Mount Rainier

National Park Service
U.S. Department of the Interior

Mount Rainier National Park

Fish Management Plan
Environmental Assessment

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Mount Rainier National Park
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Contents

Chapter 1: Purpose of and Need for Action

A. Introduction

The National Park Service (NPS) is considering the implementation of a Fish Management Plan at Mount Rainier National Park. The purpose of the plan is to guide management of native and nonnative fish populations in the park. This Environmental Assessment (EA) evaluates three alternatives: Alternative 1 would continue existing fish management policies, goals and actions. Alternative 2, the preferred alternative, would implement revised fishing regulations consistent with NPS, Washington State, and Endangered Species Act policy, while providing for continued recreational fishing opportunities. Park rivers, streams and lakes would be managed to reduce nonnative fish populations. Nonnative fish would eventually be removed from two streams and from 10 of 35 lakes with reproducing fish populations. Alternative 3 would include Alternative 2 actions, and nonnative fish removal would occur in ten additional park lakes and two additional streams with more complex habitat. In addition, native salmon and bull trout would be reintroduced to stream reaches.

Mount Rainier National Park is comprised of 236,381 acres in west central Washington, on the western and eastern slopes of the Cascade Range. About 83 percent of the park lies in Pierce County and 17 percent is in Lewis County. The park's northern boundary is approximately 65 miles southeast of the Seattle-Tacoma metropolitan area and 65 miles west of Yakima. The elevations of the park range from about 1,400 feet above sea level at the Tahoma Woods Administrative Site to 14,410 feet at the summit of Mount Rainier. About 2.0 million people visit the park annually, with most visitation (75 percent) occurring between June and September. In 1988, Congress designated approximately 97 percent (228,480 acres) of Mount Rainier National Park as wilderness under the Washington Park Wilderness Act.

The focal point of the park is the towering snow- and ice-covered volcano, a prominent landmark in the Pacific Northwest. The base of the volcano spreads over an area of about 100 square miles. Mount Rainier is the second most seismically active and most hazardous volcano in the Cascade Range. The 26 major glaciers that flank the upper mountain cover 35 square miles. Steep glaciated valleys and ice carved peaks dominate the park landscape. The Carbon, Mowich, White, West Fork White, Nisqually, South Puyallup, and North Puyallup rivers and their tributaries carry water from Mount Rainier to the Puget Sound (Table 1). The Ohanapecosh and Muddy Fork Cowlitz flow into the Cowlitz River and on into the Columbia River. There are approximately 470 mapped rivers and streams, including approximately 383 perennial streams and 84 intermittent streams. With very few exceptions (parts of the Huckleberry Creek, Chenuis Creek and Nisqually River watersheds), park rivers and streams originate within the park.

There are also approximately 382 lakes and ponds, and over 3,000 acres of other wetland types (mineral geothermal springs, waterfalls, etc.) (Samora et al. 2013). Originally fishless, there are now 35 lakes with reproducing nonnative fish populations. Approximately 29 of these lakes are in designated wilderness. Among those waterbodies not in wilderness are the Littorals Pond (White River watershed) and Mowich and Tipsoo lakes.

Management Policies (NPS 2006, Section 4.4.3) allows for sport fishing unless it is specifically prohibited by a park’s enabling legislation or proclamation. Fishing is an activity that has the potential to alter the abundance, size and age structure, and behavior of fish populations with consequences for other species and ecosystem functions. The National Park Service allows fishing as a means of providing for public enjoyment and customary and traditional use but must ensure that it is managed in a manner that avoids unacceptable impacts and impairment of park resources. These same policies prohibit fish stocking in park waters and call for management actions that perpetuate native fish species.

B. Purpose

The Fish Management Plan (Fish MP) would direct long-term management for fish within lakes, rivers and streams in the park (Figure 1). The plan is intended to provide a programmatic framework for meeting fish management goals and objectives in all park waters. Long-term fish management goals and objectives in the plan have been designed to manage park fish populations and fishing consistent with the mission and

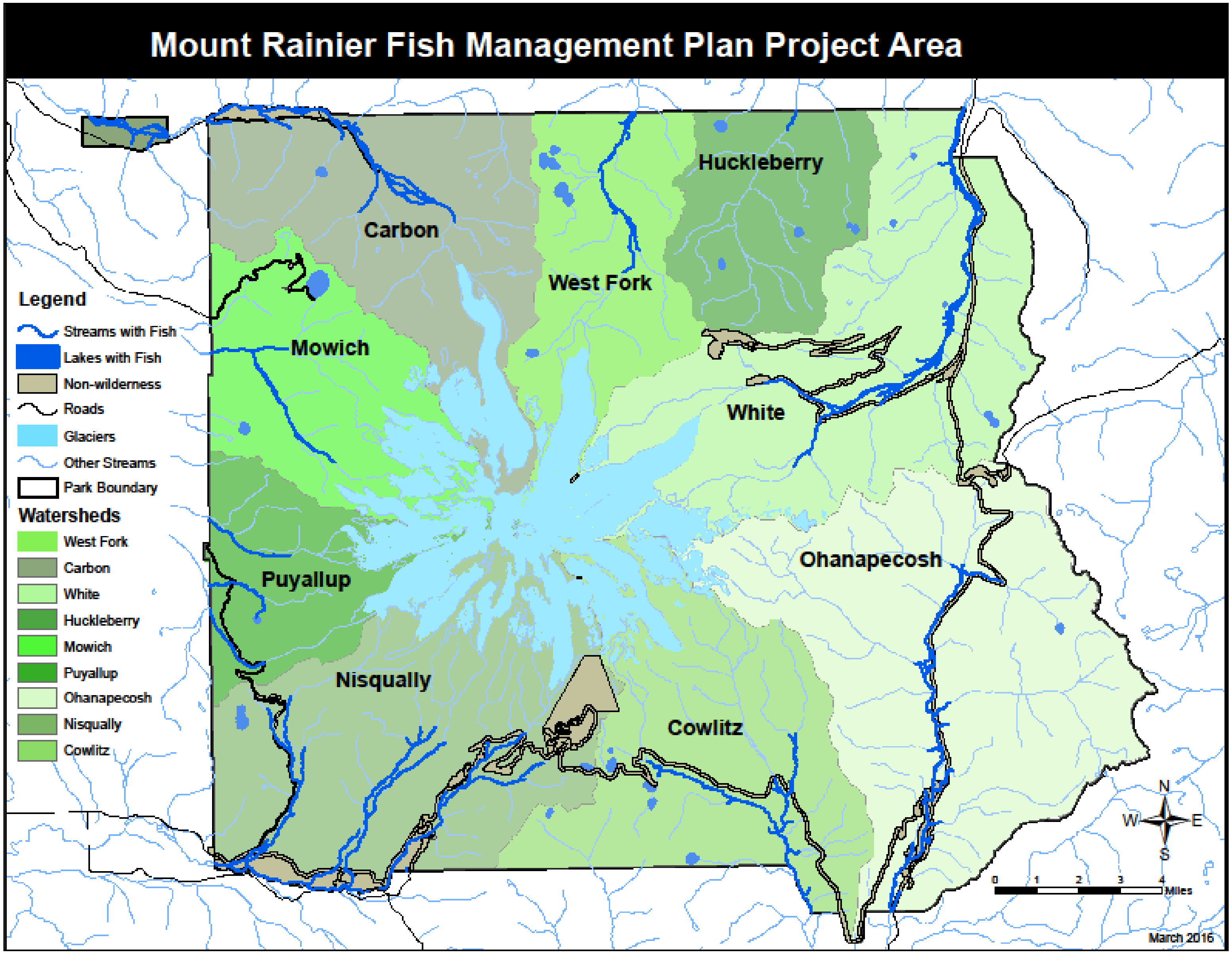

Figure 1. Project area

Table 1: Major Rivers and Watersheds

Major Rivers/Watersheds	Drains To	Destination	Watershed Acreage
Carbon River	Puyallup River	Puget Sound	25,884
Cowlitz River	Columbia River	Columbia River	28,040
Huckleberry Creek	White River	Puget Sound	13,673
Mowich River	Puyallup River	Puget Sound	19,152
Nisqually River		Puget Sound	35,802
Ohanapecosh River	Cowlitz River	Columbia River	41,715
Puyallup River (North and South Fork)		Puget Sound	13,635
West Fork White River	White River	Puget Sound	17,821
White River		Puget Sound	38,961

management policies of the National Park Service and its obligation to recover threatened and endangered species, especially when recovery plans are available. The Fish MP is consistent with Management Policies (NPS 2006) and the Bull Trout Recovery Plan (USFWS 2015). Through the Fish MP, the NPS would conserve native fish populations in Mount Rainier National Park by reducing or eliminating nonnative fish. The NPS would also address other threats to native fish in the park while providing for continued recreational fishing opportunities and related visitor experiences.

Fish management goals identified by the NPS for Mount Rainier National Park include:

- Protect native (including threatened and endangered) fish populations consistent with the biological management policies of the NPS that promote the conservation of native biological integrity.

- Implement actions identified by the U.S. Fish and Wildlife Service (USFWS) and the NPS in the bull trout recovery plan (USFWS 2015). Carbon River bull trout are a genetically distinct population in the Puyallup core area and have been identified as a priority for conservation by the USFWS.

- Reduce the impact of nonnative fish so that they do not create unacceptable impacts to native fish and other wildlife, including amphibians.

- Provide for and regulate recreational fishing opportunities and visitor experiences consistent with the conservation of native species, including fish.

- Restore the natural abundance, diversity, dynamics, distribution, habitats and behaviors of native animal populations that were present prior to the introduction of nonnative fish.

C. Need

A new Fish Management Plan for the park is needed to address the following:

- The park has a statutory responsibility to restore and protect native fish populations and other native aquatic species and to avoid unacceptable impacts to park resources, consistent with the Endangered Species Act (ESA) and the Bull Trout Recovery Plan (USFWS 2015) including designated critical habitat within the park.

- The USFWS and National Marine Fisheries Service have listed populations of bull trout, Chinook salmon, and steelhead as threatened within Mount Rainier. In 2010, the USFWS also designated approximately 30 miles of streams in the park as bull trout critical habitat. The presence of nonnative fish and their impact and potential impact on threatened and endangered fish in the park is inconsistent with the NPS mission and management policies to protect native, including threatened and endangered, species.

- Current park-specific federal fishing regulations do not align with USFWS and NPS goals for native fish species management and recovery. For example, the current regulations provide little to no protection for native fish, including threatened and endangered species. Management that provides for recreational fishing in rivers, streams and lakes in ways that do not harm native fish is needed.

- Listed populations of fish in the park, including bull trout, have been adversely affected through competition and predation by nonnative fish in the Carbon and White rivers and elsewhere in the park.

- Changes in park fish populations and management operations are needed to enable the recovery of bull trout within the park. This plan would contribute to the goal of reducing threats to the bull trout, and to its potential recovery and delisting.

- Nonnative brook trout pose an ongoing hybridization threat to native threatened bull trout in the Carbon River watershed. Similarly, elsewhere in the park, rainbow trout present a hybridization risk to coastal cutthroat trout.

- Habitat in the park that was naturally fishless now contains nonnative fish. Adverse impacts continue to occur to native fish and aquatic communities.

- The results of long-term research into the ecological impacts of historic fish stocking on native fish and wildlife populations have not yet been applied as directed by NPS policies. For example, studies in the park have documented desirable amphibian population increases when fish are removed. The Fish MP is needed to guide efforts to restore natural conditions through nonnative fish removal.

D. Background

Fish Presence in the Park: Fifteen fish species are present in Mount Rainier National Park streams and lakes. Of these, eight are native and seven are nonnative. Fish species include three sculpins (Cottidae), one stickleback (Gasterosteidae), and 11 salmonids (Salmonidae).

Fish populations naturally occur in the nine large valley bottom rivers and their tributary junctions up to natural fish barriers. These rivers bear native fish populations of bull trout (*Salvelinus confluentus*), coastal cutthroat trout (*Oncorhynchus clarkii clarkii*), coho salmon (*O. kisutch*), rainbow (steelhead) trout (*O. mykiss*), Chinook salmon (*O. tshawytscha*), pink salmon (*O. gorbuscha*), mountain whitefish (*Prosopium williamsoni*) and shorthead sculpin (*Cottus confuses*) (Samora 2013). Other sculpins present include slimy sculpin (*C. cognatus*), and torrent sculpin (*C. rhotheus*) (NPSpecies https://irma.nps.gov/NPSpecies/Search/SpeciesList accessed January 2017).

Prior to stocking efforts, there were no naturally occurring fish populations in any of the approximately 380 mapped lakes and ponds in the park (Larson et al. 1992). With the exception of those mentioned above, most of the 470 mapped streams were also originally fishless. Early in the park's history, the NPS and others, including the state, introduced nonnative stocks of rainbow trout (*O. mykiss*), cutthroat trout (*O. clarkia clarkii*), brook trout, and kokanee salmon (*O. nerka*) to enhance recreational fishing. According to unpublished park records, official recorded stocking in the park occurred from 1915 through 1964 (49 years) in 38 streams, and from 1915 through 1972 (57 years) in 44 lakes (Table 2). In some areas iron and concrete barricades were installed to retain fish in the lakes and to make it easier to procure eggs for the Silver Springs Hatchery, established outside the park on the White River (in May 1966).

Fish are currently transported around the Mud Mountain Dam on the White River as mitigation for construction of the dam; a sockeye salmon was found in 2005 in the White River watershed (in Fryingpan

Table 2: Park Watershed Presence of Native and Nonnative Fish

Watershed	Native Fish	Nonnative Fish	Historic Records (Shmoe 1925)	Notes
Carbon[+]	Bull trout* Sculpin sp.[^] Coho salmon* Coastal cutthroat trout* Mountain whitefish Rainbow/Steelhead trout*	Eastern brook trout Cutthroat trout[#]	Chinook salmon* Coho salmon*	Includes designated bull trout critical habitat.
Cowlitz	Coastal Cutthroat trout* Rainbow trout Sculpin sp.[^]	Eastern brook trout Rainbow trout Cutthroat trout[#]		Riffe Dam From genetic surveys in 2006, there may be a native - rainbow trout population near the park boundary (Ostberg 2008).
Huckleberry	Sculpin sp.[^] Rainbow/Steelhead trout* Coastal cutthroat trout*	Eastern brook trout Rainbow trout Cutthroat trout[#] Sockeye salmon[%*]		Mud Mountain Dam Steelhead documented just outside park boundary
Mowich[+]	Bull trout* Sculpin sp.[^] Coastal cutthroat trout*	Eastern brook trout Kokanee Sculpin sp.	Chinook salmon* Coho salmon*	Electron Dam. Includes designated bull trout critical habitat.
Nisqually	Sculpin sp.[^] Coastal cutthroat trout*	Eastern brook trout Kokanee salmon Cutthroat trout[#] Rainbow trout Sculpin sp.		Alder and LaGrande Dams (located at natural fish barriers). 500,000 kokanee stocked annually in Alder Lake.
Ohanapecosh	Coastal cutthroat trout*	Eastern brook trout Rainbow trout Cutthroat trout[#]		Mayfield Lake (dam) Dominated by cutthroat trout. Heavily hybridized.
Puyallup	Bull Trout* Coastal cutthroat trout* Spring run Chinook* Fall run Chinook*	Eastern Brook trout	Coho salmon*	Electron Dam. Includes designated bull trout critical habitat.

Watershed	Native Fish	Nonnative Fish	Historic Records (Shmoe 1925)	Notes
White[+]	Chinook salmon* Coho salmon* Rainbow/Steelhead trout* Bull Trout* Sculpin sp.[^] Coastal cutthroat trout* Pink Salmon[x]	Eastern Brook trout Rainbow trout Cutthroat trout[#] Sockeye salmon[%*] Stickleback		Mud Mountain Dam Includes designated bull trout critical habitat. Chinook, coho, and pink salmon, steelhead and bull trout transported around dam. White River early run Chinook genetically most distinctive stock in central/south Puget Sound, last spring run population in South Puget Sound (Samora et al. 2013)
West Fork[+]	Rainbow/Steelhead trout* Coastal cutthroat trout* Bull Trout* Sculpin sp.[^]	Rainbow trout Cutthroat trout[#] Eastern brook trout	Chinook salmon* Coho salmon*	Mud Mountain Dam

Information from Samora et al. 2013 and Hoffman et al. 2014

*Sensitive species (bull trout [coast Puget Sound DPS]; Chinook salmon, coho salmon, coastal cutthroat [Southwestern Washington/Columbia River ESU], and steelhead). Sockeye are listed outside the park in the Snake River and Ozette Lake.

[#]West slope (*Oncorhynchus clarkii lewisi*) or Yellowstone (*O.c. bouvieri*)

[%]Recent migrant. Although sockeye are currently considered nonnative, no actions that would affect them are planned.

^Other potential park sculpin (native and nonnative) species include Riffle sculpin (*C. gulosus*), prickly sculpin (*C. asper*), Torrent sculpin (*C. rhotheus*), Coast Range sculpin (*C. aleuticus*), reticulate sculpin (*C. perplexus*)

[+]Essential Fish Habitat is present where Chinook, coho, and pink salmon occur in the park; park rivers and streams are included in EFH (Samora et al. 2013).

[x]Unknown whether they are native

Note: Hatchery strains of rainbow, west slope (*O. clarkii lewisi*) and Yellowstone (*O. clarkii bouvieri*) cutthroat trout, and eastern brook trout (*S. fontinalis*) were widely stocked and may have hybridized or replaced some native stocks within their historic ranges (Samora et al. 2013).

Creek). The Cowlitz, Ohanapecosh, Nisqually, Mowich, West Fork and Carbon rivers also have reproducing nonnative trout populations (brook trout, westslope cutthroat trout [*O. clarkii lewisi]*, and Yellowstone cutthroat trout [*O. clarkii bouvierii*]), and genetic surveys have shown that westslope and Yellowstone cutthroat hybridize with native rainbow trout and cutthroat trout (Table 2).

As early as 1976, park planning documents called for the removal of fish from formerly fishless lakes. Lakes were initially ranked by ease of access for fish removal priority (unpublished report: Lake Naturalization Plan c. 1970s). Concerted fish removal efforts occurred at about four lakes, and all but one of these attempts (Tipsoo Lake) were successful. In the meantime, accidental and purposeful introductions of nonnative fish by anglers have continued. For example, despite NPS efforts to remove trout in Tipsoo Lake, unauthorized reintroductions have occurred. More recently, nonnative sculpin (*Cottus* spp.) were introduced into Mowich Lake and Lake George, most likely as bait fish, and threespine sticklebacks (*Gasterosteus aculeatus*) were discovered in Deadwood Lake. Currently 35 lakes are known to have reproducing nonnative fish populations.

E. Issues and Impact Topics from NPS, Tribal and Public Scoping

The general public, as well as federal, state, and local agencies and organizations were provided an opportunity to identify issues and concerns regarding the potential effects from a park Fish Management Plan. Two tribes provided comments during scoping, and several others were present at a meeting where specific information about the project was presented and discussed. A variety of comments were also received from park staff with expertise in fish and wildlife, vegetation, water resources, and planning. These concerns, along with public issues and concerns, have been addressed in this plan.

Most public comments were supportive of the fish management plan and of removing nonnative fish under certain circumstances. Some commenters, however, disagreed about the need to remove nonnative fish from some or all lakes and/or rivers. Public comments also identified concerns about impacts on downstream resources, amphibians, invertebrates and other natural resources. More details regarding public scoping are provided in Section H of this chapter and Chapter 4, Section C.

Impact topics are retained in the Environmental Consequences section if

- The environmental impacts associated with the issue are central to the proposal or are of critical importance;
- A detailed analysis of environmental impacts related to the issue is necessary to make a reasoned choice among alternatives;
- The environmental impacts associated with the issue are a big point of contention among the public or other agencies; or
- There are potentially significant impacts to resources associated with the issue (NPS 2016).

Issues that were generated by internal and public scoping include the following:

- Downstream and non-target impacts of gillnetting and piscicides on water quality, fish and people.
- Effects from past stocking of fish in the park.
- Extent and authorization of wilderness use for fishing.
- Replacing former top predators (amphibians) with fish, and the effects of fish on the abundance and community structure of amphibians, invertebrates, and microscopic plants and animals.
- Effects of continued fishing under current or modified regulations on streams, rivers, and lakes in the park.
- Continued ability to fish in certain park lakes.
- Methods and reasons for removing nonnative fish from lakes and streams.
- What to do when special status fish are hooked.
- Priorities for fish removal efforts.
- Removing unnatural barriers to fish passage, such as culverts.
- Effects of a changing climate exacerbating effects of nonnative fish on native species, such as by more direct predation, introduced diseases, and reduced water levels increasing loss of habitat, especially for breeding.
- Need for monitoring to determine success of efforts.

- Opportunities for anglers to reduce catch of special status species.
- Impacts of the proposed action on Mount Rainier Wilderness character.

As a result, the impacts of the alternatives for the following topics were analyzed in this EA: water resources (hydrology and water quality); fish and wildlife; special status species; visitor experience (visitor enjoyment and human health and safety); and wilderness.

F. Issues and Impact Topics Considered but Dismissed

Issues and impact topics were dismissed from further evaluation if:

- They do not exist in the analysis area, or
- They would not be affected by the proposal, or the likelihood of impacts is reasonably low, or
- Through the application of mitigation measures, there would be no measurable effects from the proposal.

Impacts on Wetlands: Placement of a fish weir in Ranger Creek and/or other Carbon River tributaries (e.g. June, Poch creeks) would affect the stream bottom, itself a riparian wetland (forested riverine wetland). Placement of the weir would be termed temporary fill in a wetland from anchoring it to the bottom. A very small area (less than 0.50 cubic foot) of stream bottom substrate would be penetrated by the weir anchors (T-bar posts driven approximately one foot deep), and the weir itself would cover approximately 10.4 - 26.4 square feet (1.6 x 16.5 feet, 1.6 x 6.5 feet) of stream bottom. Placement would likely meet the regulatory requirements for a nationwide permit under the Army Corps of Engineers and EPA implementation of the Clean Water Act (sections 401/404), likely for Aquatic Habitat Restoration, Enhancement, and Establishment Activities. This temporary disturbance would not result in long-term or permanent loss or disturbance of wetland habitat.

Impacts on Vegetation: The effects of allowing fishing at subalpine and alpine lakes where fish have previously been stocked would continue to result in minimal effects on vegetation, compared to effects from regular trail use, because a relatively small number of visitors participate in recreational fishing. Reflection and Tipsoo lakes would continue to be closed to fishing to avoid additional shoreline impacts on subalpine vegetation at these popular and easily accessible roadside lakes. Although there are no trails designed specifically for fishing access at these heavily visited lakes, a few designated hiking trails and social trails lead to and abut the shorelines. Fishing prohibitions would continue to be beneficial to vegetation in these areas, along with existing swimming and camping prohibitions and resource protection messages reinforced by regular ranger patrols and signs. Some adverse impacts from visitors trampling vegetation near the water's edge where there are no designated access points would continue to occur.

Impacts on Wildlife from Human Activity: There would be a variety of adverse effects from human activity; however these impacts would not be extensive or prolonged.

Impacts from Staff and Research Activities: Overall impacts from staff/researcher camping and other activities would be small. Presence of staff may displace some wildlife. Depending on the species, these animals could be subject in the short-term to additional predation or competition in the area they were displaced to; however they would be expected to reoccupy previous territories as soon as the disturbance ceased. Fish, amphibian and water quality monitoring and research activities could also affect wildlife. Loss of aquatic invertebrates could occur from trampling within streams during electroshocking and during construction of weirs as well as from ongoing monitoring activities. Some disturbance or mortality of invertebrates not able to move quickly away from activities would likely occur. Some wildlife reactions to disturbance would be behavioral, such as flight responses, but these events would not be expected to cause lasting harm.

Impacts on Special Status Mammals: Because there is no evidence that gray wolf, grizzly bear or Canada lynx currently occur within the park, there would be no effect on these species. There would be no change in the availability or quality of potential habitat for these species.

Impacts on Archeological Resources: Although some digging within streambeds is necessary to construct weirs, proposed areas would be surveyed prior to ground disturbance, and installation sites would be relocated to avoid archeological resources.

Impacts on Cultural Resources, Historic Structures, and the Mount Rainier National Historic Landmark District: In addition to its natural wonders, the park has a long history of human activities, including thousands of years of use by Native Americans for hunting and gathering, as well as for spiritual and ceremonial purposes. In the late 19th and early 20th century, miners, climbers, and tourists, among others, arrived. Accordingly, the park has rich and diverse cultural resources, including prehistoric and historic archeological resources and historic structures. Most developed areas of Mount Rainier National park are included in a comprehensive National Historic Landmark District (NHLD) that was designated in 1997. The district was created in recognition of the national significance of Mount Rainier in the history of American park planning and design and the development and implementation of the National Park idea in the early half of the 20th century. Mitigation measures for ground disturbance would be used to avoid impacts to archeological resources, while other built resources, including the NHLD, would not be affected by the proposed plan.

Impacts on Indian Trust Resources: Secretarial Order 3175 requires that any anticipated impacts to Indian trust resources from a proposed project or action by Department of Interior agencies be explicitly addressed in environmental documents. The federal Indian trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights, and it represents a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes. At least six federally recognized tribes have traditional association with Mount Rainier: Muckleshoot Indian Tribe, Puyallup Tribe of Indians, Cowlitz Indian Tribe, Squaxin Island Tribe, Nisqually Indian Tribe, and the Yakama Indian Nation. The proposed action would not limit access or numbers of fish downstream and as such would not have an adverse effect to reserved treaty rights and other trust responsibilities that the NPS has to its traditionally associated tribes. Therefore, Indian trust resources were dismissed from further analysis in this EA.

Impacts on Environmental Justice: USDOI policy requires either an analysis or specific dismissal of environmental justice (USDOI 1997). Ashford and other communities surrounding the park contain both minority and low-income populations; however, environmental justice was dismissed as an impact topic for the following reasons:

- The impacts associated with implementation of the preferred alternative would not disproportionately affect any minority or low-income population or community.
- Implementation of the preferred alternative would not result in any identified effects, including human health effects specific to any minority or low-income community.

No measureable impacts on the socioeconomic environment would occur as a result of implementation of the alternatives. Impacts on the socioeconomic environment would not affect the physical or social structure of nearby communities.

Impacts from Interpretation and Education Efforts: There would be long-term beneficial impacts on visitor experience from improvements in interpretation and education for recreational anglers. Providing direct information, such as through a fishing guide or app, would help anglers distinguish native from nonnative fish and ascertain fishing regulations, thus limiting confusion while facilitating behaviors that benefit native fish. Information would also be provided about the level of mercury contamination in the park's fish populations, which have been shown to be subject to exposure through atmospheric deposition. These communications would benefit anglers and others interested in fish.

Impacts on Wild and Scenic Rivers: The National Wild and Scenic Rivers System was created by Congress in 1968 (Public Law 90-542;16 U.S.C. 1271 et seq.) to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. Under Alternatives 2 and 3, there would be temporary adverse effects on rivers potentially eligible for the National Wild and Scenic River System. However, these impacts would not noticeably affect the characteristics that contribute to eligibility. Fish weir operations on tributaries to the

Carbon River and electrofishing on the Carbon and West Fork White and Muddy Fork tributaries would temporarily and negligibly affect the free flowing characteristics of these rivers. Other temporary adverse effects on outstandingly remarkable values, such as fish and wildlife, would not measurably affect the characteristics that make these rivers potentially eligible. Treatments using electrofishing or piscicides would primarily affect tributaries. Adverse effects, primarily on nonnative species, would be combined with widespread and long-term beneficial effects on native fish, amphibians, and invertebrates in potentially eligible wild and scenic rivers and their tributaries as a result of removal of nonnative fish from some lakes and tributaries. Initially, beneficial effects would be most pronounced from the removal of brook trout associated with the Carbon River.

G. Decision to be Made

This Environmental Assessment (EA) will be used by the NPS Pacific West Regional Director to make a decision, based on a recommendation from the Superintendent of Mount Rainier National Park, about whether to implement a new Fish Management Plan for the park. This decision will be documented in the anticipated Finding of No Significant Impact (FONSI) for this EA. If the EA had revealed significant impacts on park resources from the project, an Environmental Impact Statement and Record of Decision would have been prepared.

H. Summary of Public Scoping

A scoping newsletter was released May 5, 2016, and posted on the NPS Planning, Environment and Public Comment (PEPC) website to solicit public comment on the proposed plan. Newsletters were mailed to the park's public scoping mailing list and included the interested public, libraries, tribes, agencies, and several media outlets, including major newspapers. The newsletter provided the following three optional questions for commenters to answer:

1) Where do you fish within Mount Rainier National Park? What fishing opportunities within the park are most important for you to maintain?
2) What suggestions do you have for changing the current fishing regulations at Mount Rainier? How would these changes meet National Park Service, U.S. Fish and Wildlife Service, and Washington Department of Fish and Wildlife goals for managing native fish populations?
3) What methods do you think should be used to remove nonnative fish in selected lakes in the park, if any?

Approximately 26 people responded to the preliminary alternatives scoping request, which included three alternatives (Alternative 1: No Action, Alternative 2: which focused on mechanical methods to remove nonnative fish, and Alternative 3: which allowed for both mechanical and chemical methods to remove nonnative fish). Also included in the newsletter was background information. Most comments were supportive of the fish management plan and of removing nonnative fish under certain circumstances. Some commenters, however, disagreed about the need to remove nonnative fish from some or all lakes and/or rivers. The Seattle Times released an article summarizing the proposal on July 23, 2016. The proposal was also featured on NWHikers.net on June 6, 2016, where several people commented.

