. Drummond and Marcias-Garcia (1983) consider this gartersnake a “terrestrial-aquatic generalist.” Surveys often locate the northern Mexican gartersnake in riparian habitat, but it has also been found hiding under cover in grassland habitat up to a mile away from any surface water (Cogan 2015). The subspecies has historically been associated with three general habitat types: 1) source-area wetlands (e.g. Cienegas or stock tanks); 2) large-river riparian woodlands and forests; and 3) streamside gallery forests (Hendrickson and Minckley 1984, Rosen and Schwalbe 1988).

Threats
Predatory harmful non-native species are a significant concern in almost every northern Mexican gartersnake locality in the United States and the most significant reason for their decline (USFWS 2014). Harmful non-native species can directly threaten northern Mexican gartersnakes passively, such as through physical injury to northern Mexican gartersnakes from the dorsal or pectoral spines of harmful nonnative fish during ingestion (Emmons et al. 2016) or actively through direct predation of neonatal or juvenile northern Mexican gartersnakes (Young and Boyarski 2013, Akins 2012). Neonatal and juvenile gartersnakes are considered the most at risk from predation by harmful non-native species but larger size classes of gartersnakes could still be prey for predatory fish that reach large sizes and possess large gapes, such as largemouth bass and flathead catfish. Harmful non-native fish are most likely to capture northern Mexican gartersnakes when they enter or swim across pool or run habitat within streams or water bodies that support these fish. Crayfish are most likely to seize neonatal gartersnakes in the shallows or along the bottom of pools, slow runs, backwaters, or tanks resulting in the drowning of individual gartersnakes. Bullfrogs often reside at the edge of water bodies on land or in the water and are most likely seize gartersnakes as they forage along aquatic edge habitat.

Other threats include dewatering or alteration of rivers and streams from dams, diversions, flood-control projects, and groundwater pumping that change flow regimes, reduce or eliminate habitat, and favor predatory harmful non-native species; and effects from climate change and drought (USFWS 2014, 79 FR 38678).

Previous Consultations
Given the wide-range of the northern Mexican gartersnake, numerous Federal actions affect this species every year. A complete list of all formal consultations affecting this species in Arizona is on our Arizona Ecological Services website.

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated effects of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the effect of State and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.
Activities/effects addressed by existing permitted actions

A portion of SRP’s proposed activities are already permitted under existing Section 10(a)(1)(A) Recovery Permits and applicable State Permits. NAU, AGFD, GEI, and ERO Resources (ERO) will perform the gartersnake survey and handling activities and fish sampling (Appendix A: Table 1).

We addressed effects from the proposed action to the flycatcher, cuckoo, bald eagle, and rail within Roosevelt Lake’s conservation space in our 2003 Incidental Take Permit (ITP) issued to SRP for the Roosevelt Dam Habitat Conservation Plan (and associated biological opinion, 2-21-03-F-0003).

These existing 10(a)(1)(A) recovery permits (Appendix A: Table 1) and 10(a)(1)(B) HCP permit reduce the scope of activities evaluated under formal consultation to the gartersnake research within the Roosevelt Lake conservation space (up to elevation 2151 feet) including the Tonto Creek and Salt River deltas.

Description of the Action Area

The completion of Roosevelt Dam in 1911 created Theodore Roosevelt Lake. The Tonto National Forest surrounds Roosevelt Lake and the lake covers much of the southern portion of the Tonto Basin, situated between the Sierra Ancha, Mazatal, and Superstition mountains. As originally constructed, Roosevelt Dam was 280 feet high and had a water storage capacity of 1,284,205 acre-feet. Subsequently, capacity slightly increased and decreased over time as the spillway was modified and silt accumulated. From 1989 through early 1996, Roosevelt Dam was subjected to extensive modifications by the Bureau of Reclamation (Reclamation) to provide additional conservation storage capacity (to 1,653,043 acre-feet) and to address safety concerns identified under the Reclamation Safety of Dams Act of 1978 (43 USC § 506 et seq.). The modified Dam provides for additional water conservation storage space, dam safety, and for the first time, dedicated flood control space. The top of SRP’s original conservation storage space was at an elevation 2,136 feet. This elevation represents the existing storage capacity held by SRP in 1995 when modifications to the Dam were completed to add additional conservation storage and flood control space to Roosevelt. The top of the new conservation space is at elevation 2,151 feet. The uppermost increment of storage behind Modified Roosevelt, from elevation 2,151 feet up to elevation 2,218 feet, is reserved for flood control and dam safety purposes. SRP operates Roosevelt and its other reservoirs to provide water to their shareholder lands, various Phoenix area cities, Indian communities, and irrigation and water conservation districts pursuant to a complex set of laws, contracts, and agreements (RHCP 2002). The reservoir also is an important recreation site, and supports boating, camping, fishing, and other recreational pursuits (Appendix A: Figure 3).

