Environmental Consequences

Welcome

You are now in the "Environmental Consequences" chapter. Here are the topics you can read about.

INTRODUCTION

This "Environmental Consequences" chapter analyzes both beneficial and adverse impacts that would result from implementing any of the alternatives described in this *Draft Mountain Lakes Fishery Management Plan / Environmental Impact Statement* (plan/EIS). In addition, this chapter includes a summary of laws and policies relevant to each impact topic, definitions of impact "thresholds" (for example, negligible, minor, moderate, and major), methods used to analyze impacts, and the analysis methods used for determining cumulative effects. As required by the Council on Environmental Quality (CEQ) regulations implementing the *National Environmental Policy Act* (NEPA), a summary of the environmental consequences for each alternative is provided in table 15, which can be found in the "Alternatives" chapter. The resource topics presented in this chapter, and the organization of the topics, correspond to the resource discussions contained in the "Affected Environment" chapter.

SUMMARY OF LAWS AND POLICIES

Three overarching environmental protection laws and policies guide the actions of the National Park Service (NPS) in the management of the parks and their resources—the *Organic Act of 1916*, NEPA and its implementing regulations, and the *Omnibus Management Act*. For a complete discussion of these and other guiding regulations, refer to the section titled "Related Laws, Policies, Plans, and Constraints" in the "Purpose of and Need for Action" chapter. These guiding regulations are described in brief below.

> The *Organic Act of 1916* (16 USC 1) commits the NPS to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations.
>
> The *National Environmental Policy Act of 1969* is implemented through regulations of the CEQ (40 CFR 1500–1508). The NPS has, in turn, adopted procedures to comply with NEPA and CEQ regulations, as found in *Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making* (NPS 2001b) and its accompanying handbook.
>
> The *Omnibus Management Act* (16 USC 5901 et seq.) underscores NEPA in that both are fundamental to park management decisions. Both acts provide direction for connecting resource management decisions to the

analysis of impacts and communicating the impacts of these decisions to the public, using appropriate technical and scientific information. Both acts also recognize that such data may not be readily available, and they provide options for resource impact analysis should this be the case.

Section 4.5 of *Director's Order 12* adds to this guidance by stating, "when it is not possible to modify alternatives to eliminate an activity with unknown or uncertain potential impacts, and such information is essential to making a well-reasoned decision, the National Park Service will follow the provisions of the CEQ regulations (40 CFR 1502.22)." In summary, the NPS must state in an environmental assessment or impact statement (1) whether such information is incomplete or unavailable; (2) the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific adverse impacts that is relevant to evaluating the reasonably foreseeable significant adverse impacts; and (4) an evaluation of such impacts based on theoretical approaches or research methods generally accepted in the scientific community.

Collectively, these guiding regulations provide a framework and process for evaluating the impacts of the alternatives proposed in this plan/EIS.

GENERAL METHODOLOGY FOR ESTABLISHING IMPACT THRESHOLDS AND MEASURING EFFECTS BY RESOURCE

The general approach for establishing impact thresholds and measuring the effects of the alternatives on each resource category includes the following elements:

- general analysis methods as described in guiding regulations
- basic assumptions used to formulate the specific methods used in this analysis
- thresholds used to define the level of impact resulting from each alternative
- methods used to evaluate the cumulative effects of each alternative in combination with unrelated factors or actions affecting park resources
- methods and thresholds used to determine if impairment of specific resources would occur under any alternative

These elements are described in the following sections.

GENERAL ANALYSIS METHODS

The analysis of impacts follows CEQ guidelines and *Director's Order 12* procedures (NPS 2001b) and is based on the underlying goal of conserving biological integrity in the mountain lake ecosystem. One hallmark of this analysis is the application of results of the scientific research conducted in the North Cascades National Park Service Complex (North Cascades Complex) along with the other best available scientific literature applicable to the region and setting, the species being evaluated, and the actions being considered in the alternatives. A substantial amount of research has been conducted to answer many of the key questions about impacts on the natural resources of the North Cascades Complex. In addition, there is a substantial body of research conducted on similar questions in other national parks and natural areas. For some species or species groups in question, a large number of other studies have been conducted in the region or the range of the species. Other research and publications address broader ecological issues or landscape-level analysis.

The North Cascades Complex has been compiling spatial data that includes the recorded distribution of various organisms and landscapes. That database has been added to, refined, and cross-checked during the impact analysis, and compatible data from other research has been used in conjunction with data from the North Cascades Complex.

The NPS created an interdisciplinary planning team (also referred to as the Technical Advisory Committee) comprised of NPS staff from the North Cascades Complex, NPS Fisheries Program staff, NPS Environmental Quality Division, the Washington Department of Fish and Wildlife (WDFW), and other individual resource specialists assisting the NPS with preparation of this plan/EIS. The team also consulted with various experts in the field of fisheries management and other applicable scientific studies. The committee met periodically throughout the analysis and provided important input to the impact analysis.

The Technical Advisory Committee provided recommendations to managers of the North Cascades Complex on matters regarding the mountain lakes fishery, ecosystem status, and the analysis approach for this plan/EIS.

For each resource topic addressed in this chapter, the applicable analysis methods are discussed under each resource section.

ASSUMPTIONS

Several guiding assumptions were made to provide context for this analysis. These assumptions are described below.

ANALYSIS PERIOD

This plan/EIS establishes goals, objectives, and specific implementation actions needed to manage the mountain lakes fishery for the next 15 years; therefore, the analysis period used for assessing impacts is up to 15 years. The impact analysis for each alternative is based on the principles of adaptive management, which would allow the NPS and WDFW to change management actions as new information emerges through monitoring the results of management actions and ongoing research throughout the life of this plan/EIS.

GEOGRAPHIC AREA EVALUATED FOR IMPACTS

The geographic study area for this plan/EIS includes all three administrative units of the North Cascades Complex. However, the focus of this document is the 91 mountain lakes in the North Cascades Complex that have a history of fish presence (refer to “Map 1” and the “Map 1 Table” located in the envelope that accompanied this document). While management actions are applied to 91 lakes in this plan/EIS, the analysis area for analyzing impacts includes streams and other lakes connected to the 91 lakes, the terrestrial and cultural resources surrounding the lakes, and communities in the vicinity of these lakes.

Duration and Type of Impacts

For the purpose of the analysis provided in this plan/EIS, the following assumptions are used for all impact topics (the terms “impact” and “effect” are used interchangeably throughout this document):

> *Short-term impacts*: Those occurring from fishery management actions in the immediate future.
>
> *Long-term impacts*: Those occurring from fishery management actions over several seasons through the next 15 years and beyond.
>
> *Direct impacts*: Those occurring as a direct result of fishery management actions, including lake treatment methods.
>
> *Indirect impacts*: Those occurring from fishery management actions that would indirectly alter a resource or condition.

Future Trends

Visitor use and demand are anticipated to follow trends similar to recent years. Visitation to the North Cascades Complex has fluctuated slightly, but generally remained at an average of 412,012 people per year between 1996 and 2002.

In the absence of notable anticipated changes in facilities or access, the average visitation is expected to continue and be reflected across user groups.

IMPACT THRESHOLDS

Determining impact thresholds is a key component of *NPS Management Policies* (NPS 2001a) and the *Director’s Order 12* handbook (NPS 2001b). These thresholds provide the reader with an idea of the intensity of a given impact on a specific topic. The impact threshold is determined primarily by comparing the impact to a relevant standard from state or federal regulations or scientific research. Because definitions of intensity vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this document. The following intensity definitions are used throughout this analysis: negligible, minor, moderate, and major.

CUMULATIVE EFFECTS ANALYSIS METHOD

The CEQ regulations that implement NEPA require the assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as “the impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions” (40 CFR 1508.7). Cumulative impacts are considered for all alternatives, including the no-action alternative (alternative A).

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. The following points attempt to clarify potential cumulative impact issues in the vicinity of the North Cascades Complex:

No projects are proposed or in planning stages that would change the road access to any unit of the North Cascades Complex.

No new major trails or trailheads are being considered; however, a small section of the Pacific Northwest Trail within the North Cascades Complex is currently under construction.

No new resorts or major upgrades of existing facilities are being planned. Visitor use is expected to follow the same patterns that it has for several years.

A climbing management plan is expected in the winter of 2004.

The park experienced flooding in the fall of 2004, and trails, roads, and bridges were destroyed.

There would be continued logging activities proximate to the park.

Dam and reservoir operation that has occurred and continues to occur outside the North Cascades Complex would have ongoing effects.

There would be continued human recreational use (by anglers, visitors using pack animals [horses, mules, llamas], hikers, and campers) of the lakes in the study area and surrounding drainages. The level of use is expected to follow recent average visitation.

There would be a continued presence of fish in lakes located on lands surrounding the North Cascades Complex, but these lakes are not connected upstream to lakes in the study area. A drop-down of fish from lakes outside the North Cascades Complex is not expected.

There is the potential for increased acid rain from emissions related to the development of an additional power plant in the area.

There would be continued natural impacts (such as erosion, general weathering, drought, and flooding).

There would be continued disturbance to ground resources due to inadvertent ground disturbance, vandalism, artifact collection, and digging.

Based on trends, the economy in communities surrounding the North Cascades Complex would continue to evolve as industry diversification occurs.

Park operations costs, in general, are expected to increase based on recent trends.

The WDFW manages mountain lake fisheries on lands administered by the U.S. Forest Service that surround the North Cascades Complex. The WDFW management approach, described in "A Report on the Washington Department of Fish and Wildlife's High Lakes Fishery Management Program" (WDFW 2001), is expected to be similar in the foreseeable future to what is currently being done.

IMPAIRMENT ANALYSIS METHOD

The "Purpose of and Need for Action" chapter describes the related federal acts and policies regarding the prohibition against impairing park resources and values in units of the national park system.

An action constitutes an impairment when its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values" (NPS 2001a, 1.4.4). To determine impairment, the NPS must evaluate "the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts" (NPS 2001a, 1.4.4).

NPS units vary based on their enabling legislation, natural and cultural resources present, and park missions; likewise, the recreational activities appropriate for each unit and for areas in each unit vary as well. For example, an action appropriate in one unit would impair resources in another unit. Thus, this plan/EIS analyzes the context, duration, and intensity of impacts of the alternatives as well as potential for resource impairment, as required by *Director's Order #12*: *Conservation Planning, Environmental Impact Analysis and Decision-making* (NPS 2001b). An impact on any park resource or value may constitute an impairment, but an impact would be more likely to constitute an impairment to the extent that it has a major adverse impact upon a resource or value whose conservation is necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park

key to the natural or cultural integrity of the park

identified as a goal in the park's general management plan or other relevant NPS planning documents

The following process was used to determine whether the various fishery management alternatives had the potential to impair park resources and values:

Step 1. The enabling legislation, *General Management Plan* (NPS 1988b), *Strategic Plan* (NPS 2000a), and other relevant background information for the North Cascades Complex were reviewed to ascertain its purpose and significance, resource values, and resource management goals or desired future conditions.

Step 2. Resource protection goals were identified.

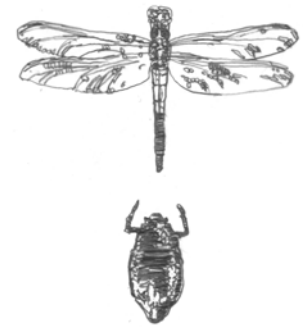
Step 3. Thresholds were established for each resource of concern to determine the context, intensity, and duration of impacts, as defined earlier in this chapter in the section titled "Impact Thresholds."

Step 4. An analysis was conducted to determine if the magnitude of impact would constitute an "impairment," as defined by *NPS Management Policies* (NPS 2001a).

The impact analysis includes findings of impairment of park resources for each of the management alternatives. Impairment findings are made for park resources affected by the alternatives. Park operations and management, socioeconomics, and visitor use are not considered park resources; therefore, impairment findings are not included as part of the impact analysis for these topics.

AQUATIC ORGANISMS

The aquatic organisms potentially affected by the proposed alternatives include plankton, macroinvertebrate, and amphibian species that are naturally occurring in mountain lakes in the North Cascades Complex, as well as native fish species in drainages downstream from the lakes. It is recognized that actions proposed under the various alternatives would also have direct impacts on the stocked fish themselves, due to a reduction or elimination of selected populations. Stocked fish are nonnative species that were stocked specifically for recreational purposes; therefore, impacts on stocked fish are not analyzed in detail here, but their value to the mountain lakes fishery is addressed in the section titled “Visitor Use and Experience” later in this chapter.



Aquatic insects, known as macroinvertebrates, are important food sources for the many species of fish that dwell in the rivers and lakes in the North Cascades Complex and are also important as indicators of water quality and habitat condition.

This section explains the methods used to analyze impacts on aquatic organisms, presents the results of analysis, and describes the guiding regulations and policies, as well as the basic assumptions and thresholds used in the analysis.

GUIDING REGULATIONS AND POLICIES

The *General Management Plan* (NPS 1988b) includes management objectives that are relevant to overall natural resources in the North Cascades Complex, including aquatic organisms. The *General Management Plan* includes the following objectives:

> To increase knowledge and understanding of the interrelationships of the natural processes, and of methods for implementation of appropriate actions.
>
> To preserve, maintain, or restore, where feasible, the primary natural resources and ecological relationships and processes.
>
> To manage the natural resources as an integral part of a regional ecosystem.
>
> To provide opportunity for research in as natural a system as possible.

The *Strategic Plan* (NPS 2000a) also includes mission goals for preserving park resources that are consistent with the goals and objectives of this analysis. Mission Goal I.a. provides for the following desired condition: “Natural and cultural resources and associated values of the North Cascades National Park Service Complex are protected, restored, and maintained in good condition and managed within their broader ecosystem and cultural context.”

Servicewide NPS regulations and policies, such as the *Organic Act of 1916*, *NPS Management Policies* (NPS 2001a), and Reference Manual 77: *Natural Resource Management*, also direct parks to provide for the protection of park resources. Broadly stated, these policies require the NPS to manage natural resources in a manner that will maintain, rehabilitate, and perpetuate the inherent integrity of water resources and aquatic systems. In summary, the NPS seeks to eliminate human-induced impacts on aquatic habitats

limit effects and mitigate damage if impacts are unavoidable

maintain and restore aquatic habitats to protect their ecological and aesthetic character and dependent plant and animal communities

METHODOLOGY AND ASSUMPTIONS

The following section describes the methodology used to evaluate the impacts of the proposed alternatives on aquatic organisms. Impacts were assessed by considering the major issues identified, examining the existing data and literature, and applying professional judgment. Key components of the methodology include assumptions made about the extent of the geographic area evaluated for impacts, the outcomes of the management actions, and the criteria used to evaluate impacts and define impact thresholds for aquatic organisms.

GEOGRAPHIC AREA EVALUATED FOR IMPACTS

For the purpose of this analysis, the area evaluated for impacts on aquatic organisms includes the 91 naturally formed mountain lakes in the North Cascades Complex that currently have, or one time had, a fish presence as a result of either documented or undocumented fish stocking activities, as described in the “Purpose of and Need for Action” chapter. In the case of stocked nonnative fish dispersing downstream and potentially affecting native fish species, impacts in downstream drainage basins that extend outside the North Cascades Complex are also considered. These drainages include the Chilliwack River (Fraser River Basin), Lake Chelan Basin (includes the Stehekin River and its tributaries), and the Skagit River and several of its tributaries.

OUTCOMES OF THE MANAGEMENT ACTIONS

Several of the management actions that would be applied to lakes under each of the action alternatives would potentially have multiple outcomes depending on the results of adaptive management decisions. Therefore, for the purpose of this analysis, the focus is on the initial outcome of management actions and the assumption that the lakes would either have fish or not have fish, based on the initial results of the actions taken. However, it is recognized that these conditions may change in some of the lakes due to decisions made in the proposed mountain lakes fishery monitoring plan (see appendix F). If future monitoring indicates that fish presence has caused unacceptable changes to native biota, and as a result fish are removed or fish populations are reduced, impacts may also be reduced from what is presented here.

IMPACT CRITERIA AND METHODOLOGY

Information and input from a number of sources were considered during the public scoping process. Site-specific research data on the effects of fish stocking in North Cascades Complex lakes, as well as additional literature from studies in other alpine lake systems, were considered. A concern identified during public scoping was that people recognize the adverse impacts on native species in mountain lakes from the widespread practice of fish stocking. While fish stocking has acknowledged benefits, it can also have negative impacts under certain circumstances when nonnative species are stocked, which can result in a loss of ecological integrity.

The methods used to evaluate impacts on aquatic organisms focus on the direct and indirect effects of fish populations in mountain lakes, primarily predation and competition for prey, effects on food webs and nutrient cycling, and effects on native fish resulting from potential downstream colonization by stocked species. Both population and community levels were considered. A population is defined as the group of individuals within a given species that are reproductively isolated from other groups and have geographically defined distributions. Communities are defined as the interacting populations of all species within a resource category.

For many aquatic species, such as macroinvertebrates and amphibians, the extent of geographic distribution is best described as a metapopulation. This is a cluster of geographically discrete populations that are connected by infrequent, but critical, interbreeding and genetic exchange with nearby populations. For example, the geographic extent of a population of aquatic macroinvertebrates with a flying adult phase, such as caddisflies (*Trichoptera*), is generally determined by drainage basin boundaries. However, adult caddisflies from one population may frequently disperse to other drainage basins and interbreed with other populations, forming a metapopulation relationship. Recolonization of suitable habitats where populations are no longer present occurs through similar mechanisms. In contrast, populations of purely aquatic zooplankton, such as large copepods, are limited to individual lakes or lake clusters that are immediately adjacent to each other.

Metapopulation: Geographically separate populations of the same species connected by infrequent, but critical, interbreeding.

The units of impact analysis for each group of aquatic organisms are described below by resource category.

Plankton. Effects on plankton are evaluated at both the population and community levels, with emphasis on the effects on larger copepod zooplankton that are the primary prey species of fish. The plankton community is composed of a complex of populations of individual species of both phytoplankton and zooplankton that occupy different trophic levels.

Macroinvertebrates. Effects on macroinvertebrates are evaluated at both the population and community levels, with emphasis on the primary prey species of aquatic insects. The macroinvertebrate community is composed of a range of insect, mollusk, flatworm, nematode, and other species occurring in each lake. Some macroinvertebrate species, including aquatic insects, have metapopulations that are considered in the analysis.

Amphibians. Effects on amphibians are evaluated at the population level, with emphasis on the effects on the long-toed salamander, an indicator species that is particularly sensitive to fish presence, and the Northwestern salamander, another species often found in different lakes than the long-toed salamander. The population structure of amphibians varies by species, depending on breeding range, adult habitats, and ability to disperse. Metapopulations are important considerations in the analysis.

Fish. Impacts on native fish in downstream drainages are evaluated at the population level, for the potential of nonnative trout stocked in mountain lakes to establish reproducing "naturalized" populations in streams, where they can affect native fish by predation, hybridization, or competition for available habitat and resources. The distribution of native fish in basins potentially affected by trout introduced to mountain lakes was determined through literature reports of native fish distribution (WDFW 2003; Cutler 2001; Smith 2002; Wydoski and Whitney 2003) and consultation with WDFW biologists (WDFW, M. Downen, pers. comm., 2004; WDFW, B. Pfeifer, pers. comm., 2004).

IMPACT THRESHOLD DEFINITIONS

Four separate sets of impact thresholds, ranging from negligible to major intensity, were defined to address potential impacts on the plankton, macroinvertebrates, and amphibians in the mountain lakes and native fish in downstream drainages. Because there is incomplete knowledge of the actual impacts that are occurring or would occur in all 91 lakes under all four alternatives, impact thresholds were developed using predictive factors that have been shown to affect the distribution and viability of these organisms. These factors were identified from a review of scientific literature and past research. For example, past research results indicate that total Kjeldahl nitrogen (TKN) and lake connectivity are important predictive factors relating to impacts on amphibians.

In addition to predictive factors, data and professional knowledge supplied by NPS and WDFW staff involved in preparing this plan/EIS were used to arrive at impact intensities, whenever possible. The assessment was done on a lake-by-lake basis, using impact thresholds based on both the predictive factors and actual knowledge of site conditions, to arrive at a final impact level for each lake and associated downstream drainage.

Because the impact thresholds used are complex and technical, appendix G provides an expanded, detailed discussion of the scientific background material that was the basis for impact threshold development. Appendix G also includes tables that show the analysis and impact results on a lake-by-lake basis for each group of aquatic organisms (see tables G-1, G-2, G-4, and G-5). A summary of the impact thresholds and the main factors considered in their development is provided in table 31.

TABLE 31: SUMMARY OF IMPACT THRESHOLDS – AQUATIC ORGANISMS[a]

Primary Predictive Factors[b] Affecting Impact Levels	Impact Intensity			
	Negligible	**Minor**	**Moderate**	**Major**
Plankton (primarily large zooplankton species)				
• Fish density[c] (higher trout densities may result in greater predation of zooplankton) • Lake depth (plankton can escape predation in deeper lakes) • Lake area (plankton can escape predation in larger lakes) • Professional knowledge of study area lakes • Impacts on larger zooplankton (copepods) are of primary concern since they are more susceptible to predation by fish than are small zooplankton.	Long-term adverse impacts would potentially be negligible even though these lakes have historically been stocked. Abundance and community structure would be expected to be influenced primarily by bio-geographical and evolutionary processes. For this assessment, negligible impacts on the zooplankton community would be expected in a lake where the following predictive factor is found: • Lake was previously stocked but is currently fishless	Minor changes in community structure would potentially occur. If fish were removed or died off, the community structure would become comparable to currently fishless lakes. For this assessment, minor impacts on the zooplankton community would be expected in a lake where the following predictive factors are found: • Lake depth >50 ft., OR • Lake area >40 ac., OR • Fish density is low (stocked trout at <100 fish/acre or reproducing trout at <50 trout/acre)	Noticeable changes in community structure would potentially occur, and large copepod abundance would be greatly reduced. If fish were removed or died off, the relative abundance of large copepods would increase. For this assessment, potentially moderate impacts on large zooplankton would be expected in a lake where the following predictive factors are found: • Lake depth <50 ft. AND • Lake area <40 ac. AND Fish density is high (reproducing trout at 50 fish/acre)	Significant changes in community structure would potentially occur, and large copepod abundance would be reduced significantly such that they are undetectable. If fish were removed or died off, the community structure may not become comparable to currently fishless lakes. For this assessment, potentially major impacts on large zooplankton would be expected in a lake where the following predictive factors are found: • Lake depth <50 ft. AND Lake area <40 ac. AND Fish density is very high (reproducing trout or multiple age classes at >400 fish/acre)
Macroinvertebrates (primarily aquatic insects – mayflies, stoneflies, caddisflies, and midges)				
• Fish densityc (higher trout densities result in greater predation of macroinvertebrates) • Lake area (macro-invertebrates can escape predation in larger lakes) • Professional knowledge of study area lakes (especially the presence/absence of habitat complexity)	Community structure would be comparable to fishless lakes with similar physical/chemical characteristics. Abundance and community structure would be expected to be influenced primarily by biogeographical and evolutionary processes. For this assessment, negligible impacts on the macroinvertebrate community would be expected in a lake where the following predictive factor is found: • Lake was previously stocked but is currently fishless	Minor changes in community structure in a lake would potentially occur; although populations would recover if fish were removed. For this assessment, minor impacts would be expected where the following predictive factor is found: • Fish density is low (stocked trout at <100 fish/acre)	Moderate changes in community structure and functional group composition in a lake would potentially occur, relative to currently fishless but otherwise similar lakes. Populations eventually would recover from impacts if fish were removed. For this assessment, moderate impacts would be expected where the following predictive factors are found: • Fish density is high (stocked trout at >100 fish/acre or reproducing trout at >50 fish/acre)	Major impacts resulting from high fish densities would include absence of more than 40% of taxa expected to commonly occur in fishless lakes of similar environmental characteristics. Additionally, significant changes in dominant taxa and functional feeding group composition also would occur. Recolonization might not occur for an extended period of time without active intervention. For this assessment, major impacts would be expected where the following predictive factors are found:

TABLE 31: SUMMARY OF IMPACT THRESHOLDS – AQUATIC ORGANISMS[a] (CONTINUED)

Primary Predictive Factors[b] Affecting Impact Levels	Impact Intensity			
	Negligible	**Minor**	**Moderate**	**Major**
Macroinvertebrates (continued) (primarily aquatic insects – mayflies, stoneflies, caddisflies, and midges)				
			AND Lake area >10 acres OR • Lake area <10 acres with high habitat complexity	• Fish density is high (stocked trout at >100 fish/acre or reproducing trout at >50 fish/acre) AND Lake area <10 acres often with limited habitat complexity
Amphibians (represented by long-toed salamanders and Northwestern salamanders)				
• Fish density[c] (higher trout densities result in greater predation of amphibians) • Presence of nearby forested habitat suitable for either principal species of interest: long-toed salamanders – open terrain at the lake with forest nearby; Northwestern salamanders - dense, closed-canopy forest • TKN[d] levels (higher TKN means higher lake productivity that, in turn, correlates with more long-toed salamanders) • Degree to which lakes are connected (higher Index of Connectivity [IOC][e] means lakes are more connected and can therefore more easily recolonize and recover from impacts) • Professional knowledge of study area lakes • Impacts on long-toed salamanders are of primary concern because of their sensitivity to fish predation	Populations likely would be present in any lake in historic range, with larval density close to that of fishless lakes. For this assessment, negligible impacts on long-toed salamanders would be expected where the following predictive factors are found: • Lake with suitable habitat is within their range AND TKN $\geq$ 0.045 mg/L, fish density is low, and IOC $\geq$ 0.4 OR • Lake with suitable habitat is within their range AND TKN < 0.045 mg/L and fish density is low OR • Lake with suitable habitat is within their range AND TKN < 0.045 mg/L, fish density is high, and IOC $\geq$ 0.7	Populations likely would be present in their historic range, but density of larvae in a lake would potentially be slightly smaller than comparable fishless lakes. For this assessment, minor impacts on long-toed salamanders would be expected where the following predictive factors are found: • Lake with suitable habitat is within their range AND TKN $\geq$ 0.045 mg/L, fish density is low, and IOC < 0.3 Minor impacts on Northwestern salamanders may occur when the following predictive factors are found: • Lake with suitable habitat is within their range AND Stocked fish density is low	Populations would be present in the historic range, but density of larvae in a lake would potentially be smaller than comparable fishless lakes, and populations may be eliminated on a temporary or local basis. Populations would deviate from normal levels. For this assessment, potentially moderate impacts on long-toed salamanders would be expected where the following predictive factors are found: • Lake with suitable habitat is within their range AND TKN $\geq$ 0.045 mg/L, fish density is high, and IOC $\geq$ 0 OR • Lake with suitable habitat is within their range AND TKN < 0.045 mg/L, fish density is high, and IOC = 0.4–0.6	Populations of long-toed salamanders would be permanently altered from normal levels, and possibly eliminated from a lake, with recolonization unlikely. For this assessment, potentially major impacts on long-toed salamanders would be expected where the following predictive factors are found: • Lake with suitable habitat is within their range AND TKN $\geq$ 0.045 Mg/L, fish density is high, and IOC < 0 OR • Lake with suitable habitat is within their range AND TKN < 0.045 mg/L, fish density is high, and IOC $\leq$ 0.3 Major impacts on Northwestern salamanders are unlikely in any lake due to larger larvae and behavioral adaptations for avoiding predation

TABLE 31: SUMMARY OF IMPACT THRESHOLDS – AQUATIC ORGANISMS[a] (CONTINUED)

Primary Predictive Factors[b] Affecting Impact Levels	Impact Intensity			
	Negligible	Minor	Moderate	Major
Amphibians (continued) (represented by long-toed salamanders and Northwestern salamanders)				
			Moderate impacts on Northwestern salamanders may occur when the following predictive factors are found: • Lake with suitable forested habitat is within their range AND Fish density is high	
Native Fish				
• Connections to downstream streams and creeks containing native fish (there must be a connection for impacts on occur) • Particular fish species/strains present (some, like brook trout, are more aggressive; some like Mt. Whitney and California golden trout, do not readily colonize downstream areas; some are not able to interbreed) • Specific professional (primarily WDFW) knowledge of potentially affected outlet stream reaches	If present in a lake with an outlet, fish are either native to basin or are unlikely to colonize downstream areas if one or more of the following predictive factors apply. • Ross Lake or Mt. Whitney rainbow trout, coastal cutthroat trout, or California golden trout are present in a west-side lake OR • Westslope cutthroat trout are present in an east-side lake OR • The lake is fishless	Relatively small numbers of individuals would potentially be affected through intra-species hybridization. Outbreeding depression may occur in vicinity of outlet stream, but effects would be localized. All native species would be indefinitely viable. For this assessment, potentially minor impacts would be expected when a surface outlet connects to a downstream basin AND one of the following additional predictive factors is found: • Reproducing strains or subspecies of rainbow or cutthroat trout not native to basin are present in a west-side lake OR • Mt. Whitney rainbow trout are stocked in an east-side lake	Although individuals of non-native species stocked in a lake would occasionally disperse downstream and rear in streams, there would be no measurable evidence of colonization or hybridization with native fish. All native species would be indefinitely viable. For this assessment, potentially moderate impacts would be expected when a surface outlet connects to a downstream basin AND the following additional predictive factors are found: • Inventories demonstrate that colonization and/or hybridization of the outlet stream has not occurred from populations of nonnative stocked fish that have a long history of high levels of reproduction AND • Reproducing brook trout are present in a west-side lake OR • Reproducing rainbow trout or rainbow/cutthroat hybrids are present in an east-side lake	There would be measurable evidence of colonization, and where interbreeding is possible, hybridization with native fish. Native species deviate from normal population levels or abundance and/or genotypes are permanently altered. On a local basis, native species may be eliminated or become hybrid swarms. For this assessment, potentially major impacts would be expected when a surface outlet connects to a downstream basin AND the following additional predictive factors are found: • Inventories demonstrate colonization and hybridization of the outlet stream from downstream dispersal of nonnative stocked fish have occurred AND Reproducing brook trout are present in a west-side lake OR • Reproducing rainbow trout or rainbow/cutthroat hybrids are present in an east-side lake

TABLE 31: SUMMARY OF IMPACT THRESHOLDS – AQUATIC ORGANISMS[a] (CONTINUED)

Notes:

a. For detailed thresholds and background information about their development, see appendix G.

b. Predictive Factors = Physical, chemical, and biological factors are used in this assessment as surrogates indicative of potential impacts on organisms. Where data are not available, depth and TKN values are estimated from knowledge of similar nearby lakes.

c. Low fish density ≤ 100 trout/acre for stocked fish or < 50 trout/acre for reproducing fish.

High fish density ≥ 100 trout/acre for stocked fish or > 50 trout/acre for reproducing fish.

Very High fish density ≥ 400 trout/acre of reproducing fish or stocked fish with multiple-year classes approximating age structure of reproducing fish.

d. TKN = Total Kjeldahl nitrogen (combined measurement of ammonia and organic nitrogen).

e. IOC = Index of Connectivity (based on the number of known salamander populations within 3.75 miles and the number of potential long-toed salamander breeding ponds within 0.4 mile).

Symbols:

< = less than

> = greater than

≥ = greater than or equal to

≤ = less than or equal to

In addition to discussing impacts related to stocking, the analysis also provides a discussion of impacts related to proposed lake treatment methods. For these impacts, no specific impact threshold definitions were developed; rather, these effects were evaluated using literature review, professional experience, and best professional judgment. Similarly, beneficial effects that are not defined in the thresholds are identified where appropriate, using best professional judgment.

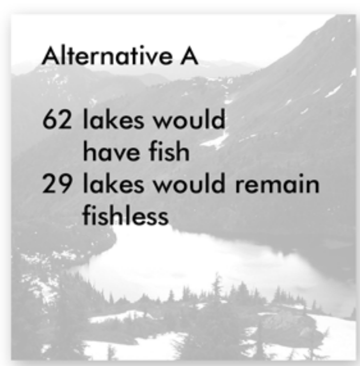
In all cases, an evaluation of impairment was performed, as described below, to determine if any major impacts would be considered an impairment.

Impairment. Major impacts on an aquatic resource or value that, due to its severity, duration, and/or timing, would result in the elimination of an aquatic species in the North Cascades Complex or would result in significant population declines in an aquatic species. In addition, these major adverse impacts on North Cascades Complex resources and values would

> contribute to deterioration of aquatic resources and values to the extent that the purpose of the North Cascades Complex would not be fulfilled as established in its enabling legislation
>
> affect resources key to the natural or cultural integrity or opportunities for enjoyment in the North Cascades Complex
>
> affect the resource whose conservation is identified as a goal in the *General Management Plan* (NPS 1988b) or other planning documents for the North Cascades Complex

IMPACTS OF THE ALTERNATIVES ON AQUATIC ORGANISMS

This section addresses impacts that would result from the implementation of the management actions for each of the lakes under each alternative; the impacts are related to the numbers of stocked or reproducing fish that would remain in the subject lakes and to any treatment method used to remove fish (except for alternative A because no lakes are currently treated for fish removal). Table 32 summarizes the predicted impact levels by alternative for each group of aquatic organisms (by numbers of lakes) related solely to the management action outcomes.



ALTERNATIVE A (NO ACTION): EXISTING MANAGEMENT FRAMEWORK OF 91 LAKES (62 LAKES HAVE FISH)

Alternative A would continue existing practices in the 91 lakes slated for management consideration in the study area. For more information on the 91 lakes, refer to table 5 and figure 4 in the “Alternatives” chapter and appendix E.

TABLE 32: OUTCOMES OF APPLYING AQUATIC ORGANISM IMPACT THRESHOLDS (NUMBERS OF LAKES FALLING INTO THE DIFFERENT IMPACT THRESHOLDS UNDER EACH ALTERNATIVE)

Plankton	Alternative A	Alternative B	Alternative C	Alternative D
Major	1[a]	0	0	0
Moderate	13	0	0	0
Minor	48	29	9	0
Negligible	29	62	82	91

a. Blum (Lower/West No. 4) Lake: Major impact based on very high fish density, 25.9 foot depth, 6.4 acre area.

Macroinvertebrates	Alternative A	Alternative B	Alternative C	Alternative D
Major	13[b]	0	0	0
Moderate	17	0	0	0
Minor	32	29	9	0
Negligible	29	62	82	91

b. These lakes include Battalion, Berdeen (Upper), Berdeen (Lower), Blum (Lower/West No. 4), Dee Dee (Upper), Diobsud No. 1, Diobsud No. 2 (Lower), Diobsud No. 3 (Upper), Doug's Tarn, Kettling, Stiletto, Triplet (Lower), and Wilcox/Sandie (Lower): Lakes with major impacts based on current monitoring data or predictive factors of high fish densities and relatively small lake areas.

Amphibians	Alternative A	Alternative B	Alternative C	Alternative D
Major	7[c]	0	0	0
Moderate	11	0	0	0
Minor	15	9	5	0
Negligible	58	82	86	91

c. These lakes include Battalion, Blum (Lower/West, No. 4), Blum (Largest/Middle, No. 3), Dee Dee (Upper), and Hanging: Major impacts based on high fish density, TKN <0.045 mg/L or unknown, Index of Connectivity (IOC) <0.3 or unknown (conservative estimates); plus Sourdough and Triplet (Lower) lakes: Major impacts based on high fish density, TKN >0.045 mg/L or unknown, IOC <0.

Native Fish	Alternative A	Alternative B	Alternative C	Alternative D
Major	1[d]	0	0	0
Moderate	9	0	0	0
Minor	26	7	1	0
Negligible	55	84	90	91

d. McAlester Lake: Major impacts based on presence of nonnative rainbows in east-side lake, with evidence of both colonization and hybridization (note: impacts on native westslope cutthroat trout are addressed in the "Special Status Species" section.

Impacts of Current Fish Stocking on Aquatic Organisms

Plankton. Under alternative A, the extent of impacts on the plankton community from stocking would vary considerably from lake to lake. Direct and indirect effects resulting from fish predation and changes in nutrient cycling would occur in varying magnitude in each lake, depending on the population characteristics (such as fish density and whether the lake is stocked or has mixed or reproducing populations) and the physical characteristics of each lake. Table 31 summarizes the thresholds used in identifying impact levels for plankton under each alternative, and appendix G provides a more detailed discussion about the predictive factors and the thresholds. Table G-1 in appendix G provides an assessment of impacts on plankton by lake for each alternative.

Plankton: "Free-floating" organisms that include phytoplankton (free-floating microscopic plants) and zooplankton (the animal counterparts of phytoplankton).

Copepod: A type of crustacean zooplankton that exhibits a wide variety of feeding preferences, even consuming other zooplankton. The larger copepods are an important component of the food base for larger vertebrate organisms such as larval amphibians and fish.

As shown in table 31, the primary concerns in the analysis of impacts on plankton are impacts on larger copepods, which tend to be more susceptible to predation by fish. Factors considered in the analysis include fish density (defined for both stocked and reproducing populations), lake depth, and lake area, as well as professional knowledge of the lakes and plankton dynamics.

Based on the thresholds established, only 1 of the 91 lakes in the study area would be expected to experience long-term, major, adverse impacts on plankton from current management actions. This is Blum (Lower/West No. 4), which has a very high density of reproducing fish and a relatively small size and depth (see table G-1 in appendix G). Research indicates that zooplankton species can be adversely affected by predation and changes in food web dynamics resulting from the introduction of fish, especially when high densities of reproducing fish are present. In some cases, it has been observed that fish stocking has resulted in the complete extirpation of some species, with larger copepods and cladocerans being the most vulnerable (Parker et al. 1996, 2001; Anderson 1972; Crumb 1978; Divens et al. 2001; Leavitt et al. 1994). However, research has shown that zooplankton were not extirpated in larger, deeper lakes (greater than 50 feet in depth), even lakes with high densities of stocked fish, because the deeper zones provide refuge habitat for the large copepod and cladoceran species that are most vulnerable to extirpation (Donald et al. 1994). Therefore, adverse impacts on plankton are more likely to be present and/or more severe in shallow lakes with very high fish densities, such as Blum (Lower/West No. 4).

Moderate long-term adverse impacts on plankton would be expected to occur in 14 of the 91 lakes in the study area. These 14 lakes have high fish densities (although not as high as seen in Blum Lower/West No. 4), are relatively shallow (less than 50 feet deep) or assumed to be shallow, and are relatively small (less than 40 acres). Impacts in these lakes would be similar to those expected in Blum (Lower/West No. 4) and would likely include a decrease in large copepod abundance, as well as changes in nutrient cycling and associated phytoplankton community changes. However, because the densities of fish in these 14 lakes are not extremely high, impacts would be considered moderate.

In 48 of the 91 lakes, impacts on plankton would be considered adverse, minor, and long term. Fourteen of the 48 lakes have high-density reproducing fish populations, but the lakes are sufficiently large and deep to provide refuge habitat. Lakes greater than 50 feet deep provide shelter for larger zooplankton, which limits the severity of impacts from introduced fish (Donald et al. 1994). The remainder of the 48 lakes support low-density stocked, mixed, or reproducing populations, which have been shown to have limited impacts on the plankton community. Several studies have shown that plankton can survive in lakes that contain lower densities of fish, especially if the fish are nonreproducing. Studies of mountain lakes in the Olympic and Cascade mountains found that one large zooplankton species continued to coexist with low densities of reproducing trout more than 20 years after the initial introduction (WESI 1993). Other studies have documented the coexistence of large diaptomids with low densities of reproducing salmonids (Hoffman and Pilliod 1999; Bahls 1990; Anderson 1972; McNaught et al. 1999). In the lakes with low-density populations of stocked fish, population structure and abundance may vary slightly for some plankton species because of the indirect effects of fish presence on food web dynamics and nutrient cycling. Populations of large zooplankton, which are preyed upon by stocked trout, may be slightly suppressed, but remain viable and healthy. Shifts in phytoplankton community structure resulting from fish stocking would persist, but it is unlikely that species would be eliminated, and the resilience and adaptive capacity of the community would be maintained. For these reasons, impacts on the plankton community in these 48 lakes would be considered minor.

Talus Tarn is one of the 29 currently fishless lakes that would remain fishless under all alternatives.

In the 29 fishless lakes, long-term adverse impacts on plankton would be considered negligible. These lakes were historically stocked with trout but currently have no fish populations. Research has shown that, with time, plankton communities can recover in lakes that have contained fish, and zooplankton can be effectively reintroduced (McNaught et al. 1999; Parker et al. 2001). Also, phytoplankton species generally are not lost entirely, although there may be a shift in species abundance and community structure that persists following fish removal (Drake and Naiman 2000). While community structure in these lakes may have shifted from historical conditions prior to fish stocking, the range of plankton species present and overall biomass and productivity in these 29 lakes would be expected to be comparable to those in similar, but otherwise fishless lakes. Therefore, residual adverse impacts of fish stocking in these lakes would be considered negligible because recovery has occurred. These lakes serve as a benchmark for expected conditions in lakes following a period of recovery after fish are removed.

Impairment of plankton species across the study area would not occur under alternative A.

Macroinvertebrates. The assessment of impacts on the macroinvertebrate community under alternative A was based primarily on fish density and lake area, relying heavily on the data and professional knowledge of NPS staff who have been monitoring macroinvertebrates in several study area lakes over several years (NPS, R. Glesne, pers. comm., 2004). Table 31 provides a summary of impact thresholds for macroinvertebrates, while appendix G provides additional background information used to develop the thresholds. Table G-2 in appendix G provides an assessment of impacts on macroinvertebrates by lake and by alternative.

In 13 of the 91 lakes, impacts on macroinvertebrates under alternative A are expected to be adverse, long term, and major. Four of these lakes are included in the current NPS benthic macroinvertebrate monitoring program. The major impact level for these four lakes was assigned based on monitoring data that shows an absence of more than 40% of the taxa expected to commonly occur in fishless lakes of similar environmental characteristics. For 9 of the 13 lakes, a major impact level was predicted due to the presence of high densities of nonnative fish (greater than 100 fish/acre for stocked lakes, greater than 50 fish/acre for lakes with reproducing fish), combined with a relatively small area (less than 10 acres) and a lack of complex habitat as defined and identified by NPS biologists familiar in this lake (NPS, R. Glesne, pers. comm., 2004). In these lakes, high densities of fish would result in more intense fish predation, which has been shown to result in substantial changes in abundance and biomass of some species, as well as phenotypic (visible characters of an organism) and behavioral changes (Chess et al. 1993; Knapp 1996; Luecke 1990; Walters and Vincent 1973). Some species may be depressed or even extirpated in some lakes.

In 17 of the 91 lakes, stocking would be expected to result in long-term, moderate, adverse impacts on macroinvertebrates. These lakes contain a high or very high density of stocked or naturally reproducing fish populations that prey on macroinvertebrates, but the lakes are larger (greater than 10 acres) and/or have a more complex or diverse habitat. Macroinvertebrate community structure in these 17 lakes would likely differ from fishless but otherwise similar lakes, as well as lakes with lower-density fish populations, but populations would recover if fish were removed.

In 32 of the 91 lakes, impacts on macroinvertebrates would be considered adverse, minor, and long term. These lakes have low-density stocked or mixed stocked/reproducing fish populations, which would have much reduced predation pressure on the macroinvertebrate community. Research has shown that while higher densities of stocked trout (716 to 1,790 fish/acre) can have substantial impacts on macroinvertebrate populations (Reimers 1958), lower densities of stocked trout (less than 100 fish/acre) have little effect on benthic fauna (Hoffman and Pilliod 1999). Predation and alteration of food web dynamics in these lakes would be expected to result in minor local reductions in macroinvertebrate abundance. Some shifts in community structure may also occur, but these would be minor relative to overall population structure.

In the 29 lakes that are now fishless, long-term adverse impacts on macroinvertebrates would be considered negligible. These lakes were historically stocked with trout but currently have no fish populations. Observed macroinvertebrate community structure and abundance in these lakes would be expected to be comparable to those in similar, but otherwise fishless lakes, indicating that a recovery has occurred. As the literature indicates, the primary prey macroinvertebrate species are relatively resistant to fish predation at the population and community levels in lake environments, with the exception of sensitive species such as phantom midges (*Chaoborus* spp.). As previously mentioned, affected species usually have a high dispersal potential, and therefore, lakes can be recolonized relatively quickly (Bilton et al. 2001; Bohonak and Jenkins 2003), so that the residual adverse effects of fish stocking in these lakes would be considered negligible.

Impairment of macroinvertebrate species across the study area would not occur under alternative A.

Amphibians. The analysis of impacts on amphibians is focused on two species: the long-toed salamander and the Northwestern salamander. These two species are sensitive to fish predation and generally not found together in the same lakes in the North Cascades Complex. Since there are limited data available on salamander presence, abundance, and viability in all 91 lakes in the study area, impacts were assessed based on several predictive factors taken from the literature and research. These factors, in various combinations, tend to correlate with certain observed levels of impacts. The factors include fish density, total Kjeldahl nitrogen (TKN), and lake connectivity, as well as availability of suitable habitat.

Table 31 summarizes the impact thresholds for amphibians, based on the predictive factors. Appendix G provides more detail concerning the factors used in the thresholds. Table G-3 in appendix G provides an assessment of impacts on amphibians by lake for each alternative. Generally, impacts would be expected to be high if TKN levels are high, the Index of Connectivity (IOC) is low, and densities of fish in a lake are high. If, for instance, densities of fish are low or the IOC is particularly high for a lake or if TKN levels are low, the impact would be reduced. In some cases where data for one or more of the predictive factors were missing, a conservative estimate was made. Impacts would be less than predicted, and future monitoring (see appendix F) would be used to determine the impacts and take appropriate management actions in the future.

The Index of Connectivity (IOC) is based on the number of known salamander populations within 3.75 miles of a study area lake and the number of potential long-toed salamander breeding ponds within 0.4 mile.

Based on the thresholds developed, in 7 of the 91 lakes in the study area, impacts on long-toed salamanders would be expected to be adverse, major, and long term. These lakes have high densities of reproducing trout with various combinations of low TKN levels and/or low IOC values, all of which are associated with declines in amphibian numbers. As research has shown, long-toed salamanders are at risk of extirpation in low-productivity lakes (TKN values less than 0.045 mg/L) with high-density fish populations (greater than 100 fish per acre) (Liss et al. 1995, 1999, 2002). Also, a low connectivity with other lakes indicates a reduced possibility of recovery of local populations that may be extirpated, since there are few nearby subpopulations to serve as sources for recolonization of the affected lake. Six of the 7 lakes do not have recorded values for TKN and have been assigned a major impact based on the possibility of low TKN values. If subsequent research shows that TKN values in these lakes are high, the level of impacts would be reduced.

In 11 of the 91 lakes, impacts on amphibians would be expected to be adverse, moderate, and long term, based on the thresholds established. Three of these lakes have high densities of reproducing trout and are within the range of Northwestern salamanders. Research has shown that the Northwestern salamander can coexist with high densities of reproducing trout and still remain viable, although at measurably reduced larval densities (Larson and Hoffman 2002; Hoffman et al. 2003). This is likely due to the large size of the older larvae and adults in this species, as well as changes in their behavior in the presence of fish (they become active only at night and stay close to the shore or other escape cover) (Brokes 1999; Hoffman et al. 2003; Larson and Hoffman 2002). Eight of the 11 lakes are within the range of long-toed salamanders, and all have various combinations of either high IOC values or high TKN values combined with high densities of reproducing trout, which contribute to moderate impacts.

In 15 of the 91 lakes, impacts on amphibians would be expected to be adverse, minor, and long term. Three of the 14 lakes are within the range of Northwestern salamanders but have low densities of trout. Research has shown that the Northwestern salamander can coexist with low densities of reproducing trout with slightly reduced larval densities (Hoffman et al. 2003). This is likely due to the large size of the older larvae and adults in this species, as well as changes in their behavior in the presence of fish (Brokes 1999; Hoffman et al. 2003; Larson and Hoffman 2002). Twelve of the 15 lakes are within the range of long-toed salamanders but have low densities of trout, causing the impacts to be minor. Three of these 12 lakes do not have recorded values for TKN and have been assigned a minor impact based on the possibility of high TKN values. If subsequent research shows that TKN values in these lakes are low, the level of impacts would be reduced.

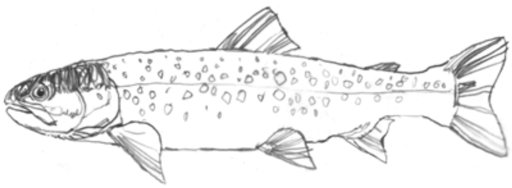
In 58 of the 91 lakes, long-term adverse impacts on amphibians would be negligible. Twenty-nine of the 58 lakes are fishless and, therefore, have no impacts on salamanders from stocked fish. Of the remaining 29 lakes, 20 have fish but do not have salamanders because they are either outside the distribution of salamanders in the North Cascades Complex or do not have suitable aquatic or terrestrial habitat for long-toed or Northwestern salamanders. Eight lakes are within the range of long-toed salamanders, but contain low densities of stocked trout with various combinations of TKN values and IOC values that indicate that long-toed salamanders should be able to survive and do well, given the lower fish densities, available nitrogen, and lake connectivity. One lake has a low density of trout, but does not have a recorded TKN value, so it has been assigned a negligible impact because it has an IOC of 0.8.

Impairment of amphibian species across the study area would not occur under alternative A.

Native Fish. Impacts on native fish populations were assessed using the professional knowledge of both NPS and WDFW staff involved in preparing this plan/EIS, who have direct experience and/or data regarding the status of native fish in many study area drainages. Where data were lacking, impacts were assessed based on predictive factors that include the particular species of trout reproducing or stocked in a lake and the type of native fish present in the downstream watershed. Also, specific knowledge of the extent of colonization and hybridization, as provided by WDFW biologists familiar with study area streams, was used to determine if major impacts existed.

Table 31 summarizes the predictive factors for native fish used in the assessment, while appendix G provides a more detailed discussion of the impact thresholds. Table G-5 in appendix G provides an assessment of impacts on native fish by lake for each alternative.

In one of the 91 lakes (McAlester), long-term adverse impacts on downstream native fish communities from reproducing populations of fish would be considered major. This lake has a surface outlet connecting to its downstream drainage and contains a high density of reproducing hybrid rainbow/cutthroat trout not native to the downstream watershed. Also, it is known that both colonization and hybridization have occurred with downstream native westslope cutthroat trout (WDFW, M. Downen, pers. comm., 2004). Research indicates that native fish communities in watersheds below mountain lakes can be adversely affected if salmonids stocked into mountain lakes colonize downstream outlets and hybridization occurs. Other impacts can occur through competition for resources (competition for food or for spawning habitat) and predation on juvenile native fish.



The WDFW refers to bull trout and Dolly Varden char collectively as "native char" because the two species are impossible to reliably distinguish between without genetic analysis.

In 9 lakes, adverse impacts on downstream native fish would be considered moderate. In these lakes, there are reproducing brook trout in a west-side lake and reproducing rainbow trout in an east-side lake. These predictive factors indicate a potential for major impacts, but neither colonization nor hybridization has occurred in the outlet streams; therefore, impacts are considered moderate (WDFW, M. Downen, pers. comm., 2004). Introductions of brook trout or closely related taxa of nonnative trout (*Oncorhynchus* sp./spp.) can have drastic consequences on native salmonids in watersheds throughout western North America (Behnke 1992; Gresswell and Varley 1988; Stoltz and Schnell 1991; Trotter 1987). Brook trout are especially aggressive and can traverse high-gradient stream reaches to colonize tributaries. They can also compete with native trout for available resources in headwater streams and tributaries (Adams et al. 2001). It has been documented that stocked rainbow trout replace native populations of westslope cutthroat trout throughout its native range, either through competition or hybridization (Behnke 1992). Westslope cutthroat trout are not native to west-side stream basins and have the potential to compete with native trout and coho salmon for resources, prey on juvenile native char, and hybridize with coastal rainbow and cutthroat trout (WDFW, M. Downen pers. comm., 2004). Future monitoring would help to validate this assessment.

In 26 of the 91 lakes, impacts on downstream native fish communities from stocked fish are expected to be adverse, minor, and long term. Five of these lakes are west-side lakes that contain populations of nonnative strains of reproducing rainbow trout (WDFW, M. Downen, pers. comm., 2004), which may adversely affect downstream populations of native char and trout. Seven of these lakes are east-side lakes that contain stocked populations of Mt. Whitney rainbow trout. This strain has a very limited potential for downstream dispersal and, on the east side of the Cascade Crest, rainbow trout do occur as a native species. Therefore, any downstream dispersal would have limited potential for hybridization. The remainder of the 26 lakes have reproducing nonnative westslope cutthroat in west-side lakes. This presents a minor impact because westslope cutthroat trout reproduce later than native salmonids, and this restricts the potential for hybridization.

In 55 of the 91 lakes, adverse impacts on downstream native fish communities from stocked fish would be considered negligible. In 26 of these lakes, either no surface outlet exists, or the trout that are present are native to the watershed in which the lake is located. For example, if westslope cutthroat trout were stocked in an east-side lake or coastal cutthroat trout were stocked in a west-side lake, it is very unlikely that the stocked trout would establish reproducing populations in outlet streams or contribute to the hybridization of native populations of coastal rainbow and cutthroat trout. Neither the Mt. Whitney nor the California golden strains are likely to disperse downstream, or if that would occur, it would likely be self-limiting due to ineffective competition (WDFW, B. Pfeifer, pers. comm., 2002; WDFW, M. Downen, pers. comm., 2004). The remaining 29 lakes are currently fishless, and any residual adverse impacts from past stocking would be considered negligible.

Impairment of native fish species across the study area would not occur under alternative A.

Impacts of Current Lake Treatment Methods on Aquatic Organisms

No lake treatments occur under alternative A; therefore, there would be no impacts on aquatic organisms from lake treatment methods.

Cumulative Impacts

No projects are proposed or in planning stages that would change the road access to any unit of the North Cascades Complex, and no new major trails or trailheads are being considered. Flooding in recent years has limited some access to certain lakes, and this would result in a short-term reduction of activity around certain lakes, including fishing. No new resorts or major upgrades of existing facilities are known. Overall, visitor use is expected to follow about the same patterns that it has for several years, resulting in the same level of fishing pressure on most lakes and connected streams. This use of the lakes and surrounding drainages would contribute negligible to minor adverse impacts on the plankton, macroinvertebrates, amphibians, and native fish that may inhabit the shallow riparian areas that visitors use to cross and enter the waters for fishing. This causes very limited compaction of shorelines and sedimentation of the waters where these animals breed, feed, and hide from other predators, with resultant negligible to minor impacts.

Mountain lake fisheries on National Forest System lands that surround the North Cascades Complex are also managed by the WDFW. The department's management approach (described in WDFW [2001]) is expected to be similar in the foreseeable future to what is currently being done. No lakes or streams inside the North Cascades Complex boundaries are directly downstream from an outside lake with reproducing fish, so no impacts would be expected in the study area from outside fishery management actions.

There would be continued, localized, and sporadic effects on native fish and other aquatic organisms from logging and dams and reservoir construction that have occurred and continue to occur outside the North Cascades Complex, including adjacent watersheds. These actions cause nonpoint pollution (primarily runoff of disturbed or exposed soils) that would adversely affect water quality by decreasing oxygen levels, increasing temperatures, and creating sedimentation that can cover spawning habitat. Impact levels on aquatic organisms in the North Cascades Complex or in downstream drainages would vary, depending on the location of the projects and the species present. Pre-construction surveys and mitigation measures are usually required to minimize effects on native species, especially any protected species, so most impacts on aquatic organisms in the study area from these actions would be negligible to minor. Even with mitigation, various levels of adverse impacts on species have occurred and may continue.

Other sources of impacts continue to occur that may affect the health and viability of native aquatic organisms. In some lakes in the North Cascades Complex, persistent organic pollutants (POP) and methyl-mercury have been found that appear to result from airborne pollutants being deposited on snow and washed into lakes. There may be an additional source of airborne pollution from the Darrington Power Plant, which, if approved, would operate about 20 miles southwest of the North Cascades Complex. Plant operation could potentially increase regional acid deposition, thereby increasing lake acidity and metal availability. Some of these pollutants might bioaccumulate to higher concentrations in the top predators in a system, such as salamanders in a lake, to the point where the pollutants would cause species to be less viable. If that occurred, then the cumulative impacts of pollutants and other impacts, perhaps from fish, might eliminate that predator species from certain lakes or even cause a more general decline in the population. Future monitoring may help to determine if bioaccumulation of persistent organic pollutants or methyl-mercury were occurring in high mountain lakes. Also, there is some concern that diseases or water mold may be spread by stocking affected fish; however, there is no evidence that this has occurred, and the water mold, *Saprolegnia*, is already present in the natural environment (WDFW 2001). In addition, hatcheries used by the WDFW are very cautious about eliminating the risk of disease or mold in their stocks, so the threat of impacts from mold or disease is considered negligible.

Overall, the cumulative impacts associated with other actions in the area, added to the impacts predicted under alternative A, would result in short- and long-term minor to potentially major adverse impacts on plankton, macroinvertebrates, amphibians, and/or certain species of native fish in individual lakes in the study area but with overall minor to moderate impacts for the region.

Conclusion

Table 32 summarizes the direct impacts expected, by numbers of lakes, for plankton, macroinvertebrates, amphibians, and native fish.

Aquatic organisms (including plankton, macroinvertebrates, and amphibians) would continue to experience long-term negligible to minor adverse impacts from fish predation and competition in lakes stocked with low densities of nonreproducing fish.

In lakes with high densities of reproducing fish, certain plankton and macroinvertebrates would continue to experience long-term moderate to major adverse impacts from intensive predation and competition. Long-term minor to moderate, adverse impacts on amphibians would continue in lakes with reproducing populations of fish, limited refugia, relatively high nutrient (for example, high total Kjeldahl nitrogen) availability, and limited lake connectivity to other water bodies with suitable amphibian habitat.

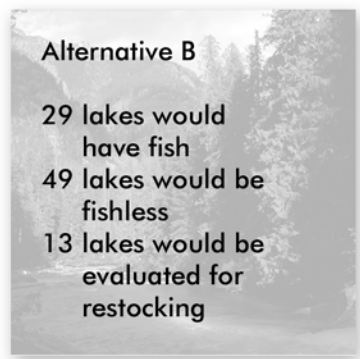
Long-term moderate to major adverse impacts from hybridization between native and nonnative fish would continue to persist.

Short- and long-term adverse cumulative impacts on aquatic organisms would vary widely depending upon trends in aquatic ecosystem stressors such as air pollution, development in surrounding watersheds, and climate change. Overall, the cumulative impacts associated with other actions in the area, added to the impacts predicted under alternative A, would result in short- and long-term minor to potentially major adverse impacts on plankton, macroinvertebrates, and amphibians, and/or certain species of native fish in individual lakes in the study area but with overall minor to moderate adverse impacts for the region.

Impairment of aquatic organisms across the study area would not occur under alternative A.

Alternative B: Proposed Adaptive Management of 91 Lakes under a New Framework (42 Lakes May Have Fish) (Preferred Alternative)

The emphasis of this alternative would be to eliminate or reduce numbers of reproducing fish from lakes in the study area. Restocking of nonreproducing fish would be allowed only where biological resources would be protected. Based on best available science, some lakes would be restocked with nonreproducing fish at low densities once reproducing fish have been removed. Lakes where information needed to make these decisions is missing would not be stocked until that information becomes available, as discussed in the monitoring program and associated adaptive management approach described in appendix F. This extensive monitoring program would be implemented in order to adjust management in the future to avoid unacceptable effects on native biota from fish presence.



The "Alternatives" chapter provides a detailed description of alternative B. For more information on the 91 lakes, refer to tables 5 and 10 in the "Alternatives" chapter and appendix E.

Impacts of Proposed Fish Stocking on Aquatic Organisms

Plankton. Under alternative B, adverse impacts in 14 lakes would gradually be reduced over time from major or moderate levels to minor levels, since all lakes that previously had very high or high densities of fish would have the densities reduced or fish eliminated, and fish density is a key factor affecting plankton in high mountain lakes. Overall, 29 of the 91 lakes would be expected to experience minor long-term adverse impacts as low-density fish populations are created or retained through various methods. Long-term direct and indirect impacts on the plankton community would continue to occur for the foreseeable future. Direct impacts would include predation and competition for prey; indirect impacts would include changes in nutrient cycling and food web dynamics.

In 62 other lakes, impacts on plankton would be considered negligible. In 13 of these lakes, fish would be removed or no longer stocked, and the lakes would be evaluated to determine if stocking at low densities would be resumed. Over the long term, adverse impacts on plankton would be reduced to negligible levels, which would increase to minor levels if fish stocking were resumed. In 20 of the 62 lakes, removal or discontinued stocking of fish would be permanent and occur over time. Adverse impacts would be gradually reduced to negligible levels, with the expected recovery of plankton populations and community structure to conditions comparable to those in historically stocked but currently fishless lakes. Beneficial effects would result from the removal of fish and the long-term recovery of the plankton community. The remaining 29 lakes with negligible impacts are those that were historically stocked but are currently fishless and would remain fishless. Plankton abundance and community structure in these lakes would primarily be influenced by biogeographical evolutionary processes.

Impairment of plankton species across the study area would not occur under alternative B.

Macroinvertebrates. Under alternative B, high-density fish populations would gradually be reduced or eliminated, which would eventually eliminate all major and moderate adverse impacts on macroinvertebrates throughout the North Cascades Complex. Low-density fish populations would be retained in 29 of the 91 lakes by either stocking with nonreproducing fish, reducing the density of existing fish populations, or supplementing low-density reproducing fish by stocking some nonreproducing fish. In these 29 lakes, long-term direct and indirect impacts on the macroinvertebrate community would continue to occur for the foreseeable future. Direct and indirect impacts would be the same as described for alternative A and would include predation and competition for prey and changes in nutrient cycling and food web dynamics. These impacts would be adverse, minor, and long term.

In 62 of the 91 lakes, adverse impacts on macroinvertebrates would be considered negligible. Thirteen of these lakes would be further evaluated prior to determining management actions. Existing low-density reproducing or stocked populations would be removed, and the response of native biota in these lakes, including macroinvertebrates, would be monitored. Low-density nonreproducing fish would be stocked only if monitoring results indicate it is appropriate. Macroinvertebrate populations and community structure would be expected to recover to levels comparable to those in currently fishless but otherwise similar lakes. Initial direct and indirect impacts would be negligible, although stocking of low-density nonreproducing fish in these lakes would result in minor impacts. In 20 of the 62 lakes, removal or discontinued stocking of fish would occur over time, and impacts would gradually be reduced to negligible levels with the expected recovery of macroinvertebrate populations and community structure to conditions comparable to those in historically stocked but currently fishless lakes. Beneficial effects would result from fish removal and by providing for the long-term recovery of macroinvertebrate populations and community structure.