Most comments addressed the three questions, but commenters also identified concerns about impacts on downstream resources, amphibians, invertebrates and other natural resources as described under *Issues and Impact Topics*.

Of those who expressed a preference for one of the preliminary alternatives, two commenters favored Alternative 2, two favored some combination of Alternatives 2 and 3, and four favored Alternative 3. One commenter stated that they had no alternative preference. Favorite fishing areas included the Ohanapecosh River (1 commenter) and high elevation lakes (4 commenters), specified as lakes on the east and north, lakes on the north including the Carbon and White river watersheds, hike-in lakes, and alpine lakes of any size. Three commenters noted that they did not fish, one commenter fishes at Olympic National Park, and one commenter did not understand the value of recreational fishing in the park.

I. Federal, State, and Local Permits and Consultation Requirements

Because of potential effects on species listed under the Endangered Species Act, this environmental assessment requires formal consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service, including a biological opinion. Instream actions would also likely require a nationwide permit under the Clean Water Act for impacts to water quality and wetlands (Sections 401 and/or 404). In addition, proposed changes to park fishing regulations would require publication of these in the Federal Register, along with an additional subsequent (separate) public comment process.

Chapter 2: Alternatives, Including the Proposed Action

This chapter describes the alternatives. An *Impact Comparison Chart* (Table 9) compares the environmental effects of the alternatives.

A. Introduction

The alternatives were generated using NPS management policies, analysis of the status of current park fish populations, interdisciplinary team analysis, tribal and public scoping, and consultation with applicable agencies and organizations.

As a programmatic and implementation document, covering a wide framework of proposed large- and small-scale actions, some specific actions would require subsequent environmental impact analysis. These would also likely include additional opportunities for public comments.

CURRENT MOUNT RAINIER NATIONAL PARK FISHING REGULATIONS

Title 36: Parks, Forests and Public Property: Part 7: Special Regulations, Areas of the National Park System

§ 7.5 Mount Rainier National Park

(a) Fishing.

(1) The following waters are closed to fishing:

i. Tipsoo Lake.
ii. Shadow Lake.
iii. Klickitat Creek above the White River Entrance water supply intake.
iv. Laughing Water Creek above the Ohanapecosh water supply intake.
v. Frozen Lake.
vi. Reflection Lakes.
vii. Ipsut Creek above the Ipsut Creek Campground water supply intake.

(2) Except for artificial fly fishing, the Ohanapecosh River and its tributaries are closed to all fishing.

(3) There shall be no minimum size limit on fish that may be possessed.

(4) The daily catch and possession limit for fish taken from park waters shall be six pounds and one fish, not to exceed 12 fish.

B. Description of the Alternatives

Alternative 1: No Action (Continue Current Management)

This alternative would continue existing fish management policies and practices in the park. This alternative is intended to serve as a baseline to compare the action alternatives.

In Alternative 1, nonnative introduced fish would continue to compete with, displace, hybridize with and predate on native and threatened fish and other aquatic species in each of the nine major watersheds in the park. There would continue to be no brook trout in three high elevation lakes, where they were previously removed (Harry, Upper Palisades, and Hidden lakes).

Summary of Alternative 1

- Current fishing regulations (see sidebar, explanation below, and Appendix 1) would continue to be inconsistent with NPS native species management policies and would not fully protect threatened species, such as bull trout, from harvest.
- There would be ongoing removal of human-constructed barriers to native fish migration into historically occupied habitat.
- The park would continue to study and monitor native and nonnative fish populations to better understand how to manage them.
- This alternative would partially meet the goals of the Bull Trout Recovery Plan.

Description of Alternative 1

Maintain existing fishing regulations

Existing Mount Rainier fishing regulations (36 CFR 7.5) are shown in the sidebar. The park's fishing regulations also include the following prohibitions from the superintendent's compendium and 36 CFR 2 included in Appendix 1:

- No fishing for bull trout or Dolly Varden.

- No fishing for Chinook or coastal cutthroat
- Ghost Lake (water supply) closed to fishing
- Edith Creek Basin above the Paradise water supply closed to fishing
- No Washington State fishing license required
- Hook and line fishing only
- No use of live bait
- No bait in streams and rivers

Existing fish regulations are generally inconsistent with NPS guidelines and USFWS management direction for species listed or proposed as threatened or endangered under the Endangered Species Act (ESA). Under existing fishing regulations, there would continue to be little or no protection for native rare, threatened, or endangered fish species. There would also continue to be no difference in how native or nonnative fish are caught and harvested. Although stocking has long since ceased, originally fishless alpine lakes and streams would continue to contain reproducing populations of nonnative fish not part of the natural ecosystem.

Bull Trout Recovery Plan Implementation (USFWS 2015)
As called for by the bull trout recovery plan, the park would continue to implement human-constructed barrier removal. The recovery plan calls for providing maximum access to tributary streams by ensuring fish passage at culverts located near the confluence of spawning tributaries with mainstem rivers.
The recovery plan also calls for reducing the contribution of road related impacts (mass wasting, sediment delivery, impaired fish passage) in bull trout spawning and rearing habitats.

To improve fish habitat, the park has been systematically addressing trail and road culverts that reduce or block fish passage; this includes hanging culverts, poorly placed culverts, and inadequately sized culverts. A list of those culverts still needing action as of the date of this plan is provided in Appendix 3/Table 12. In addition, a more detailed survey is needed at Ohanapecosh to determine whether there are additional culverts needing replacement. These barrier culverts would continue to be addressed under Alternative 1. Culvert replacement would only occur between July 15 and August 15, and most replacements are anticipated to be completed within the next five years.

Continued Research and Monitoring of Native and Nonnative Fish Populations
Park staff currently conduct fall bull trout spawning surveys in the White and Carbon River watersheds; fish surveys in six mountain lakes associated with the North Coast and Cascades Network (NCCN) Mountain Lakes Monitoring program; monitoring of park flood protection projects and fish passage barrier culvert replacement and their impacts on native fish; and studies of juvenile and adult bull trout migration in the park (in coordination with USFWS). These inventory, monitoring, and research activities would continue at generally the same levels under Alternative 1.

Alternative 2: Native Species Management (Proposed Action/Preferred Alternative)

Alternative 2 goals include:

- Reducing or eradicating brook trout in bull trout critical habitat, beginning with headwaters' source populations.
- Eradicating introduced fish in lakes where it would most improve opportunities for native amphibian survival and persistence.
- Eradicating introduced fish in lakes where it is most feasible.
- Eradicating introduced fish where the presence of these most threatens native aquatic ecosystems.

Alternative 2 would implement revised fishing regulations consistent with NPS, Washington State, and ESA policy, while providing for continued recreational fishing opportunities. Park rivers, streams, and lakes would be managed to reduce nonnative fish populations. Because nonnative fish populations would not be removed from all water bodies, they would remain at varying levels; therefore this alternative would only partially meet NPS and ESA direction for managing fish in the park.

Summary of Alternative 2

- Elimination of human-constructed barriers, including undersized or poorly located culverts (same as Alternative 1).
- New fishing regulations (see below) emphasizing catch and release of native fish species and retention or harvest of nonnative fish species.
- Implementation of most actions called for in the Bull Trout Recovery Plan for the park; removal of all source populations of brook trout above known fish barriers in bull trout habitat.
- Nonnative fish suppression and/or eradication from selected areas using citizen science angling, gillnetting in lakes and lake outlets, seining in streams, electrofishing, a fish weir (trap), and piscicides. Mechanical treatments (electrofishing, gillnetting, and weir traps) would be implemented for five years and evaluated for success before chemical treatments are proposed.
- Phased fish removal from up to 10 lakes with reproducing fish populations on a priority basis.
- Expanded research and monitoring of native and nonnative fish populations. Use of adaptive management to alter management actions based on monitoring results.
- New emphasis on interpretation, education and outreach to communicate new fishing regulations and the purpose and goals of this Fish Management Plan.
- Use the minimum tool required for all activity in Wilderness to minimize impacts on wilderness character.

Description of Alternative 2

In addition to the actions described in Alternative 1 (barrier modifications and research and monitoring), additional components would be included as part of Alternative 2.

New Fishing Regulations

Overall NPS regulations for fishing in Mount Rainier National Park would include those listed in CFR 2.3 (Appendix 1) and:

- Fishing season for streams and rivers would begin the first Saturday in June and extend through October 31, with the exception of Mowich, Carbon, West Fork, White and Huckleberry Creek, which would be closed after Labor Day to protect spawning bull trout.
- Single point barbless hooks in streams and rivers.
- Continued prohibition of fishing in or near water intakes on Klickitat Creek above the White River Entrance; Laughingwater Creek above the Ohanapecosh water intake; and Edith Creek basin above the Paradise water supply intake (similar to current regulation, minus Ipsut Creek)
- No fishing in Fryingpan Creek above the confluence of the White River.
- Catch and release of all native fish (streams and rivers throughout the park).
- Required retention of brook trout throughout the park, and rainbow trout and kokanee retention in select watersheds.
- No use of lead weights.
- Continued prohibition of fishing in Reflection, Tipsoo, Frozen, or Shadow lakes (same as current regulation).

In addition, the following exceptions would apply at park lakes:

- Multipoint hooks with barbs can be used.
- Dead and artificial bait can be used.
- No seasonal restrictions, and spawning fish may be taken.
- No catch limits for fish caught.
- Required retention of all species caught.

Regulation changes would be intended to reduce populations of nonnative fish through recreational fishing and to support native fish population management in the park (Table 3).

Implementation of Bull Trout Recovery Plan (USFWS 2015)
In addition to addressing the effects of partial or fully impassable culverts, park applicable actions in the bull trout recovery plan call for reducing the presence of brook trout because they pose a significant risk of hybridization within the Carbon River local population. The recovery plan recommends that specific efforts should prioritize removal in known bull trout spawning areas.

Lakes: Actions to reduce brook trout populations in lakes could include physical and chemical methods (gillnetting, electrofishing, piscicide use) and supervised citizen science angling to reduce or eliminate nonnative fish. Lakes where nonnative fish removal would be implemented are listed in Table 4/Appendix 2. No bull trout have been detected in any of the lakes proposed for treatment as determined by gillnetting, snorkeling, and/or angling surveys.

Streams: Source populations for brook trout in the Carbon River would also be reduced or eliminated. For example, Upper Ipsut Creek and Tolmie Creek have very low density brook trout populations occupying approximately 1.24 miles of headwater stream above waterfall barriers. Removing these fish via electrofishing would reduce the threat of their outmigration into the Carbon River and the possibility that they would breed with and compete with and/or displace bull trout.

Table 3: Summary of Proposed Fish Regulations

Watershed	Proposed Fishing Regulations	Notes
Carbon	• Retention of brook trout • Release of all other species	Bull trout and coho salmon present. Steelhead likely present
Cowlitz	• Retention of brook trout • Release of all other species	
Huckleberry	• Retention of brook trout • Release of all other species	
Mowich	• Retention of brook trout • Release of all other species	Bull trout present
Nisqually	• Retention of brook trout and kokanee • Release of all other species	Kokanee are not native to the system and are stocked outside the park
Ohanapecosh	• Retention of brook trout • Retention of all rainbow trout above Silver Falls • Release of all other species	Rainbow found above Silver Falls are not native
Puyallup	• Retention of brook trout • Release of all other species	Bull trout, and possibly Chinook salmon present
West Fork White	• Retention of brook trout • Release of all other species	Bull trout, coho and Chinook salmon also present. Steelhead possibly present.
White	• Retention of brook trout • Release of all other species	Bull trout, steelhead, coho and Chinook salmon present.

Methods for Fish Removal

To minimize non-target effects, mechanical methods (electrofishing, fish weirs, and gill nets) would be used first. The method would depend on the characteristics of the waterbody, with the most efficient means used depending on existing nonnative species. The use of mechanical methods would be used first for up to five years. Analysis of success would determine the additional need for piscicide use. Mechanical and chemical methods could be used independently or in combination for fish removal.

Mechanical

Gillnetting

Gillnetting is a method of fish collection that can be used in a variety of still water bodies (e.g. lakes and ponds) (Figure 2). Gillnetting involves placing nets that capture fish as they move around the lake. Mesh size varies from 0.4 inches to 1.5 inches and the size of nets also varies. Mesh size, length and width would be varied as needed for effective catch. Nets are typically set using inflatable watercraft during daylight hours and checked once a day; the captured fish are removed and the net is reset. Depending on fish catch, some deep water nets could be overwintered. Gillnetting would be the first method used to eradicate fish from lakes. To minimize amphibian capture, gillnets would be placed away from the shoreline when practical. Before gillnets are used in another waterbody, they would be washed and decontaminated per methods described in the park's decontamination protocol (Samora et al. 2011). This protocol includes thorough cleaning of all equipment, including waders worn by biologists and nets, before use elsewhere in the park. Fish captured by gillnetting would be disposed of near the edge of the littoral zone in backcountry locations, sunk in deep lakes, or packed out of front country locations to be disposed of in a specified dumpster.

Electrofishing

Electrofishing is a labor intensive method of fish capture which employs a backpack electrofisher to send a battery-operated low-voltage current through the water (Figure 3). When the equipment is activated and both electrodes are submerged, the resultant current temporarily stuns fish. Electrofishing has been used successfully for approximately 100 years (Cowx and Lamarque 1990 *in* NPS SEKI 2016). Stunned fish are captured using dip nets. Electrofishing can be used to inventory and monitor fish or to capture them for euthanization. Nonnative captured fish would be euthanized by decapitation or pithing (piercing the spinal cord). Electrofishing is done by a minimum of two people (usually three) wearing waders and other personal protective equipment; it is best accomplished in shallow water, such as in streams and near the edge of lakes. For small streams lacking native fish populations, electrofishing would be used with lethal, rather than stun, settings to improve efficiency.

Electrofishing is best done from downstream to upstream and requires repeated passes through an area to capture stunned fish and to fish within small pools, such as near rocks, under overhanging banks and/or adjacent to logs.

Figure 2: Gillnetting a Mount Rainier High Elevation Lake (NPS Photo).

Electrofishing in bull trout habitat is intended to be used only if other mechanical methods are ineffective for nonnative fish removal. If necessary, limited electrofishing in bull trout habitat would only occur between July 15 and August 15 to avoid impacts to developing eggs and alevins, and would occur no more than once per year at each location. Electrofishing in lakes and lake outlets (non-bull trout habitat and no ESA listed species present) could occur anytime from July to October, with the option for repeat visits.

Seining
Seining is a method of fish sampling that involves the use of a long fence-like net to encircle and draw in fish to the shoreline for collection by dip netting (Hayes 1992). The top edge of the sein has floats attached to keep the net upright in the water, and the bottom edge of the net is weighted to keep it on or near the bottom. Depending on the success of citizen angling, Ipsut, Ranger, June, Poch, and Tolmie creeks in the Carbon River Watershed would be seined. Seining would occur in the Carbon watershed from July 15-August 15th. Seining would be conducted in Carbon River treatment sites where habitat conditions allow, that is, areas with limited instream wood and velocity. Each site could be seined up to one time annually if the other methods (weir trap, above barrier electrofishing, and citizen science angling) are not effective in reducing brook trout populations after two years of effort.

Seins, once pursed (ends brought together), remain partially in the water while fish are removed with dip nets. All fish would be identified while entrapped in the sein. Only brook trout would be dip netted and removed from the sein. The remaining native fish (such as coastal cutthroat and bull trout, coho salmon, and rainbow trout/steelhead) would be released without handling or removal from the water.

Fish Weirs
A weir is a fence-like barrier erected across a stream (Figure 4). Water flows through the structure, but fish above a certain size are diverted to a trap. Biologists monitoring the device would ensure that the weir is operating properly; check and remove fish from the trap frequently; clear away accumulated debris; ensure that no other wildlife or non-target fish species are negatively affected by the weir; remove the weir should a flooding event or safety issue occur; and answer inquiries from park visitors about the purpose and need for the weir (NPS GRCA 2014).

In the Carbon River area, coinciding with headwaters area brook trout removal via electrofishing in upper Ipsut and Tolmie creeks, the park would install an upstream and a downstream fish weir near the mouth of Ranger Creek and operate it from August 1 to November 15 annually, or until no longer needed. The weir would be used to trap fish. All nonnative fish would be euthanized, while all native fish would be released unharmed.


Figure 3: Electrofishing a Mount Rainier Bull Trout Stream (NPS Photo)

Ranger Creek is the largest tributary in the watershed with 2.24 miles of spawning habitat and both brook and bull trout. If the effort at Ranger Creek is successful at collapsing the brook trout population, a second weir could be installed in the next largest spawning tributary in the Carbon watershed, June Creek, which also has brook trout and bull trout.

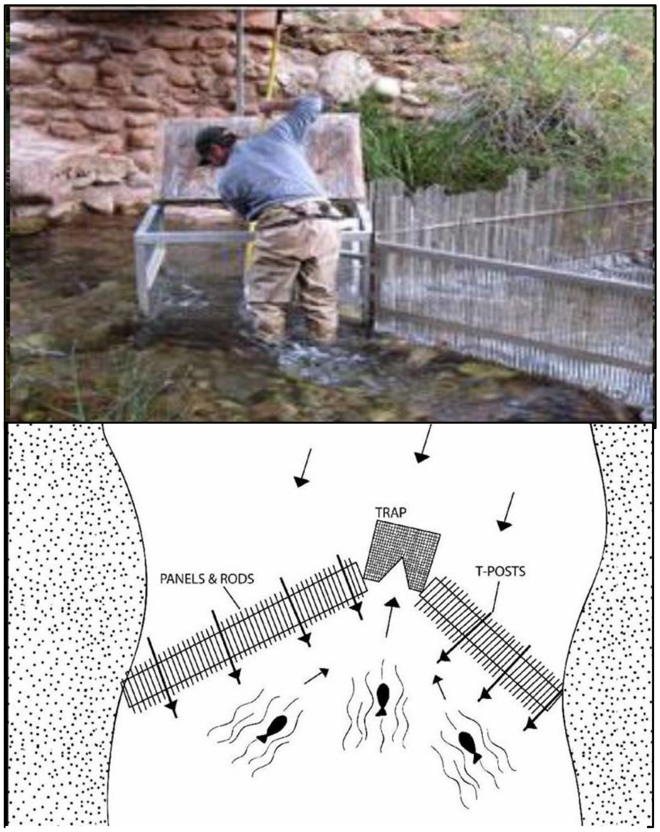

Figure 4: Typical Alaska Weir (Drawing from NPS GRCA 2006:13)

Combined, these tributaries comprise approximately 35 percent (4.23 miles) of available bull trout spawning habitat in the upper Carbon River Watershed.

These two sites were identified because of the high proportion of available habitat they represent and their relative ease of access for maintaining the trap(s). Ranger and June creeks are also perennial streams, offering spawning sites that do not run dry in drought years. Other Carbon River area tributaries (such as Falls and Spukwush creeks, the next two longest tributaries) also comprise approximately 35 percent of available habitat but may be dry in some years. Ranger and June creeks are also the most protected sites from Carbon River inundation during flooding and are the most likely long-term viable spawning sites as main river channel widening processes continue to reduce available spawning habitat in the watershed.

If needed, another potential weir site is Poch Creek, which offers some of the same characteristics as Ranger and June creeks, but which comprises a smaller percentage of habitat (<5 percent) with high densities of brook trout.

Citizen Science Angling

In the Carbon River and its tributaries, some areas would be targeted for supervised citizen science angling to suppress brook trout. After adult angling capture efficiency drops, some areas of known brook trout juvenile congregants would be electrofished and seined to target juvenile fish.

Groups of supervised volunteers would also fish at targeted sites throughout the Carbon River watershed to remove as many brook trout as possible and to monitor the success of fish restoration efforts via data collected on catch per unit of effort. Anglers would target Ipsut Creek, Ranger Creek, and side-channel and backwater areas of the Carbon River. The field portion of the citizen science angling project would take place on weekends between July 1 and Labor Day. Angling groups would rotate through the treatment sites visiting each site with a guide twice, once in July and once in August. Angling is intended to supplement the fish weir(s) and electrofishing efforts and to target areas where it is difficult to remove nonnative fish without harming native bull trout when using other methods.

Chemical Fish Removal: *Piscicide Use*

A piscicide is a substance that is toxic to fish and whose intended function is to eliminate all fish from a water body. In addition to gillnets and electrofishing, the park would employ limited use of chemical piscicides in high elevation lakes and the White River Ponds if mechanical removal proves ineffective in eliminating nonnative fish (after five years of monitoring) or where mechanical treatment is infeasible. Piscicide treatment would occur in the fall, after September 15, and would generally be used once at each site needing treatment. Among the piscicides that would be proposed for use are rotenone and, if available, antimycin.

Rotenone (derived from plants) and antimycin (derived from bacteria) are the only piscicides that have been approved by the Environmental Protection Agency (EPA) for removal of fish from fresh water habitats. Piscicides, particularly rotenone, have been used for decades by fishery managers to remove undesirable fish. Recent projects at North Cascades and Sequoia-Kings Canyon national parks have utilized or propose to utilize piscicides (NOCA 2008, NOCA 2013, SEKI 2016). Although North Cascades National Park found a small benefit to using antimycin over rotenone in the park's 2008 environmental analysis, the park subsequently found that antimycin was no longer being manufactured and therefore switched to the use of rotenone (NPS NOCA 2013). Like many chemical pesticides, rotenone and antimycin are known by several different trade names (Fintrol Concentrate™, Antimycin A™, CFT Legumine™, Synpren-Fish™, Prenfish™, and Prentox Fish Toxicant Powder™) and have different manufacturers (Aquabiotics Corp., and Prentiss, Inc.) (NPS NOCA 2013). Both are registered for use in Washington State (http://www.ecy.wa.gov/programs/wq/pesticides/seis/risk_assess.html accessed 2-13-17).

Once effective fish elimination has been achieved, potassium permanganate is used to neutralize areas treated with rotenone. Potassium permanganate is a chemical used to treat drinking water supplies and has minimal effects on oxidation, colors, and odors (see Environmental Consequences section). Antimycin is neutralized with the same chemical but dissipates more readily through oxidization. Potassium permanganate quickly reacts with a variety of rotenone compounds diminishing it to concentrations that are not harmful to aquatic or terrestrial organisms. In streams, normal flow from riffles and cascades quickly re-oxygenates water.

To minimize the use of piscicides, mechanical methods would be attempted first for all targeted lakes. Beginning with mechanical methods would allow the NPS the opportunity to learn more about each individual fish population, while decreasing the population size. Mechanical methods may potentially reduce the number of piscicide treatments needed, or may eliminate the need for piscicide treatments altogether. In this plan, mechanical methods are proposed for even some large deep lakes (Golden Lakes, 24 meters). Nonetheless, for larger lakes with complex habitat and other characteristics that may make removal using mechanical methods difficult or impossible, use of piscicides may be necessary.

In the event that piscicides are necessary in lakes where nonnative trout coexist with native trout, the impacts to native trout would be mitigated by prior removal of native fish and reintroduction post treatment to the extent practical. There are only three ponds in the White River Watershed where this potential exists, and genetic testing is underway to confirm whether there are both native and nonnative fish.

Lakes and Streams Targeted for Fish Removal

Fish would generally be removed from the areas identified in Table 4. Other water bodies, such as the ten additional lakes proposed for fish removal in Alternative 3 (Table 4) and the 15 lakes with no scheduled fish removal, would likely retain fish for an indefinite period, pending actions in priority lakes, streams and rivers. Some water bodies, including those where fish were never stocked or have already been removed (Harry Lake, Upper Palisades, and Hidden lakes) would remain fishless. In addition to the water bodies (10 of 35 lakes with reproducing nonnative fish populations), more than 1565 linear meters (0.97 miles) of stream segments (Table 3) would also be targeted for nonnative fish removal in Alternative 2.

Criteria for Fish Removal

To meet the goals regarding fish eradication identified for Alternative 2, the following are among the criteria the park has used to prioritize fish removal actions:

- Effects on rare, threatened species (*Reduce or eradicate brook trout in bull trout critical habitat, beginning with headwaters' source populations*.)
- Threat to amphibians/improve climate change resilience for sensitive amphibians (*Eradicate introduced fish in lakes to improve opportunities for native amphibian survival and persistence*.)
- Feasibility of fish removal/potential for success using mechanical methods (*Eradicate introduced fish in lakes where it is most feasible*.)
- Threat to native ecology of lakes (*Eradicate introduced fish where the presence of these most threatens native aquatic ecosystems*.)

In Alternative 2, initial actions would take place in areas where the distance to adjacent amphibian habitat and proximity to bull trout would have the greatest beneficial impact. Lakes with the highest probability of success, for instance, are lakes that are shallow and have limited (<400 m/ 0.25 miles) connected inlet and/or outlet streams.

Based on the priorities noted above, park biologists have identified the likely number of lakes and stream reaches that would be targeted for fish removal under each criterion (Appendix 2/Tables 10 and 11).

1. Identify lakes with nonnative fish. (There are 35 lakes with nonnative fish.)
2. Identify lakes with brook trout. (There are 15 lakes with brook trout.)
3. Identify known stream reaches with brook trout above native fish barriers. (There are 7 reaches with brook trout above natural fish barriers.)
4. Identify/prioritize overlap of headwater source brook trout populations in step 2 and 3 and bull trout critical habitat. (There are 12 areas where bull trout overlap with brook trout.)
5. Identify all potential treatment lakes which improve climate change resilience for sensitive amphibians. (There are 23 lakes where climate change resilience for amphibians could be improved.)
6. Omit or reduce priority sites with habitat determined to be more complex leading to a lower probability of successful eradication via mechanical or chemical treatments. For connected lakes and streams, this would be those that have 2 or more connected lakes, or are more than 25 acres, more than 25m deep, and/or longer than 400 m. (There are 19 sites where there is a lower probability of eradication based on these criteria.)
7. Prioritize lake sites with the best chance of successful fish removal via mechanical methods (<7 acres area, <0.25 miles (400m) of connected stream habitat). (There are 10 lakes where fish removal with mechanical methods would work best.)

Table 4: Ten Lakes and Lake Outlets with Proposed Fish Removal in Alternative 2

Priority	Name	Watershed	Depth In meters	Acres	Elevation in meters	Linear meters of stream habitat	Brook trout	Rainbow trout	Coastal Cutthroat Trout*	Nonnative Cutthroat trout
1	Littorals Pond	White	2	0.38	1123	180	x			
2	Unnamed Lake	Puyallup	12	3.94	1371	150	x			
3	Unnamed Lake	Huckleberry	8.9	6.24	1685	50	x			
4	White River Ranger Pond*	White	4.9	0.36	973	10	x		x	
5	White River Ranger Pond*	White	3.2	0.22	981	80	x		x	
6	White River Ranger Pond*	White	5	0.66	984	320	x		x	
7	Golden Lakes	Mowich	24	18.15	1370	100	x			
8	Golden Lakes	Mowich	0.5	2.58	1290	150	x			
9	Tipsoo Lake	Ohanapecosh	2.6	4.57	1615	150		x		
10	Bear Park Lake	White	3.5	2.36	1646	375				x
TOTAL				**39.46**		**1565**				

* Genetic testing has yet to confirm these are nonnative.

8. Prioritize stream sites based on location. Carbon River tributaries are first priority and stream length determines method (>0.31 miles (500m) of connected habitat would require chemical use, >1000m omitted)
9. Prioritize the twenty lakes and four stream treatment sites based on above criterion 1-7 in order.

Based on the above priorities, initially fish would be removed from 10 lakes. These lakes include all lakes currently containing brook trout within watersheds occupied by federally threatened bull trout. Brook trout have the potential to hybridize with bull trout. Recreational fishing opportunities would continue in 25 lakes. Gillnetting and electrofishing would be conducted at high priority sites for up to five years. Once removal method assessments were completed, further analysis would determine the need for piscicide use.

Expanded Research and Monitoring
A monitoring and adaptive management program would be developed. Through a continual process of improvement using adaptive management, the NPS would analyze management decisions by considering options, implementing actions, evaluating results, conducting additional research, and then using this information to modify future management actions.

Monitoring results would be used to provide site specific information to inform future management actions, including modifying existing actions and/or regulations that may not be having the desired effect, based on analysis of success. This includes planning management actions, implementing those actions, and learning from those actions, and then using what was learned to plan new or modified management actions in a continuous cycle of improvement (Figure 5).

Based on monitoring, the park would determine whether goals for native and nonnative fish are being met. Under an adaptive management strategy, existing actions would continue unless they are not meeting the goals for native and/or nonnative fish populations. If implementation shows fish management actions are not meeting the goals, additional management actions, such as those identified in Alternative 3, would be evaluated, including conducting future environmental impact analysis.

The park would also continue to modify management actions as needed if monitoring shows unanticipated adverse effects on native fish species. For example, if surveys caused harm to individual bull trout, actions would be modified to omit the harm. In general, modifying management actions to remove nonnative fish from lakes would outweigh small, short-term anticipated effects on amphibians and other species (see Environmental Consequences chapter).

Monitoring data associated with each action undertaken would be collected to document successful native fish and amphibian recovery. The following are examples of monitoring which may be done:
- Amphibian and invertebrate diversity and abundance in lakes before and after fish removal
- Fish population genetics monitoring and assessment
- Brook trout abundance in Carbon and White rivers at treatment sites
- Brook trout movement and spawning assessment in Carbon River
- Response of native fish to nonnative fish reduction/eradication
- Habitat utilization before and after fish passage barrier removal
- Angler volunteer self-reporting cards consisting of species and size of fish caught, location, time, method, and mortality.