In 1903, Reclamation withdrew the land that the original water storage space occupies behind Roosevelt Dam for purposes of the Salt River Federal Reclamation Project. Additional land was withdrawn in 1999 in the area that could be inundated because of the modifications to Roosevelt Dam (64 FR 67929, December 3, 1999). SRP, Reclamation, and the U.S. Forest Service (Forest Service) manage the withdrawn land surrounding the reservoir under a three-way agreement with
the Tonto National Forest being responsible for management of recreation and other public land uses.

SRP operates the reservoir system as a cohesive unit providing much of the water used in the Phoenix metropolitan area. Roosevelt is the key SRP water storage facility because of its large capacity in relation to the other reservoirs. The reservoir space behind Roosevelt Dam is greater than twice the capacity of all the other reservoirs combined. Because of its size, Roosevelt provides protection from drought.

Historically, Roosevelt Lake levels have large annual and long-term variations. The reservoir can go from completely full one year to a much smaller surface area after several years of low runoff (Appendix A: Figure 4). Reservoir fill during the winter and early spring is highly variable, with the water level rising by a few feet in some years to more than 100 feet in other years. However, annual releases are more uniform and typically lower the reservoir by about 15 to 25 feet from late spring through summer. Precipitation and run-off from 2017 raised the Roosevelt Lake elevation to about 2,125 feet, but by the end of 2018, the lake elevation dropped to near 2,090 feet (Appendix A: Figure 4). A general long-term pattern is 3 to 7 years of low runoff and decreasing reservoir levels followed by a runoff season that fills or nearly fills the lake. Another long-term pattern is decades of below- or above-average runoff (e.g., the relatively dry period of the 1950s and the relatively wet period of the 1980s).

Since reservoir creation, the amount of riparian vegetation has fluctuated with reservoir level and flood events. Currently, the riparian habitat at Roosevelt is a mixture of saltcedar, cottonwood, willow, seepwillow (Baccharis salicifolia), desert broom (Baccharis sarothroides), and arrowweed (Pluchea sericea). At the Tonto Creek delta, the water levels are typically shallow and slow moving, and the river braids in some areas with side channels and beaver ponds. The riparian habitat is diverse with mosaics of tamarisk and willows, some marsh vegetation persists, and vegetated areas are interspersed with open cobble or sandy areas. On the Salt River side of the lake, the river forms a single, wide channel. Water flows on the Salt River are typically higher and more turbid than Tonto Creek. At the upper end of the conservation space on the Salt River, riparian habitat appears to be similar to Tonto Creek (mosaic of woody vegetation) but lower in the reservoir large wide stands of monotypic tamarisk dominate.

Similar to a natural system, riparian vegetation growth and loss is dynamic in the reservoir; however, the cycle occurs irregularly and is more extreme than on a natural system. Vegetation may be flooded or completely inundated for many months or years, resulting in complete kill of riparian vegetation. As the reservoir empties, groundwater drops below the rooting zone of many riparian plants, resulting in desiccation and mortality. For some periods, inundation of both the Salt River and Tonto Creek deltas may not occur for several years. However, lakebed saturation can create conditions favorable for establishment of new vegetation or rejuvenation of existing vegetation. Establishment of new, mid-succession riparian habitat generally takes 3 to 5 years. Riparian vegetation grows within the reservoir bed, and along the reservoir margin and tributary watercourses. Reservoir levels are primarily driven by the amount of precipitation in the watershed and reservoir releases. The changing water levels that accompany normal operation of the reservoir result in constantly changing amounts, types, and distribution of riparian vegetation. The dynamic cycle of disturbance and regeneration creates, desiccates, and then periodically inundates riparian habitat.
The Tonto Creek delta to Roosevelt Lake holds a variety of native and non-native aquatic species, some of which provide food for native species and others that predate upon native species. Nowak et al. (2019) described the following species occurring within their study area within the Tonto Creek delta. Similar species occur within the Salt River delta, with the addition of fish such as channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), and black crappie (*Pomoxis nigromaculatus*).