The remaining 29 lakes are those that were historically stocked but are currently fishless and would remain fishless. Macroinvertebrate abundance and community structure in these lakes would primarily be influenced by biogeographical and evolutionary processes, with negligible residual adverse impacts.

Impairment of macroinvertebrate species across the study area would not occur under alternative B.

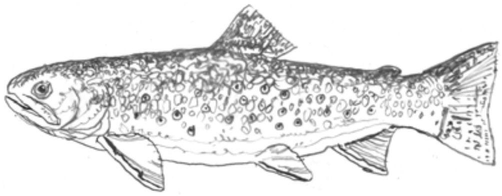
Amphibians. Under alternative B, the eventual reduction of fish density would gradually eliminate major and moderate impacts on amphibians over time. In 9 of the 91 lakes, impacts on amphibians would be expected to be minor. Three of the 9 lakes are within the range of Northwestern salamanders, but have low densities of trout. Six of the lakes are within the range of long-toed salamanders but have low densities of trout with low IOC (Index of Connectivity) values, causing the impacts to be on a minor level. Two of these 6 lakes do not have recorded values for TKN and have been assigned a minor impact based on the possibility of high TKN values. If subsequent research shows that TKN values in these lakes are low, the level of impacts would be reduced. In very general terms, impacts would be high if TKN levels are high, the IOC is low, and densities of fish in a lake are high. If, for instance, densities of fish are low or IOC is particularly high for a lake or if TKN level are low, the impact would be reduced. For a more detailed discussion of how impact levels were derived, see appendix G.

In 82 of the 91 lakes, impacts on amphibians would be negligible. Twenty-nine lakes would remain fishless, with negligible residual adverse impacts. Of the 53 remaining lakes, 20 are either outside the distribution of salamanders or do not have suitable aquatic or terrestrial habitat for long-toed or Northwestern salamanders. The remaining 33 lakes are within either the range of long-toed salamanders or the range of Northwestern salamanders. Adverse impacts on salamanders in these 33 lakes would gradually be reduced to negligible levels as the lakes either become fishless or have low densities of trout with high IOC values. For those 13 lakes that would undergo further evaluation, impacts would increase if stocking were resumed in the future.

Impairment of amphibian species across the study area would not occur under alternative B.

Native Fish. The extent of impacts on downstream native fish communities under alternative B would be reduced compared to alternative A, with the eventual elimination of the one major and nine moderate impacts identified in alternative A.

In 7 lakes, long-term impacts would be minor because high-density populations of nonnative brook and rainbow trout would be eliminated from high mountain lakes in the study area. However, there would still be reproducing rainbow trout or cutthroat trout not native to the basin in a west-side lake (e.g., westslope cutthroat in a west-side lake) or, an east-side Mt. Whitney rainbow trout in an east-side lake. The presence of these nonnative fish would result in some competition, predation, and possible interbreeding with native species, but because of the greatly reduced densities that would remain in the lakes, it is unlikely that a large number of fish would escape to downstream waters. In the case of the Mt. Whitney rainbow, there are no native rainbows present on the east side, and therefore, there is some concern about the potential for hybridization.



Brook trout, a nonnative fish, are especially aggressive and can compete with native trout for available resources.

In 84 lakes, long-term adverse impacts on native fish would be negligible. In 55 of these lakes, high densities of fish would be removed and either not restocked or restricted to low-density nonreproducing trout. Impacts on downstream native fish communities from reproducing populations of fish would gradually be reduced to negligible levels because nonreproducing fish would be the only fish stocked in any of the lakes after removal of the present populations. In other lakes with negligible impacts, any reproducing trout remaining would be incapable of establishing reproducing populations in outlet streams or hybridizing with native populations of fish, similar to alternative A, or there is no connecting outlet to downstream basins. Finally, 29 of the 84 lakes are fishless and would remain fishless, with residual negligible impacts on downstream native fish. Overall, the reduction in density and/or elimination of fish would yield a long-term beneficial effect to downstream native fish.

Impairment of native fish species across the study area would not occur under alternative B.

Impacts of Proposed Lake Treatment Methods on Aquatic Organisms

The lake treatment methods that are proposed in this plan/EIS are discussed in detail in the "Alternatives" chapter.

The method proposed for use in each lake was selected based on the type of fish population present and the physical characteristics of the lake environment. The proposed methods have a range of potential adverse impacts on aquatic organisms, depending on the methods and aquatic resource category considered.

Natural Methods. Under alternative B, natural methods would be used at 12 lakes. The use of natural methods means discontinuing all stocking and allowing the remaining nonreproducing fish to gradually die out and/or be eliminated through fishing. This approach is effective only in lakes without extensive natural reproduction. Because natural removal methods involve no direct actions within each lake, very limited human presence, and no mechanized transport (such as helicopters), these methods would result in effectively no or negligible adverse impacts on any group of aquatic organisms.

Mechanical Methods. Mechanical removal methods involve two different approaches: (1) the use of gillnets, fyke nets, or hook and line to remove fish, possibly combined with electrofishing and/or trapping; and (2) physical exclusion of fish from their spawning habitat. In the case of gillnetting, helicopters would be used to transport equipment to the site. The use of nets and traps is proposed for 8 lakes. This method has effectively no potential for direct or indirect impacts on plankton; therefore, impacts on plankton from this removal method are considered negligible. There is some risk of impacts on macroinvertebrate species from trampling or other sources of mechanical injury, but the extent of these potential impacts is considered to be minor. Amphibians face some risk of direct impacts from trampling, or possibly from electroshocks if they are in the immediate vicinity of the apparatus while it is being operated. Amphibian adults, which may not survive prolonged submersion, may be captured in traps or entangled in nets; however, the number of individuals potentially impacted would be small, and nets and traps would be inspected daily to reduce or eliminate nontarget organism mortality. Therefore, impacts on amphibian populations would be short term and minor. There is effectively no potential for impacts on native fish in downstream drainages; therefore, the extent of impacts on native fish is considered negligible. All impacts resulting from use of nets or traps would be of short-term duration, and no impacts relating to noise from the short-term presence of a helicopter over the site would be expected to affect any aquatic species.

The spawning habitat exclusion treatment method involves blocking access to the tributary spawning areas of mountain lakes by “cobbling over” gravel beds in the inlet or outlet tributaries to the lake, which creates a barrier to the spawning habitat. This method is proposed for only one lake: Wilcox/Lillie, Upper. Because these actions would not take place in the subject lake, and would not result in any appreciable changes in lake characteristics, this approach poses essentially no risk of adverse direct impacts on plankton and native fish. Physical modification of tributary areas presents some risk of direct impacts on macroinvertebrates and amphibians in these areas, but impacts would be minor and short term.

Chemical Method. The chemical method is proposed for use in 19 lakes under alternative B. This involves the use of the piscicide antimycin to kill fish populations (refer to the “Alternatives” chapter for details about this chemical and its mode of action). The chemical method would be proposed for large lakes with reproducing fish populations where mechanical removal methods would not be practical. Antimycin was selected for use over other piscicides because it is effective at relatively low concentrations, degrades rapidly, does not repel target fish, and has been shown to have only relatively minor and/or short-term impacts on nontarget organisms. Effects of antimycin on plankton and invertebrates vary depending on concentration levels and on the type of organism, as evidenced by numerous studies. Rabe and Wissmar (1969) observed a reduction in zooplankton abundance following antimycin application in an alpine lake environment, but this effect was short term. Controlled applications of antimycin in experimental ponds (generally applied at typical concentrations for fish control) resulted in no observable effects on any species of macrobenthos (Houf and Campbell 1977). However, antimycin treatments at higher concentrations have been observed to result in macroinvertebrate mortality in stream environments, with these effects being of short-term duration (Jacobi and Degan 1977; Morrison 1987). Furthermore, a recent report written by Finlayson et. al. (2001) states that the toxicity of antimycin to aquatic invertebrates has been found to be similar to that of fish at concentrations comparable to those that would be used in lakes in the North Cascades Complex study area. Some taxa, such as water fleas, copepods, amphipods, stoneflies, and caddisflies, are reportedly more sensitive to antimycin; while stoneflies, dragonflies, annelid worms, and water bugs appear to more resistant (Schnick 1974). Field tests of antimycin effects have shown no observable impacts on various amphibian species at typical fish-control treatment levels.

Benthos: Organisms that live in or on the bottom in aquatic habitats (the benthic zone). “Macrobenthos” includes all invertebrates that are found in the benthos; they are typically larger than one millimeter.

Antimycin has little potential for adverse impacts on downstream fish populations if application is effectively controlled. It degrades rapidly in turbulent water, losing its effectiveness after an elevational drop of 200 to 300 feet (Tiffan and Bergersen 1996). The distance and elevation drop separating high mountain lakes from native fish populations would create an effective separation from the treated environment. To ensure complete protection of downstream fish populations, antimycin applications would be neutralized at the lake outlet by adding small amounts of potassium permanganate, which is an oxidizer with no adverse impacts on water quality or nontarget organisms (Morrison 1987).

Based on the available literature, the potential impacts of chemical fish treatment on plankton, macroinvertebrates, and amphibian populations and communities in 19 lakes would be direct, short term, and minor. Potential direct and indirect impacts on native fish would be negligible.

Antimycin use would result in moderate, direct, short-term impacts (of one to several years' duration) to sensitive plankton and macroinvertebrates, since it would be expected to cause an initial die-off and/or reduction in density to sensitive species in the treatment area. However, sensitive taxa would be expected to recover (in terms of their previous abundance and diversity) within one to several years after treatment. Over the long term, taxa would indirectly benefit from the removal of fish predation. Impacts on amphibian populations and communities would be direct, short-term, and minor. Potential direct and indirect impacts on downstream native fish would be negligible.

Cumulative Impacts

Cumulative impacts under alternative B would be similar to those described under alternative A, but slightly reduced due to the eventual elimination of impacts in those lakes and connected watersheds where nonnative fish would be eliminated, resulting in 49 fishless lakes (compared to 29 fishless lakes under alternative A).

No lakes or streams inside the North Cascades Complex boundaries are directly downstream from an outside lake with reproducing fish, so no impacts would be expected in the study area from outside fishery management actions.

Overall, the impacts associated with other actions in the region, added to the residual impacts predicted under alternative B, would have minor to moderate adverse impacts on all groups of aquatic organisms on both an individual lake and regional basis.

Conclusion

Table 32 summarizes the direct impacts expected, by numbers of lakes, for plankton, macroinvertebrates, amphibians, and native fish.

Aquatic organisms (including plankton, macroinvertebrates, and amphibians) would continue to experience long-term negligible to minor adverse impacts from fish predation and competition in lakes that would continue to be stocked with low densities of nonreproducing fish. These impacts would decline further in the future as stocking is curtailed or eliminated in lakes based on adaptive management decisions pertaining to stocking.

Removal of reproducing populations of fish from select lakes would eventually result in long-term beneficial effects on aquatic organisms in those lakes; however, removal of reproducing fish populations would take many years. Until fish are removed, minor to major impacts on aquatic organisms would persist as described in alternative A.

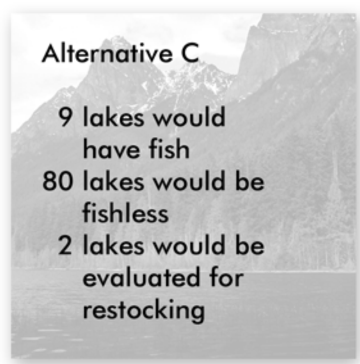
Mechanical methods of fish removal (netting, trapping, spawning habitat exclusion) would have short-term negligible to minor adverse impacts on aquatic organisms. Chemical methods of fish removal (application of the piscicide antimycin) would have short-term negligible to moderate adverse impacts on certain aquatic organisms.

Long-term minor to moderate adverse impacts on native fish would continue to be primarily associated with hybridization between native and nonnative fish. The risk of hybridization would decline over the long term as reproducing populations of fish were removed and fewer nonnative fish dispersed downstream from lakes. The risk of hybridization, however, would not be entirely eliminated primarily because reproducing populations of nonnative fish are now present in many drainages throughout the North Cascades Complex.

Compared to alternative A, there would be a long-term beneficial cumulative impact on native aquatic organisms because a minimum of 20 lakes would eventually become fishless. Short- and long-term adverse cumulative impacts on aquatic organisms from threats other than nonnative fish would vary widely depending upon trends in aquatic ecosystem stressors such as air pollution, development in surrounding watersheds, and climate change.

Impairment of aquatic organisms across the study area would not occur under alternative B.

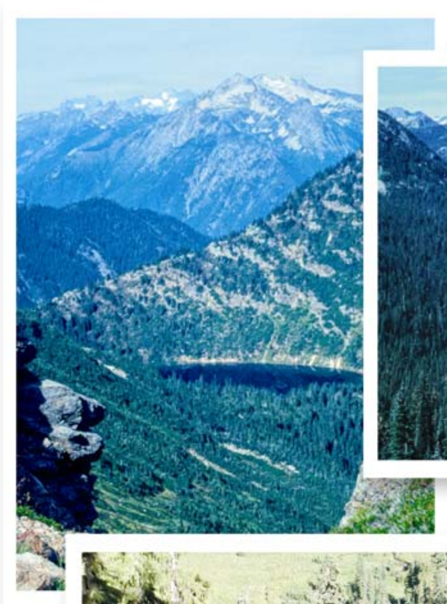
ALTERNATIVE C: PROPOSED ADAPTIVE MANAGEMENT OF 91 LAKES UNDER A NEW FRAMEWORK (11 LAKES MAY HAVE FISH)



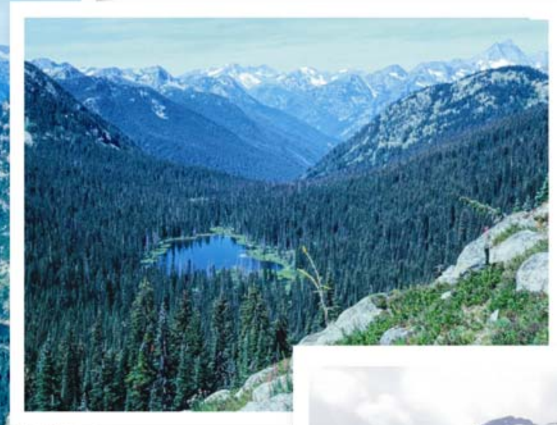
Under alternative C, 9 lakes in Ross Lake and Lake Chelan National Recreation Areas would have fish and 2 lakes would be evaluated for restocking. Eleven other lakes in the national recreation areas would remain fishless or be returned to fishless conditions. The remaining 69 lakes (which are in the national park) would be returned to their natural fishless conditions or would remain fishless.

The "Alternatives" chapter provides a detailed description of alternative C. For more information on the 91 lakes, refer to tables 5 and 12 in the "Alternatives" chapter and appendix E.

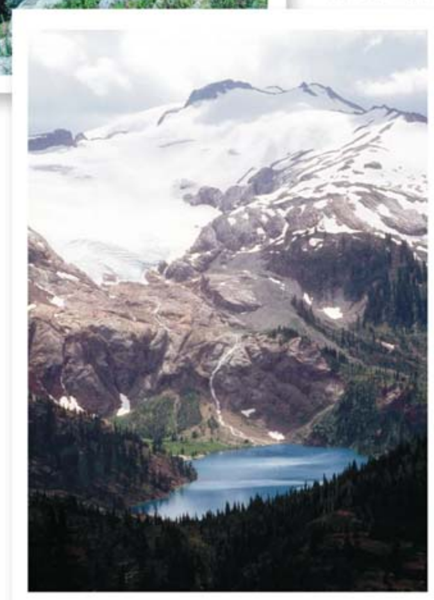
Sourdough Lake

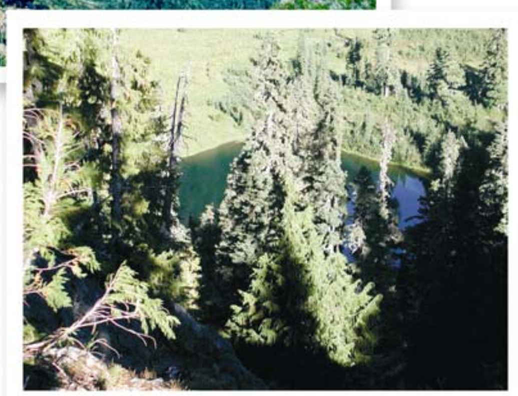


Dagger Lake

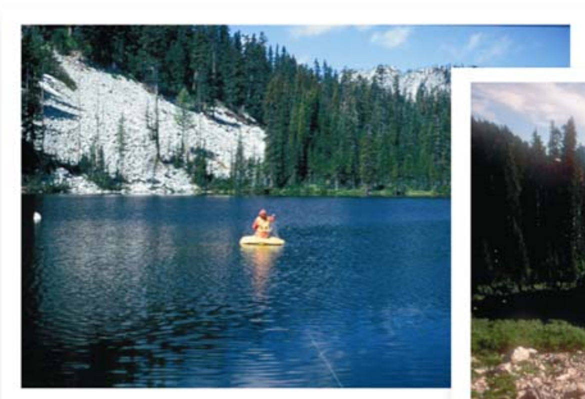


Green Lake



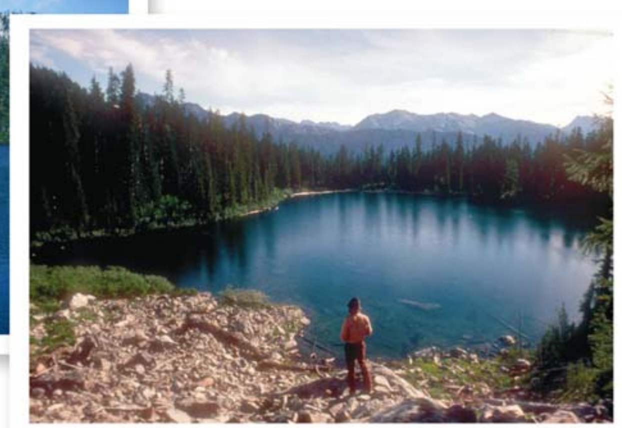


Diobsud Lake No. 2, Lower



McAlester Lake

Battalion Lake



Under alternative B, a management action code of "2B" would be applied to the six lakes pictured above, in addition to Blum (Largest/Middle, No. 3) and Dee Dee, Upper.

Impacts of Proposed Fish Stocking on Aquatic Organisms

Plankton. Under alternative C, more lakes would be treated over time to remove fish, so impact levels would gradually be reduced in more lakes in the study area, compared to alternative A. At the completion of all lake treatments, minor impacts would occur in 9 lakes, where low-density fish populations would be retained by either replacing high densities of fish with lower densities, or continuing to stock with low densities of nonreproducing fish. In these lakes, adverse impacts on the plankton community would be long term and minor. Direct and indirect impacts would be of the same type as described under alternative A and would include predation and competition for prey and changes in nutrient cycling and food web dynamics.

Two of the 91 lakes would be further evaluated prior to determining management actions. In these lakes, existing low-density reproducing or stocked populations would be removed, and the response of native biota, including plankton, would be monitored. Low-density nonreproducing fish would be stocked only if results of monitoring indicate it would be appropriate. Plankton populations and community structure would be expected to recover to levels comparable to those in currently fishless but otherwise similar lakes. Initial direct and indirect impacts would be negligible, although restocking the lakes with low-density nonreproducing fish would be expected to result in minor impacts.

In 51 of the 91 lakes, existing low-density reproducing or stocked populations of introduced fish would be removed. Plankton populations and community structure would be expected to recover to levels comparable to those in historically stocked but currently fishless lakes that are otherwise similar. Minor impacts would be reduced to negligible over time. Residual long-term adverse impacts would be considered negligible, and long-term beneficial effects would result.

Under alternative C, the 29 historically stocked but currently fishless lakes would remain fishless. Plankton abundance and community structure in these lakes would primarily be influenced by biogeographical and evolutionary processes, as described for alternative A, with residual adverse negligible impacts.

Impairment of plankton species across the study area would not occur under alternative C.

Macroinvertebrates. Under alternative C, more lakes would be treated over time to remove fish, so impact levels would gradually be reduced in more lakes in the study area. Minor impacts would occur in 9 lakes, where low-density fish populations would be retained by either replacing high densities of fish with lower densities, or continuing to stock with low densities of nonreproducing fish. In these lakes, the impacts on macroinvertebrates would be minor and long term. Direct and indirect impacts would be the same as those described under alternative A (those impacts are predation and competition for prey and changes in nutrient cycling and food web dynamics).

In two other lakes, further evaluation would be completed prior to determining management actions. In these lakes, the existing low-density reproducing or stocked populations would be removed, and the response of native biota, including macroinvertebrates, would be monitored. Low-density stocked populations would be reintroduced only if monitoring results indicate it is appropriate. Macroinvertebrate populations and community structure would be expected to recover to levels comparable to those in currently fishless but otherwise similar lakes. Direct and indirect impacts would be negligible. Restocking of low-density nonreproducing fish in these lakes would be expected to result in minor impacts.

In 51 lakes, removal or discontinuation of fish stocking would allow for the expected gradual recovery of macroinvertebrate populations and community structure to conditions comparable to those in historically stocked but currently fishless lakes. Minor impacts would gradually be reduced to long-term negligible impact levels, and long-term beneficial effects would result.

Under alternative C, 29 historically stocked but currently fishless lakes would remain fishless. Macroinvertebrate abundance and community structure in these lakes would primarily be influenced by biogeographical or evolutionary processes, as described for alternative A, with negligible residual adverse impacts.

Impairment of macroinvertebrate species across the study area would not occur under alternative C.

Amphibians. Under alternative C, no lakes would experience major or moderate impacts on amphibians, and more lakes would have impacts gradually reduced from minor to negligible levels because more lakes would either become fishless or be reduced to low fish densities.

In five lakes, adverse impacts on amphibians are predicted to be minor. Three of these lakes are within the range of Northwestern salamanders but have low densities of trout. Two of these lakes are within the range of long-toed salamanders but have low densities of trout with low IOC (Index of Connectivity) values, which indicate minor impact levels.

Northwestern salamander

In 86 of the 91 lakes, impacts on amphibians would be considered negligible. Twenty-nine lakes would continue to remain fishless, with negligible residual adverse impacts. Of the 57 remaining lakes, 20 are either outside the range of salamanders or do not have suitable aquatic or terrestrial habitat for long-toed or Northwestern salamanders. Thirty-four of these lakes are within the range of long-toed salamanders, and 3 are within the range of the Northwestern salamander. Impacts on salamanders in these 37 lakes would gradually be reduced to negligible levels because the lakes have either become fishless or have low densities of trout with high IOC values. For a more detailed discussion of how impact levels were derived, see appendix G.

Impairment of amphibian species across the study area would not occur under alternative C.

Native Fish. Under alternative C, the potential for adverse impacts on downstream native fish would be substantially reduced over time, compared to alternative A, with no major or moderate adverse impacts. Only one lake, Unnamed MR-16-01, would continue to have minor impacts on downstream native fish. In Unnamed MR-16-01, a low-density population of reproducing cutthroat trout would continue to remain in a west-side lake, which would pose a minor threat to downstream native fish through competition. The reproductive status of the trout would need to be evaluated to determine if a minor impact actually exists.

In 90 lakes, long-term impacts on native fish would be negligible. In some of these lakes, fish would be removed and either not restocked or restocked with low densities of nonreproducing trout. Impacts on downstream native fish from stocked fish would eventually become negligible because nonreproducing fish would be the only fish stocked in any of the lakes after removal of the present populations. In other lakes with negligible impacts, any reproducing trout remaining would be incapable of establishing reproducing populations in outlet streams or hybridizing with native fish, similar to alternative A, or there is no connection to downstream basins. The 29 currently fishless lakes would remain fishless, with residual negligible adverse impacts. Overall, the widespread reduction in fish densities and/or elimination of fish under alternative C would be a long-term benefit to downstream native fish.

Impairment of native fish species across the study area would not occur under alternative C.

Impacts of Proposed Lake Treatment Methods on Aquatic Organisms

Under alternative C, the types of impacts associated with the various lake treatment methods would be the same as described for alternative B; however, the number of lakes affected by those treatments would vary, and more lakes would experience impacts (albeit minor and short term) from chemical and mechanical treatments to remove fish.

Natural Methods. Under alternative C, 21 lakes would be subject to natural fish removal methods, which means stocking would be discontinued; this is 9 more lakes than alternative B. There would be few, if any, impacts on any aquatic organisms from this type of treatment, which involves natural die-out and removal by fishing, so impacts would remain about the same – negligible and short term.

Mechanical Methods. There would be 10 lakes slated for mechanical treatment, an increase of only 2 lakes over alternative B. Impacts on macroinvertebrates and amphibians would be short term and minor, and impacts on native fish and plankton would be negligible for all aspects of this treatment. Overall, impacts would be about the same as for alternative B.

Chemical Method. For chemical treatment, the number of lakes treated would increase to 25. Impacts on sensitive plankton and macroinvertebrates from the use of antimycin would be moderate, direct, and short term due to the expected die-off of certain sensitive species in the vicinity of the treatment. Impacts on sensitive taxa would be expected to return to their previous abundance and diversity within one to several years after treatment. Over the long term, taxa would indirectly benefit from the removal of fish predation. Impacts on amphibian populations and communities would be direct, short term, and minor. Potential direct and indirect impacts on downstream native fish would be negligible. Six more lakes would be treated in this manner compared to alternative B, but the overall increase in impact intensity would be minor because adverse impacts from the use of antimycin are so limited.

Cumulative Impacts

Cumulative impacts under alternative C would be similar to those described under alternative A but reduced due to the elimination of impacts in those lakes and connected watersheds where high-density populations of fish would be eliminated, resulting in up to 80 fishless lakes (compared to 29 fishless lakes under alternative A). There would be reduced fishing pressure on the lakes and connected streams in the North Cascades Complex. Anglers would be displaced to surrounding lakes, and there would be negligible to minor impacts on aquatic organisms from visitors crossing and entering the waters for fishing.

No lakes or streams inside the North Cascades Complex boundaries are directly downstream from an outside lake with reproducing fish, so no impacts would be expected in the study area from outside fishery management actions.

Overall, the impacts associated with other actions in the region, added to the residual impacts predicted under alternative C, would have minor to moderate adverse impacts on all groups of aquatic organisms, both at an individual lake and in the region.

Conclusion

Table 32 summarizes the direct impacts expected, by numbers of lakes, for plankton, macroinvertebrates, amphibians, and native fish.

Aquatic organisms (including plankton, macroinvertebrates, and amphibians) would continue to experience long-term negligible to minor adverse impacts from fish predation and competition in national recreation area lakes that would continue to be stocked with low densities of nonreproducing fish. These impacts could decline further in the future as stocking is curtailed or eliminated in lakes based on adaptive management decisions pertaining to stocking.

Removal of reproducing populations of fish from lakes in the national park portion of the North Cascades Complex would eventually result in long-term beneficial effects on aquatic organisms in those lakes where removal proved feasible; however, removal of reproducing fish populations from the entire national park unit and select lakes in the national recreation areas would take many years. Until fish are removed, minor to major impacts on aquatic organisms would persist as described in alternative A.

Mechanical methods of fish removal (netting, trapping, spawning habitat exclusion) would have short-term negligible to minor adverse impacts on aquatic organisms. Chemical methods of fish removal (application of the piscicide antimycin) would have short-term negligible to moderate adverse impacts on certain aquatic organisms.

Long-term minor to moderate adverse impacts on native fish would continue to be associated with hybridization between native and nonnative fish. The risk of hybridization would decline over the long term as reproducing populations of fish are removed and fewer nonnative fish dispersed downstream from lakes. The risk of hybridization, however, would not be entirely eliminated primarily because nonnative fish are now present in many drainages throughout the North Cascades Complex.

Compared to alternative A, there would be a long-term beneficial cumulative impact on populations of native aquatic organisms because a minimum of 51 lakes (all lakes in the national park unit and select national recreation area lakes) would eventually become fishless. Short- and long-term adverse cumulative impacts on aquatic organisms from threats other than nonnative fish would vary widely depending upon trends in aquatic ecosystem stressors such as air pollution, development in surrounding watersheds, and climate change.

Impairment of aquatic organisms across the study area would not occur under alternative C.

Alternative D: 91 Lakes Would Be Fishless

Under alternative D, the goal would be to remove fish from all 91 lakes in the study area. All 91 lakes would eventually be unavailable for fishing, with some fish remaining in certain lakes as management actions are implemented over time.

The “Alternatives” chapter provides a detailed description of alternative D. For more information on the 91 lakes, refer to tables 5 and 13 in the “Alternatives” chapter and appendix E.

Impacts of Proposed Fish Stocking on Aquatic Organisms

Plankton. In the 62 fish-bearing lakes where fish populations would be removed or allowed to die out, the plankton community would generally be expected to recover over the years to conditions comparable to those in historically fish-bearing but currently fishless lakes, with resultant negligible impacts. Since lakes would be treated over time, some minor to moderate impacts would continue until all high-density populations of nonnative fish were removed. Upon removal, the phytoplankton community structure that would develop in each lake may be different from what was historically present before fish stocking, but all species would most likely be present, based on studies completed to date (Drake and Naiman 2000).

Research has shown that, in many cases, zooplankton that have been adversely impacted can recover after fish are removed (Parker et al. 2001), and zooplankton species can be effectively reintroduced to lakes through managed introductions (McNaught et al. 1999; Parker et al. 2001). Therefore, it is expected that most zooplankton species would eventually recover to abundance comparable to historic levels, unless the population has been completely extirpated by predation, and that extirpated species would be reintroduced from adjacent lakes if desired. Using such approaches, the zooplankton community structure would be rehabilitated to levels comparable to those in fishless but otherwise similar lakes. Long-term effects of fish removal would be expected to be beneficial, with larger changes occurring in lakes that currently have high-density fish populations.

Twenty-nine lakes were historically stocked with trout but are currently fishless. Observed plankton community structure and abundance in these lakes is generally comparable to those in similar fishless lakes. Plankton populations in these lakes would be influenced mainly by biogeographical or evolutionary processes. Residual adverse impacts of fish stocking in these lakes would be considered negligible after recovery has occurred. These lakes serve as a benchmark for expected conditions in lakes following a period recovery after fish are removed.

Impairment of plankton species across the study area would not occur under alternative D.

Macroinvertebrates. Removal of fish from 62 lakes would eventually result in the expected recovery of the macroinvertebrate community to levels comparable to those in historically stocked but currently fishless lakes. Macroinvertebrate species in individual lakes that have been extirpated by predation would be expected to recolonize from adjacent areas within several years, depending on species and proximity of other breeding areas. Research indicates that effects on macroinvertebrates are often limited to the segments of the population exposed to fish predation and that, while some population segments may be depressed or even temporarily eliminated, these species usually have a high dispersal potential and recolonize relatively quickly (Bilton et al. 2001; Bohonak and Jenkins 2003). Species would also be reintroduced through management intervention if desired. Residual adverse impacts in all 62 lakes would be negligible and long term, with some minor to possibly major impacts remaining for several years until all lakes with high densities of fish are treated. The eventual removal of fish would result in long-term beneficial effects in all these lakes, with the greater benefits occurring in lakes that currently have higher fish densities.

Twenty-nine lakes were historically stocked with trout but currently have no fish populations. Observed macroinvertebrate community structure and abundance in these lakes is generally comparable to those in similar fishless lakes. Macroinvertebrate populations in these lakes would be influenced mainly by biogeographical or evolutionary processes. Residual adverse impacts of fish stocking in these lakes would be considered negligible after recovery has occurred. These lakes would serve as a benchmark for expected conditions in lakes following a period of recovery after fish are removed.

Impairment of macroinvertebrate species across the study area would not occur under alternative D.

Amphibians. Under alternative D, fish would gradually be removed from 62 lakes, resulting in long-term residual adverse impacts on amphibian communities from fish populations, but at a negligible level. Until all high-density populations are removed, some minor to major impacts would continue. Long-term effects of fish removal would be beneficial. In the absence of fish predation, terrestrial amphibian adults, surviving larvae, or neotenic adults would be expected to re-establish populations in a lake.

Impairment of amphibian species across the study area would not occur under alternative D.

Native Fish. Under alternative D, fish would eventually be removed from 62 lakes (or allowed to disappear through natural mortality or not being restocked), resulting in a reduction of impacts on downstream native fish communities to negligible levels over time. Some minor to moderate adverse impacts may continue for several years as management actions are implemented. The long-term effects of fish removal would be beneficial.

Impairment of native fish species across the study area would not occur under alternative D.

Impacts of Proposed Lake Treatment Methods on Aquatic Organisms

For alternative D, the types of impacts associated with the various lake treatment methods would be the same as described under alternative B; however, the numbers of lakes affected by those treatments would vary, and more lakes would experience impacts (albeit minor and short term) from chemical and mechanical treatments to remove fish.

Natural Methods. Under alternative D, 26 lakes would be subject to natural removal methods where stocking would be discontinued. This is 14 more lakes than alternative B and 5 more than alternative C. However, since there are few, if any, impacts on aquatic organisms from this type of removal, overall impacts would remain about the same – short term and negligible.

Mechanical Methods. There would be 11 lakes slated for mechanical treatment under alternative D, an increase of only 1 lake over alternative C and 3 lakes more than alternative B. Again, with minimal adverse impacts expected, impact levels would remain short term and minor for amphibians and macroinvertebrates and negligible for native fish and plankton.

Chemical Method. The same number of lakes (25) would be chemically treated under alternative D as under alternative C. Impacts on plankton and macroinvertebrates from the use of antimycin would be moderate, direct, and short term due to the expected die-off of certain sensitive species in the vicinity of the treatment. The sensitive taxa would be expected to return to their previous abundance and diversity within one to several years after treatment. Over the long term, taxa would indirectly benefit from the removal of fish predation. Impacts on amphibian populations and communities would be direct, short term, and minor. Potential direct and indirect impacts on downstream native fish would be negligible.

Cumulative Impacts

Under alternative D, cumulative adverse impacts on all aquatic organisms would be less than that described for alternative A, since all 91 lakes would eventually be fishless, thus eliminating the adverse impacts associated with fish presence. However, cumulative impacts under alternative D would still occur, even with the added beneficial effects of fish removal because there are so many other actions that would adversely affect all the groups of aquatic organisms in the region.

Overall, the impacts associated with other actions in the region, added to the long-term beneficial effects predicted under alternative D, would be expected to result in negligible to minor adverse impacts on plankton, macroinvertebrate, amphibian, and native fish, both at an individual lake and in the region.

Conclusion

Table 32 summarizes the direct impacts expected, by numbers of lakes, for plankton, macroinvertebrates, amphibians, and native fish.

Aquatic organisms (including plankton, macroinvertebrates, and amphibians) would continue to experience long-term negligible to minor adverse impacts from fish predation and competition until stocked populations of fish gradually died out or were removed through treatment. Once these stocked fish are gone, native aquatic communities would eventually revert to predisturbance (that is, prestocking) conditions, and this would result in long-term beneficial impacts on native aquatic organisms.

Removal of reproducing populations of fish from all study area lakes in the North Cascades Complex would eventually result in long-term beneficial effects on aquatic organisms in those lakes where removal proved feasible; however, removal of reproducing fish populations from study area lakes would take many years. Until fish are removed, long-term minor to major adverse impacts on aquatic organisms would persist as described in alternative A.

Mechanical methods of fish removal (netting, trapping, spawning habitat exclusion) would have short-term negligible to minor adverse impacts on certain aquatic organisms. Chemical methods of fish removal (application of the piscicide antimycin) would have short-term negligible to moderate adverse impacts on certain aquatic organisms.

Long-term minor to moderate adverse impacts on native fish would continue to be associated with hybridization between native and nonnative fish. The risk of hybridization would decline over the long term as reproducing populations of fish are eventually removed from study area lakes in the North Cascades Complex. The risk of hybridization, however, would not be entirely eliminated primarily because nonnative fish are now present in many drainages throughout the North Cascades Complex.

Compared to alternative A, there would be a long-term beneficial cumulative impact on populations of native aquatic organisms because all study area lakes in the North Cascades Complex would eventually become fishless. Short- and long-term adverse cumulative impacts on aquatic organisms from threats other than nonnative fish would vary widely depending upon trends in aquatic ecosystem stressors such as air pollution, development in surrounding watersheds, and climate change.

Impairment of aquatic organisms across the study area would not occur under alternative D.

WILDLIFE

Black bears are omnivores that will eat any kind of food (plant or animal), including fish, if the opportunity presents itself.

The wildlife potentially affected by the proposed alternatives include mammals, birds, and reptiles that are either native to lake habitats in the North Cascades Complex or are occurring in high mountain lakes in the North Cascades Complex due to the presence of stocked fish. Amphibians and fish are discussed in the section titled "Aquatic Organisms." Additionally, wildlife inhabiting drainages downstream from lakes in the North Cascades Complex may also be affected by mountain lakes fishery management decisions. Impacts would occur from stocking or fish removal and associated activities under proposed management actions.

This section describes the methods used to analyze impacts on wildlife and results of the analysis. The following section discusses the regulations and policies used to guide NPS decision making, in addition to the assumptions and thresholds used to analyze impacts on wildlife.

GUIDING REGULATIONS AND POLICIES

The *General Management Plan* (NPS 1988b) includes the following management objectives that are relevant to overall natural resources, including wildlife, for the North Cascades Complex:

> Increase knowledge and understanding of the interrelationships of the natural processes, and of methods for implementation of appropriate actions.
>
> Preserve, maintain, or restore, where feasible, the primary natural resources and those ecological relationships and processes.
>
> Manage the natural resources as an integral part of a regional ecosystem.
>
> Provide opportunity for research in as natural a system as possible.

The *Strategic Plan* (NPS 2000a) includes goals for preserving resources in the North Cascades Complex that are consistent with the goals and objectives of this analysis. Mission Goal I.a. states that

> Natural and cultural resources and associated values of the North Cascades National Park Service Complex are protected, restored, and maintained in good condition and managed within their broader ecosystem and cultural context.

Servicewide NPS regulations and policies, including the NPS *Organic Act of 1916*, *NPS Management Policies* (NPS 2001a), and NPS Reference Manual 77, *Natural Resource Management*, also direct national parks to provide for the protection of park resources. The *Organic Act* directs national parks to conserve wildlife unimpaired for future generations and is interpreted to mean that native animal life are to be protected and perpetuated as part of a park unit's natural

ecosystem. Parks rely on natural processes to control populations of native species to the greatest extent possible; otherwise, they are protected from harvest, harassment, or harm by human activities. The *NPS Management Policies* (NPS 2001a) make restoration of native species a high priority. Management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity, and ecological integrity of plants and animals (NPS 2001a, 4.1). Policies in the NPS *Natural Resources Management Guidelines* state, "the National Park Service will seek to perpetuate the native animal life as part of the natural ecosystem of parks" and that "native animal populations will be protected against . . . destruction . . . or harm through human actions."

METHODOLOGY AND ASSUMPTIONS

The following discussion describes the methodology used to evaluate the impacts of the proposed alternatives on wildlife in the North Cascades Complex. Analysis methods are qualitative and are based on anecdotal evidence and field observations by NPS staff, reviews of existing data and literature, and best professional judgment. NPS staff provided information on species distribution in the North Cascades Complex.

The analysis presented in this section assumes that the historic and current stocking in mountain lakes has created favorable ecological conditions for piscivorous (fish eating) wildlife that previously were unlikely to inhabit these lakes due to lack of favorable resources. Piscivorous wildlife or other species that eat fish opportunistically are now present at a number of lakes in the North Cascades Complex because they have become accustomed to the presence of fish in previously fishless lakes.

GEOGRAPHIC AREA EVALUATED FOR IMPACTS

The geographic area evaluated for impacts on wildlife includes the North Cascades Complex, which is comprised of the north and south units of North Cascades National Park, Ross Lake National Recreation Area, and Lake Chelan National Recreation Area. More specifically, these impacts were evaluated for wildlife likely to occur in or near the 91 mountain lakes in the North Cascades Complex with a history of fish stocking, or those species that would be disturbed by management activities; for example, aircraft and helicopter noise would disturb wildlife during stocking or lake treatment activities. Impacts on wildlife inhabiting the drainage basins that extend beyond the North Cascades Complex boundaries are also considered because stocking or removing fish that migrate downstream from high mountain lakes may impact wildlife that use those fish as a food resource.

OUTCOMES OF MANAGEMENT ACTIONS

Several of the management actions that would be applied to lakes under each of the action alternatives have potential multiple outcomes, depending on the results of future monitoring and adaptive management decisions made based on these results. Therefore, for the purpose of this plan/EIS, the focus is on the initial outcome of the management actions, with the assumption that the lakes would either have fish or not have fish, based on the initial results of the actions taken. It is recognized that these conditions may change in some of the lakes due to decisions made under the proposed mountain lakes fishery monitoring plan presented in appendix F. If future monitoring indicates that fish presence has caused unacceptable changes to native biota, and as a result, fish are removed or reduced, impacts would also be reduced from what is presented here.

IMPACT CRITERIA AND METHODOLOGY

Potential impacts on wildlife and wildlife habitat were evaluated based on the species present and their association with stocked fish, as well as the effects of stocking or lake treatment methods associated with fish removal. Information on habitat and other existing data were acquired from staff at the North Cascades Complex, the WDFW, U.S. Fish and Wildlife Service, and available literature.

Methods to evaluate impacts on wildlife use alternative A as the baseline condition against which the action alternatives are compared because it represents current management practices. The analysis focuses on effects to wildlife from fish populations in mountain lakes, as well as impacts incurred as a result of management activities and removal of fish at the population and community levels. A population is defined as a group of individuals within a given species that are reproductively isolated from other groups and have geographically defined distributions. Communities are defined as the interacting populations of all species in a resource category. Literature on wildlife responses to noise provided available research to assess potential impacts on species from the use of helicopters or fixed-wing aircraft during lake management or lake treatment activities in the North Cascades Complex.

IMPACT THRESHOLD DEFINITIONS

The following thresholds were used to determine the magnitude of effects on wildlife and wildlife habitat as a result of implementation of any of the alternatives, including stocking and treatment methods:

Negligible. An action would result in no observable or measurable impacts on native wildlife species, their habitats, or the natural processes sustaining them and would be of short duration, localized, and well within natural population fluctuations.

Minor. An action would result in detectable impacts, but they would not be expected to result in substantial population fluctuations and would not be expected to have any measurable long-term effects on native species, their habitats, or the natural processes sustaining them. Occasional responses to disturbance by some individuals would be expected, but without interference to feeding, reproduction, or other factors affecting population levels.

Moderate. An action would result in detectable impacts on native wildlife, their habitats, or the natural processes sustaining them. Key ecosystem processes may experience disruptions that would be outside natural range of fluctuation (but would return to natural conditions). Sufficient habitat would remain functional to maintain viability of native wildlife populations.

Major. An action would result in detectable impacts on native wildlife, their habitats, or the natural processes sustaining them. Key ecosystem processes might be disrupted permanently. Adverse responses to disturbance by some individuals would be expected, with negative impacts on feeding, reproduction, or other factors resulting in a long-term decrease in population numbers and genetic variability.

Impairment. An action would disrupt ecosystem processes resulting in elimination of a species or large population declines, locally and range-wide. In addition, these adverse, major impacts on the North Cascades Complex's resources and values would

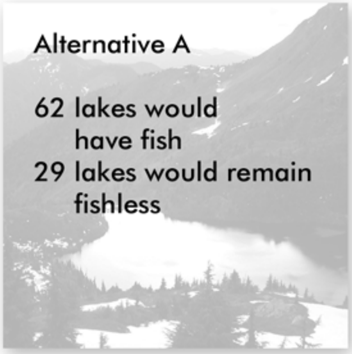
> contribute to deterioration of wildlife resources and values to the extent that the purpose of the North Cascades Complex would not be fulfilled as established in its enabling legislation
>
> affect resources key to the natural or cultural integrity or opportunities for enjoyment in the North Cascades Complex
>
> affect the resource whose conservation is identified as a goal in the *General Management Plan* (NPS 1988b) or other planning documents for the North Cascades Complex

IMPACTS OF THE ALTERNATIVES ON WILDLIFE

This section analyzes impacts for each of the four alternatives. The first section under each alternative addresses impacts that would result from stocking decisions made for each of the 91 lakes. The impacts are related to the numbers of stocked fish that would remain in the subject lakes, as well as disturbance from stocking activities. Next, a section is provided to address impacts related to the various lake treatment methods. Finally, cumulative impacts are discussed, and an overall summary of impacts is presented at the end of each alternative analysis.

Many wildlife species inhabiting the North Cascades Complex that are considered in this plan/EIS are not directly linked to fish or aquatic habitats, but under any of the alternatives, management activities resulting in increased human presence and the noise from fixed-wing aircraft or helicopters have the potential to adversely affect wildlife.

ALTERNATIVE A (NO ACTION): EXISTING MANAGEMENT FRAMEWORK OF 91 LAKES (62 LAKES HAVE FISH)



The current mountain lakes fishery management activities at the North Cascades Complex, which are described in the "Alternatives" chapter, would continue under the no-action alternative.

For detailed information on the 91 lakes, refer to table 5 and figure 4 in the "Alternatives" chapter and appendix E.

Impacts of Current Fish Stocking on Wildlife

The majority of impacts on wildlife under alternative A would be related to the number of fish stocked and/or density of reproducing fish in the lakes. To a lesser degree, noise and disturbance associated with stocking activities are also considered. As described in the "Alternatives" chapter, current stocking is accomplished by packing fry into lakes or dropping fry from fixed-wing aircraft. Impacts on wildlife from helicopters are only discussed under alternatives B, C, and D because, under those alternatives, helicopters would only be used to apply treatments to remove fish; they are no longer used to stock fish in the North Cascades Complex. Stocking would occur infrequently, anywhere from annually to every 10 years, and would vary from lake to lake. As described in the "Alternatives" chapter, a fly-over occurs once per stocking cycle, and the plane flies over the lake very briefly, typically less than a minute. The preferred stocking method is for one or two people to backpack the fish to the lake. In some cases, backpack stocking requires overnight camping because of the extensive distances. Mitigation measures to prevent impacts from campers around lakes are outlined below and in appendix I.

Fish are a primary food source for bird species such as the belted kingfisher.

In the 62 lakes under alternative A that have been stocked with fish, impacts on wildlife would be negligible to minor. Stocking fish in the North Cascades Complex has altered lake community dynamics over time. Many wildlife species that historically did not inhabit the high mountain lakes have expanded their ranges to include new areas where fish have become abundant. Under alternative A, fish-eating wildlife would continue to use the lakes in the North Cascades Complex that are stocked. Fish are a primary food source for several species that are observed at or regularly inhabit mountain lakes in the North Cascades Complex. These species include river otters and several bird species such as mergansers, belted kingfishers, and ospreys. Ospreys have been seen feeding on fish at several lakes in the North Cascades Complex, although they do not nest at the lakes. For other species, like the garter snake, there may be adverse impacts from fish presence because fish would compete for the same prey (salamanders, insects).

Impacts from stocking activities associated with fixed-wing aircraft and backpackers would be expected to affect the species discussed previously, including species that do not live in or next to the lakes but inhabit nearby woods. Those species are deer, elk, mountain goats, bats, and a variety of raptors and passerine birds. The intensity of noise impacts would decrease with increased distance from the lakes because the intensity of sound decreases with distance (there is generally a 6 decibel reduction in sound level for each doubling of distance from a noise source due to spherical spreading loss), plus the trees provide some buffering capacity. Noise disturbance would occur as aircraft approach and fly over the lakes during stocking. Stocking by fixed-wing aircraft occurs during the summer and fall months when wildlife are active. Noise from aircraft would approach 70 to 80 decibels, compared to estimated typical background levels of 20 to 40 decibels in the North Cascades Complex (see table 33).

Noise at high levels can cause behavioral and physiological reactions in wildlife that vary by species and individuals (Knight and Gutzwiller 1995). Additional factors affecting wildlife response to noise include duration and previous exposure to noise, habitat type, season, activity occurring at time of disturbance, and the existing physical condition of the individual (Radle 2004). Physiological responses in wildlife include an increased heart rate and stress. Behavioral responses vary from mild reactions, such as changes in body position, to severe panic and escape reactions that interrupt normal activities or, in extreme cases, abandonment of normal territories or home ranges. For ungulates such as deer and elk, behavioral reactions seem to be related to a past experience with human and aircraft disturbance. In previous studies on ungulate responses to aircraft overflights in national parks, herd response to aircraft varied from no response to panic and escape (DOI 1988). Birds typically flush from a nest or perch in response to a disturbance but will usually return within a few minutes (NPC 2004).

TABLE 33: SOUND LEVEL COMPARISON CHART*

Decibels	How it Feels	Equivalent Sounds
140–160	Near permanent damage level from short exposure	Large caliber rifles such as .243, 30–06
130–140	Pain to ears	.22 caliber weapon
100	Very loud, conversation stops	Air compressor at 20 feet; garbage trucks and city buses; power lawnmower; diesel truck at 25 feet
90	Intolerable for phone use	Steady flow of freeway traffic; 10 horsepower outboard motor; garbage disposal; helicopter at 1,000 feet (70–90 decibels)
70–80		Fixed-wing aircraft or helicopter flyover; automatic dishwasher or vacuum cleaner (80 decibels)
60	Quiet	Window air conditioner in room; normal conversation
50	Sleep interference	Quiet home in evening
40		Library; frontcountry camping or developed site
30		Soft whisper
20		In a quiet house at midnight; leaves rustling; remote sites (Death Valley, interior wooded areas with backcounty camping)

Note:

* Modified from *Pictured Rocks National Lakeshore Personal Watercraft Use Final Environmental Impact Statement*, 2003; Tetra Tech 1987; U.S. Forest Service 2001.

Most noise disturbances would not be severe enough to cause detectable changes in population size or reproductive success (Knight and Gutzwiller 1995). Aircraft flyovers for stocking would occur from every 1 to 10 years, and the duration of each flyover would be short. Backpackers may trample vegetation while stocking fish at lakeshores; however, this impact is expected to be negligible, and habitat would return to pre-disturbance conditions. Wildlife in or near lakes may experience short-term and temporary disturbances from stocking activities, such as interruption of activity or temporary flushing or fleeing, but this would not change population structure or function. Many wildlife species such as bats, rodents, and forest-dwelling birds would incur only negligible or no impacts under alternative A because stocking would occur far enough away from these species that normal activities would not be disturbed.

In the 29 lakes that were historically stocked but are currently fishless, impacts on wildlife would be negligible. Under alternative A, the 29 lakes would remain fishless.

Impairment of wildlife species across the study area would not occur from current fish stocking under alternative A.

Impacts of Current Lake Treatment Methods on Wildlife

Under alternative A (no action), none of the 91 lakes addressed in this plan/EIS are currently being treated.

Cumulative Impacts

Recreational use of the lakes and surrounding drainages would contribute negligible to minor impacts on the wildlife in the North Cascades Complex. Some of this disturbance to wildlife from backpackers, campers, and non-anglers would be mitigated by natural topography of the landscape and forested areas that provide refuge. Other species that inhabit the more open lands would eventually become accustomed to human presence or move to other areas.

On a landscape scale, the piscivorous wildlife generally benefit from the presence of stocked fish in mountain lakes where resources were previously lacking. Continued presence of fish in North Cascades Complex lakes, coupled with continued presence of fish in lakes on surrounding lands, would tend to make piscivorous wildlife more widespread and increase their populations. Conversely, it is likely that species unable to adapt to stocked fish would, or have already become, locally reduced or eliminated over the past 100 years.

There would be continued, localized, and sporadic effects on wildlife from logging and dams and reservoir construction that has occurred and continues to occur outside the North Cascades Complex, including in connected watersheds. These actions can cause severe habitat loss for many forest-dwelling species such as birds, bats, and rodents. The loss of adjacent habitats places more pressure on the wilderness lands in the North Cascades Complex to provide habitat for wildlife, especially larger-bodied species with broad home ranges.

Other sources of impacts continue to occur that may affect the health and viability of species dependent on aquatic resources. There is concern about persistent organic pollutants and methyl-mercury found in some lakes in the North Cascades Complex, which appear to result from airborne pollutants being deposited on snow and washed into lakes. There is the potential for increased acid rain from emissions related to the development of an additional power plant in the area; emissions would contribute to an increase in lake acidity and metal availability. In some cases, the concentrations of some of these pollutants in the water in preliminary studies appear to be high enough to raise concerns that, in conjunction with other negative influences, organisms at higher trophic levels may be affected. Toxins can be passed from the tissue of one organism to those that feed on it, meaning that a toxin can move up the food chain and biomagnify to higher concentrations in the top predators (such as osprey or river otters) in a lake to the point where pollutants would cause reproductive failure. If that occurred, then the cumulative effects of pollutants coupled with other impacts, perhaps from nonnative fish, might eliminate that predator species from certain lakes or even cause a more general decline in the population.

Overall, the impacts associated with other projects and fishery management actions in the area, plus impacts from potential airborne pollution, added to the impacts predicted under alternative A, would be expected to result in long-term, minor, adverse cumulative impacts on wildlife populations and communities in the region.

Conclusion

The historic and current stocking of fish created suitable conditions for piscivorous wildlife, such as fish-eating ducks, while potentially restricting populations of other species, such as amphibians, that are prey for several wildlife species. Impacts from activities associated with periodic fixed-wing aircraft stocking (noise disturbance) and backpack stocking (human presence and habitat trampling) under alternative A would be short term negligible to minor and adverse on wildlife at or near the lakes. Animals that roost or dwell further away from lakes, such an ungulates, bats, rodents, and many forest-dwelling birds, would incur short-term negligible adverse impacts or no impacts from stocking activities. None of the 91 lakes are currently treated for fish removal under alternative A; therefore, wildlife in or near the lakes would not incur impacts from lake treatments.

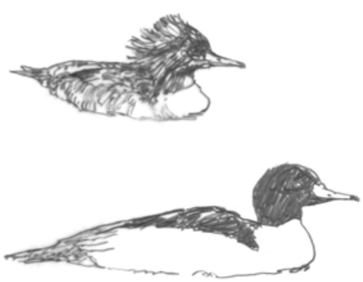
The impacts associated with other projects and fishery management actions in the area, plus impacts from potential airborne pollution, added to the impacts predicted under alternative A, would result in long-term minor adverse cumulative impacts on wildlife populations and communities in the region.

Impairment of wildlife species across the study area would not occur under alternative A.

ALTERNATIVE B: PROPOSED ADAPTIVE MANAGEMENT OF 91 LAKES UNDER A NEW FRAMEWORK (42 LAKES MAY HAVE FISH) (PREFERRED ALTERNATIVE)

The goal of this alternative is to eliminate or reduce reproducing fish from lakes in the study area. Restocking of nonreproducing fish would be allowed only where biological resources would be protected. Based on best available science, some lakes would be restocked with nonreproducing fish at low densities once reproducing fish have been removed. Lakes where critical information is missing would not be stocked until that information becomes available. An extensive monitoring program (see appendix F) would be implemented in order to adjust management in the future to avoid unacceptable effects on native biota from fish presence.

The "Alternatives" chapter provides a detailed description of alternative B. For more information on the 91 lakes, refer to tables 5 and 10 in the "Alternatives" chapter and appendix E.



Common mergansers have been observed on Coon Lake and are frequently seen along the Stehekin and Skagit rivers (female-top sketch, male-lower sketch).

Impacts of Proposed Fish Stocking on Wildlife

Under alternative B, impacts of fish stocking on wildlife, including impacts related to the noise and disturbance associated with periodic stocking activity, would be similar to alternative A. Up to 49 lakes would eventually be fishless, compared to 29 under alternative A, and all other lakes would have low densities of fish or be evaluated prior to restocking or fish removal. Removing high densities of fish and/or eliminating fish would result in minor impacts on piscivorous wildlife. Several lakes with high fish densities would be treated to remove all fish. Piscivorous species inhabiting these lakes, such as mergansers or otters, would be displaced to other lakes in search of food if a lake is returned to a fishless state. Species that only occasionally feed on fish if available, such as black bears, would incur negligible impacts under alternative B; however, the consumption of fish by wildlife in the North Cascades Complex is not a natural occurrence because fish are not native to the high mountain lakes. Fish stocking in the North Cascades Complex has created a reliance on lake resources for piscivorous wildlife that now inhabit the area and would be adversely impacted by fish removal.

Impacts on wildlife would be negligible in the 29 lakes that are currently fishless and would not be stocked under alternative B.

Impairment of wildlife species across the study area would not occur from fish stocking under alternative B.

Impacts of Proposed Lake Treatment Methods on Wildlife

The treatment methods proposed for each lake were selected based on the type of fish population present (reproducing vs. nonreproducing), and physical characteristics of the lake, such as depth and surface area. Each proposed method described below may or may not impact wildlife in the North Cascades Complex.

Natural Methods. Under alternative B, 12 previously stocked lakes would be treated using natural methods. This method is only effective in lakes without extensive natural fish reproduction. Natural removal methods involve no direct actions in each lake, very limited human presence, and no mechanized transport (such as helicopters); therefore, impacts of natural trout removal would be negligible on wildlife.

Mechanical Methods. Under alternative B, up to 8 lakes are being considered for mechanical treatment. For gillnetting, helicopters would transport equipment and lower it to the site, and a team would set nets by hand using float tubes. If traps are used, they would also be set by hand, generally near lake inlets and outlets. The method of gillnetting may unintentionally ensnare nontarget animals such as beavers, river otters, mergansers, ospreys, and salamanders, and traps would also capture small nontarget animals. Standard mitigation would require ground crews to check nets and traps frequently and release any ensnared animals. Although the impacts on individuals, family units, or localized populations of any associated loss would be serious, populations of these animals in the North Cascades Complex would only experience minor impacts.

Electrofishing would be used in lakes where a more thorough removal of all fish is required. Electrofishing would not adversely affect any terrestrial wildlife, and any waterfowl or larger aquatic mammals would avoid the areas being treated. If a backpack generator is needed, minor short-term impacts would result from motor noise, which may cause animals to temporarily flee or avoid the area being treated.

To conduct gillnetting, crews would be required to camp at a lake for several days. Temporary displacement of sensitive wildlife may occur during extended periods of continuous human presence; however, animals are expected to return to areas after a disturbance is removed.

Bioaccumulation: The accumulation of a harmful substance such as a heavy metal or an organochlorine in a biological organism, especially one that forms part of the food chain.

Helicopters used for lake treatment have the potential to stress wildlife, depending on the species and individual response. Helicopters hovering overhead are known to generate noise levels of about 70 to 90 decibels, compared to background levels of 20 to 40 decibels (refer to table 33). Mountain goats are particularly stressed by helicopters and exhibit severe fright and escape responses in the presence of a helicopter (NPS 1994). Other species, such as raptors, may temporarily flush from a nest or perch in the presence of a helicopter but would return after take-off. Helicopters hover over a lake for only a short period of time before landing, and the presence of trees may provide a sight and sound barrier for wildlife in nearby forests. Impacts on wildlife on or near the lakeshore, especially waterfowl and mammals such as otters that nest or den along the shoreline, would be minor, short term, and very infrequent. Impacts would be negligible for those animals occurring farther away from the lakes, such as bear, deer, elk, and many raptors and songbirds.

Chemical Method. Up to 18 lakes under alternative B would be chemically treated to remove fish using the piscicide, antimycin. The chemical method would be used in large lakes with reproducing fish populations where mechanical removal methods would not be practical. Antimycin is very specific in its action; when applied at recommended dosages, it affects fish but is unlikely to affect waterfowl or mammals (Schnick 1974). Also, antimycin is used in such slight quantities that residues are extremely small, and it has not been shown to bioaccumulate (Schnick 1974).

Impacts of fish removal using the chemical antimycin would be negligible to minor. The use of small motorized boats to apply antimycin would cause short-term noise disturbances to waterfowl on the lake or other species (such as beavers or otters) around the immediate lake shore; however, these disturbances would be short term and negligible for those species.

Cumulative Impacts

Cumulative impacts on wildlife under alternative B would be very similar to those described for alternative A, with some additional effects on piscivorous wildlife that would be displaced from lakes where fish are removed.

Overall, the impacts associated with other projects and fishery management actions in the area, plus potential impacts from possible airborne pollution, added to the residual adverse and long-term beneficial effects predicted under alternative B, would be expected to result in long-term minor adverse cumulative impacts on wildlife populations and communities in the region.

Noise disturbances during aircraft stocking would affect some wildlife species that inhabit nearby woods, such as this hanging bat.

Conclusion

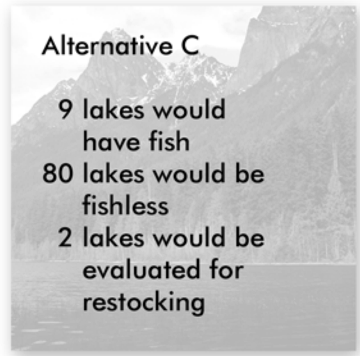
The historic and current stocking of fish created suitable conditions for piscivorous wildlife, such as fish-eating ducks, while potentially restricting populations of other species, such as amphibians, that are prey for several wildlife species. Removal of fish would result in the loss of a food source for fish-dependent species, requiring them to disperse to other areas in search of resources; because of this, piscivorous wildlife would incur long-term negligible to minor adverse impacts when lakes are returned to fishless conditions. Stocking activities would decrease, and wildlife at or near the lakes would incur short-term negligible to minor adverse impacts from periodic fixed-wing aircraft stocking (noise disturbance) and backpack stocking (human presence and habitat trampling) that would continue under alternative B but to a lesser degree than under alternative A. Stocking activities would have short-term negligible adverse impacts or no impacts on animals, such as ungulates, bats, rodents, and many forest-dwelling birds, that roost or dwell further away from the lakes. Mechanical and chemical treatment methods used to remove fish under alternative B would result in short-term negligible to minor adverse impacts on wildlife, with short-term disturbance to birds and mammals that inhabit the lake and lakeshore from the noise of human presence and helicopters used to transport equipment for mechanical treatment.