Educational and Interpretive Strategies
The following educational strategies would be part of Alternative 2:
- Creating a fishing guide with park fishing regulations and additional information including fish species present in the park, appropriate methods to handle fish, and aquatic invasive species information.

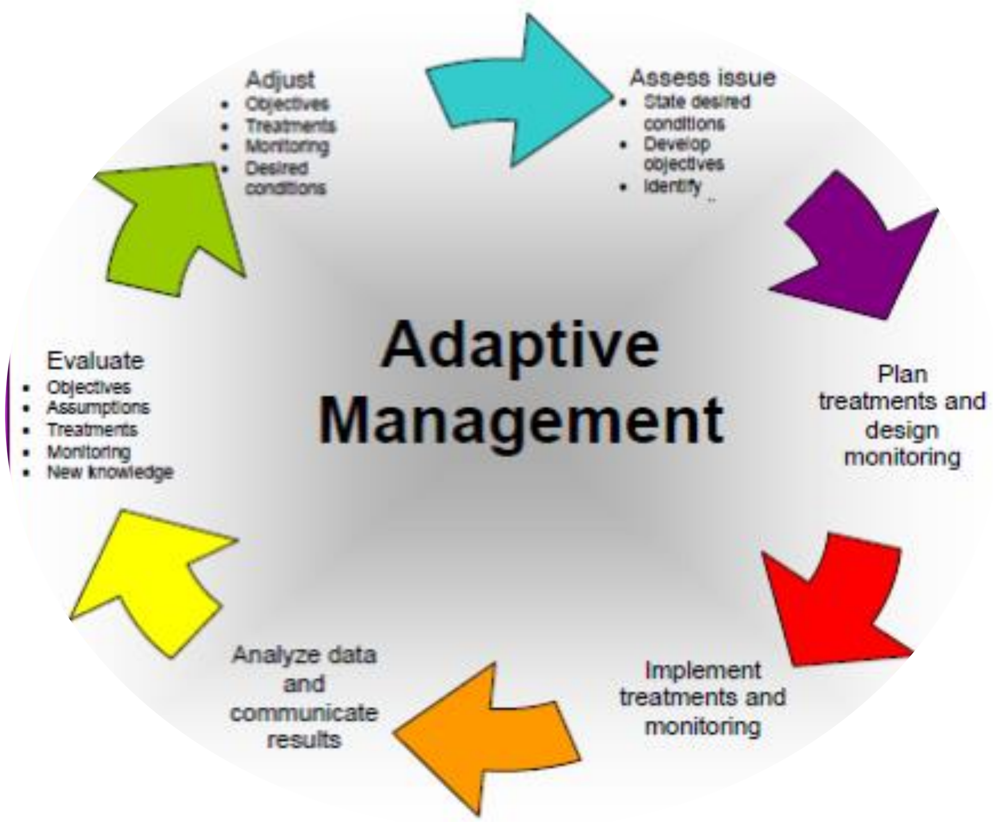

Figure 5: Adaptive Management Framework

- Using the citizen science model to recruit and train nonnative fish removal program volunteers to help with stream and lake fish removal projects.
- Creating or taking advantage of a fishing phone app to provide information about park fishing regulations and/or special status fish species and habitats.

Collaboration with Partners
The park would also collaborate with partners to implement the Fish Management Plan and work with stakeholders to promote native fish recovery. Collaboration efforts may include identifying barriers to restoration of native fish species and ecosystem recovery within the park, and where possible, addressing issues outside the park such as fish stocking practices and barriers to fish migration downstream of the park. For example, the park could work with state and tribal fisheries managers to replace kokanee stocking in Alder Lake with native cutthroat trout stocking.

Current partners include:

- Washington Department of Fish and Wildlife
- NPS Water Resources Division
- Native American Indian tribes (Nisqually, Muckleshoot, Puyallup)
- U.S. Fish and Wildlife Service
- National Marine Fisheries Service

The park also cooperates with universities for research and monitoring and has recently begun collaborating with angling groups, such as the Hi-Lakers and Trailblazers.

Alternative 3: Intensive Native Species Management

Alternative 3 goals are the same as those in Alternative 2. Other actions would also be similar to Alternative 2; however in the later phases of implementation of Alternative 3, 10 additional park lakes and two additional streams with more complex habitat would be treated to remove populations of nonnative fish and to expand the distribution and resilience of native fish and amphibians. By including additional elements described below, this Alternative would increase consistency with NPS and ESA policy by contributing to the conservation of native species. Nonnative fish would eventually be removed from 20 of 35 lakes with reproducing fish populations. Specific actions would be phased for implementation as feasible based on treatment methods, staffing and funding. As in Alternative 2, fish removal from lakes would include gillnetting for up to five years, unless determined infeasible, before evaluating whether to continue gillnetting and/or to use piscicides.

Summary of Alternative 3

In addition to actions described in Alternative 2, Alternative 3 would include:

- Expanded implementation of nonnative fish control and/or eradication from park lakes and streams. As in Alternative 2, methods could include gillnetting, electrofishing and chemical piscicides.
- Implementation of all of the actions in the bull trout recovery plan, including conducting a feasibility study for potential translocation of bull trout into the Puyallup and Mowich watersheds to enhance existing populations.
- Potential reintroduction of steelhead, Chinook, and coho salmon where these are documented to have been extirpated from suitable habitat.
- Phased fish removal from up to 20 lakes with reproducing fish populations on a priority basis.

Description of Alternative 3

NPS Regulation Changes

Actions would be the same as in Alternative 2.

Lakes and Streams Targeted for Fish Removal

In addition to the 10 lakes identified for fish removal in Alternative 2, 10 more lakes and 2 more streams would eventually have fish removed from them. Priority for fish removal from lakes would initially be the same as in Alternative 2. Later the lakes in Table 5 would be treated. There would also be nonnative fish eradication from an additional estimated 4095 linear meters of streambed. No fish removal is proposed from remaining lakes (Table 6).

Expanded Implementation of Bull Trout Recovery Plan (USFWS 2015)

Actions in Alternative 2 would be expanded to include ways to address other problems identified by the bull trout recovery plan, including the small population size in the Puyallup and Mowich rivers; the importance of identifying and protecting spawning areas in these rivers; determining the factors that are limiting the abundance of bull trout in these rivers; and the feasibility of enhancing these populations.

To fully meet these recovery plan objectives, the park would conduct a feasibility study to determine whether translocating bull trout into the Mowich and Puyallup watersheds would need to occur. If the results of this study indicated a need, translocation of bull trout may be considered and additional environmental impact analysis conducted. Currently bull trout are known to be greatly diminished in both watersheds.

Table 5: Additional Lakes (10) and Lake Outlets Targeted for Fish Removal in Alternative 3

Priority	Name	Watershed	Depth in meters	Acres	Elevation in meters	Stream Habitat (linear meters)	Brook Trout	Rainbow Trout	Nonnative Cutthroat Trout
11	Louise Lake	Cowlitz	17.2	18.98	1402	380	x		
12	Mystic Lake	West Fork	3.5	7.40	1739	450			x
13	Unnamed Lake	Ohanapecosh	3.9	8.36	1414	350			x
14	Blue Lake	Cowlitz	10.5	14.08	1331	370		x	
15	Lake James	West Fork	23	16.53	1348	400		x	
16	Lake Eleanor	Huckleberry	16	17.20	1521	400		x	
17	Green Park Lake	Huckleberry	10	7.90	1657	750		x	
18	Green Lake	Carbon	29	12.54	973	780			x
19	Lake Ethel	West Fork	29.5	26.49	1327	100		x	
20	Mowich Lake	Mowich	60	114.32	1505	115	sculpin	kokanee	
TOTAL				**243.8**		**4095**			

Salmon Reintroduction
In the White River, salmon and steelhead have been naturally colonizing upstream habitats and reoccupying historic sites over the past decade, potentially in part due to the improvements made in fish passage at Mud Mountain Dam. Salmon are now found several miles into the park. Current guidance from the National Marine Fisheries Service on salmon reintroduction is to allow natural recolonization if possible (Anderson et al. 2014).

Under Alternative 3, natural recolonization and improved fish passage at dam sites for the White, West Fork, Mowich and Puyallup rivers would be encouraged to further improve recolonization and habitat conditions. The Carbon River has a steep natural canyon outside the park that is known to be a seasonal fish passage barrier and which has, therefore, potentially inhibited recolonization within the park. Because of this, the park may reintroduce adult spawning salmon and steelhead initially to Ranger Creek. This location is currently accessible via motor vehicle. Current research shows that starting adult reintroduction efforts high in the watershed in multiple locations is most successful, because many adults drop down and spawn downstream of the drop site or in lower tributaries after release (Anderson et al. 2014).

Expanded Research and Monitoring
Actions would be the same as in Alternative 2.

Educational and Interpretive Strategies
Actions would be the same as in Alternative 2. In addition, there would be enhanced efforts where piscicide use is proposed. Treated areas would be signed in advance of, during, and following treatment, as appropriate.

Collaboration with Partners
Actions would be the same as in Alternative 2.

Table 6: Additional Lakes with Fish Where No Fish Removal is Currently Proposed

Name	Watershed	Depth (in meters)	Acres	Elevation (in meters)		Brook Trout	Rainbow	Non-Native Cutthroat	Other
Lower Palisades Lake	Huckleberry	19.4	3.94	1678		X			
Unnamed Lake	Huckleberry	8.8	1.08	1664		X			
Reflection Lakes	Nisqually	5.3	0.42	1484		X			
Reflection Lakes	Nisqually	37.7	17.83	1481		X			
Snow Lake	Cowlitz	35.1	5.93	1427		X		X	
Bench Lake	Cowlitz	36.1	8.24	1385		X			
Deadwood Lakes	White River	11.5	7.23	1600			X		Stickleback
Deadwood Lakes	White River	8.8	7.61	1597			X		Stickleback
Adelaide Lake	West Fork	13.1	7.28	1383			X		
Marjorie Lake	West Fork	26.2	10.42	1391			X		
Oliver Lake	West Fork	68.9	22.59	1392			X		
Unnamed Lake	White River	18.7	1.26	1469				X	
Unnamed Lake	White River	21	2.44	1522				X	
Lake George	Nisqually	139.4	35.54	1307					Sculpin
Unnamed Lake	Carbon	unknown	5.70	1611			X		

C. Mitigation Measures Incorporated into the Action Alternatives

Mitigation measures listed under resource sections in *Environmental Consequences* have been developed to lessen the potential adverse effects of the action alternatives and would be implemented under all alternatives, including the proposed action.

D. Description of Options Considered but Eliminated from Detailed Study

- *Immediate Removal of All Nonnative Fish from the 35 Lakes with Reproducing Populations.*

This action was discussed and considered internally, but dismissed for several reasons. Among these include the need to start small and scale up fish removal operations based on budget, resources, and timing. Since only small areas have been treated as study sites so far, there is uncertainty about the success of treatment in larger, more complex areas.

- *Install Aquatic Invasive Species (AIS) Inspection Stations to Prevent AIS In Park Lakes. Limit or Prohibit Boating to Safeguard against AIS Introduction.*

Interdisciplinary team members reviewed this suggestion from public scoping but determined that because there are only a few lakes in the park that are used and/or open to non-motorized boating, creating, installing, staffing and funding aquatic invasive species inspection stations would not address the problem from a small number of non-motorized kayaks, canoes, row boats and other inflatable water craft. Similarly, prohibiting boating on the one lake accessible by motorized vehicles that currently allows boating (Mowich Lake) would not measurably affect the outcome for aquatic invasive species in the park.

- *Elimination of Recreational Fishing in the Park.*

Public and internal comments suggested the elimination of recreational fishing in the park. This alternative was considered but dismissed because it would not improve native fish habitat. Continuing to allow recreational fishing for nonnative fish is part of the action alternatives because anglers would continue to reduce nonnative fish in a small way in park lakes that naturally evolved without fish. With proposed changes in regulations to protect rare, threatened and endangered trout and salmon, in combination with other methods, recreational fishing would increase pressure on nonnative fish populations and benefit native fish.

- *Manipulation of Natural Barriers to Improve Special Status Fish Populations.*

The manipulation of natural barriers to fish passage was identified through internal scoping. This action would not benefit native fish, would not be consistent with NPS policy, and would not meet the purpose and need for the plan.

- *Requiring a State Fishing License.*

A state license is not currently required because the NPS retains exclusive jurisdiction for law enforcement authority in Mount Rainier National Park. Requiring a state fishing license could discourage people from fishing and reduce overall angling pressure as an effective tool for managing nonnative (and native) fish populations. This option, which was brought up during internal scoping, was dismissed because fishing will be encouraged as a tool to implement parts of the proposed action. If fewer fish are caught, the effectiveness of the proposed alternatives to reduce nonnative fish, and on reducing the adverse effects of nonnative fish on native fish and amphibian populations, may be limited.

- *Imposition of Stiff Penalties for Using Live Bait.*

Public scoping suggested the institution of stiff penalties for using live bait. Mount Rainier National Park does not have the authority to impose fines for infractions. Penalties are set by courts.

- *Stocking of Non-Reproducing Fish. Use of Gill Netting, then Replanting with Native Trout (Cutthroat).*

Stocking of native rainbow trout in Deadwood Lake, a very popular recreational fishing area, was suggested during public scoping as a way to prevent future illegal replanting of fish. This suggestion was briefly considered but dismissed because it is contrary to NPS management policies. Stocking non-reproducing fish in lakes and/or stocking with fish native to the watershed but not present originally would also have more adverse effects on native fish and amphibians than the alternatives considered in this plan.

- *Not removing Nonnative Fish.*

Not removing nonnative fish was suggested during public scoping. However not removing nonnative fish would be inconsistent with the objectives of this plan and would have more adverse effects on native fish and amphibians than the alternatives considered in this plan.

- *Stock Nonnative Non-reproducing Brook Trout*

Stocking non-reproducing (YY) brook trout is currently being explored as a new method of reducing brook trout populations over the long-term. This method, developed by the Idaho Department of Fish and Game, relies on hatchery broodstock whose progeny have no X chromosomes. They are produced by rearranging chromosomes, rather than by genetically modifying or gene splicing fish. Therefore, they can produce only male progeny. In theory, over time, if enough of these males were stocked and mated, the population would skew toward males and eventually become a non-reproducing population (Schill 2016). In a recent experiment, the fish were developed, successfully bred, and all progeny were XY males. However the success of the introduction in reducing brook trout has yet to be confirmed. Further research is planned (Schill 2016). Because this method is still being tested, and additional confirmation of the potential for breeding with bull trout has not been addressed, it was discussed during internal scoping but dismissed from additional consideration. If this method is later proved to be effective in reducing difficult to eradicate brook trout populations, the park could undertake new environmental impact analysis to reconsider it.

Chapter 3: Affected Environment and Environmental Consequences

This section describes the affected environment (existing setting or baseline conditions) and analyzes the potential environmental consequences (impacts or effects) that would occur as a result of implementing the no action and preferred alternatives. Cumulative effects are analyzed for each resource topic carried forward. In many sections, the description of the affected environment has been integrated into the environmental consequences (description of impacts). In others, relevant background information that helps to understand the impacts is provided before the description of impacts.

A. Cumulative Effects

Cumulative impacts were determined by combining the impacts of the actions included in the alternatives with other past, present, and reasonably foreseeable future actions, within and near the park. Therefore, it is necessary to identify other past, present, and reasonably foreseeable future projects that could result in cumulative impacts. The geographic scope of the analysis includes actions throughout the park, as well as on surrounding lands where overlapping resource impacts are possible within the next 10 years. Several past and ongoing projects could contribute to cumulative effects.

<u>Past Actions</u>

- The earliest fish stocking in 1895 began prior to establishment of the park (1899) and continued through 1972. Stocking fish resulted in reproducing populations of nonnative fish in naturally fishless lakes, as well as in some rivers and streams, where they compete with native fish. Occasional additional unauthorized introductions of nonnative fish have occurred since stocking ended.
- Water is impounded at hydroelectric and flood control facilities surrounding the park on the White, Puyallup, Nisqually and Cowlitz Rivers. These dams are an impediment to upstream migration of native anadromous fish. They are generally located too far downstream to affect flow or hydrology within the park.
- Fish hatcheries present outside the park in the Carbon, Nisqually, White and Cowlitz watersheds affect native fish by introducing hatchery stock. Hatchery stock is present in the same streams and rivers, occupying the same areas, as native wild fish.
- Levee systems and urban development in the Puyallup River watershed confine and disconnect the estuary and lower Puyallup River from upper sections.
- Overfishing, in rivers and the ocean, has contributed to the decline of native salmonids.
- Park infrastructure, including roads and developed areas (buildings, trails, and campgrounds), has adversely affected rivers from its location within or near floodplains. Development and infrastructure has contributed sediment and debris during flooding. Some of these areas have also acted as barriers to fish movement within streams.

<u>Current Actions</u>

- There would continue to be ongoing monitoring of fish and amphibians and their habitat throughout the park. Inventory and monitoring of other species (birds, mammals) also takes place.
- The Washington Department of Fish and Wildlife and the Puyallup, Muckleshoot and Nisqually tribes monitor fish populations outside the park in several rivers, including the White, West Fork, and Nisqually.
- During snow-free seasons, the park undertakes a variety of maintenance work on trails, including trimming vegetation, clearing the ground surface, constructing and replacing drainage features (culverts, bridges, rock bars) and obliterating social trails. Similar work to improve backcountry camps is undertaken cyclically. Extensive trail work often requires helicopter support.
- Road maintenance, including snow plowing, is also undertaken regularly. Highways maintained by the state also use magnesium salts to prevent icing. Activities include grading gravel roads,

ditch cleaning, reshaping, removal of downed trees and debris, invasive plant removal and repairing minor surface failures (i.e. potholes).

- Resource management activities include nonnative invasive plant removal (including some use of herbicides in terrestrial applications), hazard tree management, and native plant restoration projects, primarily in subalpine areas.
- Flood protection is an ongoing challenge in the park. Glacial river aggradation rates in the park exceed one foot per decade and cause inverted floodplains. Floodplain management includes the need for frequent repair of flood protection structures, proposals for channel dredging, and bridge repairs.
- Outside the park, and on some park roads managed by the Washington State Department of Transportation, use of salts on the roadways in winter may be affecting nearby streams and rivers. Use of sand within the park may also contribute to already high aggradation rates on rivers.

Climate Change: Based on a wide body of scientific data and analysis, global climate change is driven by both natural and anthropogenic forces, particularly by the increase in the atmospheric concentration of carbon dioxide (CO_2) since the mid-18th century (IPCC 2013 *in* NPS MORA NOCA 2014). According to the U.S. Global Change Research Program, the average annual temperature in the Pacific Northwest will increase by 3.3 - 9.7 degrees F between 2070 and 2099, with the largest increases during the summer (Mote et al. 2014 *in* NPS MORA NOCA 2014). These changes in temperature are expected to be accompanied by change in precipitation patterns as well, with a projected decrease in summer precipitation by as much as 30 percent by the end of the century (Mote et al. 2014 *in* NPS MORA NOCA 2014). Climatologists predict that the snow water equivalent (the liquid content of snowpack) will decrease substantially in the Washington Cascades – up to 46 percent – by the 2040s, with the watersheds of the park projected to shift from snow dominant watersheds to transient (mix of snow and rain) by as early as the 2040s (Strauch et al. 2013 *in* NPS MORA NOCA 2014). This change in precipitation regime is expected to lead to increased frequency of spawning redd scour and summer low flow and temperature extremes. Because of these projected increases in temperature and changes in precipitation patterns tied to global climate change, the Pacific Northwest can expect to see major changes in species distribution and phenology, with cascading effects on ecological communities (Lawler et al. 2012; Mawdsley et al. 2009; West et al. 2009, Lawler et al. 2009 *in* NPS MORA NOCA 2014). Climate-driven factors such as temperature extremes, drought, water stress, insect and disease outbreaks, and changes in fire frequency and forest structure, and their complex relationships, are expected to impact fish and wildlife habitat. Climate change will affect species' range expansions, with more effects on species at the edge of their range (Naney et al., 2012 *in* NPS MORA NOCA 2014) and more southerly populations, increasing the conservation importance of more northerly populations (NPS MORA NOCA 2014).

Future Actions

- The Mount Rainier National Park General Management Plan, approved in 2001, includes proposed management actions at Mowich Lake, Sunrise, Paradise and a variety of other park locations. Depending on the outcome of planning, these projects have the potential to affect fish.
- The Mount Baker-Snoqualmie National Forest, the Wenatchee National Forest, and the Gifford Pinchot National Forest undertake a similar range of management actions on trails, roadways and in minor developed areas to manage forest resources and visitor use as occurs in the park. In addition, these areas have many more miles of unpaved roads that may contribute sediment during use and damage from storms. Portions of these forests border the park on all sides.
- The Mount Baker-Snoqualmie, Gifford Pinchot, Wenatchee and other national forests included in the Northwest Forest Plan also actively pursue a variety of restoration actions (aquatic conservation strategy, riparian reserves, late-successional reserves).
- Ongoing fish production at nearby hatcheries affects fish within the park. Hatchery management actions include the capture and release of native fish and the movement of these fish through or around some dams.
- The U.S. Army Corps of Engineers (ACOE) has plans to upgrade the trap and haul system of fish capture on the White River at Mud Mountain Dam, which is likely to further improve fish passage.

B. Water Resources: Hydrology and Water Quality

Hydrology: Affected Environment and Impacts

Because streams and rivers within the park have been altered very little by humans, they represent outstanding examples of pristine aquatic ecosystems of North America (Gregory et al. 1991 *in* Samora et al. 2013). Exceptions are from the effects of dams and urban development located outside of the park (Samora et al. 2013).

The Puyallup and Mowich River drainages are blocked by the Electron Dam, the Nisqually River by the Alder and LaGrande Dams, and the White River by Mud Mountain Dam. These dams block fish passage in these rivers and their upstream tributaries within the park. On the White River, all salmonids are transported around Mud Mountain Dam, while the Electron Dam on the Puyallup has a fish ladder, allowing improved fish access to headwater habitats (https://www.nps.gov/mora/learn/nature/fish.htm accessed 6 October 2016). The Carbon River is the only major drainage without dams blocking fish passage; however a steep canyon outside the park reduces fish passage. These human-constructed barriers also retain sediment and alter water flow and the areal extent of that flow in rivers. Anadromous use of the park, however, is increasing in recent years. Populations may be responding to fish passage improvements at Mud Mountain Dam, Electron Dam and restoration efforts in the Commencement Bay Estuary and lower Puyallup River, in addition to changes in fishing and commercial harvest regulations that have improved opportunities for native fish.

Impacts from Alternative 1 (No Action)

Changes in Hydrology: There would be no additional effects on hydrology. Downstream of the park existing barriers to flow would continue on six major rivers (Table 1).

Replacement of Culverts/Removal of Barriers: Under Alternative 1, there would continue to be small adverse effects on hydrology from human-constructed barriers in streams, including from undersized or poorly set culverts beneath roads and trails. Approximately nine culverts are in need of improvement beneath roads and trails. Most are in the White River Campground. These culverts would continue to result in constricting or blocking flows and in creating small waterfalls on streams. During high flows, these and other culverts could be overtopped and could increase sediment delivery to streams and rivers, resulting in some adverse effects, similar to that occurring elsewhere during storms. Although there are now two gauging stations located within the park, they are on the Nisqually and White Rivers, and there is little information elsewhere on flow and discharge.

Impacts from Alternatives 2-3

Replacement of Culverts/Removal of Barriers: Because undersized or poorly set culverts would be removed and replaced or reset, water flow impediments would diminish and natural sediment and water would flow unimpeded by past development in the White River Campground stream, Ranger Creek, and two unnamed streams that flow into the White River.

Placement of Temporary Fish Weirs: Location of fish weirs in the Carbon River and its tributaries would also disrupt water flow, slowing it down and possibly creating small eddies in the immediate vicinity of the trap. Weir placement would be relatively close to the Carbon River Road, outside wilderness, and could disturb sediment during placement. Use could temporarily trap a small volume of sediment on the upstream flow side, but would not affect flow volumes or rates. Before placement, during operations and upon removal, flow characteristics would be normal.

Water Quality: Affected Environment and Impacts

Water quality within most park rivers meets Class AA water standards according to data collected at the Nisqually River station near Longmire (Samora 1998). Class AA waters are characterized by exceptional water quality and are designated under state administration of the Clean Water Act.

There are few contaminants in park watersheds and little development near most park lakes, which have characteristically good water quality (physical, chemical and biological parameters[1]). A limnological study in 2000 found that "limnological measurements of transparency, dissolved oxygen, conductivity, pH, and nutrient concentrations, made between 1989 and 1998, were similar among the set of lakes" they studied [Harry, Dick (never stocked), Clover, Crystal (fish removed), Owyhigh (fish removed), Eunice (fish removed), Tipsoo, and Shriner (never stocked)], except for Eunice Lake, which had consistently low acid-neutralizing capacity (Drake and Naiman 2000). The study also found that the lakes were "typical of high-elevation lakes at Mt. Rainier in that they are deficient in nutrients (oligotrophic), drain relatively small watersheds (9-64 ha), and are normally ice free for <6 months each year" (Drake and Naiman 2000).

Some park waters are affected by park operations, including wastewater treatment plants (which discharge to the Nisqually River and Ohanapecosh River); septic systems (near major developed areas, such as the White River, Carbon River, Sunrise, etc.); stormwater and snowmelt runoff from roads (affecting areas such as Tipsoo and Reflection lakes, etc.); and developed areas (which affect the Nisqually River, Paradise River, Ohanapecosh River, White River, and Carbon River); in addition to natural erosion from hillsides. Backcountry/wilderness use may also affect adjacent waterbodies but is unlikely to more than minimally affect water quality.

Impacts from Alternative 1

Water Quality: Characteristically good water quality conditions would continue under Alternative 1. Exceptions to meeting Class AA standards would continue to be transient and would result from runoff into waterbodies emanating from nearby roads and developed areas, particularly after long dry spells, when pollutants from vehicles would be more concentrated along roadways and in parking areas. Other potential impacts to water quality from backcountry travelers not following established sanitation principles and practices to minimize human impacts would continue to occur. Because these water resources are separated (in most cases) by wide areas of native soil and vegetation from roadways and backcountry/wilderness camps, potential contaminants would be filtered and would continue to be unlikely to more than minimally affect adjacent waterbodies.

Impacts from Alternatives 2 and 3

In addition to ongoing impacts from Alternative 1, actions in Alternatives 2-3, including electrofishing, gillnetting, fish disposal, and the use of piscicides and base camps, could affect water quality.

Water Contact Activities: There would be small, temporary increases in turbidity (suspended sediment) during electrofishing, placement of gill nets, seining, and during monitoring. Staff routinely enters water bodies (lakes, streams and rivers) for these activities, walking on stream, river and lake bottoms when necessary, and on protruding rocks or adjacent shorelines when available. Where the bottom consists of closely spaced rocks (gravel, cobbles or boulders), there would be minimal effects from disturbing soil, and therefore the smallest effects on turbidity. Where fine sediment (e.g. silt and clay) is present, slightly larger, but still small effects on turbidity would occur from the temporary suspension of particles in the water column as the substrate was disturbed during fish monitoring and management activities.

As with electrofishing, there would be minimal disturbance of streambed substrates from people walking on stream bottoms while pursing the net and from the capture of small pieces of wood in the net. Locations proposed to be seined in the Carbon River Watershed are small streams in areas with minimal wood debris, where walking in streams would be limited to a few steps. Seining is typically more effective if samplers avoid stepping in streams, which can cause fish to seek cover and avoid capture in the sein. Therefore streambed disturbance would be avoided to the extent practical. Background levels of turbidity would not be increased.

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[1] These characteristics include temperature, aquatic biota (fish, amphibians, and invertebrates), conductivity, dissolved oxygen, pH, turbidity, alkalinity, suspended solids, dissolved solids, total nitrogen (including nitrate, nitrite, and ammonia), total phosphorus and orthophosphate, silica, sodium, potassium, calcium, chloride, sulfate, and magnesium.

Impacts from water contact activities on water quality would be short-term and localized, lasting during and slightly beyond activities in water. When gill nets are placed by inflatable water craft, such as rafts or float tubes, there would be fewer impacts. The degree of suspended sediment caused by these activities would not affect sunlight penetration, oxygen demand or downstream habitat because it would not be continuous or consistent or of a sizable quantity. Instead, released sediments would quickly dissipate and would be less intense than releases caused by natural background erosion (such as from small landslides or calving of weak edges) during storms.

Backcountry Camping: Conducting work in numerous areas would require overnight stays in the park's backcountry and/or wilderness. To the extent possible, work crews would camp in existing backcountry or wilderness campsites, using minimum impact techniques and facilities (where provided). Use of established camps and Leave No Trace© (minimum impact) techniques would minimize the potential for human waste, personal care products and human food sources to affect water resources. In the late 1980s, most backcountry camps were moved away from sensitive resources, such as lakes. Similarly, the presence of vegetated areas and the requirements associated with waste and wastewater disposal adjacent to streams and lakes would minimize effects.