**Aquatic species identified at the Tonto Creek delta to Roosevelt Lake (Nowak et al. 2015, 2019).**

**Fish**

**Amphibians**
American bullfrog (*Lithobates catesbeianus*), lowland leopard frog (*Lithobates yavapaiensis*), Woodhouse toad (*Anaxyrus woodhousii*), red-spotted toad (*Anaxyrus punctatus*), and Colorado River toad (*Incilius alvarius*).

**Invertebrates**
Crayfish (*Orconectes virilis, Procambarus clarki*).

**Previous related consultations within the action area**
SRP summarized the broader history of biological opinions and Endangered Species Act compliance at Roosevelt Lake including species such as the flycatcher and bald eagle (RHCP 2002). These projects, primarily consulting with Reclamation and the Forest Service go back to the 1980s and involve actions such as safety of dams, recreation facilities, and raising Roosevelt Dam (RHCP 2002). As noted above, SRP developed a Habitat Conservation Plan (RHCP 2002) with us, and we conducted intra-Service Section 7 consultation on the issuance of their 10(a)(1)(B) permit.

Additionally, we completed a biological opinion (22410-2011-F-0290) that addressed Wildlife and Sportfish Restoration (WSFR) funding a suite of activities related to AGFD’s aquatic species management under the State Wildlife Grant and Sport Fish Restoration Grant for a period of 10-years beginning on July 1, 2011. The project area covers a wide variety of Arizona aquatic habitats, including Roosevelt Lake. We also informally consulted (02EAAZ00-2017-I-0923) with the FWS’s National Fish Habitat Partnership for funding AGFD to purchase materials for, construct, and place fish habitat structures within Roosevelt Lake for sport fish.
**Status of the species and critical habitat within the action area**

Northern Mexican Gartersnake

**Status and distribution**

When listed in 2014, we knew the northern Mexican gartersnake occurred at lower Tonto Creek and its delta within Roosevelt Lake (USFWS 2014; Nowak et al. 2015). There are no gartersnake historical records at the Salt River delta and field surveys in 2014 found no gartersnakes (Nowak et al. 2015).

The first northern Mexican gartersnake record for Tonto Creek was from 1995, near Kayler Butte at the Arizona State Highway 188 crossing (Holycross et al. 2006). Gartersnake surveys at Tonto Creek in 2004 and 2005, resulted in capturing 17 northern Mexican gartersnakes (Holycross et al. 2006, pp. 40–44) and records have continued since (Burger 2010; Madara-Yagla 2010; 2011, 2012, pers. comm.; Nowak 2015; Nowak et al. 2015; GCWG 2016, Nowak et al. 2019).

In 2015, SRP engaged with the FWS, AGFD, and NAU to develop a gartersnake distribution, abundance, movement, and seasonal habitat use assessment at the Tonto Creek delta. Nowak et al. (2019) conducted field surveys from 2015 to 2017 and recorded 68 gartersnakes in streamside and other riparian habitat on Tonto Creek within Roosevelt Lake (Appendix A: Table 2, Figure 5). Roosevelt Lake water levels ranged between elevation 2084 – 2126 feet during Nowak et al.’s (2019) study and gartersnake detection rates were highest at Orange Peel (nearest the reservoir pool at that time) compared to A Cross Road (top of conservation storage space). Nowak et al.’s (2019) plotted gartersnake locations (trapped, visual encounter and telemetry locations) along waterways and isolated pools during the active season (March through October) (Appendix A: Figure 5).

**Habitat Use (active season)**

Gartersnake home ranges at Roosevelt varied in shape, but generally tracked natural features, particularly the Tonto Creek channel. At lower Tonto Creek during the 2015 – 2017 seasons, biologists found adult female snakes at a mean of $36.58 \pm 4.25$ yards to water. Adult male snakes had a similar overall mean of $33.45 \pm 12.13$ yards to water. Nowak et al. (2019) found that gartersnakes at Roosevelt occur within obligate wetland plants (e.g., cattails, sedges, and grasses) in addition to streamside patches of woody riparian vegetation. There are limited detections of gartersnakes using open water and bare floodplain, however if these open water/ground areas occur between more commonly used areas, gartersnakes likely cross them. Gartersnakes along Tonto Creek at Roosevelt selected for more ground cover in all years, locations closer to water in 2016, and areas with greater canopy cover in 2017 (Nowak et al. 2019).

