UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
BIN C15700
Seattle, WA 98115-0070

July 11, 2002

Greg Yuncevich
Bureau of Land Management
Cottonwood Field Office
Route 3, Box 181
Cottonwood, Idaho 83522

RE: Endangered Species Act Section 7 Consultation: Biological Assessment of 2002 Noxious Weed Control Program [BLM # 6522.4,6840 (087)] (One project)

Dear Mr. Yuncevich:

Enclosed is the biological opinion prepared by the National Marine Fisheries Service (NOAA Fisheries) on the Bureau of Land Management Cottonwood Field Office's 2002 Noxious Weed Control Program. The enclosed document represents NOAA Fisheries' biological opinion on the effects of the proposed action on listed species and designated critical habitat in accordance with Section 7 of the Endangered Species Act of 1973 as amended (16 USC 1531 *et seq*.).

In this biological opinion, NOAA Fisheries has determined that the proposed action is not likely to jeopardize the continued existence of Snake River spring/summer and fall chinook salmon or Snake River steelhead. A complete administrative record of this consultation is on file with NOAA Fisheries' Habitat Division in Boise, Idaho. The duration of this biological opinion is through December 31, 2002, when the authorization of this proposal expires.

In addition to the biological opinion, enclosed as section 6, is a consultation regarding Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267). NOAA Fisheries finds that the proposed action will not adversely affect EFH for Snake River chinook salmon.

Comments or questions regarding this biological opinion and MSA consultation can be directed to Bob Ries at (208) 882-6148 or Dale Brege at (208) 983-3859.

Sincerely,

For Michael R Crouse

D. Robert Lohn
Regional Administrator

Enclosure

cc: B. Ruesink - FWS
J. Hanson - IDFG
I. Jones -NPT

Endangered Species Act
Section 7 Consultation Biological Opinion
and
Magnuson-Stevens Act
Essential Fish Habitat Consultation

2002 Bureau of Land Management Noxious Weed Control Program in the Snake, Salmon and Clearwater River Drainages

Idaho, Clearwater, Lewis, and Nez Perce Counties, Idaho

Agency: Bureau of Land Management, Cottonwood Resource Area

Consultation Conducted By: National Marine Fisheries Service, Northwest Region

Date Issued: 07/11/2002

Issued by: for Michael R Crouse
D. Robert Lohn
Regional Administrator

Refer to: F/NWR/20002/00385

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I. BACKGROUND

The Bureau of Land Management (BLM), Cottonwood Field Office (CFO) proposes to eradicate noxious weeds (exotic plants that quickly spread and displace native species) across the Cottonwood Resource Area, through physical removal, regulatory restrictions, and biological and chemical controls. The goals of the proposed noxious weed treatments are to stop or slow the spread of noxious weeds, and to eradicate established infestations.

The CFO submitted a draft biological assessment (BA) in November 2001. The National Marine Fisheries Service (NOAA Fisheries) reviewed the draft BA, and provided recommendations for revisions. Prior to consultation, a conditional effect determination was made by the Level 1 team (Team) comprised of BLM, U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (FWS) and NOAA Fisheries personnel. The Team determined that the proposed noxious weed control program was likely to adversely affect Snake River spring/summer and fall chinook salmon (*Onchorynchus tshawytscha*), and Snake River steelhead (*O. mykiss*). The Team determined that the proposed action would not likely to adversely affect Essential Fish Habitat (EFH) for chinook and coho salmon. The CFO requested formal consultation with NOAA Fisheries on the effects of the weed program on listed salmon and steelhead, through a letter and BA, dated May 16, 2002, and received by NOAA Fisheries on May 20, 2002.

This biological opinion (Opinion) considers the potential effects of the proposed action on Snake River spring/summer and fall chinook salmon, and Snake River steelhead, which occur in the proposed project area. Snake River chinook salmon were listed as threatened under the Endangered Species Act (ESA) on April 22, 1992 (57 FR 14653), critical habitat was designated on December 28, 1993 (58 FR 68543) and further refined October 25, 1999 (64 FR 57399). Snake River steelhead were listed as threatened August 18, 1997 (62 FR 43937). The objective of this Opinion, under the ESA, is to determine whether the proposed action is likely to jeopardize the continued existence of Snake River spring/summer and fall chinook salmon or steelhead, or destroy or adversely modify designated critical habitat. The objective of this Opinion, under the Magnuson-Stevens Act (MSA) is to determine if the proposed action will adversely affect EFH. This consultation is conducted pursuant to section 7(a)(2) of the ESA and its implementing regulations (50 CFR 402) and the MSA section 305(b) and its implementing regulations (50 CFR 600).

II. PROPOSED ACTION

Proposed actions are defined by NMFS regulations (50 CFR 402.02) as "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas." Because the CFO will carry out the proposed action, a Federal nexus exists for interagency consultation under the ESA section 7(a)(2). The weed treatments would occur on BLM lands in the Cottonwood Resource Area, which include tributaries to the Lower Snake River Hydrologic Unit Code (HUC) 17060703, Lower Salmon River (17060209), Clearwater River (17060306), and the South Fork Clearwater River (17060305). The duration of the action is the 2002 field season, which begins on the signature date of this Opinion, and ends no later than January 31, 2002.

The CFO proposes to use a variety of weed control techniques, depending on the weed species, weed distribution, and other local factors. Weeds would be killed primarily by treatment with herbicides, and to a lesser extent, by physical removal, and biological control agents (insects or pathogens). Certain regulatory restrictions would also be used to prevent or reduce the spread of weeds by people using BLM lands. The proposed action, described fully in the May 16, 2002, BA, includes numerous techniques and constraints to prevent or minimize alteration of desirable riparian vegetation, and to help keep harmful chemicals out of the water. Precautionary measures for herbicide use includes no-spray buffers, limitations on application methods and application rates, timing of application to avoid sensitive life stages of listed fish, and specification of certain chemical formulations that have relatively lower risk than similar chemicals used for the same purpose. These precautionary measures in the May 16, 2002, BA are intended to reduce the risk of harmful effects to listed fish and other non-target species.

Proposed weed treatments include physical removal of weeds (2 to 5 acres), restrictions on use of BLM lands (vehicle closures, weed-free hay, etc.), release of insects or pathogens for biological control at five sites, application of herbicides, and restoration of treated sites following weed removal. The majority of lands would be treated with herbicides. Approximately 1,562 acres are proposed for aerial treatment, and 873 acres for ground-based treatment. Included in the
2002 noxious weed control program are 625 acres which were identified for the Maloney Creek Fire Rehabilitation Project. All noxious weed control measures would be conducted in accordance with identified standards and project specific requirements in Appendix D of the BA. Weed control activities may occasionally be used in conjunction with prescribed fire, however, prescribed fire is not part of the proposed action.

The BLM would determine the specific treatment (method, application rate, and timing of application) for each given location based on site-specific considerations such as: (1) Physical growth characteristics of target weeds (rhizomatous vs. tap-rooted, etc.); (2) seed longevity and germination; (3) infestation size; (4) relationship of the site to other infestations; (5) relationship of the site to listed and/or proposed species; (6) distance to surface water; (7) equipment access to site; (8) type and amount of human use of the area; (9) effectiveness of treatment on the target weed; and (10) cost. Depending on these various factors, one or more treatment methods may be used.

A. Mechanical Control

Mechanical weed control includes the use of hand-operated power tools and simple hand tools to cut, clear, mow, or prune herbaceous and woody species. In manual treatments, workers cut plants above ground level; pull, grub, or dig out plant root systems to prevent subsequent sprouting and regrowth; scalp at ground level or remove competing plants around desired vegetation; or place mulch around desired vegetation to limit the growth of competing vegetation. Mechanical control activities for noxious weeds include the use of wheeled tractors, crawler-type tractors, or specially designed vehicles with attached implements for mechanical vegetation treatments (e.g. plows, harrow, rangeland drill). Mechanical control activities typically would occur on old agricultural areas or livestock feeding sites with moderate slopes (less than 20%). All mechanical control activities would include associated rehabilitation measures which include seeding and planting of desirable species.

B. Biological Weed Control

Biological control treatments would include the use of insects, pathogens, or some combination of the two. Biological weed control activities include the release of insect agents which are parasitic and "host specific" to target noxious weeds. This activity includes the collection of beetles/insects, and supplemental stocking of populations. The use of biological control agents follow BLM procedures in the *Use of Biological Control Agents of Pests on Public Lands* (USDI 1990). Insect and pathogen methods generally are applied in conjunction with other control methods (i.e. herbicides).

C. Regulatory Control

Regulatory control methods would involve restrictions on the use of BLM lands and required practices to prevent or minimize the spread of weeds by people who use BLM lands. Regulatory control measures include requirements to:

- Clean all ground surface disturbing equipment moving into or out of weed infested areas before and after use.
- Use only certified, noxious weed-free grains, hay, or pellets for feeding domestic animals and wildlife; inspect all feeding sites during and following use.
- Use only certified noxious weed-free seed, along with hay, straw, or mulch, or other vegetation material for site stability and revegetation projects.
- Use only noxious weed-free gravel and fill material from inspected sites.
- Revegetate disturbed areas as soon as practical; use temporary fencing when necessary to assure new seedling establishment.
- Evaluate current and proposed vegetation management practices (i.e. livestock grazing, prescribed burning, and seeding), and implement practices to restore desired plant communities
- Close areas to vehicle access if vehicles are the primary cause of introduction and/or spread.

D. Herbicide Use

The 2002 weed control program proposes the use of picloram; 2,4-D; glyphosate; clopyralid; and sulfometuron methyl, with water as the carrier. The herbicides may be applied in spot applications with a mixture that includes one or more of the following surfactants: (1) M-90; (2) Crop Oil - M; or (3) Preference, mixed at a rate of 2 quarts surfactant per 100 gallons of water. Use of surfactants will be in accordance with herbicide label instructions. No more than 1 quart of surfactant per 100 gallons will be authorized when using broadcast application. The BA provides an in depth summary of the proposed herbicide treatments that will occur in each subbasin and 6th code HUC. Table 1 summarizes the proposed herbicide treatment acres by subbasin.

Table 1. Subbasin summary of 2002 proposed herbicide treatments.

Herbicide Name	Active Ingredient (AI)	Application Rate (1bs. AI/Acre)	Lower Snake (acres)	Lower Salmon (acres)	Little Salmon (acres)	Clear-water (acres)[2]	S. Fork Clear-water (acres)
Tordon/2,4-D	Picloram/2,4-D	0.25 & 1.0	435	905	195	40	58
Rodeo	Glyphosate	1.5	51	19	2	2	3
Transline	Clopyralid	0.3	51	94	13	8	15
Oust [1]	Sulfometuron Methyl	0.0625 (1 oz.)	150	200	0	0	0
Total acres treated:			687	1218	210	50	76
Subbasin acreage:			455,040	793,600	372,500	1,497,000	752,000
Percentage of subbasin treated:			0.15%	0.15%	0.06%	0.003%	0.01%

[1] Use of Oust herbicide on all public lands in Idaho is suspended under BLM, Idaho State Office, Instruction Memorandum No. ID-2002-003). [2] Acreage exclusive of the North Fork and Middle Fork Clearwater Rivers.

1. Ground-based Herbicide Application

Proposed ground-based herbicide treatments include use of booms or individual spray nozzles mounted on trucks or all terrain vehicles, hand-pump spraying, hand-spreading granular formulations, wicking, wiping, dripping, painting, or injecting target weeds. Ground-based application methods are typically used to treat small or sensitive areas, such as road right-of-ways, recreation sites, and riparian areas.

2. Aerial Application

Aerial application (helicopter) is commonly used to treat larger infested areas, which occur in remote rugged terrain commonly found in canyon grasslands. Helicopter application will use paper markers to indicate spray strips and areas sprayed. Sensitive areas to be avoided (i.e. buffers) will be marked with bright-colored ribbon on the ground.

3. Best Management Practices for Herbicide Treatments

The proposed Best Management Practices (BMPs) are described fully in Appendix D of the BA. The BMP's include several which are specific to the use of herbicides in watersheds with listed salmonids and designated critical habitat.

a. Stream and Riparian Buffers

1. No aerial application within 100 feet of any surface waters or identified groundwater recharge areas.

2. Broadcast application using boom sprayers would not occur within 25 feet of water.

3. Spot spraying from backpacks or vehicle-mounted handguns would not occur within 10 feet of water.

4. Ground application within 10 feet of any waters would only be done by hand wicking, wiping, dripping, painting, or injecting.

5. Buffers (Table 2) will be based on the delineated 'greenline' boundary for all waters (perennial, intermittent, ephemeral, lakes, reservoirs, ponds, springs, seeps, bogs, wetlands). The greenline is defined as that specific area where a more or less continuous cover of vegetation is encountered when moving away from the center of an observable channel.

Table 2. Buffers, maximum wind speed, application methods, and herbicide restriction associated with aquatic habitats, riparian areas, and wetland resources.

Buffer	**Max. Wind Speed** mile per hour (mph)	**Herbicide Application Method**	**Herbicides Authorized (Aquatic Level of Concern)**
>300 feet from outer edge or riparian area for fish bearing waters	5 mph	aerial	low, moderate, and high
>200 feet from outer edge or riparian areas for fish bearing waters	5 mph	aerial	low and moderate
>150 feet from outer edge of riparian areas for non-fish bearing waters	5 mph	aerial	low, moderate, and high
0 - 100 feet from live waters or shallow water tables	n/a	no applications of picloram will be authorized	n/a
>100 feet from outer edge of riparian areas for non-fish bearing waters	5 mph	aerial	low and moderate
>100 feet and areas outside riparian areas	8 mph	all ground/broadcast spraying	low, moderate, and high
>50 feet and areas outside riparian areas	15 mph	wicking, dipping, painting, and injecting	low, moderate, and high
15-100 feet from live water or shallow water tables; or within riparian areas	8 mph	ground/spot spraying (no broadcast boom spraying), wicking, wiping, dipping, painting, injecting selective spraying of target species only (e.g., spot treatment of individual plants)	low and moderate
<15 feet from live water or shallow water tables	5 mph	backpack sprayer, hand-pump sprayer, wicking, wiping, dipping, painting, and injecting selective spraying/treatment of target species only (e.g., spot treatment of individual plants)	aquatic approved herbicides only no surfactants authorized

b. Wind Speed Restrictions and Weather Considerations

1. Aerial (helicopter) application would only occur when winds do not exceed 5 mph.

2. Winds may not exceed 8 mph for any application method except wicking, wiping, dripping, painting, or injecting.

3. Treatment would be delayed if precipitation is forecasted to occur within 24 hours of scheduled application.

4. During application, weather conditions would be monitored hourly by trained personnel at spray sites. Additional weather monitoring would occur whenever a weather change may impact safe placement of the herbicide on the target area.

c. Equipment Handling

1. Herbicides would be mixed and loaded in areas where accidental spills cannot flow into water or contaminate groundwater.

2. Regular testing on field calibration and calculation would take place to prevent gross application errors.

3. Spray tanks would not be washed or rinsed in or near water. All chemical containers would be disposed of at sites where the containers will not cause contamination of salmon or steelhead habitat.

d. Additional Safeguards

1. Only aquatic-approved herbicides would be used adjacent to any water, or if soils are wet, regardless of location.

2. No more than one application of picloram would be made on a given site in any given year to reduce the potential for picloram accumulation in the soil.

3. Due to the remote nature of treatment areas, sufficient clean water would be available on sprayer mixing and project sites for applicators to wash off any chemical inadvertently splashed onto skin.

4. If an application is made in an area frequented by people (i.e. hiking, camping, working), the area would be posted to prevent any post treatment contamination.

e. Additional measures specific to watersheds with listed/proposed fish species and critical habitat

1. Any use of the Rodeo formulation of glyphosate will be without an adjuvant unless the adjuvant is specifically approved for aquatic use by Environmental Protection Agency (EPA) on the label.[1]

2. No ester formulations of 2,4-D will be used.

3. No carrier other than water will be used.

4. Broadcast spraying within 25 feet of water will cease if wind speeds exceed 5 mph.

5. Wicking, wiping, dripping, painting, or injecting will not occur near water if winds exceed 15 mph.

6. All aerial applications would be on the contour, parallel to stream drainages. No turns are allowed over live water even though booms are turned off at the end of each run.

7. All aerial applications that include an adjuvant will comply with the highest required buffer, depending on the Quotient Value (QV), or level of concern determined for the herbicide or adjuvant.

III. ENDANGERED SPECIES ACT

A. Status of the Species and Critical Habitat

1. Snake River Fall Chinook

The Snake River fall chinook salmon Evolutionarily Significant Unit (ESU), listed as threatened on April 22, 1992, (67 FR 14653), includes all natural populations of fall chinook salmon in the mainstem Snake River below Hell's Canyon Dam, and the Tucannon, Grande Ronde, Imnaha, Salmon, and Clearwater Rivers. Fall chinook from the Lyons Ferry Hatchery are included in the ESU but are not listed. Critical habitat was designated for Snake River fall chinook salmon on December 28, 1993 (58 FR 68543).