Culvert Replacement: Culvert replacement to improve fish passage would result in a potential for disturbance of soils and vegetation, potentially affecting water quality. Some culverts may also have drop-inlet covers (grates) that screen large rock while allowing the passage of smaller materials with water runoff. Although there would be a range of localized short- and long-term adverse effects particularly near inlets and outlets, after work was completed restoration would include seeding and planting riparian vegetation, including any that might be salvaged from the area before work is initiated. Because culvert replacement would be conducted during dry periods and would take only a few hours, most culvert replacements would have short-term adverse effects. Replacement of larger culverts on perennial streams would likely take longer and have more potential for adverse impacts. Where necessary, bypass areas to allow unimpeded flow would mitigate some adverse effects but would also temporarily increase sediment discharge. As appropriate, additional environmental impact analysis, including obtaining necessary permits, would occur.

Fish Carcass Disposal: Fish disposal from gillnetting has the potential to affect water quality. Disposing of large quantities of fish in some lakes can cause overconsumption of oxygen by the processes of decomposition, which could affect water quality and in turn, other aquatic species. Fish disposal in lakes can also be beneficial, returning nutrients to the ecosystem, which may benefit other aquatic and terrestrial species, as well as the lakes themselves. These beneficial effects would be more likely to occur because the park's lakes are nutrient poor (oligotrophic). Fish disposal in other parks has been known to locally increase nitrogen, phosphorus, and dissolved organic carbon (Premke et al. 2010 *in* NPS SEKI 2016). Lakes could also experience algae blooms, nutrient cycling effects, and fluctuation of bacterial concentrations over several seasons from lake mixing and fish decomposition processes, and from the concentration of fish carcasses in backwater areas. Hydrological cycles would contribute additional influxes of water from inflow from streams, rain and/or snow, reducing high nutrient loads through flushing. These would be expected to decrease nutrient loads naturally over time to background levels.

Disposal of fish carcasses from experimental gillnetting in the park has included formal trash disposal and release back into lakes. The numbers of fish have been small and dispersed over time, and adverse effects have not been found. In the Carbon River area, caught fish have generally been disposed of in area dumpsters. During more extensive fish removal from lakes, nonnative fish are typically sunk to the bottom of lakes by puncturing their swim bladders. This allows their bodies to decompose and the nutrients within them to be released back to the environment, supporting the local ecosystem in the park's nutrient-poor lakes. Generally, the first year or two of gillnetting results in the highest catches, and it is during this time that lakes would be monitored most closely. These initial catches would result in the highest pulse of nutrients back to the system, which would benefit numerous aquatic species. In other parks where nonnative fish removal has been undertaken (e.g. Sequoia and Kings Canyon and North Cascades), decomposition of fish from removal during gillnetting has had no visible adverse effects on amphibians, such as mountain yellow-legged frogs (NPS SEKI 2016:142).

The small number of fish that could be caught by anglers and returned to lakes and/or streams would also be unlikely to affect biological oxygen demand. Under the regulation changes in Alternatives 2-3, anglers would be asked to retain (throw back carcass, or carry out) nonnative species.

Piscicide Use: Use of chemical piscicides would affect water quality in the vicinity of the application. Downstream effects would also occur, and although these would be mitigated by the use of neutralizing chemicals (potassium permanganate), the neutralizer itself would also affect water quality. These effects would be minimal since the neutralizing agent is often used to treat drinking water supplies for other contaminants that cause oxidation, colors, and odors (Tucker and Boyd 2011 *in* NPS SEKI 2016).

Depending on manufacturer availability, one of two available piscicides could be used: rotenone and/or antimycin. They have similar effects; however rotenone is more effective in penetrating deeper lakes, where increased thermal stratification may be present (NPS NOCA 2008). Antimycin oxidizes (dissipates) more readily but is neutralized with the same chemical and methods. Both are naturally derived substances.

Chemical piscicides are not known to affect characteristics of water quality, such as pH, although as noted below, the pH of water bodies can affect how quickly piscicides dissipate, with faster dissipation in areas that have higher pH and the need for more chemical in areas with lower pH (CDFW 2007 *in* NPS SEKI 2016: 207). Similarly, other water quality parameters including conductivity are minimally affected by potassium permanganate and are not affected by piscicides (CDFW 2007 *in* NPS SEKI 2016: 207).

Potassium permanganate quickly reacts with a variety of rotenone compounds diminishing to concentrations that are not harmful to aquatic or terrestrial organisms.

Where piscicides are used in streams (as proposed in Alternative 3), normal flow from riffles and cascades also serves to quickly re-oxygenate water. In lake and stream treatments, monitoring of dissolved oxygen would be undertaken to ensure that piscicides do not adversely affect this water quality measure for other aquatic species. For example, indicator fish sensitive to the piscicide are often placed at intervals 30 and 60 minutes downstream to ensure that the piscicide has been neutralized adequately and will no longer affect sensitive species. If warranted by fish showing stress, additional neutralizing compound can be added downstream. Because of the neutralization and distance, there would be no effects close to or outside the park boundary.

Both piscicides and neutralizing chemicals would diminish quickly. Studies in California documenting the effects of rotenone and the compounds associated with it found that it had decreased to half its concentration by 6-14 days in water, 0-49 days in sediment and 6-13 days in catfish, which are not affected by it (Vasquez et al. 2012 *in* NPS SEKI 2016: 207). Where elevated temperatures or pH occur, dissipation was even faster (2 days); neither was detected 46 days later (Finlayson et al. 2014 *in* NPS SEKI 2016: 207).

Fish Removal: Eventually it is likely that there would be improvement (beneficial effects) in a variety of water quality parameters, such as clarity and dissolved oxygen, from fish removal in lakes. Studies have shown improved water quality from fish removal, including from “increased water clarity, decreased phytoplankton standing stock, higher dissolved oxygen concentrations, establishment of macrophytes, and decreased ammonia concentrations” (Hanson 1990; Sondergaard et al. 1990 *in* Drake and Naiman 2000).

Cumulative Effects: *Hydrology*: Ongoing effects on hydrology include the presence of dams on six major rivers in the park. The dams block fish passage into and out habitat downstream of the dams. Since the late 1940s, one dam (Mud Mountain Dam) has simulated fish passage by trucking fish upstream, partially providing for natural fish runs, depending on the number of fish captured, their health during transport and the degree to which they return. The trap and haul system used to capture returning fish has had poor survival rates over the last 75 years, with consequent reduction of anadromous runs of salmon and steelhead in the upper White River watershed, including the park. As a result, this system was found to be inadequate in Army Corps of Engineers (ACOE) consultation with the National Marine Fisheries Service (NMFS). NMFS recently determined that continued use of the system would jeopardize the survival of salmonids and requested that the ACOE install an upgraded system by 2020. The new system is predicted to bring survival of fish through the system up to 95 percent (NMFS 2014).

Over time, the cumulative effects of climate change could result in a hotter, drier climate with warmer temperatures during winter storms. Already, the Pacific Northwest has seen a transition in shoulder season precipitation that bounces from snow to rain-on-snow, with increases in precipitation that falls as rain, resulting in more extreme flooding in the park. Flooding adversely affects infrastructure, such as roads, trails and campgrounds. Climate change and associated perturbations not only affect water quality, but could also eventually affect the potential for native fish to persist in some intermittent streams in the park and in areas where warmer temperatures are outside the range tolerated by some fish.

Water Quality: Ongoing effects on water quality from backcountry and wilderness camping would continue to cause a small range of generally transient and discountable cumulative impacts when low impact techniques are not used. Although some effects on water quality could occur from park crews working on fish eradication, the use of minimum impact (Leave No Trace©) techniques by fish crews would minimize this potential.

Although piscicides would dissipate rapidly to below thresholds of discovery, their use would be additive to the use of other chemicals in the park, including herbicides and road de-icers (these are terrestrial applications but may reach water bodies through run off or leaching). Overall cumulative adverse effects would remain low because of the low retention time of piscicides. In Alternative 2, use of piscicides would also be limited to application in hard to treat lakes, which would further lessen potential impacts.

Impact Avoidance, Minimization and Mitigation Measures
The following measures would be used to reduce impacts to water resources (including hydrology and water quality):

- Employing appropriate best management practices when working in or near water. Comply with Washington State Hydraulic Code.
- Using vegetable-based hydraulic fluid in all machinery.
- Employing appropriate best management practices when working in or near water.
- Locating staging areas away from or protecting nearby surface water resources.
- Using temporary sediment-control devices such as filter fabric fences, sediment traps, or check dams as needed during culvert replacement to minimize fine sediment delivery to streams.
- Minimizing soil disturbance, and reseeding or revegetating disturbed areas as soon as practical.
- Retaining silt fencing in disturbed areas until stabilization (by reseeding or revegetation).
- Using native duff and imported topsoil to cover exposed soil as soon as practical.
- Installing protective construction fencing around, adjacent to, or near wetland and/or riparian areas to be protected.
- Limiting the duration of in-water work as much as possible.
- Timing projects undertaken adjacent to or near wetlands to occur during the dry season, usually late summer.
- Developing and implementing a Stormwater Pollution Prevention Plan (SWPP) for construction activities to control surface runoff, reduce erosion, and prevent sedimentation from entering water bodies during construction.
- When overnight stays are needed, fish crews would stay in backcountry or wilderness campsites when possible and would use Leave No Trace© camping techniques.
- Use of block nets and/or temporarily constructed rock barriers would be used at inlets and outlets to isolate lakes for fish removal.
- During initial fish removal, gillnets would be checked frequently. Later gillnets could be overwintered.
- Use of piscicides, including transportation, storage and handling, would follow current guidelines and safety precautions as described on the Material Safety Data Sheet and labeling.

- To verify conditions in lakes prior to treatment with piscicides, water quality data, including Secchi disk depth transparency, water temperature, dissolved oxygen and pH depth profiles. Analysis will also be made of nutrient and chlorophyll-A samples, zooplankton samples, and littoral benthic macroinvertebrate samples. There will also be visual surveys for amphibians during the mechanical fish removal phase.
- Where large numbers of fish are present, monitoring of lake water quality measures, such as dissolved oxygen, would occur and, if monitoring indicators warranted, non-lake nonnative fish disposal methods would be used.
- Analysis of fish size and/or biomass would be used to predict the potential water quality impacts from decomposition during fish removal from gillnetting. If impacts were determined to be unacceptable (e.g. from a large number or size of fish in a small lake), fish would be disposed of in terrestrial areas, rather than returned to lakes.
- Fish weirs would be installed with the least possible streambed disturbance. Once brook trout spawning run timing was better understood, annual placement duration could also be reduced.
- Field crews would continue to use boats, banks and gravel bars to the extent possible to avoid stream and lakebed disturbance, thereby minimizing water quality impacts.
- Care would be taken to locate the proposed weir in a stable area, where minimal disturbance would be needed for placement. It would be removed seasonally, with up to three months of use each year and for up to five seasons.
- Effectiveness of the weir would be evaluated annually and the project would be discontinued if determined to be ineffective.
- Upon successful reduction of brook trout, extension of weir operations to future years could be considered if results indicate this is necessary. Upon removal of the weir, area conditions would be restored, leaving no lasting impact.

Conclusion: There would continue to be no additional adverse effects on hydrology or water quality under Alternative 1. Alternatives 2 and 3 would have a range of small effects on hydrology and water quality from actions to minimize the effects of and to remove nonnative fish from park watersheds, including the Carbon and White rivers. Over time, measures of water quality would improve and there would be reduced adverse effects on hydrology and water quality from implementation of Alternatives 2 or 3. With more nonnative fish eradication, short- and long-term beneficial effects on aquatic ecosystems, such as those described in Drake and Naiman (2000) would increase over time, particularly under Alternative 3.

C. Fish and Wildlife

Affected Environment

U.S. Fish and Wildlife Service designations

FE = Federally Endangered: a listed species that is in danger of extinction throughout all or a significant portion of its range.

FT = Federally Threatened: a listed species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

FPROP = Federal Proposed: a species proposed in the *Federal Register* as threatened or endangered.

FC = Federal Candidate: a species for which there is sufficient information to propose for listing as threatened or endangered.

FSC = Federal Species of Concern: *a* species whose conservation standing is of concern to the U.S. Fish and Wildlife Service, but for which status information is still needed.

Washington State Designations

SE = Washington State Endangered: a species native to Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state.

ST = Washington State Threatened: a species native to Washington that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats.

SC = Washington State Candidate: a species that is being reviewed for possible listing as state endangered, threatened, or sensitive.

SS = Washington State Sensitive: a species native to Washington that is vulnerable or declining and is likely to become endangered or threatened throughout a significant portion of its range within the state without cooperative management or removal of threats.

— = No designation

Amphibians and Reptiles: Currently 19 species of reptiles and amphibians are known to occur in the park. Native amphibians include the Pacific and Cope's giant salamanders, western redback salamander, Northwestern and long-toed salamanders, Larch Mountain and Van Dyke's salamanders, tailed frog, Pacific chorus frog, northern red-legged frog, Cascades frog, western toad, and Ensatina. Some of these are considered rare (Table 8). Reptiles include 3 garter snake species, the rubber boa, and the Northern alligator lizard.

Native Fish: Eight native species of fish occur in the park, including rainbow trout/steelhead, coho and Chinook salmon, shorthead sculpin, bull trout, coastal cutthroat trout, and mountain whitefish. Although native fish were historically present in streams and rivers, historically there were no fish in subalpine and alpine lakes. Inventories for fish in 2001-2003 also found no fish presence in 27 of 138 stream segments surveyed (Samora et al. 2013 in Hoffman et al. 2004). Most of these fishless reaches were randomly selected low gradient habitat above impassable barriers. A few sites were sampled under high turbidity conditions where the fishless result is likely due to sampling error.

Fish are found in a variety of habitats, including open water and areas with overhanging logs and large and small gravel, cobbles and boulders. During the North Coast and Cascades Network (NCCN) inventory, most fish were found in riparian areas with moderate cover. Approximately 79 percent of fish were observed in streams where overstory vegetation exceeded 40 percent (Samora et al. 2013).

Bull trout, rainbow trout/steelhead and coho salmon spawn in the Carbon, White and West Fork White rivers. Coastal cutthroat trout are common in the Nisqually, White and Ohanapecosh rivers (Samora et al. 2013, Mount Rainier National Park, unpublished data 2001-2015). As noted in Table 2, the Cowlitz River may have a wild population of rainbow trout (see also Special Status Species section). Based on current, limited data (hybrid results from six fish), no steelhead have yet been confirmed in the park, but are confirmed just outside the park boundary. Currently hatchery steelhead and Chinook are known to be planted in Huckleberry Creek.

Coho salmon have been documented in the White and Carbon rivers and their tributaries. Coho salmon likely occupy the lower portion of the White River and tributaries within the park annually based on juvenile and adult presence, but since park spawning surveys end just as they begin to arrive in the park, only sporadic documentation of their presence exists (Wright 2016 unpublished report). Historic records (Schmoe 1925) and WDFW occupancy models indicate greater distribution of salmon and steelhead throughout the Puyallup Basin in the Carbon, West Fork, White and Mowich rivers than is currently documented as occupied in the park.

Of the three cutthroat trout subspecies present in the park, only coastal cutthroat are native. Coastal cutthroat trout are similar to rainbow/steelhead in that they have a wide array of life history strategies, including as freshwater residents, migrants and some that migrate to estuaries as anadromous or sea run forms. Coastal cutthroat are a species of concern in Oregon and California, but not in Washington. Introgression (hydridization) of coastal cutthroat with introduced cutthroat and rainbow trout has been documented in the Nisqually, West Fork, Ohanapecosh and Carbon rivers. Coastal cutthroat are a mixture of hybrids and pure individuals (Samora et al. unpublished report).

Mountain whitefish are known to occupy the Carbon River. They are also likely present seasonally elsewhere in the park and are abundant in winter; however very limited winter sampling has occurred. Mountain whitefish are a widespread salmonid, occurring throughout the Pacific Northwest.

Recent Migrants: Trucking fish around Mud Mountain Dam has been conducted since 1948, when a fish trap was constructed. The current fish barrier and trap is planned for replacement (http://www.nws.usace.army.mil/Missions/Civil-Works/Programs-and-Projects/Projects/Mud-Mountain-Dam-Fish-Passage/ accessed 14 September 2016).

Pink salmon are trucked around Mud Mountain Dam to access the upper White River watershed. Although they were not documented as historically present in the park (Schmoe 1925), they may have been present before dam construction (Samora et al. 2013). Pink salmon are plentiful and migrate quickly out to sea upon emergence. Maturing fish return to freshwater to spawn after only 18 months (Samora et al. 2013). Although some spawn near the ocean, others migrate up to 311 miles upstream. Pink salmon have been observed in increasing numbers in the park since 2006 (Samora et al. 2013). Over 200 returned to Sunrise Creek in 2015.

Sockeye salmon were also not originally documented in the park (Schmoe 1925), and their presence has been rare over the years. Although nonnative kokanee (non-anadromous sockeye) are common in the Nisqually watershed, sockeye presence in the park is unusual and may be related to salmon recovery efforts outside the park that involve salmon and trout transport around Mud Mountain Dam. They may also have been present prior to dam construction but are likely not native to the Puyallup/White River system. Sockeye are threatened by dams, overharvest, and habitat modification and degradation (Hoffman et al. 2014:189). They have no special status in the park, but two evolutionary significant units are designated elsewhere as endangered – Snake River, and threatened – Lake Ozette. No anadromous sockeye were observed or collected in park surveys between 2001-2003; however from 1983 to 2008, between 5 and 378 (annual average of 42) were transported above Mud Mountain Dam annually (Marks et al. 2016). Sockeye are also rare in Huckleberry Creek (Marks et al. 2016). They have been detected in the White River drainage on a few occasions (Samora et al. 2013). In 2005, a mature adult was found in Fryingpan Creek in the White River watershed.

Kokanee have been stocked in Mowich Lake, and that population continues to reproduce and survive in the lake (*in* Hoffman et al. 2014:194). Kokanee are also stocked in Alder Lake and are known to migrate into the park for spawning (Nisqually River watershed).

Table 7: Number of fish/species stocked in MORA streams (1915–1964) and lakes (1915–1972) *(Table 43 from Hoffman et al. 2004)*

Species	Streams	Lakes
Cutthroat Trout	316,597	641,738
Westslope Cutthroat Trout	1,667,364	1,430,947
Rainbow Trout	254,039	1,925,568
Steelhead	50,000	491,600
Steelhead eggs	15,000	0
Eastern Brook Trout	749,200	1,586,060
Total	3,052,200	6,075,913

Nonnative Fish: In addition to hatchery raised fish, there are seven nonnative fish species in the park. Beginning more than a century ago (1895), nonnative fish were planted in rivers, streams and lakes in the park. Stocking continued through 1972 (Samora et al. 2013). Westslope cutthroat trout (also called Montana black-spotted trout) were the first non-anadromous salmonid released in Washington (1895), and fish from Yellowstone were planted in the late 1920s. By 1928, an extensive fish stocking program was underway in the park (NPS 1932 in Samora et al. 2013). From 1915-1953, nearly two million (1,983,961) cutthroat trout (including 1,667,364 westslope cutthroat) were planted in park streams. From 1922-1958, a smaller number (319,039) of rainbow trout were planted (Samora et al. 2013) (Table 7).

Reproducing populations of nonnative fish are present in approximately 35 lakes and all of the park watersheds, including many streams and the nine major rivers.

The effects of nonnative fish on native aquatic ecosystems have been studied in the park and in other national parks, such as North Cascades. For example, in preparation for the Mountain Lakes Fishery Management Plan in North Cascades National Park Service Complex, the USGS, in cooperation with Oregon State University undertook a 10-year research program on the ecological effects of fish stocking.

Microscopic algae known as diatoms[2] have been studied in some park lakes. These studies have shown that even in lakes where fish removal has occurred, there continue to be depressed diatom assemblages. When researchers analyzed lake bottom core samples for the presence of diatoms in three watersheds (Mowich, White and Ohanapecosh) in lakes with stocked fish, where stocked fish had been removed, and where fish were never stocked, they concluded that lakes with fish and lakes with fish that had been removed had a significantly different array of diatom assemblages (in the five most common species) than lakes that maintained their baseline conditions (no stocking) (Drake and Naiman 2000).

Lake bottom core samples, representing over 480 years, were collected. In four of the five lakes, diatom species changed approximately 80 years before the study commenced, suggesting that they changed with fish introduction. Species tended to change within 10-20 years of fish introduction. Only one lake (Harry) did not manifest a significant difference but instead showed a trend toward dissimilarity (Drake and Naiman 2000. Some of the changes observed in diatom assemblages (e.g. Shriner and Eunice lakes) were not attributed to fish introduction, but rather to increased sedimentation (potentially from overgrazing), while some were not able to be definitively linked to a specific event (Drake and Naiman 2000). Adding top predators [e.g. fish] results in suppression and release of progressively lower components of stream food chains and strongly influences the abundance and community structure of algae (Power et al. 1985, 1992 *in* Drake and Naiman 2000).

Invertebrates: There are a wide variety of known and unknown invertebrates, including insects, spiders, worms, and freshwater mussels, that occur in the park. Native and nonnative fish eat macroinvertebrates from along the bottom and in the water column of rivers and streams and within lakes. Species include stoneflies, mayflies, caddisflies, dragonflies, damselflies, diving beetles, backswimmers, whirligig beetles, and water striders. These may be eaten as nymphs or as adults. Smaller fish also eat plankton (single-celled plant and animal microorganisms) from the water column.

Impacts on Fish and Wildlife

Impacts from Alternative 1

There would continue to be small ongoing beneficial effects on some native wildlife from the opportunity to prey on nonnative fish. In contrast, research has shown that there would also continue to be widespread adverse effects from the presence of those nonnative fish on native fish populations, native amphibians, and on other native aquatic biota, such as macroinvertebrates and diatoms, in subalpine and

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[2] Diatoms—a class of algae that have cell walls made of silica—occur throughout the water column. When they die, their remains (portions of the cell walls called *frustules*) settle onto the bottom, where, because of their high silica content, they are preserved in the bottom sediments like tiny bits of glass. As bottom sediments accumulate they contain a chronological record of the diatom species present in the lake through time (https://www.nps.gov/piro/learn/nature/upload/Diatoms_2011-1.pdf).

alpine lakes. Nonnative fish commonly have adverse effects on the distribution, abundance, age structure, genetics and behavior of native fish species, amphibians and other aquatic life.

Among other adverse effects, nonnative fish have altered the composition and abundance of other native aquatic organisms, including amphibians and invertebrates, in rivers and lakes. Nonnative introduced fish would continue to adversely affect native aquatic species abundance and distribution.

Studies conducted in the park have shown that amphibians increase when introduced fish are removed. Between 1993 and 1998, 66 brook trout were removed from a Harry Lake (NPS code lw11) as part of a study to determine the effects of fish removal on declining amphibian populations (Hoffman et al. 2004). In another study conducted between 1996 and 2003, 2,185 fish were removed from Hidden Lake and a seasonally-attached adjacent shallow pond as a continuation of the same study (Larson et al. 2016). No amphibians were observed in the pond prior to fish removal. Amphibians in the lake included northwestern salamanders, long-toed salamanders, and Cascades frogs. After fish removal, amphibians in both water bodies increased markedly and additional species (tailed frogs) were detected in the pond (Larson et al. 2016).

Researchers determined that “reproducing populations of fish (established through past stocking of lakes with sufficient spawning habitat) can overpopulate a lake and measurably deplete or extirpate their food base. More specifically, long-toed salamanders, large crustacean zooplankton, and several near shore macroinvertebrates appear to be at greatest risk in relatively warm, productive lakes with self-sustaining trout populations (Liss et al. 2002, Tyler et al. 1998)” (*in* Rawhouser and Anthony 2015).

The same study did not identify statistically significant effects to native species in lakes when stocking consisted of low density, non-reproducing fish. “The research confirmed that the ecological effects of nonnative fish appear to be related to predation intensity: fish stocked at low densities represent the lower end of the predation gradient, whereas lakes with reproducing populations of fish represent the higher end of the predation gradient” (Liss et al. 2002 *in* Rawhouser and Anthony 2015).

In Mount Rainier, research and monitoring efforts have documented nonnative trout dispersing downstream from lakes and competing or hybridizing with native fish. For example, nonnative rainbow trout in the West Fork have hybridized with native coastal cutthroat trout. In the Carbon River, nonnative westslope cutthroat trout have hybridized with native coastal cutthroat trout and rainbow trout.

According to Drake and Naiman (2000):

> The natural trophic structure of the lakes consists of primary producers (diatoms and chrysophytes but no noticeable biomass of aquatic macrophytes), herbivorous invertebrates, predatory invertebrates (e.g., chironomids [midges] and dragonfly larvae), and dense populations of salamanders and frogs that prey on invertebrates and cannibalize each other. Amphibians are important predators in western U.S. mountain lakes (Tyler et al. 1998), but salamanders and frogs are found in low densities, if at all, in MRNP [Mount Rainier National Park] lakes that contain fishes.[3]

Although salamanders are the natural top vertebrate predator in naturally fishless lakes, in most lakes (35) in the park, nonnative fish would continue to occupy this role under Alternative 1. Nonnative introduced fish would continue to feed on salamander and other amphibian eggs and larva, as well as macroinvertebrates such as whirligig beetles, and stonefly, dragonfly, damselfly, and mayfly larvae. The

[3] Drake and Naiman studied Harry, Dick (never stocked), Clover, Crystal (fish removed), Owyhigh (fish removed), Eunice (fish removed), Tipsoo, and Shriner (never stocked) lakes and took core samples from the Ohanapecosh, White and Nisqually Rivers in Mount Rainier National Park. Update: Apparently, however, Clover, Crystal, Eunice and Owyhigh lakes were stocked but the populations were self-limiting and fish eventually died out (but were not removed).

presence of fish would also continue to adversely affect the long-term prognosis for some deepwater-associated amphibians in the park. According to a University of Washington study, approximately 70 percent of lakes over 6.5 feet deep in the park contain nonnative fish (Ryan 2014). Because of the probability of droughts causing lake drying related to climate change, this leaves approximately one-third of the deepwater habitats in the park critical for amphibians if dying associated with climate change continues (Ryan 2014).

Where native and nonnative fish occur together in streams, native fish may be adversely affected by competition for food and habitat, predation and, in some cases, hybridization from the nonnative fish (such as wild cutthroat/hatchery rainbow hybrids and wild bull trout/nonnative brook trout hybrids). In studies conducted up to 2010, however, no brook trout hybridization has been found in the park (DeHaan et al. 2008 *in* Samora et al. 2013).

Interbreeding can affect the adaptive characteristics of the native population and reduce the purity of native fish species (NPS NOCA 2013:4). The potential for nonnative brook trout to hybridize with bull trout could alter genetic integrity. Although bull trout/brook trout hybrids have not yet been documented in the park, they have been documented elsewhere in the Pacific Northwest. A study of the Malheur River watershed in Oregon found numerous first generation hybrids and several second generation hybrids (DeHaan et al. 2010). “Extinction of local bull trout populations, presumably due to hybridization, has been documented in systems where large numbers of brook trout were present” (Leary et al. 1993; Kanda et al. 2002 *in* DeHaan et al. 2010).

Native fish, particularly bull trout, and amphibians are also predated on and outcompeted by nonnative fish. As a result, over time, populations of native fish and amphibians within and outside the park have likely diminished where brook trout and other nonnative fish populations have been established. Amphibians were once the top predator in the naturally fishless lakes in the park. Now they are diminished or extirpated as a result of predation by nonnative fish.

Because most catchable size fish (>6 inches) in the White River are bull trout (Wright 2016 unpublished report), there would continue to be long-term direct adverse effects on bull trout from allowing unrestricted fishing to continue in this area. Without conservation measures, bull trout would likely continue to be one of the most common fish caught. Depending on the knowledge of anglers, these fish may or may not be released, resulting in mortality of fish retained.

Impacts from Alternatives 2-3

Impacts from Nonnative Trout Removal: “Nonnative trout also have adverse effects on benthic invertebrates and zooplankton assemblages” (Knapp et al. 2001, Knapp 2005, Knapp et al.2005, Finlay and Vredenburg 2007 *in* NPS SEKI 2016: 155). Therefore, it is likely that removal of nonnative fish would have long-term beneficial effects from the opportunity for these populations to expand in areas where fish are eradicated.

With removal of nonnative fish from forested, subalpine and alpine lakes and some streams, it is likely that salamander populations would recover. Approximately one-third of lakes and lake outlets in the park with nonnative fish populations would have fish removed under Alternative 2 and two-thirds under Alternative 3. Fish removal would also occur from two separate streams in Alternative 2 and four in Alternative 3.

As noted previously, nonnative fish in naturally fishless lakes in the park have replaced salamanders as the top predator. Depending on the depth of the lakes, northwestern and/or long-toed salamanders are present. Northwestern salamanders inhabit deeper lakes, while long-toed salamanders inhabit shallower lakes (less than seven feet deep). Because these shallower lakes often freeze completely or fill with snow in winter, fish often cannot survive in them; therefore it is mostly likely that fish have had more effects on northwestern salamanders (USGS 2003).

Nonnative fish prey on organisms in bottom sediments and terrestrial insects stranded on the water's surface (USGS 2003). Nonnative fish feeding alters the nutrient cycle in lakes, and also adversely affects other ecosystem processes, such as the presence of plankton and diatoms by changing the composition of these present in lakes with fish.

Fish in naturally fishless lakes not only reduce populations of salamanders, they also change their behavior. Researchers have found that when fish are removed, there is more activity in offshore areas. Populations of northwestern salamanders in a park lake before and after nonnative brook trout removal were compared. Also included was an unstocked reference lake which did not contain fish. Salamander egg masses increased after fish removal (Hoffman et al. 2004). The study also found that behavior of northwestern salamanders was different in a lake with brook trout compared to a lake without and changed to be like the fishless lake after fish were removed. Salamanders in the lake with brook trout were primarily nocturnal and confined to shallow shoreline areas, while salamanders in the fishless lake were active during all parts of the day and present in deeper water. After nonnative brook trout were removed, northwestern salamanders became more abundant and were increasingly seen during the day and in deeper water.