Nowak et al. (2019) determined gartersnake habitat use was associated with fluctuating water levels. Flood events that inundated habitat in 2017 affected gartersnake movements at Roosevelt Lake, particularly at Orange Peel (which was closest to Roosevelt Lake’s pool of water).
Brumation Sites and Activity Patterns

Nowak et al. (2019) radio-tracked 14 gartersnakes (12 females, two males) to 23 brumation sites at lower Tonto Creek with Roosevelt Lake. Brumation sites ranged from 0.76 to 419 yards (mean = 91.0 ± 23.33 yards) from the water’s edge and generally moved further from the water’s edge during winter (Appendix A: Figure 5). Gartersnakes used multiple underground retreats during the winter season including rodent and crayfish burrows, cavities formed by partially buried woody debris and cracked clay soils in the previously flooded lake floodplain, and under flood debris piles (Nowak et al. 2019). Telemetered gartesnakes were found brumating in a variety of macrohabitat types, including riparian woodland (eight locations), meadow (five locations), dry edge (five locations), dead woodland floodplain (two locations), shrub-forb upland (two locations), and mesquite upland (one location). Predominant ground cover type associated with brumation sites consisted of debris/litter (13 locations) or live vegetation (10 locations).

Gartersnakes at lower Tonto Creek within Roosevelt Lake have the ability to move brumation sites in advance of rising reservoir levels. Nowak et al. (2019) found that five of the nine snakes that changed brumation sites at lower Tonto Creek were associated with flooding. Andrews (2010) hypothesized that this behavior could offer an adaptive advantage for snakes inhabiting dynamic environments, particularly those that experience flooding where structural habitat features may be transformed. The duration of gartersnake inactivity varied per individual snake at Lower Tonto Creek, but generally lasted from late November to late February/early March.

Prey Availability and Predators

Northern Mexican gartersnakes are at risk from predatory aquatic species at Roosevelt Lake and lower Tonto Creek. The Roosevelt reservoir lake body is not productive northern Mexican gartersnake habitat because of its sport fishery and management. Beginning in 2014, AGFD began stocking 4.6 million Florida-strain largemouth bass, 3.3 million bluegill, and 4.5 million black crappie annually into Roosevelt Lake (to which Tonto Creek drains) in order to control the gizzard shad population, which was thought to be depressing the existing reservoir sport fish population (AGFD 2014). Roosevelt Lake sport fish likely increases gartersnake predation risk when snakes occur at the reservoir and the Tonto Creek delta (especially with increasing hydrologic connection to Tonto Creek). Hickerson et al. (2014) considered predatory non-natives to be the biggest stressor to native aquatic species in Tonto Creek, as did Timmons et al. (2015). One-third of northern Mexican gartersnakes detected in 2014 had tail-scarring (Nowak et al. 2015), which could be indicative of predation attempts by a variety of species, including predatory aquatic species.

Soft-rayed fish and larval and sub-adult bullfrogs are likely serving as prey for this gartersnake population, as well as toads and other small terrestrial vertebrates. Gartersnake prey items at Roosevelt identified by Nowak et al. (2019) included American bullfrog (n = 2 tadpoles, n = 2 juveniles), Woodhouse’s toad (n = 4 metamorphs, n = 1 juvenile), largemouth bass (n = 1), red shiner (n=1), western mosquitofish (n = 1), and one fecal sample with unidentified mammal hair. Nowak et al. (2015, 2019) observed the gartersnake population in the presence of non-native species (backwaters and shallow streamside habitats) at Roosevelt.
Nowak et al. (2019) confirmed two predated gartersnakes. A hawk (common black hawk or red-tailed hawk) predated one gartersnake and another female gartersnake, found with the head missing, appeared scavenged. Nowak et al. (2019) believed an avian predator might have killed this female gartersnake.

Critical habitat
There is no proposed gartersnake critical habitat within the Roosevelt Lake conservation space.

EFFECTS OF THE ACTION

In accordance with 50 CFR 402.02, effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of all other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see §402.17).

The proposed research and anticipated effects of the study covered in this analysis occur between fall 2019 and December 2021. The proposed study will gather information to better understand and accurately define the potential longer-term effects of water operations on the gartersnake. The data and analyses developed during the study will assist SRP in preparing a proposed amendment to the Roosevelt HCP Section 10(a)(1)(B) permit that would minimize and mitigate any post-2021 adverse effects to gartersnakes and/or any proposed or designated critical habitat resulting from Roosevelt operations.