Counts of returning wild fall chinook salmon at Lower Granite Dam from 1975 through 1980 averaged 600 fish per year (Waples et al. 1991). From 1985 to 1999 an average of 459 naturally produced fall chinook salmon reached Lower Granite Dam (USDI 2000). In recent years, two fall chinook satellite hatchery facilities have been operated on the Snake River to increase the

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[1] NMFS has not carried out an ESA Section 7(a)(2) analysis of the use of pesticides in water, consequently, NMFS is not relying on EPA approval in the analysis of jeopardy/adverse modification in this opinion.

numbers of fall chinook salmon. The facilities are used to acclimate dnd release one-year smolts from Lyons Ferry hatchery. Detailed information on the current range-wide status of Snake River chinook salmon under the environmental baseline, is described in the chinook salmon status review (Myers et al. 1998)

2. Snake River Spring/Summer Chinook

The Snake River spring/summer chinook salmon ESU, listed as threatened on April 22, 1992 (67 FR 14653), includes all natural-origin populations in the Tucannon, Grande Ronde, Imnaha, and Salmon Rivers. Some or all of the fish returning to several hatchery programs are also listed, including those returning to the Tucannon River, Imnaha, and Grande Ronde hatcheries, and to the Sawtooth, Pahsimeroi, and McCall hatcheries on the Salmon River. Critical habitat was designated for Snake River spring/summer chinook salmon on December 28, 1993 (58 FR 68543) and was revised on October 25, 1999 (64 FR 57399).

Spring/summer chinook salmon in the Clearwater River drainage are not included in the listed ESU because the stock is largely non-indigenous (Matthews and Waples 1991). Indigenous spring/summer chinook salmon in the Clearwater River drainage were eliminated by the Lewiston Dam (Schoen et al. 1999; Murphy and Metsker 1962). Lewiston Dam was completely removed in 1973. Re-introduction of spring/summer chinook salmon following the removal of the Lewiston Dam has resulted in naturally reproducing runs in Lolo Creek, and mainstem and tributaries of the Lochsa, Selway, and South Fork Clearwater Rivers (Larson and Mobrand 1992).

Historically, the Snake River drainage is thought to have produced more than 1.5 million adult spring/summer chinook salmon in some years during the late 1800s (Matthews and Waples 1991). By the 1950s the abundance of spring/summer chinook had declined to an annual average of 125,000 adults. Adult returns counted at Lower Granite Dam reached all-time lows in the
mid-1990s (<8,000 adult returns), and numbers have begun to increase since 1997. Habitat problems are common in the range of this ESU. Spawning and rearing habitats are likely impaired by factors such as tilling, water withdrawals, timber harvest, grazing, mining, and alteration of floodplains and riparian vegetation. Mainstem Columbia River and Snake River hydroelectric developments have altered flow regimes and estuarine habitat, and disrupted migration corridors. Competition between natural indigenous stocks of spring/summer chinook salmon and spring/summer chinook of hatchery origin has likely increased due to an increasing proportion of naturally-reproducing fish of hatchery origin.

Compared to the greatly reduced numbers of returning adults for the last several decades, exceptionally large numbers of adults returned to the Snake River drainage in 2000 and in 2001. These large returns are thought to be a result of favorable ocean conditions, and above average flows in the Columbia River Basin when the smolts migrated downstream. However, the large returns are only a fraction of the returns of the late 1800s. Recent increases in the population due to favorable climate conditions are not expected to occur in most years, and the long-term trend for this species indicates a continuing population decline. Detailed information on the current range-wide status of Snake River chinook salmon under the environmental baseline, is described in chinook salmon status review (Myers et al. 1998), and the draft Clearwater Subbasin Summary (CBFWA 2001).

3. Snake River Steelhead

The Snake River steelhead ESU, listed as threatened on August 18, 1997 (62 FR 43937), includes all natural-origin populations of steelhead in the Snake River basin of Southeast Washington, northeast Oregon, and Idaho. None of the hatchery stocks in the Snake River basin are listed, but several are included in the ESU.

Natural runs of Snake River steelhead have been declining in abundance over the past decades. Some of the significant factors in the declining populations are mortality associated with the many dams along the Columbia and Snake Rivers, losses from harvest, loss of access to more than 50% of their historic range, and degradation of habitat used for spawning and rearing. Possible genetic introgression from hatchery stocks is another threat to Snake River steelhead since wild fish comprise such a small proportion of the population. Additional information on the biology, status, and habitat elements for Snake River steelhead are described in Busby et al. (1996).

The 2000 and 2001 counts at Lower Granite Dam indicate a short-term increase in returning adult spawners. Adult returns (hatchery and wild) in 2001 were the highest in 25 years and 2000 counts were the sixth highest on record (Fish Passage Center 2001a). Increased levels of adult returns are likely a result of favorable ocean and instream flow conditions for these cohorts. Although steelhead numbers have dramatically increased, wild steelhead comprise only 10% to 20% of the total returns since 1994. Consequently, the large increase in fish numbers does not reflect a change in steelhead status based on historic levels. Recent increases in the population are not expected to continue, and the long-term trend for this species indicates a decline.

Survival of downstream migrants in 2001 was the lowest since 1993. Low survival was due to record low water run-off, and elimination of spills from the Snake River dams to meet hydropower demands (Fish Passage Center 2001b). Average downstream travel times for steelhead nearly doubled and were among the highest observed since recording began in 1996. Consequently, wide fluctuations in population numbers are expected over the next few years when adults from recent cohorts return to spawning areas. Detailed information on the current range-wide status of Snake River steelhead, under the environmental baseline, is described in the steelhead status review (Busby et al. 1996), status review update (BRT 1997), and the draft Clearwater Subbasin Summary (CBFWA 2001).

B. Evaluating Proposed Actions

The standards for determining jeopardy are set forth in section 7(a)(2) of the ESA as defined by 50 CFR Part 402 (the consultation regulations). NOAA Fisheries discusses the analysis necessary for application of these particular contexts of the listed species in NMFS (1999). The jeopardy analysis involves the following steps: (1) Define the biological requirements and current status of the listed species; (2) evaluate the relevance of the environmental baseline to the species'current status; (3) determine if the effects of the proposed or continuing action on listed species; and (4) determine whether the species can be expected to survive with an adequate potential for recovery under the effects of the proposed or continuing action, the environmental baseline and any cumulative effects, and considering measures for survival and recovery specific to other life stages. If NOAA Fisheries finds the action is likely to jeopardize the continued existence of the listed species, NOAA Fisheries must identify reasonable and prudent alternatives for the proposed action.

Furthermore, NOAA Fisheries evaluates whether the action, directly or indirectly, is likely to destroy or adversely modify the listed species' designated critical habitat. NOAA Fisheries must determine whether habitat modifications appreciably diminish the value of critical habitat for both survival and recovery of the listed species. NOAA Fisheries identifies those effects of the action that impair the function of any essential element of critical habitat. NOAA Fisheries then considers whether such impairment appreciably diminishes the habitat's value for the species' survival and recovery. If NOAA Fisheries concludes that the action will destroy or adversely modify critical habitat it must identify any reasonable and prudent alternatives available.

For the proposed action, NOAA Fisheries' jeopardy analysis considers direct or indirect mortality of fish attributable to the action. NOAA Fisheries' critical habitat analysis considers the extent to which the proposed action impairs the function of essential habitat, which includes those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat: "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.110). When analyzing herbicide applications, NOAA Fisheries establishes risks to listed species by considering the toxicity of herbicides proposed for use, and examining the likelihood of exposure of listed species to those herbicides. NOAA Fisheries' EFH analysis considers the effects of proposed actions on essential elements necessary for juvenile and adult migration, spawning, and rearing of chinook and coho salmon, including cumulative effects and the magnitude of such effects.

1. Biological Requirements

The first step in the method NOAA Fisheries uses for applying the ESA standards of section 7(a)(2) to listed salmon and steelhead is to define the species' biological requirements that are most relevant to the particular consultation. The biological requirements are defined in this Opinion as the habitat characteristics necessary to support successful adult and juvenile migration, spawning, and rearing. Those necessary habitat characteristics include an appropriate range of channel substrate sizes, and adequate water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions (Busby et al. 1996; Spence et al. 1996; 62 FR 43937, August 18, 1997; 65 FR 7764, February 16, 2000). Spawning and egg incubation require clean gravels and an ample supply of cool, well-oxygenated water. Juvenile rearing requires a complex physical environment with ample pools, shade, cover, and food production. Successful juvenile and adult migration require ample stream flow and velocity, in-channel cover, low water temperatures, and unobstructed passage.

a. Snake River Fall Chinook

The spawning grounds in the Snake River above Hell's Canyon, between Huntington, Oregon (River Mile [RM] 328) and Auger Falls (RM 607) were historically the most important for this species. Only limited spawning activity was reported downstream from RM 273 (Waples et al. 1991), about 1 mile upstream of Oxbow Dam. Since then, irrigation and hydrosystem projects on the mainstem Snake River have blocked access to or inundated much of this habitat, causing the fish to seek less-preferable spawning grounds wherever available. Natural fall chinook salmon spawning now occurs primarily in the Snake River below Hells Canyon Dam and the lower reaches of the Clearwater, Grand Ronde, Salmon, and Tucannon Rivers.

Adult Snake River fall chinook salmon enter the Columbia River in July and migrate into the Snake River from August through October. Fall chinook salmon generally spawn from October through November and fry emerge from March through April. Downstream migration generally begins within several weeks of emergence (Allen and Meekin 1973), and juveniles rear in backwaters and shallow water areas through mid-summer prior to smolting and migrating to the ocean. Once in the ocean, they spend 1 to 4 years, though usually three, before beginning their spawning migration. Fall returns in the Snake River system are typically dominated by 4 year old fish.

b. Snake River Spring/Summer Chinook

Habitat requirements of spring/summer chinook salmon vary by season and life stage, and they occupy a diverse range of habitats. Distribution and abundance of spring/summer chinook salmon may be influenced by cover type and abundance, water temperature, substrate size and quality, channel morphology, and stream size. The present range of spawning and rearing habitat for the naturally spawned Snake River spring/summer chinook salmon ESU is primarily limited to the Salmon, Grande Ronde, Imnaha, and Tucannon drainages. In addition to these major drainages, Asotin, Granite, and Sheep Creeks provide minor amounts of spawning and rearing habitat (CBFWA 1990).

Life histories of spring/summer chinook salmon are highly variable, both among and within populations, enabling salmon to adapt to a wide range of physical circumstances (Thorpe 1994). Most adult Snake River spring/summer chinook salmon return to natal streams from May through September. Spawning generally occurs in mid-August through the end of September. In Idaho, most spawning areas for spring/summer chinook salmon are found in streams at elevations of roughly 3,000 to 6,500 feet. Cover is essential for adult chinook salmon prior to spawning, especially for early migrants which remain in tributaries for several months prior to spawning. Temperature may influence the suitability of spawning habitat. The primary evolutionary factor determining the time of spawning may be the number of temperature units required for successful incubation. Survival and emergence success of Snake River chinook salmon embryos can be limited by fine sediment and low flows (Chapman 1988). Other potential factors that affect egg-to-fry survival include redd disturbance, bottom scour, microbial infection, and water quality (Beaucham et al. 1983; Healey 1991).

Juvenile spring/summer chinook salmon emerge from spawning gravels from February through June (Peery and Bjornn 1991). After emergence, fry concentrate in shallow, slow water near stream margins with cover (Hillman et al. 1987). As fry grow, they occupy deeper pools with submerged cover during the day and shallower inshore habitat at night. Elevated levels of sediment, from roads and other land disturbances, affects growth and survival of juvenile chinook salmon in many parts of the Snake River drainage. Fine sediment deposition can reduce habitat capacity by filling small spaces between rocks, and when suspended, it may result in damaged gills, reduced feeding, avoidance of sedimented areas, reduced reactive distance, suppressed production, and increased mortality (Reiser and Bjornn 1979). Key habitat factors for juvenile rearing include streamflow, pool morphology, cover, and water temperature (Steward and Bjornn 1990). Chinook salmon parr tend to select specific rearing habitats that segregate them, both temporally and spatially, from other native salmonids (Everest and Chapman 1972). They also tend to be most abundant in low gradient, meandering stream channels. Juvenile salmon often occupy different habitats in winter than in summer with two overwintering strategies, which include migration and concealment cover beneath cobble or rubble substrate or beneath undercut banks (Hillman et al. 1987).

Typically, after rearing in their nursery streams for about one year, smolts begin migrating seaward in April and May (Bugert et al. 1990, Cannamela 1992). After reaching the mouth of the Columbia River, spring/summer chinook salmon probably inhabit nearshore areas before beginning their northeast Pacific Ocean migration, which lasts 2 to 3 years. Because of their timing and ocean distribution, these stocks are subject to very little ocean harvest. For detailed information on the life history and stock status of Snake River spring/summer chinook salmon, see Matthews and Waples (1991), NMFS (1991), and 56 FR 29542 (June 27, 1991).

c. Snake River Steelhead

Steelhead can be divided into two basic run-types based on the state of sexual maturity at the time of river entry and the duration of the spawning migration (Burgner et al. 1992). The stream-maturing type, or summer steelhead, enters fresh water in a sexually immature condition and requires several months in freshwater to mature and spawn. The ocean-maturing type, or winter steelhead, enters fresh water with well-developed gonads and spawns shortly after river entry (Barnhart 1986). Variations in migration timing exist between populations. Some river basins have both summer and winter steelhead, while others only have one run-type.

In the Pacific Northwest, summer steelhead enter fresh water between May and October (Busby et al. 1996; Nickelson et al. 1992). During summer and fall, prior to spawning, they hold in cool, deep pools (Nickelson et al. 1992). Snake River steelhead migrate inland toward spawning areas from June thru October. They overwinter in the larger rivers, and resume migration in early spring to natal streams, where they spawn (Meehan and Bjornn 1991; Nickelson et al. 1992). Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity. Intermittent streams may also be used for spawning (Barnhart 1986; Everest 1973). Steelhead enter streams and arrive at spawning grounds weeks or even months before they spawn and are vulnerable to disturbance and predation prior while they are staged at spawning areas. Cover, in the form of overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, floating debris, deep water, turbulence, and turbidity (Giger 1973) are required to reduce disturbance and predation of spawning steelhead. Steelhead are iteroparous, or capable of spawning more than once before death. However, few Snake River steelhead spawn more than once due to stress from the long migration distance, and relatively poor physical condition of the fish after spawning.

Depending on water temperature, steelhead eggs may incubate for 1.5 to 4 months before hatching. Summer rearing takes place primarily in the faster parts of pools, although young-of-the-year are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small wood. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Nickelson et al. 1992).

Juveniles rear in fresh water for 1 to 4 years, then migrate to the ocean as smolts. Snake River steelhead generally rear in smaller streams for 2 years, but can range from 1 to 4 years and occasionally up to 7 years with some becoming resident (Busby et al.1996). Steelhead typically reside in marine waters for 2 or 3 years prior to returning to their natal stream to spawn at 4 or 5 years of age. Age structure appears to be similar to other west coast steelhead, dominated by 4-year-old spawners (Busby et al. 1996).

2. Environmental Baseline

The environmental baseline is an analysis of the effects of past and on-going human and natural factors leading to the current status of the species, or its habitat and ecosystem within the action area. More specifically, the environmental baseline is defined to include "the past and present impacts of all Federal, state or private actions and other human activities in the action area, including the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation and the impacts of state and private actions are contemporaneous with the consultation in progress" (50 CFR 402.02).

The action area is defined as all areas (bankline, adjacent riparian zone, and aquatic area) to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area considered in this Opinion consists of all rivers and streams on BLM lands in the following subbasins (4^{th} code HUCs): Lower Snake River (17060703), Lower Salmon River (17060209), Little Salmon River (17060210), Clearwater River (17060306), and South Fork Clearwater River (170603050); and rivers and stream downstream from BLM lands that potentially receive herbicide inputs through direct contamination, runoff, or percolation. The BLM administered lands in the action area are located in widely scattered small to moderate sized parcels intermingled with private, state, and other Federal lands.

a. Lower Snake River Subbasin

The Lower Snake River subbasin includes the Snake River drainage from the confluence with the Clearwater River (RM 139.3) upriver to the confluence with the Salmon River (RM 188.2). The subbasin includes a total of 455,040 acres and BLM lands comprise approximately four percent of the area. Private lands comprise the majority of the subbasin, followed by USFS, Idaho Department of Fish and Game (IDFG), BLM, Idaho Department of Lands (IDL), Nez Perce Tribe, and The Nature Conservancy (TNC).

Elevations within the subbasin range from 700 feet at the mouth of the Clearwater River to more than 5,000 feet. The Snake River flows through a canyon that is 2,000 to 5,000 feet deep. Uplands may include steep and rugged mountains or plateaus with rolling and moderate slopes. Lower elevation areas are dominated with canyon grassland habitats, while breaklands may have patterned grassland and timbered sites. The moderately sloped plateau areas are cultivated farmlands, pasturelands, or forested areas. Higher elevation areas are forested. Soils in the subbasin are derived principally from basalt and are typically loam to clayey loam in texture.