In Mount Rainier, Cascades frogs also increased following experimental fish removal, and tailed frogs returned to downstream habitat following fish removal (Larson et al. 2016).

Other studies in California's Sierra Nevada have also documented the ability of other species to recover from the effects of introduced fish. For example, long-toed salamanders, mountain yellow-legged frogs, and gray-crowned rosy finches increased (Funk and Dunlap [long-toed salamander], 1999; Knapp et al., 2001b [mountain yellow-legged frog]; Vredenburg 2004 [mountain yellow-legged frog] *in* Hoffman et al. 2004; Matthews et al. 2002 [Pacific tree/chorus frogs]; and Epanchin et al. 2010 *in* NPS SEKI 2016:155 [gray-crowned rosy finch]).

Impacts from Seining: Sein netting is one of the least harmful methods for capturing fish and is therefore often the first method prescribed in fish rescue operations. There is, however, potential for net and handling injury of fish (including natives) which would be minimized through good technique and systematic training of technicians. Very conservative thresholds of one native fish mortality per site per year would be set to minimize impacts of seining efforts. There is potential for stress and disruption of normal behavior in native fish from being trapped within the sein. Effects on native fish would be minimal because fish are collected alive and are generally unharmed.

Impacts from Electrofishing: Depending on the strength of the direct current and its pulse, electrofishing may result in temporary injury to and direct or delayed mortality of non-target fish, such as sculpin. In the park, there has been some observed mortality of fish from electrofishing during removal of stranded fish from a dewatered channel. There was also one mortality associated with monitoring. In Sequoia and Kings Canyon national parks during nearly 500 hours of electrofishing, no non-fish vertebrate mortality occurred. Stunned amphibians (Pacific tree/chorus frogs and mountain yellow-legged frogs) either hopped away immediately after the electrofishing was stopped, or took from seconds to two minutes to recover (NPS SEKI 2016:155). Trained and certified technicians would operate electrofishers to ensure harm is minimized.

Invertebrates may also be affected by electrofishing; however most would either be unharmed or would recover quickly after being caught in the electrofishing current or dipnets used to catch nonnative fish. In general, however, dipnet mesh is too coarse to catch most invertebrates. Removing nonnative trout from 10 lakes in Alternative 2 and 20 lakes in Alternative 3, as well as numerous stream segments in both alternatives, would allow invertebrate and plankton populations in areas of fish removal to expand in abundance, distribution and diversity, resulting in long-term beneficial effects.

Impacts from Fish Weirs: No intact habitat areas would be modified; however an area of approximately 10.4 - 26.4 square feet (1.6 x 16.5 feet, 1.6 x 6.5 feet) in one or more (nonwilderness) tributaries of the Carbon River would be cleared slightly (rearranging large cobbles) for trap placement. During placement and anchoring, slight localized increases in turbidity could occur but would not be expected to adversely affect fish or other aquatic organisms. Trampling the stream bottom during placement could affect benthic macroinvertebrates, such as dragonfly larvae.

Brook trout spawning timing in Ranger, June and Poch creeks is uncertain (spawning was previously documented once in late September during bull trout surveys). In park lakes, brook trout spawn as early as early August. Brook trout spawn in October and November throughout their native and nonnative range. To better determine brook trout spawning timing, the weir would be placed from early August through November 15 the first year. Following this initial assessment, weir placement timing would be reduced to minimize impacts on native fish migrations occurring at the same time (bull trout and coho salmon). Depending on brook trout run timing, a longer sampling period would be done every five years to document impacts of efforts on all species and to determine if brook trout spawning timing is changing.

There would also be potential for adverse effects on native fish from handling of those trapped by the weir. Because handling and holding native fish would be minimized and native fish would be expected to be released unharmed, overall adverse effects would be small.

Impacts from Gillnetting: There would be both adverse and beneficial effects on fish and wildlife from gillnetting. Beneficial effects primarily occur after fish eradication, while adverse effects often occur during netting. Gillnets would be placed in high elevation lakes to remove nonnative fish. Nets are typically set in straight lines using inflatable watercraft during daylight hours and checked once a day, the captured fish taken, and then the net reset. Because gillnets remain in place within the water column in a lake for a period of several hours to several days, including occasionally overwintering, they are very effective.

During placement, a vertical length of gillnetting is set along a line in a lake to trap fish. When fish swim into the mesh, they may be caught in one of three ways: wedged, gilled or tangled. Wedged fish are caught in the mesh around their body; gilled fish are caught by their gills from trying to free themselves after swimming into the net; and tangled fish are caught by entanglement of some part of their body (e.g. teeth, spines or other protrusions). Mesh size varies depending on the intended catch. The size of the mesh, strength of the twine, and net length and depth are restricted in commercial applications; however noncommercial applications, such as those employed in the park, are not restricted. During setting of nets, the weighted bottom (groundline) and/or anchors for the net could disturb benthic invertebrates, while the floating top (floatline) could entangle animals, such as ducks or other aquatic organisms. Depending on how the net is set, it can capture fish at the base, middle or top of the water column. Depending on fish catch, some deep water nets could be overwintered.

Initially, gillnetting would be tried for a period of time (for example, up to five years). If gillnets are reused in another area, they would be washed and decontaminated per methods described in the park's decontamination protocol (Samora et al. 2011). Fish captured by gillnetting would be disposed of near the edge of the littoral zone or in deeper lakes in backcountry locations, and packed out of frontcountry locations to be disposed of in a dumpster.

Adverse effects could include non-target species caught in the nets; however this is fairly unlikely based on previous experience in the park and the lack of native fish in most still waterbodies. Most gillnetting efforts result in a low incidence of non-target species bycatch. At Sequoia and Kings Canyon National Parks, the following species have inadvertently been caught in gillnets: American dipper, Pacific tree frog, mountain garter snake, eared grebe, northern water shrew, spotted sandpiper, several unknown birds, and one small unidentifiable native vertebrate (NPS SEKI 2016:155). At Mount Rainier, bycatch has been exceedingly rare. In 30 nights of gillnetting since 2005, the single loss of a goldeneye duckling was reported (Wright pers. comm. 2016). Bycatch is also reduced by careful monitoring of the nets and by using nets specific to the type of fish intended to be caught. The mesh size also regulates the size of fish caught. Gillnets minimize amphibian capture by placement away from the shoreline. When non-target species are caught, they are released unharmed, injured, or dead, with attendant adverse effects from trauma and/or mortality, depending on when they were found, how long they had been in the nets, and whether they had suffered injury.

Impacts from Piscicide Use: Piscicide use would be designed to target nonnative fish, which would be killed and removed from the site or returned to the lake from which they were taken to naturally decompose. Depending on the number of fish present in lakes, fish removal would result in mortality of hundreds to thousands of fish. Most would be in small size classes, but some would be large. Piscicides would be used at sites where gillnetting has been or would be ineffective. In areas where gillnetting is marginally successful or unsuccessful (does not result in fish removal), effectiveness would be improved using piscicides. Under Alternative 2, piscicides would be used in lakes and lake outlets outside of bull trout habitat. None of the treated lake outlets would be below natural barriers, and they would be electrofished first to rule out bull trout presence. Two headwaters streams would be treated with mechanical methods only.

Piscicides are safe, short-acting and do not bioaccumulate. As with gillnetting, however, use of piscicides has the potential for non-target effects on other aquatic species. Although non-target effects are possible, the benefits of eliminating nonnative fish outweigh the potential risks from non-target piscicide effects because nonnative fish have had far greater adverse effects on aquatic ecosystems in the park.

In addition to nonnative fish, some amphibians such as Pacific chorus/treefrogs are known to be particularly vulnerable to piscicide use. Piscicides affect gill breathing organisms. Possible effects on treefrogs would be reduced or eliminated from conducting treatments outside of their aquatic stage, when adults have moved to terrestrial areas. According to research cited in the Sequoia and Kings Canyon fisheries plan, many, if not all, tadpoles would have metamorphosed into froglets by late summer/early fall. These froglets would also have moved into adjacent terrestrial habitat (NPS SEKI 2016: 164). For those tadpoles that remain, there would be an effort to move these prior to treatment. According to Hamilton (1941 *in* NPS SEKI 2016:164), the specific response of tadpoles to piscicides depends on their development stage. Because piscicides affect gill breathers, gill respirating tadpoles would likely suffer mortality, while those that had transitioned to air breathing would be less affected. Research has shown that Pacific treefrog adults exposed to piscicide treatment would not be expected to experience mortality; however some temporary adverse effects could occur (Billman et al. 2012 *in* NPS SEKI 2016:164). Amphibian eggs are also thought to be less sensitive to rotenone because they do not take up oxygen at the same rate (Seymour 1999 and Ling 2003 *in* NPS SEKI 2016: 145).

There could also be a temporary loss of invertebrates in lakes, which would not be anticipated to affect birds or bats to any great degree because of the number of these species occurring elsewhere, and because dependence has long been reduced in these areas because of potentially depressed populations of these species from consumption by nonnative fish.

Antimycin, an antibiotic, kills fish by inhibiting cellular respiration. It loses toxicity within a few hours, leaving no residue. In both field and laboratory applications, it has had no short- or long-term effects on other vertebrates (amphibians, reptiles, birds, mammals), or populations of phytoplankton (microscopic aquatic plants) or macrophytes (large aquatic plants). Antimycin has been shown to directly kill phytoplankton and aquatic insects, but populations of these organisms quickly recover at or near pre-treatment levels (Grisak and Marotz 2003 in NPS GRCA 2006:15). Antimycin loses effectiveness quickly in streams with high gradients, and is less effective in cold and alkaline waters (pH over 8.5) (NPS GRCA 2006:16). Antimycin is also currently less available than rotenone-based piscicides. At the present time, it is not being manufactured. In fact, after North Cascades proposed use of antimycin, the park could not find any available and wrote supplemental environmental impact analysis to use rotenone instead (NPS NOCA 2013). Nonetheless, both have been used successfully in parks with few adverse effects.

Impacts from Fish Disposal: Disposal of nonnative fish would generally have no adverse effect or would have wholly beneficial effects on other wildlife by increasing productivity of phytoplankton and consequently species that feed on them (invertebrates and zooplankton) and by providing a direct food source for species such as coyotes or scavengers. Decomposition of fish carcasses would be spread out over time and is a slow process in park oligotrophic (nutrient poor) lakes. In one study cited in NPS SEKI 2016, it took 68-80 days for full decomposition to occur (Premke et al. 2010).

In other national parks that have used fish disposal in high elevation lakes, no observed adverse effects (algal blooms or mortality of other species) have occurred (NPS SEKI 2016:159). Where nonnative fish are present, they would continue to alter nutrient cycles. Paleolimnological analyses in the Rocky Mountains found that "algal production increased substantially following trout introductions and was maintained for the duration of fish presence" (NPS SEKI 2016: 159). The nonnative fish fundamentally altered nutrient cycles and primary production by accessing benthic phosphorous sources not normally available to aquatic communities in low nutrient lakes (Schindler et al. 2001 *in* NPS SEKI 2016: 159).

After disposal, there would be some potential for electrofished, gillnetted or piscicide-killed fish to be eaten by other wildlife. This easily scavenged food source could benefit some species, such as turkey vultures, jays, and crows or ravens. Although there are no specific piscicide tolerance levels for these species, the analysis for the Sequoia and Kings Canyon plan (citing Knapp, R. unpublished data regarding the average size of fish in high elevation lakes [76 g] and the potential for fish to be eaten after treatment) noted that a single juvenile American robin with an average weight of 55 grams at fledging would have to consume approximately 647 trout to reach its median lethal dose of rotenone, making this an extremely unlikely scenario (Howell 1942 in NPS SEKI 2016: 165). Birds present in high elevation lake habitats include belted kingfishers, osprey, golden eye, common mergansers, and barred owls. These species would have the potential to eat piscicide-contaminated fish and would also be anticipated to be similarly negligibly affected.

Mammals, such as raccoons or coyotes, feeding on piscicide-killed fish would be similarly unaffected by the small concentrations of piscicides that they might consume. For instance, analysis for Sequoia and Kings Canyon National Parks reported that a 15 gram northern water shrew would have an estimated daily food intake of 14.3 grams. If its entire daily ration came from treated trout, it would receive 3.2 micrograms of rotenone. This is far below the 5,250 microgram median lethal dose of rotenone for a species of this size (house mouse), demonstrating that adverse effects would be negligible. Similarly, the consumption dose for a 23.3 pound coyote consuming its entire daily diet from treated trout would receive approximately 71.1 micrograms of rotenone, which would be also be far below its presumed lethal dose of 4,240 micrograms (NPS SEKI 2016: 166-167).

Impacts from Culvert Replacement: In some areas, culvert replacement has the potential to cause a small degree of sedimentation in adjacent or nearby aquatic habitat, should best management practices fail. If wattles or other erosion protection measures deteriorate or fail, sedimentation could have negative consequences, such as by reducing dissolved oxygen in streams for fish and amphibian species occurring in, and downstream of, areas where sedimentation occurs. Because mitigation measures would be expected to be effective and would remain in place until the potential for impacts is concluded, overall impacts to fish and wildlife from these actions would be minimal, far below background effects, and would have no lasting effects beyond project actions, including removal of erosion protection measures and stabilization. Overall effects of culvert removal on fish and other wildlife would be long-term and beneficial from restoration of bank full flows in areas of replacement and from removal of impediments to fish passage.

Impacts from New Regulations: Over time, the requirement to retain nonnative fish caught via angling throughout the park would likely reduce the number of nonnative fish in lakes and slightly reduce nonnative fish in streams and rivers. A few small lakes with small fish populations have the potential to be fished out by anglers. Because most catchable size fish in the White River are bull trout (Wright 2016 unpublished report), there would continue to be impacts from angler catch of these species. However unlike Alternative 1, gear restrictions would increase the likelihood of survival after release, and the change to fishing season length would protect spawning bull trout, thereby reducing inadvertent angling impacts on bull trout and other native fish species. Allowing the capture and removal of nonnative species would simultaneously provide more opportunities for sensitive and listed species to persist.

There would also be long-term beneficial effects on native fish and wildlife from the cessation of use of lead-containing fishing tackle. This would reduce the potential for lead to bioaccumulate in fish and reduce overall toxicity of lead in the environment passed on to fish-eating species.

Additional Impacts from Alternative 3
Impacts would be similar to Alternative 2, however because additional lakes, lake outlets and two other stream segments would be treated to remove nonnative fish, overall effects would be more widespread. Furthermore, because the additional lakes that would be treated in Alternative 3 are more difficult to access, it is likely that there would be more helicopter use. These lakes are also deeper, and the lake outlets and streams have more complex habitats; therefore use of piscicides would likely be more prevalent, resulting in more potential for adverse effects on some native species, including bull trout.

Studying and potentially implementing translocation of bull trout in the Mowich and Puyallup river watersheds could result in more concentrated actions in these areas, causing further localized disturbance to some wildlife in the vicinity of the actions.

Impact Avoidance, Minimization and Mitigation Measures
The following measures would be used to reduce impacts on wildlife, including fish (see water resources section for mitigation measures applicable to culvert replacement):

- In piscicide treatment areas with obvious presence of native amphibians, as many larval, juvenile and adult individuals as possible would be captured and temporarily moved to a nearby holding area while treatments are conducted. Afterwards, they would be returned.
- Where possible, conduct piscicide treatments outside the larval season for amphibians.
- Decontamination procedures (following Samora et al. 2011) would be used when monitoring, gillnetting, or piscicide treatments were conducted (after each use in each lake or stream).
- Gillnets would be monitored to the extent practical to keep wildlife from becoming caught in the nets.
- Weir traps would be checked daily while in operation to minimize holding time for native fish or other wildlife incidentally captured at the weir.
- Citizen science angling and electrofishing would have a very low tolerance for hooking or electrofishing mortality of native fish. One native fish per site per year. If this threshold is met the site will not be revisited until the following season.
- Trained and certified technicians would operate electrofishers and sein nets to minimize potential harm from inexperience.
- Limited electrofishing in bull trout habitat would only occur between July 15 and August 15, to avoid impacts to developing eggs and alevins, and would occur no more than once per year at each location.
- Very conservative thresholds of one native fish mortality per site per year would be set to minimize impacts of fish removal efforts.
- Piscicide treatments would not be used in areas where bull trout are present (Alternative 2) or would be minimized and bull trout isolated from use (in Alternative 3).

Cumulative Effects: Arguably, the largest effects on park fish and fish habitat are the dams on the Puyallup-Mowich drainage (Electron Dam), on the White River (Mud Mountain Dam), on the Cowlitz River (Riffe Dam), and Ohanapecosh River (Mayfield Lake). Alder and LaGrande Dams on the Nisqually River likely have minimal effects because they are at the site of a large natural fish barrier (waterfall). The other dams initially blocked many anadromous salmonids (including bull, cutthroat and steelhead trout and coho, Chinook, sockeye, and pink salmon) from entering the park once they left. This has been partially mitigated in some areas, such as by recent construction of a fish ladder on the Electron Dam (2000) and by trucking salmonids around Mud Mountain Dam since 1948. As additional changes have been made at the dams, fish passage has improved somewhat. The Carbon River is the only major drainage without dams blocking fish passage.

The introduction of nonnative fish from stocking that began before the park was established and continued into the early 1970s has also had a substantial effect on aquatic systems. The past stocking and continued presence of nonnative fish has altered the natural function of native aquatic ecosystems, including the native food web, and the type and distribution of species throughout the park and on adjacent lands. Nonnative fish have affected amphibian populations, and amphibian decline, in general, is a worldwide phenomenon. As described in Larson et al. (2016),

> The negative effects of fish on amphibian species is only one aspect of a number of potential causes contributing to the decline of amphibians in the western United States, as well as worldwide. These causes include habitat fragmentation and loss, environmental pollutants, climate change, and an emerging infectious disease chytridiomycosis (Wake and Vredenburg 2008; Hayes and others 2010).

No actions proposed in Alternatives 2 or 3 would come close to the longstanding adverse effects on aquatic systems that would continue to be part of Alternative 1. Instead, as described in the analysis, under Alternatives 2 and 3 there would be short-term adverse effects combined with cumulative beneficial impacts on native species from the removal of nonnative fish from streams, lakes and rivers using the variety of methods described herein. Based on research, removal of nonnative fish would increase some populations of native amphibians, such as long-toed salamanders, and allow others, such as tailed frogs, to repopulate suitable habitat (Larson et al. 2016).

Studies have also documented that changes in diatom assemblages may not respond to simple fish removal. Drake et al. (2000) concluded that:

> Diatom assemblages in the two restored lakes (Eunice and Owyhigh) have not returned to and have not shown a consistent trend toward predisturbance conditions, for which there are several potential explanations. First, recovery may take longer than the 20-30 years since fishes were removed from lakes. Second, ecological conditions in stocked lakes may have been driven past a threshold of change-exceeding the bounds of resiliency-from which they will not return spontaneously. Third, other disturbances, such as loss of lakeshore vegetation, may also have affected diatom communities in lakes over the last 30 years.

Drake et al. (2000) also noted that “Analyses of baseline conditions and changes over time in Mt. Rainier lakes suggest that full ecological restoration will involve more than simply removing fishes.” Some species, however, such as diatoms, would continue to show the lingering effects of nonnative fish presence (Drake and Naiman 2000).

A number of other activities in the park have a small range of adverse effects on fish and wildlife, primarily from noise and disturbance. These include public recreational activities, such as camping and angling, trail maintenance and other recreational facility maintenance activities, and resources management activities, such as monitoring and wildlife surveys. Actions in Alternatives 2 and 3 would contribute an additional small degree of disturbance, but would not change the overall range of disturbance, which would remain minimal.

The long-term effects of climate change could also affect wildlife in the park and in surrounding areas. Within the park and elsewhere “shallow fish-free wetlands used by native species are disproportionately vulnerable to climate-induced drying” (Ryan et al. 2014). According to the study, wetlands, where water is intermittently present or which have short-lived hydro-periods, would continue to be the most vulnerable, while perennial and/or large water bodies are less vulnerable to shifts (such as warming temperatures) that cause drying. As a result, changes to water supply in streams, rivers and lakes caused by climate change could affect recovery efforts if these continue and worsen. Because the plan timeframe covers a period of approximately 10 years rather than decades, overall effects are not anticipated to affect the potential for recovery of fish and other aquatic species in the park.

Conclusion: The continued presence of self-sustaining populations of nonnative fish in park waterbodies (lakes, streams and rivers) would be greatest under Alternative 1 (approximately 35 lakes), less over time under Alternatives 2 (approximately 20 lakes and lake outlets) and 3 (approximately 15 lakes and lake outlets). Combined with fish management actions taking place outside the park, Alternative 1 would have no additional effects. Alternative 2 would have benefits on native aquatic species, including native fish, amphibians and invertebrates in some areas in the park, and Alternative 3 would have more widespread benefits on native aquatic species in the park. A comprehensive fish management program involving the use of chemical piscicides, electrofishing and gillnetting may adversely affect some fish and wildlife, however these short-term and/or limited adverse effects would be small compared to other important park values and conservation efforts, such as restoring native fish and amphibian populations. In the future, some native aquatic ecosystems would be more productive and therefore more resilient to the effects of climate change.

D. Special Status Species

Threatened Fish

Affected Environment

Three native salmonids in the park are federally listed as threatened, including bull trout (listed 1998, critical habitat designated 2010, recovery plan 2015), Puget Sound steelhead trout (2007 listed, critical habitat designated 2016) and Chinook salmon (listed 1990, critical habitat 1993-2005, recovery plans 2007). All three fish species are also listed by the State of Washington as threatened. Washington State also considers rainbow trout/steelhead as a game fish. Three other species (coastal cutthroat trout, and coho and sockeye salmon, are considered sensitive by the USFWS and/or NMFS and Washington State).

Bull Trout (*Salvelinus confluentus*)
Range: Bull trout are native to northwestern North America. Historically, bull trout were found in most major river systems in the Pacific Northwest north toward Canada and east into Montana. Although they are thought to have occurred historically in northern California, they have been extirpated.

Threats: Bull trout are threatened by competition with introduced fish species, siltation, habitat fragmentation (dams) and degradation, hybridization with brook trout, and climate change (which may increase temperatures in critical bull trout habitat (Hoffman et al. 2014).

Description: Bull trout are char. Their habitat is characterized by clear cold water (generally below 55 degrees F), silt-free rocky substrate in riffle run areas, well-vegetated stream banks, abundant stream cover, deep pools, relatively stable flow regime and stream banks, and productive fish and aquatic insect populations. Bull trout exhibit a variety of life history strategies, including resident, resident migratory and anadromous. Bull trout eat plankton and other aquatic life, as well as other fish eggs and fish as they grow older.

Spawning Season: Bull trout spawn from late August to mid-October in the Carbon, Mowich, West Fork, Huckleberry, White and Puyallup watersheds.

Environmental Baseline: Status in Mount Rainier National Park (including Project Action Area)
Native char surveys were used to document bull trout in the park (Samora 2013). In Mount Rainier, bull trout have been documented from the Carbon, Mowich, White, West Fork, and Puyallup Rivers and their tributaries. During studies to analyze baseline data for fish in the park, the most catchable fish size found in the White River were bull trout. Initially, the park considered closing the White River to fishing within the park to better protect these catchable size fish; later analysis reconsidered this because of the benefits of eliminating remaining brook trout in the same area through fishing (Wright 2016 unpublished report). Bull trout were also common during sampling in the Carbon River, but a high proportion of brook trout were also found (Wright 2016 unpublished report).

Bull trout "have relatively narrow habitat requirements including cold water temperature; pristine water quality; clean stream substrates for spawning and rearing; complex habitat structure; and high connectivity of movement corridors" (Hoffman et al. 2004). No bull trout brook trout hybrids were documented from the 2001-2006 surveys, which included genetic testing of some fish; however, this risk continues to be present, especially where they coexist in the Carbon, Puyallup, Mowich and White rivers. Two recent studies found that hybrid populations, whether from brook trout released downstream or in headwaters, were found closest to the source populations and in midstream locations, but not at both ends (DeHaan et al. 2010).

Rainbow/Steelhead Trout (*Oncorhynchus mykiss*)
Rainbow trout and steelhead are the same species with different life history strategies. They have habitat needs similar to cutthroat trout and hatch in gravel-bottomed, fast-flowing, well oxygenated streams. Rainbow trout remain in freshwater while steelhead migrate to the ocean. Adult steelhead develop a much more pointed head, become more silvery in color and typically grow much larger than rainbow trout that remain in fresh water (Samora et al. 2013).

Range: Rainbow trout occur throughout the U.S and Canada. Their migratory form (steelhead) occurs in coastal areas. Non-hybrid rainbow trout were found in the Carbon and Cowlitz watersheds, while hybrids (with westslope cutthroat and coastal cutthroat) were found in the Ohanapecosh, Nisqually, and Carbon watersheds (Samora et al. 2013 in Hoffman et al. 2004). The West Fork has both hybrid and non-hybrid rainbow trout (Samora et al. 2013).

Threats: Rainbow/steelhead trout are threatened by competition with introduced fish species, habitat fragmentation (dams), degradation and loss, and hybridization with cutthroat trout (Hoffman et al. 2014:189).

Description: Rainbow/steelhead trout can be resident fish, migratory within a stream or river and anadromous (steelhead). They eat zooplankton, aquatic and terrestrial insects, mollusks, crustaceans, fish eggs, minnows, and other small fishes (including other trout).They live up to 11 years and are sexually mature at 2-3 years. Although most fish are smaller, steelhead can weigh up to 55 lbs. and be 45 inches long (http://www.fisheries.noaa.gov/pr/species/fish/ steelhead-trout.html accessed 1 November 2016).

Spawning Season: Rainbow/steelhead trout have not recently been documented to spawn in the park. This is in part due to lack of access and staff during spawning season. Historic accounts and current habitat models suggest they previously spawned up to Klickitat Creek in the White River, Ipsut Creek in the Carbon River, in the North Mowich River and West Fork (Schmoe1925, and WDFW Salmonscape). Steelhead spawn in several spawning pockets in redds in their natal stream, migrating from the marine environment. Similar to bull trout, but unlike other salmonids, they can spawn more than one time. Winter run steelhead spawn from November through April. Redds have been documented in the White and Carbon river watersheds just outside the park boundary.

Environmental Baseline: Status in Mount Rainier National Park (including Project Action Area)
According to Hoffman et al. (2004), steelhead are thought to be present in the Carbon, Mowich, West Fork, and White river watersheds; however steelhead have not been distinctly identified from the non-anadromous life form of rainbow trout in the park (Hoffman et al. 2014:194). Although there are no barriers to steelhead migration on the Carbon River, steelhead are transported around two dams blocking their passage in three watersheds.

According to the Muckleshoot Tribe and Washington Department of Fish and Wildlife (1993), steelhead redds and spawning have been observed in the Carbon and White river watersheds (Hoffman et al. 2014:194). These steelhead are part of one of the five distinct population segments (DPS) listed as threatened by the U.S. Fish and Wildlife Service. Another four DPS are also listed as threated in the Puget Sound (Hoffman et al. 2014:194). Because they are threatened in Washington, park steelhead populations could be important contributors to the future status of this anadromous life form in the state (Hoffman et al. 2014:194). The majority of steelhead returning to the Puyallup River system are winter-run fish, entering the river beginning in winter.

<u>Chinook Salmon</u> (*Oncorhynchus tshawytscha*)
Range: Chinook are found in the mountain west, including California, Colorado, Idaho, Nevada and Montana as well as in Canada.

Threats: Chinook are threatened by resource extraction, dams, habitat modification and degradation (Hoffman et al. 2014:189).

Description: Chinook are the largest salmon, with adults often exceeding 40 pounds. They eat aquatic and terrestrial insects, crustaceans and other fish. Depending on where they occur, they exhibit two different life history strategies: some spend more time as young in streams; some spend more time as young in the ocean.

Spawning Season: Chinook use a variety of freshwater habitats, but more commonly spawn in larger mainstem rivers or tributaries. Adults migrate to marine waters as young and when mature return to their natal stream to spawn once before dying within a few days to a month. Seasonal runs may occur in the spring, summer, fall and/or winter.

Environmental Baseline: Status in Mount Rainier National Park (including Project Action Area)
In Mount Rainier, habitat for Chinook includes the White River, West Fork White River, Carbon and Mowich rivers. In White River surveys, Chinook comprised the smallest number of fish sampled (Wright 2016 unpublished report). The Puyallup River basin has two historically independent populations of Chinook: Puyallup River fall-run and White River spring-run. The Puyallup River fall-run includes Chinook that spawn and rear in the Carbon River and its tributaries.

Chinook salmon in the White River are present as a result of trucking around Mud Mountain Dam and are unique. According to Samora et al. (2013), “the White River early-run Chinook salmon population is genetically the most distinctive stock in central and south Puget Sound. It is the last existing early returning “spring” Chinook salmon population in southern Puget Sound.”

Spring Chinook salmon have been documented as present in the White watershed, with in-park individuals typically <3.9 inches (100 mm) TL [total length] (Samora et al. 2013 in Hoffman et al. 2014:194). Adult Chinook are also transported upstream of the Mud Mountain Dam, and spawn and rear in the White River within the park. Puyallup River fall Chinook salmon may also be present in the park, but this has not been documented. Of the eight Chinook salmon “evolutionarily significant units” (ESUs) in Washington, four are federally listed as threatened (including the Puget Sound and Lower Columbia ESUs) and one is listed as endangered (Hoffman et al. 2014:194).