As identified in the Environmental Baseline, all proposed gartersnake survey and handling activities included in SRP’s research plan are currently approved through existing Section 10(a)(1)(A) recovery permits held by SRP’s contractors (ERO and NAU) and AGFD through our Section 6 agreement (Appendix A: Table 1).

Therefore, in this effects section, we will address effects due to proposed actions included in Study 2 (Assess Roosevelt Reservoir lake level fluctuation effects to gartersnake habitat) and Study 4 (Identify non-native fish and prey species composition and size class within the Tonto Creek delta at and above the Roosevelt Lake prevailing water level).

Roosevelt Lake Level Fluctuations (Study 2)

We are unable to predict specifically how fluctuating Roosevelt Lake levels from 2019 through 2021 will affect gartersnakes and its habitat/prey due to unexpected future weather patterns, precipitation, runoff, and dam operations; therefore, we will consider a range of effects from various lake storage levels. For example, extreme precipitation and higher than normal Salt River and Tonto Creek flows in 2019 through 2021 could cause a rapid change to the Roosevelt Lake levels, covering gartersnake habitat within the Roosevelt Lake conservation space with water for the duration of this permit. Conversely, a period of drought would likely cause lake levels to drop, changing the location and configuration of gartersnake habitat more slowly. Additionally, a moderate rise and drop in lake levels from more temperate rainfall may maintain
existing habitat conditions. Because this opinion covers actions from 2019 to 2021, we will only provide an analysis for the range of effects reasonably expected to occur solely from operations occurring during this period.

Complete inundation of gartersnake habitat, due to the lake filling to capacity or near capacity and held at higher levels can be expected to cause gartersnake harm, harassment, and fatalities at Roosevelt Lake. Unlike flooding on rivers where water expands and contracts across the floodplain over a relatively short duration of time, water within the Roosevelt Lake conservation space can fill rapidly and be held higher for a longer period of time, eliminating the variety of gartersnake prey habitat and vegetated cover within the conservation space. Although this scenario is less likely to occur because extreme flood events are rare, we would expect gartersnakes within the Roosevelt conservation space to immediately be displaced, exposed to increased predation from predatory fish, and possibly die from drowning.

Adverse effects from harm and harassment may also occur to displaced gartersnakes following Roosevelt Lake filling and held near capacity. Displaced gartersnakes that escape rising water levels may have more difficulty in foraging in a less complex aquatic environment, mating, and reproducing. Gartersnakes may have more difficulty finding and acquiring food such as amphibians or fish without shallow or isolated waters and vegetation for cover that occurs within the conservation space when lake levels are lower. Gartersnakes or their young may also occur or attempt to acquire food in aquatic habitats that hold increased abundance of non-native aquatic predators or occur in more exposed, less vegetated habitat, increasing their predation, injury, and fatality risk. Subsequently, following displacement, gartersnakes can have reduced survivorship with greater difficulty acquiring food, which results in less reproduction and productivity.

Because gartersnakes are able to move, avoid rising Roosevelt Lake elevations (Nowak et al. 2019), and swim, we expect most gartersnakes will be able to escape rapidly rising water levels. In the event the conservation space fills during the coldest months of the year, gartersnakes may have more difficulty moving out of the affected area due to limitations in ectothermic physiology; cold snakes do not move efficiently. Because gartersnakes evolved within dynamic stream environments, we anticipate most will be able to adjust to changing water levels, even within the unique lake conservation space.

Adverse effects to gartersnakes that may result from moderate lake level fluctuations may not occur (or be more subtle) and may increase as Roosevelt Lake levels decline. Lake levels that increase and decline moderately may help to maintain a diversity of shallow water, moist soil conditions, and vegetation that replenishes and provides gartersnake prey and prey habitat, foraging opportunities, and vegetated cover. Moderate and relatively rapid fluctuations in lake levels that mimic normal river fluctuations may not noticeably increase gartersnake predation exposure and changes in food availability (but may still occur), because vegetation and prey habitat persists, and gartersnake movements are less dramatic. However, if lake levels continue to recede, aquatic habitat may become less complex (depending on the contours of the lake bottom), reducing shallow foraging areas and exposing more un-vegetated areas. If lake levels continue to recede during the proposed action, gartersnakes may have less foraging opportunities and cover, and increased exposure to aquatic and terrestrial predators, resulting in reduced survivorship and productivity.
Because gartersnakes within the Roosevelt Lake conservation space at Tonto Creek are fairly numerous and widespread (Nowak et al. 2019), it is likely that snake populations have withstood the effects of lake fluctuations and storage and persisted through previous lake filling events (as recent as 2007-2010) and periods with lower storage (2012-2016).