Vegetation types are diverse due to the large amount of relief and its effects on precipitation and climate. Vegetative communities are influenced by livestock grazing, agriculture, timber harvest, fires, and development. The canyon grasslands are primarily a broad extension of the Pacific bunchgrass formation, dominated by bluebunch wheatgrass and Idaho fescue. Sand dropseed and red three-awn have become disclimax species on some river benches, bars, and toeslope areas. Yellow starthistle and annual grasses (*e.g.* cheatgrass) are common invaders of canyon grasslands within the subbasin. Elevations above 3,000 feet often have patterned grassland and timbered sites, with bluebunch wheatgrass/Idaho fescue on south and west aspects and Douglas fir sites on north and east aspects. Dry south-facing slopes may have grasslands with scattered overstory conifers and shrubs. Basalt outcrops may be common on these sites. Draw bottoms and north and east facing slopes have mixed conifers and shrubs. Localized, steep rocky areas exist with low vegetation production. The mixed conifer overstory includes Douglas-fir, grand-fir, larch, and ponderosa pine. A dominant vegetation cover that occurs in plateau areas or prairies is dry cropland which includes lesser amounts of pasture and hay lands. Commonly grown crops include winter wheat, spring barley, dry peas, and hay. Above 5,000 feet Douglas-fir and grand fir habitat types are common. The timber is interspersed with patches of perennial grassland, shrubs, and riparian vegetation. Other areas are heavily forested.

The mainstem Snake River is used as an upstream and downstream passage corridor by sockeye salmon, fall chinook salmon, spring/summer chinook salmon, steelhead, bull trout, and westslope cutthroat trout. Fall chinook salmon will use the mainstem Snake River for spawning and rearing. Spring/summer chinook salmon and steelhead will use the mainstem river to a limited extent for rearing. Steelhead will use most accessible tributaries for spawning and rearing. Within the subbasin, spring/summer chinook salmon are currently only using Asotin Creek for spawning and rearing. Spring/summer chinook salmon will also use the mouth area or lower reaches of accessible tributaries for juvenile rearing.

Private land uses include roads, livestock grazing, timber harvest, recreation, agriculture, urban development, and residences. The cities of Lewiston and Clarkston occur near the confluence of the Snake River and Clearwater River. The Hells Canyon National Recreation area occurs upstream of Cache Creek (RM 177.1). Land uses on BLM lands in the basin include timber harvest, roads, and recreation. The BLM currently has no authorized grazing use in the subbasin. Noxious weed control, recreation, prescribed burning, and wildlife/fisheries management activities are common activities occurring on BLM lands in the subbasin. The BLM coordinates various activities within the subbasin with the IDFG, IDL, USFS, and TNC. River-based recreation is a very popular recreational activity for the Snake River and a control period for river based recreation occurs during the summer months.

b. Lower Salmon River Subbasin

The Lower Salmon River Subbasin includes the Salmon River from its mouth to French Creek (RM 104.8). This reach of the Salmon River is characterized by a steep rocky canyon where the channel alternates between large pools and boulder dominated rapids with a gradient of approximately 0.23%. Mean annual discharge for the Salmon River is estimated at 11,210 cubic feet per second (cfs) at the U.S. Geological Survey (USGS) White Bird gage station (RM 53.7; 0.1 miles upriver from White Bird Creek). The period of record is 1910 to 1999 (ongoing). The lowest flow recorded was 1,000 cfs (January 4, 1995) and the maximum flow recorded was 130,000 cfs (June 17, 1974). Minimum mean monthly flow was estimated at 4,242 cfs in January and maximum mean monthly flow is 38,650 cfs in June. The average high mean daily flow during spring runoff is 44,800 cfs and the average low mean daily flow in late summer is 4,340 cfs.

The Salmon River flows into the Snake River at RM 188.2. The subbasin includes a total of 793,600 acres, and BLM lands comprise approximately seven percent of the area. Private lands comprise the majority of the subbasin, followed by USFS, BLM, IDFG, and IDL. Elevations within the subbasin range from 916 feet at the mouth to over 8,000 feet. Private land uses include livestock grazing, timber harvest, recreation, agriculture, communities, and residences. Historically, mining was a major land use along the Salmon River and in the Florence area. Public lands are limited to blocks of USFS lands in the mid and upper portions of the watersheds from White Bird up the Salmon River. The BLM lands within the subbasin are scattered and generally comprise a small percentage of any of the watersheds. Down river, from White Bird Creek, approximately 80% of the river corridor is in BLM ownership, while upriver from White Bird Creek to French Creek approximately 30% of the river corridor is in BLM ownership. Land uses on public lands include timber harvest, livestock grazing, roads, mining, and recreation.

The canyon grasslands are primarily a broad extension of the Pacific bunchgrass formation. The dominant habitat types are bluebunch wheatgrass and Idaho fescue. Sand dropseed and red three-awn have become disclimax species on some river benches, bars, and toeslope areas. Yellow starthistle and annual grasses (i.e. cheatgrass) are common invaders of canyon grasslands when they are in poor to fair ecological condition. In locations where a suitable seed source is has been established, yellow starthistle is also invading canyon grasslands and displacing native vegetation that is presently in good ecological condition.

The mainstem Salmon River is used primarily by listed salmonids as an upstream and downstream passage corridor. Fall chinook salmon use the mainstem Salmon River for spawning and rearing; although such use is at very low levels. Spring/summer chinook salmon and steelhead use the mainstem Salmon River to a limited extent for rearing. Steelhead will use accessible tributaries for spawning and rearing. Spring/summer chinook salmon use White Bird Creek and Slate Creek for spawning and rearing, and also use the mouth area or lower reaches of accessible tributaries for juvenile rearing.

Overall, the water quality of the Salmon River is generally good. However, summer water temperatures in portions of the subbasin are elevated above those that might naturally occur, and sometimes well above the lethal limit for salmon and steelhead. Temperatures recorded at the USGS White Bird stream gage in the Salmon River ranged from 16.5°C to 28.0°C during July, from 1976 to 1991. A combination of erodible soils, natural fires, periodic intense climatic events, and development of road systems have resulted in substantial natural and unnatural erosion and delivery of sediment to the Salmon River. Suspended sediment concentrations and turbidity in the river also become high enough that visibility in the water column is only a few inches. These conditions most often occur in the spring and summer from rainfall events and runoff from snow melt. Such occurrences can last several weeks. Sediment delivery events also occur as a result of summer rainstorms and may last over a week in duration. Suspended sediment concentrations in the Salmon River near White Bird Creek ranged from 2 mg/L to 65 mg/L from 1976-91, except in May, when suspended sediment concentrations ranged from

6 mg/ to 503 mg/L. A suspended sediment concentration of 25 mg/L was suggested as a standard which would provide high protection to aquatic organisms (Thurston et al., 1979). Most of the time the Salmon River would meet this standard, however, during spring run-off, rain on snow events, or intense summer rainstorms, suspended sediment concentration can significantly exceed this amount.

The river has tremendous capability to transport sediment ranging in size from sand to large cobbles. A general observation of the river bed does not indicate that deposition of fine sediment is a serious problem. The riverbed appears to be largely composed of cobble and boulder material which would seem to offer abundant cover for salmonids. Although interstitial deposition of fines is evident, certain habitats such as pool tailouts, appear to be relatively free of fine sediment deposition. During a 1993 survey at RM 65.7, the BLM estimated cobble embeddedness in the Salmon River to be 26.3% and surface fines (particles size less than 6.3mm). to be 4.4%. This indicates low to moderate impacts to rearing habitat. During a 1994 survey at RM 90.8, the BLM estimated cobble embeddedness to be 39.5% and found spawning gravels to contain 19.5% fines.

Stream channels are highly variable throughout the subbasin. Headwater streams, breakland streams, and smaller tributary streams are predominately steep-gradient, confined channels, with high sediment transport capacity. These steep gradient streams may be subject to frequent scouring events. The larger tributaries are typically moderate gradient and are moderately confined. These channels are also efficient at sediment transport. The upper reaches of some streams flowing through low gradient prairie areas, meadows, or forest stringer meadows generally have Rosgen C and B channel types (Rosgen 1996).

Many tributaries have elevated summer water temperatures which often reach 20°C. Elevated deposited sediment levels exist in many tributaries. The amount of deposited sediment is dependent on channel types, flow regimes, land types, and land uses within the watershed.

c. Little Salmon River Subbasin

The Little Salmon River subbasin includes a total of 372,500 acres. The BLM lands within the subbasin total 16,344 acres (4%). Fifty-six percent of the subbasin are USFS lands (Payette and Nez Perce National Forests); 30.5% are privately owned lands; six percent are Wilderness, National Recreation Area, and Wild and Scenic River Corridor (all in the Rapid River subwatershed); and 3.5% are administered by the State. The upper half of the watershed occurs in a wide valley surrounded by forested mountain slopes. The valley is characterized as pasture and meadowlands, with the Little Salmon River meandering through the valley. Near the mid section of the watershed, the valley narrows (RM 21.5), and the river flows through a narrow, steep canyon to its mouth. The mean subbasin elevation is 5,430 feet, with elevations ranging from 1,760 to 9,393 feet. Annual precipitation ranges from less than 20 inches at Riggins, Idaho, to over 50 inches near Brundage Mountain.

The riparian vegetation along the Little Salmon River is generally dominated by black cottonwood, willows, red-osier dogwood, syringa, horsetail, black hawthorn, and alder. Along the lower reaches of the Little Salmon River willow, Douglas hackberry, and poison ivy are common. The meadow riparian areas associated with the upper valley are commonly dominated by willows and sedges. Many of the tributary streams have a narrow riparian vegetation zone confined by steep canyon walls. Common riparian species include red-osier dogwood, syringa, willows, alder, water birch, and blue elderberry. It is often common for conifer species to also occur in the riparian areas. The higher elevation riparian areas may have grand fir, Englemann spruce , subalpine fir, and lodgepole pine, while the lower elevation riparian areas may have Douglas fir and grand fir.

Uplands are characterized by grasslands on dry, south-facing slopes, sometimes with scattered conifers and shrubs. North-facing slopes are vegetated with conifers and tall shrubs. Localized, steep rocky areas exist with low vegetation production, while other areas are heavily forested. Mid to upper elevation areas are dominated by grand-fir, Douglas-fir, larch, Engelmann spruce, and subalpine fir/lodgepole pine. Whitebark pine is found in localized areas at higher elevations. Common understory shrub species include ninebark, oceanspray, serviceberry, spiraea, snowberry, grouseberry, and big huckleberry.

A large variety of past and present land uses have impacted listed species habitat to varying levels. Human activities in the subbasin include logging, roads, trails, water withdrawal, agriculture, livestock grazing, residences, communities, and recreation. The higher elevation lands of the USFS have been used for timber harvest, livestock grazing, and recreation. The BLM lands within the subbasin have also been used similar to the USFS, primarily for timber harvest and livestock grazing. Major subwatersheds in the Little Salmon River include Rapid River, Elk Creek, Boulder Creek, Hazard Creek, Hard Creek, Round Valley Creek, and Goose Creek. U.S. Highway 95 parallels the Little Salmon River, and encroaches on riparian areas and floodplains in the lower canyon reach. Several small towns occur in the subbasin, ranging in size from a few hundred people to slightly more than one thousand. The predominant uses on BLM lands which have impacted aquatic habitat include roads, timber harvest, and livestock grazing.

The Little Salmon River drainage (below RM 24.0) provides habitat for listed spring/summer chinook salmon, steelhead, and bull trout. PACFISH key/priority/special emphasis watersheds for spring/summer chinook salmon, steelhead, and bull trout include Rapid River, Boulder Creek, Hazard Creek, and Hard Creek. Rapid River is considered a stronghold for spring/summer chinook salmon, steelhead, and bull trout. The most significant chinook and steelhead spawning and rearing areas are found in Rapid River and Boulder Creek drainages. To a lesser extent, chinook salmon and steelhead spawning and rearing also occurs in Hazard Creek, Hard Creek, and the mainstem Little Salmon River. All tributary streams that are accessible, below RM 24.0, are used for steelhead spawning and rearing. Adult steelhead have been observed in Squaw Creek, Sheep Creek, Denny Creek, Hat Creek, Lockwood Creek, Rattlesnake Creek, Elk Creek, and Trail Creek. These small steep gradient tributaries provide limited production. The mouth areas of these streams or lower reach segments (downstream from barriers) may provide rearing habitat for juvenile chinook salmon, but the value of these small tributaries for rearing is limited.

d. Clearwater River, and Middle Fork Clearwater River Subbasins

The Clearwater River subbasin includes a total of 1,497,000 acres. The BLM lands within the subbasin total 21,340 acres (one percent). The USFS lands total 136,000 acres (nine percent). The majority of the ownership in the subbasin is private. Other ownership in the drainage include IDL, Nez Perce Tribe, Corps of Engineers (COE), and IDFG. The Clearwater River flows into the Snake River at Lewiston, Idaho, and Clarkston, Washington. The analysis area includes 74.7 miles of the mainstem Clearwater River, face drainages, and tributaries.

Elevations within the subbasin range from 700 feet at the mouth of the Clearwater River to 5,810 feet in the headwaters of Lolo Creek. The Clearwater River flows through a canyon that is 2,000 to 3,000 feet deep. The adjacent plateaus or uplands are rolling and moderately sloped, and are primarily agricultural areas. Higher elevation areas in the subbasin are forested.

Private land uses include agriculture, timber harvest, livestock grazing, recreation, roads, urban development, and residences. Potlatch Corporation, a private timber company, has significant land ownership in the upper Potlatch and Lolo Creek watersheds. Scattered Nez Perce Tribal lands also occur throughout the subbasin. The USFS lands are limited to blocks in the upper Potlatch, Lolo, and Orofino Creek watersheds. The BLM lands within the subbasin are scattered and generally comprise only a small percentage of any watershed. Land uses on BLM lands primarily include timber harvest, livestock grazing, roads, and recreation.

The subbasin provides habitat for listed fall chinook salmon, steelhead, and bull trout. Spring/summer chinook salmon occurring within the subbasin are not ESA listed. The Nez Perce Tribe has been active in recent introductions of fall chinook salmon and coho salmon within the subbasin. The mainstem Clearwater River is used as an upstream and downstream passage corridor by fall chinook salmon, steelhead, spring/summer chinook salmon, and coho salmon. Fall chinook salmon use the mainstem Clearwater River for spawning and rearing. Primary use by fall chinook salmon occurs Down river from the North Fork Clearwater River. Steelhead use accessible tributaries for spawning and rearing. Spring/summer chinook salmon and steelhead will use the mainstem river, to a very limited extent, for spawning and rearing. Lolo Creek is currently the only tributary used by spring/summer chinook salmon for spawning and rearing. Spring/summer chinook salmon use the mouth area or lower reaches of tributaries for juvenile rearing.

e. Lower South Fork Clearwater River and Tributaries

The South Fork Clearwater River subbasin is approximately 746,000 acres in size. Elevations range from 1,240 feet at the mouth to 10,000 feet. The lower South Fork of the Clearwater River subbasin is predominantly within the Palouse Prairie section of the Great Plains-Palouse Dry Steppe Province. The Palouse Prairie section is characterized by elevations ranging from 1,200 feet to 6,000 feet, and precipitation from 10 to 30 inches per year, evenly distributed throughout fall, winter and spring. Winter precipitation is mostly snow, and summers are relatively dry. Climate is warm temperate with a maritime influence. This area is characterized by loess plains, hills with large steptoes and some river breaklands. Loess plains have low to medium density branching drainage patterns. The bedrock geology is predominantly Columbia River basalt, and to a lesser extent quartz dioritic gneiss. Soils developed in basalt are typically loams to clay loams. Rapid changes in runoff volumes are possible on basalt due to gain or loss of water to gravel intervals. Land use includes dry farming and livestock grazing on about 90% of the area.

Plant community composition is dependent on aspect, elevation, and soils. Habitat types vary from warm and dry (15 inches of precipitation) to cooler (30 inches of precipitation). Common vegetation types include conifer, Palouse/canyon grasslands, and agriculture (dry farming for wheat, barley). The Palouse/canyon grasslands vegetation includes bluebunch wheatgrass, Idaho fescue, arrowleaf balsamroot, cheatgrass, and shrubs/trees associated with some aspects. Good examples of relict Palouse grasslands are very rare, due to agricultural activity and livestock grazing have altered these habitats significantly. Canyon grasslands are in poor ecological condition and are generally heavily infested with noxious weeds, particularly yellow starthistle. Common timber types include Douglas fir and ponderosa pine; grand fir occurs at higher elevations and areas with higher moisture regimes (i.e. riparian areas, higher elevations, north aspects).