The impacts associated with other projects and fishery management actions in the area, plus impacts from potential airborne pollution, added to the residual adverse and long-term beneficial effects predicted under alternative B, would be expected to result in long-term minor adverse cumulative impacts on wildlife populations and communities in the region.

Impairment of wildlife species across the study area would not occur under alternative B.

Alternative C: Proposed Adaptive Management of 91 Lakes under a New Framework (11 Lakes May Have Fish)

The goal of this alternative is to eliminate all fish in lakes in the national park and reduce or eliminate reproducing fish in the Lake Chelan and Ross Lake National Recreation Areas, but still allow for some sport fishing in these two areas.



The "Alternatives" chapter provides a detailed description of alternative C. For more information on the 91 lakes, refer to tables 5 and 12 in the "Alternatives" chapter and appendix E.

Impacts of Proposed Fish Stocking on Wildlife

The types of impacts on wildlife from fish stocking would be similar to those described for alternative A; however, there would be 80 lakes that would be fishless compared to 29 lakes under alternative A, with reductions in fish densities in the national recreation area lakes. Lakes with high densities of fish would be treated or evaluated, then treated to remove the fish. Loss of fish resources in these lakes would result in minor to possibly moderate impacts on piscivorous wildlife. Piscivorous species, such as mergansers or otters, would move to other lakes in search of food if a lake is returned to a fishless state. Some wildlife, such as black bears, that feed on fish opportunistically would incur negligible impacts under alternative C because the availability of fish would be less. The consumption of fish by wildlife is not a natural occurrence because fish are not native to the high mountain lakes in the North Cascades Complex, and fish stocking has created a reliance on lake resources for piscivorous wildlife that now inhabit the area and would be adversely impacted by fish removal.

Under alternative C, 29 historically stocked, but currently fishless lakes, would remain fishless. Impacts on wildlife would be negligible in the 29 lakes that would remain fishless.

Impairment of wildlife species across the study area would not occur from fish stocking under alternative C.

Impacts of Proposed Lake Treatment Methods on Wildlife

Under alternative C, the types of impacts associated with the various lake treatment methods would be the same as described for alternative B; however, the number of lakes affected by those treatments would increase, with more wildlife incurring short-term minor impacts from chemical or mechanical treatments to remove fish.

Natural Methods. Under alternative C, 21 previously stocked lakes would be treated using natural methods (lakes would not be restocked, and fish would die out from fishing pressure and natural mortality). Because natural removal methods involve no direct actions in each lake, very limited human presence, and no mechanized transport (such as helicopters), impacts of natural trout removal would be negligible on wildlife.

Mechanical Methods. Under alternative C, up to 10 lakes are being considered for mechanical treatment, an increase of 2 lakes over the number proposed for mechanical treatment under alternative B. Impacts relating to the presence of ground crews and activities such as electrofishing, helicopter use, and netting, would be the same as described for alternative B but would occur at slightly more lakes. Although the impacts on individuals, family units, or localized populations of any associated loss would be serious, populations of these animals in the North Cascades Complex would only experience minor impacts. Minor short-term impacts on some species, such as waterfowl and amphibians, would result from the presence of ground crews and helicopter use.

Chemical Method. There would be 25 lakes treated with the piscicide, antimycin, under alternative C, an increase of 7 lakes over the number that would be chemically treated under alternative B. Impacts on nontarget wildlife would be negligible to minor, as described under alternative B. Noise-related impacts from helicopter and small-boat use during chemical treatment would be short term and minor, but would occur at more lakes over time.

Cumulative Impacts

Cumulative impacts under alternative C would be similar to those described under alternative A, but with additional impacts on piscivorous wildlife that have become dependent on fish in the stocked lakes.

Overall, the impacts associated with other projects and fishery management actions in the area, plus potential impacts from increased airborne pollution, added to the impacts predicted under alternative C, would be expected to result in long-term minor adverse cumulative impacts on wildlife populations and communities in the region.

Conclusion

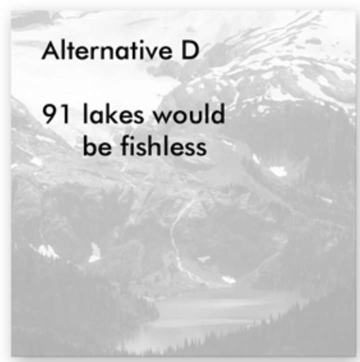
The historic and current stocking of fish created suitable conditions for piscivorous wildlife, such as fish-eating ducks, while potentially restricting populations of other species, such as amphibians, that are prey for several wildlife species. Removal of fish would result in the loss of a food source for fish-dependent species, requiring them to disperse to other areas in search of resources; because of this, piscivorous wildlife would incur long-term negligible to minor adverse impacts when lakes are returned to fishless conditions. Stocking activities would substantially decrease, and wildlife at or near the lakes would incur short-term negligible to minor adverse impacts from periodic fixed-wing aircraft stocking (noise disturbance) and backpack stocking (human presence and habitat trampling) that would continue under alternative C but to a much lesser degree than under alternatives A and B. Stocking activities would have short-term negligible adverse impacts or no impacts on animals, such as ungulates, bats, rodents, and many forest-dwelling birds, that roost or dwell further away from the lakes. Mechanical and chemical treatment methods used to remove fish under alternative C would result in short-term negligible to minor adverse impacts on wildlife, with short-term disturbance to birds and mammals that inhabit the lake and lakeshore from the noise of human presence and helicopters used to transport equipment for mechanical treatment.

The impacts associated with other projects and fishery management actions in the area, plus impacts from potential airborne pollution, added to the residual adverse and long-term beneficial effects predicted under alternative C, would be expected to result in long-term minor adverse cumulative impacts on wildlife populations and communities in the region.

Impairment of wildlife species across the study area would not occur under alternative C.

Alternative D: 91 Lakes Would Be Fishless

Sport-fishing opportunities in most of the study area lakes would generally be eliminated within a period of 5 years. Self-sustaining (reproducing) populations of fish would be gradually removed over time—the rate of removal would depend on resource (funding and personnel) availability and differences among fish removal methods. Complete removal of self-sustaining populations of fish in some of the larger, deeper lakes might not be feasible (9 lakes potentially fall into this category—refer to table 7 in the “Alternatives” chapter). These lakes would continue to provide sport-fishing opportunities for the foreseeable future, and the goal of complete removal might never be achieved. The phase out of nonnative fish would allow for the protection of biological resources in and around the lakes.



The “Alternatives” chapter provides a detailed description of alternative D. For more information on the 91 lakes, refer to tables 5 and 13 in the “Alternatives” chapter and appendix E.

Impacts of Proposed Fish Stocking on Wildlife

Under alternative D, the 29 lakes that are currently fishless would remain fishless, and fish stocking would be gradually phased out. Nine lakes would be evaluated for the feasibility of fish removal; if complete removal of fish were not possible, then density would be reduced. The remaining 62 lakes would be treated to remove fish over time. Loss of fish resources in the lakes that would become fishless would result in minor to possibly moderate impacts on piscivorous wildlife. Piscivorous species, such as loons, mergansers, or otters, would have to find alternative areas of suitable habitat outside the North

Cascades Complex or would die out; however, piscivorous wildlife inhabiting high mountain lakes are not naturally occurring in the North Cascades Complex, and removal of fish would eventually return the habitat to its condition prior to human manipulation. Some wildlife, such as black bears, that feed on fish opportunistically would incur negligible impacts under alternative D because the availability of fish would be less.

Impairment of wildlife species across the study area would not occur from fish stocking under alternative D because stocking would no longer occur.

Impacts of Proposed Lake Treatment Methods on Wildlife

Under alternative D, the types of impacts associated with the various lake treatment methods would be the same as described for alternative B; however, the number of lakes affected by those treatments would increase, with more wildlife incurring short-term minor impacts from chemical and mechanical treatments.

Natural Methods. Under alternative D, 26 lakes currently stocked under alternative A would not be restocked, and fish would die out from fishing pressure and natural mortality. Because natural removal methods involve no direct actions within each lake, very limited human presence, and no mechanized transport (using helicopters) of equipment, impacts of natural trout removal would be negligible on wildlife.

Mechanical Methods. Under alternative D, a total of 11 lakes are being considered for mechanical treatment, an increase of 1 lake over alternative C, and 3 lakes more than alternative B. Impacts relating to the presence of ground crews, electrofishing, helicopters use, and netting would be the about the same as described for alternatives B and C. Although the impacts on species' individuals, family units, or localized populations of any associated loss would be serious, populations of these animals in the North Cascades Complex would only experience minor impacts. Minor short-term impacts on some species, such as waterfowl and amphibians, would result from the presence of ground crews and helicopter use.

Chemical Method. There would be 25 lakes chemically treated to remove fish using the piscicide, antimycin, the same as alternative C, but an increase of 7 lakes over the number of lakes that would be chemically treated under alternative B. Impacts on nontarget wildlife would be negligible, as described under alternative B. Noise-related impacts from the helicopter and small boat used during lake treatment would be short term and minor but would occur at 25 lakes over time.

Cumulative Impacts

Cumulative impacts under alternative D would be similar to those described under alternative A, but with additional impacts on piscivorous wildlife that have become dependent on fish in the stocked lakes.

Overall, the impacts associated with other projects and fishery management actions in the area, plus possible impacts from potential airborne pollution, added to the impacts predicted under alternative D, would be expected to result in minor adverse cumulative impacts on wildlife populations and communities in the region.

Conclusion

Alternative D would have long-term minor to moderate adverse impacts on fish-eating wildlife in lakes that would become fishless. Removal of fish would result in the loss of habitat for fish-eating species, requiring them to relocate to other areas (potentially outside the North Cascades Complex) in search of resources, which would result in local population decreases for those species, returning the area to pre-stocked conditions. Under alternative D, stocking activities would be eliminated, a slight benefit to wildlife that have been disturbed by the noise and human disturbance associated with stocking activities. Mechanical and chemical treatment methods used to remove fish under alternative D would result in short-term negligible to minor adverse impacts on wildlife, with short-term disturbance to birds and mammals that inhabit the lake and lakeshore from the noise of human presence and helicopters used to transport equipment for mechanical treatment.

The impacts associated with other projects and fishery management actions in the area, plus impacts from potential airborne pollution, added to the residual adverse and long-term beneficial effects predicted under alternative D, would be expected to result in long-term minor adverse cumulative impacts on wildlife populations and communities in the region.

Impairment of wildlife species across the study area would not occur under alternative D.

SPECIAL STATUS SPECIES

GUIDING REGULATIONS AND POLICIES

Special status species of plants and wildlife are included in this section. The *Endangered Species Act* (16 USC 1531 et seq.) mandates that all federal agencies consider the potential effects of their actions on threatened and endangered species and species of special concern. If the NPS determines that an action may adversely affect a federally listed species, consultation with the U.S. Fish and Wildlife Service is required to ensure that the action would not jeopardize the species' continued existence or result in the destruction or adverse modification of critical habitat.

Informal consultation was initiated with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (now NOAA Fisheries) during the internal scoping period for this project. A list of species that are known to occur or may occur in the North Cascades Complex was requested. The U.S. Fish and Wildlife Service sent a list of federally listed species, by county occurrence; this list is included in appendix C. For the purpose of this analysis, only those species known to occur in the North Cascades Complex, and that would experience some level of impacts as a result of fishery management actions, are addressed in this section.

This plan/EIS has been submitted to the U.S. Fish and Wildlife Service and NOAA Fisheries for review. If these two entities and other federal agencies agree that no adverse impacts on listed species are likely to occur, no further consultation would be required. If further consultation is needed, this plan/EIS is intended to meet the requirements of a biological assessment.

If actions associated with any fishery management alternative are likely to adversely affect one or more of the federally listed threatened or endangered species identified at the North Cascades Complex, formal consultation would be initiated with the U.S. Fish and Wildlife Service, and a biological assessment would be prepared to document the potential effects to listed species. From the date that formal consultation is initiated, the U.S. Fish and Wildlife Service or NOAA Fisheries has 90 days to consult with the NPS and 45 days to prepare a biological opinion based on the biological assessment and other scientific sources. In the biological opinion, the biological assessment would state whether the proposed fishery management actions would likely jeopardize the continued existence of the listed species or result in the destruction or adverse modification of critical habitat. Such an opinion would most likely be the same as a determination of impairment. To ensure that a species would not be jeopardized by mountain lakes fishery management activities, the NPS would confer with the U.S. Fish and Wildlife Service or NOAA Fisheries to identify recommendations for reducing adverse impacts and would integrate those into the preferred alternative for fishery management in the North Cascades Complex.

NPS Management Policies (NPS 2001a) state that the potential effects of agency actions will also be considered on state or locally listed species. The NPS is required to control access to critical habitat of such species and to perpetuate the natural distribution and abundance of these species and the ecosystems upon which they depend.

METHODOLOGY AND ASSUMPTIONS FOR SPECIAL STATUS WILDLIFE SPECIES

This section describes the methodology used to evaluate the impacts of the proposed alternatives on state and federally listed wildlife and plant species. State and federally listed species were identified through discussions with staff from the North Cascades Complex and informal consultation with the U.S. Fish and Wildlife Service, NOAA Fisheries, and the WDFW (see appendix C). The primary steps in assessing impacts on listed species were to determine

- which species inhabit areas likely to be affected by fishery management actions described in the alternatives
- current and future distribution of fishery management actions
- potential areas of impact as a result of implementation of any of the alternatives, including downstream areas

The information contained in this analysis was obtained through best professional judgment of NPS staff from the North Cascades Complex and experts in fishery management, the U.S. Fish and Wildlife Service, WDFW, and available literature.

Geographic Area Evaluated for Impacts

The geographic area evaluated for impacts on special status species includes the 91 lakes in the North Cascades Complex (the study area) that have a history of fish presences as a result of documented or undocumented fish stocking. The North Cascades Complex is comprised of the north and south units of North Cascades National Park, Ross Lake National Recreation Area, and Lake Chelan National Recreation Area. For fish populations potentially affected by downstream colonization, impacts in downstream drainage basins that extend beyond the boundaries of North Cascades Complex are also considered. These basins include the Chilliwack River (Fraser River Basin), Lake Chelan Basin (including the Stehekin River and its tributaries), and the Skagit River and several of its tributaries.

Outcomes of the Management Actions

Several of the management actions that would be applied to lakes under each of the action alternatives have potential multiple outcomes, depending on the results of future monitoring and adaptive management decisions. Therefore, for the purpose of this plan/EIS, the focus is on the initial outcome of the management actions and the assumption that the lakes either would have fish or would not, based on the initial results of the actions taken. It is recognized, however, that these conditions may change in some of the lakes due to decisions made under the proposed monitoring program and adaptive management approach described in the section titled “Adaptive Management” in the “Alternatives” chapter. If future monitoring indicates that fish presence has caused unacceptable changes to native biota, and as a result fish are removed or reduced, impacts may also be reduced from the levels presented in this “Special Status Species” section.

IMPACT CRITERIA AND METHODOLOGY

Impacts on special status species include any activity that would be considered a “take” or cause harm to a species as defined under the *Endangered Species Act*, including harassment. A determination of the potential effects to listed species is treated very conservatively in order to provide maximum protection. Stocking fish in waters that were previously fishless can provide a certain species, such as a piscivorous species, with the opportunity to expand its range into areas previously unsuitable due to lack of food resources. While fish stocking has acknowledged benefits, it can also have negative effects through the introduction of nonnative species, which can alter dynamics of a community, with the resulting loss of ecological integrity.

Potential impacts on special status species or their habitat were evaluated based on species presence, a species’ association with stocked fish, and the effects of stocking or lake treatment methods associated with fish removal. Also, where local surveys of fish distribution and abundance were available, existing data and professional knowledge were used to further assess the potential for impacts.

The methods to evaluate impacts on special status species used alternative A as the baseline condition against which the action alternatives were compared because it represents current management. The analysis focused on the effects to special status species from stocked fish in mountain lakes, as well as impacts from other management activities. Literature on wildlife responses to noise provided available research to assess potential impacts on listed species known to occur in the North Cascades Complex.

IMPACT THRESHOLD DEFINITIONS FOR FEDERALLY LISTED SPECIAL STATUS WILDLIFE SPECIES

The following thresholds were used to determine the magnitude of effects on federally listed special status species and their associated habitat that would result from implementation of any of the alternatives, including fish stocking and lake treatment methods to remove fish. Since impacts on native fish were already analyzed in detail in the “Aquatic Organisms” section in this chapter, the assessment of whether an effect on listed native fish would be likely was based on an examination of the same predictive factors and professional knowledge used in the analysis of aquatic organisms. The background information used for the analysis of impacts on native fish can be found in appendix G.

No effect. When a proposed action would not affect a listed species or designated critical habitat.

May affect / not likely to adversely affect. Effects on special status species are discountable (i.e., extremely unlikely to occur and not able to be meaningfully measured, detected, or evaluated) or are completely beneficial.

May affect / likely to adversely affect. When an adverse impact to a listed species may occur as a direct or indirect result of proposed actions and the effect is not discountable or beneficial.

Is likely to jeopardize proposed species / adversely modify proposed critical habitat (impairment). The appropriate conclusion when the NPS or the U.S. Fish and Wildlife Service identifies situations in which the proposal would jeopardize the continued existence of a proposed species or adversely modify critical habitat to a species within or outside the North Cascades Complex boundaries.

State Listed and Special Status Wildlife Species

The assessment of impacts on wildlife species listed by the state of Washington (but not at the federal level) used the same thresholds developed for the assessment of impacts on wildlife, in general; these are repeated below.

Negligible. An action would result in no observable or measurable impacts on native wildlife species, their habitats, or the natural processes sustaining them and would be of short duration, localized, and well within natural population fluctuations.

Minor. An action would result in detectable impacts, but they would not be expected to result in substantial population fluctuations and would not be expected to have any measurable long-term effects on native species, their habitats, or the natural processes sustaining them. Occasional responses to disturbance by some individuals would be expected, but without interference to feeding, reproduction, or other factors affecting population levels.

Moderate. An action would result in detectable impacts on native wildlife, their habitats, or the natural processes sustaining them. Key ecosystem processes may experience disruptions that would be outside the natural range of fluctuation (but would return to natural conditions). Sufficient habitat would remain functional to maintain viability of native wildlife populations.

Major. An action would result in detectable impacts on native wildlife, their habitats, or the natural processes sustaining them. Key ecosystem processes might be disrupted permanently. Adverse responses to disturbance by some individuals would be expected, with negative impacts on feeding, reproduction, or other factors resulting in a long-term decrease in population numbers and genetic variability.

Impairment. The action would contribute substantially to the deterioration of special status wildlife species in the North Cascades Complex to the extent that they would no longer function as a natural system. In addition, some of these adverse major impacts on the North Cascades Complex's resources and values would

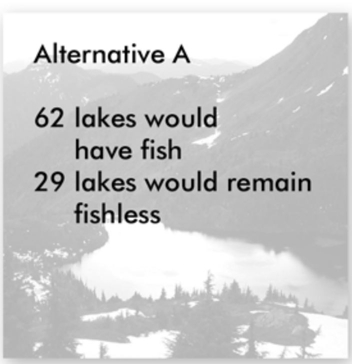
> contribute to deterioration of special status wildlife resources and values to the extent that the purpose of the North Cascades Complex would not be fulfilled as established in its enabling legislation
>
> affect resources key to the natural or cultural integrity or opportunities for enjoyment in the North Cascades Complex
>
> affect the resource whose conservation is identified as a goal in the *General Management Plan* (NPS 1988b) or other planning documents for the North Cascades Complex

IMPACTS OF THE ALTERNATIVES ON SPECIAL STATUS WILDLIFE SPECIES

This section analyzes impacts on federally listed and state-listed species for each of the four alternatives. Cumulative impacts are discussed, and an overall summary of impacts is presented at the end of each alternative analysis.

Some special status species that inhabit the North Cascades Complex are considered in this plan/EIS that are not directly linked to fish or aquatic habitats, such as the Canada lynx and grizzly bear. These species are included because, under any of the alternatives, management activities would adversely affect wildlife through an increased human presence and noise from fixed-wing aircraft and helicopters associated with lake management activities.

Alternative A (No Action): Existing Management Framework of 91 Lakes (62 Lakes Have Fish)



Alternative A (no action) would continue existing practices in the 91 lakes slated for management consideration in the study area. Of these 91, 62 lakes contain fish today. These 62 lakes are a subset of the study area's 91 lakes that were naturally fishless but have a history of fish stocking or fish presence. The remaining 29 lakes are currently fishless and are not actively managed for fish. These management activities would continue under the no-action alternative.

The "Alternatives" chapter provides a detailed description of alternative A. For more information on the 91 lakes, refer to table 5 and figure 4 in the "Alternatives" chapter and appendix E.

Impacts of Current Fish Stocking on Special Status Wildlife Species

For impact assessment purposes, the 11 species listed below are grouped together because the only impacts to these species would be from incidental short-term noise effects from stocking activities (airplane noise or human and vehicle access while approaching a lake). In addition, the 11 species either do not depend solely on lake resources or only eat fish opportunistically.

American Peregrine Falcon — federal species of concern, state endangered

California Wolverine — federal species of concern, state candidate

Canada Lynx — federal threatened, state threatened

Gray Wolf — federal endangered, state endangered

Grizzly Bear — federal threatened, state endangered

Pacific Fisher — federal species of concern, state endangered

Marbled Murrelet — federal threatened, state threatened

Little Willow Flycatcher — federal species of concern

Northern Goshawk — federal species of concern, state candidate

Northern Spotted Owl — federal threatened, state endangered

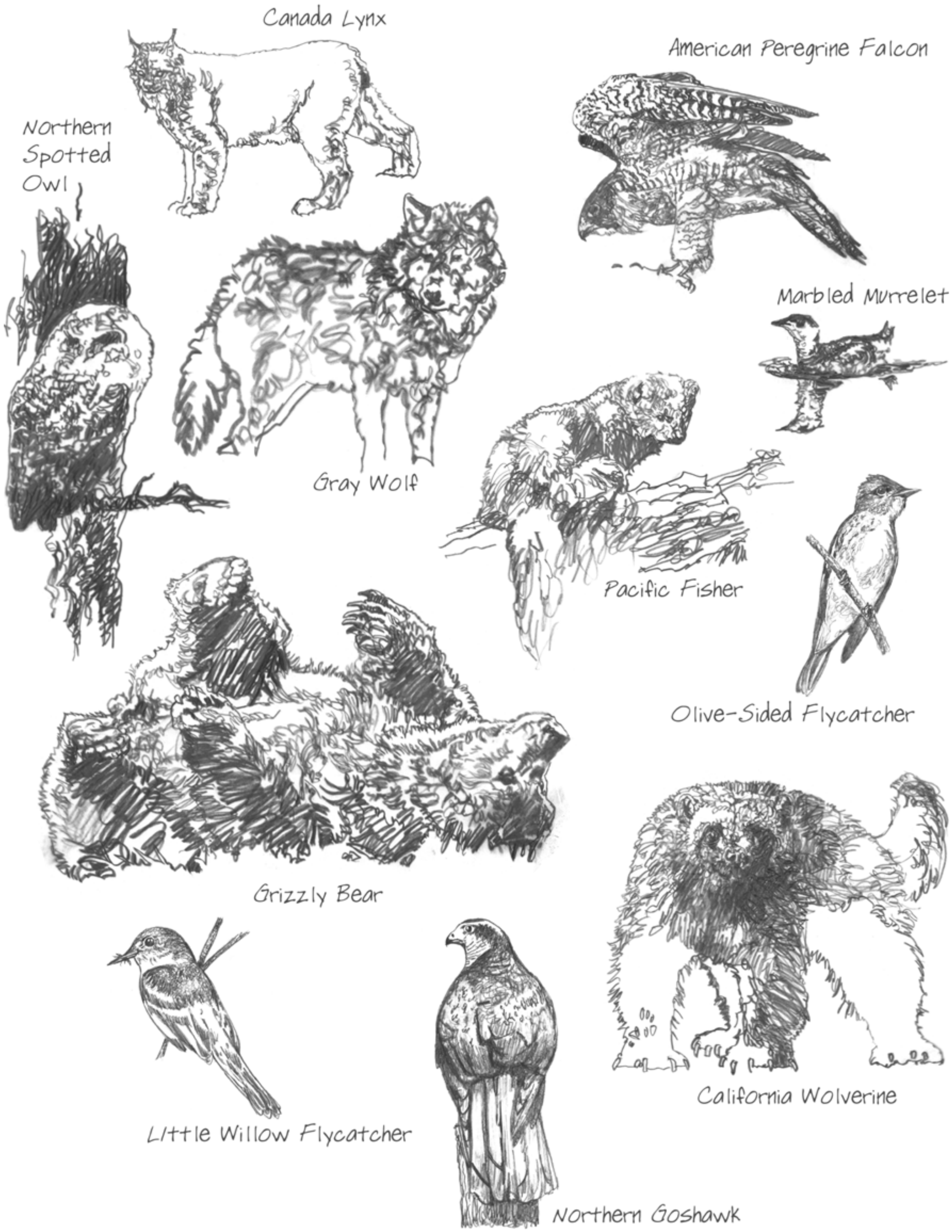
Olive-sided Flycatcher — federal species of concern

As discussed in the "Wildlife" section in this chapter, noise disturbance can result in behavioral and physiological reactions in wildlife that vary by species and individual (Radle 1998). Special status wildlife may experience short-term and temporary disturbances from stocking activities, such as interruption of activity or temporary flushing or fleeing, but this would not change population structure or function.

Although these 11 species may be present in nearby forests, most are expected in very limited numbers in the North Cascades Complex and are not known to nest or den in the areas immediately surrounding any of the high mountain lakes in the study area. While an occasional passing aircraft or vehicle may cause temporary disturbance and/or a flight response similar to that experienced by other species, no other impacts stemming from fish stocking would affect them. Therefore, actions under alternative A may affect, but are not likely to adversely affect any of the above 11 species.

The following 13 listed species are known to be present in the aquatic habitats of the 91 lakes or the adjacent habitats. The impacts on each species from alternative A are discussed below.

Yuma Myotis (Federal Species of Concern). Yuma myotis are insect-eating bats that forage over high mountain lakes in the North Cascades Complex. Noise from stocking activities or human presence are not expected to affect the species, though bats may experience a minimal amount of stress when roosting during the day if stocking activities occur near them. Stocked fish compete for the same insect food base as Yuma myotis. This competition in stocked lakes is not likely to noticeably affect insect availability for Yuma myotis; therefore, it may be affected, but is unlikely to be adversely affected from actions under alternative A.


Canada Lynx
American Peregrine Falcon
Northern Spotted Owl
Marbled Murrelet
Gray Wolf
Pacific Fisher
Olive-Sided Flycatcher
Grizzly Bear
California Wolverine
Little Willow Flycatcher
Northern Goshawk

Long-eared Bat (Federal Species of Concern). Long-eared bats glean insects from foliage, but also forage over water. Noise from stocking activities or human presence is not expected to affect long-eared bats. Similar to Yuma myotis, stocking activities may cause some level of stress to individuals roosting near a lake during stocking activities. Long-eared bats may be affected, but are unlikely to be adversely affected from fish stocking under alternative A.

Bald Eagle (Federal Threatened, State Threatened). Bald eagles are a common winter resident along the Skagit River and can be seen in other low-elevation riparian areas of the North Cascades Complex. There is a nest near the head of Lake Chelan that has been active since 2001. A pair of bald eagles has nested at the head of Baker Lake (within 1 to 1.5 miles of the North Cascades Complex boundary) for many years. Alternative A may affect, but is not likely to adversely affect bald eagles because they only rarely, if ever, use the stocked mountain lakes in the North Cascades Complex to forage or roost.

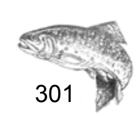
Harlequin Duck (Federal Species of Concern). Harlequin ducks are summer migrants that nest on the shores of larger low-gradient streams in the North Cascades Complex and are widely distributed in large tributaries of the Skagit and Stehekin rivers. They are not associated with mountain lakes, and it is unlikely that enough fry escape down the outlets of mountain lakes to contribute to their forage base. In addition, harlequin ducks primarily feed on aquatic invertebrates and only eat trout fry opportunistically. Impacts from alternative A would include a reduction in this duck's aquatic food base as a result of stocking fish that may prey on invertebrate species that occur in the same drainages. Noise impacts would occur from stocking activities but would be short term, minor, and infrequent. Implementation of alternative A, may affect, but is unlikely to adversely affect harlequin ducks.

The Harlequin duck is a federal species of concern that feeds primarily on aquatic invertebrates.

Cascades Frog (Federal Species of Concern). The North Cascades Complex is considered the northern boundary of the Cascades frogs' range (Bury and Adams 2000). Predation by nonnative trout and habitat loss throughout the frog's southern range is likely the reason for its federal status as a Species of Concern; however, the frog is not listed by the state of Washington (WDFW, D. Stinson, pers. comm., 2004).

The Cascades frog primarily inhabits small pools and streams in subalpine meadows but also occurs in bogs, marshy areas, ponds, and small lakes. The Cascades frog has been documented in three locations in the North Cascades Complex: two ponds and a stream in Bridge Creek drainages (Bury et al. 2000). The distribution of these frogs in the North Cascades Complex is likely patchy, and they are often not found in areas that appear to have suitable habitat. (Leonard et al. 1993). The status of the frog and reasons for its patchy distribution are unknown.

The species is not known to occupy larger, deeper lakes that contain fish, and it is unknown if this absence from large lakes is due to past fish predation or if the species naturally prefers shallower waters (Bury and Adams 2000). Because the species is not generally associated with lakes stocked with fish, implementation of alternative A may affect, but is not likely to adversely affect, Cascades frogs.



Columbia Spotted Frog (Federal Species of Concern, State Candidate Species). The Columbia spotted frog is a highly aquatic species that lives in mountainous areas in or near cold, slow-moving streams, springs, marshes, ponds, and small lakes without extensive emergent vegetation (Leonard 1993). In the North Cascades Complex, the Columbia spotted frog has been documented in wet meadows, seasonal streams, seeps, and various lakes and ponds at elevations ranging from 2,500 to 5,900 feet (Bury et al. 2000; Liss et al. 1995). The frog has been documented in these four lakes in the Stehekin River watershed: Dagger, McAlester, Kettling, and Coon. Two of these lakes, Dagger and McAlester, have reproducing populations of stocked trout. These lakes also have extensive meandering inlet and outlet streams that may protect the frogs from predation (OSU, B. Hoffman, pers. comm., 2003). Tadpoles metamorphose into adults during their first summer and can use temporary or shallow ponds as breeding sites that are inaccessible to predatory fish (Bull and Marx 2002; Pilliod and Peterson 2001; Llewellyn and Peterson 1998). Within the main body of lakes inhabited by the Columbia spotted frog, stocked trout limit the frog’s use of the open water areas. This may reduce the number of frogs in the lake, but does not extirpate Columbia spotted frogs from the surrounding wetlands and nearby temporary ponds, which are extensive enough to support viable breeding populations of the species.

Under alternative A, Columbia spotted frogs may be affected but are not likely to be adversely affected in the lakes in which they have been documented. The number of frog larvae in the main portion of these lakes would likely be noticeably reduced in relation to a similar fishless lake, but populations of Columbia spotted frogs in the lakes that contain stocked trout would remain indefinitely viable in the North Cascades Complex.

Northern Red-Legged Frog (Federal Species of Concern). Northern red-legged frogs have been documented in wetlands and ponds along the Skagit River near Newhalem. There is no documented presence of the species in the 62 lakes containing stocked fish; however, not all lakes in the North Cascades Complex have been surveyed. Lower-elevation lakes in the Ross Lake National Recreation Area (Thunder, Hozomeen, Willow, and Ridley) have suitable habitat for northern red-legged frogs, and they have been observed in the general vicinity of Hozomeen village (URS, R. Nielsen, pers. comm., 2004). For this analysis, it is assumed that some of the 62 lakes would contain northern red-legged frogs.

Adult northern red-legged frogs are highly terrestrial, but they are typically found near ponds or streams. Although adults breed in both temporary and permanent water sources, the breeding season is short, occurring only for one to two weeks. Breeding sites must have little or no flow, must last long enough for metamorphoses to occur before the end of summer, and must contain sturdy underwater stems of some sort for egg attachment (Nussbaum et al. 1983). Northern red-legged frogs co-evolved with trout in the coastal lowlands, and these behavioral mechanisms allow them to survive. Like spotted frogs, northern red-legged frog tadpoles are able to avoid fish predation because they metamorphose into adults in shallow waters (Nussbaum et al. 1983). Under alternative A, a number of lower-elevation lakes that would continue to have fish and be stocked would contain northern red-legged frog tadpoles or breeding adults. Nonnative trout may prey on tadpoles, but this is not likely to affect the population of northern red-legged frogs in the North Cascades Complex. Therefore, northern red-legged frogs may be affected, but are not likely to be adversely affected under alternative A. The extent of impacts, nevertheless, would need to be verified through additional monitoring.

Tailed Frog (Federal Species of Concern). Tadpole and adult tailed frogs have been documented in the outlets of six lakes in the North Cascades Complex (including Upper Bouck and Nert lakes) that are currently stocked (Liss et al. 1995; Bury et al. 2000). Past research has shown that tailed frogs have evolved in stream environments with fish predation but are not generally found directly inhabiting lakes; instead, they are found in stream outlets. Stocked trout are likely to have minimal effects on tailed frogs in lakes (NPS, R. Glesne, pers. comm., 2003). The lakes do not provide primary habitat for tailed frogs, which are widely distributed throughout the North Cascades Complex in moderate to high-gradient streams; therefore, tailed frogs would incur no effect under alternative A or any other alternative.

Nert Lake (shown above), along with Upper Bouck, are two of six lakes with documented populations of tailed frogs.

Western Toad (Federal Species of Concern, State Candidate Species). Intensive surveys of the Big Beaver Valley in the early 1970s indicated that Western toads were common in a variety of habitat types, except in rockslides (Taber 1974). More recent amphibian surveys in North Cascades Complex found a fragmented distribution of adult Western toads in or near four lakes considered in this analysis: Battalion, Lower Thornton, Trapper, and Willow (Liss et al. 1995). Tadpoles were observed at Trapper Lake. Western toad tadpoles and adults are probably not preyed upon by trout because they secrete a toxin (Corn 1998) that is unpalatable to trout (Llewellyn and Peterson 1998; Bury and Adams 2000; Tyler et al. 2003). For these reasons, Western toads would not be affected under alternative A.

The federally listed fish species in the North Cascades Complex inhabit rivers downstream from the high mountain lakes addressed in this plan/EIS. The level of effect on these downstream fish communities would be expected to vary depending on several factors: whether there is a connection from the lake to a downstream basin (an outlet); the species of trout stocked; the extent of reproduction in a lake; and the species of native fish in the downstream watershed. Impacts were assessed using the same predictive factors identified for impacts to nonlisted native fish as a guidance and considering the evidence of colonization and/or hybridization reported for these species (WDFW, M. Downen, pers. comm., 2004). A more detailed evaluation for each of the listed fish species is provided below.

Bull Trout (Federal Threatened, State Candidate). Bull trout are found in the Chilliwack, Skagit, and Ross drainage basins on the west side of the Cascade Crest, and juveniles are found in the higher stream reaches. Bull trout were once found on the east side of the crest; however, they have been extirpated from those drainages, and the NPS and other agencies are interested in restoration. Bull trout on the west side of the Cascade Crest are at risk from hybridization and/or competition from introduced fish in upstream lakes that are connected to the west-side drainages. In addition, fish that might enter downstream drainages may also enter the forage base for bull trout.

The lower Skagit River harbors one of the most robust populations of bull trout in the western United States. WDFW estimates (based on available habitat, spawning surveys, and fishery interceptions rates) range from 10,000 to 15,000 migratory adults. Strong populations (greater than 100 spawning individuals annually) in the Skagit core area occur in every major sub-basin of the Skagit including the Baker, Sauk, Whitechuck, Suiattle, Cascade, and mainstem. Consequently, the Skagit is one of only two river systems where a recreational fishery is still managed, allowing the retention of two fish per day over 20 inches (WDFW, M. Downen, pers. comm., 2004).

The major tributaries in the North Cascades Complex that are used by bull trout for spawning below the Seattle City Light projects include Bacon Creek, Goodell Creek, Marble Creek, and the South Fork of the Cascade. The populations in Bacon and Goodell creeks are part of WDFW's long-term monitoring program, and both Marble and the South Fork of the Cascade are sampled periodically. Bacon, Goodell, and Marble creeks all support populations of over 100 spawning adults, and the South Fork of the Cascade supports more than 500 spawning adults. Other lesser tributaries such as Thornton, Damnation, Day, Lookout, and Sibley are not spawning tributaries but are frequented by sub-adult and adult fish in search of foraging opportunities (WDFW, M. Downen, pers. comm., 2004).

Bull trout probably colonized the upper Skagit Basin above the Seattle City Light projects shortly after the last glacial recession and are now considered a separate population from the lower Skagit. In the Ross basin, which is part of the larger upper Skagit core population, bull trout show a life history analogous to the anadromous life history shown in the lower Skagit. Major spawning tributaries within the North Cascades Complex boundary include Ruby, Big Beaver, Lightning, Silver, and Little Beaver creeks (WDFW, M. Downen, pers. comm., 2004).

Both brook trout and nonnative westslope cutthroat trout present potential threats to bull trout in west-side drainages connected to lakes containing these species. The primary concern is the potential for hybridization with introduced brook trout, which would affect the reproductive success of the bull trout population. Brook trout occur in three west-side lakes within the Baker and Ross drainage basins: Hozomeen, Blum (Lower West No. 4), and Sourdough. The potential for hybridization between the bull trout and brook trout is of particular concern in Hozomeen Creek in the Ross watershed, but hybridization has not yet been documented (WDFW, M. Downen, pers. comm., 2004). The lack of hybridization may be related to differences in spawning habitat because brook trout tend to spawn in warmer water, while bull trout spawn in very cold water.

Potential impacts on bull trout would also result from competition for resources and predation on juvenile bull trout inhabiting upper stream reaches if either westslope cutthroat or brook trout are stocked in west-side lakes. The nonnative, more mature resident fish would disperse to downstream drainages and prey upon juvenile char.

There are currently 21 west-side lakes (see table G-5 in appendix G) containing brook or westslope cutthroat trout that have outlets to drainages with bull trout populations, but not all drain to spawning tributaries (WDFW, M. Downen, pers. comm., 2004). In addition, studies in Montana and other regions where westslope cutthroat co-occur suggest the two species co-exist, although some competition has been observed. Overall, the extent of the impacts from competition and predation is likely minor, although more data would be required to more accurately assess this impact.

In summary, the potential impacts on bull trout from westslope cutthroat trout are likely minor and related mainly to competition for resources. The impacts on bull trout from introduced brook trout would be more serious if colonization and hybridization would occur, but information from WDFW about the four lakes containing brook trout indicate this has not occurred in the downstream drainages; therefore, alternative A may affect, but is not likely to adversely affect, bull trout.

Chinook Salmon (Federal Threatened). Chinook (king) salmon occur in the lower reaches of the Skagit River and its major tributaries and in the mainstem of the Baker River. Hybridization with nonnative fish is not known to occur, and attempted hybridization between Chinook and nonnative species has not been successful. There is a slight possibility that if mature stocked fish migrate from lakes to downstream drainages containing Chinook salmon, they may affect Chinook salmon through competition. This effect, though, is questionable given their vastly different life histories. Also, predation is unlikely because westslope cutthroat trout generally do not consume young fish but rather feed on aquatic and terrestrial insects.

Currently, there are reproducing westslope cutthroat trout in 13 lakes in the Skagit basin and reproducing brook trout in 1 lake in the Baker drainage basin (see table G-5 in appendix G). Considering the fact these fish would not likely colonize as far downstream as Chinook are found, and the lack of hybridization and predation potentials, alternative A may affect, but is not likely to adversely affect Chinook salmon.

Coho Salmon (Federal Candidate Species, State Candidate Species). The Georgia Strait/Puget Sound Evolutionarily Significant Unit (ESU) of Coho salmon inhabits the Skagit, Baker, and Chilliwack rivers and their higher-order, lower-gradient tributaries. Coho salmon spend their first year in the birth tributary and the next 18 months in the ocean before returning to spawn from November through early February. Because the young spend roughly one year in freshwater before smolting (when young salmon swim to the ocean), they must compete with other native salmonids and potentially with introduced fish dispersing downstream. Hybridization with nonnative fish does not occur.

Reproducing westslope cutthroat trout are currently in 15 lakes in the Skagit Basin, and reproducing brook trout are in 1 lake in the Baker drainage basin and 2 lakes in the Ross drainage basin (see table G-5 in appendix G). Impacts on Coho salmon would be limited because of the lack of potential for hybridization or predation by westslope cutthroat trout, as described above for Chinook salmon; therefore, alternative A may affect, but is unlikely to adversely affect Coho salmon.

Westslope Cutthroat Trout (Federal Species of Concern). Westslope (inland) cutthroat trout are native to the Stehekin River and its tributaries on the east side of the Cascade Crest, though the species was introduced to stream basins on the west side of the Cascade Crest, where it is considered a threat to west-side native fish. Within the westslope cutthroat trout's native range on the east side, introduced stocks of rainbow trout in Lake Chelan and various other lakes at the headwaters of the Stehekin River have replaced some native populations of westslope cutthroat trout through either competition between the species or hybridization (Behnke 1992). Recent genetic research has demonstrated that rainbow trout dispersing downstream from stocked mountain lakes in the Stehekin drainage are responsible for some of the hybridization (WFRC, C. Ostberg, pers. comm., 2004). There are two genetically "pure" strains of westslope cutthroat still present in the headwaters of the Stehekin River drainage and in Park Creek, Flat Creek, and likely, Bridge Creek. The persistence of these two pure strains may be related to water temperature because rainbow trout do not appear to be able to spawn in the colder waters of the Stehekin drainage (WFRC, C. Ostberg, pers. comm., 2004).

Under alternative A, nine lakes in the Stehekin basin with stream outlets have reproducing rainbow or rainbow/cutthroat hybrid trout that would adversely impact native westslope cutthroat trout inhabiting downstream drainages. Documentation of colonization and hybridization has been confirmed in one downstream drainage (outlet to McAlester Lake). Based on the evidence, native westslope cutthroat trout may be affected and are likely to be adversely affected in at least one lake through hybridization by introduced rainbow/cutthroat trout under alternative A.

State-Listed Wildlife Species. Under alternative A, six species listed at the state level (black-backed woodpecker, golden eagle, Lewis' woodpecker, merlin, pileated woodpecker, and Vaux's swift) would experience negligible to minor adverse impacts from fish stocking or associated activities. Noise impacts from aircraft stocking or human presence may temporarily flush one of these state candidate species, as previously described for several federally listed species, but would not result in any detrimental effects to populations.

The common loon (Washington State sensitive species) would incur negligible adverse impacts. Continuation of fish stocking would provide beneficial effects by supporting an adequate food base for nesting common loons near Hozomeen Lake or other stocked lakes.

Cumulative Impacts

Cumulative impacts on special status species are considered for past, present, and future projects occurring in the North Cascades Complex or on lands outside the North Cascades Complex boundary. No new major roads, trails, resorts, or major upgrades of facilities are proposed or in the planning stages. Some access had been eliminated or reduced due to flooding of trails. Visitor use is expected to remain at about the same levels it has been for several years, resulting in about the same level of human presence near most lakes and connected streams. Human recreational use of the lakes and surrounding drainages may cause adverse impacts on special status species in the North Cascades Complex due to noise and disturbance associated with human presence. However, some of this disturbance to listed species from backpackers, campers, and anglers would be mitigated by the natural topography of the landscape (which can provide sound or visual buffering) and the forested areas that provide refuge for wildlife. In addition, sport and commercial fishing may also result in direct adverse impacts on salmon populations in the Pacific Northwest.

Mountain lake fisheries on National Forest System lands that surround the North Cascades Complex are managed by the WDFW. The department's management history is described in WDFW (2001), and management would continue to evolve with continued interest in the stocking of native species. Lakes stocked in the past are assumed to have a range of impacts on special status species similar to what has been analyzed for the North Cascades Complex lakes, which varies from no effect, to may affect, to likely to adversely affect, depending on the species. On a landscape scale, the piscivorous species generally benefit from the presence of stocked fish in mountain lakes where resources were previously lacking. Because stocking has occurred in previously fishless lakes, fish-eating species, such as ospreys, have expanded their territories and home ranges, which benefits individuals. However, ecologically speaking, introduction of nonnative species is considered detrimental to community dynamics of a listed species. A species already considered threatened or endangered due to its rarity would potentially face an increasing threat of local extirpation through nonnative species competition, predation, or hybridization. Continued presence of fish in North Cascades Complex lakes, coupled with continued presence of fish in lakes on surrounding lands, would tend to make piscivorous species more widespread and increase their populations.

There would be continued, localized, and sporadic effects on special status wildlife species from logging and water projects occurring outside the North Cascades Complex, including in connected watersheds. These actions can cause severe habitat loss for many species of plants and animals, particularly, listed salmon species that are unable to return to spawning habitat. Logging along the Pacific Coast has caused siltation and reduced shade cover, resulting in increased stream temperature to lethal levels for the juveniles and eggs to survive.

Other sources of impacts continue to occur that may affect the health and viability of species dependent on aquatic resources. There is concern about persistent organic pollutants and methyl-mercury found in some lakes in the North Cascades Complex, which appear to result from airborne pollutants being deposited on snow and washed into lakes. There is the potential for increased acid rain from emissions related to the development of an additional power plant in the area; emissions would contribute to an increase in lake acidity and metal availability. In some cases, the concentrations of some of these pollutants in the water in preliminary studies appear to be high enough to raise concerns that, in conjunction with other influences, higher trophic-level organisms may be affected. Toxins can be passed from the tissue of one organism to those that feed on it, meaning that a toxin can move up the food chain and bioaccumulate to higher concentrations in the top predators, such as bald eagles, to the point where they cause reproductive failure. If that occurred, then the cumulative impacts of the pollutants coupled with other impacts, perhaps from fish, might eliminate that predator species from certain lakes or even cause a more general decline in the population.

Alternative A, combined with other actions in the area, may affect, and is likely to adversely affect special status species in the study area on a cumulative basis, especially special status amphibians and fish. The actions under alternative A, however, only add small incremental impacts to the potential overall impacts on listed species and affect one species of native fish (westslope cutthroat trout). Also, an accurate determination of the magnitude of cumulative impacts on each special status species cannot be made because available information and research on each species' biology, status, and distribution is insufficient. Additional research and population monitoring of special status species that would be affected by the alternatives in this plan/EIS, combined with research completed in the region, would help to better determine cumulative impacts.

Conclusion

Based on available information, fixed-wing aircraft noise and human disturbance associated with periodic fish stocking activities under alternative A would have a range of short-term negligible to minor effects on special status wildlife species. Fish removal does not occur under alternative A, so there would be no impacts on special status wildlife species from lake treatments to remove fish.

Based on the available information, alternative A would have ***no adverse effects on federally listed species*** from fish stocking. Regarding ***federally listed species:***

> **21 species may be affected but are not likely to be adversely affected** (American peregrine falcon, California wolverine, Canada lynx, gray wolf, grizzly bear, marbled murrelet, Northern goshawk, Northern spotted owl, Pacific fisher, Yuma myotis, long-eared bat, bald eagle, harlequin duck, little willow flycatcher, olive-sided flycatcher, Cascades frog, Columbia spotted frog, northern red-legged frog, bull trout, Chinook salmon, Coho salmon).
>
> **2 species would incur no effect** (tailed frog and Western toad).
>
> **1 species may be affected and is likely to be adversely affected** (westslope cutthroat trout)—effects would be limited to one drainage downstream from McAlester Lake as a result of documented hybridization and colonization.

Regarding ***state-listed species that are not federally listed***, 6 species would incur short-term negligible to minor adverse impacts (solely from noise related to stocking activities), and the common loon would incur short-term negligible adverse impacts. Continuation of stocking would provide beneficial effects by supporting an adequate food base for nesting loons near Hozomeen Lake and other stocked lakes.

Cumulative impacts on each special status species from projects or actions occurring throughout the region would be adverse; however, alternative A would contribute only a small increment to overall cumulative impacts.

Impairment of special status wildlife species across the study area would not occur under alternative A.

Alternative B: Proposed Adaptive Management of 91 Lakes under a New Framework (42 Lakes May Have Fish) (Preferred Alternative)

The emphasis of this alternative would be to eliminate or reduce reproducing fish from lakes in the study area (refer to tables 4 and 5 in the "Alternatives" chapter). Restocking of nonreproducing fish would be allowed only where biological resources would be protected. Based on best available science, some lakes would be restocked with nonreproducing fish at low densities once reproducing fish have been removed. An extensive monitoring program (see appendix F), which includes adaptive management provisions, would be implemented to avoid unacceptable future effects on native biota.

Alternative B

29 lakes would have fish
49 lakes would be fishless
13 lakes would be evaluated for restocking

The "Alternatives" chapter provides a detailed description of alternative B. For more information on the 91 lakes, refer to tables 5 and 10 in the "Alternatives" chapter and appendix E.

Impacts of Proposed Fish Stocking and Lake Treatment Methods on Special Status Wildlife Species

Similar to alternative A, alternative B may affect, but is not likely to adversely affect, any of the 11 species listed below that either do not depend on lake resources or only eat fish opportunistically, or they would not be disturbed by activities associated with fish stocking or lake treatments to remove fish.

American Peregrine Falcon — federal species of concern, state candidate

California Wolverine — federal species of concern, state threatened

Canada Lynx — federal threatened, state threatened

Gray Wolf — federal endangered, state endangered

Grizzly Bear — federal threatened, state endangered

Pacific Fisher — federal species of concern, state endangered

Marbled Murrelet — federal threatened, state threatened

Little Willow Flycatcher — federal species of concern

Northern Goshawk — federal species of concern, state candidate

Northern Spotted Owl — federal threatened, state endangered

Olive-sided Flycatcher — federal species of concern

Both of the lakes pictured below have a high density of reproducing fish.

Blum Lake–Largest/Middle No. 3

Blum Lake–Lower/West No. 4

The following 13 listed species are known to be present in the aquatic habitats of the 91 lakes or the adjacent habitats. The impacts on each species from alternative B are discussed below.

Yuma Myotis (Federal Species of Concern). Similar to alternative A, Yuma myotis may be affected, but are unlikely to be adversely affected from actions under alternative B. Yuma myotis bats may experience a minimal amount of stress if stocking or treatment activities occur near a diurnal (daytime) roost. Competition for insects with fish in stocked lakes is not likely to noticeably affect insect availability for Yuma myotis.

Long-eared Myotis (Federal Species of Concern). Similar to alternative A, long-eared myotis may be affected but are unlikely to be adversely affected from actions under alternative B. Long-eared bats may experience minor stress if stocking or treatment activities occur near a diurnal (daytime) roost. Competition for insects with fish in stocked lakes is unlikely to affect insect availability for long-eared myotis.

Bald Eagle (Federal Threatened, State Threatened). Similar to alternative A, alternative B may affect, but is not likely to adversely affect, bald eagles because they only rarely, if ever, use the high-elevation stocked lakes in the North Cascades Complex to forage or roost.

Harlequin Duck (Federal Species of Concern). Similar to alternative A, implementation of alternative B, may affect, but is unlikely to adversely affect, harlequin ducks because implementation of alternative B would potentially reduce the aquatic food base for the species due to competition with introduced trout. In addition, noise impacts would occur from stocking activities but would be short term, minor, and infrequent.

Cascades Frog (Federal Species of Concern). The status and distribution of Cascades frogs in the North Cascades Complex is generally unknown, but the species has been documented in two ponds and one stream location in the Bridge Creek drainage (Bury et al. 2000). Because the species is not generally associated with lakes stocked with fish, implementation of alternative B, may affect, but is not likely to be adversely affect Cascades frogs. Removal of fish in high mountain lakes may serve to benefit Cascades frogs if their absence in larger, deeper lakes was due to past predation by nonnative fish.

Columbia Spotted Frog (Federal Species of Concern, State Candidate Species). Under alternative B, one of the lakes containing Columbia spotted frogs (Kettling Lake) would be chemically treated to become fishless. Two lakes, Dagger and McAlester, would be chemically treated to remove all reproducing fish. The lakes would be evaluated to determine if restocking is advisable, and these lakes would be stocked with nonreproducing fish at low densities. Coon Lake would continue to be stocked at low densities under alternative B. These three lakes (Dagger, McAlester, and Coon) have extensive meandering inlet and outlet streams that may protect the frogs from fish predation (OSU, Hoffman, pers. comm., 2003). Within the main body of lakes inhabited by the Columbia spotted frog, stocked fish likely limit frog use. This may reduce the number of frogs in the lake, but it would not eliminate spotted frogs from the surrounding wetlands and nearby temporary ponds, which are extensive enough to support viable breeding populations of the species.

Under alternative B, Columbia spotted frogs may be affected but are not likely to be adversely affected in the lakes where stocking would continue. The number of frog larvae in the main portion of stocked lakes would likely be noticeably reduced in relation to a similar fishless lake. Populations of Columbia spotted frogs in the lakes that contain stocked trout would remain viable in the North Cascades Complex indefinitely. Also, populations of frogs in lakes that would become fishless under alternative B would not incur further impacts from fish predation. Moreover, the reduction in fish density and the elimination of fish would be a beneficial effect to the frogs.

Chemical treatment with antimycin to remove fish in Kettling, Dagger, McAlester, and Coon lakes may affect, but is unlikely to adversely affect, Columbia spotted frogs. As discussed in the “Aquatic Organisms” section in this chapter, the use of antimycin is not known to have adverse impacts on amphibians. Impacts on northern Columbia spotted frogs from trampling would be mitigated to the greatest extent possible, as described in appendix I.

Northern Red-Legged Frog (Federal Species of Concern). As described in alternative A, Northern red-legged frogs have been documented in wetlands and ponds along the Skagit River near Newhalem and in the Big Beaver valley but have not been confirmed in the 62 lakes in the study area that currently contain fish because surveys have not been completed. Lower-elevation lakes in the Ross Lake National Recreation Area (Thunder, Hozomeen, Willow, and Ridley) have suitable habitat for the species and would contain northern red-legged frogs.

Under alternative B, maintaining Thunder Lake as fishless and chemically removing fish from Hozomeen Lake would result in long-term beneficial effects to any red-legged frogs present in these lakes. As discussed in the “Aquatic Organisms” section in this chapter, the use of antimycin may have short-term adverse impacts on amphibians. Impacts on northern red-legged frogs from trampling or other disturbance related to lake treatment would be mitigated to the greatest extent possible, as described in the appendix I. If northern red-legged frogs are found to occur in Willow or Ridley lakes, nonnative fish may prey on northern red-legged frog tadpoles. The species may be affected, but are not likely to be adversely affected, by stocked fish in those lakes. Adverse impacts from nonnative fish are not likely to affect the population of northern red-legged frogs in the North Cascades Complex. The extent of the impacts would need to be verified through monitoring.

Tailed Frog (Federal Species of Concern). Tadpole and adult tailed frogs have been documented in the outlets of six lakes in the North Cascades Complex, including Upper Bouck and Nert lakes (Liss et al. 1995; Bury et al. 2000), which are currently stocked. The lakes would no longer be stocked under alternative B and would eventually become fishless. Some populations of tailed frogs have evolved in stream environments with fish predation (NPS, R. Glesne, pers. comm., 2003). In the North Cascades Complex, many populations are found in high-gradient tributaries that are inaccessible to fish. Under alternative B, threats to tailed frogs from predatory fish would cease. Removal of fish in Upper Bouck and Nert lakes would occur simply through discontinued stocking, and therefore, alternative B would have no effect on tailed frogs in the North Cascades Complex.

Western Toad (Federal Species of Concern, State Candidate Species). Recent amphibian surveys in North Cascades Complex found a fragmented distribution of adult Western toads in or near four lakes considered in this analysis: Battalion, Lower Thornton, Trapper, and Willow (Liss et al. 1995). Tadpoles were observed at Trapper Lake. Battalion Lake would be treated to remove all fish and then monitored to evaluate for restocking after additional data is gathered. Dagger Lake would be evaluated to determine if fish removal is feasible; if not, then fish density would be reduced. The remaining lakes would continue to be stocked at low densities. Western toad tadpoles and adults are probably not preyed upon by trout because they secrete a toxin (Corn 1998) that is unpalatable to trout (Llewellyn and Peterson 1998; Bury and Adams 2000; Tyler et al. 2003). For these reasons, Western toads would not be affected under alternative B. Fish in Battalion Lake would be removed using chemical treatment methods, and as discussed in the "Aquatic Organisms" section in this chapter, the use of antimycin is not known to have adverse impacts on amphibians. Impacts on Western toads from trampling during lake treatments would be mitigated to the greatest extent possible, as described in appendix I. Based on potential minor disturbance from lake treatment activities, Western toads may be affected, but are unlikely to be adversely affected by actions under alternative B.

Bull Trout (Federal Threatened, State Candidate). Under alternative B, the potential for future adverse impacts on bull trout would be reduced compared to alternative A, and there would be a long-term beneficial effect on the species from removal of fish and reduction in fish densities. Of particular benefit to bull trout would be the eventual removal of brook trout from Hozomeen and Sourdough lakes, reducing the possibility of hybridization between bull and brook trout. Two lakes (Lower Thornton and Firn) would continue to contain nonnative westslope cutthroat trout; however, Lower Thornton does not drain to bull trout spawning tributaries where competition would be an issue. Cutthroat in Thornton Creek would probably provide sub-adult bull trout with a foraging opportunity. Moreover, there is currently no evidence of widespread distribution of westslope cutthroat in the Skagit River. To the contrary, snorkeling surveys only note occasional occurrence of individuals of the species. It is unlikely that the few low-density westslope trout in these lakes would adversely affect bull trout; therefore, actions in alternative B may affect, but are not likely to adversely affect, bull trout.

Chinook Salmon (Federal Threatened). Under alternative B, 24 lakes in the Baker and Skagit basins would be treated to remove fish or decrease fish densities (refer to table G-5 in appendix G), and the potential for adverse impacts on Chinook salmon would eventually be eliminated in these basins. These actions would have long-term beneficial effects on Chinook salmon. One lake in the Skagit basin (Lower Thornton) would continue to have reproducing westslope cutthroat trout, but this would not cause impacts on native Chinook salmon in that basin from competition and predation, as explained under alternative A. Chinook salmon are not likely to be in upstream reaches near the lake, and the fish density would be maintained at low levels; therefore, alternative B may affect, but is not likely to adversely affect, Chinook salmon in the study area.

Coho Salmon (Federal Candidate Species, State Candidate Species). Under alternative B, 26 lakes in the Baker, Skagit, and Chilliwack basins would be treated to remove fish or decrease fish densities, and the potential for adverse impacts on Coho salmon would eventually be eliminated in these basins (refer to table G-5 in appendix G). This reduction in density and elimination of fish would have long-term beneficial effects to Coho salmon. One lake in the Skagit basin (Lower Thornton) would continue to have reproducing westslope cutthroat trout, which would not cause impacts on native Coho salmon in that basin from competition and predation, as explained under alternative A. Alternative B may affect, but is not likely to adversely affect Coho salmon in the study area.

Westslope Cutthroat Trout (Federal Species of Concern). Under alternative B, reproducing populations of rainbow cutthroat hybrid trout would be removed from McAlester Lake, where evidence of downstream colonization and hybridization has been confirmed. Westslope cutthroat trout in downstream drainages would incur long-term beneficial effects from the elimination of nonnative reproducing fish in this lake. Actions under alternative B, may affect, but are not likely to adversely affect westslope cutthroat trout in its native range, although it is recognized that until all reproducing nonnative fish are removed from McAlester Lake, the potential for continued hybridization with westslope cutthroat trout would exist.

State Listed and Other Special Status Wildlife Species. Under alternative B, six species (black-backed woodpecker, golden eagle, Lewis' woodpecker, merlin, pileated woodpecker, and Vaux's swift) may incur minor impacts from fish stocking and lake treatment activities. Noise impacts from fixed-wing aircraft, helicopters, or human presence may temporarily flush individuals of these state candidate species if present near a lake when stocking or treatment activities are occurring, but this would not result in any detrimental impacts on these wildlife species.

The common loon (Washington State sensitive species) would be adversely affected by actions under alternative B because stocked fish would be removed from Hozomeen Lake. This may result in minor to moderate impacts on the pair of breeding loons that has nested at Hozomeen Lake since at least 1971. Adequate fish resources to support a family of loons may exist in nearby Ross, Ridley, and Willow lakes. Loons are declining in Washington due to the loss of low-elevation lake habitats and associated human disturbances (Richardson et al. 2000). While the loss of habitat at Hozomeen Lake is unlikely to affect the overall population of common loons, at the local level, the breeding pair of loons would be displaced from Hozomeen Lake and either would choose an adjacent area to nest or would stop nesting in the North Cascades Complex. Therefore, common loons would incur minor to moderate adverse impacts under alternative B.

Cumulative Impacts

Under alternative B, cumulative impacts on special status species would be similar to those described for alternative A. There would, however, be a reduction of impacts on native fish in several drainages and on amphibians due to the eventual removal of fish in 20 lakes and replacement of high-density reproducing fish with lower-density nonreproducing fish in others.

Overall, the impacts associated with other projects, uses, and actions occurring in the region (as described under alternative A), added to the impacts predicted under alternative B, may affect, and are likely to adversely affect certain special status species in the region on a cumulative basis. However, the actions under alternative B add only small incremental impacts to the potential overall impacts on listed species, and only for one species of native fish (westslope cutthroat trout). Also, an accurate determination of the magnitude of cumulative impacts on special status species cannot be made because available information and research on species' biology, status, and distribution is insufficient. Additional research and population monitoring of special status species that would be affected by this plan/EIS, combined with research completed in the region, would help to better determine cumulative impacts.

Conclusion

Fixed-wing aircraft noise and human disturbance associated with periodic fish-stocking activities under alternative B would have a range of short-term negligible to minor effects on some special status wildlife species but would be reduced from the effects that would occur under alternative A. Short-term impacts related to lake treatments to remove fish would be minor, mostly due to noise from helicopters transporting lake treatment equipment and human disturbance during treatment activities. The use of the chemical, antimycin, to remove fish is not known to have adverse impacts on amphibians. There would be long-term beneficial effects on some aquatic species because most high-density reproducing populations of fish would be replaced with low-density nonreproducing stocked fish.