**Non-native Fish and Prey Species Composition and Size Class within the Tonto Creek Delta at and above the Roosevelt Lake Prevailing Water Level (Study 4)**

Electroshocking fish within gartersnake habitat has the possibility of injuring or killing gartersnakes, but those risks should be minimized by proposed conservation measures. Shocking will be set at levels that are expected to stun, but not kill fish or other aquatic wildlife (including gartersnakes). Additionally, conservation measures will minimize injury/fatality risk. Any gartersnake accidentally shocked that is nonresponsive, will be handled carefully and moved to a safe, covered area until it recovers. Gartersnakes are cryptic and can occur in areas where they are difficult to detect. As a result, there is some risk of injury or fatality when adding electricity to the water. Even though biologists will take all reasonable measures to minimize electroshocking gartersnake injury or fatality, we cannot eliminate this risk.

**CUMULATIVE EFFECTS**

Cumulative effects are those “effects of future State or private activities, not involving federal activities, that are reasonably certain to occur within the action area” considered in this Opinion (50 CFR 402.02).

Since the land within the action area is managed by primarily by the Forest Service, most activities that could potentially affect these species are Federal activities and subject to additional section 7 consultation.

Higher or reduced reservoir levels may provide opportunities for unregulated boaters, water/jet skiers, or terrestrial recreationists to access to gartersnake habitat. Subsequently, people may disrupt gartersnakes, brumation sites, or cover temporarily or permanently. Increasing recreation access to gartersnake habitat may exacerbate adverse human-snake interactions, leading to the killing of snakes (ophidiophobia: fear of snakes).

**JEOPARDY AND ADVERSE MODIFICATION ANALYSIS**

Section 7(a)(2) of the ESA requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat.
Jeopardy Analysis Framework

Our jeopardy analysis relies on the following:

“Jeopardize the continued existence of” means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). The following analysis relies on four components: (1) Status of the Species, which evaluates the range-wide condition of the listed species addressed, the factors responsible for that condition, and the species’ survival and recovery needs; (2) Environmental Baseline, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) Effects of the Action (including those from conservation measures), which determines the direct and indirect effects of the proposed federal action and the effects of any interrelated or interdependent activities on the species; and (4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the action area on the species. The jeopardy analysis in this biological opinion emphasizes the range-wide survival and recovery needs of the listed species and the role of the action area in providing for those needs. We evaluate the significance of the proposed Federal action within this context, taken together with cumulative effects, for the purpose of making the jeopardy determination.

Conclusion

After reviewing the current status of the northern Mexican gartersnake, the environmental baseline for the action area, the effects of the proposed permit issuance to SRP, and the cumulative effects, it is our biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the northern Mexican gartersnake. Critical habitat for this species has been proposed but is not within the action area.

We base this conclusion on the following:
- Experienced, professional biologists will implement the proposed electroshocking conservation measures and methodology to minimize the likelihood of gartersnake injury or fatality.
- The project is short duration, which will limit effects to a small portion of 2019, 2020, and 2021.
- Moderate lake and river fluctuations within the Roosevelt Lake conservation space may closely mimic natural stream behavior and help maintain aquatic habitat, prey, and vegetation important for gartersnake populations.
- An existing, abundant number of gartersnakes currently occur within Roosevelt Lake, and therefore likely have persisted through previous wide-ranging (high, medium, or low) Roosevelt Lake water storage levels. As a result, any adverse effects that occur during the proposed study are not expected to eliminate or extirpate local populations or jeopardize the northern Mexican gartersnake.
The conclusions of this biological opinion are based on full implementation of the project as presented in the Description of the Proposed Action section of this document, including any Conservation Measures that were incorporated into the project design.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to Section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. “Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. “Harm” is further defined (50 CFR § 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. “Harass” is defined (50 CFR § 17.3) as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. “Incidental take” is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.