The mainstem South Fork Clearwater River begins at the confluence of American and Red Rivers (RM 62.5). From this point to about Tenmile Creek (RM 47.1), the mainstem is a relatively low gradient riffle/pool stream dominated by gravel and cobble substrate (USDA 1998). It has been highly altered by dredge mining and the placement of State Highway 14. From Tenmile Creek to Mill Creek (RM 32.8), the mainstem is steeper, more confined, and the substrate is dominated by boulders and cobbles. This is a high energy reach through which sediment is readily transported. From Mill Creek to just above Threemile Creek (RM 7.6) to its confluence with the Middle Fork Clearwater River at Kooskia (RM 74.7), the South Fork is a relatively flat, unconfined riffle/pool channel with gravel and cobble substrate. This reach tends to be aggradational, with fine sediment depositing in the relatively few pools, and gravel and cobble depositing from upstream sources at the mouths of tributaries. This lowest reach of the river has also been partially confined by dikes, most notably in the vicinity of Stites and Kooskia, Idaho.

The lower South Fork Clearwater River below Farrens Creek (RM 24.5; USFS boundary) has been affected to various degrees by aggradation, channelization, diking, riparian vegetation removal, and encroachment by developments, such as roads and buildings (USDA 1998). Highway 14 parallels the river and has encroached on riparian areas and channels. Aggradation of the river is associated with bedload from upstream sources, but most noticeably from the major Camas Prairie tributaries (e.g. Butcher, Threemile, and Cottonwood Creeks) and local bank erosion. In the unconfined reaches, the net result is a channel that is wider and shallower, and with less large pools than existed under natural conditions. Fish habitat has been degraded through a reduction in cover and water depth, and through an increase in sediment deposition and summer water temperatures. In some years, much of the lower South Fork becomes unsuitable for cold water fishes due to warm water temperatures (USDA 1998). The South Fork Clearwater River, Butcher Creek, Cottonwood Creek (mainstem and South Fork), Red Rock Creek, Stockney Creek, and Threemile Creek are currently listed as 303(d) Water Quality Limited Segments under the Clean Water Act.

Physical characteristics of the subbasin have been altered by agriculture, residential and commercial developments, livestock grazing, timber harvest, roads, and recreation. Highway 14 parallels the South Fork Clearwater River. In 1911, a dam was constructed on the lower South Fork Clearwater River mainstem at approximately RM 22. The dam was a complete fish migration barrier to salmonid migration from 1911 to 1935, and from 1949 until 1963, when the dam was removed (Cramer et al. 1998). A second dam existed on the mainstem Clearwater River near Lewiston from 1927 to 1974. Marginal fish passage existed from 1927 to 1939. An improved fish ladder was installed in 1939 and was in place until 1974 when the dam was removed. Flood plain developments occur on private lands, and numerous communities are present in the Lower South Fork Clearwater River subbasin.

Steelhead, bull trout, cutthroat trout, spring/summer chinook salmon, rainbow/redband trout, and Pacific lamprey are present in the mainstem South Fork Clearwater River. Tributary streams in the drainage can be broadly characterized as fish bearing tributary streams, non-fish bearing face drainages, and the mainstem river. The small face drainages are primarily composed of high energy breakland tributaries of the South Fork Clearwater River. The fish bearing tributaries are typically third and fourth order streams, with first and second order intermittent and perennial drainages that are non-fish bearing. The BLM lands occur in five tributary drainages that provide fish habitat in the Lower South Fork of the Clearwater River. The five tributary streams include Threemile Creek, Sally Ann Creek, Butcher Creek, Mill Creek, and Cottonwood Creek. The face drainages do not provide fish habitat due to low base flows, barriers, and steep gradient.

Fall chinook salmon use the mainstem Clearwater River as a juvenile and adult migration corridor. Primary fall chinook use within the Clearwater River subbasin is Down river from the North Fork of the Clearwater River (RM 40.5). Steelhead use the mainstem South Fork Clearwater River as a juvenile and adult migration corridor. The mainstem South Fork Clearwater River is also used for adult over-wintering, juvenile rearing, and to a limited extent for spawning. Primary spawning and rearing occurs in South Fork Clearwater River tributary streams. Spring/summer chinook salmon use the mainstem South Fork Clearwater River as a juvenile and adult migration corridor. The mainstem South Fork Clearwater River is also used to a limited extent for juvenile rearing. Spring chinook spawning and rearing occurs primarily in larger tributary streams upriver from the USFS boundary.

C. Analysis of Effects

Effects of the action are defined as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR 402.02). Direct effects occur at the project site and may extend upstream or downstream based on the potential for impairing essential elements of critical habitat. Indirect effects are defined in 50 CFR 402.02 as "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." They include the effects on listed species or critical habitat of future activities that are induced by the proposed action and that occur after the action is completed. "Interrelated actions are those that are part of a larger action and depend on the larger action for their justification" (50 CFR 403.02). "Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR 402.02).

In NOAA Fisheries analysis approach (NMFS 1999), the effects of proposed actions on listed salmon and steelhead are evaluated in the context of the status of the species and their habitats. To avoid jeopardy and destruction/adverse modification of critical habitat for listed salmon and steelhead, proposed actions generally must cause no more than minimal amounts of incidental take of the species, and also must restore, maintain, or at least not appreciably interfere with the recovery of the properly functioning condition (PFC) of the various fish habitat elements within a watershed.

1. Effects of the Proposed Action

The BA provides a detailed analysis of the effects of the proposed action on listed species and their critical habitat in the action area. The effects analysis in this Opinion focuses on those elements of the proposed action that have the potential to affect fish, their prey, or riparian functions. The analysis is based primarily on toxic effects of herbicides on listed fish and their prey, and secondarily on the physical effects of weed removal. Toxic effects may potentially harm listed fish by killing them outright, through sublethal changes in behavior or physiology, or indirectly through a reduction in the availability of prey. Physical effects of weed removal could potentially affect riparian functions such as shade, cover, debris recruitment, and sediment filtering.

a. Activity-Specific Effects

Physical Weed Control

Physical weed removal includes manual or mechanized techniques to remove weeds (hand pulling, grubbing, mowing, tilling, discing, or plowing). The primary effect on aquatic species is exposure of bare topsoil to increased erosion, and subsequent runoff into aquatic systems. In locations where weeds are removed from stream banks, removal of weeds would result in a temporary loss of cover, which would be replaced by new plant growth through natural regeneration, or from re-seeding disturbed sites with desirable vegetation to compete with noxious weeds targeted for control. The amount of area where weeds would be physically removed is a small percentage of the CFO's management area. Soil disturbance and resulting production of sediment from this activity will likely be insignificant.

Regulatory Weed Control Mechanisms

Regulatory control measures would have virtually no effect on listed fish or critical habitat. Proposed regulations would primarily restrict activities that could spread noxious weeds. In situations where vehicle access is restricted to reduce the spread of weeds, there could be a possible reduction in sediment. In situations where livestock grazing is reduced in riparian areas, the condition of riparian vegetation could improve.

Biological Weed Control

Biological weed control may be used in conjunction with other weed control methods, however, biological control is not part of the proposed action. Any introduction of insects or pathogens, that may affect listed species, will be consulted on separately by the USDA Animal Plant Health Inspection Service (APHIS) prior to release. Insects are the primary biological control agent, however, mites, nematodes or pathogens could also be used. The potential effects of biological weed control on listed fish or critical habitat would depend on the specific control agent proposed for use, which are not known at this time.

Chemical Weed Control

In the proposed action, the risks of herbicides effects on salmon and steelhead occur primarily through their toxicological effects on aquatic organisms, rather than physical changes in fish habitat (except for contamination by the herbicides themselves). Herbicides also affect terrestrial vegetation and watershed characteristics by killing or injuring plants, but these terrestrial changes in the proposed action are not expected to noticeably affect the aquatic environment because of the small proportion of land proposed for treatment, restricted use of herbicides in riparian areas, and regrowth of native vegetation in treated areas. One possible exception is in settings where exotic plants have become a significant vegetative component that has altered watershed processes through a shift in hydrologic characteristics or change in fire frequency, such as some breaklands in the Salmon and Snake River canyons (e.g. Vitousek et al.1996). In these settings, restoration of native vegetation may also restore certain watershed processes to a more properly functioning condition (see NMFS (1996) for explanation), and the use of herbicides may be the only feasible control method available.

Proposed chemical weed control activities involve the use of five herbicides that may be used in several combinations or in formulations that include adjuvants, such as surfactants, emulsifiers, or "inert" ingredients that are unknown. The ecological risks to aquatic species and toxicological effects are not fully known for the herbicides and formulations in the proposed action. There is ample information available to assess the risk of direct mortality from the active ingredients in the herbicide formulations in the proposed action. There is incomplete information available on ecological effects of the herbicides and their formulations (including effects on the invertebrates on which fish feed), sublethal effects of the active ingredients on listed species, and lethal or sublethal effects of product formulations (mixtures of active ingredients, adjuvents and inert ingredients). Due to concerns about the uncertainty of effects of pesticides on listed salmon and steelhead, EPA has been directed by the 9th District Court (Washington Toxics Coalition v. EPA) to consult with NMFS on the effects of 55 pesticides, including 2,4-D, which is proposed for use by the CFO.

The effects of the chemicals on listed fish are dependent on their toxicity to listed fish and other aquatic organisms, and the amount (or likelihood) of exposure to the chemicals. Following this conceptual model, the effects analysis in this Opinion consists of three parts: (1) An evaluation of the likelihood that listed fish and other aquatic organisms will be exposed to the chemicals; (2) an evaluation of the direct effects of herbicide exposure on listed fish; and (3) an evaluation of the indirect effects of the chemicals on the biotic community. The background information for each chemical's toxicity, and information related to the environmental fate and transport is in Appendix A.

b. Likelihood That Listed Fish and Other Aquatic Organisms will be Exposed to Herbicides

The most effective mechanism to avoid adverse effects of herbicides on listed fish is to keep the chemicals out of the waters where listed fish occur. Herbicides can enter water through atmospheric deposition, spray drift, surface water runoff, groundwater contamination and intrusion, and direct application. The proposed action includes numerous BMPs intended to minimize or avoid water contamination from herbicides (See Section 2.4.3 in this Opinion, and Appendix D in the BA). The BMPs include stream and riparian buffers where chemical use is restricted or prohibited, limits on the amount of chemicals carried at a given time or applied to a given area, and rules governing application methods and timing. The BMPs and the likelihood of herbicides entering the water depend on the type of treatment and mode of transport.

Water Contamination from Wind Drift

Herbicide spraying can introduce chemicals directly into water through wind drift. Drift may occur during any spraying activity, including aerial applications, boom spraying, and hand spraying. Wind drift is more likely to occur during most aerial applications, and less likely to occur to a significant extent during ground-based spraying, unless sprays are directed into the air, or sprays are delivered in a fine mist. Water contamination from wind drift is primarily dependent upon the elevation of the spray nozzle, air movement, and droplet size. The smaller a droplet, the longer it stays aloft in the atmosphere, allowing it to travel farther. In still air, a droplet of pesticide the size of 100 microns (mist-size) takes 11 seconds to fall 10 feet. The same size droplet at a height of 10 feet travels 13.4 feet horizontally in a 1 mph wind, and 77 feet at
5 mph wind. Droplets released from spray equipment are not uniform in size, consequently, the indicated droplet size is the median diameter, with half the droplets smaller than the indicated diameter. During temperature inversions little vertical air mixing occurs and drift can translocate contaminates several miles. Low relative humidity and/or high temperature conditions will increase evaporation and the potential for drift. In the proposed action, aerial application equipment will be designed to deliver a median droplet diameter of 200 to 800 microns, and provisions are included for humidity and wind speed. With the proposed BMPs, the aerial droplet size is believed by BLM to be large enough to avoid excessive drift into no-spray buffers, while providing adequate coverage of target vegetation.

A study by Rashin and Graber (1993), looking at the effectiveness of BMPs used in Washington for aerial pesticide application, found BMPs to be only partially effective, or ineffective for a variety of aerial applications and monitoring periods. They determined that numerous factors influenced the effectiveness of BMPs for aerial herbicide application, including streamflow regimes, application equipment and operating parameters, relationships between stream flow and operating factors (e.g., nozzle configuration), decisions about buffer size or necessity, weather, herbicide used, and topography and other site factors. The authors concluded that improvements to all BMPs were necessary to ensure achievement of State water quality standards, forest practice rules and product label restrictions. They proposed minimum buffers of 15 to 25 meters for downwind applications; 75 to 90 meters for upwind application along flowing streams, including those with minor or intermittent flows. They also recommended certain measures for determining the presence of surface water in ephemeral streams, specifications on the type of nozzle configurations and orientations, and operational restrictions based on weather conditions.

The BMPs for aerial applications in the proposed action appear to offer a similar level of protection as the BMPs recommended by Rashin and Graber (1993), with a few minor differences. Even with the BMPs recommended by Rashin and Graber (1993), they expect that the BMPs will not entirely keep herbicides from reaching the water. The amounts of chemicals expected to reach the water from wind drift were not quantified in the BA, and they are not known. However, based on the expected BMP effectiveness, the amount of chemical drift reaching the water is likely to be below concentrations where lethal or sublethal effects are known to occur in salmon or steelhead. However, because little is known about the sublethal effects of the herbicides on salmon and steelhead, the effects of herbicides on aquatic ecosystems, and concentrations where these effects might occur, it is possible that spray drift may reach the water in concentrations that could harm salmon or steelhead though sublethal effects, or indirectly though effects on other aquatic organisms.

Water Contamination from Runoff, Leaching, and Percolation

All of the herbicides can potentially enter streams through water transported by runoff, leaching, or percolation. Water contamination from rain events could transport chemicals to waterways, and convey them to chinook salmon or steelhead habitat. The adsorption of herbicides onto soils, stability, solubility, and toxicity of a chemical determine the extent to which it will migrate and adversely affect surface waters and groundwater (Spence et al. 1996). For example, Picloram is highly soluble and readily leaches through the soil. It is also resistant to biotic and abiotic degradation processes. It can also move from target plants, through roots, down into the soil, and into nearby non-target plants. Given this capability, a sufficient buffer zone is recommended to protect riparian vegetation when using picloram. Glyphosate and 2,4-D, though very soluble, bind well with organic material in soils and therefore are not leached easily. All four herbicides are susceptible to transport in surface runoff, especially if applications are followed immediately by high rainfall events. However, data limitations make it difficult to precisely estimate the degree of ecological risk

The potential concentrations of chemicals in the water, as a result of contamination from the proposed action, are not known. The BA provides rough estimates of the amount of chemicals expected to reach the water, based on modeling or monitoring reported in published literature. Indicators of potential exposure are characterized by available information on factors that determine the likelihood of the chemicals reaching water. Indicators include physical properties of the chemicals; soil properties such as the amount of organic material, soil depth, soil type, pH, water content, and oxygen content; and environmental conditions such as temperature, and rainfall amounts. An environment containing dry soil with low microbial presence, which receives periodic high-intensity rainfall events, will be very susceptible to both leaching and surface runoff of picloram. This will also be true to a lesser extent with 2,4-D and glyphosate.

b1. Exposure to Picloram

While most grasses are resistant to picloram, it is highly toxic to many broad-leafed plants. Picloram is persistent in the environment, and may exist at levels toxic to plants for more than a year after application at normal rates. In normal applications, nontarget plants may be exposed to chemical concentrations many times the levels that have been associated with toxic effects. Picloram's mobility allows it to pass from the soil to nearby, nontarget plants. It can also move from target plants, through roots, down into the soil, and into nearby nontarget plants. Given this capability, an applicator does not have to spray the buffer zone in order to affect the riparian vegetation. Spray drift may kill plants some distance away from the area being treated. Crop damage from irrigation water contaminated by picloram has been documented the U.S. Environmental Protection Agency (U.S. EPA 1995, USFS 1995).