Based on the available information, alternative B would have ***no adverse effects on federally listed species*** from fish stocking or lake treatments to remove fish. Regarding ***federally listed species:***

> **23 species may be affected but are not likely to be adversely affected** (American peregrine falcon, California wolverine, Canada lynx, gray wolf, grizzly bear, little willow flycatcher, marbled murrelet, Northern goshawk, Northern spotted owl, olive-sided flycatcher, Pacific fisher, Yuma myotis, long-eared bat, bald eagle, harlequin duck, Cascades frog, Columbia

spotted frog, northern red-legged frog, Western toad, bull trout, Chinook salmon, Coho salmon, westslope cutthroat trout).

1 species would incur no effect (tailed frog).

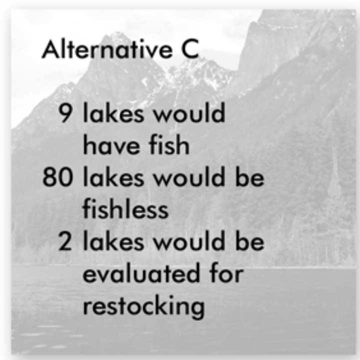
Regarding ***state-listed species that are not federally listed***, 6 species would incur short-term negligible to minor adverse impacts from noise related to stocking and lake treatment activities, and the common loon would incur long-term minor to moderate adverse impacts due to the removal of its primary food source from Hozomeen Lake.

Cumulative impacts on each special status species from projects or actions occurring throughout the region would be adverse; however, alternative B would contribute only a small increment to overall cumulative impacts.

Impairment of special status wildlife species across the study area would not occur under alternative B.

Alternative C: Proposed Adaptive Management of 91 Lakes under a New Framework (11 Lakes May Have Fish)

The goal of this alternative is to eliminate all fish in lakes in the national park and reduce or eliminate reproducing fish in the Lake Chelan and Ross Lake National Recreation Areas, but still allow for some sport fishing in the two recreation areas.



The "Alternatives" chapter provides a detailed description of alternative C. For more information on the 91 lakes, refer to tables 5 and 12 in the "Alternatives" chapter and appendix E.

Impacts from Proposed Fish Stocking and Lake Treatment Methods on Special Status Wildlife Species

Similar to alternatives A and B, alternative C may affect, but is not likely to adversely affect, any of the following 11 species because they either do not depend on lake resources or only eat fish opportunistically, or would not be disturbed by activities associated with fish stocking or lake treatments to remove fish.

American Peregrine Falcon — federal species of concern, state endangered

California Wolverine — federal species of concern, state candidate

Canada Lynx — federal threatened, state threatened

Gray Wolf — federal endangered, state endangered

Grizzly Bear — federal threatened, state endangered

Pacific Fisher — federal species of concern, state endangered

Marbled Murrelet — federal threatened, state threatened

Little Willow Flycatcher — federal species of concern

Northern Goshawk — federal species of concern, state candidate

Northern Spotted Owl — federal threatened, state endangered

Olive-sided Flycatcher — federal species of concern

The following 13 listed species are known to be present in the aquatic habitats of the 91 lakes or the adjacent habitats. The impacts on each species from alternative C are discussed below.

Yuma Myotis (Federal Species of Concern). Yuma myotis may be affected, but are unlikely to be adversely affected from actions under alternative C. Yuma myotis bats may experience a minimal amount of stress when roosting during the day if stocking or treatment activities occur near a roost.

Long-eared Myotis (Federal Species of Concern). Long-eared myotis may be affected but are unlikely to be adversely affected from actions under alternative C. The species may experience a minor stress if stocking or treatment activities occur near a roost.

Bald Eagle (Federal Threatened). Similar to alternative A, alternative C may affect but is not likely to adversely affect bald eagles because they only rarely, if ever, use the high-elevation stocked lakes in the North Cascades Complex to forage or roost.

Harlequin Duck (Federal Species Of Concern). Similar to alternative A, implementation of alternative C, may affect, but is unlikely to adversely affect harlequin ducks, as implementation of alternative C may result in a slight reduction in the availability of invertebrates due to competition with introduced trout. In addition, noise impacts would occur from stocking activities, but would be short term, minor, and infrequent.

Cascades Frog (Federal Species of Concern). In the North Cascades Complex, the Cascades frog has been documented in two ponds and one stream location in the Bridge Creek drainage (Bury et al. 2000). The species seems to be absent from lakes stocked with fish; however, it is unknown if this is due to predation from stocked trout or a preference for shallower waters. For these reasons, implementation of alternative C, may affect, but is not likely to adversely affect, Cascades frogs. Removal of fish in some high mountain lakes under alternative C would provide an overall benefit for Cascades frogs if their absence in larger, deeper lakes was due to past predation by nonnative fish.

Columbia Spotted Frog (Federal Species of Concern, State Candidate Species). Under alternative C, Coon Lake, which contains Columbia spotted frogs, would continue to be stocked with low densities of fish, while chemical treatment methods would be used to remove fish in Kettling and Dagger lakes. McAlester would be chemically treated to remove all reproducing fish and would then be evaluated to determine if restocking is advisable, so there may be fish stocked again in this lake but at low densities. Impacts on Columbia spotted frogs in these lakes would be similar to those described for the species under alternative B, and long-term benefits would occur from the removal of fish in other mountain lakes. Under alternative C, Columbia spotted frogs may be affected but are not likely to be adversely affected, by stocking or treatment activities.

Northern Red-Legged Frog (Federal Species of Concern). Under alternative C, Hozomeen Lake would be chemically treated to remove fish, while Willow and Ridley lakes would continue to be stocked at low densities. Because fish would remain in Willow and Ridley lakes, Northern red-legged frogs may be affected, but are not likely to be adversely affected, by stocked fish under alternative C, similar to impacts described in alternative B. Northern red-legged frogs would experience long-term beneficial effects from removal or reduction of fish in other lakes, and the extent of adverse impacts would need to be verified through monitoring.

Tailed Frog (Federal Species of Concern). Tadpole and adult tailed frogs have been documented in the outlets of six lakes in the North Cascades Complex, including Upper Bouck and Nert lakes (Liss et al. 1995; Bury et al. 2000), which are currently stocked. The lakes would no longer be stocked under alternative C and would eventually become fishless. Some populations of tailed frogs have evolved in stream environments with fish predation (NPS, R. Glesne, pers. com., 2003). In the North Cascades Complex, many populations are found in high-gradient tributaries that are inaccessible to fish. Under alternative C, threats to tailed frogs from predatory fish would cease. Removal of fish in Upper Bouck and Nert lakes would occur simply through discontinued stocking, and therefore, alternative C would have no impact on tailed frogs in the North Cascades Complex.

Western Toad (Federal Species of Concern, State Candidate Species). Recent amphibian surveys in North Cascades Complex found a fragmented distribution of adult Western toads in or near four lakes considered in this analysis: Battalion, Lower Thornton, Trapper, and Willow (Liss et al. 1995). Tadpoles were observed at Trapper Lake. Battalion Lake would be treated to remove all fish and then monitored to evaluate for restocking after additional data is gathered. Lower Thornton Lake would become fishless under alternative C, and Willow Lake would continue to be stocked at low densities. If feasible, fish would be removed from Trapper Lake. Western toad tadpoles and adults are probably not preyed upon by trout because they secrete a toxin (Corn 1998) that is unpalatable to trout (Llewellyn and Peterson 1998; Bury and Adams 2000; Tyler et al. 2003). For these reasons, Western toads would not be affected under alternative C. Impacts on Western toads from continued stocking activities or lake treatment would be similar to those discussed in alternative B and be limited to very localized disturbances from human presence and habitat trampling. Western toads may be affected, but are unlikely to be adversely affected, by actions under alternative C; nevertheless, long-term beneficial impacts on western toads would result from removal or reduction of fish in these lakes.

Bull Trout (Federal Threatened). Under alternative C, all lakes that connect to drainages containing bull trout either would be treated to have fish removed or treated and then stocked with low densities of nonreproducing fish; therefore, the potential for hybridization with bull trout and/or competition for resources would be unlikely under this alternative. Because lake treatment would occur over an extended period of time, and reproducing fish would not be removed from high mountain lakes immediately, it is recognized that bull trout in the Hozomeen and Sourdough drainages would be at some risk until all reproducing populations of nonnative trout were removed. Long-term beneficial effects would be realized as the program is completed. Bull trout may be affected, but are unlikely to be adversely affected, by fish stocking activities under alternative C.

Chinook Salmon (Federal Threatened). Under alternative C, all lakes that connect to drainages containing Chinook salmon either would be treated to have fish removed or treated and then stocked with low densities of nonreproducing fish; therefore, the potential for predation or competition for resources would be very low under this alternative. Because lake treatment would occur over an extended period of time, and reproducing populations of fish would not be removed from high mountain lakes immediately, it is recognized that some impacts from stocked fish would occur until all reproducing populations of nonnative trout were removed. Long-term beneficial effects would be realized as the program is completed. Chinook salmon may be affected, but are unlikely to be adversely affected, by fish stocking activities under alternative C.

Coho Salmon (Federal Candidate Species, State Candidate Species). Under alternative C, all lakes that connect to drainages containing Coho salmon either would be treated to have fish removed or treated and then stocked with low densities of nonreproducing fish; therefore, the potential for predation or competition for resources would be very low under this alternative. Because lake treatment would occur over an extended period of time, and reproducing populations of fish would not be removed from high mountain lakes immediately, it is recognized that some impacts from stocked fish would occur until all reproducing populations of nonnative trout were removed. Long-term beneficial effects would be realized as the program is completed. Coho salmon may be affected, but are unlikely to be adversely affected, by fish stocking activities under alternative C.

Westslope Cutthroat Trout (Federal Species of Concern). Impacts on westslope cutthroat trout under alternative C would be the same as described for alternative B, with long-term beneficial effects from the reduction in density and elimination of nonnative reproducing fish, especially in McAlester Lake. Actions under alternative C, may affect, but are not likely to adversely affect, westslope cutthroat trout, although it is recognized that until all reproducing fish were removed from McAlester Lake, the potential for continued hybridization with westslope cutthroat trout would exist.

State Listed and Other Special Status Wildlife Species. Under alternative C, six species (black-backed woodpecker, golden eagle, Lewis' woodpecker, merlin, pileated woodpecker, and Vaux's swift) may be affected, but are not likely to be adversely affected, by fish stocking and lake treatment activities. Noise impacts from fixed-wing aircraft, helicopters, or human presence may temporarily flush individuals of these state candidate species if they are present near a lake when stocking or treatment activities are occurring, but this would not result in any detrimental impacts on these wildlife species.

The common loon (Washington State sensitive species) may be adversely affected by actions under alternative C because stocked fish would be removed from Hozomeen Lake. Impacts would be the same as described for alternative B, which would be minor to moderate impacts on the pair of breeding loons that has nested at Hozomeen Lake since at least 1971. Adequate fish resources to support a family of loons may exist in nearby Ross, Ridley, and Willow lakes. Loons are declining in Washington due to loss of low-elevation lake habitat and associated human disturbances (Richardson et al. 2000). While the loss of habitat at Hozomeen Lake is unlikely to affect the overall population of common loons, at the local level, loons would be displaced from Hozomeen Lake and either would choose an adjacent area to nest or would discontinue to nest in the North Cascades Complex. Therefore, under alternative C, common loons nesting at Hozomeen Lake would incur minor to moderate impacts.

Cumulative Impacts

Cumulative impacts under alternative C would be similar to those described for alternative A but with substantially reduced impacts on amphibians and native fish from reductions in fish densities and/or removal of reproducing nonnative fish in the North Cascades Complex.

Overall, the impacts associated with other projects, uses, and actions occurring in the region (as described under alternative A) added to the impacts predicted under alternative C, may affect, and are likely to adversely affect certain special status species in the region on a cumulative basis. Actions under alternative C would provide beneficial effects from the reduction of nonnative fish species, which would help limit the extent of cumulative impacts on native fisheries. However, the adverse impacts from development, water pollution, and other projects would cumulatively result in adverse impacts on many special status species. In most cases, an accurate determination of the magnitude of cumulative impacts on special status species cannot be made because available information and research on species' biology, status, and distribution is insufficient. Additional research and population monitoring of special status species that would be affected by the alternatives in this plan/EIS, combined with research completed in the region, would help to better determine cumulative impacts.

Conclusion

Fixed-wing aircraft noise and human disturbance associated with periodic fish-stocking activities under alternative C would have a range of short-term negligible to minor effects on some special status wildlife species but would be reduced from the effects that would occur under alternatives A and B. Short-term impacts related to lake treatments to remove fish would be minor, mostly due to noise from helicopters transporting lake treatment equipment and human disturbance during treatment activities. The use of the chemical, antimycin, to remove fish is not known to have adverse impacts on amphibians. There would be long-term beneficial effects on some aquatic species because most high-density reproducing populations of fish would be replaced with low-density nonreproducing stocked fish.

Based on the available information, alternative C would have ***no adverse effects on federally listed species*** from fish stocking or lake treatments to remove fish. Regarding ***federally listed species:***

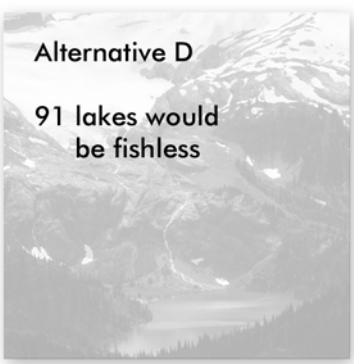
> **23 species may be affected but are not likely to be adversely affected** (American peregrine falcon, California wolverine, Canada lynx, gray wolf, grizzly bear, little willow flycatcher, marbled murrelet, Northern goshawk, Northern spotted owl, olive-sided flycatcher, Pacific fisher, Yuma myotis, long-eared bat, bald eagle, harlequin duck, Cascades frog, Columbia spotted frog, northern red-legged frog, Western toad, bull trout, Chinook salmon, Coho salmon, and westslope cutthroat trout).
>
> **1 species would incur no effect** (tailed frog).

Regarding ***state-listed species that are not federally listed***, 6 species would incur short-term negligible to minor adverse impacts from noise related to stocking and lake treatment activities, and the common loon would incur long-term minor to moderate adverse impacts due to the removal of its primary food source from Hozomeen Lake.

Cumulative impacts on each special status species from projects or actions occurring throughout the region would be adverse; however, alternative C would contribute only a small increment to overall cumulative impacts.

Impairment of special status wildlife species across the study area would not occur under alternative C.

ALTERNATIVE D: 91 LAKES WOULD BE FISHLESS



The emphasis of this alternative would be to either maintain as fishless or eliminate fish from 62 of the 91 mountain lakes in the study area. All 91 lakes would eventually be unavailable for fishing as management actions are completed over time.

The "Alternatives" chapter provides a detailed description of alternative D. For more information on the 91 lakes, refer to tables 5 and 13 in the "Alternatives" chapter and appendix E.

Impacts of Proposed Lake Treatment Methods on Special Status Wildlife Species

Similar to other alternatives, alternative D may affect, but is not likely to adversely affect, any of the following 11 species because these species either do not depend on lake resources, or only eat fish opportunistically, or would not be disturbed by activities associated with lake treatment.

American Peregrine Falcon — federal species of concern, state endangered

California Wolverine — federal species of concern, state candidate

Canada Lynx — federal threatened, state threatened

Gray Wolf — federal endangered, state endangered

Grizzly Bear — federal threatened, state endangered

Pacific Fisher — federal species of concern, state endangered

Marbled Murrelet — federal threatened, state threatened

Little Willow Flycatcher — federal species of concern

Northern Goshawk — federal species of concern, state candidate

Northern Spotted Owl — federal threatened, state endangered

Olive-sided Flycatcher — federal species of concern

The following 13 listed species are known to be present in the aquatic habitats of the 91 lakes or the adjacent habitats. The impacts on each species from alternative D are discussed below.

Yuma Myotis (Federal Species of Concern). Similar to alternative A, Yuma myotis may be affected, but are unlikely to be adversely affected, by actions under alternative D. The species may experience a minimal amount of stress if lake treatment activities occur near a diurnal (daytime) roost.

Long-eared Myotis (Federal Species of Concern). Similar to alternative A, Long-eared myotis may be affected, but are unlikely to be adversely affected, by actions under alternative D. The species may experience a minimal amount of stress if lake treatment activities occur near a diurnal (daytime) roost.

Bald Eagle (Federal Threatened). Similar to alternative A, alternative D may affect but is not likely to adversely affect bald eagles because they only rarely, if ever, use the high-elevation lakes in the North Cascades Complex to forage or roost.

Harlequin Duck (Federal Species of Concern). Similar to alternative A, implementation of alternative D, may affect, but is unlikely to adversely affect harlequin ducks through short-term, minor, and infrequent noise impacts from lake treatment activities.

Cascades Frog (Federal Species of Concern). Cascades frogs have been documented in two ponds and one stream location in the Bridge Creek drainage (Bury et al. 2000). The species seems to be absent from lakes stocked with fish, and it is unknown if this absence is due to past predation from stocked trout or a preference for shallower waters. Removal of stocked fish from all lakes in the North Cascades Complex under alternative D would not affect Cascades frogs.

Removal of fish in all lakes under alternative D would benefit Cascades frogs as this unnatural source of predation would be eliminated.

Columbia Spotted Frog (Federal Species of Concern, State Candidate Species). Under alternative D, adverse impacts on Columbia spotted frogs would be less than other alternatives. Fish would eventually be removed from lakes in the study area, resulting in long-term benefits to the frog. Lake treatment actions proposed under alternative D may affect, but are unlikely to adversely affect, Columbia spotted frogs.

Northern Red-Legged Frog (Federal Species Of Concern). Northern red-legged frogs would incur long-term beneficial effects under alternative D, and adverse impacts on the species would be minimal and restricted to lake treatment activities to remove fish from study area lakes. Northern red-legged frogs may be affected, but are unlikely to be adversely affected, from implementation of alternative D.

Tailed Frog (Federal Species of Concern). Tadpole and adult tailed frogs have been documented in the outlets of six lakes in the North Cascades Complex, including Upper Bouck and Nert lakes (Liss et al. 1995; Bury et al. 2000), which are currently stocked. The lakes would no longer be stocked under alternative D and would eventually become fishless. Some populations of tailed frogs have evolved in stream environments with fish predation (NPS, R. Glesne, pers. comm., 2003). In the North Cascades Complex, many populations are found in high-gradient tributaries that are inaccessible to fish. Under alternative D, threats to tailed frogs from predatory fish would cease. Removal of fish in Upper Bouck and Nert lakes would occur simply through discontinued stocking, and therefore, alternative D would have no impact on tailed frogs in the North Cascades Complex.

Western Toad (Federal Species of Concern, State Candidate Species). Impacts on Western toads from lake treatment would be similar to those discussed in alternatives B and C and would be limited to localized disturbances from human presence and habitat trampling. Western toads may be affected, but are unlikely to be adversely affected, by actions under alternative D. Western toads would benefit from elimination of fish in study area lakes.

Bull Trout (Federal Threatened). Bull trout may be affected, but are unlikely to be adversely affected, by actions under alternative D. The long-term process of fish removal would eventually eliminate any future threats to bull trout inhabiting downstream basins connected to high mountain lakes—a beneficial effect.

Chinook Salmon (Federal Threatened). Alternative D would provide long-term beneficial effects on Chinook salmon because most lakes would be treated for fish removal and no lakes would be stocked. As with other native fish species, Chinook salmon may be affected, but are unlikely to be adversely affected, by actions under alternative D. The long-term process of fish removal would eventually eliminate threats to Chinook salmon inhabiting downstream basins connected to high mountain lakes.

Coho Salmon (Federal Candidate Species, State Candidate Species). Alternative D would provide long-term beneficial effects on Coho salmon because most lakes would be treated for fish removal and no lakes would be stocked. As with other native fish species, Coho salmon may be affected, but are unlikely to be adversely affected, by actions under alternative D. The long-term process of fish removal would eventually eliminate threats to Coho salmon inhabiting downstream basins connected to high mountain lakes.

Westslope Cutthroat Trout (Federal Species of Concern). As with other native fish species, westslope cutthroat trout may be affected, but are unlikely to be adversely affected, by actions under alternative D. The long-term process of fish removal or reduction would eventually greatly reduce or eliminate threats to native fish inhabiting downstream basins connected to high mountain lakes—a beneficial effect.

State Listed and Other Special Status Wildlife Species. Under alternative D, six species (black-backed woodpecker, golden eagle, Lewis' woodpecker, merlin, pileated woodpecker, and Vaux's swift) may experience negligible to minor adverse impacts from lake treatment actions. Noise impacts from helicopters transporting lake treatment equipment or human presence may temporarily flush individuals of these state candidate species if they are near a lake when treatment activities are occurring, but this would not result in any detrimental impacts on these wildlife species.

The common loon (Washington State sensitive species) may be adversely affected under alternative D because stocked fish would be removed from Hozomeen Lake. Impacts would be the same as described for alternative B, which would be minor to moderate impacts on the pair of breeding loons that has nested at Hozomeen Lake since at least 1971. Adequate fish resources to support a family of loons may exist in nearby Ross, Ridley, and Willow lakes. Loons are declining in Washington due to loss of low-elevation lake habitat and associated human disturbances (Richardson et al. 2000). While the loss of habitat at Hozomeen Lake is unlikely to affect the overall population of common loons, at the local level, loons would be displaced from Hozomeen Lake and either would choose an adjacent area to nest or would discontinue to nest in the North Cascades Complex.

Cumulative Impacts

Cumulative impacts resulting from implementation of alternative D would be similar to those described for alternative A, but with extremely reduced effects to amphibians and native fish because of reduced fish densities and/or removal of reproducing nonnative fish in the North Cascades Complex.

Overall, the impacts associated with other projects, uses, and actions occurring in the region (as described under alternative A), added to the impacts predicted under alternative D, may affect, and are likely to adversely affect, certain special status species in the region on a cumulative basis. Actions under alternative D would provide beneficial effects from the reduction of nonnative fish species, which would help limit the extent of cumulative impacts to native fisheries. Cumulatively, the adverse impacts from development, water pollution, and other projects would adversely affect many special status species. In most cases, an accurate determination of the magnitude of cumulative impacts on special status species cannot be made because available information and research on species' biology, status, and distribution is insufficient. Additional research and population monitoring of special status species that would be affected by alternatives in this plan/EIS, combined with research completed in the region, would help to better determine cumulative impacts.

Conclusion

All fish stocking would be discontinued under alternative D. Short-term impacts related to lake treatments to remove fish would be minor, mostly due to noise from helicopters transporting lake treatment equipment and human disturbance during treatment activities. The use of the chemical, antimycin, to remove fish is not known to have adverse impacts on amphibians.

Based on the available information, alternative D would have ***no adverse effects on federally listed species*** from lake treatments to remove fish. Regarding ***federally listed species:***

> **22 species may be affected but are not likely to be adversely affected** (American peregrine falcon, California wolverine, Canada lynx, gray wolf, grizzly bear, little willow flycatcher, marbled murrelet, Northern goshawk, Northern spotted owl, olive-sided flycatcher, Pacific fisher, Yuma myotis, long-eared bat, bald eagle, harlequin duck, Cascades frog, Columbia spotted frog, northern red-legged frog, Western toad, bull trout, Chinook salmon, Coho salmon, and westslope cutthroat trout).
>
> **2 species would incur no effect** (Cascades frog and tailed frog).

Regarding ***state-listed species that are not federally listed***, 6 species would incur negligible to minor adverse impacts from noise related to fish removal activities, and the common loon would incur minor to moderate adverse impacts due to the removal of its primary food source from Hozomeen Lake.

Cumulative impacts on each special status species from projects or actions occurring throughout the region would be adverse; however, alternative D would contribute only a small increment to overall cumulative impacts.

Impairment of special status wildlife species across the study area would not occur under alternative D.

METHODOLOGY AND ASSUMPTIONS FOR SPECIAL STATUS PLANT SPECIES

Shoreline vegetation around lakes (riparian zones) may be sensitive to trampling by humans or stock (horses, mules, llamas). Many state special status plant species are expected to occur in riparian areas, although no surveys have been conducted to ascertain the presence or absence of these species at specific lakes (NPS, M. Bivin, pers. comm., 2004). In those lakes having riparian areas that include marshes, wet meadows, bogs, seeps, stream edges, and swamps, the probability of having special plant species is higher. Potential impacts on state special status plants were estimated utilizing a methodology similar to that used in the “Vegetation” section in this chapter. Three factors were considered in the analysis: vegetation type, presence or absence of fish in a lake, and accessibility of a lake to anglers.

Vegetation Type

The general type of vegetation found at the shoreline was used as a proxy for the presence of special status species because no surveys to determine which special status plant species are present at each lake have been conducted. For example, shorelines that are dominated by bedrock, talus, and/or snow are assumed to have less habitat for sensitive plant species. Because the vast majority of the state-listed special status plant species grow in areas classified as having meadow or shrub cover (see appendix M), there may be a greater likelihood that lakes with high percentages of these potentially sensitive cover types would face more severe impacts from angler use than those with less sensitive cover types (forest and bare). Analysis methods are qualitative and based on analysis of cover types from aerial photographs (this is described in the “Vegetation” section of the “Affected Environment” chapter). Because the estimates of cover types have not been checked through ground surveys, information about the actual communities surrounding the lakes is lacking; therefore, in order to assess the potential impacts of the alternatives presented under this plan/EIS, it was necessary to use these unverified cover estimates in this analysis.

Presence or Absence of Fish

Lakes that are not stocked are not likely to be visited for the purpose of fishing, and impacts caused by anglers at these lakes are expected to be negligible.

Accessibility of the Lakes to Anglers

Hendee et al. (1977, p. 10) found that the “ease of access, reflected by the distance and elevation gain to the lake, seemed to be directly related to the amount of use.” Trail access to the lake also influences the amount of visitation a lake receives. Most anglers prefer lakes with direct trail access, although some anglers prefer more remote and inaccessible lakes (WDFW, B. Pfeifer, pers. comm., 2004; C. Fowler, memorandum, 2003).

The number of visitors, as well as the activities in which those visitors participate, can influence the degree to which vegetation is impacted. Average annual backcountry overnight use was estimated based on backcountry permit data from 1999 to 2002, which indicated that the average annual backcountry overnight use for all camps and cross-country zones near the 91 study area lakes was approximately 4,035 visitors per season (see the “Fishing” section under “Visitor Use and Experience” in the “Affected Environment” chapter and also “Map 2” and “Map 2 Table” located in the envelope that accompanied this plan/EIS). Analysis of backcountry permit data for the 2003 season (NPS 2003C) indicates that approximately 10.5% of all overnight visitors to camps and cross-country zones intended to fish. Taking into account incomplete sampling due to dispersed access, highly variable and broad time of entry and departure, and purposeful or inadvertent avoidance of backcountry permit registration, a reasonable estimate of annual angling use of the study area lakes would be about 1,000 people per year. The day-use visitor survey performed in 2003 indicates that about 75 of the 1,432 day-use visitors were engaged in fishing at the study area lakes (see table 25 in the "Affected Environment" chapter). More information on visitor use would allow for a more accurate assessment of the impacts that anglers have on high mountain lakes. For the purpose of analyzing impacts on special status plant species, three levels of visitor use were defined.

Low: 0 to 34 visitors of which 0 to 4 were estimated to be anglers

Medium: 35 to 99 visitors of which 4 to 10 were estimated to be anglers

High: 100 to 450 visitors of which 11 to 47 were estimated to be anglers

It is important to reiterate that impacts on special status plant species are unknown, and even very light visitor or angler use at a given lake (see the "Map 2 Table") would result in major localized impacts on a particular species. This is because any trampling of even a very small population of a rare plant has the potential to have a major impact on the species; however, their rarity may also decrease the likelihood of anglers coming into contact with the plants and may serve to protect localized pockets of a plant species from impacts associated with fishing. Without plant surveys or visitor use information, the impact analysis must be based on the assumptions stated above. Actions that can be taken to reduce impacts include surveys and subsequent monitoring of indicator or rare plants at lakes before management actions are implemented, erecting signs and fencing, relocating (or even closing) trail access, and establishing other important mitigation measures.

Beyond the loss of plants through trampling, angler use may cause indirect effects such as erosion and sedimentation, alteration of plant communities, and alteration of food and nutrient inputs to surrounding lakes and creeks. In some cases, bare ground may be exposed leading to soil erosion in subalpine and alpine areas where natural recovery is difficult, and restoration efforts require years of work. Additionally, trampling may lead to changes in site hydrology, which may exclude sensitive wetland species from impacted sites. Due to lack of data for both trail and off-trail lake access by anglers, it was not possible to assess the impact anglers have non-lakeshore communities that visitors travel through to reach the lakes.

FEDERALLY LISTED PLANTS

No federally listed plant species or species proposed for listing occur in the North Cascades Complex, therefore, none of the activities described in any of the alternatives would affect federally listed plant species.

IMPACT THRESHOLD DEFINITIONS FOR STATE LISTED SPECIAL STATUS PLANT SPECIES

The following thresholds were used to evaluate the degree of impact from fishery management activities on state listed special status plant species:

Negligible. Impacts would have no measurable or perceptible changes in plant community size, integrity, or continuity.

Minor. Impacts would be measurable or perceptible but would be localized within a relatively small area. The overall viability of the plant community would not be affected and, if left alone, would recover.

Moderate. Impacts would cause a change in the plant community (such as its abundance, distributions, quantity, or quality); however, the impact would remain localized.

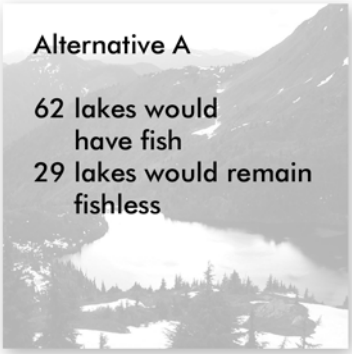
Major. Impacts on the plant community would be substantial, highly noticeable, and permanent.

Impairment. The action would contribute substantially to the deterioration of special status plant species in the North Cascades Complex to the extent that the special status plants would no longer function within a natural system. In addition, these adverse major impacts on the North Cascades Complex's resources and values would

> contribute to deterioration of special status plant resources and values to the extent that the purpose of the North Cascades Complex would not be fulfilled as established in its enabling legislation
>
> affect resources key to the natural or cultural integrity or opportunities for enjoyment in the North Cascades Complex
>
> affect the resource whose conservation is identified as a goal in the *General Management Plan* (NPS 1988b) or other planning documents for the North Cascades Complex

IMPACTS OF THE ALTERNATIVES ON SPECIAL STATUS PLANT SPECIES

ALTERNATIVE A (NO ACTION): EXISTING MANAGEMENT FRAMEWORK OF 91 LAKES (62 LAKES HAVE FISH)



Alternative A (no action) would continue existing management practices in the 91 lakes in the study area. The “Alternatives” chapter provides a detailed description of alternative A. For more information on the 91 lakes, refer to table 5 and figure 4 in the “Alternatives” chapter and appendix E.

No federally listed plant species occur in the North Cascades Complex. State-listed special status plant species occur in the North Cascades Complex (see appendix C, table C-2), although no surveys have been undertaken to determine the presence or absence of these species at specific lakes. Therefore, it is unknown whether any particular species exists at a given lake. Appendix C provides an overview of state of Washington special status plant species and potential habitats. More than half of the species listed in this appendix may occur as shoreline vegetation including marshes, wet meadows, bogs, seeps, stream edges, and swamps. Those lakes with a higher percent ground cover of meadow (see appendix M) are more likely to provide habitat for these species, and generally, the likelihood of impact from trampling would be higher. In addition, low woody species with brittle stems (e.g., *Salix* spp.) and tree seedlings are resistant to low levels of trampling but recover slowly following damage at high levels of trampling (Cole and Trull 1992). Lakes with a higher percentage of shrub ground cover are more likely to provide habitat for these species and may also be impacted at higher levels than areas with no cover (bare).

Impacts of Current Fish Stocking on State-Listed Special Status Plant Species

Using methodology similar to that described for the “Vegetation” section in this chapter, of the 62 lakes available for fishing under alternative A, 52 are classified as having meadow and 7 are classified as having shrub cover in the shoreline vegetation (see appendix M). For the lakes with these types of shoreline cover, and that experience low visitor use, fish stocking has and may continue to have only negligible to minor adverse impacts on any special status plant species. For the remainder of lakes receiving medium to high visitor use (visitor use levels can be found on “Map 2 Table”), continued fish stocking would result in short-term negligible to major adverse impacts on any state special status species that might grow in the shoreline environment. For the lakes with no shoreline classified as meadow or shrub, adverse impacts on any state special status species may be negligible to moderate. It was not possible to determine if any of these communities include any state-listed special status species, which is why the range of potential impacts is so broad.

Impacts of Lake Treatment Methods on State-Listed Special Status Plant Species

No lakes are proposed for fish removal under alternative A; therefore, impacts would be negligible.

Cumulative Impacts

Visitor use is expected to follow the same patterns that it has for several years. Trampling by horses, mules, or llamas may also occur in areas around lakes. This trampling, combined with angler use, other visitor use, and fish stocking, is likely to result in minor to moderate cumulative impacts at some lakes and moderate to major at others, depending on the intensity of use and location of sensitive plant species.

Conclusion

Fish-stocking activities at lakes with shoreline meadow or shrub vegetation would have short-term negligible to minor adverse impacts on any special status plants in the shoreline areas of lakes in zones or near camps with low visitor use. Stocking activities at lakes in zones or near camps with medium to high visitation would result in short-term negligible to major adverse impacts on any special status plants.

No lakes are treated for fish removal under alternative A.

Trampling by stock (horses, mules, llamas) and visitors (anglers and other visitors) would likely result in minor to moderate cumulative impacts at some lakes and moderate to major at others, depending on the intensity of use and location of sensitive plants.

Impairment of special status plant species across the study area would not occur under alternative A.

Alternative B: Proposed Adaptive Management of 91 Lakes under a New Framework (42 Lakes May Have Fish) (Preferred Alternative)

The goal of this alternative is to eliminate or reduce reproducing fish from select lakes in the study area. Forty-two lakes would potentially be available for fishing. Of these, 29 lakes would continue to have fish, and 13 lakes would be evaluated for restocking. Twenty lakes would revert to fishless conditions, and the 29 currently fishless lakes would remain fishless. The "Alternatives" chapter provides a detailed description of alternative B. For more information on the 91 lakes, refer to tables 5 and 10 in the "Alternatives" chapter and appendix E. For additional information on shoreline vegetation, see the "Vegetation" section in this chapter and appendix M.

Alternative B

29 lakes would have fish
49 lakes would be fishless
13 lakes would be evaluated for restocking

Of the 42 lakes that may potentially be available for fishing (refer to table 10), 35 have some amount of meadow shoreline vegetation. Twenty-two of the 35 lakes are within cross-country zones or near camps that experience medium or high visitor use, and impacts may remain negligible to moderate over time. The other 13 lakes that have meadow vegetation, and may potentially be available for fishing under this alternative, have fewer than 34 annual visitors in a given year and very little trail access. Impacts on state-listed special status plant species at these 13 lakes may be negligible or minor.

Impacts of Proposed Fish Stocking on State-Listed Special Status Plant Species

Alternative B proposes the discontinuation of stocking or removal of fish in 44 lakes, as well as the restocking of 24 of those lakes after evaluation or monitoring (refer to tables 5 and 10 in the "Alternatives" chapter). Twenty-one of the 24 lakes that may be restocked have some meadow vegetation around the shore that is vulnerable to trampling (3 of the 24 lakes have no meadow vegetation at present). Should the 21 lakes be restocked, impacts would not change from what they are now. Fourteen of the 21 lakes are within cross-country zones or near camps that have medium or high levels of visitor use, with the possibility of short-term negligible to moderate adverse impacts on meadow vegetation. Seven of the 21 lakes that may be restocked are within zones or near camps that have low visitor use and may experience negligible or minor impacts on meadow riparian vegetation. If the lakes are not restocked, negligible to moderate beneficial effects on meadow vegetation may occur.

Impacts of Proposed Lake Treatment Methods on State-Listed Special Status Plant Species

The use of mechanical or chemical method to remove fish would involve trampling of riparian or wetland vegetation, but mitigation measures described in appendix I would be implemented; those include maximizing the use of boats or wading in the lake to avoid sensitive lakeside vegetation. With mitigation measures in place, the impact of fish removal activities on state-listed plants would be negligible to minor.

Natural Methods. A total of 12 lakes under alternative B would receive natural treatment to remove fish. Natural treatment is the cessation of stocking, which over time would mean the die-off of all fish in a lake. During this period of die-off, fishing and any associated trampling would continue with impacts as described above; however, a similar and permanent benefit from the eventual elimination of all angler-related foot traffic would eventually occur.

Mechanical Methods. Mechanical methods would be used to treat up to 8 lakes. Impacts on state special status plant species would likely be short term and range from negligible to minor if personnel involved in removing fish are trained to avoid state-listed special status plant species.

Chemical Method. Chemical treatment is proposed for 19 lakes. There would be a short-term negligible impact on state special status plant species from human activity in an area during chemical removal of reproducing fish, but the proposed chemicals should have no effect on plant species.

Cumulative Impacts

Visitor use beyond angling is expected to follow the same patterns that it has for several years. Trampling by horses, mules, or llamas may also occur in areas around lakes. This trampling, combined with angler use, other visitor use, and lake treatment and fish stocking activities, would result in negligible cumulative impacts on state-listed special status plant species at some lakes and moderate or major cumulative impacts at other lakes, depending on the intensity of use and location of sensitive plants.

Conclusion

Fewer lakes would be stocked under alternative B. Trampling during stocking activities may result in short-term negligible to moderate adverse impacts on any special status plants that may be present in the shoreline of lakes that are in cross-country zones or near camps that receive medium to high use, and negligible to minor adverse impacts at lakes in zones or near camps that have low visitor use. There would long-term beneficial effects on special status plant species at lakes where stocking would not occur.

Select lakes would be treated for fish removal under alternative B. Trampling during mechanical and chemical lake treatment activities may result in short-term negligible to minor adverse impacts on any special status plants that may be present in the shoreline of lakes that are in cross-country zones or near camps that receive medium to high visitor use, and negligible to minor adverse impacts at lakes in zones or near camps that have low visitor use.

Trampling by stock (horses, mules, llamas) and visitors (anglers and other visitors) would likely result in negligible cumulative impacts at some lakes and moderate to major at others depending on the intensity of use and location of sensitive plants.

Impairment of special status plant species across the study area would not occur under alternative B.

Alternative C: Proposed Adaptive Management of 91 Lakes under a New Framework (11 Lakes May Have Fish)

Alternative C

9 lakes would have fish
80 lakes would be fishless
2 lakes would be evaluated for restocking

Under alternative C, 9 lakes in Ross Lake and Lake Chelan National Recreation Areas would have fish and 2 lakes would be evaluated for restocking. Eleven other lakes in the national recreation areas would remain fishless or be returned to fishless conditions. The remaining 69 lakes (which are in the national park) would be returned to their natural fishless conditions or would remain fishless.

The “Alternatives” chapter provides a detailed description of alternative C. For more information on the 91 lakes, refer to tables 5 and 12 in the “Alternatives” chapter and appendix E.

Impacts of Proposed Fish Stocking on State-Listed Special Status Plant Species

There would potentially be 80 lakes unavailable for fishing in alternative C, as opposed to 29 in alternative A. This alternative would benefit state-listed plant species.

Currently, of the 9 lakes that would remain available for fishing, 3 are classified as having at least some meadow, wetland, or shrub cover in its shoreline vegetation and are classified as high- to moderate-use areas. Impacts from sport fishing may be negligible to major at these lakes. The remaining lakes experience low visitor use and/or have no shoreline classified as meadow, wetland, or shrub. These lakes are more likely to experience negligible to moderate impacts on state-listed plant species.

Impacts of Proposed Lake Treatment Methods on State-Listed Special Status Plant Species

Fifty-five lakes are proposed for fish removal under alternative C.

Natural Methods. Twenty-one lakes would be treated with natural methods to remove fish. Natural treatment is usually the cessation of stocking, which over time would mean the die-off of all fish in a lake. During this period of die-off, angling and any associated trampling would continue with impacts as described above; however, a similar and permanent benefit from the eventual elimination of all angler-related foot traffic would eventually occur.

Mechanical Methods. Mechanical treatment is proposed for up to 10 lakes. Impacts on state special status plant species would be short-term negligible to minor if personnel involved in removing fish were trained to avoid state-listed special status plant species.

Chemical Method. A total of 25 lakes are proposed for chemical treatment. There would be a short-term negligible impact on state-listed species from human activity associated with chemical removal of reproducing fish, but the proposed chemicals should have no effect on plant species.

Cumulative Impacts

Visitor use is expected to follow the same patterns that it has for several years. Trampling by horses, mules, or llamas may also occur in areas around lakes. This trampling, combined with decreases in angler use, would result in negligible to minor cumulative impacts, depending on the intensity of use and location of sensitive plants. These impacts over the long term would be reduced to a negligible level as lake treatments are completed, although more serious impacts resulting from non-angler visitor use would still be possible.

Conclusion

Considerably fewer lakes would be stocked under alternative C than under alternatives A and B. Trampling during stocking activities may result in short-term negligible to moderate adverse impacts on any special status plants that may be present in the shoreline of lakes that are in cross-country zones or near camps that receive medium to high use, and negligible to minor adverse impacts at lakes in zones or near camps that have low visitor use. There would long-term beneficial effects on special status plant species at lakes where stocking would not occur.

A higher number of lakes would be treated for fish removal under alternative C than under alternative B. Trampling during mechanical and chemical lake treatment activities may result in short-term negligible to minor adverse impacts on any special status plants that may be present in the shoreline of lakes that are in cross-country zones or near camps that receive medium to high use, and negligible to minor adverse impacts at lakes in zones or near camps that have low visitor use.

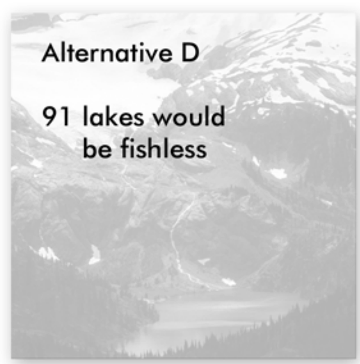
Trampling by stock (horses, mules, llamas) and visitors (anglers and other visitors) would likely result in negligible to minor cumulative impacts depending on the intensity of use and location of sensitive plants. These impacts over the long term would be reduced to a negligible level as lake treatments are completed.

Impairment of special status plant species across the study area would not occur under alternative C.

ALTERNATIVE D: 91 LAKES WOULD BE FISHLESS

Under alternative D, all 91 lakes would be fishless.

The “Alternatives” chapter provides a detailed description of alternative D. For more information on the 91 lakes, refer to tables 5 and 13 in the “Alternatives” chapter and appendix E.



All lakes potentially would be unavailable for fishing in alternative D, as opposed to 62 in alternative A; therefore, this alternative is most likely to benefit state special status plant species because sport fishing would eventually be eliminated in the study area lakes.

Under this alternative, there would be a widespread beneficial effect.

Impacts of Proposed Fish Stocking on State-Listed Special Status Plant Species

Stocking would not occur in any of the study area lakes.

Impacts of Proposed Lake Treatment Methods on State-Listed Special Status Plant Species

Sixty-two lakes are proposed for fish removal under alternative D.

Natural Methods. A total of 26 lakes would receive natural treatment to remove fish. Natural treatment is usually the cessation of stocking, which over time would mean the die-off of all fish in a lake. During this period of die-off, angling and any associated trampling would continue with impacts as described above; however, a similar and permanent benefit from the eventual elimination of all angler-related foot traffic would eventually occur.

Mechanical Methods. Up to 11 lakes are proposed for mechanical treatment. Impacts on state special status plant species would be short-term negligible to minor if personnel involved in removing fish were trained to avoid state-listed special status plant species.

Chemical Method. A total of 25 lakes are proposed for chemical treatment. There may be a short-term negligible impact on state-listed species from human activity associated with chemical removal of reproducing fish, although the proposed chemicals themselves should have no effect on plant species.

Cumulative Impacts

Visitor use is expected to follow the same patterns that it has for several years. Trampling by horses, mules, or llamas may also occur in areas around lakes. Decreases in angler use may offset some of these continuing impacts, but the possibility of negligible to minor cumulative impacts on state special status plant species from activities not related to angling would remain. These impacts over the long term would be reduced to a negligible level as lake treatments are completed.

Conclusion

Fish stocking would not occur under alternative D, which would result in long-term beneficial effects on special status plant species.

Mechanical and chemical lake treatment activities to remove fish would result in short-term negligible to minor adverse impacts.

Trampling by stock (horses, mules, llamas) and visitors would likely result in negligible to minor cumulative impacts depending on the intensity of use and location of sensitive plants. These impacts over the long term would be reduced to a negligible level as lake treatments are completed.

Impairment of special status plant species across the study area would not occur under alternative D.

VEGETATION

GUIDING REGULATIONS AND POLICIES

The *General Management Plan* (NPS 1988b) includes the following management objectives that are relevant to overall natural resources for the North Cascades Complex, including vegetation:

> To increase knowledge and understanding of the interrelationships of the natural processes, and of methods for implementation of appropriate actions.
>
> To preserve, maintain, or restore, where feasible, the primary natural resources and those ecological relationships and processes.
>
> To manage the natural resources as an integral part of a regional ecosystem.
>
> To provide opportunity for research in as natural a system as possible.

The *Strategic Plan* (NPS 2000a) also includes goals for preserving park resources that are consistent with the goals and objectives of this analysis. Mission Goal I.a. states, "Natural and cultural resources and associated values of the North Cascades National Park Service Complex are protected, restored, and maintained in good condition and managed within their broader ecosystem and cultural context."

Servicewide NPS regulations such as the *Organic Act of 1916* and the *NPS Management Policies* (NPS 2001a) also direct parks to provide for the protection of park resources, including shoreline vegetation. The *NPS Management Policies* state that "Where human activities or structures have altered the nature or rate of natural shoreline processes, the Service will, in consultation with appropriate state and federal agencies, investigate alternatives for mitigating the effects of such activities or structures and for restoring natural conditions."

METHODOLOGY AND ASSUMPTIONS FOR VEGETATION

A primary concern identified in the public scoping process was that of adverse effects of fish stocking on native plant species near mountain lakes. All visitors to the mountain lakes in the North Cascades Complex may impact shoreline vegetation through (1) trampling by humans or stock (horses, mules, or llamas); (2) activities associated with camping; (3) activities associated with fishing; and (4) indirect impacts, which can include increased erosion and sedimentation rates, depending on the particular shoreline cover surrounding a lake. These impacts may be long term because vegetation grows slowly in the short growing season of the mountains, and soil compaction or erosion makes regrowth of vegetation even more difficult.

SOURCES OF INFORMATION

In order to assess impacts associated with fish stocking and angling, it was necessary to consider (1) which plant communities are found in areas likely to be affected by fishery management actions described in the alternatives, and (2) effects of angling on different plant communities above and beyond effects of other visitors.

Plant communities around the shoreline of study area lakes (see appendix M) were described using aerial photos. Lake perimeter distance was estimated by on-screen digitizing of shoreline distance using 1:12000 black and white Digital Orthophoto Quads. Lakeshore vegetation cover types were estimated from 1:12000 color photos (false color infrared) analyzed in stereo (3-dimensional). Cover-type values are percentages of the total perimeter for each lake within an 82-foot buffer defined as the riparian zone. The photographs were taken in August 1998 (NPS 2003a). It is important to note that the aerial photos only offer large-scale estimates of cover and have not been checked through ground observations; therefore, precise information about the actual vegetation communities surrounding the lakes is lacking. Impact predictions are characterized as ranges (for example, minor to moderate) primarily for this reason.

In addition, the data available on lake visitation by anglers versus all other recreational users is incomplete and sometimes contradictory. In a study of high mountain lakes conducted by Hendee et al. (1977), the researchers concluded that "manipulating the fishery to modify visitation at high lakes is, at best, a partial solution" because other visitors would continue to affect the resources. Many anglers observed and interviewed during the course of the study cited reasons other than fishing as their primary motivation for visiting the lakes, which suggests that their use patterns may not change as a result of fish removal. On the other hand, research conducted in the late 1980s by Hospodarsky and Brown (1992) suggests that anglers spent three times longer in riparian zones than other user groups. The researchers hypothesized that if time spent in the riparian zone were proportionate to impacts, then anglers would have up to three times as great an impact as hikers (Hospodarsky and Brown 1992). This hypothesis has yet to be tested. It is also important to note that many anglers fish with rafts, which limits trampling of riparian vegetation (WDFW 2001).

Perennating: to survive from one growing season to the next with reduced or arrested growth between seasons.

Scientific literature was consulted to obtain additional information that factors into the impact analysis. Work done by Cole and Trull (1992) shows that both plant stature and location of perennating tissues at or below the ground, influence the ability of vegetation types to resist and recover from trampling. Tall, tough, woody shrubs and grasses that occur in bunches or as turf (for example, *Carex* spp.) were most resistant to damage by trampling. Low, woody species with brittle stems (such as *Phyllodoce* spp.) and tree seedlings resisted low levels of trampling but were sensitive to high levels of trampling. Broad-leaved herbaceous species were most sensitive to the effects of trampling. Species that recovered most quickly following damage were fast-growing herbaceous species or tufted or turf-producing grasses. Woody species, as well as more uncommon broad-leaved species that suffered damage to their regenerative tissues recovered more slowly following damage.

Potential indirect impacts of trampling include increased erosion and sedimentation rates associated with loss of roots and the plants' ability to hold soils and compaction of riparian soils. Reduced lakeshore vegetation may reduce organic matter input, thereby altering patterns of nutrient cycling. Terrestrial insects and other organisms that get into the lake and become prey to aquatic organisms may also be affected indirectly through loss of shoreline vegetation that serves as habitat. There are no data on the levels of indirect impacts anglers may have on lakeshore environments; therefore, it was only possible to describe the impact qualitatively.

The trampling of vegetation and creation of social trails are a common problem, especially in subalpine areas. Photo is of Sahale Arm with Doubtful Lake in the background (date unknown).

Anglers and other visitors traveling cross-country or off trail to reach certain remote lakes would adversely affect vegetation, but there is no available information on the degree of impact or even the vegetative communities where such an impact might take place. The WDFW believes that no conclusions are possible; however, comparative conclusions are common in environmental impact statements. The impact is, therefore, considered a possibility and described qualitatively, but no assessment on the degree of impact is possible.

ASSUMPTIONS

As noted above, the number of visitors, as well as the activities in which those visitors participate, can influence the degree to which vegetation is impacted. Since neither data specific to particular plant communities nor particular impacts of anglers at the 91 study area lakes were available, the potential impact to plant communities around mountain lakes was tied to the fishing potential of a given lake, the level of visitor use in the cross-country zones or established camps near the 91 lakes, and the cover types that are present in the 82-foot riparian zone surrounding the lakes in the study area.

Average annual backcountry use was estimated based on backcountry permit data from 1999 to 2002. The data are not lake specific but based on backcountry overnight use permits issued for cross-country zones or camps located near lakes. Data from the backcountry overnight use permit database for 2003 suggest that anglers comprise about 10.5% of all backcountry overnight visitors to the 91 lakes in the study area (NPS 2003c). Data on day use by anglers was estimated for 7 of the lakes (refer to table 25 in the "Affected Environment" chapter). More information on visitor use would allow for a more accurate assessment of the impacts that anglers have on specific mountain lakes. For the purpose of analyzing the impacts on vegetation, three levels of visitor use were considered (see appendix M for shoreline cover data and "Map 2" and "Map 2 Table" for more information on the average annual overnight visitation at the 91 lakes).

Low: 0 to 34 visitors of which 0 to 4 were estimated to be anglers

Medium: 35 to 99 visitors of which 4 to 10 were estimated to be anglers

High: 100 to 450 visitors of which 11 to 47 were estimated to be anglers

Trail and stock (horses, mules, llamas) access to lakes may result in trampling of vegetation and changes in the hydrology of impacted sites. Although trail and stock access would influence the extent of shoreline impacts to a given lake, it is difficult to identify those lakes that hold an increased interest to anglers; therefore, no assumptions in this regard were considered valid and none were made.

The following assumptions regarding vegetative cover were made based on the aerial surveys described above under "Sources of Information" (appendix M lists the shoreline cover types for the 91 lakes in the study area).

> Deciduous and/or coniferous trees are dominant in the forest cover type.
>
> Shrub cover type is characterized by the predominance of woody shrubs.
>
> Meadow cover describes areas where forbs and graminoids (grasses) are dominant, but may include low-lying shrubs as well.
>
> Areas that are not vegetated are assigned to the bare cover type and include exposed bedrock, talus slopes, and cliffs (talus slopes may contain plants, but the frequencies at which they occur have not been quantified; therefore, talus slopes are included in the bare cover type [Liss 1995; NPS, M. Bivin, pers. comm., 2004]).

Deciduous: Trees that lose their leaves at the end of the growing season; also called hardwoods.

Methods Used to Analyze Impacts

For a given lake, impacts on vegetation were determined using the following methods:

Classifying the type of shoreline surrounding the lake. For example, shorelines that are dominated by bedrock, talus, and/or snow may not be as sensitive to trampling as lakeshores with an abundance of low meadow vegetation or low-lying shrub species that recover slowly following damage. At lakes that have high percentages of potentially sensitive cover types (that is, shrub and meadow types), the vegetation is more likely to face more severe impacts due to angler use than at those lakes with less sensitive cover types (bare of vegetation).

Identifying whether or not the lake provides a fishing opportunity. Evidence suggests that anglers use riparian areas more extensively than other visitors. Lakes with fish are likely to experience a greater impact on riparian community types than fishless lakes. For those fishless lakes that are to remain fishless in all alternatives, the potential impacts on vegetation would be negligible and would resemble other lakes in the park where fishing does not occur.

Identifying those lakes where stock (horses, mules, llamas) have direct access to the shoreline and the lake. Although it is extremely difficult to identify one type of user as the reason for shoreline impacts, lakes such as McAlester Lake are known to have impacts from stock associated with the shoreline vegetation of the lake. If a lake is available for fishing, has stock access, and has a high percentage of cover types that are sensitive to trampling (i.e., huckleberry-heather shrub communities), impacts would be greater than at other lakes that do not have these factors associated with them (refer to table 23 in the "Affected Environment" chapter for lakes accessible by horseback).

Identifying those lakes that are most accessible. Hendee et al. (1977) found that the “ease of access, reflected by the distance and elevation gain to the lake, seemed to be directly related to the amount of use.” Trail access to the lake also influences the amount of visitation a lake receives. Most anglers prefer lakes with direct trail access, although some anglers prefer more remote and inaccessible lakes (WDFW, B. Pfeifer, pers. comm., 2004; WDFW, B. Fowler, pers. comm., 2003).

DEFINITIONS OF INTENSITY LEVELS

Negligible. Impacts would have no measurable or perceptible changes in plant community size, integrity, or continuity.

Minor. Impacts would be measurable or perceptible but would be localized within a relatively small area. The overall viability of the plant community would not be affected and, if left alone, would recover.

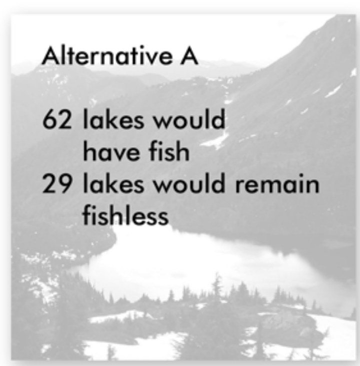
Moderate. Impacts would cause a change in the plant community (such as abundance, distributions, quantity, or quality); however, the impact would remain localized.

Major. Impacts on the plant community would be substantial, highly noticeable, and permanent.

Impairment. The action would contribute substantially to the deterioration of vegetation in the North Cascades Complex to the extent that vegetation would no longer function as a natural system. In addition, these adverse major impacts on the North Cascades Complex’s resources and values would

- contribute to deterioration of these resources to the extent that the North Cascades Complex’s purpose would not be fulfilled as established in its enabling legislation
- affect resources key to the North Cascades Complex’s natural or cultural integrity or opportunities for enjoyment
- affect the resource whose conservation is identified as a goal in the *General Management Plan* or other planning documents for the North Cascades Complex

IMPACTS OF THE ALTERNATIVES ON VEGETATION



ALTERNATIVE A (NO ACTION): EXISTING MANAGEMENT FRAMEWORK OF 91 LAKES (62 LAKES HAVE FISH)

The current mountain lakes fishery management activities at the North Cascades Complex, which are described in the “Alternatives” chapter, would continue under the no-action alternative. For more information on the 91 lakes, refer to table 5 and figure 4 in the "Alternatives" chapter, appendix E, appendix M, and "Map 2" and "Map 2 Table" located in the envelope that accompanied this document.

Impacts of Current Fish Stocking on Vegetation (Riparian Vegetation)

A well-used campsite at Stout Lake.

Trampling from visitor use, including hiking, fishing and stock (horses, mules, llamas) use, would continue at current levels or worsen around the shorelines of well-used lakes if alternative A were selected. The degree of these impacts would vary and range from negligible to moderate depending on the factors identified under "Methodology and Assumptions" in this section; these factors include the type and extent of vegetation, access, fishing potential, availability of overnight camping, and stock access. Impacts would be more likely where a lake's shoreline is covered in meadow or wetland vegetation. Of the 62 lakes that would continue to have fish in this alternative, 52 lakes are classified as having from 2% to 76% meadow in the shoreline; cover data is absent for one lake.

Of the 52 lakes that contain fish and have shoreline meadow vegetation, 20 lakes are located in cross-country zones or are near established camps that have low visitor use—continued fish stocking is expected to have only negligible adverse impacts on vegetation at these lakes. Another 19 lakes with shoreline meadow vegetation are in zones or near camps that have a medium level of visitor use—continued fish stocking in these lakes would result in negligible to minor adverse impacts on meadow vegetation. Negligible to moderate adverse impacts on shoreline meadow vegetation would occur at 13 lakes that are in cross-country zones or near camps that receive high visitor use.

The backcountry overnight use permit data are not lake specific but based on backcountry overnight use permits issued for cross-country zones or camps near the 91 lakes in the study area.

These assessments of impacts are broad for several reasons. Because impacts due to anglers alone have not been investigated, it is difficult to determine how continued fish stocking may affect riparian communities. A single angler who spends the majority of the time in meadow or shrub communities would potentially have a significant local impact on sensitive vegetation. Anglers who use rafts and limit the time spent along the shoreline would unlikely have more than a negligible impact on the riparian vegetation of the lakes they visit.

Negligible to moderate adverse impacts would occur at the 7 lakes where shrub communities are present and meadow communities are not. It is not possible to determine if more resistant high-stature shrubs (such as willows) or sensitive low-lying shrubs (such as heather and huckleberry) are dominant at individual lakes, which is why the range of potential impact is broad. Forest cover dominates shoreline at one lake that experiences low visitor use, and thus, fish stocking may have negligible adverse impacts. Forest cover is dominant at 2 lakes that experience high visitor use; the effects of continued fish stocking at these lakes would be negligible to minor and adverse. One lake with fish is classified as having only the bare cover type in the riparian zone, so impacts at this lake would be negligible.

The 29 lakes that are currently fishless experience negligible impacts from fish stocking.

Impacts of Lake Treatment Methods on Vegetation (Riparian Vegetation)

No lakes are currently treated or would be treated for fish removal in the future under alternative A; therefore, impacts would be negligible.

Impacts of Other Mitigation

To reduce effects of visitors (including anglers) on shoreline vegetation and on other visitors' wilderness experience, additional visitor education efforts toward leave-no-trace visits would be instituted. This would decrease the overall adverse impacts to those lakes with an abundance of meadow and shrub cover types depending on the effectiveness of the campaign on the visitors to these lakes.

Cumulative Impacts

Under alternative A, cumulative impacts on shoreline vegetation from other recreationists may be negligible to moderate when added to those from angler use. Although use by anglers and other visitors (including visitors with stock—horses, mules, or llamas) may increase in the future, there is little likelihood that their shoreline activities would affect the overall integrity of the plant community greater than moderate impacts. No projects are proposed or in planning stages that would change the road access to any unit of the North Cascades Complex, and no new trails or trailheads are being considered; consequently, there would be no increase in impacts resulting from new trails to the mountain lakes in the North Cascades Complex.

Conclusion

Fifty-nine of the 62 lakes in the study area where fishing would continue have meadow and/or shrub vegetation. Of these, about 75% have low to medium visitation, and vegetation would experience only negligible impacts. The remaining 25% that have high visitation would continue to experience minor to moderate, long-term, adverse impacts from trampling. Forest shoreline vegetation would generally not be affected more than a negligible or minor level from visitor use, including angling. Cumulative impacts would be negligible to moderate and adverse over the long term.

Impairment of vegetation across the study area would not occur under alternative A.

ALTERNATIVE B: PROPOSED ADAPTIVE MANAGEMENT OF 91 LAKES UNDER A NEW FRAMEWORK (42 LAKES MAY HAVE FISH) (PREFERRED ALTERNATIVE)

Impacts of Proposed Fish Stocking on Vegetation (Riparian Vegetation)

Alternative B

29 lakes would have fish
49 lakes would be fishless
13 lakes would be evaluated for restocking

In alternative A, 62 lakes are available for fishing, and of these, 52 have meadow vegetation in the shoreline. Not all of the vegetation is equally vulnerable to trampling by visitors because visitor use, fish stocking practices, and access differ. In alternative B, fewer lakes would be available for fishing, and a new category of management prescriptions, that of monitoring to determine future activities, would be added.

Under alternative B, up to 20 lakes would be permanently returned to fishless conditions. Of these lakes, 16 do have some meadow vegetation, and all would experience negligible to moderate benefits from a reduction in visitor use attributable to fishing. Nine of the lakes are in areas that have medium or high levels of visitor use and/or trails leading to the lakes. Although reducing fishing opportunities at these lakes may benefit riparian vegetation to a greater degree than those where visitor use is low, it is also likely that at least some may experience high levels of use that are unrelated to fishing. In these cases, meadow shoreline vegetation may continue to experience minor or moderate impacts.

As in all alternatives, the 29 currently fishless lakes would remain fishless, with continuing possible negligible impacts from past stocking and trampling and loss of lakeside vegetation.

All reproducing fish would be removed from McAlester Lake, and monitoring would help determine whether to restock.