Other Special Status Fish

Affected Environment

Two species of native fish found in the park are federal species of concern, including coastal cutthroat trout and coho salmon. Another species is considered rare in the park (sockeye salmon) but does not have federal status in the project area.

<u>Coastal Cutthroat Trout</u> (*Oncorhynchus clarkii clarkii*)
Similar to rainbow trout/steelhead, coastal cutthroat (federal species of concern, state game fish) exhibit a variety of life forms, including residential nonmigratory, freshwater migratory and saltwater migratory. A petition to list the fish in the western Cascades, including northern California, Oregon and Washington was denied. Due to a lawsuit, a status review was reopened in 2009. Cutthroat trout spawn from December through June. Eggs hatch within six to seven weeks, depending on temperature; alevins emerge between March and June.

Land use activities with the potential to affect coastal cutthroat trout habitat include forest management, agriculture and livestock management, dams and barriers, urban and industrial development, mining, and estuary degradation. Two of these, forest management and estuary degradation, are the principal reasons for declines across the range of coastal cutthroat trout in the proposed rule (64 FR 16402).

Despite impacts, coastal cutthroat trout have survived at densities comparable to healthy-sized populations elsewhere and appear to be capable of surviving long periods under these conditions (https://www.fws.gov/oregonfwo/species/data/coastalcutthroattrout/ accessed 5 October 2016). Cutthroat are somewhat numerous in the White River, comprising the second largest number and a wide size distribution in sampling conducted in the White River (Wright 2016 unpublished report). Coastal cutthroat are threatened by habitat degradation, overfishing, dams, and introduction of hatchery stock (Hoffman et al. 2014:189).

Coho Salmon (*Oncorhynchus kisutch*)
Coho (federal species of concern Puget Sound/Strait of Georgia ESU, federally threatened Lower Columbia River, State Food Fish) were historically found in the White, West Fork, Carbon, North Puyallup and Mowich rivers. They are anadromous and spawn once in their stream of origin at two (male jacks) or three years old. In White River surveys, coho comprised the third largest number of fish sampled (after bull and cutthroat trout) (Wright 2016 unpublished report), however they were a distant third, with only 55 fish found during surveying from 2010 to 2012. Coho salmon have been documented to spawn in the park. They are present in small numbers, and are found infrequently in the Carbon River.

Conservation efforts include captive-rearing in hatcheries, removal and modification of dams that obstruct salmon migration, restoration of degraded habitat, acquisition of key habitat, and improved water quality and instream flow (http://www.fisheries.noaa.gov/pr/species/fish/coho-salmon.html accessed 5 October 2016). Coho are threatened by habitat degradation and loss, increasing water temperature, poor ocean conditions, and the genetic effects of hatchery stock (Hoffman et al. 2014:189).

Special Status Birds

Affected Environment

Two birds occurring in the project area, the northern spotted owl and the marbled murrelet, are listed as threatened by the USFWS.

Northern Spotted Owl (*Strix occidentalis caurina*)
The northern spotted owl (federally threatened, state endangered) is strongly associated with mature or old growth forests that are structurally complex – containing large habitat areas of trees with several species, sizes, and ages, standing and down dead trees, and multistoried canopies. Median home range sizes are typically 3,000 to 5,000 acres per pair. Spotted owls nest in cavities or platforms in trees.

The northern spotted owl was listed in 1990 because of widespread loss of suitable habitat across the species range and the inadequacy of existing regulatory mechanisms to conserve the species (USFWS 1990). Many populations of spotted owls continue to decline, especially in the northern parts of the species' range.

Status of Northern Spotted Owls in Mount Rainier National Park (including Project Action Area): Park spotted owls surveys have been conducted since 1983, and annually since 1997.

> These surveys track annual occupancy rates of historic nest sites and territories by Spotted and Barred Owls. . . . a significant proportion (40%) of the Rainier Spotted Owl Demographic Study Area (DSA) overlaps MORA (Forsman et al. 2011). Data from the DSA allows evaluation of the rate and possible causes of population change in Spotted Owls on the west slope of the Washington Cascades. Results are available from analysis of data from 1992–2008 for the Rainier DSA in Forsman et al. (2011:Table 1) (*in* Hoffman et al. 2014:207).

Northern spotted owls have been declining both within the park and throughout their historic range, likely attributed to barred owl presence (including predation and competition).

> Populations in Washington exhibited a long, gradual decline after the mid-1990s, and have declined 40−60% over the last 15 yrs. An increase in fecundity of NSO in the Rainier DSA between 1992 and 2008 was off-set by high annual variability (no young produced at all in some years) and precipitous declines in survival during the last 5 yrs (2004 – 2008) of the demographic study (Forsman et al. 2011). The population was estimated to be declining in the Rainier DSA at

a rate of 7.1%/yr between 1992 and 2008. Decreased survival was associated with higher proportions of territories where Barred Owls were detected for Rainier, suggesting that the negative effects of Barred Owls may be the prominent cause of population declines of the NSO in the Rainier DSA. Monitoring surveys at MORA also document an increase in Barred Owl occupancy within the park, and a 45% decrease in NSO occupancy rates from peak levels recorded in 1998 (Bagnall 2013) (*in* Hoffman et al. 2014:210).

Historic and recent loss of nesting and roosting habitat is a major factor to which population declines of Spotted Owls have been related. Wildfire has been the leading cause of habitat loss since implementation of the Northwest Forest Plan (Davis et al. 2011), but large fires occur infrequently at MORA (Hemstrom and Franklin 1982). However, although estimated rates of population decline were highest for study areas in Washington, estimated habitat loss has been only 0.4% in the western WA Cascades where average habitat suitability remains relatively high (Davis et al. 2011). MORA is estimated to have approximately 32,375 ha (80,000 acres) of NSO habitat (Bagnall 2013) (*in* Hoffman et al. 2014:210).

In addition to loss of habitat, unfavorable weather conditions and climate change may also be contributing factors to population declines of Spotted Owls by lowering demographic rates (Glenn et al. 2010). Low temperatures during the early nesting season in some years of the last 2 decades were associated with low fecundity in the Rainier DSA and elsewhere (Forsman et al. 2011). Most climate change models predict warmer, wetter winters and hotter, drier summers for the Pacific Northwest. These conditions have been associated with lower population growth rates, survival, and recruitment of Spotted Owls, suggesting that future climate conditions may be less favorable for them. Prolonged summer drought may cause declines in populations of Northern Flying Squirrels, woodrats, and other small mammal prey species, ultimately affecting survival, recruitment, and population growth rates of owls (*in* Hoffman et al. 2014:210).

Marbled Murrelet (*Brachyramphus marmoratus marmoratus*)

The marbled murrelet (federally threatened, state threatened) is a small seabird that feeds on fish in ocean waters within one mile of the shore. Due to their secretive nature and cryptic coloration, information on the distribution and abundance of marbled murrelets in Washington has been difficult to gather (NPS 1996a).

The marbled murrelet was listed as a threatened species in Washington, Oregon, and northern California in 1992. The primary reasons for listing included extensive loss and fragmentation of old-growth forests which serve as nesting habitat for murrelets and human-induced mortality in the marine environment from gillnets and oil spills (USFWS 1992). Although some threats such as gillnet mortality and loss of nesting habitat on Federal lands have been reduced since the 1992 listing, the primary threats to species continue (NPS MORA and USFWS 2010). Surveys from 2000 to 2008 documented that murrelet populations throughout the listed range have continued to decline at a rate of 2.4 to 4.3 percent per year. This represents an overall population decline of 19 to 34 percent since 2000 (USFWS 2010). Since 2008, populations have continued to decline. The USFWS Recovery Plan for the marbled murrelet emphasizes maintaining and protecting occupied habitat and minimizing the loss of unoccupied suitable habitat (USFWS 1997a in USFWS 2008).

Status of Marbled Murrelets in Mount Rainier National Park (including Project Action Area):

Marbled Murrelet surveys have been conducted in Mount Rainier National Park since the 1990s (Schaberl and Myers 2003). All surveys were conducted using standard protocol developed by the Pacific Seabird Group (Evans Mack et al. 2003), or using marine radar (ABR 2011). Survey data were used to determine occupancy status of surveyed stands, but did not provide information on population status or trends. Population trends have been estimated using data from surveys of murrelets in near-shore marine waters (Miller et al. 2012) (*in* Hoffman et al. 2014:207).

Surveys for Marbled Murrelets (1995 - 2009) have documented behavior indicative of nesting in the northwest corner of the park (Dhundale 2009). Evidence of occupancy has been documented in every survey year for the Carbon River drainage. Murrelet occupancy also has been documented by both audio-visual and radar surveys in drainages of the South Puyallup and Mowich Rivers. Presence in the Nisqually River drainage also is based on radar detections, but needs to be confirmed with audio-visual surveys. Outside of MORA, populations of Marbled Murrelets have been declining throughout the region, with the steepest declines in Washington (Miller et al. 2012), where loss of older forest habitat has also been the greatest (Raphael et al. 2011). Data from Murrelet surveys cannot be used to determine trends within the park because of the variability in locations of survey effort and stations among years. However, the data are useful for tracking the occupancy status of specific locations that have been consistently surveyed using the standard protocol (Evans Mack et al. 2003). Murrelets have consistently been detected on the Carbon River throughout all survey years, indicating the importance of this drainage as nesting habitat within the park (Hoffman et al. 2014:214).

Special Status Amphibians and Invertebrates

Affected Environment

Nest predators, such as brown-headed cowbirds and corvids (ravens and crows), may be adversely affecting marbled murrelet productivity (Hoffman et al. 2014:222). Additional surveys are needed in the Nisqually River drainage to determine whether this area is also being used for nesting.

Impacts on Special Status Species

See also the previous section (Fish and Wildlife Impacts)

<u>Impacts from Alternative 1 on Northern Spotted Owls and Marbled Murrelets</u>: There would be no effect on northern spotted owls or marbled murrelets from actions under Alternative 1. There would be no loss of habitat or disruption due to noise or human activity.

Table 8: Special Status Amphibians and Invertebrates

Species	Federal Status	State Status	Status in Project Area
Cope's giant salamander (*Dicamptodon copei)*	_	SM	This species has been confirmed in only in one location in the park through genetic analysis of larvae, which are difficult to differentiate from the coastal giant salamander. They generally inhabit small to mid-sized streams and adjacent moist forests.
Tailed frog (*Ascaphus truei)*	_	SM	Tailed frogs inhabit many of the park's clear, fast-flowing streams and lake outlets.
Cascades frog *(Rana cascadae)*	proposed	_	Cascade frogs are a montane species, primarily occurring above 2,625 feet in montane meadows, marshes, and ponds (U.S. Forest Service 1995). Distribution of the Cascades frog in the park is not well known. Surveys have documented these amphibians in the Huckleberry, Carbon, Mowich, Puyallup, Nisqually, Cowlitz, Ohanapecosh, and White River. Cascades frogs within Mount Rainier have been proposed for listing under the ESA.
Western toad (*Bufo boreas)*	FSC	SC	Western toads were formerly more abundant, but recently they have been found only in a few montane lakes and wetlands in the park.
Columbia torrent salamander (*Rhyacotriton kezeri*)	FSC	SC	This species has not been documented from in the park, but has been documented immediately outside the park boundary.
Larch Mountain salamander *(Plethodon larselli)*	FSC	SS	Larch mountain salamanders are found in forested and talus environments that provide cool, moist conditions under wood or rock substrates. The salamander has been found near the park boundary and in several locations in the park.
Van Dyke's salamander *(Plethodon vandykei)*	FSC	SC	Van Dyke's salamander is found in a variety of habitats, including stream banks, upland forests, talus, and seeps, at a large range of elevations. Salamanders have been documented in several locations throughout the park.
California floater (mussel) *(Anodonta californiensis)*	_	SC	Freshwater mollusks can inhabit permanent water bodies of all sizes. Mussels may also be found in sand-gravel substrates that are stable. The California floater is expected to occur in the park in suitable habitat but has not yet been documented.
Fender's soliperlan stonefly (*Soliperlan fenderi)*	FSC	_	This species has been identified on three occasions in Tahoma Creek tributaries in the park.

FSC = federal species of concern; SC = state candidate; SM = state monitor species; SS = state sensitive

Impacts from Alternative 1 on Special Status Fish: There would continue to be adverse effects on special status fish, including bull trout, steelhead and coastal cutthroat trout, and Chinook and coho salmon, under Alternative 1, especially where nonnative fish and native fish are competing for the same resources, and when there is potential for hybridizing. There would continue to be no effect on Essential Fish Habitat for coho, Chinook or pink Salmon or steelhead in the Carbon, White or West Fork rivers. No changes would be made to spawning or rearing habitat for these (or other) species. Adverse effects on bull trout and other listed salmonids would continue to occur from the potential for these species to not only be hooked, but to be retained during recreational fishing in the rivers and streams where they are present. Within the park, there are currently no regulations that would prevent fishing for and/or capture of rare, threatened or endangered species; however the superintendent's compendium prevents the capture and retention of bull trout. Fish harvesting can also result in long-term changes to the age structure and abundance of nonnative and native species. Because of the low levels of fish harvesting occurring in the park, it is unknown whether or not this is occurring.

Impacts from Alternative 1 on Special Status Amphibians: (see Fish and Wildlife impacts).

Impacts from Alternative 2

Alternative 2 has the potential to affect special status species, including federally listed species. The implementation of alternative may affect, but would not likely to adversely affect Northern spotted owls and marbled murrelets and most listed fish species, including steelhead trout, and Chinook salmon. Alternative 2 may affect, and is likely to adversely affect, bull trout because of the potential for bull trout to be harmed during seining, electrofishing and operation of weirs. The project is also likely to impact individual coho salmon, which is not federally listed, but is a park special status species.

Most of the effects on bull trout and other fish species would be beneficial, however. Beneficial effects would be from removal of nonnative fish. Removal/eradication of nonnative fish from lakes and lake outlets and Ipsut and Tolmie Creeks (Carbon River Watershed) would result in fewer opportunities for nonnative fish to compete or hybridize with native fish, particularly bull, rainbow and cutthroat. There would continue to be no adverse effect on Essential Fish Habitat from implementation of Alternative 2 or 3.

Impacts from Transport of Piscicides and Equipment: Under Alternatives 2 and 3, transport of equipment to treat high elevation lakes with piscicides could require helicopter assistance. This activity may affect, but would not likely adversely affect Northern spotted owls and marbled murrelets. As described in the alternatives and under impacts to fish and wildlife, mitigation measures including flights outside of habitat (including known nesting areas) and/or from helibases above the elevation of nesting habitat would be used. The lakes proposed for nonnative fish removal are distributed throughout the park. If helicopters are deemed necessary, flight paths would be determined based on lake site location. Flights would originate out of Kautz Creek Helibase or Tahoma Woods, both located in the Nisqually Watershed. Flight paths over spotted owl and marbled murrelet habitat would be 2000 ft above ground level (AGL), except on departure and approach. Flights would not be lower than 500 AGL over spotted owl and marbled murrelet habitat

Project implementation independent of helicopter transport would not be expected to cause above ambient noise; however human activity could disrupt animals in the vicinity, including northern spotted owls and marbled murrelets in suitable habitat (although much work would also occur above the elevation of suitable habitat for these species). Although there would be no habitat loss that could affect northern spotted owls or marbled murrelets, crushed vegetation may occur from staging helicopter drops and landings, if they occurred. Neither species is anticipated to be affected by the removal of nonnative trout from high elevation lakes because neither species is known to prey on trout from forested or subalpine lakes.

Impacts from Removing Nonnative Species from Streams and Lakes via Electrofishing, Weirs, Angling and Piscicides: As in Alternative 1, along with the expected beneficial effects of reducing competition with nonnative fish by removing them, there would be a potential for some adverse effects to native special status fish. Among these include the potential for hook injuries from fishing in native species habitat, accidental stunning during electrofishing, and accidental mortality from trapping. While impacts from hook injuries could affect bull trout, steelhead, coho, and Chinook, impacts from accidental mortality during trapping would primarily apply to bull trout because of the rarity of other native fish species in areas where the weir would be used. In addition, the season during which weirs would be used is not when coho, Chinook and steelhead are typically detected in streams. Because brook trout have been documented to spawn as early as August in lakes and in October and November in their native habitat, weirs would be placed from early August through November 15 the first year to better identify brook trout spawning timing in each site where placed. This would result in the weir being placed during bull trout spawning season. Following initial assessment, weir placement timing would be reduced to minimize impacts on native fish migrations occurring at the same time (bull trout. Depending on brook trout run timing, a longer sampling period would be done every five years to document impacts of efforts on all species and to determine if brook trout spawning timing is changing.

Impacts from weir placement would affect bull trout habitat (restricting upstream movement), and the weir could concentrate fish that would otherwise move throughout the tributary stream. There would also be some potential for inadvertent fish handling injuries to occur as brook trout were captured and removed, and disturbance impacts from monitoring and removing fish from the weir. A slight increase in the potential for predation from native species such as other fish, raccoons or other medium-sized mammals could also occur from concentrating fish near the weir.

Serious injuries from handling and hook injuries could result in mortality; however hook injuries would be reduced by changes in fishing regulations to only permit use of single point barbless hooks for fishing in rivers, consistent with Washington State regulations. The potential for injuries from handling would continue but could be reduced through education.

Existing adverse impacts on bull trout under Alternative 1 would be reduced in Alternative 2 by removing nonnative fish in 10 lakes, lake outlets and Tolmie and Ipsut creeks, and by changes in fishing regulations that require retention/removal of nonnative fish from lakes, streams and rivers. Beneficial impacts would increase in Alternative 3, where removal would occur from 20 lakes and lake outlets and two additional streams.

Approximately 58-78 percent of differences in population dynamics for bull trout may be explained by the presence of nonnative fish (Kovach et al. 2016). Although bull trout are cold-water adapted species that are likely to be affected more by climate change than some other species, most of the variation in population dynamics is explained by interactions with nonnative fish, therefore addressing stressors from the immediate threat of nonnative fish on bull trout populations is a proactive strategy that may improve opportunities for long-term survival (Kovach et al. 2016). Other factors that influence bull trout presence include whether there is cold water present, how much development/human use is present, and how much spawning and rearing habitat is present. These other characteristics of bull trout habitat – clean, complex, and connected (Rieman and McIntryre 1993 *in* USFWS 2015a) – would continue to be widely available in the park.

Eliminating source populations for brook trout in the Carbon River and its tributaries, such as in the headwaters of Upper Ipsut Creek and Tolmie Creek, would have long-term beneficial effects on bull trout and likely other native fish. At Crater Lake National Park, brook trout were eliminated from a stream using antimycin-A and electrofishing. After brook trout were eliminated, bull trout increased "approximately tenfold" and spread from 1.18 miles of stream to 6.9 miles (Buktenica et al. 2013). Elimination from 9.1 miles of stream required 184 person days over six years for electrofishing plus another 17 for piscicide treatments. It also required separating bull trout from brook trout eradication areas when piscicides were used because bull trout are also susceptible to piscicide treatments (Buktenica et al. 2013).

In the majority of lakes and streams proposed for treatment, some distance (more than 0.62 miles) exists between treatment areas and occupied habitats. This is adequate for neutralizing piscicides so as not to affect native fish downstream. Two exceptions are the littorals pond and White River ponds, which are floodplain ponds with outlets that have fish barriers within a few hundred meters of native bull trout bearing waters.

Because of the habitat configuration in the littorals pond, piscicides are unlikely to be needed to successfully eradicate bull trout. In the event piscicides are needed, the outlet has extremely low flow and is disconnected between pools below the fish barrier for approximately 656 feet in the fall. A spring increases instream flow below this reach, and native bull trout are possibly present. This reach typically has a few stranded young of the year brook trout likely washed out of the lake during spring high flow and these fish could be used as indicators for successful neutralization of piscicides.

The White River ponds are three connected small ponds separated by small stream reaches. In the event that piscicide use is necessary, there are several treatment options that may be explored based on the distance to occupied bull trout habitat below the fish barrier. One option is to treat all three lakes and the lowest outlet if it is determined adequate neutralizing distance is available. If adequate neutralizing distance is not available, the outlet of the lowest lake could be the neutralizing station allowing for 1,050 feet of unoccupied habitat buffer that would be electrofished to remove brook trout. A third option would be to neutralize at the inlet to the lowest lake providing greater buffer for native bull trout, but reducing the probability of successful eradication since the lowest lake is the largest and most complex.

Removing nonnative brook trout from headwater streams above barriers via electrofishing would reduce the threat of their outmigration into the Carbon River and the possibility that they would begin to breed with bull trout. Similarly, locating a weir on Ranger Creek and potentially other major tributaries to capture brook trout would improve spawning opportunities for bull trout. Reducing competition with brook trout could also allow existing populations of coho salmon (found in June and Ranger creeks) to increase and to outcompete brook trout, similar to the existing situation in the White River, where brook trout numbers are much lower (Wright 2016 unpublished report). Because electrofishing would result in capture of bull trout as well as brook trout, potential adverse effects could occur. Similarly, electrofishing could also adversely affect coastal cutthroat trout and coho salmon, which are also present in the White and Carbon rivers, although coho are there in very low numbers. Although other salmon are also present, they are unlikely to be present during summer (prior to spawning in the fall).

Using electrofishing alone has proven to be a successful method of brook trout removal when conducted systematically in streams where brook trout co-occur with another species of concern (in this case study, native westslope cutthroat trout in Montana) (Bradley et al. 2014). Electrofishing may also be preferable to piscicide use because of public perception regarding chemical use (Bradley et al. 2014) and/or to reduce the need to temporarily translocate bull trout from piscicide treated areas. However, success depends on the consistency, thoroughness, and number of treatments during a single season, as well as the use of barriers to isolate an area and/or to prevent additional immigration from nearby source areas (Bradley et al. 2014).

Impacts from Alternative 3

Most impacts would be the same as in Alternative 2. Because the second set of ten lakes and two additional streams that would be treated in Alternative 3 are deeper and/or have more complex habitat, piscicide use would occur in Alternative 3. Whereas most treatments in Alternative 2 would be mechanical, it is likely that half or more of the treatments in Alternative 3 would involve the use of piscicides. While a series of mitigation measures would be used to avoid piscicide use in bull trout habitat (as in Alternative 2), more use would likely occur because of the difficulty in treating some areas with mechanical means.

Alternative 3 also proposes to translocate and/or reintroduce bull trout in the Mowich and Puyallup watersheds. As a result, there would be additional adverse effects on bull trout from capturing and handling individual fish. If similar reintroduction techniques were used for other special status species, these would also have the potential to result in additional short-term adverse and long-term beneficial effects. Because the specific actions involved in potential translocation and/or reintroduction are unknown at this time, these actions would require additional environmental impact analysis, including additional consultation with the USFWS/NMFS upon development.

Impact Avoidance, Minimization and Mitigation Measures

The following measures would be used to reduce impacts on special status species:

- Weirs would be monitored while in use, and brook trout and westslope cutthroat trout would be captured, while bull trout and other native species would be released.
- Catch and release fishing regulations would be implemented for all native fish.
- Fishing brochures and apps would be provided to help anglers identify nonnative vs. native fish.
- No limits, no season fishing with required retention of nonnative fish would be implemented for all lakes in the park.
- There would be a focus on mechanical methods for removal of nonnative fish in Alternative 2, and use of piscicides in Alternative 2 would be limited to those areas where bull trout do not occur.
- Limited electrofishing in bull trout habitat would only occur between July 15 and August 15, to avoid impacts to developing eggs and alevins, and, would occur no more than once per year at each location.
- Analysis of stream invertebrates would be made before piscicide treatments to ensure that species were widely distributed and able to recolonize the area following potential impacts related to piscicide use (after Buktenica et al. 2013).
- Analysis of amphibians would occur before piscicide treatments to ensure that none were in the gill breathing stage during treatment timing.

Cumulative Impacts: Cumulative impacts would be the same as discussed under Fish and Wildlife. In addition, according to the natural resources condition assessment (Hoffman et al. 2004), there are four potential future issues that may affect fish presence in the park.

> They include: (1) habitat alteration due to changing climate, especially decreasing water availability and increasing air and water temperatures; (2) loss of habitat and stream corridor passage and connectivity due to human activities in and near the park; (3) atmospheric deposition with an increase in the concentrations of nutrients and pollutants in park watersheds; and (4) continued presence or future introduction of nonnative fish species; especially the potential for hybridization of Eastern Brook Trout with Bull Trout, and decline or loss of 1[one] or more native amphibian species.

Conclusion: Under Alternative 1, ongoing fish management actions would have no effect on northern spotted owls and marbled murrelets but would continue to adversely affect listed fish species.

Because there would be no habitat loss and noise and disturbance effects would be avoided during the nesting season by implementation of mitigation measures, actions under Alternatives 2 and 3 may affect, but not likely adversely affect Northern spotted owls and marbled murrelets. Because fish management actions to remove nonnative fish would be conducted in areas and during times when most listed fish species were not present and because fishing regulations would require catch and release of native and retention of nonnative fish, proposed actions may affect, but would not likely adversely affect, steelhead trout and Chinook salmon. There would be no loss of habitat for these species, and they would also benefit from the removal of nonnative fish through reduced competition and potential for hybridization.

While most of the above actions would also be unlikely to adversely affect and/or would benefit bull trout, coastal cutthroat trout and coho salmon, use of a weir to capture brook trout from tributaries in the Carbon River could inadvertently result in capture and handling of bull trout and coho salmon since they both also occur in Carbon tributaries. Similarly, electrofishing in bull trout habitat would result in stunning and capture of bull trout as well as coho salmon. Elsewhere electrofishing would also occur in coastal cutthroat habitat. Therefore actions may affect, likely to adversely affect bull trout. Coastal cutthroat trout and coho salmon (not federally listed but are park special status species) under Alternatives 2 and 3 may also be adversely affected. Similarly, use of piscicides in headwaters streams where these species occur would be closely controlled to mitigate potential effects; however, that activity has the potential to adversely affect these species during capture from treatment of areas where they co-occur, particularly under Alternative 3.

E. Visitor Experience

Affected Environment

Day use is the predominant form of visitation at Mount Rainier, with most visitors (80 percent) coming to the park between May and October (Johnson et al. 1990). Park visitation is highly dependent on regional weather conditions. Visitors are drawn to the park from the surrounding region when the weather is clear and the mountain is visible, particularly on weekends and in summer. Visitation is also affected by external factors, such as road construction, fires or flood damage on major access routes.

Recreational fishing data has occasionally been collected in the park. Sporadic voluntary creel data collection occurred between 1950 and 1987. Some of the most detailed information comes from a survey conducted in 1983, when 394 anglers reported fishing in 53 streams and 34 lakes. Catch rates of 1.7 fish per hour in streams and 0.79 fish per hour in lakes were also reported; however there was low overall reporting made. Most angling pressure was focused on lakes, large clear tributaries and the Ohanapecosh River. Because more than 97 percent of the park is comprised of wilderness, most of the fishing that occurs (approximately 13,000 anglers per year), takes place in wilderness.

Tracking of wilderness permits in the early 1990s found that 200 backcountry permits were issued to groups planning to fish in wilderness (Samora 1993). Destinations near trailside camps included Mystic Lake, Golden Lakes, Lake George, and Snow Lake. Other areas popular for fishing included the Northern Lakes, Palisades, and Deadwood Lakes backcountry/wilderness zones. In that study, most backpackers (71 - 79 percent) were from Washington State (Samora 1993). Lakes which hosted from 2 – 39 parties (groups of 1-5 individuals) were identified (Samora 1993).

A recreational fishing study conducted at Mount Rainier and North Cascades during July and August 2016 used "in-person paper surveys to collect information such as: the importance and popularity of fishing, the perceived importance of protecting lake ecology, and the level of knowledge visitors have regarding lake ecology and the presence of contaminants" (Chiapella and Strecker 2016). In the park, 200 visitors were surveyed at trailheads (Comet Falls, Sunrise, and Paradise), at other trailheads and trail crossings around Longmire, at Snow Lake, and at Cougar Rock campground. Of the visitors surveyed, four reported that they were fishing in the park (eight of the 200 additional visitors surveyed at North Cascades noted that they were fishing there) (Chiapella and Strecker 2016). Of 15 activities identified in the survey, fishing was the least reported recreational activity. Of the visitors who fished in Mount Rainier, 47 percent reported consuming fish caught in the park.

When asked about fishing in the park, nearly 60 percent [120 people] of park visitors "either disagreed with or had a neutral opinion that mountain lakes were important for fishing" (Chiapella and Strecker 2016). Further:

> Visitors were then asked if they knew mountain lakes were originally fishless, but had historically been stocked with fish. At MORA, 41% of visitors knew that mountain lakes were once stocked with fish. . . When asked how they viewed stocked fish in the lakes, there was a mixed response. Many respondents were neutral on the issue and/or said they didn't know enough to respond. . . While roughly one-third of respondents agreed that fish were important for recreation and add value to mountain lakes, the majority of respondents at MORA (52%) agreed that stocking has a negative effect on lake ecology . . . while 11% of respondents at both parks disagreed that stocking would adversely affect lake ecology. In addition, 11% of respondents at MORA . . . thought fish would benefit the lake ecosystem, and 5% at each park thought the fish would have no effect (Chiapella and Strecker 2016)

When asked what should be done about the fish after knowing that lakes had originally been stocked, visitors responded (responses summarized for both Mount Rainier and North Cascades, 400 individuals):

Most (80%) survey respondents agreed that the ecological concerns of fish stocking were legitimate, and most (>50%) believe that action should be taken – in the form of fish removal – to alleviate the effects of fish on mountain lake ecosystems (Chiapella and Strecker 2016).