The measures described below are non-discretionary, and must be undertaken by the FWS so that they become binding conditions of any grant or permit issued to the SRP, as appropriate, for the exemption in Section 7(o)(2) to apply. We have a continuing duty to regulate the activity covered by this incidental take statement. If we (1) fail to assume and implement the terms and conditions or (2) fail to require SRP to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of Section 7(o)(2) may lapse. In order to monitor the impact of incidental take, SRP must report the progress of the action to us and its impact on the species as specified in the incidental take statement [50 CFR §402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

We anticipate the take of northern Mexican gartersnakes because of this proposed action. Incidental take can be expected in the form of harm, harassment, injury and death from fluctuating water levels and storage, and electrofishing. Changes in water storage can cause gartersnake injury/fatalities and reduced survivorship and reproduction due to displacement; alterations in prey, prey availability, prey habitat and vegetated cover; terrestrial and aquatic predation; and drowning. Electrofishing may injure or kill gartersnakes. This take will be authorized through issuance of an incidental take permit pursuant to 10(a)(1)(A) of the Act.

The following amount of incidental take will be authorized by the proposed Permit:

We anticipate incidental take of northern Mexican gartersnakes will be difficult to assess and detect, and the amount that occurs could vary depending on precipitation and water storage. Gartersnakes are not all individually marked, occur over broad area, and are cryptic, small, generally fossorial, and therefore difficult to individually find, track, and evaluate. The maximum amount of take is more likely to occur if Roosevelt Lake fills toward capacity.
Because gartersnakes occur and evolved in a dynamic aquatic environment, are distributed across a fairly broad area within Roosevelt’s conservation space, and have likely persisted and withstood (Appendix A, Figure 5) previous Roosevelt Lake water storage fluctuations (high, medium, or low), we anticipate the maximum amount of take will be no more than 30 percent of the approximately 70 known gartersnakes detected within Roosevelt Lake from 2015 to 2017 (this would be about 21 gartersnakes). Again, note that marked/known gartersnakes represent a subset of the total population in this area, making the overall percentage of gartersnakes affected, smaller.

Because gartersnakes are difficult to detect, tracking each existing individual gartersnake’s disposition to assess the amount or extent of take is not possible. We recognize gartersnake surveys are imperfect and unable to reliably detect all affected gartersnakes. Nowak et al.’s (2015, 2019) VES detection rates and numbers within the Roosevelt Lake conservation space from 2015 through 2017 resulted in an average detection rate of 0.065 gartersnakes/hour.

We expect biologists will be able to detect a proportion of the gartersnake population within the existing conservation space or displaced from a fill event. Therefore, the number of gartersnakes detected will represent a subset of the total number of gartersnakes affected.

The amount or extent of allowable gartersnake take will be exceeded if less than 10 individual unique gartersnakes are detected annually in 2020 and 2021. Surveyors must detect at least 10 individual gartersnakes annually between May and December 2020, and May and December 2021, when water storage is likely to have captured most of the winter and spring runoff. Biologist must detect gartersnakes within the Roosevelt Lake conservation space or within 0.25 mile above the full pool, 2,151 elevation, if Roosevelt Lake reaches capacity or near capacity.

EFFECT OF THE TAKE

In this biological opinion, we have determined that the level of anticipated take is not likely to result in jeopardy to the northern Mexican gartersnake. Although we anticipate some incidental take to occur, the implementation of the conservation measures should ultimately result in avoidance and minimization of adverse effects.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

The associated 10(a)(1)(A) permit contain all measures necessary to avoid, minimize, and mitigate incidental take of the northern Mexican gartersnake. Annual reporting requirements will be specified in SRP’s permit. Those reporting requirements that are outlined in the Section 10(a)(1)(A) permit will satisfy the reporting/monitoring requirements pursuant to Section 7 of the Act and its implementing regulations. Therefore, no additional reasonable and prudent measures and terms and conditions are necessary.
Disposition of Dead or Injured Listed Species

Upon locating a dead, injured, or sick listed species initial notification must be made to the FWS's Law Enforcement Office, 4901 Paseo del Norte NE, Suite D, Albuquerque, NM 87113; 505-248-7889) within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the animal, a photograph if possible, and any other pertinent information. The notification shall be sent to the Law Enforcement Office with a copy to this office. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve the biological material in the best possible state.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

We have no further conservation recommendations that are in addition to the proposed action and conservation measures.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on for the issuance of a Recovery Permit for the threatened northern Mexican gartersnake for scientific purposes and/or enhancement of propagation or survival. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

For further information please contact Greg Beatty at 602-242-0210. Please refer to the consultation number, 02EAAZ00-2019-F-0868, in future correspondence concerning this project.
Ms. Susan Jacobsen, Classification and Restoration Division Chief