Alternative B proposes the discontinuation of stocking or removal of fish in 44 lakes, as well as the restocking of 24 of those lakes after evaluation or monitoring (refer to tables 5 and 10 in the "Alternatives" chapter). Twenty-one of the 24 lakes that may be restocked have some meadow vegetation around the shore that is vulnerable to trampling (3 of the 24 lakes have no meadow vegetation at present). Should the 21 lakes be restocked, impacts would not change from what they are now. Fourteen of the 21 lakes are within cross-country zones or near camps that have medium or high levels of visitor use, with the possibility of negligible to moderate impacts on meadow vegetation. Seven of the 21 lakes that may be restocked are within zones or near camps that have low visitor use and may experience negligible or minor impacts on meadow riparian vegetation. If the lakes are not restocked, negligible to moderate beneficial effects on meadow vegetation may occur.

Of the 42 lakes that may potentially be available for fishing (refer to table 10), 35 have some amount of meadow shoreline vegetation. Twenty-two of the 35 lakes are within cross-country zones or near camps that experience medium or high visitor use, and impacts may remain negligible to moderate over time. The other 13 lakes that have meadow vegetation, and may potentially be available for fishing under this alternative, have fewer than 34 annual visitors in a given year and very little trail access. Impacts on vegetation at these 13 lakes may be negligible or minor.

Negligible to moderate adverse impacts are expected for the 6 lakes that would continue to have fish or would be restocked and where shrub communities are present and meadow communities are not. It was not possible to determine if more resistant high-stature shrubs (such as willows) or sensitive low-lying shrubs (such as heather and huckleberry) are dominant at individual lakes, which is why the range of potential impact is broad. Forest cover is dominant at 1 lake that experiences high visitor use; the effects of continued fish stocking at this lake may be minor and adverse.

Impacts of Lake Treatment Methods on Vegetation

Natural Methods. Natural methods would be used to remove fish from 12 lakes. Ongoing impacts from sport fishing would continue until fishing is no longer satisfactory to anglers and fish are no longer present, after which time, conditions would likely improve.

Mechanical Methods. Mechanical methods would be used to treat up to 8 lakes. One lake is proposed for spawning habitat exclusion. A 30-foot section of spawning habitat would be covered with rock taken from a nearby talus slope and moved by hand to the lake. Adverse impacts on meadow vegetation from covering vegetation with rock and from trampling would be minor to moderate and short-term. Setting gillnets and using electroshocking equipment would result in some trampling, although mitigation by avoiding vegetation and wading near the shore rather than walking through shoreline vegetation would reduce the impact to negligible or minor and short term.

Chemical Methods. Chemical treatment is proposed for 19 lakes. There would be a negligible impact on vegetation from chemical removal of reproducing trout.

Impacts of Other Mitigation

Impacts of other mitigation would be similar to those under alternative A. Additional signs would be posted in riparian areas that were most heavily used to allow for recovery of vegetation. Furthermore, using an adaptive management approach for lakes to be evaluated would provide an opportunity to monitor the level of impact anglers have on vegetation, and possibly make fishery management decisions based at least in part on the condition of shoreline vegetation at a given lake.

Cumulative Impacts

Cumulative impacts would be similar to alternative A (negligible to moderate, adverse, and long term), although potentially reduced because there would be fewer lakes available for stocking and fishing.

Conclusion

Twenty-nine of the 35 lakes in the study area where fishing would continue have meadow vegetation that is sensitive to trampling. Eleven of the 29 lakes are within cross-country zones or near camps that would continue to experience low visitor use, with resulting negligible to minor adverse impacts. Eighteen of the 29 lakes are within cross-country zones or near camps that would continue to experience medium to high visitor use, and vegetation would experience negligible to moderate impacts. In addition to the 29 lakes that are currently fishless in alternative A, alternative B would return 20 lakes to a fishless condition with possible negligible to moderate benefits to shoreline meadow vegetation over time. Temporary negligible to moderate adverse impacts on shoreline vegetation from trampling related to chemical or mechanical lake treatments would occur, and continued fishing as a means of natural removal would have short-term negligible to moderate adverse impacts. Cumulative impacts would be negligible to moderate, adverse, and long term.

Impairment of vegetation across the study area would not occur under alternative B.

ALTERNATIVE C: PROPOSED ADAPTIVE MANAGEMENT OF 91 LAKES UNDER A NEW FRAMEWORK (11 LAKES MAY HAVE FISH)

Impacts of Fish Stocking on Vegetation (Riparian Vegetation)

Alternative C

9 lakes would have fish
80 lakes would be fishless
2 lakes would be evaluated for restocking

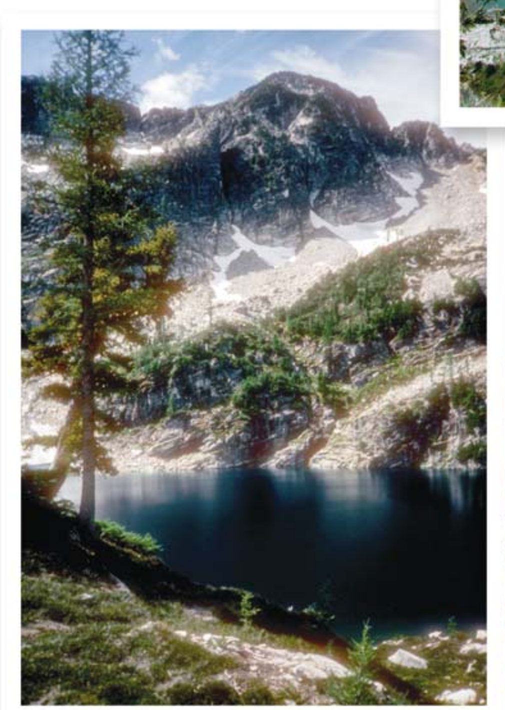
Alternative C proposes an adaptive management framework for 91 lakes, where 11 of the 22 lakes in the Ross Lake and Lake Chelan National Recreation Areas may have fish, and the remaining 69 lakes, which are in the national park, either would remain fishless or be returned to their natural fishless condition. Of the other 11 lakes in the national recreation areas, 3 would remain fishless, 3 would have high-density reproducing fish removed, and stocking would be discontinued in 5 lakes. The "Alternatives" chapter provides a detailed description of alternative C. For more information on the 91 lakes, refer to tables 5 and 12 in the "Alternatives" chapter, appendix E, and "Map 2" and "Map 2 Table" located in the envelope that accompanied this document.

Under alternative C, adverse impacts on riparian zone vegetation would be negligible to moderate in those lakes with an abundance of meadow vegetation, which allows for walking along the shore. All 9 lakes that would continue to have fish have from 20% to 58% meadow in the shoreline. The 2 lakes that would be evaluated for possible future stocking of fish at low densities also have meadow vegetation.

As noted earlier, visitor numbers, trail access, and stock access influence the degree of impact. Of the 9 lakes with meadow vegetation that would be available for continued fishing, 5 are located in cross-country zones or are near camps that have low visitor use and most likely experience negligible impacts in the riparian zone. This would continue under alternative C. None of the 9 lakes are located in zones or are near camps that receive a medium level of visitation. Two of the

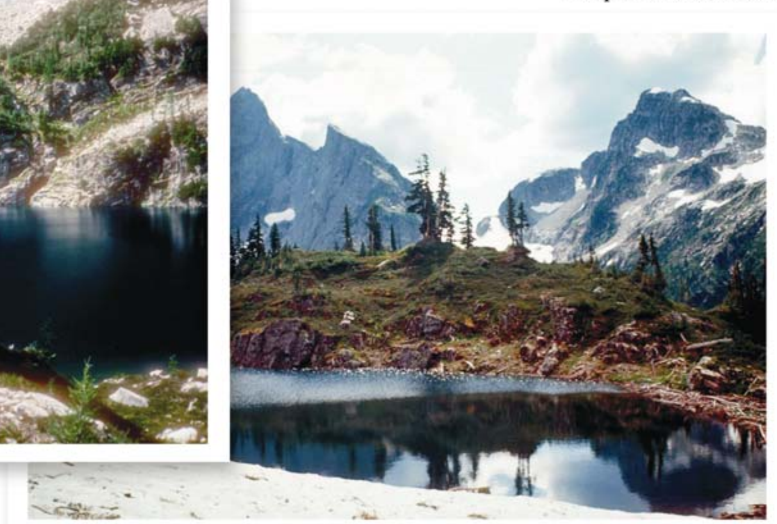
Azure Lake

Wild Lake



Pegasus Lake

Despair Lake, Lower



Lakes that are currently fishless would remain fishless under all alternatives.

9 lakes, however, are located in zones or are near camps that experience high visitor use—impacts on meadow vegetation at these 2 lakes may continue to be negligible to moderate. There are 2 lakes (McAlester and Battalion) that would be evaluated before restocking. McAlester is located near an established backcountry camp that receives a high level of use—impacts on meadow vegetation in this area would be negligible to moderate. Battalion is located in a cross-country zone with very low use, and impacts on meadow vegetation would be negligible.

Two of the lakes where fishing would continue have vegetation dominated by forest, and one lake has shoreline vegetation dominated by shrub. One of the lakes dominated by forest and the one lake dominated by shrub are located in cross-country zones or near backcountry camps that experience a low level of use—impacts on forest and shrub vegetation may be negligible. The other lake dominated by forest (100%) is located near a high-use backcountry camp—impacts on vegetation may be negligible to moderate. All three lakes are accessible by stock (horses, mules, llamas).

In this alternative C, 29 lakes (3 in the national recreation areas and 26 in the national park) would remain fishless, and 51 additional lakes (8 in national recreation areas and 43 in the national park) would become fishless. Of the 51 lakes that would become fishless, 43 are classified as having from 2% to 76% meadow in the shoreline. Impacts on riparian vegetation should be monitored at the 2 lakes that would be evaluated prior to restocking. As angler use declines at the 43 lakes, there would be negligible to moderate beneficial effects on meadow vegetation. There are 14 lakes with shoreline meadow that are in cross-country zones or near camps that experience low visitor use—discontinuation of fish stocking or fish removal would have negligible beneficial effects on vegetation at these lakes. For the 19 lakes that are in cross-country zones or near camps that experience medium visitor use or have trail or livestock access, discontinued fish stocking or fish removal would result in negligible to minor beneficial impacts on meadow vegetation. A negligible to moderate beneficial effect would be expected at the 10 lakes with shoreline meadow that are in cross-country zones or near camps that experience high visitor use or have trail or stock access. Negligible impacts from past visitor use at the 29 lakes that are currently fishless would remain or heal in time.

There would be negligible to moderate beneficial effects on vegetation dominated by shrubs at 5 lakes that would become fishless. It was not possible to determine if more resistant high-stature shrubs (such as willows) or sensitive low-lying shrubs (such as heather and huckleberry) are dominant at individual lakes, which is why the range of potential impact is broad. Forest cover is dominant at 1 lake that experiences high visitor use; the impacts of continued fish stocking at this lake may be minor and adverse.

Impacts of Proposed Lake Treatment Methods on Vegetation

Natural Methods. Twenty-one lakes would be treated with natural methods. Impacts on meadow vegetation from anglers would continue until the lakes are sufficiently fished out. These impacts would range from negligible to moderate, and depend on the factors identified earlier; however, the adverse impacts would be short term, and vegetation would return to more natural conditions as fishing declines over time.

Mechanical Methods. Mechanical treatment is proposed for up to 10 lakes. One lake is proposed for spawning habitat exclusion. A 30-foot section of spawning habitat would be covered with rock taken from nearby talus slope and moved by hand to the lake. Adverse impacts on meadow vegetation from covering vegetation with rock and from trampling would be minor to moderate and short term. Setting nets and using electroshocking equipment would result in some trampling, although mitigation by avoiding vegetation and wading near the shore rather than walking through shoreline vegetation would reduce the impact to negligible or minor and short term.

Chemical Method. Under alternative C, chemical treatment is proposed for 25 lakes. There would be a negligible impact on vegetation from chemical removal of trout because chemicals would be applied primarily from a boat and would not affect vegetation. Placing and removing a boat would have some temporary negligible or minor site-specific impacts.

Impacts of Other Mitigation

Impacts of other mitigation would be the same as under alternative B. Additional signs would be posted in riparian areas that were most heavily used to allow for recovery of vegetation. Furthermore, using an adaptive management approach for lakes to be evaluated would provide an opportunity to monitor the level of impact anglers have on vegetation.

Cumulative Impacts

Cumulative impacts would be similar to alternative A (negligible to moderate, adverse, and long term), although potentially reduced because there would be fewer lakes available for stocking/fishing.

Conclusion

Alternative C would provide substantial long-term benefits to meadow and sensitive forest vegetation from the return of 51 additional lakes to fishless conditions compared to alternative A. The majority of these lakes have meadow vegetation, and 29 of the 51 lakes are located in cross-country zones or near camps that receive a medium to high level of use. To the extent this use is attributable to fishing and fishing-related stock use, benefits to vegetation would occur at these lakes. Of the 9 lakes where fishing would continue, 6 are in cross-country zones or near camps that experience light use now, which would most likely continue to have negligible adverse impacts on vegetation. Three lakes are in cross-country zones or near camps that would continue to experience medium or high use, with resulting negligible to moderate adverse impacts on meadow vegetation. One lake may continue to experience minor or even moderate impacts on shoreline forest vegetation. Temporary negligible or minor adverse impacts on shoreline vegetation from trampling related to chemical or mechanical lake treatment would occur, and continued fishing as a means of natural removal would have short-term negligible to moderate adverse impacts. Cumulative impacts would be long term, negligible to moderate, and adverse.

Impairment of vegetation across the study area would not occur under alternative C.

ALTERNATIVE D: 91 LAKES WOULD BE FISHLESS

Alternative D proposes that 29 currently fishless lakes would remain fishless, and 62 lakes would become fishless from discontinuing stocking or removing fish using natural, chemical, or natural treatment methods. The result would be fishless conditions in 91 lakes in the study area. The "Alternatives" chapter provides a detailed description of alternative D. For more information on the 91 lakes, refer to tables 5 and 13 in the "Alternatives" chapter, appendix E, appendix M, and "Map 2" and "Map 2 Table" located in the envelope that accompanied this document.

Impacts of Fish Stocking on Vegetation (Riparian Vegetation)

Adverse impacts on the riparian zone would decline following the return of lakes to fishless conditions, and negligible to moderate beneficial impacts would occur as disturbed meadow areas recover. Of the 62 lakes that would remain fishless or become fishless, 52 are classified as having from 2% to 76% meadow in the shoreline. As noted earlier, meadow vegetation may be particularly sensitive to trampling.

There are 20 lakes with shoreline meadow that are located in cross-country zones or near camps that currently experience low visitor use. Discontinuing stocking and removing fish is expected to have negligible beneficial impacts on vegetation at these lakes. For the 19 lakes that are in cross-country zones or near camps that currently experience medium visitor use or have trail or stock (horses, mules, llamas) access, discontinued fish stocking and fish removal may result in negligible to minor beneficial impacts on meadow vegetation. Negligible to moderate beneficial impacts are expected at the 13 lakes with shoreline meadow that are in cross-country zones or near camps that experience high visitor use or have trail or stock access. Visitor use data is missing for one of the lakes that has shoreline meadow cover.

Vegetation at the 29 lakes that are currently fishless would continue to experience negligible adverse impacts from past visitor use but would be undetectable compared to natural conditions in time.

Impacts of Lake Treatment Methods on Vegetation

Under alternative D, discontinued stocking and fish removal are proposed for 62 lakes.

Natural Methods. Natural treatment is proposed for 26 lakes. Impacts on meadow vegetation from anglers would continue until the lakes are sufficiently fished out. These impacts would range from negligible to moderate and depend on the factors identified earlier; however, impacts would be short term, and vegetation would return to more natural conditions over time as visitor use related to fishing declines.

Mechanical Methods. Mechanical treatment is proposed for 11 lakes. One lake is proposed for spawning habitat exclusion. A 30-foot section of spawning habitat would be covered with rock taken from nearby talus slope and moved by hand to the lake. Adverse impacts on meadow vegetation from covering vegetation with rock and from trampling would be minor to moderate and short term. Setting nets and using electroshocking equipment would result in some trampling, although mitigation by avoiding vegetation and wading near the shore rather than walking through shoreline vegetation would reduce the impact to negligible or minor and short term.

Chemical Method. Chemical treatment is proposed for 25 lakes. Adverse impacts would be negligible and short term because chemicals would be applied from a boat. Dragging a boat across meadow vegetation would have temporary, minor impacts, although these impacts would be easily mitigated by carrying boats.

Impacts of Other Mitigation

Impacts of other mitigation would be the same as under alternative B. Additional signs would be posted in riparian areas that were most heavily used to allow for recovery of vegetation. Furthermore, the adaptive management plans for lakes set for evaluation provide an opportunity to monitor the level of impact anglers have on vegetation.

Cumulative Impacts

Cumulative impacts would be similar to alternative A (negligible to minor, adverse, and long term), although reduced because there would be no lakes available for stocking/fishing.

Conclusion

Under alternative D, 62 additional lakes would be returned to fishless conditions compared to alternative A. Vegetation at these lakes would experience overall beneficial impacts under alternative D. The degree of benefit would range from negligible to moderate and would depend on the level of visitor use, access, sensitivity of the vegetation, and other factors. The majority of these lakes have meadow vegetation. If high visitor use, stock use, and trail use are related to fishing, a decline in fishing opportunity would offer substantial benefits to this more sensitive vegetative community. Temporary negligible or minor adverse impacts on shoreline vegetation from trampling related to chemical or mechanical lake treatment would occur, and continued fishing as a means of natural removal would have short-term negligible to moderate adverse impacts. Cumulative impacts would be negligible to moderate, adverse, and long term.

Impairment of vegetation across the study area would not occur under alternative D.

CULTURAL RESOURCES

GUIDING REGULATIONS AND POLICIES

Federal actions that have the potential to affect cultural resources are subject to a variety of laws.

The *National Historic Preservation Act* (1966, as amended; NHPA) is often the principal legislative authority for managing cultural resources associated with NPS projects. Section 106 of the NHPA requires all federal agencies to consider the effects of their actions on cultural resources determined eligible for inclusion in the National Register of Historic Places (National Register). Such resources are termed "historic properties." Agreement on mitigation of effects to historic properties is reached through consultation with the State Historic Preservation Officer; Tribal Historic Preservation Officer, if applicable; and, as required, the Advisory Council on Historic Preservation (Advisory Council). In addition, the NHPA requires that federal agencies take actions to minimize harm to historic properties that would be adversely affected by a federal undertaking. Section 110 of the NHPA, among other things, charges federal agencies with the responsibility for establishing preservation programs for identification, evaluation, and nomination of historic properties to the NRHP.

Other important laws and regulations designed to protect cultural resources are

Native American Graves Protection and Repatriation Act (NAGPRA), 1990

American Indian Religious Freedom Act (AIRFA), 1978

National Environmental Policy Act (NEPA), 1969

Archeological Resources Protection Act (ARPA), 1979

Executive Order 11593, 1971

In addition, the NPS is charged with protection and management of cultural resources in its custody. This is furthered through the implementation of *NPS-28: Cultural Resources Management Guidelines* (NPS 1997), *NPS Management Policies* (NPS 2001a), and the 1995 Service-wide Programmatic Agreement with the Advisory Council and the National Conference of State Historic Preservation Officers. These documents charge NPS managers with avoiding, or minimizing to the greatest degree practicable, adverse impacts on park resources and values. Although the NPS has the discretion to allow certain impacts in parks, that discretion is limited by the statutory requirement that park resources and values remain unimpaired, unless a specific law directly provides otherwise.

METHODOLOGY AND ASSUMPTIONS

The NPS categorizes cultural resources by the following categories: archeological resources, cultural landscapes, historic structures, museum objects, and ethnographic resources. The actions proposed in the alternatives would have minimal impact on museum objects, and hence, they are not discussed further. A review of reference materials regarding cultural resources in the North Cascades Complex, as well as communications with NPS staff, were completed to identify and evaluate potential impacts on cultural resources located in the study area. The North Cascades Complex contains a number of cultural resources that are eligible or included in the National Register (see the "Cultural Resources" section in the "Affected Environment" chapter).

CEQ regulations require assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts on cultural resources over time can include total loss of sites or parts of sites due to development, soil erosion, or lack of appropriate maintenance; loss of integrity and interpretive value; and the gradual loss of the cultural resource base within a park. Cumulative impacts are considered for both the no-action and action alternatives.

The descriptions of effects on cultural resources that are presented in this section are intended to comply with the requirements of both NEPA and section 106 of the NHPA. In accordance with the Advisory Council's regulations implementing section 106 (36 CFR Part 800, *Protection of Historic Properties*), impacts on cultural resources were identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects that are either listed in or eligible to be listed in the National Register; (3) applying the criteria of adverse effect to affected cultural resources either listed in or eligible to be listed in the National Register; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

Under the Advisory Council's regulations, a determination of either *adverse effect* or *no adverse effect* must also be made for affected National Register-eligible cultural resources. An *adverse effect* occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion in the National Register (for example, diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association). Adverse effects also include reasonably foreseeable effects caused by the proposal that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5, *Assessment of Adverse Effects*). A determination of *no adverse effect* means there is an effect, but the effect would not diminish, in any way, the characteristics of the cultural resource that qualify it for inclusion in the National Register.

CEQ regulations and *Director's Order 12: Conservation Planning, Environmental Impact Analysis and Decision-making* (NPS 2001b) also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact; for example, reducing the intensity of an impact from major to moderate or minor. Any resultant reduction in intensity of impact due to mitigation, however, is an estimate of the effectiveness of mitigation under NEPA only. It does not suggest that the level of effect as defined by section 106 is similarly reduced. Cultural resources are nonrenewable resources, and adverse effects generally consume, diminish, or destroy the original historic materials or form, resulting in a permanent loss in the integrity of the resource that can never be recovered. Therefore, although actions determined to have an adverse effect under section 106 may be mitigated, the effect remains adverse.

The "Section 106 Summary" follows the cultural resources impact analyses, and a section 106 statement is included in the conclusion statements for each cultural resource evaluated. The section 106 summary is intended to meet the requirements of section 106 and is an assessment of the effect of the undertaking (implementation of the alternative) on cultural resources, based on the criterion of effect and criteria of adverse effect found in the Advisory Council's regulations.

GEOGRAPHIC AREA EVALUATED FOR IMPACTS

For the purpose of this analysis, the "Area of Potential Effect" is defined as the North Cascades Complex.

DEFINITIONS OF INTENSITY LEVELS

Archeological Resources

Negligible: Impact is at the lowest levels of detection – barely measurable with no perceptible consequences, either adverse or beneficial. For purposes of section 106, the determination of effect would be *no adverse effect*.

Minor: **Beneficial effect** – maintenance and preservation of a site(s). For purposes of section 106, the determination of effect would be *no adverse effect*.

Adverse impact – disturbance of a site(s) results in little, if any, loss of integrity. For purposes of section 106, the determination of effect would be *no adverse effect*.

Moderate: **Beneficial effect** – stabilization of a site(s). For purposes of section 106, the determination of effect would be *no adverse effect*.

Adverse impact – disturbance of a site(s) results in loss of integrity. For purposes of section 106, the determination of effect would be *adverse effect*. A memorandum of agreement is executed between the NPS and applicable State or Tribal Historic Preservation Officer and, if necessary, the Advisory Council in accordance with 36 CFR 800.6(b). The mitigation measures identified in the memorandum of agreement would reduce the intensity of impact under NEPA from major to moderate.

Major: **Beneficial effect** – active intervention to preserve a site(s). For purposes of section 106, the determination of effect would be *no adverse effect*.

Adverse impact – disturbance of a site(s) results in loss of integrity. For purposes of section 106, the determination of effect would be *adverse effect*. The NPS and applicable State or Tribal Historic Preservation Officer are unable to negotiate and execute a memorandum of agreement in accordance with 36 CFR 800.6(b).

Historic Structures

Negligible: Impact(s) is at the lowest levels of detection – barely measurable with no perceptible consequences, either adverse or beneficial. For purposes of section 106, the determination of effect would be *no adverse effect*.

Minor: **Beneficial effect** – stabilization/preservation of features in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties*. For purposes of section 106, the determination of effect would be *no adverse effect*.

Adverse impact – impact would alter a feature(s) of a structure but would not diminish the overall integrity of the resource. For purposes of section 106, the determination of effect would be *no adverse effect*.

Moderate: **Beneficial effect** – rehabilitation of a structure in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties*. For purposes of section 106, the determination of effect would be *no adverse effect*.

Adverse impact – impact would alter a feature(s) of the structure, diminishing the overall integrity of the resource. For purposes of section 106, the determination of effect would be *adverse effect*. A memorandum of agreement would be executed between the NPS and applicable State or Tribal Historic Preservation Officer and, if necessary, the Advisory Council in accordance with 36 CFR 800.6(b). The mitigation measures identified in the memorandum of agreement would reduce the intensity of impact under NEPA from major to moderate.

Major: **Beneficial effect** – restoration of a structure in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties*. For purposes of section 106, the determination of effect would be *no adverse effect*.

Adverse impact – impact would alter a feature(s) of the structure, diminishing the overall integrity of the resource. For purposes of section 106, the determination of effect would be *adverse effect*. The NPS and applicable State or Tribal Historic Preservation Officer are unable to negotiate and execute a memorandum of agreement in accordance with 36 CFR 800.6(b).

Cultural Landscapes

Negligible: Impact(s) is at the lowest levels of detection – barely perceptible and not measurable. For purposes of section 106, the determination of effect would be *no adverse effect*.

Minor: **Beneficial effect** – preservation of landscape patterns and features in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*. For purposes of section 106, the determination of effect would be *no adverse effect*.

Adverse impact – impact(s) would alter a pattern(s) or feature(s) of the cultural landscape but would not diminish the overall integrity of the landscape. For purposes of section 106, the determination of effect would be *no adverse effect*.

Moderate: **Beneficial effect** – rehabilitation of a landscape or its patterns and features in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*. For purposes of section 106, the determination of effect would be *no adverse effect*.

Adverse impact – impact(s) would alter a pattern(s) or feature(s) of the cultural landscape, diminishing the overall integrity of the landscape. For purposes of section 106, the determination of effect would be *adverse effect*. A memorandum of agreement is executed between the NPS and applicable State or Tribal Historic Preservation Officer and, if necessary, the Advisory Council in accordance with 36 CFR 800.6(b). The mitigative measures identified in the memorandum of agreement reduce the intensity of impact under NEPA from major to moderate.

Major: **Beneficial effect** – restoration of a landscape or its patterns and features in accordance with the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*. For purposes of section 106, the determination of effect would be *no adverse effect*.

Adverse impact – impact(s) would alter a pattern(s) or feature(s) of the cultural landscape, diminishing the overall integrity of the resource. For purposes of section 106, the determination of effect would be *adverse effect*. The NPS and applicable State or Tribal Historic Preservation Officer are unable to negotiate and execute a memorandum of agreement in accordance with 36 CFR 800.6(b).

Ethnographic Resources

Some places of traditional cultural use may be eligible for inclusion in the National Register as traditional cultural properties because of their association with cultural practices or beliefs of a living community that (a) are rooted in that community's history and (b) are important in maintaining the continuing cultural identity of the community (*National Register Bulletin, Guidelines for Evaluating and Documenting Traditional Cultural Properties*).

Negligible: Impact(s) would be barely perceptible and would neither alter resource conditions, such as traditional access or site preservation, nor alter the relationship between the resource and the affiliated group's body of practices and beliefs. For purposes of section 106, the determination of effect on traditional cultural properties would be *no adverse effect*.

Minor: **Beneficial effect** – would allow access to and/or accommodate a group's traditional practices or beliefs. For purposes of section 106, the determination of effect on traditional cultural properties would be *no adverse effect*.

Adverse impact – impact(s) would be slight but noticeable but would neither appreciably alter resource conditions, such as traditional access or site preservation, nor alter the relationship between the resource and the affiliated group's body of practices and beliefs. For purposes of section 106, the determination of effect on traditional cultural properties would be *no adverse effect*.

Moderate: **Beneficial effect** – would facilitate traditional access and/or accommodate a group's practices or beliefs. For purposes of section 106, the determination of effect on traditional cultural properties would be *no adverse effect*.

Adverse impact – impact(s) would be apparent and would alter resource conditions. Something would interfere with traditional access, site preservation, or the relationship between the resource and the affiliated group's practices and beliefs, even though the group's practices and beliefs would survive. For purposes of section 106, the determination of effect on traditional cultural properties would be *adverse effect*.

Major: **Beneficial effect** – would encourage traditional access and/or accommodate a group's practices or beliefs. For purposes of section 106, the determination of effect on traditional cultural properties would be *no adverse effect*.

Adverse impact – impact(s) would alter resource conditions. Something would block or greatly affect traditional access, site preservation, or the relationship between the resource and the affiliated group's body of practices and beliefs, to the extent that the survival of a group's practices and/or beliefs would be jeopardized. For purposes of section 106, the determination of effect on traditional cultural properties would be *adverse effect*.

All Cultural Resources

Impairment. The action would contribute substantially to the deterioration of cultural resources in the North Cascades Complex. In addition, any adverse major impacts on the North Cascades Complex's resources and values would

contribute to deterioration of cultural resources and values to the extent that the purpose of the North Cascades Complex would not be fulfilled as established in its enabling legislation

affect resources key to the natural or cultural integrity or opportunities for enjoyment in the North Cascades Complex

affect the resource whose conservation is identified as a goal in the *General Management Plan* (NPS 1988b) or other planning documents for the North Cascades Complex

IMPACTS COMMON TO ALL ALTERNATIVES

The potential impacts on archeological resources and mitigation measures common to all alternatives are addressed below. For this plan/EIS, archeological resources, historic structures, ethnographic resources, and cultural landscapes are analyzed. A programmatic agreement, as defined in 36 CFR 800.14(b), is designed to address complex federal project situations (for example, when effects on historic properties cannot be fully determined prior to approval of undertaking). A programmatic agreement would be implemented, if necessary.

Under all alternatives, management actions (fish stocking and/or removal) at many of the mountain lakes would result in varying degrees of pedestrian-related ground disturbance in the North Cascades Complex (see tables 4 and 5). Pedestrian access to these lakes by management crews would be via existing roads and trails or cross-country hiking. Crews would be small (1–2 people), and short-term camping would occur. Work around shorelines would be necessary where fragile vegetation and soils would be disturbed. All of these actions have the potential for soil disturbance, which would uncover or damage archeological resources.

Several lakes (less than 10) recommended for fish management actions, and access routes (trails) serving these and other lakes proposed for management actions, have been identified as particularly sensitive regarding the presence and nature of cultural resources. (Because of the sensitive nature of these resources, their location is not publicly available information.)

In general, ground disturbance has the potential to result in adverse impacts of unknown intensity on recorded and unrecorded archeological resources in these areas. Depending on the activity, mitigation measures designed to reduce ground disturbance would be implemented (see appendix I for the current and proposed mitigation measures.

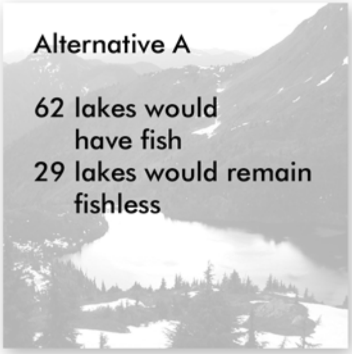
In addition to the mitigation measures identified in appendix I, the following measures may be necessary:

> Surveys by professional cultural resource specialists would proceed any proposed ground disturbance.
>
> If cultural resources are inadvertently unearthed/disturbed during proposed activities, all work in the immediate vicinity would be halted until the resource would be appropriately evaluated and mitigated, if necessary.
>
> Crews would be provided with fundamental training regarding the sensitivity of archeological resources and the need to protect them, as well as instructing them to report any newly discovered cultural resources to the park archeologist.
>
> Evaluation of cultural resources in these identified sensitive areas to determine National Register eligibility would be a significant aid in avoiding adverse impacts on historic properties. Where documented/recorded sites exist, the monitoring of the areas where ground disturbance is proposed would further mitigate any adverse impacts on archeological resources.

For most lakes, these measures would likely mitigate potential adverse impacts from fish management activities to archeological resources to negligible to minor and site specific.

The use of helicopters (and associated landing pads) to transport fish removal equipment to lakes has the potential to create negligible to minor, short-term, adverse visual impacts on cultural landscapes in the North Cascades Complex.

ALTERNATIVE A (NO ACTION): EXISTING MANAGEMENT FRAMEWORK OF 91 LAKES (62 LAKES HAVE FISH)



Alternative A (no action) would continue current management of the 91 lakes in the study area. The "Alternatives" chapter provides a detailed description of alternative A. For more information on the 91 lakes, refer to table 5 and figure 4 in the "Alternatives" chapter and appendix E.

Archeological Resources. It is estimated that approximately 1,000 visitors engaged in sport fishing in 2003 at the mountain lakes in the study area (see the "Visitor Use and Experience" section in this chapter). The continuation of existing sport fishing activities involves the use of the study area by anglers who often bring in stock (horses, mules, llamas) and camp overnight for an average of two days per visit (NPS, R. Zipp, pers. comm., 2003), all of which results in ground disturbance. Designated backcountry overnight use areas and camps are shown on "Map 2" and the "Map 2 Table" located in the envelope that accompanied this document. Adverse impacts on archeological resources of unknown intensity are possible as a result. Of particular concern are those resources that have not yet been identified, recorded, and protected by the NPS. Additional visitor educational information and scheduled monitoring of sensitive areas would aid in mitigating potential adverse effects to negligible to minor, over the long term.

Historic Structures. This alternative would probably involve the highest number of anglers, many of whom would spend a night or two in the backcountry where a number of historic structures are known to exist. Consequently, a slightly higher likelihood for adverse impacts (such as vandalism) on historic structures exists than under the other three alternatives. The potential impact intensity on historic structures is unknown but is likely not higher than negligible to minor and site specific given the small number of anglers visiting the areas where structures exist. Systematic and periodic monitoring of resource conditions and additional education of backcountry users (possibly through backcountry permit issuance process) would likely reduce this effect to negligible.

Backcountry homesteads are part of the cultural landscape of the North Cascades Complex.

Cultural Landscapes. Twenty-four cultural landscapes have been identified in the North Cascades Complex; five have been determined eligible for inclusion in the National Register (see the "Affected Environment" chapter). One designated cultural landscape exists at a lake that has been identified as sensitive regarding cultural resources (NPS, J. Kennedy, pers. comm., 2004). This lake and the associated designated cultural landscape currently sustain some of the highest visitor levels in the North Cascades Complex. This particular cultural landscape is believed important because of its mining-related historic structure, features, and artifacts. The continuation of current levels of fishing activities proposed under this alternative would likely result in minor, site-specific adverse impacts on this designated cultural landscape. Periodic and systematic minor monitoring of the resource would further reduce impacts.

This alternative would continue current fishery management practices and angler use. Such activities would result in possible elements of a cultural landscape being inadvertently impacted by physical changes such as the creation of social trails, modification of historic structures, and artifact removal. These activities would result in adverse impacts of unknown intensity, particularly where cultural landscapes have not been inventoried, evaluated, and appropriately protected. For any cultural landscape that is determined to be at risk of impact as a result of this alternative, mitigation measures may be necessary to avoid adverse impacts on historic properties. Mitigation actions (such as systematic recordation, additional cultural resource inventory, National Register eligibility determination, and increased visitor information) would reduce impacts on cultural landscape resources to site specific to localized and minor in intensity. Periodic and systematic monitoring of resource conditions and additional education of backcountry users (possibly through backcountry permit issuance process) would likely reduce this potential impact further.

Ethnographic Resources. Because no ethnographic resources have been documented in the North Cascades Complex, it is unlikely that impacts would occur as a result of the no-action alternative. It is assumed that, should such impacts occur, communications among the NPS, affected Tribes, and the State Historic Preservation Officer would be initiated, and any adverse effects would be mitigated to negligible through a cooperative agreement.

Cumulative Impacts

As is true under all alternatives, a number of cultural resources have undoubtedly sustained adverse impacts from natural and human forces over the lengthy period of human occupation of the area. Because the majority of the North Cascades Complex has not been formally inventoried for cultural resources, any unidentified resources, especially those archeological resources exposed on or located near the surface, would be particularly vulnerable to human and natural impacts. Cumulative natural impacts (erosion, general weathering,) and human impacts (inadvertent ground disturbance, vandalism, artifact collection, digging) that result in resource loss are expected to continue, and possibly increase, creating adverse impacts of unknown intensity on cultural resources. Ultimately, the resource base would be diminished, resulting in an incomplete historical record and likely errors in cultural interpretation as a result. The eventual completion of a North Cascades Complex-wide cultural resource inventory designed to identify/protect historic properties would benefit cultural resources in the region.

Dam and reservoir construction during the 20th century, along with construction of related hydroelectric facilities (including the company towns of Newhalem and Diablo), likely resulted in major cumulative adverse impacts on cultural resources that continue today. Filling of reservoirs (Ross, Diablo, and Gorge lakes) undoubtedly inundated an unknown number of prehistoric and historic cultural resources. Archeological sites are known to currently exist in drawdown zones of Lake Chelan and Ross Lake. It is likely that the degradation of recorded and unrecorded sites along shorelines and drawdown zones as a result of wave action, changing reservoir levels, and recreational activity creates ongoing negligible to major adverse site-specific impacts on cultural resources (depending on the resource). The inventory and appropriate mitigation of these vulnerable resources would be of benefit to these resources.

Ongoing adverse impacts on cultural resources from park visitors other than anglers (hikers/campers/climbers) also exist within the North Cascades Complex. Archeological resources are particularly vulnerable to ground disturbance (see "Impacts Common to All Alternatives" in this section). Cultural landscapes can be adversely affected by a variety of recreational uses. For instance, visual impacts (such as social trails or road and facility construction) can alter character-defining features. Historic resources are exposed to potential impacts of vandalism and alteration, to name two, which can alter their integrity and significance. In general, these cumulative adverse impacts on cultural resources are of unknown intensity and scope because so little of the area has been inventoried and evaluated. Periodic and systematic monitoring of known resource conditions by the NPS likely aids in mitigating adverse impacts to known cultural resources, possibly to the negligible to minor and site-specific level.

Of the numerous lakes and trails used recreationally, several have been identified as sensitive regarding cultural resources. In fact, many of these sensitive lake and trail areas currently experience some of the highest levels of visitor use in the North Cascades Complex, making cultural resources in these areas even more vulnerable to potential cumulative adverse impacts. As is the case with many of the mountain lakes, at least one of these sensitive lake areas requires some cross-country hiking to access it, likely resulting in ground disturbance and other human impacts in areas where cultural resources have not been inventoried. This activity creates the potential for visitors to encounter, if only inadvertently, previously unrecorded and unprotected cultural resources, resulting in possible adverse impacts of unknown intensity. For these sensitive areas, further mitigation measures may be necessary to avoid adverse impacts on historic properties (for example, National Register eligibility evaluations of known sites, additional cultural resource inventory, and increased visitor information) (see the discussion of ground-disturbance potential under "Impacts Common to All Alternatives" that appeared earlier in this section). Implementation of such measures would likely result in negligible to minor, site-specific impacts on cultural resources within these sensitive areas.

Conclusion

Alternative A would not change the number of lakes for fishing or the number of anglers using them over the long term. Potential adverse impacts of unknown intensity on archeological resources would be mitigated to negligible to minor. Mitigation would also help keep impacts on historic structures from exceeding minor levels. Potential impacts on cultural landscapes would be mitigated to no greater than minor. No impacts on ethnographic resources are anticipated. For the purpose of compliance with section 106 of the *National Historic Preservation Act*, there would be no adverse effect on cultural resources. Adverse cumulative impacts would range from negligible to minor over the long term.

Impairment of cultural resources across the study area would not occur under alternative A.

Alternative B: Proposed Adaptive Management of 91 Lakes under a New Framework (42 Lakes May Have Fish) (Preferred Alternative)

The emphasis of this alternative is to eliminate or reduce the density of reproducing fish from certain mountain lakes in the study area.

Alternative B

29 lakes would have fish
49 lakes would be fishless
13 lakes would be evaluated for restocking

The "Alternatives" chapter provides a detailed description of alternative B. For more information on the 91 lakes, refer to tables 5 and 10 in the "Alternatives" chapter and appendix E.

Archeological Resources. The adverse effects described in alternative A would be similar under alternative B. Impacts on archeological resources of unknown intensity as a result of sport fishing activities would occur. With mitigation, these adverse site-specific impacts would be reduced to negligible to minor over the long term.

Alternative B proposes fish removal by a variety of means. Lake treatment methods include natural (cease stocking, increase fishing limits), mechanical (gill netting/electrofishing, fyke nets, trapping, and spawning habitat exclusion), and chemical (piscicide such as antimycin). NPS implementation of all these techniques would result in potential ground disturbance with impacts on archeological resources as described earlier in the "Impacts Common to All Alternatives" section. Negligible to minor archeological resource impacts, with proposed mitigation, would occur over the long term.

The use of mechanical and chemical means of fish removal would require the use of transport helicopters and landing pads. Many lakes would have adequate natural landing areas that would not require ground disturbance (such as leveling) for preparation (NPS, R. Mierendorf, pers. comm., 2004). In these cases, it is unlikely that cultural resources would be impacted; however, review by a cultural resource professional of the surface area prior to its use as a landing pad would ensure this. In those cases where ground preparation is required for helicopter landing, there would be potential for adverse impacts of unknown intensity to archeological resources. The surface survey and monitoring of the ground disturbance of these areas by a cultural resource professional would mitigate these site-specific impacts to negligible to minor over the long term.

Historic Structures. Fewer anglers, but more fishery management actions would occur under alternative B. The potential impact intensity under alternative B for historic structures is unknown but is likely not higher than negligible to minor and site specific given the small number of anglers visiting the area. Periodic and systematic monitoring of resource conditions and additional education of backcountry users (possibly through backcountry permit issuance process) would likely reduce this potential impact further.

Cultural Landscapes. The nature of angling and related activities would remain similar to that currently observed, with many anglers typically spending a night or two in the backcountry where a number of cultural landscape resources exist. Due to the slightly fewer numbers of anglers, alternative B would result in a modest reduction in the likelihood of adverse impacts on cultural landscapes when compared to alternative A. The intensity of potential impacts on cultural landscapes under alternative B is unknown because so many identified resources remain unevaluated. For any cultural landscape that is determined to be at risk of impact as a result of the implementation of alternative B, mitigation measures may be necessary to avoid adverse impacts on historic properties (refer to the discussion under “Impacts Common to All Alternatives” in this section and “Appendix I: Mountain Lakes Fishery Current and Proposed Mitigation Practices”).

Impacts on the designated cultural landscapes that were noted in alternative A would be minor in alternative B.

Ethnographic Resources. Ethnographic resources have not been documented in the North Cascades Complex, so it is unlikely that impacts would occur as a result of alternative B. It is assumed that, should such impacts occur, communications among the NPS, affected Tribes, and the State Historic Preservation Office would be initiated, and any adverse effects would be mitigated to negligible through a cooperative agreement.

The proposed use of chemical methods for fish removal would temporarily affect water quality, possibly an issue for Native Americans who may use some of these water bodies for traditional contemporary purposes (ceremonial bathing, vision quests). Depending on the location, amount, and type of chemicals used, such actions would result in adverse impacts of unknown intensity to such ethnographic resources. Impacts would be mitigated to negligible through an agreement among the NPS, affected Tribes, and the State Historic Preservation Office regarding when and where such removal methods would be used and in a manner that would not adversely affect these resources.

Cumulative Impacts

Cumulative impacts would be similar to those described under alternative A and would range from adverse negligible to minor over the long term.

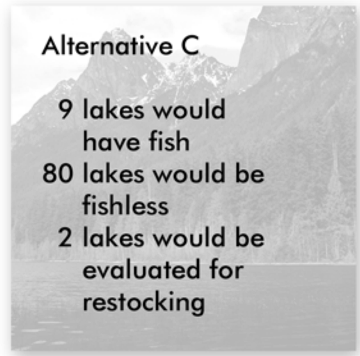
Conclusions

Possible impacts on archeological resources that would result from preparation of mechanical fish removal equipment and helicopter use (and associated landing pads adjacent to lakes) to transport the equipment would be mitigated to negligible to minor through survey and monitoring prior to use. Possible adverse impacts on historic structures are of unknown magnitude but would not likely exceed negligible to minor. Potential impacts on identified cultural landscapes would be mitigated to no greater than minor. The temporary water-quality degradation from chemicals used to remove fish would potentially result in adverse impacts of unknown intensity to ethnographic resources used by Native Americans for traditional purposes. Such impacts would be mitigated to negligible through an agreement with the NPS, affected Tribes, and the State Historic Preservation Office regarding the timing of management activities and locations of specific areas that should be avoided. For the purpose of compliance with section 106 of the *National Historic Preservation Act*, there would be no adverse effect on cultural resources. Adverse cumulative impacts would range from negligible to minor over the long term.

Impairment of cultural resources across the study area would not occur under alternative B.

Alternative C: Proposed Adaptive Management of 91 Lakes under a New Framework (11 Lakes May Have Fish)

Under alternative C, 9 lakes in Ross Lake and Lake Chelan National Recreation Areas would have fish and 2 lakes would be evaluated for restocking. Eleven other lakes in the national recreation areas would remain fishless or be returned to fishless conditions. The remaining 69 lakes (which are in the national park) would be returned to their natural fishless conditions or would remain fishless.



The “Alternatives” chapter provides a detailed description of alternative C. For more information on the 91 lakes, refer to tables 5 and 12 in the “Alternatives” chapter and appendix E.

Archeological Resources. In the long term, and when compared to alternative A, sport fishing activities would be further reduced under alternative C, resulting in negligible impacts on archeological resources in general. Alternative C also proposes that one lake identified as sensitive be returned to its natural fishless state. This lake area and its trail access contain a substantial number of archeological resources. In the long term, this reduction in the number of anglers to this lake and its access route represents a long-term benefit for cultural resources.

Historic Structures. Activities would involve a small number of anglers spending a night or two in the backcountry where historic structures are known to exist. With fewer anglers, the likelihood for adverse impacts (such as vandalism) on historic structures would be further reduced, likely to the negligible level in the long term. In addition, one lake that has been identified as sensitive, particularly for historic resources, would revert to a fishless condition under this alternative. This lake sustains some of the highest visitor numbers of all 91 lakes in the study area. Reducing anglers at the lake and its access trail would notably reduce risk of adverse impacts, a benefit to the historic resources around this lake.

Cultural Landscapes. As is the case under all alternatives, a number of cultural landscapes remain unevaluated in the study area. This alternative would result in fewer numbers of anglers than under alternatives A. Fishing activities would involve a small number of anglers spending a night or two in the backcountry where cultural landscapes have been identified. With fewer anglers, the likelihood of adverse impacts on cultural landscapes would be further reduced, but of unknown intensity. For any cultural landscape that may be determined at risk of adverse impacts as a result of this alternative, mitigation measures (such as systematic recordation, additional cultural resource inventory, National Register eligibility evaluation, and increased visitor information) would aid in reducing impacts on cultural landscapes to site specific to localized and negligible to minor in intensity.

More specifically, one designated cultural landscape exists at a lake that has been identified as sensitive regarding cultural resources, particularly historic resources (NPS, J. Kennedy, pers. comm., 2004). This lake would revert to a fishless condition under alternative C. The lake area and its associated cultural landscape currently sustain some of the highest visitor numbers of all 91 lakes in the study area. Elimination of anglers in this area would notably reduce risk of adverse impacts, a benefit to cultural landscape resources around this lake.

Ethnographic Resources. Impacts on ethnographic resources under alternative C would be similar to those described in alternative B.

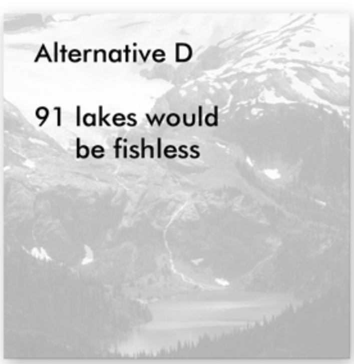
Cumulative Impacts

The removal of fish or maintaining fishless conditions in 80 mountain lakes in the study area would ultimately reduce human activity related to fishing and, over the long term, fishery management, thereby reducing ground disturbance to a greater degree than under alternative A. Over time, fewer visitors (anglers, fish management crews) to a number of the lakes and their access trails would result in a cumulative, localized, long-term benefit for cultural resources by reducing exposure to human activity.

Conclusions

The impact of reduced sport-fishing opportunities would result in negligible impacts on archeological resources in general, with beneficial effects as a result of the return of one lake identified as sensitive to a fishless state. Adverse impacts on historic structures are likely to be negligible; the elimination of fishing at one particularly sensitive lake would result in a benefit to historic structures. Cultural landscapes in the study area may incur no greater than minor adverse impacts; in one case, a benefit to the resources would be realized. Impacts on ethnographic resources would likely be mitigated to negligible. For the purpose of compliance with section 106 of the *National Historic Preservation Act*, there would be no adverse effect on cultural resources. There would be cumulative beneficial effects for cultural resources from reduced human activity at a number of mountain lakes.

Impairment of cultural resources across the study area would not occur under alternative C.



ALTERNATIVE D: 91 LAKES WOULD BE FISHLESS

The goal of this alternative is to remove fish from (or maintain as fishless) all 91 lakes in the study area. The “Alternatives” chapter provides a detailed description of alternative D. For more information on the 91 lakes, refer to tables 5 and 13 in the “Alternatives” chapter and appendix E.

Archeological Resources. All sport fishing would be eliminated under this alternative. While anglers make up only a small number of visitors to the North Cascades Complex, the presence of fish management crews would also be eliminated in the long term, reducing ground-disturbing activities further. Reduction in human activity would be a beneficial effect on archeological resources in the study area, particularly those located in areas identified as sensitive.

Impacts on archeological resources related to fish removal are described under "Impacts Common to All Alternatives" in this section.

Historic Structures. The likelihood for adverse impacts (such as vandalism) on historic structures would be notably reduced, resulting in a benefit in the long term, particularly to those areas that have been identified as sensitive.

Cultural Landscapes. Potential impacts on cultural landscapes from the use of helicopters for fish management activities under alternative D are similar to those described earlier in the "Impacts Common to All Alternatives" section.

More specifically, one cultural landscape exists at a lake that has been identified as sensitive, particularly for historic resources. This lake would revert to fishless under alternative D, as would be the case under alternative C. This lake and the associated cultural landscape currently sustain some of the highest visitor numbers of all 91 lakes in the study area. Elimination of anglers in this area would notably reduce risk of adverse impacts, a minor site-specific to localized benefit to cultural landscape resources around this lake.

Ethnographic Resources. Impacts on ethnographic resources as a result of fish management activities under alternative D would be similar to those described in alternative B.

Cumulative Impacts

Removing fish from 62 mountain lakes in the study area would ultimately reduce human activity. When compared to alternative A, ground disturbance related to fishing and fish management activities would be eliminated over time, likely resulting in cumulative beneficial effects on cultural resources in the North Cascades Complex.

Conclusions

Under alternative D, the long-term effects of elimination of fishing at all of the mountain lakes in the study area would result in reduced human fishing activity, a benefit to archeological resources in the North Cascades Complex. More specifically, those lake and trail areas identified as sensitive regarding cultural resources would incur benefits by way of reduced risk of disturbance. Adverse impacts on cultural landscapes would likely be negligible; minor benefits may be realized at one designated cultural landscape where fishing would be eliminated. For the purpose of compliance with section 106 of the *National Historic Preservation Act*, there would be no adverse effect on cultural resources. Cumulative impacts would be beneficial.

Impairment of cultural resources across the study area would not occur under alternative D.

SECTION 106 SUMMARY

This plan/EIS provides an analysis of impacts on cultural resources of four alternatives (the no-action alternative and three action alternatives). The project involves 91 lakes, 90 of which are located in designated wilderness areas.

Visitors to the North Cascades Complex typically access areas on foot along existing trail networks, though cross-county hiking is required to reach some lake areas. Anglers (and other visitors) occasionally pack in stock (horses, mules, llamas), and their stays are typically one to two nights in designated camp areas. Overnight anglers (approximately 1,000 annually) account for approximately 10.5% of backcountry visitors to study area lakes. Fishery management activities conducted by the NPS and WDFW are also typically accomplished via similar access routes to lake areas, though occasional helicopters or fixed-winged aircraft are used.

The North Cascades Complex consists of approximately 684,000 acres, of which less than 5% has been inventoried for cultural resources. As a result, specific direct impacts on cultural resources are difficult to assess. The use of a Programmatic Agreement as defined under 36 CFR 800.14(b) would be appropriate to ensure that no adverse effects on historic properties result from the implementation of the proposed fishery management plan.

Impacts are currently best assessed in areas that contain known, recorded cultural resources. To the extent possible, impacts have been determined by identifying those areas likely to be impacted (lakes and the access routes [trails] to them) and classifying them as to their sensitivity regarding known cultural resources (presence/nature). While several lakes and trails have been identified as sensitive based on the presence of recorded cultural resources, it is a near certainty that numerous and significant unidentified resources exist in the study area and are vulnerable to impact. The following summarizes effects on all cultural resources whether listed in or determined eligible for the National Register or unevaluated for the National Register.

One of the greatest potential impacts on archeological resources is ground disturbance (from pedestrians or vehicles), a result that would occur from implementation of any of the alternatives. Alternative A (the no-action alternative) would, in the long term, result in the greatest potential for ongoing ground disturbance of all alternatives. While potential impact levels are unknown, the implementation of mitigation measures would likely ensure that adverse impacts would not exceed minor intensity, resulting in *no adverse effect* to archeological resources. In some cases (alternatives C and D), minor benefits to archeological resources would be expected (*no adverse effect*) as a result of reduced human activity.

The continuation of ongoing sport fishing under alternative A would result in negligible to minor adverse impacts on historic structures (*no adverse effect*) which would be mitigated further to negligible. The incremental reduction in sport fishing activities under alternatives B, C, and D would result in varying effects to historic structures, none of which is anticipated to exceed the minor intensity (*no adverse effect*). Alternative D would likely create a negligible to minor benefit to historic structures because of its complete elimination of sport fishing and consequent reduction in human activity, particularly in sensitive areas (*no adverse effect*).

Ongoing sport fishing under alternative A would likely result in adverse impacts on cultural landscapes in the North Cascades Complex, which would be mitigated to no greater than minor (*no adverse effect*). Incremental reduction in sport fishing proposed under alternatives B, C, and D would result in varying effects, none of which would exceed minor intensity (*no adverse effect*). In fact, the reduction of fishing opportunities proposed under alternatives C and D would result in minor benefits (*no adverse effect*) at one designated cultural landscape. Under alternative D, the complete elimination of sport fishing would likely result in negligible to minor, long-term benefits (*no adverse effect*) to cultural landscapes in the North Cascades Complex. The use of helicopters for fish management activities under all alternatives has the potential to create minor visual impacts (*no adverse effect*) to cultural landscapes that would likely be mitigated further.

While the potential to impact ethnographic resources exists under alternative A, no specific resources are known (no recorded resources). The potential to adversely affect ethnographic resources exists to an unknown degree under alternatives B, C, and D in that these alternatives propose chemical fish removal actions; however, any adverse impacts would likely be mitigated to negligible (*no adverse effect*) through negotiated agreements among the NPS, affected Tribes, and the State Historic Preservation Office.

Cumulative major adverse impacts on cultural resources have occurred in the past as a result of the construction of hydroelectric projects (dams, reservoirs, related facilities) in the form of site inundation and destruction (*adverse effect*). These adverse effects were created at a time when little or no formal protection existed for historic properties. In fact, only a small percentage of the North Cascades Complex has been inventoried to date. A North Cascades Complex-wide inventory of cultural resources, including shorelines of reservoirs and lakes associated with the hydroelectric projects where archeological resources are known to exist, would result in major, regional benefits to cultural resources in the North Cascades Complex (*no adverse effect*). Ongoing recreational use of the North Cascades Complex would likely result in no greater than minor adverse impacts on cultural resources (*no adverse effect*). The anticipated reduction of human activity, which would result under alternatives C and D, would likely create negligible to minor cumulative benefits to cultural resources in the long term (*no adverse effect*).

Further reduction of potential adverse impacts on cultural resources would be accomplished by periodic and systematic monitoring of known/recorded cultural resources in the North Cascades Complex. Those cultural resources identified as at risk of adverse impacts would be evaluated for National Register eligibility (if they have not yet been), and where necessary, mitigation measures would be implemented. These actions would include monitoring, site stabilization, and visitor management actions (signage, interpretive materials). The NPS would actively work with affected Tribes to protect ethnographic resources and privacy for traditional activities.

In cases where they have not been identified as part of this analysis, potential adverse impacts (as defined in 36 CFR 800) on cultural resources listed in or eligible for listing in the National Register would be coordinated between the NPS and the State Historic Preservation Office to determine the level of effect on the property and to determine any necessary mitigative measures.

NPS staff at the North Cascades Complex would continue to educate visitors regarding cultural resource protection, with particular emphasis on surface artifacts, architectural features, and traditional activities. If necessary, additional mitigation measures would be developed in consultation with the State Historic Preservation Officer and affected Tribes. Continuing implementation of the *Cultural Resources Management Guidelines* and adherence to *NPS Management Policies* (NPS 2001a) and the 1995 Service-wide Programmatic Agreement with the Advisory Council on Historic Preservation and National Conference of State Historic Preservation Officers would all aid in reducing the potential to adversely impact historic properties.

Copies of this plan/EIS have been distributed to affected/concerned Native American Tribes, the Washington State Historic Preservation Officer, and the Advisory Council on Historic Preservation for review and comment related to section 106 compliance.

Pursuant to 36 CFR Part 800.5, implementing regulations of the National Historic Preservation Act that address the criteria of effect and adverse effect, the NPS finds that implementing a fishery management plan for the North Cascades Complex, with mitigation measures, would not result in any new adverse impacts, (*no adverse effect*) to archeological sites, historic structures, or ethnographic resources currently identified as eligible for or listed in the National Register. In some cases, benefits to these resources would occur as a result of implementation of the proposed alternatives (*no adverse effect*).

VISITOR USE AND EXPERIENCE

RECREATIONAL USE

GUIDING REGULATIONS AND POLICIES

The *NPS Management Policies* (NPS 2001a) state that the enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks and that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. While recreation is a key component of the *NPS Management Policies*, they also state that "Exotic species will not be allowed to displace native species if displacement can be prevented," and that "All exotic plant and animal species that are not maintained to meet an identified park purpose will be managed - up to and including eradication - if (1) control is prudent and feasible, and (2) the exotic species interferes with . . . native species or natural habitats; or disrupts the genetic integrity of native species."

This dual nature of visitor enjoyment and resource conservation is evident in the NPS *Organic Act of 1916* and subsequent legal interpretations of it. While the NPS is mandated to leave resources "unimpaired for future generations," it also has been directed to conserve resources when conflicts arise between visitor experience and those resources (refer to the "Impairment Analysis" section under "General Methodology" in this chapter). Guiding documents for North Cascades Complex, such as the *Strategic Plan* (NPS 2000a), also address these issues, stating that the purpose of the North Cascades Complex is to

> Preserve for the benefit, use, and inspiration of present and future generations certain majestic mountain scenery, snowfields, glaciers, alpine meadows, and other unique natural features, biological processes, and cultural resources in the North Cascades.
>
> Provide outdoor recreation use and enjoyment for the public, and for the conservation of the scenic, scientific, historic, and other values contributing to public enjoyment within Ross Lake and Lake Chelan National Recreation Areas.

The goals of providing recreational opportunities and protecting the natural systems in the North Cascades Complex are also evident in the objectives of this plan/EIS. With regard to recreation and conservation, the objectives state that this plan/EIS should

> Advance the protection and rehabilitation of native biological integrity by maintaining native species abundance, viability, and sustainability.
>
> Provide a spectrum of recreational opportunities, including sport fishing, while minimizing impacts to the biological integrity of natural mountain lakes.

METHODOLOGY AND ASSUMPTIONS

The purpose of this impact analysis is to identify the level of impact that implementing each of the proposed alternatives would have on recreational opportunities available in the North Cascades Complex.

To determine the impacts on visitor use and experience, two major groups of users important in this analysis were identified: anglers who participate in or value fishing in the mountain lakes in the North Cascades Complex, and non-anglers who participate in other forms of recreation in the North Cascades Complex.

GEOGRAPHIC AREA EVALUATED FOR IMPACTS

The study area for this analysis is the North Cascades Complex (see “Map 1” located in the envelope that accompanied this document) and the 91 naturally formed mountain lakes in the North Cascades Complex that currently have, or at one time had, a fish presence as a result of either documented or undocumented fish stocking activities. The 91 lakes addressed in this plan/EIS are scattered throughout the North Cascades Complex: 7 are in Ross Lake National Recreation Area, 15 are in Lake Chelan National Recreation Area, and the remaining 69 are located in the north and south units of North Cascades National Park (for more details, refer to the “Alternatives” chapter).

IMPACT THRESHOLD DEFINITIONS

The impact intensities for visitor use are defined below. Where impacts to visitor experience become moderate or minor, it is assumed that current visitor satisfaction would begin to decline, and the North Cascades Complex would not be achieving some of its long-term visitor goals. The impact thresholds below refer to adverse impacts unless otherwise stated in the analyses as beneficial effects.

Negligible. No impacts on the visitor experience or only temporary effects are expected. There would be little noticeable change in visitor experience (or in the defined indicators of visitor satisfaction) or behavior.

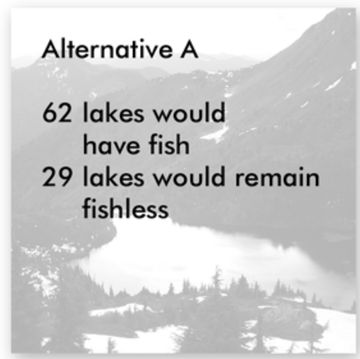
Minor. Desired visitor experience is changed, but without appreciably limiting or enhancing critical characteristics of the experience. Visitor satisfaction remains stable (that is, 20% of the users are not satisfied with their experience). Other areas in the North Cascades Complex would remain available for similar visitor experience and use without derogation of the resources and values of the North Cascades Complex.

Moderate. Critical characteristics of the desired experience are changed, or the number of participants engaging in an activity is altered. Visitor satisfaction begins to decline (that is, 20% to 50% of the users are not satisfied with their experience). Other areas in the North Cascades Complex would remain available for similar visitor experience and use without derogation of the resources and values of the North Cascades Complex, but some visitors who desire this experience would be required to pursue their choice in other available local or regional areas.