A small number (<10%) of respondents think that this issue is blown out of proportion, and that fish add value to mountain lakes and stocking programs should be reinstated, despite these concerns (Chiapella and Strecker 2016).

When asked about specific management approaches, many respondents (roughly 40%) did not have an opinion, or felt they did not know enough to comment. Over 40% of visitors in both parks thought that some lakes should be designated for fishing, while others should be designated for pristine nature, and many (40% on average) worried that removing fish from too many lakes would then increase the negative effects of visitors on lakes that still had fish. The opinion that fish would be best removed using only manual methods was also a popular one, with over 40% of respondents in agreement at both parks. Lastly, over 40% of respondents said they still needed to know more about the issue to have an informed opinion about it (Chiapella and Strecker 2016).

Responses to public alternatives scoping questions about favorite fishing areas in the park for this environmental assessment yielded the following results: one commenter favored the Ohanapecosh River, and four listed high elevation lakes. Specific lakes mentioned included those on the "east and north," "lakes on the north including the Carbon and White river watersheds," "hike-in lakes," and "alpine lakes of any size" (NPS MORA 2016). By contrast, three commenters noted that they did not fish, one identified fishing at Olympic National Park, and one responded that they did not see the value of recreational fishing in the park (NPS MORA 2016).

Several public comment respondents mentioned catch and release fishing, others mentioned fishing for native cutthroat and rainbow trout, and nonnative brook trout. A few also noted the presence of native/nonnative trout hybrids (cutthroat-rainbow and brook-bull), although park studies have not yet documented brook-bull trout hybrids.

1. Impacts on Visitor Enjoyment of High Elevation Lakes, Fish and other Aquatic Species and Recreational Fishing

Impacts from Alternative 1

Visitor Enjoyment: The ability to access park areas, the range and enjoyment of visitor activities/recreational opportunities, the accessibility of information, interpretation and education, and wilderness values and experience are important to the visitor experience in the park, and these would not change under Alternative 1.

Only a small percentage of visitors fish in the park. In the 2012 visitor survey, approximately one percent of visitors participated in fishing while at the park (Manni et al. 2013). One to two percent of people in the 1993 and 2012 surveys identified fishing as one of their activities. In 2012 however, 13 percent thought that they would like to do it on a future visit (Manni et al. 2013). These opportunities would not change under Alternative 1. There would be no additional impacts on visitor enjoyment of fish and fishing. All of the fish species originally present in the park would remain, although some, such as bull trout and Chinook, are present in low numbers. In addition, two species not historically reported from the park are now found, one more abundantly (pink salmon – considered native) and one rarely (sockeye salmon – considered nonnative). In addition, there are four nonnative game fish to be found, including westslope and Yellowstone cutthroat, hatchery rainbow trout, and brook trout. Visitors have the opportunity to not only see native fish in their native habitats, including spawning fish in the appropriate seasons, but also to fish for them in streams, lakes and rivers. There are also a variety of nonnative game fish to be enjoyed or not, depending on visitors' knowledge of native and nonnative fish and fishing.

Recreational Fishing: Because there would be no changes in fishing regulations or access to fishing, including places where fish could be caught, there would be no additional impacts on recreational fishing under Alternative 1. Visitors to the park would continue to be able to fish without a state license. The wide variety of native and nonnative fishing opportunities, including in lakes, streams and rivers would remain.

At the same time, opportunities to fish in lakes would remain high from abundant nonnative fish historically stocked and reproducing in these naturally fishless lakes.

There would be ongoing adverse effects from the loss of opportunity to fish in areas closed to fishing for decades. These include water intake areas and some lakes, including Reflection, Tipsoo, Shadow and Frozen lakes. Some of these were closed to fishing to minimize shoreline impacts on subalpine vegetation from trampling during access to fishing sites. Some have fish (Reflection and Tipsoo lakes) and others have lost fish naturally over time (Shadow and Frozen lakes). There would also continue to be opportunities to retain some native fish, though others, such as bull trout, would continue to be prohibited from retention.

Impacts from Alternatives 2 and 3

Visitor Enjoyment: Impacts would be similar to Alternative 1; however, over time there would be fewer nonnative fish in some lakes (10 lakes in Alternative 2 and 20 in Alternative 3), lake outlets and some streams (two streams in Alternative 2 and four in Alternative 3), and amphibians and other native aquatic species, such as invertebrates, would be expected to increase due to reduced predation. It is in these areas that brook trout would be systematically targeted to eliminate or reduce their populations. Opportunities to see native aquatic species in their natural habitats could increase. Other nonnative fish species could also be expected to decline over time with removal of all nonnative species caught; however it is likely that nonnative fish would still persist in low densities for decades, depending on whether the lakes were targeted for gillnetting or piscicide treatments. Over time, the absence of nonnative fish in some areas could adversely affect visitor enjoyment of some areas for some, but would benefit visitor enjoyment for others. Although the presence of other wildlife, such as grebes and ospreys is often dependent on the presence of fish, other non-water dependent species may be seen instead.

Recreational Fishing: As in Alternative 1, visitors to the park would continue to be able to fish without a state license. Initially, opportunities for recreational fishing would not change. Later, as nonnative fish were removed from some areas (approximately 10 lakes and associated stream segments under Alternative 2, and approximately 20 lakes and stream segments under Alternative 3), these would no longer contain fish. This would eliminate some fishing opportunities. Nonetheless, fishing opportunities would remain in approximately 25 lakes and associated streams under Alternative 2 and 15 lakes and streams under Alternative 3, as well as in streams and rivers. Because fishing has consistently been rated low on the scale of recreational activities that visitors engage in during visitor surveys (ranked by between and one and two percent of park visitors as important or accomplished during a park visit), this loss would likely be imperceptible to most park visitors. Those visitors primarily engaging in fishing in the park, however, would find the loss of these opportunities difficult, especially if they included areas typically visited or fished. Regardless, fishing opportunities would remain in all quadrants of the park, albeit not in some specific areas. With few exceptions, anglers could choose to fish in remaining lakes, as well as rivers and streams throughout the park.

Some visitors would potentially find some changes in regulations, such as no use of lead, undesirable; however it is likely that other visitors would understand the need for the changes and would not find them so. Similarly, although the fishing seasons would remain similar, earlier closures (Labor Day, instead of October) in some watersheds would be enacted to protect spawning fish. These slight changes would not be expected to have more than small effects on angler enjoyment, since other areas would continue to be open to fishing.

Catch and release fishing opportunities would continue to be available in most streams and rivers for some time during implementation. At the same time, there would be widespread benefits to fish and amphibian populations in areas where fish were removed, which would increase the ability of anglers and other visitors to see and to interact with native fish and amphibians and other species in their habitats throughout the park. Because it would likely take decades before fish removal programs could be implemented throughout the park, diminished fishing opportunities would occur in stages over time, reducing the overall impacts of this recreational loss. The length of time for fish removal would be dependent upon the methods used. For example, because in most areas gillnetting would be tried first before the use of piscicides for a period of up to five years, fish removal would be a slow, systematic process.

2. Impacts on Human Health and Safety

Impacts from Alternative 1

There would be no additional impacts from continued implementation of Alternative 1. No ongoing actions would threaten human health or safety. There would continue to be little information associated with fishing in the park related to providing safety precautions or information.

Fish in the park and in the 21 other parks tested by the NPS and USGS have been documented to contain mercury; however levels are generally low, below significance thresholds. Although the park considered placing an advisory in the fishing regulations, upon discussion and analysis by the Washington State Department of Health (WDH), the minimal levels were found to not warrant one. According to a fish advisory flyer for Olympic National Park, the WDH recommended “that women who are or might become pregnant, nursing mothers, and children limit fish to one serving per week when mercury levels in fish tissue exceed 156 parts per billion (ppb), and to not eat fish with levels above 1000 ppb” (OLYM and WDH 2015). During this intensive study of the park, fish samples of mercury levels varied among each other more than twentyfold, depending on the sampling site in the park. The highest levels were detected in cutthroat trout in two unnamed lakes and in brook trout in Palisades Lake and another unnamed lake (USGS NPS 2014). Most levels in the park were below the level of concern for birds (139 ppb), as well as humans (300 ppb) and other fish (325 ppb) (USGS NPS 2014).

Impacts from Alternatives 2 and 3

In addition to minimal effects under Alternative 1, there would be a range of potential impacts on human health and safety from implementation of Alternatives 2 or 3. These include potential impacts on visitors, park employees and volunteers.

Effects Associated with Treatment Areas: Under Alternatives 2 and 3, there would be risks for visitors associated with encountering a lake undergoing treatment to remove nonnative fish with electrofishing, gillnetting or piscicide use. With electrofishing, the risks are extremely small. Not only is the current not strong enough to affect the individuals using the electrofishing equipment and appropriate protection, but park staff would be present to warn nearby visitors to stay out of the water during operations. Although gillnets would be placed in the water and left unattended for some period of time, from a few hours to over winter, the nets are not likely to entangle swimmers because very few people swim in the park’s cold lakes. Regardless, the areas would be posted no swimming on the net itself, and treatment lakes would also be posted. In addition, the mesh on the nets would be too small and anchored too well to allow for entanglement if unauthorized swimming did occur.

Additional Threats to Public Safety from Use of Piscicides: Based on an Environmental Protection Agency (EPA) study (EPA 2007 *in* NPS SEKI 2016: 237), reregistration for rotenone found that human health effects were below the level of concern (Schnick 1974 and Dawson et al. 1991, respectively *in* NPS SEKI 2016: 237). Where a neutralizer is used or water treatment is used, there is no likelihood of chronic exposure (NPS SEKI 2016: 237). Typical public water supply treatment, including carbon filters, ozone or chlorination, also neutralize piscicides (NPS SEKI 2016: 237). Piscicides are also broken down by light, dissolution and bacteria (Schnick 1974 and Dawson et al. 1991, respectively *in* NPS SEKI 2016: 237).

Target concentrations would vary from approximately 25-100 micrograms/liter, whereas the toxicity (LD50) of rotenone is 136-227 mg/lb (Gosselin et al. 1984, Ujváry 2010 in NPS SEKI 2016:237). According to the analysis from Sequoia and Kings Canyon national parks: “At the concentrations applied, a 150 lb (68 kg) person would have to drink a minimum of 28,758 gallons of treated water to obtain a lethal dose. . .” As a result, even if someone were to swim in and/or ingest several liters of water, they would be very unlikely to be harmed. Application crews, by contrast, could be subject to a higher risk because they would have access to the undiluted form of the piscicide. This risk would be minimized by the state requirement for only trained and certified applicators to apply it and by the use of personal protective equipment.

Therefore, there would be little risk to the public from the use of piscicides. When direct ingestion of piscicides has been studied (e.g. for reregistration, EPA 2007), the EPA has concluded that piscicides do not cause birth defects, reproductive dysfunction, gene mutation or cancer (Abdo et al. 1988 *in* NPS SEKI 2016: 238). Piscicides break down rapidly using the neutralizing effects of potassium permanganate and hydrolysis, with half-lives (without neutralization) of between 20 days in very cold water and 1.5 days in warmer water for rotenone and between 310 hours at pH 6.5 to 1.5 hours at pH10 for antimycin-A (Marking and Dawson 1972). Therefore, there would be no or limited effects downstream where people might gather water. There would be no effects outside the park boundary because treatment would occur far upstream and/or be neutralized within the park.

Under Alternatives 2 and 3, threats to employee safety include hazards associated with transport to the site by vehicle, foot and/or helicopter; use and transport of materials and equipment; working in water; working with unfamiliar materials or equipment; cross-country travel over uneven ground and through vegetation; work at high elevation; and day and overnight work and stays in backcountry/wilderness.

For employees and cooperators, the same safety protection measures would be applied during transport of personnel, materials and equipment to treatment sites, as well as during monitoring. These include safety information and equipment associated with hiking, carrying, and transport of hazardous materials and equipment, and wilderness first aid. Employees and cooperators would have training in safety and job hazard analyses, which would be conducted for each component of the operations, thereby reducing risks. Threats would be managed by identification, discussion, training, proper equipment and protocols. Project management would also include ensuring employees are physically capable of doing the work in terms of their own fitness.

Helicopter work safety would be managed the same for this project as with other projects in the park, with use only when critical to the project and only a limited number of trained staff transported and designated to receive supplies at the drop sites. Specific protocols and job hazard analyses for helicopter use designed by the park would be reviewed and used during each operation. As a result, actions for the project under Alternatives 2 or 3 are not expected to vary from those under Alternative 1 for other operations, resulting in no additional risk to human health or safety from use, except associated with individuals and/or frequency.

Although using piscicides and neutralizing chemicals would be among the most hazardous work performed, there would be no exposure to personnel handling the chemical (i.e. mixers, loaders, or applicators) or the public if recommended safety precautions are used. Precautions would also be followed to ensure that consumption of treated fish did not occur, and as discussed in the fish and wildlife section, there would also be little risk to wildlife from consumption. Even if consumption of treated fish occurred, toxicity is below the level of concern (EPA 2007).

Additional Impacts from Alternative 3

There would be additional tasks performed and likely higher concentrations of piscicides used to treat larger waterbodies under Alternative 3. As a result, there would be the need to transport more piscicides. Nonetheless, overall procedures, including on- and offsite safety meetings and training associated with conducting operations under the proposed actions would be the same. Overall risks may vary slightly but would not be inherently more hazardous than under Alternative 2.

Impact Avoidance, Minimization and Mitigation Measures

The following measures would be used to reduce impacts to water resources:

- The public would be notified of area restrictions, including piscicide use, through signs located at trailheads, at ranger stations, and via the wilderness permit system and through other public notification processes, such as on the park website.
- To ensure adequate protection, all personnel handling piscicides would be required to wear personal protective equipment (PPE) as required by the EPA and listed on the product label.

- As required by law, piscicide and neutralizer (potassium permanganate) product labels and MSDS/SDS (Material Safety Data Sheet) would be followed.
- Treatment areas would be clearly marked and identified with posted signs.
- Public access to project areas would be prohibited during and following treatment.
- Fish killed by piscicides would not be consumed and treated waters would not be ingested.
- As required by NPS guidelines, on- and offsite safety meetings would be held prior to application of piscicides and implementation of the actions associated with the alternatives. This meeting would include review of the piscicide and neutralizer product labels and material safety data sheets (MSDS); need for and use of required PPE; and information about exposure control, safe mixing and application of the products, health effects, and first aid measures. In addition environmental considerations including driving conditions, helicopter safety (if applicable), water safety, weather conditions (related to the potential for dehydration, sun exposure), safe use of application equipment, radio communication, and situational awareness would be included.
- Piscicides and neutralizers would be stored according to label and MSDS instructions in the original containers until applied to the treatment area.
- Transport would include storage inside of a locked lined box, and use on site would include placement inside a contained area, not close to waterbody shorelines.
- There would continue to be periodic monitoring of mercury levels in fish, and consultation with the WDH regarding findings and recommendations regarding fish consumption advisories, if any, would be followed.
- Existing safety precautions would continue to be used in research related to fish control, and in inventory and monitoring activities.

Cumulative Impacts: *Visitor Enjoyment of Fish and Fishing*: Cumulative adverse effects in Mount Rainier and other nearby national parks and forests would continue under Alternative 1 from ongoing (and likely increasing) losses of native fish and amphibians. In a small number of areas, where fish removal has occurred or where fish have naturally depopulated, such as in some parts of North Cascades and in a few lakes in Mount Rainier, there could be an increase in visitor enjoyment of fish for visitors who preferred to see native fish and native aquatic ecosystems.

Under Alternatives 2 and 3, for those who perceive the loss of nonnative fish as an adverse effect, there could be an increase in cumulative adverse effects from actions undertaken to reduce populations of nonnative fish in naturally fishless aquatic ecosystems. There would be similar disparate opinions and cumulative impacts on visitor enjoyment from the use of piscicides in Alternatives 2 and 3, with some visitors considering them a necessary part of future beneficial effects and other visitors considering their use unnecessary or more harmful than useful.

Beneficial and adverse effects from nonnative fish removal in naturally fishless aquatic ecosystems that is occurring elsewhere under Alternative 1 would also occur in Mount Rainier under Alternatives 2 and 3, resulting in similar but more widespread effects in the park, as nonnative fish were systematically removed from approximately 10 (Alternative 2) or 20 (Alternative 3) lakes in the park. Combined with fish removal conducted elsewhere this would contribute to cumulative beneficial and adverse effects on visitor enjoyment.

Human Health and Safety: Although there are inherent risks associated with the proposed work, including work in wilderness, none of these are cumulative in nature. Alternatives 1-3 would not add to this risk. There would be no cumulative effects on human health and safety.

Conclusion: *Visitor Enjoyment of Fish and Fishing*: There would be both adverse and beneficial effects on visitor enjoyment of fish and fishing, depending on visitors' perception of these activities. There would be no additional beneficial effects under Alternative 1; however the adverse effects of past stocking on native aquatic ecosystems would continue and would likely continue to affect visitor enjoyment of fish and fishing in either a positive or negative way. With fish removal in Alternatives 2 and 3 by both mechanical and chemical means, long-term beneficial effects would likely eventually predominate with most visitors taking pleasure in the fact that park ecosystems were preserved; however, there would be a range of short-term adverse effects on visitor perceptions of fish and fishing in the park, especially if a favorite fishing area was the target of fish removal. Eventually, visitors would be displaced to other areas of the park where fishing opportunities would remain abundant and greater than the current demand.

Human Health and Safety: Although there are risks associated with managing the fish program in the park, including removal of nonnative fish, adherence to designated safety procedures, job hazard analyses, use of personal protective equipment, and other protocols would minimize these risks for staff, cooperators and visitors. As a result, the overall likelihood of an accident would be low. There would be no adverse effects on public health and safety.

F. Wilderness

Affected Environment

In 1988, Congress designated approximately 97 percent (228,480 acres) of Mount Rainier National Park as wilderness (Washington Park Wilderness Act). Mount Rainier Wilderness encompasses the full breadth of the diverse Mount Rainier landscape of glacial ice and snow, old growth forests, river headwaters, streams and waterfalls, abundant wetlands, summertime flower-filled subalpine meadows, and rock scree slopes with perennial snow patches. Park wilderness values include natural, ecological, geological, cultural, scenic, scientific and recreational opportunities. Natural quiet and natural darkness are also considered wilderness values. The wilderness boundary is set close to developed areas, generally 200 feet from either side of the centerline of paved roads and 100 feet from the centerline of unpaved roads.

The Mount Rainier Wilderness offers a wide array of scenic, natural and ecological values. The park wilderness is and has been an ongoing object of scientific study. As the highest active Cascade volcano, exhibiting near-record snowfall and the largest single-peak glacial system in the continental United States, Mount Rainier offers outstanding opportunities to understand vegetation, wildlife, fire ecology, catastrophic geologic events – including lahars, glacial outburst floods and volcanic eruptions – snow, ice and other water resources. These resources afford excellent opportunities to study ecosystem structure, function, processes and components across the breadth of this volcanic landscape.

Park wilderness cultural resources are also outstanding. As a National Historic Landmark District (NHLD), the best example of implemented NPS planning in the early twentieth century, the park offers an outstanding opportunity to understand park development. In addition, it contains an unparalleled collection of rustic architecture accompanied by naturalistic landscape architecture. The Wonderland and Northern Loop trails are included as part of the NHLD and are in wilderness. The park's human history is spread over nearly 8,500 years and offers glimpses into the distribution of people across a high mountain landscape over centuries of ecological changes in climate and topography.

Mount Rainier Wilderness also offers a range of recreational experiences – including camping, hiking, fishing, mountain climbing, backpacking, photography, picnicking, and a host of winter activities, including snowshoeing, cross-country skiing, sliding and snowboarding.

Most wilderness use occurs from June through September, especially on weekends and sunny days. During other months and many summer weekdays (except during the peak season), few people are encountered in the vast majority of the wilderness area (NPS 2002). There remain, despite heavy seasonal visitation, outstanding opportunities for solitude.

The park's Wilderness Management Plan sets limits on use to protect resources while allowing visitor access and enjoyment of wilderness. Through the limits, impacts are concentrated into durable trailside and alpine camps, while and dispersed use in cross-country and alpine areas increases opportunities for solitude. The park's wilderness management plan is currently undergoing an update.

Current Use of Mechanized Equipment: Administrative use of mechanized transport and equipment is limited to essential resupply and repair of high camps, removal of human waste, search and rescue, maintenance and repair of trails, and survey and restoration/rehabilitation of natural and cultural resources when it has been determined that mechanized methods are the minimum requirement/tool for wilderness.

Administrative Improvements: There is a wide array of administrative improvements in wilderness, including signs, patrol cabins, trail shelters, fire lookouts, toilets, approximately 37 designated camps with site markers and access trails, and a system of nearly 300 miles of designated trails containing culverts, bridges, puncheon, rock and log-lining and other historic and non-historic constructed features. Over time, there have been changes in the number of wilderness camps, the number of sites (including individual and group sites), the type of toilets and their locations, and the location of the camps.

Human Impacts: Human impacts in wilderness can occur from visitors traveling through or camping in sensitive areas, or from the removal or placement of waste or objects. Programs such as *Leave No Trace*© educate wilderness visitors to take nothing from wilderness and to leave nothing behind, including food, waste, gear, or garbage. This program enjoins wilderness visitors to avoid the creation of tent platforms, campfires, wind blocks, and shelters, and promotes other minimum impact techniques such as staying and traveling on snow and other well-traveled or hardened surfaces as much as possible to avoid damage to vegetation and soils.

Impacts on Wilderness Values

Although recreational fishing is recognized as an appropriate use of wilderness, artificial support of fish populations (stocking) to create a recreational opportunity that would otherwise be absent is inconsistent with maintaining *primeval character and influence* and the degree of *naturalness* or *wildness*. The Washington Park Wilderness Act (1988) does not speak directly to fish and wildlife management, but the WPWA established the Mount Rainier Wilderness in furtherance of the purposes of the Wilderness Act of 1964. Based on this and its own management policies, and unless otherwise directed by Congress (including through park enabling legislation), the NPS does not now stock historically fishless waters in Mount Rainier National Park.

A minimum requirements analysis (MRA) is required by law whenever federal land managers are considering a use prohibited by Section 4(c) of the Wilderness Act. Minimum requirements analyses related to this plan would be conducted as part of future implementation of specific actions called for by this plan. As specific actions are proposed in wilderness, the park's environmental impact analysis process, coupled with specific analysis of the proposed minimum tool, would continue to be used and would include analysis of the effects on a variety of wilderness values. Impacts from programmatic actions are described to aid in a better understanding of the effects of this plan on wilderness.

The following discussion follows the four qualities of wilderness character as put forth in the Wilderness Act and defined by a combined U.S. Forest Service, Bureau of Land Management, and NPS position paper (Landres *et al.* 2005): 1) untrammeled, 2) natural, 3) undeveloped, and 4) outstanding opportunities for solitude or a primitive, unconfined type of recreation. The definitions for each precede the analysis of related impacts.

1. Impacts on the Untrammeled Quality of Wilderness

Untrammeled: As defined by Landres *et al.* (2005:11-12), untrammeled means that the "wilderness is essentially unhindered and free from modern human control or manipulation." Effects on the untrammeled quality of wilderness include manipulation of biotic and abiotic components of ecosystems – including manipulation of fish and wildlife, manipulation of vegetation, manipulation of abiotic components of aquatic ecosystems and/or manipulation of soils and geologic features (Landres *et al.* 2005:23).

Impacts from Alternative 1

There would be no additional effects on the untrammeled nature of the Mount Rainer Wilderness from implementation of Alternative 1; however ongoing impacts from monitoring activities and from research to determine the best ways to restore aquatic ecosystems would continue. Human manipulation of fish species in the park began in the 1880s and continued through the 1970s. The effects of this manipulation have adversely affected native species through hybridization, competition, and from reducing the abundance of native fish and amphibians (see Background and Fish and Wildlife sections). Because park wilderness was not designated until 1988, there was also limited manipulation of abiotic components from the construction of trails and trail structures, including drainage structures, some of which have impeded fish passage and/or affected fish habitat. Under Alternative 1, existing effects from the presence of nonnative fish and their effects on native fish and amphibians would continue to be adverse and long-term and would primarily continue to affect the untrammeled and natural (see below) qualities of wilderness.

Impacts from Alternatives 2 and 3

Active removal of nonnative fish through gillnetting, seining, weirs, and piscicides represents a manipulation of fish and wildlife for the duration of the treatment program, thus adversely affecting the untrammeled quality of wilderness, albeit over a finite period. In addition, as described under Alternative 1, past manipulation of fish and wildlife has affected wilderness, and these impacts would continue under Alternatives 2 and 3 but would eventually be improved in some lakes and streams in wilderness. Changes from the presence of fish in naturally fishless aquatic ecosystems have also affected other aquatic species as well as the abiotic components of aquatic ecosystems. Proposed actions under Alternative 2 would continue to affect several components of wilderness, including soils and vegetation. These effects would be small and localized and would not affect the distribution or composition of soils or vegetation. Impacts would also be widely dispersed across a broad array of sites where fish management actions would take place. Effects on vegetation would include trampling of vegetation in an effort to reach and work within proposed treatment sites. No vegetation removal is expected to occur for placement of gillnets. Placement weirs would require digging in the stream bottom to anchor equipment but would occur outside of wilderness. A very small amount of stream bottom sediment (approximately 10 - 30 square feet) would be displaced in one or more tributaries of the Carbon River.

Nonnative fish removal treatment sites could also affect intangible aspects of wilderness, including the knowledge of wilderness as an undeveloped, untrammeled, primitive area. The existence of large wilderness areas has been shown to be important to individuals who may never visit the areas, but who value knowing that such landscapes exist in the national park system and elsewhere (NPS 2006). These effects would be minimized by the purpose of the disturbance, namely to return the wilderness to its undisturbed condition as it existed prior to nonnative fish introductions.

Additional Impacts from Alternative 3

Efforts to reintroduce extirpated or low population fish back into several watersheds in the park, the additional removal of fish from twice as many lakes and streams as identified in Alternative 2, and full implementation of the bull trout recovery plan could result in additional impacts on the untrammeled quality of wilderness. As in Alternative 2, the purposes of these actions would be to restore native fish populations in the park and to reduce the effects of nonnative introduced fish on native aquatic ecosystems, including fish, amphibians, terrestrial and aquatic insects, and other classes of species, such as plankton and diatoms. Therefore, actions affecting the untrammeled nature of wilderness would be temporary and would move wilderness toward a more natural condition over time, benefitting wilderness resources and intangible values.

2. Impacts on the Natural Quality of Wilderness

Natural: As stated by Landres *et al.* 2005, “wilderness ecological systems are substantially free from the effects of modern civilization.” Effects on the natural quality of wilderness are those that would change the biotic or chemical composition or processes of wilderness plant or wildlife or soils, such as from the application of pesticides.

Impacts from Alternative 1

The introduction of nonnative fish into park lakes and streams has adversely affected the natural quality of wilderness. Although past experimental use of piscicides was successful in reducing or extirpating fish in the lakes that were treated, fish were later illegally replanted in at least one of the targeted lakes. Under Alternative 1, the existing effects of nonnative fish on aquatic systems would continue, and conditions would likely worsen over time without intervention through fish removal. Adverse effects on the natural quality of wilderness could include localized loss of amphibian populations and loss of certain genetic strains of native fish (through competition or hybridization).

Impacts from Alternatives 2 and 3

Eight of the ten proposed treatment lakes are in wilderness; however it is likely only one would be treated at a time. Activities related to the proposed action would have short-term adverse effects combined with long-term beneficial effects on ecological conditions in wilderness. Overall, successful nonnative fish removal would likely result in a return to more natural conditions at treated lakes and streams.

Adverse effects may occur from temporary placement of monitoring and fish capture equipment and/or by the use of piscicides and electrofishing to remove nonnative fish from lakes and streams. Small localized effects could include slight undetectable changes in turbidity and water infiltration from trampling saturated soils during installation and removal of weirs and gillnets and during monitoring activities. These effects would be unnoticeable because they would be minimized by preferential use of hardened surfaces and by the short time it would take for installation and/or passage during monitoring activities. The small area and short-term placement of gill nets would reduce overall impacts.

Use of piscicides would temporarily disrupt natural conditions. Use would be limited, generally occurring only following unsuccessful electrofishing and gillnetting efforts. Because piscicides affect all animals that breathe through gills, there would be adverse effects on some species, including targeted nonnative fish (as described above and in the water quality and fish and wildlife sections). When used under controlled releases with mitigation measures, piscicides would not affect the persistence of native species and would not result in long-term adverse effects on native aquatic ecosystems. Instead, use of piscicides has been shown to be effective in increasing populations of native species, including amphibians and aquatic insects, in cases where predation by fish had depressed population levels. The two piscicides proposed for use in the park are of different formulations. One is derived from plants, and one from bacteria. Although both are very effective in targeting nuisance aquatic species, their long-term activity is negligible because neither persists in the environment, and neutralization and controlled application is effective in reducing risk. Both agents dissipate quickly. The benefits of using piscicides outweigh adverse effects on the natural qualities of wilderness because they would assist the park in restoring the natural components of aquatic ecosystems, namely native amphibians, invertebrates, and special status fish species.