Picloram is extremely mobile in soil, but has a relatively short half-life in aerobic soils. Ismail and Kalihasan (1997) found that picloram moves rapidly out of the top 5 cm of soil with a half-life of about 4 to 10 days. Somewhat longer half-lives of 13 to 23 days have been reported by Krzyszowka et al. (1994). Generalized estimates of peak levels of picloram in water ranged between about 0.012 mg/L in sandy soil to 0.025 mg/L in clay soil water, applied at an application rate of 0.45 kg acid equivalents (a.e.) per acre, and modeled as transport directly into a pond (USDA 1989). Water concentrations expected from the proposed action would likely be far less than the concentrations modeled in USDA (1989). The application rate in the proposed action is one-fourth of the modeled rate, precipitation is 5 to 10 times lower than the modeled rate, chemicals would be diluted in a running stream in comparison to a pond, and no application of picloram is authorized within 100 feet of any stream.

b2. Exposure to 2,4-D

2,4-D is highly soluble in water, but it rapidly degenerates in most soils, and is rapidly taken up in plants. 2,4-D ranges from being mobile to highly mobile in sand, silt, loam, clay loam, and sandy loam. Consequently, 2,4-D is likely to contaminate surface waters if rains occur shortly after application, and unlikely to enter surface waters if rain is unlikely. The Washington Department of Ecology collected 32 stream samples downstream from a helicopter application of 2,4-D conducted according to Washington's BMPs. The 2,4-D was found in all samples collected, in highest concentrations following a rainstorm the day after the spraying (Rashin and Graber 1993). In another study, 2,4-D was found in 19 of 20 basins sampled throughout the U.S. (USGS 1998). In the USGS (1998) study, 2,4-D was found in 12% of agricultural stream samples; 13.5% of urban stream samples; and in 9.5% of the samples from rivers draining a variety of land uses. The study by Rashin and Graber (1993) demonstrates a greater likelihood of 2,4-D contamination in an environment with frequent precipitation, while the broader USGS (1998) study shows lower rates of contamination when averaged across a range of climatic conditions.

b3. Exposure to Glyphosate

Glyphosate is strongly adsorbed to most soils, and dissolves easily in water. The potential for leaching is low due to the soil adsorption, however, glyphosate can move into surface water when the soil particles to which it is bound are washed into streams or rivers (U.S. EPA 1993). Studies examined glyphosate residues in surface water after forest application in British Columbia with and without no-spray stream side zones. With a no-spray stream side zone, very low concentrations were sometimes found in water and sediment after the first heavy rain. Biodegradation represents the major dissipation process. After glyphosate was sprayed over two streams in the rainy coastal watershed of British Columbia, glyphosate levels in the streams rose dramatically after the first rain event, 27 hour post application, and fell to undectable levels in 96 hours (NIH 2002a). The highest residues were associated with sediments, indicating that they were the major sink for glyphosate. Residues persisted throughout the 171 day monitoring period. Suspended sediment is not a major mechanism for glyphosate transport in rivers.

b4. Exposure to Clopyralid

Clopyralid is stable in water over a pH range of 5 to 9 (Woodburn 1987) and the rate of hydrolysis in water is extremely slow, with a half-life of 261 days (Concha and Shepler 1994). In addition, clopyralid is extremely stable in anaerobic sediments, with no significant decay noted over a one year period (Hawes and Erhardt-Zabik 1995). Clopyralid does not bind tightly to soil and thus would seem to have a high potential for leaching. While clopyralid will leach under conditions that favor leaching, such as sandy soil, a sparse microbial population, and high rainfall, the potential for leaching or runoff is functionally reduced by the relatively rapid microbial degradation of clopyralid in soil (e.g. Baloch-Haq et al. 1993; Bergstrom et al. 1991; Bovey and Richardson 1991). A number of field lysimeter studies and the long-term field study by Rice et al. (1997) indicate that leaching and subsequent contamination of ground water are likely to be minimal. This conclusion is also consistent with a short-term monitoring study of clopyralid in surface water after aerial application (Leitch and Fagg 1985).

b5. Exposure to Sulfometuron-methyl

Sulfometuron-methyl has a half-life of one month or less in anaerobic freshwater environments, and four months in sterile soils (SERA 1999a). Application rates of 5.76 ounces of active ingredient (a.i) per acre resulted in concentrations of 0.02 (0.005-0.04) mg/L occurring in the ambient water immediately after a major rainfall (USDA 1999). When adjusted for application rates of 1.6 ounces a.e. per acre (0.1 lb a.e./acre), the expected levels of sulfometuron methyl in ambient water would be 0.005 (0.001 - 0.01) mg/L, which is 100 times lower than the concentration where mortality of bluegill sunfish or flathead minnows was reported.

At least one percent of the applied sulfometuron methyl applied to an area could run off from the application site to adjoining areas after a moderate rain, based on studies of runoff from 84 mm of total rainfall (43 mm/hour for 2 hours) by Hubbard et al. (1989) and from 12 to 30 mm of rain rainfall by Wauchope et al. (1990). In the case of a heavy rain, losses could be much greater and might approach 50% in cases of extremely heavy rain and a steep soil slope (SERA 1999a).

c. Likelihood of Direct Effects

Most direct effects of herbicides on listed salmon and steelhead are likely to be from sublethal effects, rather than outright mortality from herbicide exposure. Sublethal effects are considered under the ESA to constitute "take," if the sublethal effects "harm" listed fish. NMFS defines harm as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding or sheltering" (50 CFR 222.102). These behavioral patterns, and their underlying physiological processes are typically reported for individual test animals. However, the ecological significance of sub-lethal toxicological effects depends on the degree to which they influence behavior that is essential to the viability and genetic integrity of wild populations. It is important to note that many sublethal toxicological endpoints or biomarkers may harm fish in ways that are not readily apparent. When small changes in the health or performance of individual fish are observed (e.g. a small percentage change in the activity of a certain enzyme, an increase in oxygen consumption, the formation of pre-neoplastic hepatic lesions, etc.), it may not be possible to infer a significant loss of essential behavior patterns of fish in the wild, even in circumstances where a significant loss could occur.

An analysis of the direct impacts of herbicides on salmonids should relate the site-specific exposure conditions (i.e., expected environmental concentration, bioavailability, and exposure duration) to the known or suspected impacts of the chemical on the health of exposed fish. Where possible, such analyses should consider: (1) The life history stage (and any associated vulnerabilities) of the exposed salmonid; (2) the known or suspected mechanism of toxicity for the active ingredient (or adjuvant) in question; (3) local environmental conditions that may modify the relative toxicity of the contaminant; and (4) the possibility of additive or synergistic interactions with other chemicals that may enter surface waters as a result of parallel or upstream land use activities.

A probabilistic risk assessment (PRA), based on the relationship between the likelihood of exposure and the magnitude of effect is used to evaluate the proposed action. Traditionally, a PRA incorporates data from a standard lethal concentration (LC_{50}) exposure study as well as chronic exposure data to predict the sensitivity of an organism to the pesticide or chemical. The lethality endpoint has little predictive value for assessing whether real world pesticide exposure will cause sublethal neurological and behavioral disorders in wild salmon (Scholz et. al 2000), but in most cases, the LC_{50} is the only toxicity data available. Although little information is available on the sublethal effects of the herbicides on listed fish, there can be subtle sublethal effects that can potentially affect the survival or reproduction of large population segments. For example, Scholz et al. (2000), and Moore and Waring (1996) indicate that environmentally relevant exposures to diazinon can disrupt olfactory capacity in the context of survival and reproductive success of chinook salmon, both of which are key management considerations under the ESA (Scholz et al. 2000). The likelihood of similar effects with the chemicals proposed for use is unknown.

Based on the analysis provided in the BA, and available literature, it appears unlikely that the proposed herbicide use would cause outright fish kills at concentrations of the active ingredients likely to occur in water from the proposed action, except for circumstances where high herbicide concentrations result from heavy rainfall shortly after herbicides are applied, or as a result of an accidental spill. All LC_{50} concentrations for salmonids, for the active ingredients in the herbicides proposed for use, and reported in the literature cited in the BA and in this Opinion, are above 1 mg/L (see Appendix A), while environmental concentrations would typically be at least 1 to 2 orders of magnitude lower. While the active ingredients appear to pose a low risk of mortality, the likelihood of outright mortality of listed fish from exposure to product formulations that include unknown adjuvants is virtually unknown due to the paucity of information available.

Although lethal effects are not expected to occur under most circumstances, listed fish are likely to be exposed to herbicide concentrations where sublethal effects could occur. Potential sublethal effects, such as those leading to a shortened lifespan, reduced reproductive output, other types of "ecological death" (e.g. Kruzynski et al. 1994; Kruzynski and Birtwell 1994) or other deleterious biological outcomes is a threat to listed species from the proposed action. The toxicological endpoints identified below are possible for a variety of pesticides and are generally considered to be important for the fitness of salmonids and other fish species. They include:

- Direct mortality at any life history stage.
- An increase or decrease in growth.
- Changes in reproductive behavior.
- A reduction in the number of eggs produced, eggs fertilized, or eggs hatched.
- Developmental abnormalities, including behavioral deficits or physical deformities.
- Reduced ability to osmoregulate or adapt to salinity gradients.
- Reduced ability to tolerate shifts in other environmental variables (*e.g.* temperature or increased stress).
- An increased susceptibility to disease.
- An increased susceptibility to predation.
- Changes in migratory behavior.

Most of these endpoints (above) have not been investigated for the herbicides in the proposed action, however some limited data are available. Information on sublethal effects of glyphosate is available for many of the above endpoints, and of those reported, glyphosate appears to carry a low risk for sublethal effects. SERA (1998a) reported that sulfometuron-methyl had no effect on hatchability, growth, or survival of flathead minnow eggs or fry, at concentrations of 1.17 mg a.i. per liter (L). Potential chronic effects of sulfometuron methyl at concentrations between 1.17 mg a.i./L and 100 mg a.i./L cannot be dismissed but long-term exposure to greater than 1 mg a.i./L sulfometuron methyl is unlikely (SERA 1998a). Woodward (1979). found that picloram concentrations greater than 0.61 mg/L decreased growth of cutthroat trout, and a similar finding was reported by Mayes (1984). Maximum exposure concentrations not affecting survival and growth of cutthroat trout ranged from 290 to 48 rug/l in Woodward's (1979) study. Tests with the early life-stages of rainbow trout showed that picloram concentrations of 0.9 ppm reduced the length and weight of rainbow trout larvae, and concentrations of 2 ppm reduced survival of the larval fish (Mayes et al. 1987). Woodward (1976), in a study of lake trout, found that picloram reduced fry survival, weight, and length at concentrations of 0.04 ppm, and that the rate of yolk sac absorption and growth of lake trout fry was reduced in flow-through tests at concentrations as low as 0.35 mg/l. Yearling coho salmon exposed to 5 ppm of picloram for 6 days suffered "extensive degenerative changes" in the liver and wrinkling of cells in the gills (U.S. EPA 1979).

Little et al. (1990) examined behavior of rainbow trout exposed for 96 hours to sublethal concentrations of 2,4-D amine, and observed inhibited spontaneous swimming activity and swimming stamina. Changes in schooling behavior and red blood cells, reduced growth, impaired ability to capture prey, and physiological stress were reported for 2-4,D NIH 2002b; Gomez et. al. 1998; Cox 1999). The 2,4-D can also combine with other pesticides and have a synergistic effect, resulting in increased toxicity. Combining 2,4-D with picloram damages the cells of catfish (*Ictalurus spp*) gills, although neither individual pesticide has been found to cause this damage (Cox 1999).

The consequences of these sublethal effects are uncertain, but the loss of physiological or behavioral functions can adversely affect the survival, reproductive success, or migratory behavior of individual fish. Such effects, in turn, can be expected to reduce the viability of wild populations. Additional endpoints could also be significant if a clear relationship is established between the observed impairment and the "essential biological requirements" of salmonids (i.e. the likelihood that the exposed animal will survive the various phases of its life cycle and return to its natal river system to spawn.).

d. Likelihood of Indirect Effects

Indirect effects of pesticides can occur through their effects on the aquatic environment and non-target species. The likelihood of adverse indirect effects is dependant on environmental concentrations, bioavailability of the chemical, and persistence of the herbicide in salmon habitat. For most pesticides, including the chemicals in the proposed action, there is little information available on environmental effects, such as negative impacts on primary production, nutrient dynamics, or the trophic structure of macroinvertebrate communities. Most available information on potential environmental effects must be inferred from laboratory assays;

however, a few observations of environmental effects are reported in the literature. Due to the paucity of information, there are uncertainties associated with the following factors: (1) The fate of herbicides in streams; (2) the resiliency and recovery of aquatic communities; (3) the site-specific foraging habits of salmonids and the vulnerability of key prey taxa; (4) the effects of pesticide mixtures that include adjuvants or other ingredients that may affect species differently than the active ingredient; and (5) the mitigating or exacerbating effects of local environmental conditions. Where uncertainties cannot be resolved using the best available scientific literature, the benefit of the doubt should be given to the threatened or endangered species in question [H.R. Conf. Rep. No. 697, 96th Cong., 2nd Sess. 12 (1979)].

It is becoming increasingly evident that indirect effects of contaminants on ecosystem structure and function are a key factor in determining a toxicant's cumulative risk to aquatic organisms (Preston 2002). Moreover, aquatic plants and macroinvertebrates are generally more sensitive than fish to the acutely toxic effects of herbicides. Therefore, chemicals can potentially impact the structure of aquatic communities at concentrations that fall below the threshold for direct impairment in salmonids. The integrity of the aquatic food chain is an "essential biological requirement" for salmonids, and the possibility that herbicide applications will limit the productivity of streams and rivers should be considered in an adverse effects analysis.

The potential effects of herbicides on prey species for salmonids are also an important concern. Juvenile Pacific salmon feed on a diverse array of aquatic macroinvertebrates (i.e. larger than 595 microns in their later instars or mature forms; Cederholm et al. 2000). Terrestrial insects, aquatic insects, and crustaceans comprise the large majority of the diets of fry and parr in all salmon species (Higgs et al. 1995). Prominent taxonomic groups include Chironomidae (midges), Ephemeroptera (mayflies), Plecoptera (stoneflies), Tricoptera (caddisflies), and Simuliidae (blackfly larvae) as well as amphipods, harpacticoid copepods, and daphniids. Chironomids in particular are an important component of the diet of nearly all freshwater salmon fry (Higgs et al. 1995). In general, insects and crustaceans are more acutely sensitive to the toxic effects of environmental contaminants than fish or other vertebrates. However, with a few exceptions (e.g. daphniids), the impacts of pesticides on salmonid prey taxa have not been widely investigated. Where acute toxicity for salmonid prey species are available, however, they should be used to estimate the potential impacts of herbicide applications on the aquatic food chain.

Human activities that modify the physical or chemical characteristics of streams often lead to changes in the trophic system that ultimately reduce salmonid productivity (Bisson and Bilby, 1998). In the case of herbicides, a primary concern is the potential for impacts on benthic algae. Benthic algae are important primary producers in aquatic habitats, and are thought to be the principal source of energy in many mid-sized streams (Minshall, 1978; Vannote et al., 1980; Murphy, 1998). Herbicides can cause significant shifts in the composition of benthic algal communities at concentrations in the low parts per billion (Hoagland et al., 1996). Moreover, based on the data available, herbicides have a high potential to elicit significant effects on aquatic microorganisms at environmentally relevant concentrations (DeLorenzo et al. 2001). In many cases, however, the acute sensitivities of algal species to herbicides are not known. In

addition, Hoagland et al. (1996) identify key uncertainties in the following areas: (1) The importance of environmental modifying factors such as light, temperature, pH, and nutrients; (2) interactive effects of herbicides where they occur as mixtures, (3) indirect community-level effects,
(4) specific modes of action, (5) mechanisms of community and species recovery, and
(6) mechanisms of tolerance by some taxa to some chemicals. Herbicide applications have the potential to impair autochthonous production and, by extension, undermine the trophic support for stream ecosystems. However, existing data gaps make it difficult to precisely estimate the degree of ecological risk, and limited information is available on the ecological effects of the chemicals in the proposed action.