Major. Impacts eliminate or detract from multiple critical characteristics of the desired experience or greatly reduce or increase participation. Visitor satisfaction declines substantially (that is, more than 50% of the users are not satisfied with their experience). Other areas in the North Cascades Complex would remain available for similar visitor experience and use without derogation of the resources and values of the North Cascades Complex. Some visitors who desire this experience would be required to pursue their choice in other available local or regional areas. Other visitors may not be able to duplicate their desired experience elsewhere.

IMPACTS OF THE ALTERNATIVES ON VISITOR RECREATIONAL USE

Alternative A (No Action): Existing Management Framework of 91 Lakes (62 Lakes Have Fish)



Alternative A (no action) would continue existing management practices of the 91 lakes in the study area. The “Alternatives” chapter provides a detailed description of alternative A. For more information on the 91 lakes, refer to table 5 and figure 4 in the “Alternatives” chapter, appendix E, and “Map 2” and “Map 2 Table” located in the envelope that accompanied this document.

Visitation increased throughout the North Cascades Complex between 2000 and 2001, but had decreased during the prior two years (1999 and 2000). The impacts from flooding that occurred in October 2003 have largely been repaired, but the Upper Stehekin Valley Road remains extensively damaged and impassable to vehicles; its fate remains uncertain. Long-term closure of the road would reduce backcountry use of the Stehekin Valley, but it is otherwise assumed that visitation levels for the North Cascades Complex would remain steady over the next 10 years.

The majority (80% in 2002) of the visitors to the North Cascades Complex recreate in Ross Lake National Recreational Area along State Route 20 and do not venture far from the highway corridor. These visitors participate in bicycling, day hiking, picnicking, and fishing, as well as touring the hydroelectric project in the summer. Because these visitors do not travel into the backcountry areas of the North Cascades Complex, which includes the study area’s 91 lakes, they likely would experience no effects from implementation of alternative A.

Visitors enjoy other activities in the North Cascades Complex such as boating, paddling, hunting (in the recreation areas only), hiking, camping, mountaineering, horseback riding, and fishing in mountain lakes, creeks, rivers, and reservoirs. No boating or paddling occurs in the mountain lakes. Very few people hunt, which is limited to the national recreation areas, and hunting season typically occurs in the fall and winter, when mountain lakes ice over, and visitation is low; therefore, no impacts are expected on, or from, these users. Impacts on the remaining visitors to the North Cascades Complex are discussed below.

Impacts on Hikers and Backcountry Campers

Family outing at Cascade Pass.

Hikers. Day hiking is one of the most popular backcountry activities in the North Cascades Complex. Although most lakes in the park cannot be fished in one day, eight lakes do provide day-use fishing. For most day hikers, these lakes include Hozomeen, Willow, Ridley, Lower and Middle Thornton, Monogram, Coon, and Hidden. These lakes are among the top 10 most popular fishing destinations in the North Cascades Complex. The relative accessibility of these lakes would lead to increased fishing at these locations with future increases in visitation; however, day-use anglers represent a small number of overall day-use visitors. Increased fishing of popular day-use lakes would result in a long-term, adverse impact on day-use visitors seeking solitude, although the current fishing pressure on these lakes is so slight that increased fishing pressure would probably have a negligible impact for the foreseeable future.

Some of the day-use lakes were stocked by aircraft in the past, but are currently backpack stocked. Stocking frequency varies by lake (refer to table 6 in the "Alternatives" chapter), although the majority of lakes are stocked only once every four to five years. Stocking typically occurs after lakes thaw (usually early July) and before fall in order for fry to acclimatize to the lakes. The summer months are also when visitation is highest. Day hikers would likely experience negligible impacts to their use and experience from implementation of alternative A because angling would not be expected to noticeably increase, and aircraft stocking of these lakes has been discontinued and replaced with backpack stocking.

Backcountry Campers. The NPS maintains over 200 backcountry overnight campsites. The most commonly used camps occur along the shores of Ross Lake. These sites accommodate between 25% and 40% of all backcountry overnight users (excluding users in cross-country zones). Ross Lake reservoir would not be affected by fishery management actions, so Ross Lake campers would not be affected by management actions under alternative A.

Camping at Perfect Pass.

Of the remaining 200 backcountry overnight campsites that are not situated along Ross Lake, numerous camps are located near fishable lakes (see "Map 2" and "Map 2 Table" in the envelope that accompanied this document). Non-anglers who camp at these lakes may possibly share the established camps with anglers, particularly where lakes provide good fishing. In addition, the two McAlester Lake camps, the Hozomeen Lake camp, the Thornton Lake camp, and the Rainbow Lake camp are among the top 10 campsites visited by anglers (see the "Visitor Use and Experience" section in the "Affected Environment" chapter for details).

Dispersed camping is permitted in cross-country zones, and visitors commonly camp near lakes. Non-anglers camping in cross-country zones near lakes with fish would come into contact with anglers. Given the generally low and dispersed use of cross-country zones, there would be little competition or conflict between anglers and non-anglers for campsites, solitude, or other desired experiences. These visitors would be able to select their own camping locations and would not be required to use or share established campsites.

Visitors to lakes containing stocked fish (at established campsites or within cross-country zones) would experience negative impacts if stocking by aircraft occurred during their visit. Twenty-one lakes in the study area are currently stocked by fixed-wing aircraft. Stocking cycles vary between lakes, and lakes are usually stocked during the summer when visitation is highest. Given the small number of backcountry campers, the low probability of camping at a lake being stocked by aircraft, as well as the short-term and infrequent nature of aircraft stocking activities, non-anglers who camp in the backcountry would experience negligible, adverse, temporary impacts that would occur over the long term.

Impacts on Climbers and Mountaineers

North Cascades is a renowned destination for mountaineering, and bolted sport climbing and bouldering (forms of rock climbing) are becoming increasingly popular in the frontcountry portions of Ross Lake National Recreation Area. However, the frontcountry areas of Ross Lake are not in the study area, so rock climbers would not be affected under alternative A.

Mountaineering in the North Cascades is becoming more popular.

Eldorado, Forbidden, and Sahale peaks are the most popular mountaineering destinations. There are also several relatively popular lakes for fishing in these areas, including Trapper, Doubtful, and Hidden. Given the limited amount of backcountry overnight campsites (such as Pelton Basin Camp and Sahale Camp) in this area, mountaineers and anglers may compete for the same backcountry campsites at these popular locations, although there is currently no evidence that competition for backcounty campsites is occurring at this time. Mountaineering occurs throughout the remainder of the North Cascades Complex, though numbers are low and usage is very dispersed. Other than competing for campsites at certain high-use areas, conflict between mountaineers and anglers over campsites would not be expected because these activities generally do not overlap.

Some mountaineers are believed to also fish while visiting the North Cascades Complex, and these individuals likely view fishing as an enjoyable component of their mountaineering experience. Mountaineers who fish would perceive no impacts to their fishing experience because management actions would remain unchanged under alternative A.

Mountaineers who do not engage in or value fishing would experience impacts similar to those described for hikers and backcountry campers regarding noise from fixed-wing aircraft stocking activities. Given the low probability of camping at or traveling near a lake being stocked by aircraft, as well as the infrequent and short-term nature of stocking activities, mountaineers would experience negligible, adverse, temporary impacts that would occur over the long term.

Impacts on Stock Users and Horseback Riders

Many trails and backcountry camps are available for stock use (limited to horses, mules, and llamas); there are 29 backcountry camps in the entire North Cascades Complex available for stock use. Only 11 of the 91 lakes in the study area are accessible by horseback, and the number of stock users who fish in mountain lakes is not known. Horseback riding is popular on the east side of Lake Chelan in the Stehekin River valley.

Stock users would experience impacts from fixed-wing aircraft stocking at the lakes that are accessible by horseback. Stock users comprise less than 2% of all visitors to the North Cascades Complex, and 7 of the 11 lakes accessible by horseback would be stocked by aircraft under alternative A (refer to table 23 in the "Affected Environment" chapter). Aircraft stocking would occur very infrequently, so the adverse impacts from this activity would be negligible over the long term as stocking activities continue.

Impacts on Anglers

A young angler.

The majority of sport fishing in the North Cascades Complex occurs in the two primary reservoirs: Ross Lake and Lake Chelan, including its tributary, the Stehekin River. Approximately 11.5% of backcountry overnight use involves sport fishing (11.5% pertains to fishing at all water bodies in the North Cascades Complex, not just the 91 lakes). The mountain lakes most frequently fished appear to be those that are most accessible, with a decent potential to catch fish. Based on surveys conducted in the 2003 field season, less than 3% of day users surveyed were fishing (refer to table 25 in the "Affected Environment" chapter). The majority of anglers spend one or more nights in the backcountry because most of the lakes cannot be accessed in one day (see the "Angler Use Summary" section under "Visitor Use and Experience" in the "Affected Environment" chapter).

Under alternative A, anglers would perceive no change to their visitor experience in the North Cascades Complex. Although anglers may be present at lakes when aircraft stocking occurs, this user group is likely to view such activity as compatible with their backcountry experience because aircraft stocking is a common method for maintaining the mountain lake fishery. Impacts on anglers would be beneficial and long term because they would continue to fish at the mountain lakes that are currently available for fishing.

Cumulative Impacts

Alternative A would likely not change angler use inside or outside the boundaries of the North Cascades Complex, so displacement of anglers to lakes outside the NPS boundaries would not be expected. No new resorts or major upgrades to existing visitor facilities are currently planned. No projects are currently proposed or planned that would change road access to any unit of the North Cascades Complex, and no new major trails or trailheads are being considered, although a small section of the Pacific Northwest Trail in the North Cascades Complex is currently under construction. Given the vast number of miles available for hiking throughout the North Cascades Complex (386 miles), this construction would likely have no discernable effects on visitors.

Record flooding in the fall of 2003 damaged or destroyed many trails, roads, and bridges. Most of the flood damage was repaired in the 2004 field season. The upper Stehekin Valley Road remains extensively damaged, and an environmental assessment is being prepared to determine whether or not to repair the damage. For the foreseeable future, visitor use of the upper portion of the Stehekin Valley Road may remain greatly reduced, and this would cause some decline in backcountry visitation to portions of the upper Stehekin Valley. Some visitors might enjoy the increased solitude and wilderness setting, while others might lament the reduced access to backcountry areas in the Stehekin Valley, including fishable lakes. Therefore, the cumulative impacts on visitor use either would be adverse or beneficial to backcountry users in the Stehekin Valley.

When combined with the overall long-term, negligible, adverse impacts on non-anglers, cumulative impacts would be minor to moderate, adverse, and short term, depending on the fate of the Stehekin Valley Road. When combined with the long-term beneficial impacts on anglers, cumulative impacts would be short term, minor to moderate and adverse, depending on the extent of flood damage to trails accessing lakes within the study area.

Conclusion

Impacts on non-anglers under alternative A would primarily be related to noise and disruption from fixed-wing aircraft stocking activities. Such adverse impacts would be negligible and temporary but would continue over the long term as stocking activities continue. Anglers would experience long-term beneficial impacts because they would continue to enjoy fishing activities unchanged from the past. Cumulative impacts would result from the partial loss of the Stehekin Valley Road due to flooding that occurred in the fall of 2003. The fate of the road is currently uncertain. If the road is not repaired, then access to backcountry portions of the Stehekin Valley may be more difficult, and this would reduce the amount of backcountry visitation. Some visitors might enjoy the increased solitude and wilderness setting, while others might lament the reduced access to backcountry areas in the Stehekin Valley, including fishable lakes. Therefore, adverse cumulative impacts on visitor use would be minor to moderate over the long term.

Alternative B: Proposed Adaptive Management of 91 Lakes under a New Framework (42 Lakes May Have Fish) (Preferred Alternative)

The goal of this alternative is to eliminate or reduce reproducing fish populations from select lakes in the national park and the two national recreation areas. The "Alternatives" chapter provides a detailed description of alternative B. For more information on the 91 lakes, refer to tables 5 and 10 in the "Alternatives" chapter, appendix E, and "Map 2" and "Map 2 Table" located in the envelope that accompanied this document.

Alternative B

29 lakes would have fish
49 lakes would be fishless
13 lakes would be evaluated for restocking

The majority of the North Cascades Complex's visitors (80% in 2002) recreate in the frontcountry portions of Ross Lake National Recreation Area along State Route 20 and do not venture far from the highway corridor. Because frontcountry visitors do not travel into the backcountry of the North Cascades Complex, they would likely experience no impacts from implementation of alternative B.

Impacts on Hikers and Backcountry Campers

The spectacular view is worth the long hike.

Hikers. Most day-use fishing currently occurs at Hozomeen, Willow, and Ridley, Lower and Middle Thornton, Monogram, Coon, and Hidden lakes. Under alternative B, the reproducing population of brook trout in Hozomeen Lake (one of the most popular fishing destinations in the North Cascades Complex) would be removed, if feasible, and the lake would remain fishless. The reproducing population of cutthroat trout at Monogram Lake would be removed and then restocked after a resting period. Management actions would not change for the other readily accessible day-use lakes, and they would remain available for fishing. The loss of fishing opportunity in Hozomeen lake, and the temporary loss of fishing opportunity at Monogram Lake, might have a beneficial impact on day hikers seeking greater solitude because fewer anglers may be present. The magnitude of this beneficial impact would be very slight because anglers represent a small number of overall day-use visitors to these lakes. For example, of the 244 estimated day users who visited Hozomeen, Willow, and Ridley lakes in 2003, only 7 were estimated to be anglers (refer to table 25).

Under this alternative, strong preference would be given to backpack stocking (stocking frequency varies by lake and occurs during summer months) as opposed to fixed-wing aircraft. Of the lakes listed above, Hidden, Thornton (Lower and Upper), and Monogram might be stocked by aircraft. Aircraft stocking would only be used if it was determined that fish would not survive a long-distance backpack trip. Noise from the presence of aircraft continuing stocking activities would be reduced compared to alternative A since fewer lakes would be stocked. Aircraft stocking occurs very infrequently, so negligible, beneficial impacts on day hikers would continue over the long term.

Under alternative B, up to 49 lakes either would be treated to remove fish or maintained as fishless. Fish removal activities would likely have a short-term, adverse impact on day hikers who may perceive the presence of helicopters, field crews, and the application of chemical (piscicide) or gillnetting/electrofishing treatments as incompatible with their visitor experience. The duration of fish removal treatments would vary according to methods. For example, gillnetting would likely occur over a three-year period. Chemical treatment with the piscicide antimycin would take place over several days in one summer season. Gillnetting/electrofishing would occur during the summer and fall months, which coincide with peak visitor use. Chemical (piscicide) treatment would vary according to fish species and would occur prior to spawning. The timing would be early season for cutthroat trout and later in the season (August or early September) for brook trout (see the "Alternatives" chapter for details). Spawning habitat exclusion, recommended at this point for just one lake (Wilcox/Lillie, Upper) would probably have a negligible impact on day-use visitors because the lake is remote and seldom visited. Natural treatment methods (that is, cessation of stocking) would have a negligible impact on the day-use visitor experience. Only a handful of lakes would be treated in any given season, and most of the lakes would not be accessible by day users. In light of these reasons, the impacts of alternative B on day-use hikers would be negligible.

Mitigation to reduce impacts on day-use visitors from management actions would include visitor education and public outreach to inform the public when and where these actions would take place (see appendix I).

Backcountry Campers. The North Cascades Complex maintains over 200 backcountry campsites. The most commonly used backcountry camps occur along the shores of Ross Lake. These sites accommodate between 25% and 40% of all backcountry users (excluding users in cross-country zones). Because Ross Lake reservoir is not part of this plan/EIS, Ross Lake campers would likely experience no effect from implementation of this alternative.

Reduced angling opportunities at certain lakes under alternative B would reduce the number of backcountry campers at lakes that currently contain fish (refer to “Map 1 Table” and “Map 2 Table”).

Dispersed camping is permitted in cross-country zones, and camping next to lakes in cross-country zones is common. Non-anglers camped in cross-country zones near lakes with fish would come into contact with anglers, although the number of lakes available for fishing would be reduced compared to alternative A. Given the generally low backcountry use at developed camps, and low, dispersed use of cross-country zones, there would be little competition or conflict between anglers and non-anglers for campsites, solitude, or other desired experiences.

Visitors to lakes containing stocked fish (either at formally established campsites or in cross-country zones) would experience negative impacts if stocking activities, particularly stocking by fixed-wing aircraft, occurred during their visit. However, fewer lakes would be available for fishing under this alternative (29) than alternative under A (62), and preference would be given to backpack stocking. Although backpack stocking would also interfere with backcountry campers’ visitor experience, this type of lake stocking would likely be viewed as more compatible and less intrusive. Compared to alternative A, backcountry campers who are also non-anglers would experience beneficial long-term impacts since there would be fewer lakes affected by stocking activities.

Backcountry campers would also be exposed to fish removal activities, as described above for hikers. Backcountry visitors may view such activity as more intrusive, since they may be more interested in achieving a wilderness experience than day users, and have invested considerably more effort to reach the backcountry. Several factors, however, would reduce the potential impact of fish removal on the visitor experience. A small number of lakes would be treated each season, and the lakes proposed for treatment are located in cross-country zones that do not receive high backcountry visitation. The lakes include Lower and

Middle Blum, Triplet Lower and Upper, Diobsud No. 1 and No. 2 (including 3 other lakes in the area), and Wilcox/Lillie (including 4 other lakes in the area). The cross-country zones and camps near the 91 lakes in the study area are shown on "Map 2" and "Map 2 Table." In addition, rangers issuing backcountry overnight use permits would inform campers when fish removal treatments are occurring and would recommend alternate destinations. Therefore, impacts from fish removal efforts would be minor to moderate under alternative B.

Hiking is a popular activity in the North Cascades Complex.

Impacts on Climbers and Mountaineers

As described under alternative A, rock climbers would likely experience no effect under alternative B because they primarily use frontcountry areas around Ross Lake. As described under alternative A, some popular mountaineering peaks are located near lakes that are also popular with anglers, particularly Doubtful Lake, which experiences the highest amount of backcountry fishing visitation in the North Cascades Complex each season and would be stocked under alternative B. Therefore, mountaineers and anglers would share access and may compete for the same backcountry campsites at these locations. Some mountaineers, though, also fish while visiting the North Cascades Complex, and these individuals likely view fishing as compatible with mountaineering. Given the relatively small number of mountaineers that visit the North Cascades Complex, any adverse impacts on mountaineers related to fishing in the backcountry are likely to be negligible. Mountaineers who fish would perceive negligible impacts on their fishing experience.

Mountaineers would experience impacts similar to those described for hikers and backcountry campers regarding stocking activities. The preference given to backpack stocking under this alternative would result in beneficial effects that would occur over the long term. Regarding lake treatment activities, such activities would occur over the course of a few seasons, and not all lakes would be treated at once; therefore, impacts from fish removal treatments would be short term, adverse, and minor.

The overall impacts on mountaineers who do not engage in sport fishing would be beneficial over the long term. Short-term, negligible to minor adverse impacts would occur from lake treatment actions under alternative B over the long term. Mitigation to reduce impacts on visitors from management actions included public outreach to inform the public when and where these actions would take place (see appendix I).

Impacts on Stock Users and Horseback Riders

The high-use areas in the study area are illustrated on "Map 2" and "Map 2 Table" (located in the envelope that accompanied this document). There are 29 backcountry camps in the North Cascades Complex available for stock (horses, mules, llamas) users and horseback riders. Of the 91 lakes, 11 are accessible by horseback. Some of the more popular fishing lakes are in the Lake

Chelan area; these lakes are also accessible by horseback. Management actions for alternative B would include returning some of these lakes to a fishless condition, while others are treated and restocked (refer to "Map 1 Table" and "Map 2 Table"). Impacts of returning some lakes to a fishless condition would be moderate, adverse, and long term for stock users that fish in the lakes in Lake Chelan National Recreation Area. For those stock users and horseback riders who do not engage in sport fishing, impacts from treatment of lakes (mechanical and chemical fish removal) would be minor and adverse over the short term but beneficial over the long term as management actions are completed.

Impacts on Anglers

The majority of sport fishing in North Cascades Complex occurs at Ross Lake reservoir and Lake Chelan, including its tributary, the Stehekin River. Approximately 10.5% of backcountry overnight users fish (in the 91 study area lakes that currently contain fish), and only a few lakes in the North Cascades Complex are visited by day-use anglers; the majority of backcountry mountain lake fishing requires overnight use.

Of the 91 lakes in the study area, approximately 29 would be available for fishing over the long term, compared with 62 under alternative A (refer to tables 5 and 10 in the "Alternatives" chapter). Fish removal would take time and may not be feasible for all lakes targeted for removal; these lakes would continue to be fishable until fish were removed (refer to table 7). Although all lakes that would have fish removed and undergo a resting or evaluation period before being restocked (pertains to 13 lakes) may still be available for fishing, several years (possibly from five to eight) would pass before the lakes would be successfully fished.

Following fish removal or evaluation, some lakes may be restocked, others may not. Anglers would have to wait for stocked fry to mature to a catchable size, and thus, some of these lakes may not be immediately available for fishing, which would increase the amount of adverse impact anglers would experience. Since the majority of lakes affected are in the backcountry, overnight or backpacking anglers would be most affected by alternative B, compared to day-use anglers.

Of the most popular day-use fishing destinations, only Hozomeen Lake would become fishless under alternative B. Willow and Ridley lakes, which are located in the same area, would continue to be stocked. Lower and Middle Thornton, Hidden, and Coon lakes, which are also popular day-use fishing destinations, would continue to be stocked as well. Monogram Lake would be stocked after reproducing fish are removed.

Cutthroat trout from Willow Lake (top). Brook trout from Hozomeen Lake (bottom).

Lake treatment methods to remove fish would adversely affect some anglers' experience. As described for other park visitors, the presence of helicopters and equipment, such as gillnets, would be disruptive over the short and long term because fish removal would be a long, slow process. Therefore, the impact on anglers from lake treatment methods would be minor to moderate and adverse over the short and long term.

Fewer mountain lakes would be available for fishing under alternative B compared to alternative A (see table 5 in the "Alternatives" chapter). The impact to anglers from lost fishing opportunity compared to alternative A would be moderate and adverse over the long term, particularly for some anglers who enjoy fishing a particular lake or group of lakes. If a favorite lake were no longer available for stocking, some anglers may not choose to sport fish in other available lakes or may not return to the North Cascades Complex at all. This loss of fishing opportunity for these anglers would be a major, adverse, long-term impact.

Cumulative Impacts

Under alternative B, 20 lakes would be returned to a fishless condition, and 13 other lakes would be evaluated to determine if they should be restocked. This net loss of fishing opportunity would displace some day-use and backcountry anglers to lakes outside the North Cascades Complex, including those in Ross Lake and Lake Chelan National Recreation Areas and surrounding areas outside NPS boundaries. NPS angler survey data suggest that approximately 1,000 anglers fish in mountain lakes annually (see the section titled "Visitor Use and Experience" in the "Affected Environment" chapter). For this displacement analysis, it is assumed that 50% of anglers (approximately 500 anglers per year) would be displaced from fishing in the national park and may choose to fish in other lakes outside the North Cascades Complex.

Damage caused by floods is a chronic problem for NPS management. This photo shows a December 2004 debris flow on Rhode Creek that blocked the entrance to Colonial Creek campground in Ross Lake National Recreation Area.

There are approximately 400 lakes available for sport fishing within a 100-mile radius of the North Cascades Complex, and many of these lakes are located on adjacent U.S. Forest Service lands (WDFW, M. Downen, pers. comm., 2004). The additional use of 500 anglers spread across 400 lakes would have a negligible cumulative impact on those lakes, though it is unlikely that anglers would be evenly displaced across such a broad area. A more reasonable scenario would involve angler displacement to relatively similar terrain found on adjacent Forest Service wilderness areas such as the Glacier Peak Wilderness. According to WDFW fishery biologists (WDFW, B. Pfeifer, pers. comm., 2004), some of the more readily accessible lakes on adjacent Forest Service lands are already overused by anglers. Additional use of these lakes by anglers displaced from the North Cascades Complex would have a cumulative, adverse impact on visitor use and experience in those areas. The magnitude of impact would depend on individual values and expectations and would range from negligible to minor.

After several years of drought, the North Cascades Complex experienced exceptional flooding in the fall of 2003. Many trails and several roads were damaged or destroyed. Most of the damage was repaired during the 2004 field season, with the upper Stehekin Valley Road being a notable exception. An environmental assessment is currently underway to evaluate alternatives for the extensively damaged road. Although the fate of the road remains uncertain, for the foreseeable future, visitor use of the Stehekin Valley would be lower because road access into the valley has been greatly reduced. Some visitors might enjoy the increased solitude and wilderness setting, while others might lament the reduced access to backcountry areas in the Stehekin Valley, including fishable lakes. The cumulative impacts on visitor use from flooding either would be minor adverse or beneficial to backcountry users in the Stehekin Valley.

Conclusion

Adverse impacts on non-anglers under alternative B would primarily be related to lake treatment methods. These adverse impacts would be negligible to minor over the long term. Removal of fish from some lakes would reduce visitor use and have some long-term beneficial impacts on non-anglers seeking greater solitude in the backcountry. Impacts on most anglers overall would be minor to moderate, adverse, and long term from management actions under alternative B compared to alternative A. Major adverse impacts would occur to some anglers who believe fishing in North Cascade Complex lakes is a truly unique experience that cannot be duplicated elsewhere. Cumulative impacts related to angler displacement to overused areas outside the North Cascades Complex would overall be minor to moderate, adverse, and long term. The cumulative impact of reduced access in the Stehekin Valley due to flood damage would be minor adverse or beneficial to backcountry users.

Alternative C: Proposed Adaptive Management of 91 Lakes under a New Framework (11 Lakes May Have Fish)

The emphasis of this alternative is to eliminate fish from (or maintain as fishless) 80 of the 91 lakes in the study area; 69 of the 80 lakes are in the national park portion of the North Cascades Complex. Sport fishing would still be allowed in 9 lakes in Ross Lake and Lake Chelan National Recreation Areas. Reproducing fish populations in 2 lakes in the recreation areas would be evaluated, and after evaluation, the lakes may be stocked with nonreproducing trout. Sport-fishing opportunities in the national park would gradually decline over time as stocked fish populations died off, and reproducing populations of fish were gradually removed, although removal of reproducing populations from the national park might not be feasible for some lakes (refer to table 7). If removal proved infeasible, these lakes would continue to provide sport-fishing opportunities for the foreseeable future. For lakes with stocked fish, after about 5 years, most fish would be gone and the quality of fishing would drop sharply (WDFW, M. Downen, pers. comm., 2004). Sport fishing in the national recreation areas would still be allowed, although reproducing populations of fish would be removed. In some cases the lakes would be restocked with trout that are incapable of reproducing.

Alternative C

9 lakes would have fish
80 lakes would be fishless
2 lakes would be evaluated for restocking

The "Alternatives" chapter provides a detailed description of alternative C. For more information on the 91 lakes, refer to tables 5 and 12 in the "Alternatives" chapter, appendix E, and "Map 2" and "Map 2 Table" located in the envelope that accompanied this document.

Impacts on Hikers and Backcountry Campers

Day Hikers. Day-use angling currently occurs at Hozomeen, Willow, Ridley, Lower and Middle Thornton, Monogram, Coon, and Hidden lakes. Under this alternative, Hidden, Hozomeen, Monogram, and Lower and Middle Thornton lakes would become fishless. Willow, Ridley, and Coon (which are all popular fishing destinations) would continue to be stocked. Anglers represent a small number of overall day-use visitors, so a decrease in the amount of fishable mountain lakes would have a slight beneficial effect to day hikers because fewer people may be hiking the trails.

Willow, Ridley, and Coon lakes would continue to be stocked. Up to 56 lakes would be treated to remove fish: 25 chemically, 10 mechanically, and 21 by natural treatment (fish would be eliminated by cessation of stocking, experiencing a natural die-off). Removal of fish would be a lengthy process, and only a handful of lakes would be treated in any given year. Day hikers would be negatively affected by fish removal activities (including transporting fish removal equipment with helicopters, use of motorized equipment, presence of work crews around lakes, and gillnetting) because they may perceive these activities as incompatible with their visitor experience. The impacts of fish removal on day hikers would be longer in duration than under alternative B because more lakes would be slated for fish removal. As in alternative B, only a handful of lakes would be treated in a season, so only a small portion of lakes in the North Cascades Complex would be affected each year. In addition, most of the lakes would not be accessible by day users, so fishery management actions would only affect a small portion of the North Cascades Complex. In contrast to alternative B, several more day-use lakes would undergo fish removal, leaving a greater number of day users impacted over the long term. In light of all these reasons, the impacts of fish removal on day-use hikers would be negligible to minor.

To mitigate the impacts of fish removal actions of the visitor experience, the NPS would provide information about fish removal schedules and locations, and educational programs would be provided as described under alternative B.

Backcountry Campers. Camping next to lakes (with and without fish) is common throughout the backcountry. The campsites located next to lakes are shown on “Map 2 Table,” and the management actions for alternative C are shown on “Map 1 Table.”

The majority of non-anglers visiting lakes that would contain fish under alternative C may share the camps with anglers but only in the national recreation areas. The reduction of available backcountry lakes for fishing would either concentrate anglers in sites at those remaining lakes that provide fishing, thus increasing visitation and competition for limited camping sites (the impacts of angler displacement are discussed in the “Cumulative Impacts” section below). With such limited angling pressure in the backcountry, the impact of increased competition for campsites near national recreation area lakes with fish would probably be negligible. Dispersed camping is permitted in cross-country zones, and camping next to lakes (both with and without fish) is common. Visitors in these areas would be able to select their own camping locations and would not be required to use or share established campsites.

Fewer lakes would be available for fishing under this alternative. Visitors to lakes containing stocked fish (either at campsites or in cross-country zones) would experience negative impacts if stocking activities, particularly stocking by fixed-wing aircraft, occurred during their visit; preference would be given to backpack stocking. Although backpack stocking would also interfere with backcountry campers' visitor experience, this type of lake stocking would likely be viewed as more compatible and less intrusive. In addition, only lakes in the national recreation areas would be stocked; therefore, compared to alternative A, backcountry campers would experience temporary, negligible, beneficial impacts over the long term.

Backcountry campers would also be exposed to fish removal activities. Backcountry visitors may view such activities as more intrusive, since they may be more interested in achieving a wilderness experience than day users and may have invested considerably more effort to reach the high mountain camps. Rangers issuing backcountry overnight use permits would inform campers when fish removal treatments were occurring and would recommend alternate destinations.

Overall impacts on hikers and backpackers under alternative C would be beneficial related to stocking activities but minor to moderate and adverse related to lake treatments to remove fish.

Impacts on Climbers and Mountaineers

As described under alternative A, rock climbers would likely experience no effect under alternative C because they primarily use frontcountry areas around Ross Lake.

A base camp at Pioneer Ridge.

Mountaineers who travel the backcountry may encounter anglers on trails or at camps. As described under alternative A, Eldorado, Forbidden, and Sahale peaks are popular mountaineering destinations. The lakes near these popular destinations would be returned to fishless conditions, thereby reducing the potential competition between mountaineers and anglers for limited camping sites.

The number of lakes stocked under alternative C compared to A would be reduced; therefore, the impact of stocking activities to visitors engaged in mountaineering would be negligible to minor over the long term. Lake treatment methods to remove fish would result in a minor to moderate adverse impact to visitors engaged in mountaineering since most of the lakes are located outside the areas where visitors climb. There would be a negligible beneficial impact on climbers in that the number of people using the study area may be reduced if numbers of anglers are reduced.

Overall impacts on mountaineers under alternative C would be beneficial related to stocking activities but adverse related to fish removal treatments. These adverse impacts, however, would be short term and largely avoidable if climbers chose to access other areas with lakes not undergoing treatment.

Impacts on Stock Users and Horseback Riders

"Map 2" (located in the envelope that accompanied this document) illustrates where the high-use areas are within the study area. There are 29 backcountry camps in the North Cascades Complex available for stock (horses, mules, llamas) users and horseback riders. Of the 91 lakes, 11 are accessible by horseback. Some of the more popular fishing lakes are in the Lake Chelan National Recreation Area and also accessible by horseback. Management actions for alternative C include returning some of these lakes to a fishless condition, while others are treated and restocked (refer to tables 5 and 12 in the "Alternatives" chapter).

Impacts from fish stocking activities and application of lake treatments would be similar to those described under alternative B, particularly because most horseback riding occurs in the Lake Chelan National Recreation Area, which would continue to experience stocking activities. As under alternative B, only Coon Lake would continue to be stocked by aircraft.

For those stock users and horseback riders who also engage in sport fishing in the Lake Chelan Recreational Area, impacts of returning some lakes to a fishless condition would be moderate, adverse, and long term. For those stock users and horseback riders who do not engage in sport fishing, impacts from treatment of lakes (mechanical and chemical fish removal) would be minor and adverse over the short term, but beneficial over the long term as management actions are completed.

Impacts on Anglers

The majority of sport fishing at the North Cascades Complex occurs at Ross Lake and Lake Chelan, including its tributary, the Stehekin River. Approximately 10.5% of backcountry overnight use near the 91 study area lakes involves sport fishing, and only a few lakes in the North Cascades Complex are visited by day-use anglers (the majority of high mountain lake fishing requires overnight use).

Of the 91 lakes in the study area, approximately 9 would be available for fishing over the long term, compared with 62 under alternative A. Although the lakes that would have fish removed and undergo a resting or evaluation period before being restocked may still be available for fishing, several years (possibly five to eight) would pass before the lakes would be successfully fished.

After fish removal or evaluation occurs, some lakes may be restocked, others may not. Anglers would have to wait for fry added to restocked lakes to mature to a catchable level. Therefore, some of these lakes may not be immediately available for fishing, increasing the amount of adverse impact anglers would experience in the form of lost fishing opportunity. Since the majority of lakes affected are in the backcountry, overnight or backpacking anglers would be most affected by alternative C compared to day-use anglers.

Lake treatment methods to remove fish would adversely affect some anglers' experience. As described for other park visitors, the presence of equipment, such as helicopters, motorboats, and gillnetting/electrofishing, would be disruptive over the short and long term. Fish removal would be a long, slow process, and many lakes would remain fishable for some time; therefore, the impact to anglers from lake treatment methods would be minor to moderate and adverse over the short and long term.

Fewer mountain lakes would be available for fishing under alternative C compared to alternatives A and B (refer to tables 5, 10, and 12 and figure 4 in the "Alternatives" chapter). Day-use anglers would experience long-term adverse impacts. Under this alternative, Hidden, Hozomeen, Monogram, and Lower and Middle Thornton lakes, which are popular with day-use anglers, would become fishless, but Willow, Ridley, and Coon lakes would continue to be stocked.

The impact to anglers from lost fishing opportunity compared to alternative A would be moderate and adverse over the long term. Some anglers enjoy fishing a particular lake or group of lakes and believe that fishing in the North Cascades National Park provides a unique fishing experience that cannot be duplicated elsewhere. For these anglers, loss of fishing opportunity in the national park would be a major, adverse, long-term impact.

Anglers might benefit from decreased noise and disturbance associated with aircraft stocking activities that would occur under this alternative, although it is likely that they view such activity as compatible with their visitor experience. As described for other users, anglers would also experience adverse impacts as a result of intensive treatments to remove fish.

Backcountry fishing opportunities would still be available in Ross Lake and Lake Chelan National Recreation Areas, but these opportunities would not suffice for some anglers who believe that fishing in the national park provides an experience that cannot be duplicated elsewhere. Anglers would also experience short-term, negligible, adverse impacts from fish removal treatments. Overall impacts would be moderate to major on some backcountry anglers but minor to negligible for others.

Cumulative Impacts

One cumulative impact issue for recreational use under alternative C would involve displacement of anglers to other areas due to lost fishing opportunity in the national park. Under alternative C, approximately 80 of the 91 lakes in the study area would be fishless over time (69 of those lakes are in the national park portion of the North Cascades Complex). In 9 lakes in Ross Lake and Lake Chelan National Recreation Areas, sport fishing would still be allowed. Reproducing populations of fish in 2 lakes in the recreation areas would be evaluated, and after evaluation, the lakes may be stocked with nonreproducing trout. This net loss of fishing opportunity would displace some day-use and backcountry anglers to lakes outside the North Cascades Complex, including the lakes in the two national recreation areas and surrounding area. NPS angler survey data suggest that approximately 1,000 anglers fish in mountain lakes annually (see the section titled "Visitor Use and Experience" in the "Affected Environment" chapter). For this displacement analysis, it is assumed that 50% of anglers (approximately 500 anglers per year) would be displaced from fishing in the national park and may choose to fish in other lakes outside the North Cascades Complex.

There are approximately 400 lakes available for sport fishing within a 100-mile radius of North Cascades Complex boundaries, and many of these lakes are located on adjacent U.S. Forest Service lands. The additional use of 500 anglers spread across 400 lakes would have a negligible cumulative impact on those lakes, although it is unlikely that anglers would be evenly displaced across such a broad area. A more reasonable scenario would involve angler displacement to relatively similar terrain found on more adjacent Forest Service wilderness areas such as the Glacier Peak Wilderness. According to WDFW fishery biologists, some of the more readily accessible lakes on adjacent Forest Service lands are already overused by anglers (WDFW, B. Pfeifer, pers. comm., 2004). Additional use of these lakes by anglers displaced from the national park would have a cumulative, adverse impact on visitor use and experience. The magnitude of impact would depend on individual values and expectations and would range from negligible to minor.

Record flooding in October 2003 damaged or destroyed many trails and several roads. Most of the damage was repaired during the 2004 field season, with the upper Stehekin Valley Road being a notable exception. An environmental assessment is currently underway to evaluate alternatives for the extensively damaged road. Although the fate of the road remains uncertain, for the foreseeable future, visitor use of the Stehekin Valley may be lower because road access into the valley has been greatly reduced. Some visitors might enjoy the increased solitude and wilderness setting, while others might lament the reduced access to backcountry areas in the Stehekin Valley, including fishable lakes. Therefore, the cumulative impacts on visitor use from flooding would be minor adverse or beneficial to backcountry users in the Stehekin Valley.

Conclusion

Adverse impacts on non-anglers under alternative C would be primarily related to lake treatment methods. These impacts would be negligible to minor and adverse over the long term. Removal of fish from some lakes would reduce visitor use and have some long-term beneficial impacts on non-anglers seeking greater solitude in the backcountry. Impacts on most anglers overall would be minor to moderate, adverse, and long term from management actions under alternative C compared to alternative A. Major adverse impacts would occur to some anglers who believe fishing in North Cascade Complex lakes is a truly unique experience that cannot be duplicated elsewhere. Cumulative impacts related to angler displacement to overused areas outside the North Cascades Complex would overall be minor to moderate, adverse, and long term. The cumulative impact of reduced access in the Stehekin Valley due to flood damage would be minor adverse or beneficial to backcountry users.

ALTERNATIVE D:
91 LAKES WOULD BE FISHLESS

The emphasis of this alternative would be to remove fish from 62 of the 91 lakes in the study area, with the other 29 lakes remaining fishless. Sport-fishing opportunities in most of these lakes would generally be eliminated within a period of 5 years. Self-sustaining (reproducing) populations of fish would be gradually removed over time. The rate of removal would depend on unpredictable changes in resource (funding and personnel) availability and differences among fish removal methods. Complete removal of self-sustaining populations of fish in some of the larger, deeper lakes might not be feasible (a feasibility analysis is provided in the “Alternatives” chapter). These lakes would continue to provide sport-fishing opportunities for the foreseeable future, and the goal of complete removal might never be achieved. For lakes with stocked fish, after about 5 years, most fish would be gone and the quality of fishing would sharply drop (WDFW, M. Downen, pers. comm., 2004).

The “Alternatives” chapter provides a detailed description of alternative D. For more information on the 91 lakes, refer to tables 5 and 13 in the “Alternatives” chapter, appendix E, and “Map 2” and “Map 2 Table” located in the envelope that accompanied this document.

Impacts on Hikers and Backcountry Campers

Day Hikers. Elimination of mountain lake fishing opportunities in the North Cascades Complex would have a slight beneficial effect to day hikers seeking solitude because fewer anglers would be hiking the trails. This benefit would be offset through time, however, given projected increases in visitation from population growth in the surrounding area. In addition, anglers represent a small number of overall day-use visitors in the backcountry. Fish stocking activities would cease entirely, resulting in a long-term, beneficial impact on day hikers.

Under alternative D, 62 of the 91 study area lakes that currently contain fish would be treated to remove fish. Fish removal activities would have a short-term, adverse impact on day hikers, as described under alternatives B and C. Information about fish removal schedules and locations and educational programs would be provided as described under alternative B. Removal of fish from lakes using mechanical and chemical methods would take many years, so day hikers would have ample opportunities to visit areas unaffected by fish removal actions; therefore, the short-term adverse impacts of fish removal activities would likely be minor to possibly moderate.

Backcountry Campers. Backcountry visitors would be adversely impacted by fish removal activities such as gillnetting/electrofishing and chemical (piscicide) application. Backcountry visitors may view such activities as more intrusive since they might be more interested in achieving a wilderness experience than day users and would have invested considerably more effort to reach the high mountain camps. To mitigate this impact (see appendix I), rangers issuing backcountry overnight use permits would inform campers when and where fish removal treatments were occurring and would recommend alternate destinations.

Backcountry campers at all mountain lakes in the North Cascades Complex would experience long-term beneficial impacts from cessation of stocking.

Under alternative D, overall impacts on backcountry users who do not fish would be beneficial related to cessation of stocking activities but adverse related to mechanical and chemical fish removal treatments. Some beneficial impacts to these visitors would occur because the number of anglers would decline over time.

Impacts on Climbers and Mountaineers

Eldorado, Forbidden, and Sahale peaks are the most popular mountaineering destinations. All lakes in the vicinity of these peaks would eventually be returned to fishless conditions, thereby reducing the amount of interaction between mountaineers and anglers. Mountaineers who fish while accessing these peaks would no longer be able to do so, but this adverse impact would be negligible because fishing is a secondary activity to mountaineering.

Mountaineers would experience long-term, negligible, beneficial impacts from cessation of fish stocking activities throughout the North Cascades Complex; however, mountaineers would be exposed to fish removal activities that may impede their backcountry experience. Rangers issuing backcountry overnight use permits would advise visitors of fish removal activities occurring at their destinations and would recommend alternate destinations. Impacts from fish removal would be short term, minor, and adverse to possibly moderate because fish removal would take many years.

Overall impacts on mountaineers under alternative D would be beneficial related to cessation of stocking activities, but mechanical and chemical lake treatment methods to return lakes to fishless conditions would result in minor to moderate long-term impacts. Any adverse impacts would be short term and avoidable.

Impacts on Stock Users and Horseback Riders

Some of the more popular fishing lakes are in the Lake Chelan National Recreation Area and accessible by horseback. Management actions for alternative D would include returning these lakes to a fishless condition. For those stock (horses, mules, llamas) users and horseback riders who also engage in sport fishing in the Lake Chelan National Recreational Area, impacts of returning lakes to a fishless condition would be long term, moderate, and adverse. For those stock users and horseback riders who do not engage in sport fishing, impacts from mechanical and chemical lake treatment activities to remove fish would be minor and adverse over the short term.

Impacts on Anglers

The majority of sport fishing in the North Cascades Complex occurs at Ross Lake and Lake Chelan, including its tributary, the Stehekin River. Implementation of this alternative is not likely to affect these visitors unless a substantial number of displaced mountain lake anglers choose to fish at Ross and

Stop for just a while—quiet and still, and nowhere else to be.

Chelan lakes. Sport-fishing opportunities in most of the lakes that currently contain fish would generally be eliminated within a period of 5 years. Self-sustaining (reproducing) populations of fish would be gradually removed over time. The rate of removal would depend on unpredictable changes in resource (funding and personnel) availability and differences among fish removal methods. Complete removal of self-sustaining populations of fish in some of the larger, deeper lakes might not be feasible (a feasibility analysis is provided in the "Alternatives" chapter). These lakes would continue to provide sport-fishing opportunities for the foreseeable future, and the goal of complete removal might never be achieved.

Anglers would be affected by both long-term and shorter-term direct impacts of fish removal on the visitor experience and the permanent loss of fishing opportunity. Impacts on anglers' visitor experience from fish removal activities would be greater than impacts on other user groups because anglers may be less supportive of alternative D since it would take away their ability to fish in study area lakes.

The impacts on anglers from the eventual permanent loss of fishing opportunity in the 91 study area lakes would vary. Some casual anglers would continue to fish the backcountry lakes until the lakes became fishless. The eventual inability to fish the mountain lakes would not necessarily preclude a visit to the park for these anglers because they would still participate in other backcountry activities, such as hiking and camping, which do not involve fishing but are already part of the backcountry fishing experience.

For other anglers, fishing is the primary purpose of their visit, and in some cases, it is an activity that has been passed down for several generations. These anglers believe that fishing in the North Cascades Complex is a unique experience that cannot be duplicated elsewhere.

Overall impacts on anglers who fish in the mountain lakes in the study area would be long term, adverse, and major. It is possible that over 50% may not be satisfied with their experience, and participation in the desired activity would be greatly reduced.

Cumulative Impacts

The eventual loss of fishing opportunity under alternative D would displace some day-use and backcountry anglers to lakes outside the North Cascades Complex, including those in the national recreation areas and surrounding areas. NPS angler survey data suggest that approximately 1,000 anglers fish in mountain lakes annually (see the section titled "Visitor Use and Experience" in the "Affected Environment" chapter). For this displacement analysis, it is assumed that 50% of anglers (approximately 500 anglers per year) would be displaced from fishing in the study area lakes and may choose to fish in other mountain lakes outside of the North Cascades Complex.

There are approximately 400 lakes available for sport fishing within a 100-mile radius of the North Cascades Complex, and many of these lakes are located on adjacent U.S. Forest Service lands. The additional use of 500 anglers spread across 400 lakes would have a negligible cumulative impact on those lakes, although it is unlikely that anglers would be evenly displaced across such a broad area. A more realistic displacement scenario would involve angler displacement to relatively similar terrain found on adjacent Forest Service wilderness areas such as the Glacier Peak Wilderness. According to WDFW fishery biologists, some of the more readily accessible lakes on adjacent Forest Service lands are already overused by anglers (WDFW, B. Pfeifer, pers. comm., 2004). Additional use of these lakes by anglers displaced from the North Cascades Complex would have a cumulative adverse impact on visitor use and experience. The magnitude of impact would depend upon individual values and expectations and would range from negligible to minor.

Record flooding in October 2003 damaged or destroyed many trails and several roads in the North Cascades Complex. Most of the damage was repaired during the 2004 field season, with the upper Stehekin Valley Road being a notable exception. An environmental assessment is currently underway to evaluate alternatives for the extensively damaged road. Although the fate of the road remains uncertain for the foreseeable future, visitor use of the Stehekin Valley would be lower because road access into the valley has been greatly reduced. Reduced access to the upper Stehekin Valley, coupled with the permanent loss of fishing opportunity in that same area, would have a cumulative impact on the visitor experience that is difficult to gage at this time because the future of the road remains uncertain.

Conclusion

Adverse impacts on non-anglers under alternative D would be primarily related to the lake treatment methods. These impacts would be negligible to minor and adverse over the long term. Removal of fish from some lakes would reduce visitor use and have some long-term beneficial impacts on non-anglers seeking greater solitude in the backcountry. Impacts on most anglers overall would be minor to moderate, adverse, and long term from management actions under alternative D compared to alternative A. Major adverse impacts would occur to some anglers who believe fishing in North Cascade Complex lakes is a truly unique experience that cannot be duplicated elsewhere. Cumulative impacts related to angler displacement to overused areas outside the North Cascades Complex would overall be minor to moderate, adverse, and long term. The cumulative impact of reduced access in the Stehekin Valley due to flood damage would be minor adverse or beneficial to backcountry users.

Overall, cumulative impacts would be moderate, adverse, and long term.

SOCIAL VALUES

GUIDING REGULATIONS AND POLICIES

The *National Environmental Policy Act* requires that economic and social effects be analyzed when they are interrelated with actions that also have natural or physical effects. Economic effects are addressed in the “Socioeconomic Resources” section of this chapter. The section, “Impacts of the Alternatives on Social Values,” analyzes effects on those who may or may not visit the North Cascades Complex but have expressed various points of view representing their “values” regarding the management actions proposed by the alternatives in this plan/EIS.

METHODOLOGY AND ASSUMPTIONS

Similar to the methodology used for assessing impacts on visitor use and experience, the impacts on social values are assessed given the degree to which management actions would change compared to existing management of the 91 lakes in the study area. The “Social Values” section in the “Affected Environment” chapter describes the definitions of various attitudes expressed toward wildlife management (refer to “Table 26: People’s Perceptions of Animals in American Society”).

Organized volunteers began stocking lakes in the 1930s.

This analysis is anecdotal and qualitative and based upon comments received during public scoping and the history of the fish stocking issue as documented in Louter (2003). Impacts on social values are characterized according to the simplifying assumption that “angler and angler groups” would value management actions that maintain the mountain lakes fishery, and “conservationists or conservation groups” would value management actions that would protect native ecosystems by reducing or eliminating the mountain lakes fishery. The limits of this simplifying assumption are clearly evident because social values encompass a wide spectrum of possibilities that defy discrete characterization—many anglers are conservationists, and many conservationists are anglers. Recognizing these limitations, the specific purpose of this analysis is to evaluate the impacts on social values regarding the maintenance of an artificial, nonnative recreational fishery in an NPS unit for the purpose of enhancing recreation.

Geographic Area Evaluated for Impacts

The study area for this analysis is the North Cascades Complex (see “Map 1” located in the envelope that accompanied this document) and the 91 naturally formed mountain lakes in the North Cascades Complex that currently have, or at one time had, a fish presence as a result of either documented or undocumented fish stocking activities. The 91 lakes addressed in this plan/EIS are scattered throughout the North Cascades Complex: 7 are in Ross Lake National Recreation Area, 15 are in Lake Chelan National Recreation Area, and 69 are located in the north and south units of North Cascades National Park (for more details, refer to the “Alternatives” chapter).

IMPACT THRESHOLD DEFINITIONS

Negligible. Impacts on views or values would not be perceptible or measurable.

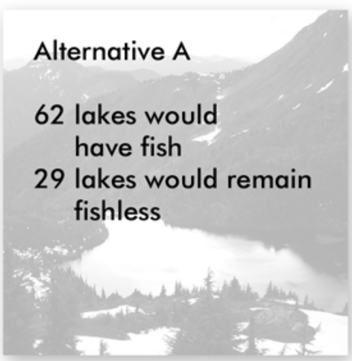
Minor. Impacts on views or values would be detectable but only localized or to a small number of groups or individuals holding these values.

Moderate. Impacts on views or values would be detectable throughout the region (within the three counties surrounding the North Cascades Complex) or to one or more groups or numbers of individuals holding these values.

Major. Impacts on views or values would be detectable in and outside the region to larger numbers of individuals or groups holding these values.

IMPACTS OF THE ALTERNATIVES ON SOCIAL VALUES

ALTERNATIVE A (NO ACTION): EXISTING MANAGEMENT FRAMEWORK OF 91 LAKES (62 LAKES HAVE FISH)



Alternative A would continue existing management of 91 lakes in the study area. The “Alternatives” chapter provides a detailed description of alternative A. For more information on the 91 lakes, refer to table 5 and figure 4 in the “Alternatives” chapter, appendix E, and “Map 1” (located in the envelope that accompanied this document).

Impacts on Social Values of Anglers and Angler User Groups

Mountain lake fishing in the North Cascades Complex follows a tradition that precedes its designation as a unit of the NPS by almost a century. Many anglers and angler user groups hold values similar to those holding conservation values. In fact, groups such as the Trail Blazers, Inc. and Washington State Hi-Lakers have assisted agencies in scientific studies and monitoring and are committed to protection of a healthy fishery.

Alternatives A provides for continued stocking of lakes in accordance with current practices. The NPS has determined that continued stocking under alternative A would require congressional action to clarify the enabling legislation to provide the NPS the authority to stock lakes in wilderness (for more information on this issue, please refer to the section titled “Implementing the Fishery Management Plan Through Congressional Action” in the “Alternatives” chapter). If Congress were to provide this authority, then the values of anglers and angler user groups would most likely not be affected because their activities would not be altered. If Congress does not act, then management actions would default to alternative D. The impacts on social values of anglers and angler user groups are defined under alternative D in this section.

Impacts on Social Values of Conservationists and Conservation Groups

In contrast to the value placed on the mountain lakes fishery by anglers who prefer the challenge and extreme scenic values found in the North Cascades Complex, many other groups and individuals believe that the mountain lakes fishery in the North Cascades Complex violates the spirit and intent of the *Wilderness Act* and the NPS conservation mission. While many anglers are also conservationists, there is a distinction between those who value the stocking of lakes for their enjoyment and those who oppose maintenance of a nonnative fishery because they place greater value on the conservation and protection of natural processes. Many of the conservation values are intertwined with wilderness values. Because the *Wilderness Act* speaks directly to specific wilderness values, that topic is addressed separately.

There has been a long-standing debate regarding the stocking of the mountain lakes and potential effects on resources in the North Cascades Complex (see the “Purpose of and Need for Action” chapter). The debate as to whether continued stocking violates *NPS Management Policies* (NPS 2001a), and whether Congress would or should sanction fish stocking, would have a continued impact to conservationists and conservation groups who oppose continued stocking and have expressed their views in and outside the region. Actions to return lakes to a fishless condition in the Sierra Nevada in California, for example, have been broadly supported by agencies, such as the U.S. Fish and Wildlife Service, and by conservation groups.

Congressional action to clarify the North Cascades Complex enabling legislation to allow for continued fish stocking would set a precedent for this NPS unit, and possibly others that have, or may have in the future, fish stocking issues. Should Congress act to clarify the North Cascades Complex enabling legislation to allow existing management practices to continue, a moderate to major adverse impact to the social values of conservationists and conservation groups would occur over the long term.

Cumulative Impacts

Continuation of management actions as described in alternative A would not alter angler use; therefore, impacts on social values of anglers would be long term and beneficial.

Continuation of management actions as described in alternative A would have a moderate to major adverse long-term cumulative impact to conservationists and conservation groups because of the perception that fish stocking and presence of fish in naturally fish-free waters is in conflict with the purposes of a national park unit. Some may feel that this would set a precedent for other agencies. Although it is unknown to what extent other agencies would continue, stop, or reduce their stocking activities in the future, the perception of such potential would influence conservationists’ perceptions on a broad scale.

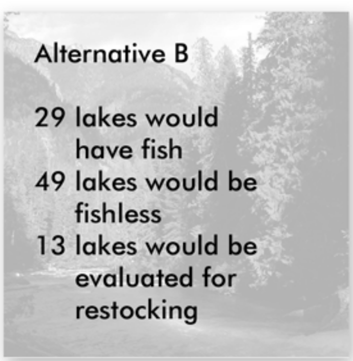
Conclusion

Two Trail Blazers packing in with stocking gear.

Continuation of existing management actions under alternative A would have a beneficial effect on the social values of anglers and angler groups because stocking and sport fishing would not change. Impacts on social values of conservationists and conservation groups would be long term, moderate to major, and adverse.

Continuation of management actions as described in alternative A would not alter angler use; therefore, cumulative impacts on social values of anglers would be long term and beneficial. Continuation of management actions as described in alternative A would have a moderate to major adverse cumulative impact on conservationists and conservation groups.

ALTERNATIVE B: PROPOSED ADAPTIVE MANAGEMENT OF 91 LAKES UNDER A NEW FRAMEWORK (42 LAKES MAY HAVE FISH) (PREFERRED ALTERNATIVE)



The emphasis of this alternative would be to eliminate or reduce reproducing fish populations from select lakes in the study area. Restocking of nonreproducing fish would be allowed only where biological resources would be protected. Based on best available science, some lakes would be restocked with nonreproducing fish at low densities once reproducing fish have been removed. If critical information needed to make management decisions is missing for some lakes, those lakes would not be stocked until that information becomes available. An extensive monitoring program (see appendix F) would be implemented to enable adaptive management and avoid major adverse impacts of fish on native biota.

The "Alternatives" chapter provides a detailed description of alternative B. For more information on the 91 lakes, refer to tables 5 and 10 in the "Alternatives" chapter and appendix E.

Impacts on Social Values of Anglers and Angler Groups

While alternative B would reduce angling opportunities in some lakes, the alternative also attempts to protect and enhance the mountain lakes fishery over the long term. Some anglers and groups who would be affected by the reduction of fishing opportunities either in the short term (while lakes are treated and potentially restocked) or over the long term (returning other lakes to a fishless condition), may oppose this alternative. Compared to alternative A, impacts on the social values of anglers and angler groups would be long term, minor, and adverse. However, some anglers and angler groups would also view adaptive management as beneficial. The impacts on social values of anglers and angler groups if Congress does not act to clarify the enabling legislation are described below under alternative D.

Impacts on Social Values of Conservationists and Conservation Groups

The intent of alternative B would be to enable adaptive management and minimize impacts on biological integrity (see the section titled “Adaptive Management” in the “Alternatives” chapter). While some conservationists and conservation groups may view this as a beneficial effect of this alternative, others may still oppose any efforts to continue stocking over the long term, even if lakes were restocked with nonreproducing fish and other measures were taken to minimize impacts on biological integrity. Therefore, the impact would be beneficial for some but moderate to major and adverse over the long term for others.

Cumulative Impacts

Management actions described in alternative B would alter angler use; therefore, social values of anglers would be affected. The use of the study area by anglers and the cumulative effects on angler use are described under “Impacts of Alternatives on Visitor Recreational Use” in this section. When added to the effects of this alternative, minor to moderate cumulative effects are expected, mostly related to the flooding damage to the upper Stehekin Valley Road that occurred in October 2003.

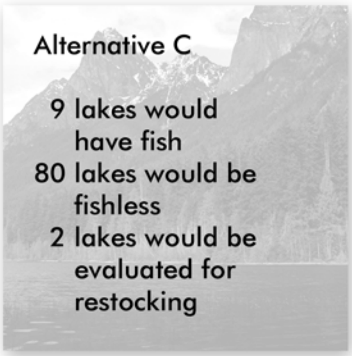
Alternative B would have a moderate to major adverse cumulative impact to conservationists and conservation groups, and some may support an adaptive management approach as defined for alternative B because of the perception that fish stocking and presence of fish in naturally fish-free waters is in conflict with the purposes of a national park unit, including national recreation areas. Some may feel this would set a precedent for other agencies. Although it is unknown to what extent other agencies would continue, stop, or reduce its stocking activities in the future, the perception of such potential would influence conservationists’ perceptions on a broad scale. Cumulative impacts on anglers and angler groups would be moderate to major, adverse, and long term compared to alternative A, although some may support the adaptive management approach, which may reduce impacts.

Conclusion

Alternative B would have a minor adverse impact on the social values of anglers and angler groups over the long term because some level of stocking and sport fishing would continue over the long term. Impacts on social values of conservationists and conservation groups would be beneficial for some who would support the new management framework, but moderate to major adverse and long term for those who oppose any stocking of lakes over the long term.

Alternative B would have a moderate to major adverse cumulative impact on conservationists and conservation groups, but some may support the adaptive management approach, which may reduce impacts to some degree. Cumulative impacts on anglers and angling groups would be moderate to major, adverse, and long term, but some may support the adaptive management approach, which may reduce impacts to some degree. Cumulative impacts related to flood damage to the upper Stehekin Valley Road would be minor to moderate, adverse, and long term.

ALTERNATIVE C: PROPOSED ADAPTIVE MANAGEMENT OF 91 LAKES UNDER A NEW FRAMEWORK (11 LAKES MAY HAVE FISH)



The emphasis of this alternative would be to eliminate fish from (or maintain as fishless) 80 of the 91 lakes in the study area; 69 of the 80 lakes are in the national park portion of the North Cascades Complex; sport fishing would still be allowed in 9 lakes in Ross Lake and Lake Chelan National Recreation Areas. Reproducing fish populations in 2 lakes in the recreation areas would be removed, and after evaluation, the lakes may be stocked with nonreproducing trout. Sport-fishing opportunities in the national park would gradually decline over time as stocked fish populations died off and reproducing populations of fish were gradually removed, although removal of reproducing populations from the national park might not be feasible for some lakes (refer to table 7). If removal proved infeasible, these lakes would continue to provide sport-fishing opportunities for the foreseeable future. For lakes with stocked fish, after about 5 years most fish would be gone, and the quality of fishing would drop sharply (WDFW, M. Downen, pers. comm., 2004). In order to protect native biological resources, alternative C would focus on reducing or eliminating reproducing fish in the lakes located in the national recreation areas. Sport fishing in the national recreation areas would still be allowed, although reproducing populations of fish would be removed, and in some cases, the lakes would be restocked with trout that are incapable of reproducing. Management actions to remove reproducing fish populations would proceed at a rate governed by the availability of funding and personnel.

The "Alternatives" chapter provides a detailed description of alternative C. For more information on the 91 lakes, refer to tables 5 and 12 in the "Alternatives" chapter and appendix E.

Impacts on Social Values of Anglers and Angler Groups

The number of lakes available for angler use in alternative C, compared to alternative A, would be greatly reduced, with fishing in the national park portion of the North Cascades Complex eventually eliminated over time. Angling opportunities would be limited to select lakes in the national recreation areas (see the "Impacts of Alternatives on Visitor Use and Experience" section of this chapter). While sport fishing would continue to some degree in the national recreation areas, anglers who value fishing in the high mountain lakes in the national park portion of North Cascades Complex would experience a moderate to major adverse impact over the long term. The impact on social values of anglers and groups should Congress not enact a change to the enabling legislation is described under alternative D.

Impacts on Social Values of Conservationists and Conservation Groups

While the number of lakes available for stocking world be reduced in alternative C compared to alternative A, some conservationists and conservation groups may still view stocking as inappropriate; others might view this as a legitimate compromise. This is because *NPS Management Policies* regarding fish stocking contain several exceptions, one of which pertains to lakes that have previously been stocked in recreation areas (NPS 2001a, 4.4.3). The impact on conservationists and conservation groups would be beneficial for some but moderate to major adverse and long term for others.