Additional Impacts from Alternative 3

Because additional lakes and streams would be treated under Alternative 3, there would be additional adverse effects on the natural qualities of wilderness from activities associated with the treatments; however these would be similar to Alternative 2 in that they would occur systematically over time, causing localized adverse effects, quickly followed by long-term widespread beneficial effects. At the same time, there would potentially be additional beneficial effects from reintroducing native trout and salmon to areas with small or extirpated populations, such as bull trout to the Puyallup and Mowich river watersheds. Because the details of this are unknown, additional environmental impact analysis would be required to avoid or minimize potential adverse effects.

3. Impacts on the Undeveloped Quality of Wilderness

Undeveloped: Wilderness is essentially without permanent improvements or modern human occupation.

Impacts from Alternative 1

There would be no additional impacts to the undeveloped quality of wilderness from the implementation of Alternative 1.

Impacts from Alternative 2

Under Alternative 2, there would be short-term temporary adverse effects on the undeveloped quality of wilderness from use of electrofishing to capture nonnative fish in some streams, particularly where bull trout are present in the Carbon River tributaries under Alternative 2. There would also be effects on the undeveloped quality of wilderness from gillnets placed in lakes, depending on the length of time they remained in place. Some would be deployed for a few hours to a few days, while others would be overwintered. Because a small number of lakes (<10) would be treated, overall effects would be small.

Additional Impacts from Alternative 3

Under Alternative 3, there could be additional short-term adverse effects from temporary placement of weirs and gillnets in other waterbodies. An additional ten lakes and approximately 4,095 linear meters of streams would be treated to remove nonnative fish over the life of the plan. Use of helicopters would also temporarily disrupt the undeveloped quality of wilderness.

4. Impacts on the Solitude/Unconfined Recreation Quality of Wilderness

<u>Outstanding opportunities for solitude or a primitive and unconfined type of recreation</u>: Wilderness provides outstanding opportunities for people to experience solitude or primitive and unconfined recreation, including the values of inspiration and physical and mental challenge (Landres *et al*. 2005: iii-iv).

Impacts from Alternative 1

There would be no additional impacts on opportunities for solitude or primitive, unconfined recreation from the implementation of Alternative 1. Recreational activities, including fishing, would not change. As noted under visitor experience, recreational fishing plays a very small part in the activities typically engaged in by visitors to the park, including to the Mount Rainier Wilderness. Recreational activities would, however, be impacted from time to time by existing facilities and by noise, such as from administrative helicopter operations implemented to manage wilderness.

Current administrative helicopter operations are limited by time of year and occur primarily in the spring (from high elevation) and in the fall (after marbled murrelets and northern spotted owls are likely to have fledged). Flights are analyzed based on the number of hours helicopters are in the park (including ground time at the helibase). Helicopters (and in some cases fixed wing aircraft) are in the park for both emergency (fires, search and rescue, and medical evacuations) and non-emergency missions. These flights are for high camp resupply, human waste removal, wildlife monitoring, and radio repeater maintenance. Flights are also associated with individual projects, such as restoration of historic structures, trail maintenance and subalpine restoration.

Impacts from Alternatives 2 and 3

Most access to lakes would be via existing trails, with supplies packed in. Many of the lakes that would be treated under Alternative 2 are relatively small (0.22 to 18.15 acres) and are relatively close to trailheads (within five miles). As a result, biologists would be able to pack in needed supplies. Therefore there would be few needs for helicopter access and effects on visitor experience would be limited to loss of fishing opportunities on the 10 lakes and more than 51,565 linear meters of outlet stream habitat, phased over time (approximately 10 years) as plan implementation progressed. There would also continue to be impacts from existing helicopter operations on visitor experience, which could increase slightly under Alternative 2 and more substantially, but occasionally, under Alternative 3. New fishing regulations may also be perceived by some anglers as imposing additional constraints on unconfined recreation.

Additional Impacts from Alternative 3

In addition to treatment of 10 lakes and more than 1,565 linear meters of stream habitat, there would be treatment of an additional ten lakes (7.4 - 60 acres) and approximately 4,095 linear meters of outlet streams. Because the additional ten lakes are mostly larger and/or more difficult to access, they would likely require helicopter support for treatment with piscicides, while gillnetting supplies would likely continue to be hiked in. Helicopters would support the transport of buckets of chemical piscicides and neutralizers, as well as equipment to ensure the proper concentrations of these were used, and to detect residue following treatments. Where necessary, test fish cages would likely also be flown into treatment areas. When possible, helicopter flights would begin and end from high elevation helispots, would be outside the northern spotted owl and marbled murrelet nesting season, and/or would use flight paths that would not affect these species (see special status species section). Because landing sites would not be in water, there would be no effect on aquatic species. During both gillnetting and piscicide operations, mid- to large mammals and birds could exhibit temporary flight responses, dispersing from the vicinity, or would remain hidden.

Similarly, treating nearly twice as much stream habitat as in Alternative 2 would require additional equipment and person-days and result in a potential for more widespread impacts on opportunities for a primitive and unconfined recreational experience. After treatment, opportunities to fish in park lakes would be diminished; however there would still be approximately 15 lakes with fish, with one of these not available for fishing. As a result, although there would be some loss of fishing opportunities in lakes with fish removal, there would continue to be abundant opportunities to fish elsewhere in the park.

Impact Avoidance, Minimization and Mitigation Measures
The following measures would be used to reduce impacts to wilderness resources:

- Minimize effects on wilderness values by avoiding actions in July and August when visitor use numbers are highest.
- Treat a small number of lakes at one time.
- Minimize number of helicopter flights.
- Begin and end helicopter overflights from high elevation (nonwilderness) helispots or helispots outside of habitat areas, outside the marbled murrelet and northern spotted owl nesting season, and avoid flight paths over nesting habitat.

Cumulative Impacts: Because of nonnative introduced fish and the presence of dams on most major rivers, there has been widespread, extensive loss of native amphibians and fish and other aquatic species in the park. Aquatic ecosystems have been irreversibly changed by the introduction and persistence of nonnative fish. Amphibians and diatom assemblages have also changed since the introduction. Research in areas where fish removal has occurred indicates that even decades after fish removal, the assemblage of species remains changed and not fully recovered to preexisting conditions.

Park wilderness has a wide array of administrative development. By 1988 when the Mount Rainier Wilderness was established, administrative developments in wilderness had already been present for decades. The range of development includes resource monitoring devices; historic cabins, shelters and fire lookouts; radio repeaters; trails structures; and other equipment necessary to administer park wilderness.

Alternative 1 would not contribute to cumulative impacts on the untrammeled, undeveloped, and solitude/unconfined recreation qualities of wilderness. However, the natural quality of wilderness would likely worsen through localized loss of species or genetic strains. Alternatives 2 and 3 would contribute long-term beneficial effects to the natural quality of wilderness. They would contribute initial adverse effects to the untrammeled, natural, undeveloped, and solitude/unconfined recreation aspects of wilderness, which would be reduced over time, as implementation of these alternatives continued. All of the adverse impacts would be short-term and collectively would increase opportunities for wilderness values to improve and persist in the long-run. Although Alternatives 2 and 3 would not contribute cumulative adverse effects on wilderness, because of the need to take a variety of actions in wilderness over a long period of time to restore native fish and aquatic ecosystems, there could be continued perceptions of trammeling.

Conclusion: Park wilderness management would continue to focus on maintaining natural processes through better understanding of long-term ecological components, systems and processes, including the effect of human influences. There would be no effect on the primary wilderness mandate to maintain the primeval character and natural influences or "naturalness" of park wilderness lands. As appropriate, the maintenance or restoration of natural processes would continue to predominate in park wilderness management actions and goals.

The park would continue to offer outstanding opportunities for primitive, unconfined recreation and physical and mental challenge under all alternatives. The unique climbing opportunities, expansive wilderness opportunities and diversity of topography and vegetation would be unchanged. With wilderness occurring within approximately 200 feet of developed areas, there are a variety of opportunities for wilderness visitors of all abilities.

Under Alternative 1, there would be no additional adverse effects on the untrammeled, undeveloped, or opportunities for primitive unconfined recreation qualities of wilderness. The natural quality of wilderness may worsen if continued nonnative fish persistence results in localized loss of species or genetic strains. Under Alternatives 2 and 3, although all four qualities would be affected, adverse effects would be short-term and counterbalanced by the high resource benefits of improving the park's native aquatic ecosystems.

Table 9: Impact Comparison Chart

	Impacts from Alternative 1	Impacts from Alternative 2	Impacts from Alternative 3
Hydrology and Water Quality	There would continue to be no additional adverse effects on hydrology or water quality under Alternative 1.	Alternative 2 would have a range of small effects on hydrology and water quality from actions to minimize the effects of and to remove nonnative fish from park watersheds, including the Carbon and White rivers. Over time, measures of water quality would improve and there would be fewer adverse effects on hydrology and water quality from culvert replacement and from nonnative fish removal.	Alternative 3 impacts would be the same as Alternative 2. In addition, with more nonnative fish eradication, short- and long-term beneficial effects on aquatic ecosystems would increase.
Fish and Wildlife	The continued presence of self-sustaining populations of nonnative trout in park waterbodies (lakes, streams and rivers) would continue to have adverse effects on other fish and wildlife species, particularly amphibians, native fish, and aquatic invertebrates under Alternative 1.	With removal of nonnative fish from 10 lakes and their outlets and Tolmie and Ipsut creeks, there would be fewer adverse effects combined with long-term beneficial effects on other fish and wildlife in these areas under Alternative 2. A comprehensive fish management program involving the use of chemical piscicides, electrofishing and gillnetting may adversely affect some fish and wildlife; however these short-term and/or limited adverse effects would be small compared to other important park values and conservation efforts, such as restoring native fish and amphibian populations.	Impacts would be similar to Alternative 2; however because twice as many lakes and their outlets and streams would be treated to remove nonnative fish, benefits would be more widespread.
Special Status Species	There would be no effect on northern spotted owls or marbled murrelets from actions under Alternative 1. There would be no loss of habitat or disruption due to noise or human activity. There would continue to be adverse effects on special status fish, including bull trout, steelhead and coastal cutthroat trout, and coho and Chinook salmon, under Alternative 1, especially where nonnative fish and native fish are competing for the same resources, and where there is potential for hybridizing. There would continue to be no effect on Essential Fish Habitat for coho, Chinook or pink Salmon in the Carbon, White or West Fork rivers. No changes would be made to spawning or rearing habitat for these (or other) species.	Because there would be no habitat loss and noise and disturbance effects would be avoided during the nesting season by implementation of mitigation measures, actions under Alternatives 2 and 3 may affect, but would be not likely to adversely affect northern spotted owls and marbled murrelets. Because fish management actions to remove nonnative fish would be conducted in areas and during times when most listed fish species were not present, and because fishing regulations would require catch and release of native and retention of nonnative fish, proposed actions may affect, but not likely adversely affect steelhead, and Chinook salmon. There would be no loss of habitat for these species and they would also benefit from the removal of nonnative fish through reduced competition and potential for hybridization. While most of the above actions would also be unlikely to adversely affect and/or would benefit bull and coastal cutthroat trout, and coho salmon, use of a weir to capture brook trout from tributaries in the Carbon River could inadvertently result in capture and handling of bull trout and coho salmon since they both also occur in Carbon tributaries. Similarly, electrofishing in bull trout habitat would result in stunning and capture of bull trout as well as coho salmon. Seining could result in capture of native fish (bull trout, coastal cutthroat trout, rainbow trout/steelhead, and coho salmon) while removing brook trout. Elsewhere electrofishing would also occur in coastal cutthroat habitat. Therefore actions may affect, and likely adversely affect bull trout under alternatives 2 and 3. Coastal cutthroat trout and coho	Impacts would be similar to Alternative 2, however because actions would be more widespread, actions could affect bull trout in other watersheds. In addition, if translocation of bull trout was proposed in the Mowich and Puyallup watersheds, it would have additional potential for adverse (and beneficial) effects on bull trout.

	Impacts from Alternative 1	Impacts from Alternative 2	Impacts from Alternative 3
		salmon (special status species) may also be negatively affected under Alternatives 2 and 3.	
Visitor Experience	*Visitor Enjoyment of Fish and Fishing*: There would be both adverse and beneficial effects on visitor enjoyment of fish and fishing, depending on visitors' perception of these activities. Although there would be no additional beneficial effects, the adverse effects of past stocking on native aquatic ecosystems would continue and would likely continue to affect visitor enjoyment of fish and fishing in either a positive or negative way. *Human Health and Safety*: Although there are risks associated with managing the fish program in the park, including removal of nonnative fish, adherence to designated safety procedures, including job hazard analyses, use of personal protective equipment and other protocols would minimize these risks for staff, cooperators and visitors. As a result, the overall likelihood of an accident would be low. There would be no adverse effects on public health and safety.	With fish removal using both mechanical and chemical means, long-term beneficial effects would likely eventually predominate with most visitors taking pleasure in the fact that park ecosystems were preserved; however, there would be a range of short-term adverse effects on visitor perceptions of fish and fishing in the park, especially if a favorite fishing area was the target of fish removal. Eventually, visitors would be displaced to other areas of the park where fishing opportunities would remain abundant and beyond the scope of the current demand.	Impacts would be the same as in Alternative 2, but would be more widespread, encompassing treatment of more lakes and their outlet streams as well as two additional streams.
Wilderness	There would be no additional adverse effects on the untrammeled, undeveloped or opportunities for primitive unconfined recreation qualities of wilderness. The natural quality of wilderness may worsen if continued nonnative fish persistence results in localized loss of species or genetic strains.	Although some wilderness qualities would be affected, effects would be short-term and counterbalanced by the high resource benefits of implementing them on improving the park's native aquatic ecosystems.	Impacts would be the same as in Alternative 2, however there would be more actions undertaken in wilderness to remove nonnative fish, including more use of piscicides and helicopters to transport them.

Chapter 4: Consultation and Coordination

A. Internal Scoping

Internal scoping began in December 2015, following analysis of native and nonnative fish populations in the park. Internal scoping documents were prepared the first interdisciplinary team meeting was held in January 2016. Afterwards the park solicited additional information from other public agencies (USFWS and WDFW) and the six affiliated American Indian tribes.

B. Native American Indian Tribes Consulted

Prior to public scoping, scoping was conducted with Native American Indian tribes affiliated with the park. Two tribes (the Nisqually Tribe of Indians and the Muckleshoot Indian Tribe) submitted comment letters then. Later, Native American Indian tribes were included in public scoping notices and letters, sent on May 8, 2016. The Nisqually Tribal Historic Preservation Officer also submitted a letter during public scoping. In addition a meeting was held on May 17, 2016 with representatives from the Cowlitz Indian Tribe, Muckleshoot Indian Tribe, Nisqually Indian Tribe, Puyallup Tribe of Indians, and Squaxin Island Tribe. Only the Confederated Tribes and Bands of the Yakama Nation were not represented.

C. Public Involvement

During the public scoping comment period for the Mount Rainier National Park (park) Fish Management Plan from May 5 to June 6, 2016, the park received 26 correspondence letters. Most (21) of these were received via the National Park Service (NPS) Planning, Environment and Public Comment (PEPC) website (http://parkplanning.nps.gov). Others were received via email (3), and hard copy (4). Three letters were received from other public agencies (U.S. Forest Service: Mount Baker-Snoqualmie National Forest, Washington Department of Fish and Wildlife Service, Washington State Historic Preservation Office); three were received from representatives of non-profit organizations (National Parks Conservation Association, Mount Rainier National Park Associates, Tahoma Audubon Society); one was received from an individual affiliated with the University of Washington; six were received from individuals affiliated with other organizations (Washington Hi-Lakers, Trail Blazers); and 12 were received from individuals not identifying affiliation with organizations.

D. Agencies Consulted

Washington State Historic Preservation Office

In accordance with Section 106 of the National Historic Preservation Act, the National Park Service provided the State Historic Preservation Officer (SHPO) of the Washington State Department of Archaeology and Historic Preservation an opportunity to comment on the effects of this project.

Proposed actions would have no effect on the Mount Rainier National Historic Landmark District for the National Register of Historic Places or on other historic or cultural resources in the park. Prior to making a decision as to which alternative or combination of alternatives would be implemented, concurrence with this determination of effect would be sought from the SHPO.

Washington Department of Fish and Wildlife

During project analysis, the NPS also contacted the Washington Department of Fish and Wildlife to determine state status for a range of rare species and to address proposed changes to the currently inconsistent fishing regulations. Representatives of WDFW were supportive of the intent of the plan and made suggestions regarding additional changes that could be made as they continue to make modifications to their own regulations.

U.S. Fish and Wildlife Service and National Marine Fisheries Service

In accordance with the Endangered Species Act, the National Park Service contacted the U.S. Fish and Wildlife Service to determine which federally listed special status species should be included in the analysis. Based on subsequent analysis of the project and its potential effects, the park has determined that there would be no effect on gray wolf, grizzly bear or Canada lynx. Under the proposed action (Alternative 2), the plan may affect, not likely adversely affect Northern spotted owls and marbled murrelets. The plan may affect, is likely to adversely affect bull trout from electrofishing and from traps set to remove brook trout. Because the project is likely to adversely affect bull trout, the NPS initiated formal consultation with the USFWS on May 22, 2017.

The National Park Service initiated informal consultation with the National Marine Fisheries Service on August 15, 2017. The plan may affect, but is not likely to adversely affect steelhead trout or Chinook salmon.

Because of nonnative fish removal from priority streams and lakes, overall effects on listed species and their habitat would be beneficial. Concurrence with these determinations of effect from the USFWS and NMFS would be obtained prior to issuance of a decision document.

E. List of Preparers, Persons and Agencies Consulted

NATIONAL PARK SERVICE
Mount Rainier National Park
Ben Diaz, Archaeologist
Rebecca Lofgren, Aquatic Ecologist (preparer)
Kevin Skerl, Chief, Natural and Cultural Resources
Darin Swinney, Acting Chief, Natural and Cultural Resources/GIS Specialist
Karen Thompson, Environmental Protection Specialist
Julie Hover, Outdoor Recreation Planner

North Coast and Cascades Monitoring Network
Ben Wright, Biological Science Technician (preparer)

North Cascades National Park
Ashley Rawhouser, Aquatic Ecologist

Olympic National Park
Sam Brenkman, Fisheries Biologist

Pacific West Regional Office
Rose Rumball-Petre, Environmental Protection Specialist (preparer)
Alan Schmierer, Regional Environmental and Wilderness Coordinator
Karen Cantwell, Acting Regional Environmental Coordinator

Washington Office, Natural Resources Stewardship and Science
Water Resources Division
Carl (Nic) Medley, Fish Biologist / Aquatic Ecologist (preparer)
John Wullschleger, Fish Program Lead

U.S. FISH AND WILDLIFE SERVICE
Jeff Chan, Fish Biologist, Listing and Recovery Division
Roger Peters, Fish Biologist

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Appendix 1: Additional Laws, Regulations and Policies Applicable to the Scope of the EA

A variety of laws and regulations for the protection of natural and cultural resources and the environment are applicable to this environmental assessment. Many of these are listed in the Mount Rainier National Park General Management Plan (NPS MORA 2002). In addition, national park units are managed under a system of management policies and director's orders, some of which also include accompanying handbooks providing detailed guidance.

<u>National Park Service Fisheries Management Guidance</u>: Section 4.4.1 of Management Policies: The Guide to Managing the National Park System guides parks in managing native and nonnative fish and recreational fishing (NPS 2006). This section identifies the following actions that parks can undertake to preserve fisheries resources unimpaired for the enjoyment of future generations, consistent with the mission of the NPS.

Among these include:

- Reintroduce threatened and endangered fish species to historically occupied reaches;
- Recover threatened and endangered fish species;
- Use natural fish barriers to protect pure strains of native fish;
- Establish fish populations in historically unoccupied lakes and river reaches, within historically occupied basins, when deemed necessary for conservation purposes;
- Protect fish habitat;
- Remove barriers to migration into historically occupied fish habitat; and
- Reduce or eradicate invasive and introduced nonnative fish species.

Management Policies also provides for recreational fishing that:

- Preserves and restores the natural abundance, diversity, dynamics, distribution, habitats and behaviors of native animal populations and the communities and ecosystems in which they occur.
- Is conducted in a manner that minimizes human impacts on native animal populations.

Magnuson-Stevens Act
The Sustainable Fisheries Act (Public Law 104-297) amended the habitat provisions of the Magnuson Act.

The Magnuson-Stevens Act (Act) now calls for direct action to stop or reverse the continued loss of fish habitat. This Act requires cooperation among the National Marine Fisheries Service (NMFS), the Fishery Management Councils, and federal agencies to protect, conserve, and enhance "essential fish habitat" (EFH). Essential fish habitat is defined for federally managed fish species as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (Pacific Fish Council 1999).

Salmon EFH includes streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California but excludes areas upstream of longstanding naturally impassible barriers (i.e. natural waterfalls in existence for several hundred years). EFH also includes aquatic areas above all artificial barriers except specifically named impassible dams. In the park, EFH includes areas above Mud Mountain Dam. Where Chinook, coho, and pink salmon occur in the park, park rivers and streams are included in EFH (Samora et al. 2013).

Title 36 - Parks, Forests, and Public Property
Title: Section 2.3 - Fishing.
Context: Title 36 - Parks, Forests, and Public Property. CHAPTER I - NATIONAL PARK SERVICE, DEPARTMENT OF THE INTERIOR. PART 2 - RESOURCE PROTECTION, PUBLIC USE AND RECREATION.
§ 2.3Fishing.

a. Except in designated areas or as provided in this section, fishing shall be in accordance with the laws and regulations of the State within whose exterior boundaries a park area or portion thereof is located. Nonconflicting State laws are adopted as a part of these regulations.
b. State fishing licenses are not required in Big Bend, Crater Lake, Denali, Glacier, Isle Royale (inland waters only), Mammoth Cave, Mount Rainer, Olympic and Yellowstone National Parks.
c. Except in emergencies or in areas under the exclusive jurisdiction of the United States, the superintendent shall consult with appropriate State agencies before invoking the authority of § 1.5 for the purpose of restricting or closing park areas to the taking of fish.
d. The following are prohibited:
    1. Fishing in fresh waters in any manner other than by hook and line, with the rod or line being closely attended.
    2. Possessing or using as bait for fishing in fresh waters, live or dead minnows or other bait fish, amphibians, nonpreserved fish eggs or fish roe, except in designated waters. Waters which may be so designated shall be limited to those where non-native species are already established, scientific data indicate that the introduction of additional numbers or types of non-native species would not impact populations of native species adversely, and park management plans do not call for elimination of non-native species.
    3. Chumming or placing preserved or fresh fish eggs, fish roe, food, fish parts, chemicals, or other foreign substances in fresh waters for the purpose of feeding or attracting fish in order that they may be taken.
    4. Commercial fishing, except where specifically authorized by Federal statutory law.
    5. Fishing by the use of drugs, poisons, explosives, or electricity.
    6. Digging for bait, except in privately owned lands.
    7. Failing to return carefully and immediately to the water from which it was taken a fish that does not meet size or species restrictions or that the person chooses not to keep. Fish so released shall not be included in the catch or possession limit: Provided, That at the time of catching the person did not possess the legal limit of fish.
    8. Fishing from motor road bridges, from or within 200 feet of a public raft or float designated for water sports, or within the limits of locations designated as swimming beaches, surfing areas, or public boat docks, except in designated areas.
e. Except as otherwise designated, fishing with a net, spear, or weapon in the salt waters of park areas shall be in accordance with State law.
f. Authorized persons may check fishing licenses and permits; inspect creels, tackle and fishing gear for compliance with equipment restrictions; and inspect fish that have been taken for compliance with species, size and other taking restrictions.
g. The regulations contained in this section apply, regardless of land ownership, on all lands and waters within a park area that are under the legislative jurisdiction of the United States.

Appendix 2: Proposed Fish Removal Priorities in Lakes and Streams

Table 10. Proposed List of Ponds and Lakes Prioritized for Fish Removal. Green represents lakes proposed in Alternative 2; yellow and orange represent lakes proposed in Alternative 3.

Priority	NAME	WATERSHED	DEPTH_M	ACRES	ELEV_M	stream habitat_M	Brook trout	Rainbow	Coastal Cutthroat	Non-native Cutthroat	Kokanee
1	LITTORALS POND	WHITE RIVER	2	0.38	1123	180	x				
2	UNNAMED LAKE	PUYALLUP	12	3.94	1371	150	x				
3	UNNAMED LAKE	HUCKLEBERRY	8.9	6.24	1685	50	x				
4	WR RANGER POND	WHITE RIVER	4.9	0.36	973	10	x		x		
5	WR RANGER POND	WHITE RIVER	3.2	0.22	981	80	x		x		
6	WR RANGER POND	WHITE RIVER	5	0.66	984	320	x		x		
7	GOLDEN LAKES	MOWICH	24	18.15	1370	100	x				
8	GOLDEN LAKES	MOWICH	0.5	2.58	1290	150	x				
9	TIPSOO LAKE	OHANAPECOSH	2.6	4.57	1615	150		x			
10	BEAR PARK LAKE	WHITE RIVER	3.5	2.36	1646	375				x	
11	LOUISE LAKE	COWLITZ	17.2	18.98	1402	380	x				
12	MYSTIC LAKE	WEST FORK	3.5	7.40	1739	450				x	
13	UNNAMED LAKE	OHANAPECOSH	3.9	8.36	1414	350				x	
14	BLUE LAKE	COWLITZ	10.5	14.08	1331	370		x			
15	LAKE JAMES	WEST FORK	23	16.53	1348	400		x			
16	LAKE ELEANOR	HUCKLEBERRY	16	17.20	1521	400		x			
17	GREEN PARK LAKE	HUCKLEBERRY	10	7.90	1657	750				x	
18	GREEN LAKE	CARBON	29	12.54	973	780				x	
19	LAKE ETHEL	WEST FORK	29.5	26.49	1327	100		x			
20	MOWICH LAKE	MOWICH	60	114.32	1505	115	sculpin				x
	LOWER PALISADES LAKE	HUCKLEBERRY	5.9	3.94	1678		x				
	UNNAMED LAKE	HUCKLEBERRY	2.7	1.08	1664		x				
	REFLECTION LAKES	NISQUALLY	1.6	0.42	1484		x				
	REFLECTION LAKES	NISQUALLY	11.5	17.83	1481		x				
	SNOW LAKE	COWLITZ	10.7	5.93	1427		x				
	BENCH LAKE	COWLITZ	11	8.24	1385		x			x	
	DEADWOOD LAKES	WHITE RIVER	3.5	7.23	1600			x			
	DEADWOOD LAKES	WHITE RIVER	2.7	7.61	1597			x			
	ADELAIDE LAKE	WEST FORK	4	7.28	1383			x			
	MARJORIE LAKE	WEST FORK	8	10.42	1391			x			
	OLIVER LAKE	WEST FORK	21	22.59	1392			x			
	UNNAMED LAKE	WHITE RIVER	5.7	1.26	1469					x	
	UNNAMED LAKE	WHITE RIVER	6.4	2.44	1522					x	
	LAKE GEORGE	NISQUALLY	42.5	35.54	1307		sculpin				
	UNNAMED LAKE	CARBON	unknown	5.70	1611			x			

Lakes that would be gillnetted/electrofished for up to five years then evaluated for piscicide use

Lakes that would likely require piscicide treatment for successful eradication

Habitat complexity lead to lower probability of successful eradication and lowered priority

Complex connected habitats or problematic access excluded from prioirties due to feasibility concerns

Table 11. Proposed list of streams targeted for brook trout removal. Green represents lakes proposed in Alternative 2; yellow represent lakes proposed in Alternative 3.

Priority	Stream Name	Watershed	GIS	Species	Stream Length	Reaches
1	Ipsut Creek	Carbon	c08-00a	SAFO	600 M	2
2	Tolmie Creek	Carbon	c01-00c	SAFO	1,,400 M	3
3	St. Andrews Creek	Puyallup	p03-01a	SAFO	1,400 M	2
4	Meadow Creek	Mowich	m02-00c	SAFO	2,700 M	4
	Chinook Creek	Ohanapecosh	o14-00e	SAFO	4,300 M	2
	Ohanapecosh River	Ohanapecosh	o00-00e	SAFO	5,200 M	1
	Stevens Creek	Cowliltz	z08-00a	SAFO	4,800 M	2
	Streams to be electrofished up to five years					
	Streams that require piscicide treatment for successful eradication					
	Complex habitats excluded from priorities due to feasibility concerns					

Appendix 3: Fish Passage Blocking Culverts

Table 12: Surveyed List of Anadromous Fish Passage Blocking Culverts Within Mount Rainier National Park

UTM E	UTM N	Stream name	drains to	Road	Blockage type	native species present	blocked linear stream distance (m)
587204	5205060	Ranger Creek	Carbon River	Carbon river trail	partial	BT,CCT	578
611813	5200902	unnamed	White River	State Route 410	partial	BT,CS,CCT	57
603719	5195214	WRCG	White River	White River Campground	complete	BT,CCT	373.2 (66.2)
603539	5195227	WRCG	White River	White River Campground loop B	complete	BT,CCT	229.4 (42.8)
603589	5195212	WRCG	White River	White River Campground loop B	partial	BT,CCT	269.1 (39.7)
603483	5195222	WRCG	White River	White River Campground loop C	partial	BT,CCT	186.6 (155.9)
603793	5195238	unnamed	White River	White River Campground	complete	BT,CCT	83.5
603332	5195217	WRCG	White River	White River Campground loop C	complete	BT,CCT	30.7

( ) identifies distance to next upstream culvert barrier

Additional survey needs: Ohanapecosh area