The growth of salmonids in freshwater systems is largely determined by the availability of prey (Chapman 1966; Mundie 1974). For example, supplementation studies (e.g. Mason 1976) have shown a clear relationship between food abundance and the growth rate and biomass yield or productivity of juveniles in streams. Therefore, herbicide applications that kill or otherwise reduce the abundance of macroinvertebrates in streams can also reduce the energetic efficiency for growth in salmonids. Less food can also induce density-dependent effects, that is, competition among foragers can be expected to increase as prey resources are reduced (Ricker 1976). These considerations are important because juvenile growth is a critical determinant of freshwater and marine survival (Higgs et al. 1995). For example, a recent study on size-selective mortality in chinook salmon from the Snake River (Zabel and Williams 2002) found that naturally reared wild fish did not return to spawn if they were below a certain size threshold when they migrated to the ocean. There are two primary reasons mortality is higher among smaller salmonids. First, fish that have a slower rate of growth suffer size-selective predation during their first year in the marine environment (Parker 1971; Healy 1982; Holtby et al. 1990). Growth-related mortality occurs late in the first marine year and may determine, in part, the strength of the year class (Beamish and Mahnken 2001). Second, salmon that grow more slowly may be more vulnerable to starvation or exhaustion (Sogard 1997).

d1. Indirect Effects of Picloram

Although picloram is toxic to salmonids, it is not as toxic to daphnia or algae at the same concentrations. In *Daphnia*, the reported acute (48-hours) LC_{50} value is 68.3 (63 to 75) mg/L (SERA 1999a). Chronic studies using reproductive or developmental parameters in daphnia report a no-effect level of 11.8 mg/L and an adverse effect level of 18.1 mg/L. Based on standard bioassays in aquatic algae, the lowest effect level for the potassium salt of picloram (EC_{25} for growth inhibition *(S. capricornutum*) is 52.6 mg/L with a corresponding "no observable adverse effects level "(NOAEL) of 13.1 mg/L.

d2. Indirect Effects of Clopyralid

From information reported in SERA (1999b) it appears that there could be potential losses in primary productivity from algae killed by clopyralid, based on an EC_{50} for algae of 6.9 mg/L. However, concentrations lethal to algae are unlikely to occur unless clopyralid is directly added to water, or if a rainfall washes the chemical into a stream shortly after it is applied. Toxic effects on aquatic invertebrates are reported only for daphnia, which has an LC_{50} of 350 mg a.e./L for the monoamine salt and 232 mg a.e./L for the acid LC_{50}. If other invertebrates respond similarly to daphnia, then lethal effects on aquatic invertebrates are unlikely.

d3. Indirect effects of 2,4-D amine and acid formulations

The SERA (1998b) report suggests that amine and acid formulations have relatively low toxicity to aquatic invertebrates and aquatic plants, although the effects are highly variable. Insect larvae are most susceptible to adverse effects, while zooplankton are the least susceptible (Sarkar 1991). Acute toxicity tests exposing the cladoceran, *Simocephalus vetulus*, to the sodium salt of 2,4-D show complete mortality following 96 hours of exposure to concentrations ranging from 0.5 to 5.0 mM (Kaniewska-Prus 1975). The EPA (1989) reported for the dimethylamine salt, a LC_{50} for grass shrimp of 0.2 mg/L. SERA (1998b) concluded that some species of aquatic algae are sensitive to concentrations of approximately 1 mg/L 2,4-D, however, low levels of the compound may stimulate algal growth in some species. Ester formulations have much greater toxicity, but are not proposed for use by the BLM.

d4. Indirect Effects of Glyphosate

Glyphosate is highly toxic to all types of terrestrial plants and is used to kill floating and emergent aquatic vegetation. Glyphosate does not appear to have similar toxicity to algae. Glyphosate is considered by EPA to be “slightly toxic” to aquatic invertebrates (SERA 1996). LC_{50} values of 780 and 930 mg/L have been reported for daphnia. Hildebrand et al. (1980) found that Roundup treatments at concentrations up to 220 kg/ha did not significantly affect the survival of daphnia or its food base of diatoms under laboratory conditions. In addition, Simenstad et al. (1996) found no significant differences between benthic communities of algae and invertebrates on untreated mudflats and mudflats treated with Rodeo. It appears that under most conditions, rapid dissipation from aquatic environments of even the most toxic glyphosate formulations prevents build-up of herbicide concentrations that would be lethal to most aquatic species.

d5. Indirect effects of Sulfometuron-methyl

Sulfometuron-methyl appears to be relatively non-toxic to aquatic invertebrates. The LC_{50} values reported in SERA (1998a) for daphnids, crayfish, and field-collected species of other aquatic invertebrates are all above 802 mg/L, some by more than a factor of 10. No daphnid mortality was reported for groups exposed to concentrations of up to 12.5 mg/L. One daphnid reproduction study noted a reduction in the number of neonates at 24 mg/L, but not at 97 mg/L or at any of the lower concentrations tested. Aquatic plants are far more sensitive than aquatic invertebrates, although there appears to be substantial differences in sensitivity among species of macrophytes and unicellular algae. There are no published or unpublished data known regarding the toxicity of sulfometuron methyl to aquatic bacteria or fungi. By analogy to the effects on terrestrial bacteria and aquatic algae, it seems plausible that aquatic bacteria and fungi will be sensitive to the effects of sulfometuron methyl. Primary production is likely to be reduced in places where sulfometuron-methyl reaches water. The USDA (1999) observed water concentrations, after a rainfall, that were 1 to 2 orders of magnitude higher than the EC_{50} concentrations for some algae. The EC_{50} concentration for the freshwater algae *Senenstrum capriconutum* was 4.6 µg a.i./L in a 120-hour EC_{50} based on a reduction in cell density relative to controls (Hoberg 1990). The EC_{50} values for other freshwater algal species are generally greater than 10 µg/L, depending on the endpoint assayed (Landstein et al. 1993), but still fall in a range of concentrations that are likely to occur after a rainfall..

e. Physical Effects of Herbicides on Watershed and Stream Functions

The use of herbicides can affect watershed or stream functions through the removal of vegetation and exposing bare soil. For boom spraying, and hand and spot applications, the potential for significant increases in erosion or water yield is limited because treatments would consist of small, scattered areas, and vegetation would typically be reestablished within a few months to a year. Aerial application could potentially affect large contiguous areas, that could be large enough to increase water yield or sediment delivery, however, the areas proposed for aerial application are some of the driest sites, mostly benches that seldom experience overland flow, and are typically drained by ephemeral channels. The proposed no-spray buffer strips and other BMPS should minimize the effects of drift, chemical leaching, or other effects of weed spraying on riparian vegetation.

No measurable adverse effects to peak/base flow, water yield, or sediment yield are likely to occur from implementation of noxious weed control and rehabilitation measures. Removal of solid stands of noxious weed vegetation by chemical treatment may result in short-term, negligible increases in surface erosion that would diminish as desired vegetation re-occupies the treated site. Only ground based spot/selective spraying will be authorized within riparian areas or within 100 feet of live water (whichever is larger). This will significantly reduce risks associated with spraying of non-target riparian vegetation. Noxious weed control measures will reduce weed competition with native riparian species and other upland species. Herbicide spraying in riparian areas will be minimal and will primarily be associated with spot spraying along road right-of-ways, and spot spraying of small patches of noxious weeds or individual plants. No aerial application of herbicides will be authorized within 200 feet of the outer edge of riparian areas for fish bearing streams or within 100 to 150 feet of the outer edge of the riparian areas for non-fish bearing streams. During 2002 no aerial application will be occurring within any Riparian Conservation Habitat Areas (RCHAs).

f. Summary of Effects

The proposed action could potentially affect listed salmon and steelhead through lethal or sub-lethal chemical effects on listed fish, through alteration of the food web from toxic chemical effects, loss of desired riparian vegetation from contact with herbicides, or through restoration of native vegetation or more naturally-functioning watershed processes that are impaired by infestations of invasive weeds.

The risk of harm to listed salmon and steelhead from contact with herbicides is a function of chemical concentration to which listed fish are exposed, and the toxicity of the chemical. Available literature cited above indicates that expected levels of exposure to the herbicides are likely to be well-below levels where the herbicides kill outright listed salmon or steelhead once they matured beyond the fry stage. This conclusion is based on the fact that reported thresholds for mortality are at least 1 to 2 orders of magnitude higher than likely herbicide concentrations in water resulting from the proposed action. Salmonid eggs and fry appear to be more sensitive to toxic effects than older life stages, and reported concentrations where mortality was observed in these life stages approach the range of concentrations that might occur in the action area. Herbicide spraying in the vicinity of steelhead or salmon eggs or fry, could result in direct mortality if chemical are sprayed into the water, or if rainfall occurs shortly after application. The relatively small amount of area treated within a given watershed, use of BMPs to reduce the likelihood of exposure, and the dilute concentrations proposed for use reduce the probability that direct mortality would occur from chemical exposure.

Although outright mortality from herbicide exposure is not expected to occur, adverse effects reported in sub-lethal assays include reductions in reproductive success, weight loss, physiological effects (endocrine system, blood chemistry, liver function, etc.), and reductions in growth, prey capture ability, and swimming ability, all of which are associated with reduced survival. Information available on sub-lethal effects is incomplete, and few herbicide formulations have been thoroughly tested for sublethal effects on salmon or steelhead. Consequently, the extent of sub-lethal effects could be much greater than indicated by available information. Harm to listed fish from effects of chemicals on food webs are also possible, but difficult to quantify due to the paucity of information.

Given the presence of listed fish in the action area, the range of soil properties in the action area, chemicals proposed for use, rainfall patterns, and proposed spray activities, it is likely that circumstances will arise where herbicide concentrations in water will reach levels where delayed mortality or reduced reproductive success would occur. Such circumstances would arise in isolated instances when various combinations of factors occur, such as: use of chemicals that persist in the environment for several months or longer; conditions that allow chemicals to move rapidly through soils; when precipitation occurs before the chemicals break down, bind to soil particles, or get taken up by plants; where listed fish or redds are in the vicinity of a spray site; or where the amount of chemical applied to an area is great enough to reach concentrations that could harm listed fish. Specific locations where harm is likely to occur from the proposed action cannot be identified at this time, since most of the above factors will not be known until spray sites are selected.

Changes in vegetation from weed spraying or other control methods can beneficially or adversely affect riparian and watershed functions. Adverse effects have been reported in instances where herbicides killed non-target plants, particularly riparian trees killed as a result of spray drift or uptake by roots. Beneficial effects to aquatic systems from noxious weed control are not well-documented, but could conceivably occur in circumstances where weed treatments kill exotic plants that would otherwise create a disclimax riparian plant community or displace native plants that provide shade, cover, habitat complexity, streambank stability, or recruitment of terrestrial invertebrate prey. In some drier portions of the action area, exotic weeds have almost completely displaced native grasses and forbs. In these areas, fire frequency, fire behavior, ground cover characteristics, and watershed hydrology are all likely to be altered by weeds, and effective weed control could reduce or eliminate these adverse effects.

2. Cumulative Effects

The cumulative effects for fisheries resources include the effects of future state, tribal, or private actions that are reasonably certain to occur in the action area. The BA revealed a moderate to high risk for cumulative effects from activities occurring on private and state lands in the action area. The BLM lands in the action area are commonly interspersed with state and privately-owned lands, with non-Federal lands typically comprising the majority of the watershed acreage. Land use within the analysis area includes agricultural, timber harvest, roads, development, recreation, mining, and livestock grazing. Current levels of these uses are likely to continue, but detailed information on non-Federal activities in the action area are not available.

Livestock grazing may partially thwart weed control efforts. Cattle can spread weeds through their droppings, and create conditions that increase the likelihood that invasive weeds will out-compete native plants. Riparian cattle grazing on non-Federal lands is likely to cumulatively affect water temperature and water quality in portions of the action area.

Streamflows in the action area are not appreciably affected by water diversions, but a small number of stream diversions, in mostly headwater streams, exist on private lands. Reduced streamflows in smaller streams could appreciably increase the likelihood of reaching herbicide concentrations where adverse effects would occur.

Impaired water quality from on-going agricultural activities is likely to be one of the largest cumulative effects present in the action area. Cultivated croplands are likely to produce large amounts of sediment and increase water yield, and relatively large amounts of pesticides are also likely to be applied to croplands in the action area. City, state, and county governments also have on-going weed spraying programs with less-stringent measures to prevent water contamination. Weeds are sprayed along road right-of-ways annually by city, state, and county transportation departments, sometimes several times a year. NOAA Fisheries staff have observed county road crews spraying herbicides on streambank vegetation and directly into the water in Clearwater and Idaho Counties, and it is probable that similar practices will continue.

Any herbicide contamination that occurs from the proposed BLM action could potentially combine with contaminants from non-Federal activities, and contribute to formation of chemical mixtures or concentrations that could kill or harm listed steelhead or salmon. In addition, fish stressed by elevated sediment and temperatures are more likely to susceptible to toxic effects of herbicides. While the mechanisms for cumulative effects are clear, the actual effects cannot be quantified.

D. Conclusion

The final step in NOAA Fisheries' approach to determine jeopardy/adverse modification is to determine whether the proposed action, in light of the above factors, is likely to appreciably reduce the likelihood of species survival in the wild or adversely modify critical habitat. NOAA Fisheries has determined that, when the effects of the proposed action are added to the environmental baseline and cumulative effects occurring in the action area given the status of the stocks and condition of critical habitat, the action is not likely to jeopardize the continued existence of the listed Snake River steelhead and chinook salmon and ESUs considered in this Opinion. Further, NOAA Fisheries concludes that the subject action would not cause adverse modification or destruction of designated critical habitat for the Snake River chinook salmon ESUs considered in this Opinion.

These conclusions are based on the following considerations:

(1) The proposed action is not likely to impair physical habitat conditions or processes, since the majority of weed treatment sites are dispersed areas that would not be large enough to have any discernable effect on stream functions, and in instances where weed control activities occur in riparian areas or over large contiguous blocks of land, the activities are restricted by BMPs that prevent or minimize adverse effects.

(2) The proposed action is likely to impair water quality where herbicides enter the stream, however, such impairments are expected to occur in isolated cases, and be of short duration (*e.g*. spikes in concentration following a rainfall).

(3) Although toxicity of the herbicides may be underestimated due to gaps in the information available on toxic effects, gross errors in the effects analysis are not anticipated because the area where adverse effects could occur is less than 0.15% of any given subbasin.

(4) The proposed action will not appreciably reduce the survival of listed Snake River salmon or steelhead because instances where listed fish are likely to be killed or harmed are expected to be uncommon because, under most circumstances (with the exceptions noted above), the BMPs in the proposed action are expected to largely prevent herbicides from reaching water concentrations where listed fish would be killed or harmed by the chemicals.

In reaching these determinations, NOAA Fisheries used the best scientific and commercial data available.

E. Reinitiation of Consultation

This concludes formal consultation under the ESA on this action in accordance with 50 CFR 402.14(b)(1). Reinitiation of consultation is required: (1) If the amount or extent of incidental take is exceeded; (2) the action is modified in a way that causes an effect on the listed species that was not previously considered in the BA and this Opinion; (3) new information or project monitoring reveals effects of the action that may affect the listed species in a way not previously considered; or (4) a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16).

IV. CONSERVATION RECOMMENDATIONS

Section 7 (a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested by NOAA Fisheries "to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information" (50 CFR 402.02). NOAA Fisheries believes the conservation recommendations listed below are consistent with these obligations, and therefore should be implemented by the CFO.

1. The CFO should use herbicides with least toxicity to listed fish and other non-target organisms whenever possible.

2. The CFO should investigate the utility of alternative forms of weed control that do not involve the use of chemicals toxic to aquatic organisms. Examples of alternatives include

substitution of vinegar or acetic acid formulations for spot-spraying weeds, and use of steam or other heat-killing methods.

In order for NOAA Fisheries to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, we recommend NOAA Fisheries be notified of the implementation of any conservation recommendations

V. INCIDENTAL TAKE STATEMENT

Sections 4 (d) and 9 of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. Harm is further defined in 50 C.F.R. 222.102 as "an act that may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering." Harass is defined as actions that create the likelihood of injuring listed species to such an extent as to significantly alter normal behavior patterns which include, but are not limited to, breeding, feeding, and sheltering. Incidental take is take of listed species that results from, but is not the purpose of, the Federal agency or the applicant carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

An incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures.

A. Amount of Extent of Take

The proposed action is reasonably certain to result in incidental take of the listed species. The NOAA Fisheries is reasonably certain the incidental take described here will occur because: (1) Recent and historical surveys indicate the listed species are known to occur in the action area; (2) the proposed action would kill or harm individual listed salmon and steelhead through lethal or sub-lethal exposure to herbicides, respectively, as a result of accidental spills, failure of BMPs to keep chemical concentrations below expected levels, unexpected toxic effects that have not been reported in the scientific literature, or additive or synergistic effects of herbicides from multiple sources in the action area; and (3) the proposed action would adversely affect availability of invertebrate prey through toxic effects of herbicides on primary productivity and invertebrate prey.

Despite the use of best scientific and commercial data available, NOAA Fisheries cannot quantify the specific amount of incidental take of individual fish or incubating eggs for this action. The quantity of take depends on the circumstances at the specific locations where treatments will occur (which are not known at this time). In circumstances where the amount of take cannot be quantified, the extent of incidental take is described (50 CFR 402.14 [I]). The extent of take in the action area is anticipated to be no more than 2,241 acres (acreage proposed for treatment), and NOAA Fisheries anticipates that take will not occur in all of streams within the treatment areas.

B. Reasonable and Prudent Measures

Reasonable and Prudent Measures are non-discretionary measures to minimize take, that are not already part of the description of the proposed action. They must be implemented as binding conditions for the exemption in section 7(a)(2) to apply. The CFO has the continuing duty to regulate the activities covered in this incidental take statement. If the CFO fails to require the applicants to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, or fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. NOAA Fisheries believes that activities carried out in a manner consistent with these reasonable and prudent measures, except those otherwise identified, will not necessitate further site-specific consultation. Activities which do not comply with all relevant reasonable and prudent measures will require further consultation.

NOAA Fisheries believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of listed fish resulting from implementation of the action. These reasonable and prudent measures will also minimize adverse effects on designated critical habitat.

1. The CFO shall minimize the amount and extent of incidental take from use of herbicides by implementing precautionary measures that keep chemicals out of water.

2. The CFO shall monitor and report on the effectiveness of the proposed conservation measures in minimizing incidental take, and report this information to NOAA Fisheries.