Cumulative Impacts

Management actions described in alternative C would alter angler use; therefore, social values of anglers and angler groups would be affected. The use of study area lakes by anglers and the cumulative effects on angler use is described under "Impacts of the Alternatives on Visitor Recreational Use" in this section. When added to the effects of this alternative, minor to moderate cumulative effects are expected and mostly related to the flooding damage to the upper Stehekin Valley Road that occurred in October 2003.

Alternative C would have a moderate to major adverse long-term cumulative impact on conservationists and conservation groups because of the perception that fish stocking and presence of fish in naturally fish-free waters is in conflict with the purposes of a national park unit, including national recreation areas. Some may feel that this would set a precedent for other agencies. Although the extent to which other agencies would continue, stop, or reduce its stocking activities in the future is unknown, the perception of such potential would influence conservationists' perceptions on a broad scale.

Conclusion

Alternative C would have a moderate to major adverse impact on the social values of anglers and angler groups over the long term because sport fishing would eventually be eliminated in the national park, and many anglers and angler groups believe that fishing in the park is a unique opportunity that cannot be duplicated elsewhere. Impacts on social values of conservationists and conservation groups would be beneficial for some who would support the new management framework but moderate to major adverse and long term for those who oppose any stocking of lakes over the long term.

Alternative C would have a moderate to major adverse cumulative impact on conservationists and conservation groups, but some may support the adaptive management approach, which may reduce impacts to some degree. Cumulative impacts on anglers and angling groups would be moderate to major, adverse, and long term, but some may support the adaptive management approach, which may reduce impacts to some degree. Cumulative impacts related to flood damage to the upper Stehekin Valley Road would be minor to moderate, adverse, and long term.

ALTERNATIVE D: 91 LAKES WOULD BE FISHLESS

Under alternative D, the goal would be to remove fish from 62 of the 91 lakes in the study area, with 29 lakes remaining fishless. Sport-fishing opportunities in most of these lakes would generally be eliminated within a period of 5 years. Self-sustaining (reproducing) populations of fish would gradually be removed over time. The rate of removal would depend on unpredictable changes in resource (funding and personnel) availability and differences among fish removal methods. Complete removal of self-sustaining fish populations in the 9 larger, deeper lakes identified in table 7 might not be feasible. These lakes would continue to provide sport-fishing opportunities for the foreseeable future, and the goal of complete removal might never be achieved. Congressional action would not be required to implement this alternative.

The “Alternatives” chapter provides a detailed description of alternative D. For more information on the 91 lakes, refer to tables 5 and 13 in the “Alternatives” chapter and appendix E.

Impacts on Social Values of Anglers and Angler Groups

Elimination of sport fishing in the 91 lakes would have a moderate to major adverse impact on social values of anglers and angler groups.

Impacts on Social Values of Conservationists and Conservation Groups

Overall, the impact on social values of conservationists and conservation groups would be beneficial.

Cumulative Impacts

Management actions described in alternative D would substantially alter angler use; therefore, social values of anglers and angler groups would be affected. The use of the study area by anglers and the cumulative effects on angler use is described under “Impacts of the Alternatives on Visitor Recreational Use” in this section. When added to the effects of this alternative, moderate to major adverse, long-term cumulative effects are expected.

Alternative D would have a beneficial cumulative impact on conservationists and conservation groups over the long term.

Conclusion

Alternative D would have a moderate to major adverse impact on the social values of anglers and angler groups over the long term, especially for those who use and value the park for this experience. Anglers may choose to pursue sport fishing outside the North Cascades Complex. Overall, impacts on social values of conservationists and conservation groups would be beneficial.

Alternative D would have a moderate to major adverse cumulative impact on conservationists and conservation groups, but some may support the adaptive management approach, which may reduce impacts to some degree. Cumulative impacts on anglers and angling groups would be moderate to major, adverse, and long term, but some may support the adaptive management approach, which may reduce impacts to some degree. Cumulative impacts related to flood damage to the upper Stehekin Valley Road would be minor to moderate, adverse, and long term.

WILDERNESS VALUES

GUIDING REGULATIONS AND POLICIES

The *Washington Park Wilderness Act of 1988* (WPWA) established 93% of the North Cascades Complex as the Stephen T. Mather Wilderness and directed the NPS to manage the wilderness in accordance with the *Wilderness Act of 1964*. The *Wilderness Act*, passed on September 3, 1964, "provides a degree of protection to the resources of the National Park System that the National Park Service Organic Act does not" (NPS 1999c). The House Report accompanying the Act, which helps to clarify Congressional intent with respect to the Act, states that its purpose is to establish a National Wilderness Preservation System made up of designated wilderness areas, "because of the undeveloped character of their lands and the need to protect and manage them in order to preserve, as far as possible, the natural conditions that now prevail" (House Report No. 1538, at 7, 88th Congress, 2nd session [July 2, 1964]). The section titled "Wilderness Values" in the "Affected Environment" chapter further describes the *Wilderness Act*, the legislation that created the wilderness areas in the North Cascades Complex, and the wilderness characteristics and values specific to the Stephen T. Mather Wilderness in the North Cascades Complex.

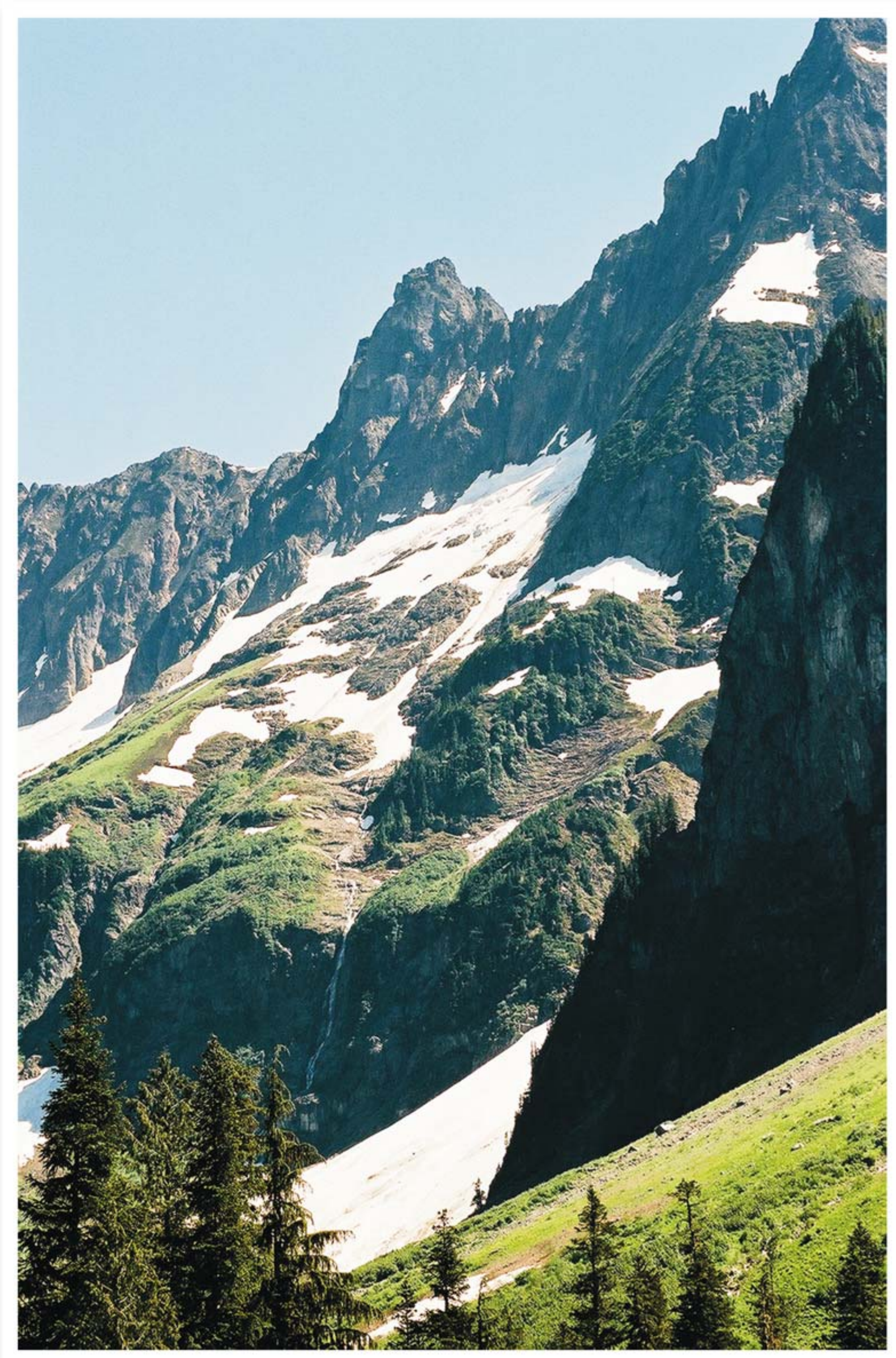
Anthropocentric: This perspective emphasizes human use and enjoyment of wilderness.

METHODOLOGY AND ASSUMPTIONS

The analyses of impacts on wilderness values is qualitative and based upon comments received during public scoping, the history of the issue as documented in Louter (2003), and review of literature regarding wilderness values of the American public.

Biocentric: This perspective emphasizes protection and maintenance of natural processes and conditions.

The magnitude and intensity of impacts on wilderness values greatly depends upon individual perspectives. Those engaged in wilderness management have found it useful to characterize impacts on wilderness values according to two alternative philosophical perspectives on wilderness: anthropocentric and biocentric. The *anthropocentric* perspective emphasizes human use and enjoyment of wilderness. The *biocentric* perspective emphasizes protection and maintenance of natural processes and conditions (Hendee and Stankey 1973). According to Hendee and Dawson (2002), the alternative labels—*anthropocentric* and *biocentric*—can "create a false distinction between wilderness 'for people's sake' and wilderness 'for nature's sake.'" This analysis is not intended to perpetuate these distinctions, nor is it intended to argue that either perspective is right or wrong. Use of the *anthropocentric* and *biocentric* concepts is merely a convenient way of describing how fishery management actions would impact wilderness values according to different perspectives.



"You must teach your children that the ground beneath their feet is the ashes of our grandfathers. So that they will respect the land, tell your children that the earth is rich with the lives of our kin . . . all things are connected."

attributed to Chief Seattle

This impact section focuses on the enduring wilderness values implicit in the *Wilderness Act* that visitors can experience when visiting the Stephen T. Mather Wilderness; those values are

> opportunities for solitude
>
> opportunities for primitive, unconfined forms of recreation (for example, the freedom for visitors to pursue nonmotorized recreational activities such as hiking, climbing, and sport fishing)
>
> naturalness, or the prevalence of natural conditions with little evidence of human impact or manipulation of natural conditions

Geographic Area Evaluated for Impacts

The study area for this analysis includes the Stephen T. Mather Wilderness, which makes up 93% of the North Cascades Complex (see “Map 1” located in the envelope that accompanied this document). For more details, refer to the “Alternatives” chapter.

Members of the public who may potentially be affected include wilderness users who would experience firsthand the potential impacts on wilderness values during their wilderness visit. There are other members of the public, however, that might never visit the Stephen T. Mather Wilderness and would never experience impacts on wilderness values firsthand, but they would still be impacted simply by knowing that various fishery management actions were occurring.

Impact Threshold Definitions

Negligible. Fishery management actions would have no discernable impact on opportunities for solitude. Opportunities for primitive and unconfined forms of recreation would essentially remain unchanged. Natural conditions would prevail with little evidence of human manipulation. The wilderness area would be affected primarily by the forces of nature. There would be outstanding opportunities for solitude or a primitive and unconfined type of recreation.

Minor. Fishery management actions would have a slightly beneficial or adverse impact on opportunities for solitude in limited areas of the wilderness. Opportunities for primitive and unconfined forms of recreation would be slightly improved or reduced in limited areas of the wilderness. Natural conditions would predominate, though human-caused impacts (either beneficial or adverse) on the natural environment would be slightly detectable in limited areas of the wilderness.

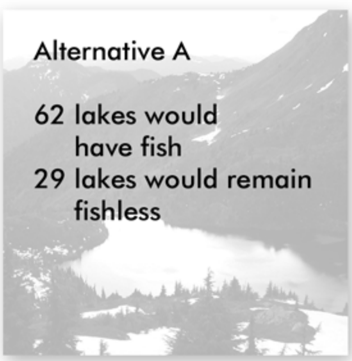
Moderate. Fishery management actions would have a readily apparent, beneficial or adverse impact on opportunities for solitude in limited areas of the wilderness. Opportunities for primitive and unconfined forms of recreation would be noticeably improved or reduced in limited areas of the wilderness. Natural conditions would predominate, though human-caused impacts (either beneficial or adverse) on the natural environment would be readily apparent in limited areas of the wilderness.

Major. Fishery management actions would have a readily apparent beneficial or adverse impact on opportunities for solitude throughout the wilderness area. Opportunities for primitive and unconfined forms of recreation would be substantially improved or reduced throughout the wilderness area. Human-caused impacts (either beneficial or adverse) on the natural environment would be readily apparent throughout the wilderness.

Impairment. Impairment would occur when the wilderness resources have been substantially altered, eliminating the characteristics that meet the criteria for consideration and classification as wilderness. Criteria for determining classification as wilderness can be found in *NPS Management Policy 6.2.1, Assessment of Wilderness Suitability or Nonsuitability* (NPS 2001a).

IMPACTS OF THE ALTERNATIVES ON WILDERNESS VALUES

ALTERNATIVE A (NO ACTION): EXISTING MANAGEMENT FRAMEWORK OF 91 LAKES (62 LAKES HAVE FISH)



The current mountain lakes fishery management activities at the North Cascades Complex would continue under the no-action alternative. The “Alternatives” chapter provides a detailed description of alternative A. For more information on the 91 lakes, refer to table 5 and figure 4 in the “Alternatives” chapter and appendix E.

The mountain lakes fishery management actions under alternative A that would directly affect wilderness values include stocking and related activities and very limited monitoring. The mountain lakes fishery would indirectly affect visitor use of lakes by providing fishing opportunities. Maintenance of the mountain lakes fishery would continue to affect the naturalness of the wilderness by manipulating natural processes to maintain an artificial recreational fishing opportunity.

Impacts on Opportunities for Solitude

Under alternative A, stocking of select lakes in the park and national recreation areas would continue in accordance with established practices. Most lakes would continue to be backpack stocked, which would occur very infrequently at a given lake, and the stocking activity would generally be limited to a few individuals. Therefore, backpack stocking would have a negligible direct short- and long-term impact on visitor solitude. Fixed-wing aircraft would be used as a method to stock lakes that could not be backpack stocked. Aircraft stocking would markedly disrupt visitor solitude along the flight path of the aircraft and especially above the lakes being stocked. The duration of impact, however, would be very brief (about a minute over a given lake every few years for each lake stocked) and very infrequent. Given the short-term and infrequent nature of aircraft stocking, there would be a minor adverse short- and long-term impact on opportunities for solitude.

Sport-fishing opportunities in the park and national recreation areas would remain at current levels. Continued stocking would provide opportunities for sport fishing and indirectly impact the solitude of other backcountry visitors such as hikers, climbers, or stock (horses, mules, llamas) users.

It is estimated that about 1,000 anglers currently fish the mountain lakes each year. Table 22 in the “Affected Environment” chapter shows that the average annual visitation to the North Cascades Complex from 1996 to 2002 was about 412,012 people. Table 24 shows that fishing in all North Cascades Complex waters (streams, rivers, reservoirs, ponds, mountain lakes) accounts for 11.5% of total visitor use. Backcountry use permit data for 2003 show that 4,035 visitors were issued backcountry overnight use permits, and that roughly 10.5% (424) of visitors who were issued permits were planning on fishing at study area lakes (62 of these lakes currently have fish). A 2003 survey of day-use visitors shows that approximately 75 day users were engaged in fishing at the most accessible day-use lakes in the study area. The estimate of 1,000 anglers who currently fish the study area lakes each year is derived from the backcountry permit data and the 2003 survey data (the estimate takes into account incomplete sampling due to dispersed access, highly variable and broad times of entry and departure, and purposeful or inadvertent avoidance of backcountry permit registrations).

These statistics indicate that angler use is a relatively small portion of overall wilderness use, and it is spread across a very wide area. Many of the lakes that contain stocked or self-sustaining populations of fish are located in untrailed or cross-country portions of the wilderness that receive very little use (refer to “Map 2” and “Map 2 Table”). Opportunities for solitude would remain negligibly impacted in these areas of the wilderness that receive very little use over the long term. Some fishable lakes, however, are located in relatively high-use areas. Continuing to provide sport-fishing opportunities (through stocking or benign neglect of reproducing fish populations) at these lakes would continue angling and reduce opportunities for solitude. In these areas, continuing to provide sport-fishing opportunities would have a minor, adverse impact on opportunities for solitude over the long term.

Impacts on Opportunities for Primitive Recreation

Fishing opportunities throughout the wilderness would remain at current levels. Continued angler use of these areas would affect recreational use by non-anglers. Most of the lakes in the North Cascades Complex are located in untrailed portions of the wilderness that receive very low use by hikers, climbers, and other non-anglers. Some fishable lakes, however, are located in areas with relatively high use. Continuing to provide sport-fishing opportunities at these lakes may displace other recreational activities during summer high-use periods by limiting the number of permits available for other users. Impacts to other visitors’ opportunities for primitive recreation in high-use areas over the summer would be minor to moderate adverse over the long term. It is noted that some illegal stocking has occurred in the past and may continue to occur under alternative A. It is impossible to quantify the degree to which illegal stocking has occurred or may occur.

Impact on Naturalness

Continuing the current management of the mountain lakes fishery would allow self-sustaining and stocked populations of fish to persist. These actions would perpetuate the existence of a nonnative, artificial fishery in lakes that were naturally fish free and would therefore diminish the value of naturalness in the Stephen T. Mather Wilderness. The magnitude of the impact would depend upon individual perception and experience.

Some wilderness users would not be aware that fish were even present in the lakes. Some visitors might notice the fish but not realize they were nonnative and may react indifferently. The impacts on the wilderness value of naturalness for these visitors would be negligible over the long term with regard to fishery management because they would encounter what they perceive to be “pristine” natural conditions in most of the wilderness. Those with anthropocentric perspective (valuing human use and enjoyment of wilderness) would experience negligible long-term impacts under alternative A.

On the other hand, some informed wilderness users would be aware of nonnative fish in the lakes due to stocking. They would also experience the indirect effects of angling, such as social trails along lakeshores, fire rings, and lost or discarded fishing tackle and equipment. The magnitude of adverse impact would vary among individuals. Those with strong biocentric views (support protection of natural processes in wilderness areas) of wilderness would experience major, long-term adverse impacts from the continued fishery management practices under alternative A.

Some people would not even have to experience these impacts firsthand to be adversely affected. Without ever visiting the North Cascades Complex, these individuals would be adversely impacted simply by knowing that the naturalness of the North Cascades Complex was being impacted by the current mountain lakes fishery management practices. The magnitude of impact is unknown.

Cumulative Impacts

The flooding in October 2003 destroyed most of the upper portion of the Stehekin Valley Road. For the foreseeable future, access to various portions of the Stehekin Valley may take much longer and may exclude some visitors from accessing portions of the area. Most mountain lake anglers are used to hiking long distances, often off trail, to access lakes, so the cumulative impact on mountain lake fishing opportunities from reduced access would likely be negligible over the short and long terms.

Stocked and reproducing populations of fish would remain in wilderness lakes throughout the region, including the study area lakes in the Stephen T. Mather Wilderness in the North Cascades Complex. This would be a major, long-term adverse cumulative impact on those who believe that continued stocking, as proposed under alternative A, in wilderness and benign neglect of reproducing populations of fish would compromise natural processes. This would be a long-term negligible cumulative impact on those who believe that human use and enjoyment of wilderness should continue.

Conclusion

Backpack stocking would have a direct short- and long-term negligible impact on visitor solitude. Given the short-term and infrequent nature of fixed-wing aircraft stocking, there would be a short- and long-term minor adverse impact on opportunities for solitude. Sport-fishing opportunities would remain at current levels. This would result in long-term negligible adverse impacts on opportunities for solitude for those areas that receive relatively little use, and long-term, minor adverse impacts on opportunities for solitude for those areas that receive high use.

Impacts on other visitors' opportunities for primitive recreation in high-use areas over the summer would be minor to moderate adverse over the long term.

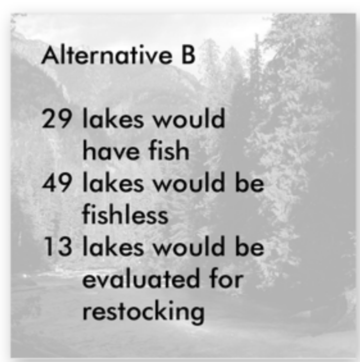
Those with anthropocentric perspective (valuing human use and enjoyment of wilderness) would experience long-term negligible impacts under alternative A. Those with strong biocentric views (support protection of natural processes in wilderness areas) of wilderness would experience long-term major adverse impacts by the continued fishery management practices under alternative A. Impacts on wilderness users who are not aware that fish are present in the lakes would be negligible over the long term.

Cumulative impacts on fishing opportunities in mountain lakes from reduced access would likely be negligible over the short and long terms.

There would be a major, long-term adverse cumulative impact on those who believe that continued stocking and continued presence of reproducing fish populations under alternative A would compromise natural processes in wilderness. There would be long-term negligible cumulative impacts on those who believe that human use and enjoyment of wilderness should continue.

Alternative B: Proposed Adaptive Management of 91 Lakes under a New Framework (42 Lakes May Have Fish) (Preferred Alternative)

The emphasis of this alternative would be to eliminate self-sustaining (reproducing) populations of fish from select lakes in the study area. Restocking of nonreproducing fish would be allowed in select lakes provided biological integrity would be conserved. Stocking of low densities of fish incapable of reproducing would be allowed to continue in select lakes. Stocking would be discontinued in lakes where data are currently lacking to make informed management decisions. A monitoring program (see appendix F) would be implemented in order to enable adaptive management of lakes.



The “Alternatives” chapter provides a detailed description of alternative B. For more information on the 91 lakes, refer to tables 5 and 10 in the “Alternatives” chapter and appendix E.

Impacts on Opportunities for Solitude

Compared to alternative A, fewer lakes in the national park and national recreation areas would be stocked. Most lakes would continue to be backpack stocked, which would occur very infrequently at a given lake, and the stocking activity would generally be limited to a few individuals; therefore, stocking would continue to have a negligible direct impact on visitor solitude over the long term. Fixed-wing aircraft would be used as a method to stock lakes that would not be backpack stocked, although fewer lakes would be stocked via aircraft compared to alternative A. Aircraft stocking would markedly disrupt visitor solitude along the flight path of the aircraft and especially above the lakes being stocked. The duration of impact, however, would be very brief (about a minute over a given lake) and very infrequent (once every few years). Given the short-term and infrequent nature of fixed-wing aircraft stocking, there would be a minor adverse short- and long-term impact on opportunities for solitude under alternative B.

Management actions related to fish removal include the use of chemical treatments (piscicides) and mechanical treatments, which would require the use of helicopters, motorized boats, electrofishing gear, gillnetting, and the routine presence of crews at select lakes. Gillnetting and piscicide application would require use of a helicopter to ferry heavy gear and the use of electrofishing gear to supplement netting. Piscicide use would be limited to one lake at time and probably only one or two lakes would be treated per season. Gillnetting would occur at several lakes at one time, depending on the availability of personnel and equipment. The noise and visual disturbance from these management actions would affect the solitude at lakes undergoing treatment and in areas along the flight path of helicopters or the access routes. Helicopter use would be limited to a few flights in a few locations over the course of a season. To minimize impacts on visitor solitude, NPS staff issuing backcountry overnight use permits would encourage users to visit areas not undergoing fish removal actions. Taken together, the impacts on solitude from fish removal activities would be long term minor to moderate adverse because most of the wilderness would remain unaffected by fish removal actions.

Fishery management actions would reduce sport-fishing opportunities in the national park and national recreation areas compared to alternative A. Opportunities for solitude would be even greater in these areas because there would be fewer anglers present to disrupt the solitude of other wilderness users. This would be a long-term minor beneficial impact. Some lakes in certain high-use areas would remain fishable. Continuing to provide sport-fishing opportunities (through stocking or where removal of self-sustaining fish populations may not be feasible) at these lakes would encourage angling and impact other users’ opportunities for solitude. In these areas, continuing to provide sport-fishing opportunities would have a minor adverse impact on opportunities for solitude over the long term.

Impacts on Opportunities for Primitive Recreation

Over time, many lakes with self-sustaining populations or stocked populations of fish would become fishless, and the overall opportunity for fishing in the wilderness would be reduced compared to alternative A. Loss of fishing opportunity would have an adverse impact on mountain lake anglers. Some anglers may simply fish elsewhere. Impacts on these anglers would be minor and long term. Other anglers believe that the lakes in North Cascades Complex offer a unique fishing opportunity that cannot be duplicated elsewhere; these anglers would experience major adverse impacts over the long term from lost fishing opportunities.

Continued angler use of lakes that remain fishable may limit the available backcountry overnight permits for other wilderness users. Most of the lakes in the North Cascades Complex are located in untrailed portions of the wilderness that receive very low use by hikers, climbers, and other non-anglers (refer to "Map 2" and "Map 2 Table"). Some fishable lakes, however, are located in areas that experience relatively high use. Compared with alternative A, angler use would become more concentrated at certain lakes that remain fishable. Continuing to provide sport-fishing opportunities (through stocking or where removal of self-sustaining populations may not be feasible) at these lakes would displace other recreational activities during summer high-use periods by limiting the number of permits available for other users. Impacts on other visitors' opportunities for primitive recreation in high-use areas over the summer would be minor to moderate adverse over the long term. It is noted that some illegal stocking has occurred in the past and may continue to occur under alternative B. It is impossible to quantify the degree to which illegal stocking has or may occur.

Impacts on Naturalness

Management of the mountain lakes fishery under alternative B would allow stocked populations of fish to persist. These actions would perpetuate the existence of a nonnative, artificial fishery in mountain lakes that were naturally fish free and would therefore diminish the value of naturalness in the Stephen T. Mather Wilderness. The magnitude of the impact would depend upon individual perception and experience.

Some wilderness users would not be aware that fish were even present in the lakes. Some visitors might notice the fish but not realize they were nonnative and may react indifferently. The impacts on the wilderness value of naturalness for these visitors would be negligible over the long term with regard to fishery management because they would encounter what they perceive to be "pristine" natural conditions in most of the wilderness. Those with anthropocentric perspective (valuing human use and enjoyment of wilderness) would experience negligible long-term impacts under alternative B. Some individuals with an anthropocentric perspective would view the application of a science-based adaptive management plan as a negligible impact, and some would view this as beneficial.

On the other hand, some informed wilderness users would be aware of nonnative fish in the lakes due to stocking. They would also experience the indirect effects of angling, such as social trails along lakeshores, fire rings, and lost or discarded fishing tackle and equipment. The magnitude of adverse impact would vary among individuals. Those with strong biocentric views (support protection of natural processes in wilderness areas) of wilderness would experience major, long-term adverse impacts from the fishery management actions proposed under alternative B. Some with a biocentric perspective would view the application of a science-based adaptive management plan as beneficial.

Some people would not even have to experience these impacts firsthand to be adversely affected. Without ever visiting the North Cascades Complex, these individuals would be adversely impacted by simply knowing that the naturalness of the North Cascades Complex was being impacted by mountain lakes fishery management actions proposed under alternative B. The magnitude of impact is unknown.

Cumulative Impacts

The flooding in October 2003 destroyed most of the upper portion of the Stehekin Valley Road. For the foreseeable future, access to various portions of the Stehekin Valley may take much longer and may exclude some visitors from accessing portions of the area. Most mountain lake anglers are used to hiking long distances, often off trail, to access lakes, so the cumulative impact on fishing opportunities in mountain lakes from reduced access would likely be negligible over the short and long term.

Stocked and some reproducing populations of fish would remain in wilderness lakes throughout the region, including the study area lakes in the Stephen T. Mather Wilderness in the North Cascades Complex. This would be a major, long-term adverse cumulative impact on those who believe that continued stocking (as proposed under alternative B) in wilderness and continued presence of reproducing populations of fish would compromise natural processes. There would be a long-term negligible cumulative impact on those who believe that human use and enjoyment of wilderness should continue. Depending on one's views regarding the application of science-based adaptive management principles in wilderness areas, cumulative impacts either would be beneficial or adverse over the long term. Fishery management actions, especially fish removal, would impose an administrative presence in wilderness, in addition to established administrative actions such as research and monitoring, ranger patrols, and fire management actions. Taken together, these additional fishery management actions would have a minor, adverse cumulative impact on solitude over the long term.

Conclusion

Backpack stocking would have a negligible direct impact on visitor solitude over the long term. Given the short-term and infrequent nature of fixed-wing aircraft stocking, there would be a short- and long-term minor adverse impact on opportunities for solitude. Fishery management actions would reduce sport-fishing opportunities in the national park and national recreation areas compared to alternative A. This would result in a long-term minor beneficial impact on opportunities for solitude in some areas. However, select lakes in certain high-use areas would remain fishable, resulting in minor adverse impacts on opportunities for solitude over the long term. The impacts on solitude from fish removal activities would be minor to moderate and adverse over the long term.

Anglers who choose to fish elsewhere due to reduced fishing opportunities would experience long-term minor adverse impacts. Anglers who believe the fishing experience cannot be duplicated elsewhere would experience long-term major adverse impacts. Impacts on other visitors' opportunities for primitive recreation in high-use areas over the summer would be minor to moderate adverse over the long term.

Those with anthropocentric perspective (valuing human use and enjoyment of wilderness) would experience long-term negligible impacts under alternative B. Some of those with an anthropocentric perspective would view the application of a science-based adaptive management plan as a negligible impact, and some would view this as beneficial. Those with strong biocentric views (support protection of natural processes in wilderness areas) of wilderness would experience long-term major adverse impacts from fishery management actions under alternative B. Some with biocentric perspectives would view the application of a science-based adaptive management plan as beneficial over the long term. Impacts on wilderness users who are not aware that fish are present in the lakes would be long term and negligible.

Cumulative impacts on fishing opportunities in mountain lakes from reduced access would likely be negligible over the short and long terms.

There would be a long-term major adverse cumulative impact on those who believe that the continued stocking (as proposed under alternative B) in wilderness and continued presence of reproducing populations of fish would compromise natural processes in wilderness. There would be long-term negligible cumulative impacts on those who believe that human use and enjoyment of wilderness should continue. Depending on one's views regarding the application of science-based adaptive management principles in wilderness areas, cumulative impacts would be long-term beneficial or adverse. Fishery management actions, including fish removal, would have long-term minor adverse cumulative impacts on solitude.

Alternative C: Proposed Adaptive Management of 91 Lakes under a New Framework (11 Lakes May Have Fish)

The emphasis of this alternative would be to discontinue stocking fish in the national park portion of the North Cascades Complex and remove all self-sustaining (reproducing) populations of fish, where feasible. Stocking of nonreproducing fish in select lakes in the national recreation areas would be allowed provided biological integrity would be conserved. Some lakes in the national recreation areas would continue to be stocked, though stocking would be discontinued in lakes where data are currently lacking to make informed management decisions. A monitoring program (see appendix F) would be

Alternative C

9 lakes would have fish
80 lakes would be fishless
2 lakes would be evaluated for restocking

implemented in order to enable adaptive management of lakes in the national recreation areas.

The “Alternatives” chapter provides a detailed description of alternative C. For more information on the 91 lakes, refer to tables 5 and 12 in the “Alternatives” chapter and appendix E.

Impacts on Opportunities for Solitude

No lakes in the national park portion of the North Cascades Complex would be stocked. Select lakes in the national recreation areas would continue to be backpack stocked, which would continue to have a long-term negligible direct impact on visitor solitude. Fixed-wing aircraft would be used as a method to stock lakes that would not be backpack stocked, although fewer lakes would be stocked via aircraft compared to alternatives A and B. Aircraft stocking would markedly disrupt visitor solitude along the flight path of the aircraft and especially above the lakes being stocked. The duration of impact, however, would be very brief (about a minute over a given lake) and very infrequent (every few years for each lake stocked). Given the short-term and infrequent nature of aircraft stocking, there would be a short- and long-term minor adverse impact on opportunities for solitude.

The management actions related to fish removal would be similar to alternative B; however, more lakes would be subjected to fish-removal activities under alternative C. The impacts on solitude from fish removal actions would be short-term minor to moderate adverse because most of the wilderness would remain unaffected by fish removal actions at any one time.

Sport-fishing opportunities in national park lakes would eventually be eliminated, except in larger, deeper lakes where complete fish removal might not be feasible (refer to table 7). Sport fishing would continue in select national recreation area lakes. Compared with alternatives A and B, opportunities for solitude would be even greater in the North Cascades Complex, over time, because fewer lakes would be available for fishing. This would have a moderate beneficial impact on solitude in these areas over the long term. Some lakes in certain high-use areas in the national recreation areas would remain fishable, and continuing to provide sport-fishing opportunities would have a minor adverse impact on opportunities for solitude over the long term.

Impact on Opportunities for Primitive Recreation

Loss of fishing opportunity in the national park would have an adverse impact on mountain lake anglers. Some anglers may simply fish elsewhere. Impacts on these anglers would be minor and long term. Other anglers believe that the lakes in North Cascades Complex offer a unique fishing opportunity that cannot be duplicated elsewhere; these anglers would experience long-term, major adverse impacts from lost fishing opportunities.

Continued angler use of lakes that remain fishable under alternative C may limit the available backcountry overnight permits for other wilderness users. Some fishable lakes in the national recreation areas are located in areas receiving relatively high use. Angler use would become more concentrated at certain lakes that remain fishable. Continuing to provide sport-fishing opportunities (through stocking or where removal of self-sustaining populations may not be feasible) at these lakes may displace other recreational activities during summer high-use periods by limiting the number of permits available for other users. Impacts on other visitors' opportunities for primitive recreation in high-use areas over the summer would be minor to moderate adverse over the long term. It is noted that some illegal stocking has occurred in the past and may continue to occur under alternative C, although it is impossible to quantify the degree to which illegal stocking has occurred or may occur in the future. Sport fishing is very important to many wilderness enthusiasts. Some mountain lake anglers believe that current mountain lake fishing opportunities are limited compared to the past. These anglers believe, to varying degrees, that many other lakes in the North Cascades Complex should be fishable. Compared with alternatives A and B, fishing opportunities would be further reduced, and this would have a major, adverse impact on these anglers.

Impacts on Naturalness

Management of the mountain lakes fishery under alternative C would allow stocked populations of fish to persist in select lakes in the national recreation areas and in nine lakes in the national park where complete fish removal may not be feasible (refer to table 7 in the "Alternatives" chapter). These actions would perpetuate the existence of a nonnative, artificial fishery in mountain lakes that were naturally fish free and would therefore diminish the value of naturalness in the Stephen T. Mather Wilderness. The magnitude of impact would depend upon individual perception and experience.

Similar to alternatives A and B, some wilderness users would not be aware that fish were even present in the stocked lakes. Some visitors might notice the fish but not realize they were nonnative and may probably react indifferently. The impacts on the wilderness value of naturalness for these visitors would be negligible with regard to fishery management because they would encounter what they perceive to be "pristine" natural conditions in most of the wilderness.

Those with an anthropocentric perspective (valuing human use and enjoyment of wilderness) would experience long-term moderate adverse impacts under alternative C due to the loss of fishable lakes in the national park; however, fishing opportunities would still remain in wilderness areas in the national recreation areas. Some of those with an anthropocentric perspective would view the application of a science-based adaptive management plan as a negligible impact, and some would view this as beneficial over the long term.

On the other hand, some informed wilderness users would be aware of nonnative fish in the lakes due to stocking. They would also experience the indirect impacts of angling, such as social trails along lakeshores, fire rings, and lost or discarded fishing tackle and equipment. The magnitude of adverse impact would vary among individuals. Those with strong biocentric views of wilderness would continue to experience long-term major adverse impacts from continued stocking of fish in the national recreation area lakes. Some with a biocentric perspective would view the application of a science-based adaptive management plan as beneficial over the long term.

Some people may not have to experience these impacts firsthand to be adversely affected. Without ever visiting the North Cascades Complex, these individuals would be adversely impacted simply by knowing that the naturalness of the North Cascades Complex was being impacted by fishery management actions under alternative C. The magnitude of impact is unknown.

Cumulative Impacts

The flooding in October 2004 destroyed most of the upper portion of the Stehekin Valley Road. For the foreseeable future, access to various portions of the Stehekin Valley may take much longer and may exclude some visitors from accessing portions of the area. Most mountain lake anglers are used to hiking long distances, often off trail, to access lakes, so the cumulative impact on fishing opportunities in mountain lakes from reduced access would likely be negligible over the short and long terms.

Stocked and some reproducing populations of fish would remain in national recreation area lakes and potentially some national park lakes where complete fish removal may not be feasible (refer to table 7 in the “Alternatives” chapter). This would be a long-term major adverse cumulative impact for those who believe that the continued stocking (as proposed under alternative C) in wilderness and continued presence of reproducing populations of fish would compromise natural processes. There would be a long-term negligible cumulative impact on those who believe that human use and enjoyment of wilderness should continue. Depending on one’s views regarding the application of science-based adaptive management principles in wilderness areas, cumulative impacts either would be beneficial or adverse over the long term. Fishery management actions, especially fish removal, would impose an administrative presence in wilderness, in addition to established administrative actions such as research and monitoring, ranger patrols, and fire management actions. Taken together, these additional fishery management actions would have a minor adverse cumulative impact on solitude over the long term.

Compared to alternatives A and B, there would be long-term moderate beneficial cumulative impacts on wilderness values due to the cessation of stocking and removal of fish from the study area lakes in the national park.

Conclusion

Backpack stocking would have a negligible direct impact on visitor solitude over the long term. Given the short-term and infrequent nature of fixed-wing aircraft stocking, there would be a short- and long-term minor adverse impact on opportunities for solitude. Sport-fishing opportunities would be eliminated, where feasible, in the national park lakes and would continue to exist in select national recreation area lakes. This would result in a moderate beneficial impact on opportunities for solitude over the long term in some areas. However, some lakes in certain high-use areas would remain fishable, resulting in minor adverse impacts on opportunities for solitude over the long term. The impacts on solitude from fish-removal activities would be minor to moderate and adverse over the long term.

Anglers who choose to fish elsewhere due to the reduced fishing opportunities would experience long-term minor adverse impacts. Anglers who believe the fishing experience cannot be duplicated elsewhere would experience long-term major adverse impacts. Impacts on other visitors' opportunities for primitive recreation in high-use areas over the summer would be minor to moderate adverse over the long term.

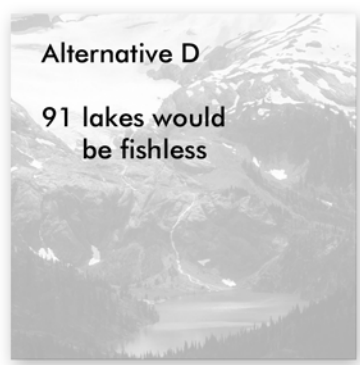
Those with an anthropocentric perspective (valuing human use and enjoyment of wilderness) would experience long-term moderate adverse impacts under alternative C due to the loss of fishable lakes in the national park; however, fishing opportunities would still remain in wilderness areas in the national recreation areas. Some of those with an anthropocentric perspective would view the application of a science-based adaptive management plan as a negligible impact, and some would view this as beneficial over the long term. Those with strong biocentric views (support protection of natural processes in wilderness areas) of wilderness would experience long-term major adverse impacts from the fishery management actions under alternative C. Some with biocentric perspectives would view the application of a science-based adaptive management plan as beneficial over the long term. Impacts are wilderness users who are not aware that fish are present in the lakes would be negligible over the long term.

Cumulative impacts on fishing opportunities in mountain lakes from reduced access would likely be negligible over the short and long terms.

There would be a long-term major adverse cumulative impact on those who believe that the stocking proposed under alternative C and continued presence of reproducing populations of fish would compromise natural processes in wilderness. There would be long-term negligible cumulative impacts on those who believe that human use and enjoyment of wilderness should continue. Depending on one's views regarding the application of science-based adaptive management principles in wilderness areas, cumulative impacts either would be beneficial or adverse over the long term. Fishery management actions, including fish removal, would have long-term minor adverse impacts on solitude. Due to the cessation of stocking in the national park, moderate beneficial cumulative impacts would be expected on wilderness values over the long term.

Alternative D: 91 Lakes Would Be Fishless

Alternative D would eventually eliminate the mountain lakes fishery in the North Cascades Complex. The "Alternatives" chapter provides a detailed description of alternative D. For more information on the 91 lakes, refer to tables 5 and 13 in the "Alternatives" chapter and appendix E.



Impacts on Opportunities for Solitude

All stocking in the North Cascades Complex would cease. Compared to alternative A, this would cause moderate to major beneficial impacts on opportunities for solitude over the long term due to the decreased use of high mountain lakes for fishing.

Management actions related to fish removal include the use of chemical treatments (piscicides) and mechanical treatments, which would require the use of helicopters, motorized boats, electrofishing gear, gillnetting, and the routine presence of crews at select lakes. Gillnetting and piscicide application would require use of a helicopter to ferry heavy gear and the use of electrofishing gear to supplement netting. Removal with piscicides would be limited to one lake at time and probably only one or two lakes would be treated per season. Gillnetting would occur at several lakes at one time, depending on the availability of personnel and equipment. The noise and visual disturbance from these management actions would affect the solitude at lakes undergoing treatment and in areas along the flight path of helicopters or the access routes. Helicopter use would be limited to a few flights in a few locations over the course of a season. To minimize impacts on visitor solitude, NPS staff issuing backcountry overnight use permits would encourage users to visit areas not undergoing fish-removal actions. Taken together, the impacts on solitude from fish removal activities would be long term, minor to moderate adverse because most of the wilderness would remain unaffected by fish-removal actions.

Fishery management actions would eliminate sport-fishing opportunities in the study area lakes; however, fishing opportunities would be available in the foreseeable future while lake treatment activities were completed. In addition, fishing opportunities would still remain in the reservoirs, rivers, and some streams throughout the North Cascades Complex.

Compared to alternative A, opportunities for solitude would increase in the wilderness because there would be fewer anglers present to disrupt the solitude of other wilderness users. This would be a long-term moderate to major beneficial impact. Fishing opportunities would be available in the nine large, deep lakes identified in table 7 where complete fish removal may not be feasible. Near those nine lakes, sport-fishing activities would affect opportunities for solitude, and this would result in a minor adverse impact over the long term for some visitors.

Impacts on Opportunities for Primitive Recreation

Over time, all lakes with self-sustaining populations or stocked populations of fish would become fishless, and the overall opportunity for fishing in the wilderness would be eliminated. Compared to alternative A, loss of fishing opportunity would have a major adverse impact on mountain lake anglers. Some anglers may simply fish elsewhere, and impacts on these anglers would be long term and minor. Other anglers believe that the lakes in North Cascades Complex offer a unique fishing opportunity that cannot be duplicated elsewhere; these anglers would experience long-term major adverse impacts from lost fishing opportunity. It is noted that some illegal stocking has occurred in the past and may continue to occur under alternative D, although it is impossible to quantify the degree to which illegal stocking has occurred or may occur in the future.

The cessation of anglers fishing at lakes in the Stephen T. Mather Wilderness would result in long-term beneficial impacts on other visitors because it may increase the availability of backcountry overnight use permits.

Impacts on Naturalness

Alternative D would remove all fish from the 62 study area lakes that currently contain fish. These actions would eliminate, where feasible, the existence of a nonnative, artificial fishery in mountain lakes that were naturally fish free and would therefore restore the value of naturalness in the Stephen T. Mather Wilderness. The magnitude of the impact would depend upon individual perception and experience.

Some wilderness users would not be aware that fish were removed from the lakes. The impacts on the wilderness value of naturalness for these visitors would be negligible over the long term. Those with an anthropocentric perspective (valuing human use and enjoyment of wilderness) would experience major long-term adverse impacts under alternative D. Some of those with an anthropocentric perspective would view the application of a science-based adaptive management plan to remove fish as a negligible impact, and some would view this as beneficial.

On the other hand, some informed wilderness users would be aware that fish had been removed. They would no longer experience the indirect effects of angling, such as social trails along lakeshores, fire rings, and lost or discarded fishing tackle and equipment. The magnitude of impact would vary among individuals. Those with strong biocentric views (support protection of natural processes in wilderness areas) of wilderness would experience major long-term beneficial impacts because all fish would be removed under alternative D. Some with a biocentric perspective may view the application of a science-based adoptive management plan as beneficial over the long term.

Some people would not even have to experience these impacts firsthand to be beneficially affected. Without ever visiting the North Cascades Complex, these individuals would be beneficially impacted simply by knowing that the naturalness of the North Cascades Complex was being protected and restored. The magnitude of impact is unknown.

Cumulative

The flooding in October 2003 destroyed most of the upper portion of the Stehekin Valley Road. For the foreseeable future, access to various portions of the Stehekin Valley may take much longer and may exclude some visitors from accessing portions of the area. Most mountain lake visitors are used to hiking long distances, often off trail, to access lakes, so the cumulative impact to mountain lake visitors from reduced access would likely be negligible over the short and long terms.

Compared to alternative A, there would be long-term major beneficial cumulative impacts on those who believe that continued stocking in wilderness and continued presence of reproducing populations of fish would compromise natural processes. There would be long-term major adverse cumulative impacts on anglers who believe that human use and enjoyment of wilderness should continue. Depending on one’s views regarding the application of science-based adaptive management principles to remove fish from wilderness areas, cumulative impacts either would be beneficial or adverse over the long term.

Fishery management actions, especially fish removal, would impose an administrative presence in wilderness, in addition to established administrative actions such as research and monitoring, ranger patrols, and fire management actions. Taken together, these additional fishery management actions would have a minor adverse cumulative impact on opportunities for solitude over the long term. Due to the cessation of stocking, long-term moderate to major beneficial cumulative impacts on wilderness values would be expected.

The displacement of anglers to other wilderness areas would result in negligible adverse impacts, even if all anglers decided to fish elsewhere.

Conclusion

Sport-fishing opportunities would be vastly reduced compared to alternative A because all stocking in the North Cascades Complex would cease, and fish would be removed from all lakes. This would result in long-term moderate to major beneficial impacts on opportunities for solitude in areas where fishing opportunities would be eliminated. However, fishing opportunities would continue to exist in the nine deep lakes where complete fish removal may not be feasible, resulting in long-term minor adverse impacts on opportunities for solitude.

Impacts on solitude from fish removal activities would be minor to moderate and adverse over the long term.

Anglers who choose to fish elsewhere because of reduced fishing opportunities would experience long-term minor adverse impacts. Anglers who believe the fishing experience cannot be duplicated elsewhere would experience long-term major adverse impacts.

The cessation of anglers using wilderness would result in long-term beneficial impacts on other visitors.

Those with an anthropocentric perspective (valuing human use and enjoyment of wilderness) would experience long-term major adverse impacts under alternative D. Some of those with an anthropocentric perspective would view the application of a science-based adaptive management plan to remove fish as a negligible impact, and some would view this as beneficial.

Those with strong biocentric views (support protection of natural processes in wilderness areas) of wilderness would experience long-term major beneficial impacts because all fish would be removed (where feasible) under alternative D. Some with a biocentric perspective would view the application of a science-based adaptive management plan as beneficial over the long term. Impacts on those wilderness users who would not be aware that nonnative fish have been removed from the lakes would be negligible over the long term.

Cumulative impacts on fishing opportunities in mountain lakes from reduced access would likely be negligible over the short and long terms. There would be long-term major beneficial cumulative impacts on those who believe that the continued stocking in wilderness and continued presence of reproducing populations of fish would compromise natural processes. There would be long-term major adverse cumulative impacts on anglers who believe that human use and enjoyment of wilderness should continue. Depending on one's views regarding the application of science-based adaptive management principles to remove fish from wilderness areas, cumulative impacts either would be beneficial or adverse over the long term. Fishery management actions, including fish removal, would have long-term minor adverse cumulative impacts on solitude. Due to the cessation of stocking, long-term moderate to major beneficial cumulative impacts on wilderness values would be expected.

The displacement of anglers to other wilderness areas would result in long-term negligible adverse cumulative impacts, even if all anglers decided to fish elsewhere.

HUMAN HEALTH

Human health issues potentially affected by the proposed alternatives include potential exposure to antimycin through consumption of chemically treated stocked fish and potential exposure to methyl-mercury and persistent organic pollutants through consumption of contaminated fish. Impacts would occur from stocking or fish removal activities under the proposed management actions (refer to tables 4 and 5 in the “Alternatives” chapter).

This section describes the methods used to analyze impacts on human health and results of the analysis. The following section discusses the regulations and policies used to guide NPS decision-making, in addition to the assumptions and thresholds used to analyze impacts on human health.

GUIDING REGULATIONS AND POLICIES

Servicewide NPS regulations and policies emphasize protection of human health in all park operations and visitor activities. *NPS Management Policies* state that the NPS will seek to provide a safe and healthful environment for visitors and employees, and that NPS will reduce or remove known hazards and apply other appropriate measures, including closings, guarding, signing, or other forms of education to do this (NPS 2001a, 8.2.5).

The U.S. Environmental Protection Agency (EPA) has guidance that provides benchmarks for concentrations of organic contaminants in fish to avoid elevated cancer risk in consumers (EPA 2004). These include recommended benchmarks for levels of methyl-mercury and other persistent organic pollutants in fish for protection of human health.

METHODOLOGY AND ASSUMPTIONS

The following discussion describes the methodology used to evaluate the impacts on human health that could result from implementation of any of the proposed alternatives. Analysis methods are qualitative and are based on reviews of existing data and literature and best professional judgment. The analysis presented in this section assumes that the historic and current stocking of trout in high mountain lakes has created favorable conditions for human take and consumption of stocked fish.

Impact Threshold Definitions

The following thresholds were used to determine the magnitude of impacts on human health as a result of implementation of any of the alternatives, including stocking and treatment methods:

Negligible: The impact on human health would not be measurable or perceptible.

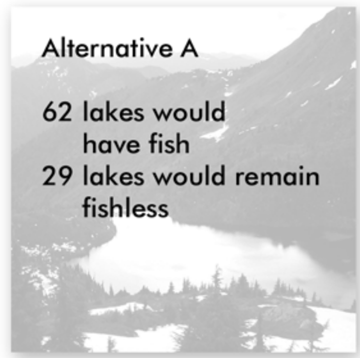
Minor: The impact on human health would be measurable or perceptible, but it would be limited in effect.

Moderate: The impact on human health would be sufficient to cause noticeable effects to human health.

Major: The impact on human health would be substantial, resulting in substantial, noticeable effects to human health.

IMPACTS OF THE ALTERNATIVES ON HUMAN HEALTH

ALTERNATIVE A (NO ACTION): EXISTING MANAGEMENT FRAMEWORK OF 91 LAKES (62 LAKES HAVE FISH)



Alternative A (no action) would continue existing management of the 91 lakes in the study area. The “Alternatives” chapter provides a detailed description of alternative A. For more information on the 91 lakes, refer to table 5 and figure 4 in the “Alternatives” chapter and appendix E.

Impacts of Current Fish Stocking on Human Health

The majority of impacts on human health under alternative A would be related to the age of the fish, number of fish stocked, and/or density of reproducing fish in the lakes (refer to table 6 in the “Alternatives” chapter). In the 62 lakes under alternative A that have been stocked with fish, direct adverse impacts on human health from consuming fish exposed to persistent organic pollutants or methyl-mercury would be negligible. Twenty-eight different organochlorine compounds were analyzed for lakes sampled in the North Cascades Complex, and only two were observed—total PCBs (polychlorinated biphenyl) and DDE (dichlorodiphenyldichloroethylene)—at concentrations below Food and Drug Administration Action Levels for fish tissue of 2 and 5 milligrams per kilogram (mg/kg), respectively. (FDA Action Levels refer to the sale and distribution of goods in the market place.) Average PCB concentrations in sampled lakes exceeded EPA’s guideline screening value of 0.02 mg/kg for elevated cancer risk. The researchers caution that these fish tissue results are preliminary, and additional sampling is needed. Also, the EPA guidelines screening values are based on conservative assumptions (for example, consumption of two 8-ounce meals of fish per month every year over a 70-year lifetime). A high level of protection is built into the thresholds—lakes containing fish would continue to be monitored for persistent organic pollutants and methyl-mercury in fish tissue, and any human health concerns would be communicated to the public.

Impacts of Current Lake Treatment Methods on Human Health

None of the 91 lakes addressed in this plan/EIS are currently treated nor would they be treated under alternative A; therefore, no impacts on human health would occur from consumption of fish exposed to piscicides.

Cumulative Impacts

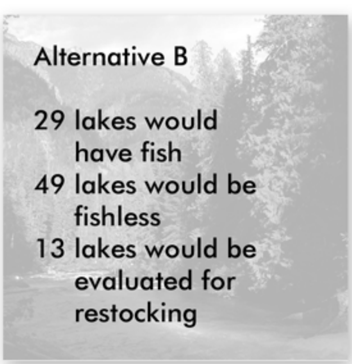
Cumulative impacts on human health are considered for past, present, and future projects occurring in the North Cascades Complex or outside its boundary. No new major roads, trails, resorts, or major upgrades of facilities are proposed or are in the planning stages. Some trails were flooded, so access has been eliminated or reduced. Visitor use is expected to remain at about the same levels that it has been at for several years, resulting in similar levels of use at most lakes and connected streams.

Mountain lake fisheries on National Forest System lands that surround the North Cascades Complex are managed by the WDFW. The department's management approach, described in WDFW (2001), is expected to be similar in the foreseeable future to current management activities. There is concern about persistent organic pollutants and methyl-mercury found in these lakes, but lakes stocked in the past are assumed to have a range of impacts on human health pollutant concentrations similar to those analyzed for North Cascades Complex lakes, which means negligible to minor impacts under alternative A.

Overall, the impacts associated with other projects and fishery management actions in the area, plus impacts from potential airborne pollution, added to the impacts predicted under alternative A, would result in negligible impacts on human health over the long term.

Conclusion

Alternative A would have negligible impacts on human health over the long term from the consumption of stocked fish that may have been exposed to persistent organic pollutants and methyl-mercury, and no adverse impacts on human health from any lake treatment chemicals since none would be used. Cumulative impacts on human health would be negligible adverse over the long term.



ALTERNATIVE B: PROPOSED ADAPTIVE MANAGEMENT OF 91 LAKES UNDER A NEW FRAMEWORK (42 LAKES MAY HAVE FISH) (PREFERRED ALTERNATIVE)

The emphasis of this alternative would be to provide sport-fishing opportunities in approximately 29 of the 91 study area lakes, and approximately 49 lakes either would remain in their current fishless state or be returned to a fishless condition. Another 13 lakes would be evaluated prior to determining final management actions. Restocking of nonreproducing fish in the 13 lakes would only be allowed if monitoring results indicate fish are not causing major adverse impacts.

The “Alternatives” chapter provides a detailed description of alternative B. For more information on the 91 lakes, refer to tables 5 and 10 in the “Alternatives” chapter and appendix E.

Impacts of Proposed Fish Stocking on Human Health

Under alternative B, impacts related to the consumption of fish potentially contaminated with methyl-mercury and persistent organic pollutants would be similar to alternative A. Reducing high densities of fish and removing fish in an additional 19 lakes using chemical treatment would decrease the probability of consumption and result in negligible impacts on human health.

Impacts of Proposed Lake Treatment Methods on Human Health

The treatment methods proposed for each lake were selected based on the type of fish population present (reproducing versus nonreproducing) and physical characteristics of the lake, such as depth and surface area (refer to appendix E for details about the 91 lakes). The chemical method involves application of the piscicide, antimycin, to 19 lakes under alternative B (refer to table 7 in the “Alternatives” chapter). The chemical method would be used in large lakes with reproducing fish populations where mechanical removal methods would not be practical. As described in the “Alternatives” chapter, the concentration of antimycin necessary to remove fish is considered to be harmless to humans (Rosenlund 2002). Antimycin breaks down very quickly in a fish’s body and in the water, reducing the likelihood of contamination if fish were caught and consumed (Rosenlund 2002). Also, antimycin is used in such small quantities that residues are extremely small, and it has not been shown to bioaccumulate (Schnick 1974). In addition, the NPS would implement mitigation measures to keep visitors and anglers away from treated lakes and to educate anglers about the use of antimycin and its effects on fish (see appendix I). Because of the lack of evidence of human health effects and the mitigation that would be used, impacts of fish removal using antimycin would be negligible to minor and adverse over the long term. Lakes containing fish would continue to be monitored for persistent organic pollutants and methyl-mercury in fish tissue, and any human health concerns would be communicated to the public.

To ensure treated fish are not caught and consumed following chemical treatment, lakes would be temporarily closed to visitors, if necessary, during and immediately after chemical treatments until it is determined that the chemical has dissipated. Educational materials about treatment dates and locations would be posted on bulletin boards, on the North Cascades Complex website, and at visitor centers. Park rangers would alert visitors as to which lakes were being treated (or were recently treated) when backcountry overnight use permits are issued. In addition, educational materials would be provided to visitors explaining the closures and describing how to recognize fish treated with antimycin (the fish becomes discolored and lethargic).

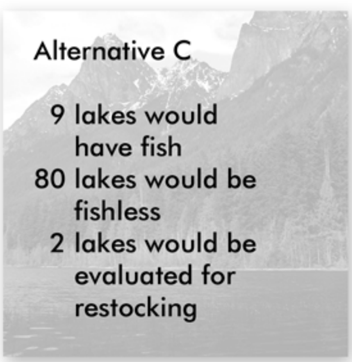
Cumulative Impacts

Cumulative impacts on human health under alternative B would be very similar to those described for alternative A, with the addition of negligible impacts on human health from the unlikely potential for consumption of chemically treated fish. Overall, the impacts associated with other projects and fishery management actions in the area, plus possible impacts from potential airborne pollution, added to the impacts predicted under alternative B, would result in negligible to minor adverse cumulative impacts on human health.

Conclusion

Alternative B would have negligible to minor adverse impacts on human health over the long term from stocking decisions and consumption of stocked fish that may have been exposed to persistent organic pollutants and methyl-mercury. Proposed chemical treatments that would be used to remove fish from 19 lakes would have negligible adverse impacts on human health over the long term. Cumulative impacts on human health would be negligible to minor adverse over the long term.

ALTERNATIVE C: PROPOSED ADAPTIVE MANAGEMENT OF 91 LAKES UNDER A NEW FRAMEWORK (11 LAKES MAY HAVE FISH)



Alternative C applies a new adaptive management framework to the 91 lakes in the study area, wherein 9 lakes in Ross Lake and Lake Chelan National Recreation Areas would have fish and 2 lakes would be evaluated for restocking. Of the other 11 lakes in the national recreation areas, 3 would remain fishless, 3 would have high density reproducing fish removed, and stocking would be discontinued in 5 lakes. The remaining 69 lakes (which are in the national park) would be returned to their natural fishless condition or would remain fishless.

The “Alternatives” chapter provides a detailed description of alternative C. For more information on the 91 lakes, refer to tables 5 and 12 in the “Alternatives” chapter and appendix E.

Impacts of Proposed Fish Stocking on Human Health

The types of impacts of fish stocking on human health would be similar to those described for alternative A; however, under alternative C, there would be approximately 80 lakes that would be fishless, as opposed to 29 lakes under alternative A, with reductions in fish densities in other lakes. Loss of fish resources in these lakes would result in decreased potential of human consumption of fish contaminated with methyl-mercury and persistent organic pollutants. Impacts on human health would be negligible over the long term.

Impacts of Proposed Lake Treatment Methods on Human Health

Under alternative C, the types of impacts associated with the various lake treatments methods would be the same as described for alternative B; however, the numbers of lakes affected by those treatments would increase, with slightly more potential for human consumption of chemically treated fish. Under alternative C, 25 lakes would be treated with the piscicide, antimycin, an increase of 6 lakes over alternative B. Impacts on human health would be negligible over the long term.

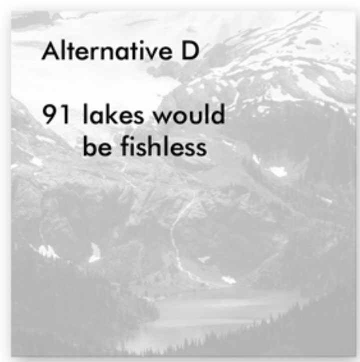
Cumulative Impacts

Overall, the impacts associated with other projects and fishery management actions in the area, plus potential impacts from increased airborne pollution, added to the impacts predicted under alternative C, would be expected to result in negligible to minor cumulative adverse impacts on human health over the long term.

Conclusion

Alternative C would have negligible to minor adverse impacts on human health over the long term from stocking decisions and consumption of stocked fish that may have been exposed to persistent organic pollutants and methyl-mercury. Proposed chemical treatments that would be used to remove fish from 25 lakes would have negligible adverse impacts on human health over the long term. Cumulative impacts on human health would be negligible to minor adverse over the long term.

Alternative D: 91 Lakes Would Be Fishless



The emphasis of this alternative is that 91 lakes in the study area would eventually be fishless. The “Alternatives” chapter provides a detailed description of alternative D. For more information on the 91 lakes, refer to tables 5 and 13 in the “Alternatives” chapter and appendix E.

Impacts of Proposed Fish Stocking on Human Health

Under alternative D, the 29 lakes that are currently fishless would remain fishless, and fish stocking would be gradually phased out. The lakes that currently have fish would be treated to remove fish over time, with the exception of the 9 lakes identified in table 7 where complete fish removal may not be feasible. Loss of fish resources in lakes would result in negligible impacts on human health over the long term.

Impacts of Proposed Lake Treatment Methods on Human Health

Under alternative D, the types of impacts associated with the various lake treatment methods would be the same as described for alternative B; however, the number of study area lakes affected by those treatments would increase, with more potential impacts on human health from possible consumption of chemically treated fish. The chemical method involving application of the piscicide, antimycin, would be used in 25 lakes under alternative D, the same as alternative C, but an increase of 7 lakes over the number that would be chemically treated under alternative B. Impacts on human health would be negligible over the long term.

Cumulative Impacts

Overall, the impacts associated with other projects and fishery management actions in the area, plus impacts from potential airborne pollution, added to the impacts predicted under alternative D, would be expected to result in negligible to minor adverse cumulative impacts on human health over the long term.