Sincerely,

Jeffrey A. Humphrey
Field Supervisor

cc (electronic):
Chief, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ (Attn. T. Jones, C. Gill)
Bruce Hallin, Salt River Project, Phoenix, AZ (Attn. C. Paradzick, M. Wicke)
District Ranger, Tonto Basin Ranger District, Tonto National Forest, Tonto Basin, AZ
Tonto National Forest Supervisors Office, Tonto National Forest, Phoenix, AZ (Attn. M. Martinez, D. Ulberg)
Chief, Environmental Division, Bureau of Reclamation, Phoenix, AZ
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Wildlife Biologist, Arizona Ecological Services, Phoenix, AZ (Attn. N. Engelmann, K. Robertson)
LITERATURE CITED

General


Northern Mexican Gartersnake

Akins, C. 2012. E-mail correspondence from Christina Akins (Arizona Game and Fish Department) (June 22, 2012; 1813 hrs).


Burger, B. 2010. E-mail correspondence from Bill Burger, Nongame Specialist, Arizona Game and Fish Department (July 12, 2010; 1556 hrs).

Cogan, R. 2015. E-mail correspondence from Roger Cogan, Conservation Coordinator at Appleton Whittell Research Ranch, National Audubon Society (April 7, 2015; 1117 hrs).


Madara, A. 2012. E-mail correspondence from Amy Madara, Tonto Basin Ranger District, Tonto National Forest (July 05, 2012; 1650 hrs.).


Nowak, E. M. 2015. E-mail correspondence from Erika Nowak (Northern Arizona University). (October 27, 2015; 1018 hrs.).


Timmons, R. J., S. A. Paulus and L. J. Upton. 2015. Fish monitoring of selected streams within


Figure 1. Roosevelt Lake research study area – Tonto Creek and Salt River deltas up to water elevation 2,151 feet.
Figure 2. SRP conservation properties along the Verde, Salt, Gila, and San Pedro Rivers.
Figure 3. Roosevelt Lake Recreation Areas.
Figure 4. Roosevelt Lake Elevation 2006-2018.
Figure 5. Northern Mexican gartersnake detections at Tonto Creek (both active season and brumation locations) within the Roosevelt Lake conservation space.
Table 1. Current personnel and permit holders for conducting field sampling under separate 10(a)(1)(A) permits.*

<table>
<thead>
<tr>
<th>Study/Action</th>
<th>Contractors</th>
<th>Contractor Federal Permit</th>
<th>Contractor State Scientific Collecting Permit #</th>
<th>Schedule</th>
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<tbody>
<tr>
<td>Study 1: Identify gartersnake habitat (VES surveys at Tonto and Salt deltas)</td>
<td>ERO AGFD</td>
<td>ERO</td>
<td>ERO SP662706 N/A</td>
<td>Fall 2019 Summer 2020</td>
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<td>Study 2: Assess Effects of Reservoir Operations** (gartersnake VES surveys at Tonto and Salt deltas)</td>
<td>ERO</td>
<td>ERO</td>
<td>ERO SP662706</td>
<td>Fall 2019 Summer 2020 Summer 2021</td>
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<tr>
<td>Study 3: Conservation Property Assessments (gartersnake VES and fish surveys at Fort Thomas Preserve)</td>
<td>AGFD NAU ERO</td>
<td>AGFD (Section 6) TE43322B-1 TE49858D-0</td>
<td>N/A SP752693 (AZ) ERO SP662706</td>
<td>Summer/Fall 2019 Summer 2020</td>
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<td>Study 4: Non-native Fish Sampling** (Marsh/Backwater/Stream/Reservoir Margins)</td>
<td>AGFD GEI**</td>
<td>AGFD (Section 6)</td>
<td>N/A</td>
<td>Fall 2019 Summer/Fall 2020</td>
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</tbody>
</table>

*Assignments are subject to change and will be based on availability and permitting.

** Note: Study 2 and 4 includes potential effects from SRP reservoir operations research and fish sampling on gartersnakes and its habitat, which SRP is seeking coverage for under the current 10(a)(1)(A) recovery permit application addressed in this biological opinion.

Table 2. Individual northern Mexican gartersnakes found at Lower Tonto Creek within the Roosevelt Lake conservation space between 2015 and 2017.

<table>
<thead>
<tr>
<th>Location</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Orange Peel</td>
<td>6</td>
<td>22</td>
<td>26</td>
<td>54</td>
</tr>
<tr>
<td>A Cross</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>30</td>
<td>32</td>
<td>68</td>
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