3. The CFO shall report to NOAA Fisheries the activities actually completed during the 2002 season.

C. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, BLM must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. To Implement Reasonable and Prudent Measure #1, above, the BLM shall:

   a. Implement all BMPs described in the Proposed Action section of this Opinion, and Appendix D of the BA.

   b. Notify NOAA Fisheries Grangeville Field Office (Dale Brege, (208) 983-3859 ext 1) one week prior to commencing the initial herbicide application.

   c. A spill contingency plan will be developed prior to herbicide applications. All individuals involved, including any contracted applicators, will be instructed on the spill contingency plan and spill control, containment, and cleanup procedures.

   d. Maintain and have an industry approved spill cleanup kit available whenever herbicides are transported or stored.

   e. Ensure all chemical storage, chemical mixing, and post-application equipment cleaning is completed in such a manner as to prevent the potential contamination of any riparian area, perennial or intermittent waterway, unprotected ephemeral waterway, or wetland.

   f. Have a licensed/certified herbicide applicator oversee and supervise appropriately trained personnel for all spray projects to ensure proper mixing and application of chemicals.

   g. Avoid helicopter (aerial) spraying of low and moderate aquatic risk herbicides (identified in the BA) within 200 feet from the outer boundary of riparian areas for fish bearing streams and lakes; or within 150 feet from the outer boundary of riparian areas for non-fish bearing perennial streams, or within 100 feet of the outer boundary of riparian areas for intermittent streams, springs, seeps, wetlands, ponds, and shallow water table areas.

   h. Use only ground-based spot/selective applications of herbicides rated as having a low or moderate level of concern for aquatic species will be authorized from 15 to 100 feet from live waters or within riparian areas (which ever is greater). No boom spraying is authorized in this zone; only single nozzle spraying equipment authorized.

   I. Use only selective spot spraying of aquatic-approved herbicides, using only backpack spraying, hand-pump spraying, wicking, wiping, painting, dipping, or injecting target species within 15 feet of live water or areas over shallow water tables,

   j. Delay treatment if precipitation is likely to occur within 24 hours of scheduled application.

k. Treat only the minimum area necessary for the control of noxious weeds.

l. Prohibit helicopter service landings or fuel storage within 200 feet of fish-bearing streams and lakes, 150 feet of other perennial streams, or 100 feet of intermittent streams, springs, seeps, wetlands, or ponds.

m. Design aerial applications to deliver a median droplet diameter of 200 to 800 microns to reduce drift.

2. To implement Reasonable and Prudent Measure #2, above, the BLM shall:

   a. Implement a monitoring strategy that includes:

      (1) Drift monitoring with use of spray cards on a representative sample of streams.

      (2) Monitoring of non-target plant mortality in riparian areas to determine if mortality of non-target plants is affecting riparian functions in NMFS' matrix (NMFS 1996).

   b. Report monitoring results to NOAA Fisheries after the field season, and prior to 2003 weed control activities, if a similar action is proposed in the following season.

3. To implement Reasonable and Prudent Measure #3, above, the BLM shall:

   a. Report to NOAA Fisheries the actual number of acres treated, the chemicals used, application method, and location of treatment sites. Use a format similar to Table 1 in the Opinion, adding a description of the application method to the table.

VI. MAGNUSON-STEVENS ACT

A. Background

The objective of EFH consultation is to determine whether the proposed action may adversely affect designated EFH for relevant species, and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH resulting from the proposed action.

B. Magnuson-Stevens Fishery Conservation and Management Act

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297), requires the inclusion of EFH descriptions in Federal fishery management plans. In addition, the MSA requires Federal agencies to consult with NOAA Fisheries on activities that may adversely affect EFH. The EFH means those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting the definition of essential fish habitat: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.110).

Section 305(b) of the MSA (16 U.S.C. 1855(b)) requires that:

- Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH;

- NOAA Fisheries shall provide conservation recommendations for any Federal or state activity that may adversely affect EFH;

- Federal agencies shall within 30 days after receiving conservation recommendations from NOAA Fisheries provide a detailed response in writing to NOAA Fisheries regarding the conservation recommendations. The response shall include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the conservation recommendations of NOAA Fisheries, the Federal agency shall explain its reasons for not following the recommendations.

The MSA requires consultation for all actions that may adversely affect EFH, and does not distinguish between actions within EFH and actions outside EFH. Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside EFH, such as upstream and upslope activities, that may have an adverse effect on EFH. Therefore, EFH consultation with NOAA Fisheries is required by Federal agencies undertaking, permitting or funding activities that may adversely affect EFH, regardless of its location.

C. Identification of EFH

The Pacific Fisheries Management Council (PFMC) has designated freshwater EFH for Pacific salmon as all streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC), and longstanding, naturally-impassable barriers (*i.e.*, natural waterfalls in existence for several hundred years)(PFMC 1999). Chief Joseph Dam, Dworshak Dam, and the Hells Canyon Complex (Hells Canyon, Oxbow, and Brownlee Dams) are among the listed man-made barriers that represent the upstream extent of the Pacific salmon fishery EFH.

Detailed descriptions and identifications of EFH for the groundfish species are found in the Final Environmental Assessment/Regulatory Impact Review for Amendment 11 to The Pacific Coast Groundfish Management Plan (PFMC 1998a) and the NMFS Essential Fish Habitat for West Coast Groundfish Appendix (Casillas *et al.* 1998). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of the potential adverse effects to these species' EFH from the proposed action is based on this information.

D. Proposed Action

The proposed action is detailed above in section 2. The action area consists of all rivers and streams on BLM lands in the following 4th code HUCs: Lower Snake River (17060703), Lower Salmon River (17060209), Little Salmon River (17060210), Clearwater River (17060306), and South Fork Clearwater River (170603050); and rivers and stream downstream from BLM lands that potentially receive herbicide inputs through direct contamination, runoff, or percolation. BLM administered lands in the action area are located in widely scattered small to moderate parcels intermingled with private, state, and other Federal lands. The entire action area is designated as EFH for chinook salmon, and the Clearwater and Lower Snake River HUCs are designated as EFH for coho salmon.

E. Effects of the Proposed Action

As described in detail in section 3.3, the proposed activities may result in detrimental effects on water quality (chemical contamination). Herbicide concentrations are expected on occasion to reach concentrations where salmon would be harmed by exposure to toxic chemicals, or through effects of toxic chemicals on the species' prey.

F. Conclusion

NOAA Fisheries believes that the proposed action may adversely affect EFH for Pacific salmon.

G. The EFH Conservation Recommendations

Pursuant to section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations for any Federal or state agency action that would adversely affect EFH. The conservation measures proposed for the project by the CFO, all Conservation Recommendations outlined above in section II.A.5 and all of the Reasonable and Prudent Measures and the Terms and Conditions contained in sections V.B and V.C. are applicable to EFH. Therefore, NOAA Fisheries incorporates each of those measures here as EFH recommendations.

H. Statutory Requirements

Please note that the MSA (section 305(b)) and 50 CFR 600.920(j) requires the Federal agency to provide a written response to NOAA Fisheries after receiving EFH conservation recommendations within 30 days of its receipt of this letter. This response must include a description of measures proposed by the agency to avoid, minimize, mitigate or offset the adverse impacts of the activity on EFH. If the response is inconsistent with a conservation recommendation from NOAA Fisheries, the agency must explain its reasons for not following the recommendation.

I. Consultation Renewal

The CFO must reinitiate EFH consultation with NOAA Fisheries if either action is substantially revised or new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR 600.920).

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APPENDIX A - Description of Herbicide Properties

Clopyralid - 3,6-dichloro-2-pyridinecarboxylic acid, is commonly known as Stinger®, Reclaim®, and Transline®, is an auxin growth regulator that acts as a synthetic auxin or hormone, altering a plant's metabolism and growth characteristics. Clopyralid is in the pyridine carboxylic acid family which includes herbicides such as picloram. The formulation of Transline is manufactured by Dow Agro and contains 40.9% clopyralid as the monoethanolamine salt and 59.1% inert ingredients. The inert ingredients in Transline are water, isopropyl alcohol, and proprietary surfactants (USFS 1995a) Clopyralid is registered by the Environmental Protection Agency (EPA) as a general use pesticide (GUP) in the United States (U.S.) and is used to control many types of broadleaf weeds. The registered use rate is 0.0625 to 4.0 lbs. of acid equivalent (a.e.)/acre (USFS 1995a).

Clopyralid does not bind tightly to soil and thus would seem to have a high potential for leaching, however, the potential of clopyralid to be transported to streams via groundwater is minimal due to its rapid degradation in soils which prevents leaching (USDI 2002). Half-life is between 15 to 287 days with soil microbes being responsible for a major portion of the degradation. Anaerobic soils have lower populations of microbes, and as a result, lower decomposition rates

Clopyralid also has a low level of toxic risk to aquatic species based on field studies. At application rates of 1 lb. per acre, the observed contamination in water was about 50 times lower than the lowest LC_{50} (concentration where 50% of test organisms are killed) for aquatic animals (.0021 mg active ingredient per liter, or a.i./L). For fish, only 96-hour toxicity bioassays are available with the lowest reported LC_{50} for clopyralid being 103 mg a.i./L. Macro-invertebrates may be less sensitive with LC_{50} s of 232 mg a.i./L (SERA 1999). The effects of clopyralid seem to be the greatest on aquatic plants. The lowest reported effective concentration expected to cause a biological effect on 50% of a group of test animals (EC50) for growth inhibition of green algae is 6.9 mg/L (SERA 1999). The EC_{50} for growth inhibition in duckweed was measured at 89 mg/L (DOW AgroSciences 1998). At lower concentrations growth of other aquatic macrophytes is stimulated (Forsyth et al. 1997).

Clopyralid may be present in soils under anaerobic (no oxygen) conditions and in soils with a low microorganism content. The half-life in the soil can range from 15 to 287 days (USFS 1995a).

The chemical formulation of Transline® includes isopropyl alcohol which is cited on EPA inert ingredient list three (Inerts of unknown toxicity for which there is little concern about toxicity) (USFS 1995a). Excessive exposure to isopropyl alcohol may cause eye, nose and throat irritation and at prolonged (hours) and high exposures may cause a lack of coordination, confusion, low blood pressure, low body temperature, circulatory collapse, respiratory arrest and even death. The manufacturer has not revealed the identity of the surfactants used in the formulated products (USFS 1995a).

2,4-D - 2,4-Dichlorophenoxyacetic acid, is commonly known as Solution®, Savage®, DPD Ester Brush Killer®, Barrage®, or a number of other products. 2,4-D is registered by the EPA as a GUP in the U.S. and is used to control many types of broadleaf weeds. 2,4-D is toxic to most broad leaf crops, especially cotton, tomatoes, beets, and fruit trees. The registered use rate is 0.475 to 3.8 pounds a.i./acre, and the method of application may be aerial and ground spraying, lawn spreaders, cut surface treatments, foliar spray, basal bark spray, or injection (Extoxnet 1996a).

2,4-D is a member of the chlorinated phenoxy family and interferes with normal plant growth processes by stimulating nucleic acid protein synthesis, and by affecting enzyme activity, respiration, and cell division. Uptake of the compound occurs through leaves, stems, and roots (Extoxnet 1996a).

There are many forms or derivatives of 2,4-D. Herbicides containing 2,4-D use the amine salt or ester forms of the compound. The amine and ester forms may differ in health-related activity and environmental fate and effects from the parent 2,4-D acid. Unless otherwise noted below, "2,4-D" refers collectively to the acid, amine salt, and ester forms.

Commercially produced 2,4-D contains one or more inert ingredients. The percentage and type depends upon the company creating the product, and whether the compound is an amine salt, ester, or the rarely used pure parent acid form. For example, HiDepr (liquid)® contains dimethylamine salt of 2,4-D (33.2%) and diethanol-amine salt of 2,4-D (16.3%), with ethylene glycol (10%) and other inerts (40.3%).

Depending upon the formulation used, the aquatic ecotoxicity rating can range from Very Highly Toxic to Practically Nontoxic to aquatic organisms (USFS 1995b). For cutthroat trout (*Salmo clarki*), LC_{50} values range between 1.0 and 100 mg/L. The Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Vertebrates (1980) reports a LC_{50} of 64 mg/L for 96 hours for cutthroat trout (95% confidence limit 57-72 mg/L) using 2,4-D acid, granular 100%/ wt 0.3 grams and pH at 7.2-7.5. Channel catfish (*Ictalurus punctatus*) had less than 10% mortality when exposed to 10 mg/L for 48 hours. Green sunfish *(Lepomis cyanellus*), when exposed to 110 mg/L for 41 hours, showed no effect on swimming response. Limited studies indicate a half-life of less than 2 days in fish and oysters (Extoxnet 1996a).

2,4-D amine salt forms are generally non-toxic to fish. However, studies have also shown that toxicities of two amine salts to fathead minnows (*Pimephales promelas*) did not change after aging test solutions 21 days. Also, fry and fingerlings are considerably more sensitive than eggs to two amine salts of 2,4-D. In fathead minnows, tests with the dimethyl amine of 2,4-D yielded 96-hour LC_{50} values ranging from 320-6300 mg/L for fingerlings and swim-up fry, compared with over 1,400 mg/L for the egg stage. In rainbow trout, tests with dodecyl/tetradodecyl amine against several life stages yielded LC_{50} values (mg/L) of 3.2 for fingerlings, 1.4 for swim-up fry, 7.7 for yolk-sac fry, and 47 for eggs (USFWS 1980). Research has shown bioconcentration in fish tissue. (Cox 1999, NIH 2002a, Walters 1999).

The 2,4-D compound that is most toxic to fish, particularly juvenile salmonids, is the butoxyethanol ester formulation. Acute LC_{50} values for this particular formulation have been found for chinook salmon fry and smolts of < 0.4 ppm; juvenile chum salmon (*Oncorhynchus keta*), < 0.8 ppm; and juvenile pink salmon (*Oncorhynchus gorbuscha*), <1.0 ppm. Sublethal effects on the growth of juvenile chinook salmon (*Oncorhynchus tshawytscha*) have been investigated. Growth was reduced by using 0.6 ppm of the butoxyethanol ester formulation. Using the same formulation, physiological stress responses in sockeye salmon occurred at 0.3 ppm. 2,4-D acid in its pure form at 100 ppm caused slight mortality in fingerling bream and largemouth bass (NIH 2002a). The 96-hour LC_{50} is reported for the granular form of 2,4-D, acid, for lake trout (*Salvelinus namaycush*) as being 45 mg/L (95% confidence limit 35-56 mg/L), 100%/ wt 0.3 g, pH 7.2-7.5. (USFWS 1980). The 48-hour LC_{50} for rainbow trout is reported at 1.1 mg/L.

Sublethal effects for the amine salt form include the reduction in the ability of rainbow trout to capture food at 5 mg/L (Cox 1999). Sublethal effects studies showed that on the growth of juvenile chinook salmon was reduced with a concentration of 0.6 ppm of the butoxyethanol ester formulation. Using the same formulation, physiological stress responses in sockeye salmon (*Oncorhynchus nerka*) occurred at 0.3 ppm (NIH 2002a). One experimental model studied acute lesions in the area of the kidney that produces red blood cells in tench (*Tinca tinca*) caused by continuous exposure to 2,4-D acid dissolved in water at 400 mg/L. Fifty fish were used; 15 for calculating the LC_{50} and 35 were euthanized in five treatment and two control groups. Tissue samples revealed marked alteration of red blood cells, characterized by progressive swelling and tissue death, and activation of white blood cells. The LC_{50} at 96 hours demonstrated the importance of the species and chemical form used as factors in calculating a product's toxicity (Gomez et. al.1998).

A relationship exists between toxicity and pH level in a waterbody. In one study, the percent of fathead minnows surviving a particular concentration of 2,4-D increased as the pH increased in the water. At a concentration of 7.43 mg/L, 60% of the fish survived in 192 hours at pH 7.6, whereas 100% survived at pH 9.8. At the former concentration, normal schooling behavior was completely disrupted and equilibrium lost after 24 hour exposure. At the latter concentration, neither effect was noted, with pH measured at 8.68 and 9.08. A relationship between pH and the degradation of 2,4-D is present in soil medium, as well (NIH 2002a).

It should be noted that degradation of 2,4-D with varying pH levels varies between forms of 2,4-D. Research has shown the dodecyl/tetradodecyl amine form to be nearly four times more toxic to fathead minnows at certain aquatic pH levels (8.5), while the acid form, a butyl ester form, and a dimethyl ester form were about half as toxic to fish at this same pH level (USFWS 1980).

The fate of 2,4-D may also be affected by several processes including runoff, adsorption, chemical and microbial degradation, photodecomposition, and leaching. In general, 2,4-D has a moderate persistence in soil with a field dissipation half-life of 59.3 days, aerobic half-life of

66 days, and a hydrolysis half-life of 39 days. For some chemicals, such as 2,4-D, the influence of soil pH is mainly responsible for transformation from anionic[2] to nonionic[3] forms with decreasing pH. This can, in turn, affect adsorption. At pH levels below 6.0, 2,4-D is in nonionic form. Increasing the pH above 6.0 turns 2,4-D anionic. In slightly acidic soils, 2,4-D will be adsorbed at a pH level of less than 6.0 but will not be readily adsorbed at a pH level of 7.0 if in the anionic form, because the negative charges of the soil and of the chemical repel each other (Welp and Brommer1999; Walters 1999).

Overall, the persistence of 2,4-D depends upon formulation, pH, soil moisture, soil type, temperature, microbes, and the status of pre-exposure to 2,4-D or its salts or esters (which alter concentrations of 2,4-D applications in the soil). Once in soil, 2,4-D esters and salts are first converted to the parent acid prior to degradation (Walters 1999).