Conclusion

Alternative D would have negligible to minor adverse impacts on human health over the long term from consumption of fish from previously stocked lakes that may have been exposed to persistent organic pollutants and methyl-mercury. Proposed chemical treatments used to remove fish from 25 lakes would have negligible adverse impacts on human health over the long term. Cumulative impacts on human health would be negligible to minor adverse over the long term.

SOCIOECONOMIC RESOURCES

GUIDING REGULATIONS AND POLICIES

The *National Environmental Policy Act of 1969* requires that economic and social impacts be analyzed in an environmental impact statement when they are interrelated with natural or physical impacts. Economic and social impacts would potentially result from the natural and physical effects of changes to fish populations in North Cascades Complex mountain lakes; therefore, this plan/EIS addresses economic and social impacts.

METHODOLOGY AND ASSUMPTIONS

Visitors who fish in the mountain lakes of the North Cascades Complex spend money in nearby communities as part of the recreational experience. Limiting or discontinuing the stocking program may affect the level of this spending and affect people who depend on it. The methodology for assessing the relative economic contribution of sport fishing in the study area was derived by estimating the annual angler numbers and applying an estimate of annual expenditures provided by the WDFW. Then, in order to estimate other secondary economic contributions from these annual expenditures to the job market and income, the model IMPLAN was used (see the "Socioeconomic Resources" section of the "Affected Environment" chapter). The impact analysis involves qualitatively assigning a change (increase or decrease) in anglers to each alternative, based on the activities under that alternative that would increase or decrease fish population. Then, the resulting economic effect is both qualitatively and quantitatively estimated. When spending in the regional or local economy is affected, a negligible, minor, moderate, or major impact would occur. The criteria for meeting these thresholds are explained below.

Geographic Area Evaluated for Impacts

The regional study area for the purpose of the socioeconomic impact analysis includes the North Cascades Complex and Whatcom, Skagit, and Chelan counties in Washington State. The local study area includes the small towns near the North Cascades Complex that have businesses that provide supplies and equipment to anglers visiting the North Cascades Complex. See the "Socioeconomic Resources" section in the "Affected Environment" chapter for further details.

Impact Threshold Definitions

Negligible: No measurable effect on the socioeconomic environment.

Minor: Only a small sector of the local and regional economies would be affected and would not be readily apparent.

Moderate: A relatively small sector of the socioeconomic environment, or the relationship between sectors of the local and regional economies, would be measurably affected, but would not alter basic socioeconomic functions and structure.

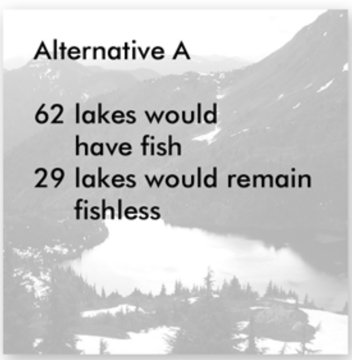
Major: Changes to the local and regional economies would occur and would become readily apparent in the form of shifts in socioeconomic functions and structure. In certain cases, entirely new economic sectors would be created, or established sectors eliminated.

IMPACTS OF THE ALTERNATIVES ON SOCIOECONOMIC RESOURCES

ALTERNATIVE A (NO ACTION): EXISTING MANAGEMENT FRAMEWORK OF 91 LAKES (62 LAKES HAVE FISH)

Impacts on the Regional Economy

The current mountain lakes fishery management activities at the North Cascades Complex, which are described in the “Alternatives” chapter, would continue under the no-action alternative. The “Alternatives” chapter provides a detailed description of alternative A. For more information on the 91 lakes, refer to table 5 and figure 4 in the “Alternatives” chapter and appendix E.



The estimated number of visitors to the North Cascades Complex who engage in sport fishing in the study area lakes is estimated at 1,000 anglers per season (refer to the “Fishing” section under “Visitor Use and Experience” in the “Affected Environment” chapter). The WDFW estimates that approximately $49.79 per trip is expended by those who sport fish in the state (WDFW 1996).

Using this estimate of expenditures, and the angler use of the study area, the total annual expenditures of anglers to the area are approximately $50,000, with additional secondary (indirect) expenditures and labor income. When factoring in the relationship between output, jobs, and income for sport fishing associated with the North Cascades Complex mountain lakes fishery in the three-county area (Whatcom, Skagit and Chelan counties), direct economic output ($50,000 annually) would most likely support one to two associated direct jobs and $10,000 in direct labor income on an annual basis (IMPLAN, Copyright Minnesota IMPLAN Group, Inc.).

The total (direct plus secondary) spending attributable to recreational mountain lake fishing in the North Cascades Complex represents, at most, 0.001% of total retail sales in the three-county area, and 0.006% of total retail sales in the combined unincorporated areas of the three counties (WDOR 2003). Revenues from mountain lakes fishing, then, account for roughly $1 out of every $100,000 spent in the three-county region. In comparison to the three-county economy as a whole, assuming angler use under this alternative remains steady (approximately

10.5% of total backcountry permit visitation) over the next 15 years, these expenditures would have a beneficial, yet negligible, long-term impact on the regional economy.

Impacts on the Local Economy

Local businesses would also continue to be affected over the long term (see the “Socioeconomic Resources” section in the “Affected Environment” for local businesses in the vicinity of the study area). Proprietors of local businesses on the west side of the North Cascades Complex that cater to fishing indicate that fishing of mountain lakes in the North Cascades Complex is very limited and accounts for a negligible portion of revenues (NPS, Roy Zipp, pers. comm., 2004). A variety of factors appear to contribute to the limited use, including access difficulties, perception that fishing is prohibited, and a general lack of knowledge that many mountain lakes in the North Cascades Complex contain fish. Given the assumption that average visitation and angling use would remain constant over the next 15 years, local businesses on the west side would continue to experience beneficial, yet negligible, long-term impacts.

Impacts on businesses in Stehekin, including the Stehekin Valley Ranch in Lake Chelan National Recreation Area, would also continue to be affected if current management of the fishery continued over the next 15 years. The relative greater use by anglers of the mountain lakes in the Lake Chelan National Recreation Area indicates the popularity of that area. Although no formal measurement of local expenditures by anglers who stay or pass through Stehekin is available, it is assumed that seasonal expenditures are higher than other local communities. For example, an estimated 28 guests per day visit the Stehekin Valley Ranch from June through August. Pack trips to Rainbow and surrounding lakes, and day trips to Coon Lake, would continue to be a large part of this local business. Existing and projected angler use in this area assumes that most anglers stay overnight and obtain backcountry overnight permits for an extended trip to the lakes around the Stehekin area. Under alternative A, expenditures of anglers who visit the ranch and other businesses in the area as part of their trip would continue, but are not expected to increase substantially. This assumption is made because the overall park visitation has remained steady over the past 10 years (see the “Visitor Use” section and table 22 in the “Affected Environment”’ chapter).

The proprietor of the Stehekin Valley Ranch has indicated that sport fishing is a large part of its income. Continuing the fishery management program under this alternative would have a long-term beneficial impact on this local business.

The 1995 *Lake Chelan General Management Plan* offers yet a different perspective of the reasons people visit the Stehekin area. Using data from 1992, the *Lake Chelan General Management Plan* identifies sightseeing, hiking, wildlife observation, photography, and bicycling as the primary visitor use activities for people visiting Stehekin. The 10%–12% of visitors who do visit the area and engage in sport fishing is a relatively small proportion of the annual visitation to the area (NPS 1995). Alternative A would have long-term beneficial impacts on local businesses in Stehekin.

Cumulative Impacts

Cumulative impacts are the direct and indirect impacts of alternative A in combination with other impacts that are occurring to the socioeconomic environment. The economy in communities surrounding the North Cascades Complex continues to evolve as industry diversification occurs. The historic basis for many northwestern Washington communities is natural resource-based industries, such as agriculture, fishing, and timber. A downturn in timber has forced diversification in all three counties (Whatcom, Skagit, and Chelan) into manufacturing industries, as well as into the recreation and tourism industries. The total (direct plus secondary) spending attributable to recreational high lakes fishing in the North Cascades Complex represents, at most, 0.001% of total retail sales in the three-county area, and 0.006% of total retail sales in the combined unincorporated areas of the three counties (WDOR 2003). In comparison to the three-county economy as a whole, these expenditures would continue to have negligible cumulative impacts on the local and regional economies.

Conclusion

Alternative A would have long-term negligible impacts on the local and regional economies. Estimated revenues from mountain lake angling account for roughly \$1 out of every \$100,000 spent in the three-county region. The effects of continuation of the current fishery management program on some local businesses in the Stehekin area would be beneficial since some patrons may also engage in sport fishing in the mountain lakes located in Lake Chelan National Recreation Area. Expenditures associated with sport fishing in the mountain lakes in the North Cascades Complex would continue to have long-term negligible cumulative impacts on the local and regional economies.

ALTERNATIVE B: PROPOSED ADAPTIVE MANAGEMENT OF 91 LAKES UNDER A NEW FRAMEWORK (42 LAKES MAY HAVE FISH) (PREFERRED ALTERNATIVE)

Impacts on the Regional Economy

The emphasis of this alternative is to eliminate or reduce the density of reproducing fish from certain mountain lakes in the study area under alternative B. The "Alternatives" chapter provides a detailed description of alternative B. For more information on the 91 lakes, refer to tables 5 and 10 in the "Alternatives" chapter and appendix E.

Alternative B

29 lakes would have fish
49 lakes would be fishless
13 lakes would be evaluated for restocking

Assuming that the 13 lakes to be evaluated would all be available for fishing at some point in the future, a total of 42 lakes (compared to 62 lakes under alternative A) would be available for fishing. While this decrease in available lakes for angler use is apparent, the relative socioeconomic impact of angler expenditures would have a negligible adverse impact on the regional economy. A relatively small amount (roughly \$1 out of every \$100,000) of direct and indirect economic contributions to the three-county area result from the sport fishing expenditures of those who use the high mountain lakes in the North Cascades Complex.

Impacts on the Local Economy

Alternative B, overall, would have a negligible impact on local businesses since the relative contribution of angler expenditures compared to total visitor expenditures is small. One business, such as the Stehekin Valley Ranch in the Lake Chelan National Recreation Area, notes that sport fishing in the high mountain lakes is very important to their livelihood. Under alternative B, six lakes in Lakes Chelan National Recreation Area would become fishless over time, and some would be treated to remove fish then re-evaluated for stocking at some point in the future. The Lake Chelan National Recreation Area backcountry use is one of the high-use areas in the North Cascades Complex. While it is estimated that 10.5% of backcountry users engage in sport fishing overall, should this use decrease, it would have long-term, major, and adverse impacts on some local businesses. This is a qualitative assessment, given that some businesses may rely on other visitor expenditures other than that of anglers. Other businesses may choose to transition their services to offer fishing in the Stehekin River as an alternative to fishing in the study area lakes.

Day hiking to Coon Lake from Stehekin would remain a popular activity, and sport fishing would continue at the lake under alternative B. Proprietors who provide services to day hikers and angling supplies for those visiting Coon Lake would not be economically affected by this alternative.

Cumulative Impacts

Cumulative impacts would be similar to alternative A. While the number of lakes available for fishing would decrease under alternative B, the overall contribution of sport fishing to the local and regional economies would be long term and negligible. The 1995 Lake Chelan *General Management Plan* did not project any substantive changes in visitor use through the year 2007; therefore, cumulative impacts on most local businesses in Stehekin would be long term and negligible. Some local businesses in Stehekin who report a large dependence on sport fishing as a source of revenues, such as the Stehekin Valley Ranch, would experience a long-term, major, and adverse impact from this alternative, since other visitor uses are not expected to substantially increase (NPS 1995).

Conclusion

Although there would be a decrease in lakes available for fishing, the relative socioeconomic impact of angler expenditures would have a negligible, adverse impact on the local and regional economies. A relatively small amount (roughly $1 out of every $100,000) of direct and indirect economic contributions to the three-county area is from sport-fishing expenditures of anglers who fish at the high mountain lakes in the North Cascades Complex. Some local businesses in Stehekin that depend on sport fishing as a primary source of income would experience a long-term major adverse impact under alternative B. Cumulative impacts would be similar to alternative A. While the number of lakes available for fishing would decrease under alternative B, the overall contribution of sport fishing to the local and regional economies would be long term and negligible.

ALTERNATIVE C: PROPOSED ADAPTIVE MANAGEMENT OF 91 LAKES UNDER A NEW FRAMEWORK (11 LAKES MAY HAVE FISH)

Impacts on the Regional Economy

Alternative C applies a new adaptive management framework to the 91 lakes in the study area, wherein 9 lakes in Ross Lake and Lake Chelan National Recreation Areas would have fish and 2 lakes would be evaluated for restocking. Of the other 11 lakes in the national recreation areas, 3 would remain fishless, 3 would have high density reproducing fish removed, and stocking would be discontinued in 5 lakes. The remaining 69 lakes (which are in the national park) would be returned to their natural fishless condition or would remain fishless.

Alternative C

9 lakes would have fish
80 lakes would be fishless
2 lakes would be evaluated for restocking

The "Alternatives" chapter provides a detailed description of alternative C. For more information on the 91 lakes, refer to tables 5 and 12 in the "Alternatives" chapter and appendix E.

The relative socioeconomic impact of angler expenditures would have a negligible adverse impact on the regional economy. A relatively small amount (roughly $1 out of every $100,000) of direct and indirect economic contributions to the three-county area is from the sport-fishing expenditures of anglers who fish the high mountain lakes in the North Cascades Complex. While alternative C would preclude sport fishing in the majority of the study area lakes, the effect of this decreased activity would not be measurable within the three-county area; hence, the impact would be long term, negligible, and adverse.

Impacts on the Local Economy

The relative socioeconomic impact of angler expenditures under this alternative would be negligible on the local economy over the long term. This is because on the west side of the North Cascades Complex, fishing expenditures are currently not substantial, and therefore, the effects of this alternative would not be measurable (see the "Socioeconomic Resources" section in the "Affected Environment" chapter). In the Stehekin area, the effects of alternative C would be the same as alternative B; that is, long-term negligible and adverse impacts would occur because the lakes in the Lake Chelan National Recreation Area would be managed the same under both alternatives.

The town of Newhalem is on State Route 20 in Ross Lake National Recreation Area.

Compared to alternative A, the effects of alternative C on the Stehekin area from angler expenditures would have a negligible impact on the local economy. Angler visitation to the Stehekin area overall constitutes an estimated average visitation of 10% to 12% (see the "Socioeconomic Resources" section in the "Affected Environment" chapter). This average is not expected to substantially change over the next 10 years; therefore, the relative economic contributions of sport fishing in the Stehekin area would remain a small portion of total revenues. However, some local businesses in Stehekin who depend on sport fishing as a primary source of income would experience a long-term, major, and adverse impact from reduced fishing opportunities proposed in alternative C.

Cumulative Impacts

Cumulative impacts of alternative C would be long term, negligible, and adverse overall to the local and regional economies. In general, angling opportunities would decrease under alternative C, which may force anglers to fish in other areas outside the North Cascades Complex. However, since the relative contribution of sport fishing to the local and regional economies is small, any shifts in angler use would be expected to result in negligible economic impacts. The majority of visitors to the North Cascades Complex are from the state of Washington, so any displacement of those visitors who also engage in sport fishing would most likely result in an increase in other areas in the state. This increase and associated expenditures (less than $50,000 direct expenditures per year) in other areas outside the North Cascades Complex would not be measurable. Cumulative impacts overall would be long term, negligible, and adverse.

Cumulative impacts on the Stehekin area overall would be long term, negligible, and adverse. The proportion of visitors who engage in sport fishing compared to other uses is relatively small (10%–20%) in the Stehekin area. Some lakes in the study area would remain available for fishing in Lake Chelan National Recreation Area, and while there would be a decreased fishing opportunity compared to alternative A, the impacts on the local economy overall would not be measurable.

Sport-fishing opportunities would decrease in the national park portion of the North Cascades Complex, which would contribute to an increase in the number of anglers who may choose to fish in the national recreation areas. This increase in angler visitation would have a negligible, but long-term beneficial impact on the Stehekin area. Some local businesses in Stehekin, however, may experience a long-term, major, and adverse impact from reduced fishing opportunities compared to alternative A because the number of lakes available for fishing in the Lake Chelan National Recreation Area would be reduced.

Conclusion

The number of lakes available for fishing would decrease under alternative C, and the relative socioeconomic impact of angler expenditures would have a negligible adverse impact on the local and regional economies. Revenues from mountain lakes angling in the North Cascades Complex account for roughly $1 out of every $100,000 spent in the three-county region. Some local businesses in Stehekin that depend on sport fishing as a primary source of income would experience a long-term, major adverse impact from alternative C. Cumulative impacts on the local and regional economies overall would be long term and negligible, while some businesses in Stehekin may experience long-term, major adverse impacts because other visitor uses are not expected to increase substantially. There would be beneficial economic impacts on Stehekin area businesses if anglers chose to fish in the Lake Chelan National Recreation Area since fishing in the mountain lakes outside of the national recreation areas would be eliminated.

ALTERNATIVE D: 91 LAKES WOULD BE FISHLESS

Impacts on the Regional Economy

The goal of this alternative is that the 91 lakes in the study area would eventually be fishless. Sport-fishing opportunities in most of these lakes would generally be eliminated within a period of 5 years, and self-sustaining (reproducing) populations of fish would be gradually removed over time. The rate of removal would depend on unpredictable changes in resource (funding and personnel) availability and differences among fish removal methods. Complete removal of self-sustaining populations of fish in some of the larger, deeper lakes might not be feasible (9 lakes potentially fall into this category—refer to table 7). These lakes would continue to provide sport-fishing opportunities for the foreseeable future, and the goal of complete removal might never be achieved. The "Alternatives" chapter provides a detailed description of alternative D. For more information on the 91 lakes, refer to tables 5 and 13 in the "Alternatives" chapter and appendix E.

This alternative would result in lost income, both direct and indirect, to the regional economy. Overall, while the relative contribution to the regional economy from sport fishing in the 91 lakes is small compared to alternative A, the impact of these lost expenditures would be long term, minor, and adverse.

Impacts on the Local Economy

Removal of all fishing opportunities in the study area lakes would have a long-term, minor, adverse impact on the local economy compared to alternative A. While the relative contribution of angler expenditures to local businesses is small, compared to alternative A, the loss of sport fishing in the high mountain lakes in the study area would be measurable but minor. Loss of all fishing opportunities in the mountain lakes in the Lake Chelan National Recreation Area would have a minor adverse impact on local businesses in Stehekin, since the revenues of sport fishing are relatively small compared to other revenue sources; however, some businesses that depend on sport fishing in the study area lakes in the Lake Chelan National Recreation Area would experience a long-term, major, and adverse impact.

Cumulative Impacts

The negligible but adverse direct and indirect long-term socioeconomic impact of alternative D, in combination with the long-term growth and diversification the region has experienced recently, would result in a long-term, negligible, and adverse cumulative impact. Cumulative impacts on the local economy, overall, would also be long term, negligible, and adverse because the relative contribution of sport fishing expenditures related to the mountain lakes in the study area is small. Some businesses in Stehekin may experience long-term, major adverse impacts from loss of this revenue source.

Conclusion

Overall, the local and regional economies would experience long-term negligible to minor adverse impacts from the elimination of sport fishing in the mountain lakes in the study area. Compared to alternative A, some Stehekin businesses would experience long-term major adverse impacts under alternative D if their primary source of income is from anglers who fish in the study area lakes. Cumulative impacts, overall, would be long term, negligible, and adverse.

MANAGEMENT AND OPERATIONS

GUIDING REGULATIONS AND POLICIES

Direction for the North Cascades Complex management and operations is set forth in the park's enabling legislation, *General Management Plan* (NPS 1988b), and *Strategic Plan* (NPS 2000a). Specifically related to the proposed mountain lakes fishery management plan, the *General Management Plan* includes the following management objectives:

> Provide the minimum NPS development necessary to provide essential services to visitors and to facilitate environmentally sound and resource-oriented recreational use.
>
> Cooperate with other governmental agencies, private organizations, local residents, and members of the public in (1) ensuring that land uses within and adjacent to the designated parklands are compatible, to the greatest degree possible, with preservation of the resource values; (2) providing adequate information to visitors on the recreational, interpretive, and educational opportunities as well as the visitor services available in the North Cascades; (3) developing programs for managing vegetation, wildlife, and fisheries; and (4) developing plans and programs for dealing with all other problems of mutual concern.

The *Strategic Plan* also contains strategies and long-term goals that describe management and operational objectives through September 30, 2005.

METHODOLOGY AND ASSUMPTIONS

A long-term commitment of funding and personnel would be needed to manage the mountain lakes fishery. Table 30 in the "Affected Environment" chapter provides the annual base funding the park has received over the past 12 years. All of the alternatives were analyzed assuming the current trend shown in table 30 of minimal increase in the park's annual budget would continue over the next 15 years. Though innovative partnerships and non-NPS funding may be available as a means of limiting NPS costs, impacts on park operations were analyzed with the assumption that NPS funding and personnel would be required to carry out the majority of management actions, especially monitoring and fish removal.

To accomplish monitoring and fish removal, a field crew of biological technicians composed of a team leader (term position) and three assistants (seasonal positions) would be hired provided soft funding could be obtained. These personnel would primarily be responsible for field work during the summer months. Existing staff at the park would supervise these employees and provide overall project management as part of existing park operations.

For management alternatives that include stocking (alternatives A, B, and C), it was assumed that the WDFW and their stakeholders would continue to stock lakes with no direct cost to the NPS.

Personnel costs were developed with the assumption that both permanent and seasonal NPS staff would be required to manage the mountain lakes fishery. Funding for resource management staff in the North Cascades Complex covers salaries and provides for a small amount of discretionary monies for ongoing, high-priority resource management projects. To fully implement each of the adaptive management alternatives presented in this plan/EIS, additional funding and personnel would be needed. Various sources of "soft" funding are available through the NPS but only on a competitive basis and typically for a maximum of three years.

Helicopters are often needed as the minimum tool to transport heavy sampling gear and time-sensitive samples to and from remote lakes. This photo shows NPS and USGS-Water Resources Division biologists sampling fish in Wilcox/Lillie, Upper Lake to detect persistent organic pollutants and methyl-mercury in fish tissue.

Costs of fish removal using gillnets were calculated using data from ongoing fish removal efforts in Sequoia-Kings Canyon National Park, California. That program developed a successful, intensive gillnetting approach on small lakes (less than 5 acres) that currently costs approximately $15,000 per 1 acre of lake surface area (NPS, D. Boiano, pers. comm., 2003). Differences between Sequoia-Kings and North Cascade Complex lakes in terms of lake morphometry (shape and structure of lakes) and other logistical constraints could make the overall cost of gillnetting higher in the North Cascades Complex, but the uncertain costs of these confounding factors were not calculated into the analyses.

The current cost of antimycin ($450/unit) was used to help develop treatment costs. Antimycin application costs were derived in part from antimycin treatment methods conducted on lakes in Rocky Mountain National Park. The calculations for estimating antimycin treatment costs are heavily dependent on an accurate understanding of lake volumes and residence times of water in the lakes. Because some estimates must use simplified assumptions of lake volumes and residence times, actual costs of lake treatments with antimycin could vary considerably from the estimates provided in the analysis.

Geographic Area Evaluated for Impacts

The geographic area evaluated for impacts on North Cascades Complex management and operations includes the north and south units of the North Cascades National Park, the Ross Lake National Recreation Area, and the Lake Chelan National Recreation Area.

Impact Threshold Definitions

Negligible. An action would have a no measurable impact on operations in the North Cascades Complex.

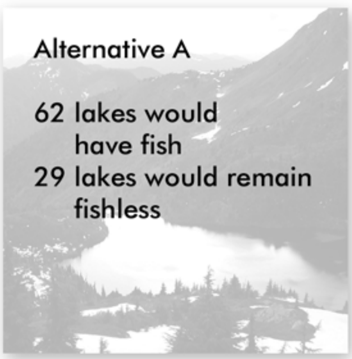
Minor. Actions with minor impacts would affect operations in the North Cascades Complex in a way that would be difficult to measure. The impacts on the resources management budget and workload would be short term, with little material effect on other ongoing resources management programs.

Moderate. Actions with moderate impacts would measurably affect operations in the North Cascades Complex. Resources management staff workloads and priorities would need to be rearranged to implement mountain lakes fishery management actions, and as a result, ongoing science and/or stewardship programs would be reduced in scope or potentially eliminated.

Major. Management actions would affect resource management operations in the North Cascades Complex. Funding for management actions would exceed the current resource management budget by 10%, consume all discretionary funding, and require additional personnel over and above what would normally be expected to be funded.

IMPACTS OF THE MANAGEMENT ALTERNATIVES ON NORTH CASCADES COMPLEX MANAGEMENT AND OPERATIONS

ALTERNATIVE A (NO ACTION): EXISTING MANAGEMENT FRAMEWORK OF 91 LAKES (62 LAKES HAVE FISH)



The current mountain lakes fishery management activities at the North Cascades Complex would continue under the no-action alternative. The “Alternatives” chapter provides a detailed description of alternative A. For more information on the 91 lakes, refer to table 5 and figure 4 in the “Alternatives” chapter and appendix E.

The costs of continuing to manage mountain lakes under alternative A would be primarily associated with stocking, very limited monitoring, and project oversight. These actions would cost approximately $18,000 per year and primarily be borne by the WDFW. Over a 15-year period, not accounting for other factors such as inflation, estimated costs to implement alternative A would be $270,000. The North Cascades Complex would continue to receive, on an irregular basis, NPS funds for periodic monitoring and research projects and funds from constituency groups to support park programs. These supplemental funds would probably be minimal. Given that the annual base funding for the North Cascades Complex (refer to table 30 in the “Affected Environment” chapter) is not expected to substantially increase, the expenditure of funds to support alternative A would be negligible in the long term.

Impacts of Current Fish Stocking on North Cascades Complex Management and Operations

Alternative A would require little NPS oversight because the cost of management actions would continue to be largely borne by the WDFW and their stakeholders. No additional NPS staff or funding would be needed because no intensive monitoring or fish removal projects would be undertaken; therefore, the impacts of alternative A would be negligible and long term.

Impacts of Current Fish Removal on North Cascades Complex Management and Operations

Fish removal is not part of current management, so there would be no cost or impact.

Cumulative Impacts

North Cascades Complex budgets, overall, are continuing to be stretched by increased public visitation, resource protection needs, and growing needs to improve infrastructure. The most recent flooding during the fall of 2004 is an example of an unexpected natural event that has cumulative impacts on North Cascades Complex management and operations. These types of events, as well as other demands on park operations, would continue. Cumulative impacts on operations and management would be negligible to minor and adverse over the long term.

Conclusion

Alternative A would have a negligible to minor adverse impact on management and operations over the long term. Total implementation costs would be $270,000 over a 15-year period and would primarily be borne by the WDFW. Average annual costs would be approximately $18,000 per year.

Cumulative impacts would be negligible to minor and adverse over the long term.

Alternative B: Proposed Adaptive Management of 91 Lakes under a New Framework (42 Lakes May Have Fish) (Preferred Alternative)

The emphasis of this alternative would be to eliminate or reduce self-sustaining fish populations from naturally formed mountain lakes in the North Cascades Complex. Some lakes would be restocked with nonreproducing fish at low densities once reproducing fish have been removed. Fish stocking would be allowed only where biological integrity could be conserved. Lakes where critical information is missing would not be stocked until that information becomes available. It is assumed that future stocking would continue to be funded and implemented by the WDFW and their stake holders with no additional cost to the NPS over the long term. An extensive monitoring program (see appendix F) would be implemented in order to enable adaptive management and ensure conservation of biological integrity over the long term.

Alternative B

- 29 lakes would have fish
- 49 lakes would be fishless
- 13 lakes would be evaluated for restocking

The “Alternatives” chapter provides a more detailed description of alternative B. For more information on the 91 lakes under consideration in this plan, refer to tables 5 and 10 in the “Alternatives” chapter and appendix E.

Fish removal with gillnets would involve initial start-up costs for durable equipment and materials, including gillnets and electrofishing gear (see table 34). Most of the costs of gillnetting would involve personnel time because gillnetting is a very labor-intensive process. Removing fish with antimycin would be less labor intensive than gillnetting. Labor costs would be limited to antimycin application and pre- and post-treatment monitoring of native biota. The cost of antimycin would be one of the most expensive components, particularly for larger lakes because relatively large volumes of antimycin would be needed for lake treatment. Fish in lakes less than 5 acres would be removed with a combination of intensive gillnetting, trapping, and electrofishing of inlet and outlet streams. Lakes larger than 5 acres would be chemically treated with the piscicide antimycin. The acreage criterion for selecting fish removal methods could change if other less costly/labor-intensive methods become available, or if other factors such as lake depth and amounts of woody debris render gillnetting infeasible.

TABLE 34: ESTIMATED TOTAL COSTS OF THE FISHERY MANAGEMENT PROGRAM UNDER ALTERNATIVE B

This table shows detailed costs for the first three years of fish removal using gillnets and antimycin. Estimated costs for antimycin assume treatment at 8 parts per billion, plus possible re-treatment, if needed. Equipment needs are based on fish removal work performed in other national parks.

Item	Description	Year I	Year 2	Year 3
Personnel	GS-7/9 Crew Leader, term appointment subject furlough (8-months/year)	$22,400	$23,300	$24,400
	3-GS-5 Biological Technicians (4 month seasonal appointments)	$25,300	$26,400	$27,500
	Technical assistance with pre-treatment monitoring and antimycin application		$11,000	
Supplies and Equipment	Gillnets: 15 per lake (60 nets, $300 each) plus two extra in years 2 and 3	$18,000	$1,000	$1,000
	Antimycin ($450/unit; up to 56 units for Middle Blum and 22 units for Lower Blum.	0	$35,100	0
	Three float tubes and five neoprene chest waders	$900	0	0
	Two LR-24 Electrofishers (battery powered, 24-volt backpack mounted)	$9,100	0	0
	Electrofisher accessories (2 each) (6-foot, one-piece anode pole and ring, rat-tail cathode, 24 volt 7Ah sealed battery, BC-24PS battery-charger, 10KV electrical safety gloves [4])	$2,900	0	0
	Two Knaack boxes for storing gear on site	$1,000	0	0
	Backpacks, sleeping bags, tents, camping gear, and field supplies	$6,000	$1,000	$1,000
Services	Zooplankton and macroinvertebrate sample analyses	$12,000	$13,000	$14,000
Travel and Transport	Helicopter ($600/hour, minimum 2-hour flights per lake to ferry equipment and personnel; two extra flights needed in year 2 to treat Blum Lake)	$9,600	$12,000	$9,600
	Per diem	$1,200	$2,000	$1,300
Training	Aviation training, pesticide applicator training	$2,000	$4,000	$2,000
Public Outreach and Education	Develop interpretive media (exhibit, web page, brochure) and work with news media	$6,900	$4,500	$4,900
Total Annual Costs:		$117,300	$133,300	$85,700
Average Annual Program Cost:				**$112,100**
	Total costs for first three years of program implementation			**$336,300**

Fish in lakes with very limited spawning habitat (such as Wilcox/Lillie, Upper Lake) would also be removed by breaking the cycle of reproduction indirectly through spawning habitat exclusion. This method, however, has only been selected for one lake at this point due to uncertainty of success.

The estimated costs of using gillnets and antimycin for fish removal under alternative B are provided in table 35. Seven lakes have been identified for the first round of fish removal using these various methods (highlighted in gray in table 35). It is assumed that it would take three years to remove fish from these six lakes, and success in fish removal efforts would be monitored and evaluated before the next round of lakes would be chosen for fish removal. Based on results, the methods and associated costs could vary from those indicated in table 35 as personnel gain experience, and innovative fish removal methods potentially become available.

Table 34 shows that the estimated annual costs of alternative B for the first three years of program implementation would be approximately $336,300. As experience is gained in lake treatment methods, larger lakes would undergo fish removal. Costs would increase because removal methods would become more difficult and time-consuming to implement, and larger volumes of antimycin would be needed for those lakes selected for chemical treatment. Therefore, the estimated annual costs after the first three years would increase to approximately $150,000. Without funding, the impact on park operations would be minimal because no additional fishery management actions would be performed.

Given the number of lakes to be treated, monitored, evaluated, and restocked in alternative B, a conservative estimate of total costs over the next 15 years would be approximately $2.14 million (NPS, R. Zipp, pers. comm., 2004). This total cost estimate assumes that all lakes could be treated within 15 years. This assumption may be too ambitious given the uncertainty of funding to implement the fishery management plan and the low feasibility of removing fish from larger, deeper lakes.

As noted previously under “Methodology and Assumptions,” if the funding for the North Cascades Complex remains at current levels, fishery management actions could not be paid for with base funding because it is specifically earmarked for base operations. Base funding levels have remained static in recent years (refer to table 30 in the “Affected Environment” chapter), while costs have risen due to inflation, cost of living increases, and other factors. This trend underscores the point that there are few discretionary dollars available to fund additional resource management programs such as a fishery management plan. Assuming this static trend continues, then reliance upon soft funding from the sources noted previously would be essential for plan implementation.

The impact of alternative B on management and operations would depend on the amount of soft funding received to implement the fishery management plan. Reliance on soft funding sources would mean that fishery management actions would be implemented in a piecemeal fashion and be subject to the unpredictable availability of funding for the foreseeable future. At a minimum, NPS resource management personnel would routinely have to write funding proposals and secure soft funding and develop and maintain partnerships to ensure that steady

TABLE 35: ESTIMATED COSTS OF FISH REMOVAL FOR MANAGEMENT ACTIONS UNDER ALTERNATIVE B

Note: The lakes highlighted in gray have been identified for the first round of fish removal.

Lake Name	NPS Lake Code	Depth (feet)	Area (acres)	Initial Fish Removal Method Proposed for Alternative B	Estimated Fish Removal Cost[a]
Battalion	MLY-02-01	16	6.3	Piscicide	$94,500
Bear	MC-12-01	152	25.7	Piscicide	$70,010
Berdeen	M-08-01	215	126.7	Piscicide	$416,521
Berdeen, Lower	M-07-01	36	7.5	Piscicide	$13,310
Berdeen, Upper	M-09-01	Unknown[b]	9.5	Piscicide	$16,354
Blum (Lower/West, No. 4)	LS-07-01	26	6.4	Piscicide	$11,771
Blum (Largest/Middle, No. 3)	M-11-01	33	12.9	Piscicide	$15,622
Bouck, Lower	DD-04-01	63	10.8	Piscicide	$19,404
Dagger	MR-04-01	16	8.2	Piscicide	$11,248
Dee Dee, Upper	MR-15-01	89	12.2	Gillnet	$25,460
Diobsud No. 1	LS-01-01	11	1	Gillnet	$15,000
Diobsud No. 2, Lower	LS-02-01	17	3.1	Gillnet	$46,500
Doubtful	CP-01-01	68	30.2	Piscicide	$42,496
Doug's Tarn	M-21-01	10	5	Gillnet	$75,000
Green	M-04-01	153	80	Piscicide	$193,764
Hanging	MC-08-01	33	88.8	Piscicide	$55,516
Hozomeen	HM-02-01	67	97.5	Piscicide	$109,008
Kettling	MR-05-01	23	9.9	Piscicide	$12,681
McAlester	MR-10-01	23	13.2	Piscicide	$13,808
Monogram	M-23-01	122	29.1	Piscicide	$64,720
Rainbow	MR-14-01	108	15.5	Piscicide	$34,159
Skymo	PM-03-01	20	10.8	Piscicide	$12,508
Sourdough	PM-12-01	107	27.6	Piscicide	$55,855
Triplet, Lower	SM-02-01	7	2.2	Gillnet	$33,000
Triplet, Upper	SM-02-02	12	2.4	Gillnet	$36,000
Wilcox/Lillie, Upper	EP-06-01	65	10.5	Spawning habitat exclusion	Volunteer labor
Wilcox/Sandie, Lower	EP-05-01	20	5.4	Gillnet	$10,904
				Total estimated cost of fish removal	**$1,505,119**

Notes:

a. This table provides a conservative estimate of fish removal costs for alternative B based upon the following assumptions: $15,000/acre for gillnetting (NPS, D. Boiano, pers. comm., 2003). Assume one-time use of piscicide antimycin per lake, $450/unit of Fintrol® (trade name) at 4 parts per billion, at $45 /acre-foot. Lake volume calculations assume lake basin is cone shaped (formula = 0.33 × maximum depth x area). Treatment costs also include salary for four-person field crew ($3,000 for 2 weeks at small lake; $4,500 for 3 weeks at medium lake; $6,000 for 4 weeks at large lake) and helicopter transportation of equipment (2 flights small lake, 4 flights medium lake, 6 flights large lake). Small lakes 1–5 acres; medium lakes, 6–20 acres; large lakes 20+ acres.

b. The depth of this lake is unknown, but for treatment purposes, a depth of 50 feet was assumed in order to calculate the cost of antimycin.

sources of funding and in-kind assistance remained available to implement the fishery management plan. Once funding were secured, resource management staff would have to take on the additional burden of training personnel, assisting with field work, and providing overall project oversight. Interpretive staff would need to assist with public outreach and education to foster public understanding and awareness of the program. Under this likely scenario, the impacts on North Cascades Complex management and operations would be moderate, adverse, and long term because NPS personnel would have to shift workload priorities to accommodate these additional tasks, and other ongoing resource management actions may not be accomplished.

Should NPS base funding levels increase and be made available to fund implementation of the fishery management plan, the adverse impacts onpark management and operations would decline to a minor level because (a) resources management staff would not have the additional burden of routinely seeking soft funding to implement this plan, and (b) additional resource management personnel could be available to manage the additional workload. Depending on the amount of funding available, the fishery management plan would also be implemented in a more holistic fashion, with objectives such as removal of self-sustaining fish populations being achieved in shorter timeframes.

Cumulative Impacts

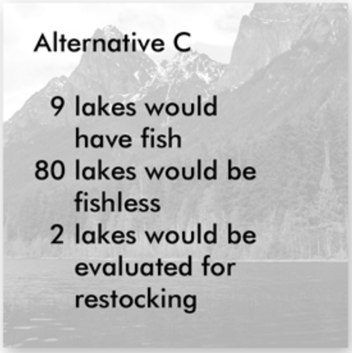
Various unanticipated issues can greatly influence North Cascades Complex operations and the funds required to respond to these events. For example, extensive flooding in 2004, national security issues, or wildfire can cumulatively affect available funds and the way the funds are appropriated. In addition, management priorities may need to be shifted to address pressing issues and to accommodate reduced funding. The cumulative impact of these unanticipated issues would be adverse and long term, but the magnitude of adverse impacts cannot be determined because the future is uncertain.

Conclusion

Alternative B would have moderate adverse impacts on management and operations over the long term, assuming all sources of funding remain fairly constant. Total implementation costs would be approximately $2.14 million over the next 15 years. Average annual costs for implementation are projected at approximately $112,100 for the first three years. As experience is gained conducting lake treatment and management, the number of lakes treated increases, raising costs to nearly $150,000 per year. Future stocking would be funded and implemented by the WDFW. However, should a long-term increase in NPS base funding for fishery management become available, implementing alternative B would have negligible to minor adverse impacts over the long term. Other sources of funding would be sought to reduce impacts on the North Cascades Complex operating budget.

Cumulative adverse impacts on operations could arise from the need to respond to future unanticipated events such as flooding, wildfire, or other events. However, the magnitude of adverse impacts may range from negligible to major depending on the severity of individual future events, which could reduce the amount of potential funding available to implement the fishery management plan or cause the NPS to shift priorities to respond to more pressing needs.

ALTERNATIVE C: PROPOSED ADAPTIVE MANAGEMENT OF 91 LAKES UNDER A NEW FRAMEWORK (11 LAKES MAY HAVE FISH)



Alternative C applies a new adaptive management framework to the 91 lakes in the study area, wherein 9 lakes in Ross Lake and Lake Chelan National Recreation Areas would have fish and 2 lakes would be evaluated for restocking. Of the other 11 lakes in the national recreation areas, 3 would remain fishless, 3 would have high density reproducing fish removed, and stocking would be discontinued in 5 lakes. The remaining 69 lakes (which are in the national park) would be returned to their natural fishless condition or would remain fishless.

Impacts of Proposed Fishery Management on North Cascades Complex Management and Operations

Alternative C would place a greater emphasis on fish removal in the national park lakes. Costs associated with removing fish in alternative C are shown in table 36. These estimates indicate that compared to alternative B, an additional $700,000 more funding would be needed to remove reproducing fish populations.

Management actions that would have an impact on North Cascades Complex management and operations would include stocking, fish removal, monitoring, evaluation, public outreach, and education. It is assumed that future stocking would continue to be funded and implemented by the WDFW and their stakeholders with no additional cost to the NPS over the long term.

Fish removal with gillnets would involve initial start-up costs for durable equipment and materials, including gillnets and electrofishing gear (see table 34). Most of the costs of gillnetting would involve personnel time because gillnetting is a very labor-intensive process. Removing fish with antimycin would be much less labor intensive than gillnetting. The cost of piscicide would be the most expensive component, particularly for larger lakes. Labor costs would be limited to piscicide application and pre- and post-monitoring of native biota.

As with alternative B, the estimated costs for the first three years of program implementation are $336,300 (see table 34), or approximately $112,100 annually. Success in fish removal efforts on these initial lakes would be monitored and evaluated before the next round of lakes would be chosen for fish removal. Based on results, the methods and associated costs would vary from those indicated in tables 34 and 36. As experience is gained in lake treatment methods, effort (and costs) to remove reproducing fish from mountain lakes would increase to approximately $150,000 annually. Costs would increase because removal methods would become more difficult and time-consuming to implement, and larger volumes of antimycin would be needed for those lakes selected for chemical treatment. Given the number of lakes to be treated, evaluated, and restocked in alternative C, total costs over the next 15 years would be approximately $700,000 more than alternative B, or approximately $2.84 million over 15 years (NPS, R. Zipp, pers. comm., 2004).

TABLE 36: ESTIMATED COSTS OF FISH REMOVAL FOR MANAGEMENT ACTIONS UNDER ALTERNATIVE C

Note: The lakes highlighted in gray have been identified for the first round of fish removal.

Lake Name	NPS Lake Code	Depth (feet)	Area (acres)	Initial Fish Removal Method Proposed for Alternative C	Estimated Fish Removal Cost[a]
Battalion	MLY-02-01	16	6.3	Piscicide	$94,500
Bear	MC-12-01	152	25.7	Piscicide	$70,010
Berdeen	M-08-01	215	126.7	Piscicide	$416,521
Berdeen, Lower	M-07-01	36	7.5	Piscicide	$13,310
Berdeen, Upper	M-09-01	Unknown[b]	9.5	Piscicide	$16,354
Blum (Largest/Middle, No. 3)	M-11-01	33	12.9	Piscicide	$15,622
Blum (Lower/West, No. 4)	LS-07-01	26	6.4	Piscicide	$11,771
Bouck, Lower	DD-04-01	63	10.8	Piscicide	$19,404
Dagger	MR-04-01	16	8.2	Piscicide	$11,248
Dee Dee, Upper	MR-15-01	89	12.2	Gillnet	$25,460
Diobsud No. 1	LS-01-01	11	1	Gillnet	$15,000
Diobsud No. 2, Lower	LS-02-01	17	3.1	Gillnet	$46,500
Doubtful	CP-01-01	68	30.2	Piscicide	$42,496
Doug's Tarn	M-21-01	10	5	Gillnet	$75,000
Firn	MP-02-01	38	5.7	Piscicide	$8,617
Green	M-04-01	153	80	Piscicide	$193,764
Hanging	MC-08-01	33	88.8	Piscicide	$55,516
Hidden	SB-01-01	258	61.7	Piscicide	$248,391
Hozomeen	HM-02-01	67	97.5	Piscicide	$109,008
Ipsoot	LS-06-01	51	8.9	Piscicide	$16,040
Jeanita	DD-01-01	8	1.4	Gillnet	$15,000
Kettling	MR-05-01	23	9.9	Piscicide	$12,681
McAlester	MR-10-01	23	13.2	Piscicide	$13,808
Monogram	M-23-01	122	29.1	Piscicide	$64,720
Rainbow	MR-14-01	108	15.5	Piscicide	$34,159
Skymo	PM-03-01	20	10.8	Piscicide	$12,508
Sourdough	PM-12-01	107	27.6	Piscicide	$55,855
Stout	EP-09-02	176	25.2	Piscicide	$77,863
Stout, Lower	EP-09-01	8	1	Gillnet	$15,000
Thornton, Lower	M-20-01	108	55.1	Piscicide	$100,209
Trapper	GM-01-01	161	147.2	Piscicide	$363,933
Triplet, Lower	SM-02-01	7	2.2	Gillnet	$33,000
Triplet, Upper	SM-02-02	12	2.4	Gillnet	$36,000
Wilcox/Lillie, Upper	EP-06-01	65	10.5	Spawning habitat exclusion	Volunteer labor
Wilcox/Sandie, Lower	EP-05-01	20	5.4	Gillnet	$10,904
				Total cost of fish removal	**$2,350,172**

Notes:

a. This table provides a conservative estimate of fish removal costs for alternative B based upon the following assumptions: $15,000/acre for gillnetting (NPS, D. Boiano, pers. comm., 2003). Assume one-time use of piscicide antimycin per lake, $450/unit of Fintrol® (trade name) at 4 parts per billion, at $45 /acre-foot. Lake volume calculations assume lake basin is cone shaped (formula = 0.33 × maximum depth x area). Treatment costs also include salary for four-person field crew ($3,000 for 2 weeks at small lake; $4,500 for 3 weeks at medium lake; $6,000 for 4 weeks at large lake) and helicopter transportation of equipment (2 flights small lake, 4 flights medium lake, 6 flights large lake). Small lakes 1–5 acres; medium lakes, 6–20 acres; large lakes 20+ acres.

b. The depth of this lake is unknown, but for treatment purposes, a depth of 50 feet was assumed in order to calculate the cost of antimycin.

As noted in "Methodology and Assumptions," if the base funding for North Cascades Complex remains at current levels, then fishery management actions could not be paid for with base funding because it is specifically earmarked for base operations. Base funding levels have remained static in recent years while costs have increased due to inflation, cost of living increases, and other factors. This trend underscores the point that there are few discretionary dollars available to fund additional resource management programs such as this fishery management plan. Assuming this static trend continues, reliance on soft funding from the sources noted previously would be essential for plan implementation.

The impact of alternative C on park management and operations would be similar to the impact of alternative B, with impacts essentially dependent on the amount of soft funding received to implement the fishery management plan. Reliance on soft funding sources would mean that fishery management actions would be implemented in a piecemeal fashion and subject to the unpredictable availability of funding for the foreseeable future. At a minimum, resource management personnel would routinely have to write funding proposals and secure soft funding and develop and maintain partnerships to ensure that steady sources of funding and in-kind assistance remained available to implement the fishery management plan. Once funding were secured, resource management personnel would need to take on the additional burden of training personnel, assisting with field work, and providing overall project oversight. Interpretive staff would need to assist with public outreach and education to foster public understanding and awareness of the program. Under this scenario, the impacts on park management and operations would be moderate, adverse, and long term because NPS personnel would have to shift workload priorities to accommodate these additional tasks, and other ongoing resource management actions may not be accomplished.

Cumulative

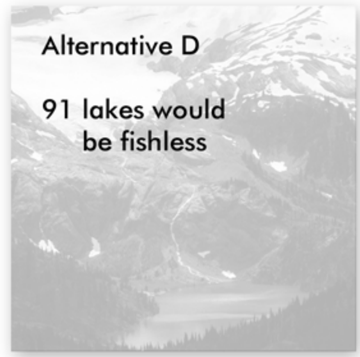
Various unanticipated events can greatly influence park management and operations and the funds required to respond to these events. For example, extensive flooding in 2004, national security issues, or wildfire can cumulatively affect available funds and the way the funds are appropriated. In addition, management priorities may need to be shifted to address pressing issues and to accommodate reduced funding. The cumulative impact of these unanticipated issues would be adverse and long term, but the magnitude of adverse impact, however, cannot be determined because the future is uncertain.

Conclusion

Alternative C would have similar moderate adverse impacts on management and operations as alternative B over the long term. Total implementation costs would be approximately $2.84 million over the next 15 years. Average annual costs would be similar to alternative B, but the additional lakes targeted for fish removal would increase the total cost. Future stocking would be funded and implemented by WDFW. Similar to alternative B, if a long-term increase in NPS base funding becomes available, adverse impacts would become minor. Other sources of funding would be sought to reduce impacts on the North Cascades Complex operating budget.

Cumulative adverse impacts on operations could arise from the need to respond to future unanticipated events such as flooding, wildfire, or other events. However, the magnitude of adverse impact may range from negligible to major depending on the severity of individual future events, which could reduce the amount of potential funding available to implement the fishery management plan or cause the NPS to shift priorities to respond to more pressing needs.

Alternative D: 91 Lakes Would Be Fishless



Under alternative D, none of the 91 lakes would be available for fishing, with the possible exception of the 9 lakes identified in table 7 where complete fish removal may not be feasible. The "Alternatives" chapter provides a detailed description of alternative D. For more information on the 91 lakes, refer to tables 5 and 13 in the "Alternatives" chapter and appendix E.

Impacts of Proposed Fishery Management on North Cascades Complex Management and Operations

Alternative D would be very similar in costs to alternative C because the majority of costs would be associated with fish-removal treatments at the study area lakes (NPS, R. Zipp, pers. comm., 2004). Costs could actually be slightly less than alternative C because fishery management actions would be centered exclusively on fish removal. There would be no costs associated with stocking, but there would be costs associated with monitoring the recovery of native organisms in lakes. The cost saving would be difficult to quantify at this point in time given the uncertainty of projecting cost savings across a 15-year timeframe. These cost savings, however, could be offset by increased law enforcement personnel to prevent unsanctioned stocking of lakes.

Another element that could have a substantial impact on management and operation costs is the valuable in-kind role of volunteer contributions to fishery management, such as assistance with lake monitoring and fish removal. Given the goal of removing all fish from the study area lakes, it is unlikely that WDFW or its angling stakeholders would be willing to assist because they would no longer have a stake in the outcome. This means that the NPS would bear the sole burden of fish removal and lose potentially valuable partnerships and in-kind sources of funding and assistance. In light of these various factors, a conservative cost estimate for implementing alternative D would be approximately $3 million over the next 15 years.

Although costs would be higher under alternative D compared to alternatives B and C, the impact of alternative D on park management and operations would be similar to the impacts of alternatives B and C. Impacts would essentially depend on the amount of soft funding received to implement the fishery management plan. Reliance upon soft funding sources would mean that fishery removal actions would be implemented in a piecemeal fashion and subject to the unpredictable availability of funding for the foreseeable future. At a minimum, resource management personnel would routinely have to write funding proposals and secure soft funding. Once funding were secured, resource management personnel would need to take on the additional burden of training personnel, assisting with field work, and providing overall project oversight. Interpretive staff would have to assist with public outreach and education to foster public understanding and awareness of the program. Under this likely scenario, the impacts on park management and operations would be moderate, adverse, and long term because NPS staff would have to shift workload priorities to accommodate additional tasks, and other ongoing resource management actions may not be accomplished.

Cumulative Impacts

As with alternatives B and C, various unanticipated events can greatly influence park operations and the funds required to respond to these events. For example, extensive flooding in 2004, national security issues, or wildfire can cumulatively affect available funds and the way the funds are appropriated. In addition, management priorities may need to be shifted to address pressing issues and to accommodate reduced funding. The cumulative impact of these unanticipated events would be adverse and long term, but the magnitude of adverse impact, however, cannot be determined because the future is uncertain.

Conclusion

Alternative D would have moderate adverse impacts on management and operations over the long term, assuming all funding sources remain fairly constant. Total cost of implementing alternative D would be approximately $3 million over the next 15 years. Average annual costs for fish removal would be similar to alternative C. Although there are no average annual costs associated with fish stocking, the additional costs of protection required to prevent unsanctioned stocking of lakes would increase total implementation costs. Other sources of funding would be sought to reduce impacts on the North Cascades Complex operating budget.

Cumulative adverse impacts on operations could arise from the need to respond to future unanticipated events such as flooding, wildfire or other events. However, the magnitude of adverse impact may range from negligible to major depending on the severity of individual future events, which could reduce the amount of potential funding available to implement the fishery management plan or cause the NPS to shift priorities to respond to more pressing needs.

SUSTAINABILITY AND LONG-TERM MANAGEMENT

In accordance with the *National Environmental Policy Act* (NEPA), and as further explained in NPS *Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making*, consideration of long-term impacts and the effects of foreclosing future options should pervade any NEPA document. According to *Director's Order 12*, and as defined by the World Commission on Environment and Development, "sustainable development is that which meets the needs of the present without compromising the ability of future generations to meet their needs." For each alternative considered in a NEPA document, considerations of sustainability must demonstrate the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. This relationship is described below for each alternative.

The NPS must consider if the effects of the project alternatives involve tradeoffs of the long-term productivity and sustainability of park resources for the immediate short-term use of those resources. It must also consider if the effects of the alternatives are sustainable over the long term without causing adverse environmental effects for future generations (NEPA section 102(c)(iv)).

Alternative A (No Action): Existing Management Framework of 91 Lakes (62 Lakes Have Fish)

Alternative A would trade off the short-term use of park resources for long-term productivity. Fishing opportunities would continue in the short and long term; however, reproducing nonnative fish would remain in some lakes, compromising the long- term productivity of native species. In addition, fish would remain in naturally fishless lakes over the long term.

Alternative B: Proposed Adaptive Management of 91 Lakes under a New Framework (42 Lakes May Have Fish) (Preferred Alternative)

Alternative B would apply adaptive management principles to remove reproducing populations of nonnative fish where feasible. Following removal, some lakes would be restocked with nonreproducing fish. This action would provide some short- and long-term angling opportunities for this and future generations. Compared to alternative A, alternative B would help conserve biological integrity over the long term because it proposes the removal of fish from mountain lakes and either restocking them with nonreproducing fish or allowing select lakes to go fishless. As indicated in the impact analyses, with the application of scientifically based adaptive management principles, the long-term adverse impacts of alternative B on resources in the North Cascades Complex would range from negligible to moderate. There would be no impairment of park resources and values, as defined by *NPS Management Policies* (NPS 2001a). However, in order to be sustainable, continued stocking would require long-term management, including monitoring and adaptive management to conserve biological integrity. These actions would require periodic commitment of funds and personnel for the foreseeable future to ensure protection of park resources.

ALTERNATIVE C: PROPOSED ADAPTIVE MANAGEMENT OF 91 LAKES UNDER A NEW FRAMEWORK (11 NATIONAL RECREATION AREA LAKES MAY HAVE FISH)

Alternative C would also apply adaptive management principles. Alternative C is different from alternatives A and B because it would require removal of fish from all naturally fishless mountain lakes in the national park—these lakes would not be restocked. Except for some lakes where removal may not be feasible, this alternative would deny future generations the ability to fish in mountain lakes in the national park portion of the North Cascades Complex. In the national recreation areas, self-sustaining (reproducing) fish populations would be removed, some select lakes would be restocked, and others would remain fishless. Over the short and long term, these actions would reduce angling opportunities compared to alternatives A and B. As indicated in the impact analyses, with the application of scientifically based adaptive management principles, the long-term adverse impacts of alternative C on resources in the national recreation areas would range from negligible to moderate. There would be no impairment of park resources and values, as defined by *NPS Management Policies* (NPS 2001a). However, in order to be sustainable, continued stocking would require long-term management, including monitoring and adaptive management to conserve biological integrity. These actions would require periodic commitment of funds and personnel for the foreseeable future to ensure protection of park resources.

ALTERNATIVE D: 91 LAKES WOULD BE FISHLESS

Alternative D proposes the removal of all fish populations, where feasible, in all study area lakes in the national park and national recreation areas, and no lakes in the study area would be restocked. Compared to alternative A, this would allow the conservation of biological integrity in the greatest number of lakes over the long term. Fish would be removed using intensive gillnetting in combination with electrofishing, cobbling over of spawning habitat, and application of the piscicide, antimycin. As indicated in the impact analyses, the long-term impacts of fish removal methods would range from negligible to moderate with no impairment of park resources, as defined by *NPS Management Polices* (NPS 2001a). Until fish were removed, these actions would require monitoring, adjustment of management actions, and commitment of funds and personnel over the long term to ensure protection of resources in the North Cascades Complex. There may be a greater potential for illegal stocking under this alternative, which may have short- and long-term impacts on park resources.

No lakes would be stocked or restocked (following fish removal) under alternative D. From a management standpoint, alternative D would be most sustainable because it would eventually eliminate any long-term management actions needed to maintain the mountain lakes fishery compared to alternatives A, B, and C. However, fishing opportunities in mountain lakes for this and future generations would largely be eliminated in the North Cascades Complex, except for a few lakes where complete removal of self-sustaining fish populations may not be feasible. Anglers would have to fish in lakes outside the North Cascade Complex to experience fishing in mountain lakes.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

The NPS must consider if the effects of the alternatives cannot be changed or are permanent (that is, the impacts are irreversible). The NPS must also consider if the impacts on park resources would mean that once gone, the resource could not be replaced; in other words, the resource could not be restored, replaced, or otherwise retrieved (NEPA section 102(c)(v)).

Alternative A (No Action): Existing Management Framework of 91 Lakes (62 Lakes Have Fish)

Alternative A would continue to have long-term impacts on park resources, and some may be permanent. There would be a permanent presence of nonnative fish in naturally fishless mountain lakes. The greatest concern is that reproducing populations of nonnative fish would remain in lakes and, in turn, continue to have permanent, adverse impacts on native biota. Self-sustaining (reproducing) fish populations could completely eliminate some species of native aquatic organisms. Once permanently gone from lakes, some of these aquatic species may not be restored or replaced; therefore, alternative A has the greatest potential to result in irreversible or irretrievable commitments of resources.

Alternative B: Proposed Adaptive Management of 91 Lakes under a New Framework (42 Lakes May Have Fish) (Preferred Alternative)

Compared to alternative A, alternative B would reduce the potential for irreversible or irretrievable commitments of resources by applying a scientifically based adaptive management program to conserve biological integrity while maintaining the mountain lakes fishery. Self-sustaining fish populations would be removed where feasible. Some lakes would be restocked with nonreproducing fish, and others would remain fishless. In lakes where self-sustaining populations would be eliminated, the fish would be irretrievably lost. In an estimated 9 lakes where complete removal of reproducing populations of fish may not be feasible (refer to table 7), there may be irreversible or irretrievable impacts to certain sensitive species of native aquatic organisms. At the landscape scale, however, populations of these organisms may remain viable in other lakes or habitat where fish are not present. Lakes that would remain available for sport fishing would be stocked with nonreproducing fish. If monitoring results indicated that biological integrity could no longer be conserved, impacts could be stopped, and potentially reversed, simply by ending stocking.

Alternative C: Proposed Adaptive Management of 91 Lakes under a New Framework (11 National Recreation Area Lakes May Have Fish)

Compared to alternatives A and B, alternative C would further reduce the potential for irreversible or irretrievable commitments of natural resources. While alternative C would apply adaptive management practices to lakes in the national recreational areas, the lakes in the national park would be returned to a fishless condition by removing all fish populations. Removal of fish populations would be irreversible and irretrievable. Nine lakes in the national park (refer to table 7) may still contain self-sustaining fish populations over the long term because complete removal may not be feasible in those lakes. The irreversible and irretrievable commitments of resources in these lakes would be similar to alternative B with respect to native aquatic organisms. However, compared to alternative B, all study area lakes in the national park portion of the North Cascades Complex would remain or become fishless. Sport-fishing opportunities would be lost as long as the fishery management plan remained viable and the lakes remained fishless.

Alternative D: 91 Lakes Would Be Fishless

Alternative D would present the least potential for irreversible and irretrievable commitments of resources. Nine lakes would still remain in question as to the feasibility of complete removal of fish populations; therefore, the potentially irreversible ecological impacts of fish in these lakes would be the same as alternatives B and C. There would be a permanent, irretrievable loss of fish populations, and loss of these populations in conjunction with ceasing to stock would eliminate sport-fishing opportunities in the mountain lakes as long as the fishery management plan remained viable and the lakes remained fishless.

ADVERSE IMPACTS THAT COULD NOT BE AVOIDED

The NPS is required to consider if the alternative actions would result in impacts that could not be fully mitigated or avoided (NEPA section 101(c)(ii)).

Alternative A (No Action): Existing Management Framework of 91 Lakes (62 Lakes Have Fish)

Alternative A would continue to have adverse impacts that could not be mitigated or avoided. The greatest concern would be those lakes where self-sustaining (reproducing) fish populations remained in naturally fishless lakes in the study area.

Alternative B: Proposed Adaptive Management of 91 Lakes under a New Framework (42 Lakes May Have Fish) (Preferred Alternative)

Alternative B would also be of concern for the estimated nine lakes where complete fish removal may not be feasible (refer to table 7). In addition, the use of fish removal methods (including gillnetting, electrofishing, and piscicides) may have adverse impacts that could not be avoided using available mitigation measures. Although fish removal using the piscicide, antimycin, would be closely monitored and mitigated, there may be short-term adverse impacts on some native aquatic species. The temporary use of mechanized equipment, such as helicopters, and presence of crews would have unavoidable short-term impacts on some park visitors. Even with mitigation (such as alerting visitors that lake management actions involving equipment may take place), some visitors may be adversely affected.

Alternative C: Proposed Adaptive Management of 91 Lakes under a New Framework (11 National Recreation Area Lakes May Have Fish)

Alternative C would have unavoidable adverse impacts similar to those described for alternative B. Nine lakes may still have reproducing populations of fish because complete fish removal may not be feasible. Equipment and activities would disrupt some visitors, and fish removal methods may have unavoidable short-term adverse impacts on some native biota.

Alternative D:
91 Lakes Would Be Fishless

Alternative D would have unavoidable adverse impacts similar to those described for alternatives B and C. Nine lakes may still have reproducing fish populations because complete fish removal may not be feasible. Equipment and activities would disrupt some visitors, and fish removal methods may have unavoidable short-term adverse impacts some native biota. For those who believe that fishing in the mountain lakes in North Cascades Complex provides an experience that cannot be duplicated elsewhere, elimination of the mountain lakes fishery would have an unavoidable impact on their recreation experience.