The rate of microbial degradation is dependent upon the water potential, depth, and temperature of the soil. Han and New (1994) found that sandy loam soil containing 2,4-D degrading single-celled filamentous bacteria (actinomycetes) and fungi had the lowest degradation rates at a low water potential, and an increase in water potential resulted in increased rates of breakdown. Dry soil conditions inhibit 2,4-D mineralization by restricting mobility, reducing the degrading activity of organisms, and suppressing the 2,4-D degrading microorganism populations. The rate of microbial degradation decreases with increased soil depths and lower temperatures (Walters 1999).

In coarse-grained sandy soils where both biodegradation and adsorption will be low, or with very basic soils, leaching to groundwater may occur (NIH 2002a). Because of the different formulations, 2,4-D ranges from being mobile to highly mobile in sand, silt, loam, clay loam, and sandy loam. Grover (1977) found that higher volumes of water were required to leach 2,4-D from soils with a high organic content. Leaching was correlated with the pH of soils, with 2,4-D leaching more readily in soils with a pH of 7.5 and higher reflecting higher adsorption to organic matter in more acidic soils.

Despite its potential mobility, 2,4-D generally persists within the top few inches of the soil. Walters (1999) applied 2,4-D at the rate of 4.49 kg/ha in the ester form to nursery plots with varying crop covers. The 2,4-D remained in the top 20 cm of the soil.

Timing and intensity of rainfall are important factors in determining the movement and extent of 2,4-D leaching in soil. It was found that 2,4-D is susceptible to runoff if rain events occur shortly after application, with runoff concentrations decreasing over time (Walters 1999). Also, the amount of litter and debris on the soil surface will provide infiltration, as 2,4-D adsorbs to the surfaces of a litter and humus layer.

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[2] Negatively charged ion

[3] No charge on the ion

Norris (1981) states that entry into waterbodies via leaching is not a significant transport method for significant quantities of 2,4-D, since most of it is adsorbed onto organic material and later readily degraded by microbial organisms. Despite assurances such as these, 2,4-D has been detected in groundwater supplies in at least five U.S. states and Canada, and very low concentrations have been detected in surface waters throughout the United States (Extoxnet 1996a).

Persistence of 2,4-D in water is dependent upon the formulation, volatilization, level of nutrients present, pH level, temperature, oxygen content, and previous contamination with 2,4-D or other phenoxyacetic acids. Microbial degradation is a possible route for the breakdown of 2,4-D, but it is very dependent on the characteristics of the water. In the lab, studies have shown that in warm, nutrient rich water previously treated with 2,4-D microbial degradation can be a major factor for dissipation. However, natural surface waters are generally cool with nutrient concentrations less than those needed to maintain 2,4-D degrading microorganism populations. These conditions would not promote the growth of microorganisms needed to achieve microbial degradation (Walters 1999). Microbial activity will play a important role in waters with bottom mud sediments and sludge. Degradation increases with sediment load (Extoxnet 1996a, NIH 2002a).

2,4-D should not be applied directly to water or wetlands, such as swamps, bogs, marshes, and potholes, and the issue of contamination by drift into such areas should be addressed (Extoxnet 1996a).

2,4-D can combine with other pesticides and have a synergistic effect, resulting in increased toxicity. Combining 2,4-D with picloram damages the cells of catfish (*Ictalurus spp*) gills, although neither individual pesticide has been found to cause this damage. Application of the insecticide carbaryl in the same area as 2,4-D ester can result in rainbow trout mortality, as carbaryl increases uptake of 2,4-D (Cox 1999).

Picloram - 4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid, is also known as Access®, Grazon®, Pathway®, or Tordon®. It is registered by the EPA as a "Restricted Use" pesticide. Sale and use of these pesticides are limited to licensed pesticide applicators or their employees, only for uses covered by certification. Picloram was placed in this category due to its mobility in water, combined with the extreme sensitivity of many important crop plants (Extoxnet 1996b).

Picloram is registered for control of woody plants and a wide range of broad-leaved weeds. Most grasses are resistant to picloram, so it can be used in range management programs to control bitterweed, knapweed, leafy spurge, locoweed, larkspur, mesquite, prickly pear, and snakeweed on rangeland in the western states. Picloram is formulated either as an acid (technical product), a potassium salt, a triisopropanolamine (TIPA) salt, or an isooctyl ester, and is available as either soluble concentrates, pellets, or granular formulations (Extoxnet 1996b). The registered use rate depends upon the plant(s) and formulation:

1. Picloram, TIPA salt: 0.27 to 2.16 pounds acid equivalent (a.e) per acre (lb a.e./A).

2. Picloram, isooctyl ester: used for basal bark treatment only.

3. Picloram, potassium salt: 1.0 to 8.5 lb a.e./A.

Picloram is a pyridine carboxylic acid herbicide. Other herbicides in this class include clopyralid, quinclorac and thiazopyrs. It is absorbed by the plant roots, leaves, and bark. It moves both up and down within the plant, and accumulates in new growth, interfering with the plant's ability to make proteins and nucleic acids (Extoxnet 1996b).

Both Grazon® PC and Tordon® K contain essentially the same amount of picloram (potassium salt) at 24.4%. "Inert ingredients", include water and dispersing agents, including surfactants, at 75.6% (Extoxnet 1996b).

The parent acid is characterized as moderately toxic to freshwater fish, with a LC_{50} of 5.5 mg/L (ppm) and slightly toxic to freshwater invertebrates (LC_{50} of 34.4 mg/L). The parent material has been tested on rainbow trout in various life stages, yielding a 96-hour LC_{50} of 8.0 mg/L for the yolk sac stage, 8.0 mg/L for the swim-up stage, and 11.0 mg/L for the fingerling stage (Extoxnet 1996b; USGS 2001). Field runoff studies conducted with cutthroat trout conclude that concentrations as low as 290 µg/l and 610 µg/l of the parent acid will affect survival & growth of cutthroat trout. Examining the toxicity of the individual picloram formulations, the EPA characterizes picloram TIPA salt as slightly toxic to freshwater fish, with a LC_{50} of 25 mg/L (ppm). A test with coho salmon yielded a LC_{50} of 20 ppm (EPA 1995). The reported 96-hour LC_{50} for the isooctyl ester in rainbow trout is 4 mg/L, and in channel catfish is 1.4 mg/L, giving it a "moderate toxicity" rating. Other LC_{50} values in aquatic invertebrates ranged from 10 to 68 mg/L (Extonet website). The picloram potassium salt is characterized by the EPA as "slightly toxic" to freshwater fish, with a LC_{50} of 13 mg/L and "slightly toxic" to freshwater invertebrates (LC_{50} of 68.3 mg/L). Fish early-life stage and Life-Cycle Aquatic Invertebrate Studies provided Lowest Observed Effect Concentrations (LOECs) of 0.88 mg/L and 18.1 mg/L, respectively (EPA 1995). In static tests of the toxicity of picloram acid to cutthroat and lake trout, the 96 hr LC_{50}'s ranged from 25 to 86 mg/L for picloram (Woodward 1976)

In a simulated field study, Mayes (1984) found that concentrations greater than 13 mg/L following rainfall increased fry mortality in cutthroat trout and concentrations greater than 0.61 mg/L decreased growth. In a study with bull trout, no adverse affect was noted from less than 0.29 mg/L (Woodward 1979).

The toxicity of technical picloram, picloram potassium salt, and picloram triisopropanolamine salt to aquatic organisms was evaluated in static acute toxicity tests. Species tested were the fathead minnow, rainbow trout, bluegill, and the daphnia (*Daphnia magna*). Rainbow trout was the most sensitive species tested with LC_{50} 96 hour median lethal concentrations of 19.3, 48, and

51 mg/L for the three picloram forms, respectively (all “slightly toxic” ratings). These LC_{50} values are 36-fold greater than picloram concentrations detected in freshwater following application to experimental watersheds (NIH 2002b).

Woodward (1976) found that the rate of yolk sac absorption and growth of lake trout fry was reduced in flow-through tests at concentrations as low as 0.35 mg/L of picloram. His research also indicated that chronic toxicity on early life stages of lake trout is more significant than might be anticipated on the basis of only acute tests with fingerlings (Woodward 1976).

Picloram is not expected to accumulate appreciably in aquatic organisms; the measured bioconcentration factor in bluegill sunfish was less than 0.54 (Extoxnet 1996b).

It should be noted that although most grasses are resistant, picloram is highly toxic to many non-target plants, and there is potential for damaging riparian habitat by spraying too close to a riparian buffer. Picloram is persistent in the environment, and may exist at levels toxic to plants for more than a year after application at normal rates.

One study examined persistence, rainfall induced migration, potential contamination of surface and groundwater, and losses by photodegradation by monitoring treatment sites for 445 days. Picloram was applied to control spotted knapweed on two sites in the Northern Rockies to represent best case and worst case conditions for on site retention of picloram. A valley bottom was treated with 0.28 kg/ha in the spring of 1985 and sampled over 445 days. In the spring of 1986, picloram was applied to both sides of a minimal construction logging road extending 4 km along a stream draining a granitic upper mountain watershed. Of the 17.1 sq km watershed, 0.15% was sprayed. Vegetation, soils, surface water, and groundwater near the road were sampled during the 90 days following application. After 90 days, 78% of the picloram remained in the mountain watershed. It was not detected in the surface water or the groundwater during the 90 days after application. At the valley bottom site, 36, 13, and 10.5% of the picloram persisted after 90, 365, and 445 days. It was concluded that loss by photodegradation was an important factor at both sites during the first seven days (NIH 2002b)

Environmental fate data indicate that picloram is mobile and persistent in laboratory and field studies (EPA 1995). Picloram is classified as moderately to highly persistent in the soil environment, with field half-lives generally from 20 to 300 days. However, some experiments show persistence exceeding 5 years. The estimated average is 90 days. Photodegradation is significant only on the soil surface and volatilization is insignificant. Degradation by microorganisms is mainly aerobic, and dependent upon application rates. Increasing soil organic matter increases the sorption of picloram and increases the soil residence time. Picloram adsorbs to clay and organic matter and is highly soluble in water. Picloram is poorly bound to soils lacking clay or organic matter, and can be leached out of the soil. These properties, combined with its persistence, mean it may pose a risk of groundwater contamination. Picloram has been detected in the groundwater of 11 states at concentrations ranging from 0.01 ug/l to 49 ug/l (Extoxnet 1996b).

Picloram is water soluble and can be carried by surface run-off. If released in water, it will not appreciably adsorb to sediments, evaporate, or readily hydrolyze. It is subject to photolysis[4], if it is near the water's surface, with reported half-lives ranging from 2.3 to 41.3 days. In laboratory studies, sunlight readily broke down picloram in water, with a half-life of 2.6 days. In the field, herbicide levels in farm ponds were 1 mg/L following spraying and decreased to 0.01 mg/L within 100 days, primarily due to dilution and sunlight (Extoxnet 1996b, NIH 2002b).

Picloram may used alone or mixed into formulations with 2,4-D and applied on deep-rooted perennials on non-cropland, or as pellets or in combination with 2,4-D or 2,4,5-T for brush control. In one study, coho salmon smolts exposed to Tordon 101 (Picloram and 2,4-D) at 0.6 - 1.8 mg/L for 96 hours prevented successful migration upon their release (Wedemeyer 1980).

Glyphosate - N-(phosphonomethyl)glycine, isopropylamine salt, commonly known as Pondmaster®, Ranger®, Roundup®, Rodeo®, and Touchdown®, is registered by the EPA as a General Use Pesticide. It may be used in formulations with other herbicides (Extoxnet 1996c). Glyphosate is a broad-spectrum, non-selective systemic herbicide used to control grasses, herbaceous plants including deep rooted perennial weeds, brush, some broadleaf trees and shrubs, and some conifers. The registered use rate is 0.3 to 4.0 pounds of a.i/acre and may be applied by aerial spraying; spraying from a truck, backpack or hand-held sprayer; wipe application; frill treatment; or cut stump treatment. It is absorbed by leaves, moves rapidly through the plant, acting to prevent production of an essential amino acid that inhibits plant growth. In some plants, glyphosate is metabolized or broken down while other plants do not break it down (Extoxnet 1996c).

Glyphosate itself is an acid, but it is commonly used in salt form (isopropylamine salt). It may also be available in acidic or trimethylsulfonium salt forms. It is generally distributed as water-soluble concentrates and powders (Extoxnet 1996c). Most commercially produced glyphosate, such as Accord® and Rodeo®, contain glyphosate (41.5%) and water (58.5%) , although some brands, such as Roundup,® include a surfactant (polyethoxylated tallowamine surfactant, 15%) (Extoxnet 1996c).

Glyphosate acid and its salts are classified as "moderately toxic" compounds by the EPA. Technical glyphosate acid (parent compound) is "practically nontoxic" to fish and may be "slightly toxic" to aquatic invertebrates. The 96-hour LC_{50} is 86-140 mg/L in rainbow trout and 120 mg/L in bluegill sunfish. The 48-hour LC_{50} for glyphosate in daphnia (water flea), an important food source for freshwater fish, is 780 mg/L. The results of a rainbow trout yolk-sac 96-hour LC_{50} static bioassay ranged from 3.4-5.3 mg/L (USGS 2002).

There is a very low potential for the compound to build up in the tissues of aquatic invertebrates or other aquatic organisms (Extoxnet 1996c). In one study of bioaccumulation and persistence,

[4]chemical decomposition by the action of radiant energy

glyphosate was applied to two hardwood communities in Oregon coastal forest and none of the 10 coho salmon fingerlings analyzed had detectable levels of the herbicide or its metabolite aminomethylphosphonic acid, although levels were detectable in stream water for three days and in sediment throughout the 55-day monitoring period (NIH 2002c).

Looking at the different formulations, the Accord® and Rodeo® formulations are practically nontoxic to freshwater fish (LC_{50} = >1,000 ppm) and aquatic invertebrate animals (LC_{50} = 930 ppm for *Daphnia*). The Roundup® formulation, which contains the surfactant, is moderately to slightly toxic to freshwater fish (LC_{50} = 5-26 ppm) and aquatic invertebrate animals (LC_{50} = 4-37 ppm for *Daphnia*). Glyphosate and its formulations have not been tested for chronic effects in aquatic animals (Extoxnet 1996c). The EPA conducted surfactant testing for both cold-water and warm-water fish for glyphosate (EPA 1993). The application rate used was lower than for technical glyphosate. A formulation of 41.2% isopropylamine salt and 15.3 "AA" surfactant provided a rainbow trout LC_{50} of 120 mg/L, which EPA considers to be "practically nontoxic." Bluegill sunfish experienced similar results, with a LC_{50} of greater than 180 mg/L. Bluegill and rainbow trout were found to be similar in sensitivity to the glyphosate formulation containing the "W" surfactant, with LC_{50} values of 150 and >100 mg/L, respectively. Neither rainbow trout (LC_{50} of 240 mg/L) nor bluebill (LC_{50} of 830 mg/L) were very sensitive to the x-77 (.5) surfactant and glyphosate (7.03%) (EPA 1993).

The surfactant MON0818 was tested separately, producing an LC_{50} of 13 mg/L for channel catfish, indicating that it is slightly toxic for catfish, who appear to be the most tolerant to this surfactant. Rainbow trout are the most sensitive, with a LC_{50} of 0.65 mg/L, classifying this as highly toxic. Based upon the available data, products containing MON0818 must include the statement: "This pesticide is toxic to fish." (EPA 1993).

In the aquatic environment with freshwater fish, toxicity appears to increase with increasing temperature and pH. As reported in the Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates (USFWS 1980), glyphosate was twice as toxic to rainbow trout at 17°C than at 7°C. With bluegills, toxicity was twice as toxic at 27°C compared to 17°C. Toxicity was also two to four times greater to bluegills and rainbow trout at a pH level of 7.5 to 9.5 than at pH 6.5 (pH of 7.0 is considered "neutral water").

Glyphosate is classified as moderately persistent in soil, with an estimated average half-life of 47 days. Field half-lives range from 1 to 74 days. It is strongly adsorbed to most soil types, including types with low organic and clay content. Therefore, even though it is also highly soluble in water, it has a low potential for runoff (except as adsorbed to colloidal matter) and leaching. One study estimated that two percent of the applied chemical was lost to runoff.

Microbes appear to be the primary pathway for degradation of phyphsate (biodegradation), while volatilization or photodegradation (photolysis) losses are negligible (Extoxnet 1996c). Under laboratory conditions, glyphosate has been rapidly and completely biodegraded by soil microorganisms under both aerobic and anaerobic conditions. In one study, after 28 days under aerobic conditions, 45% to 55% of the glyphosate was mineralized using Ray silt loam soil, Lintonia sandy loam soil, and Drummer silty clay loam soil. Norfolk sandy loam mineralized glyphosate at a much slower, but still significant, rate. Data indicate half-life values of 1.85 and 2.06 days in Kickapoo sandy loam and Dupo silt loam, respectively (EPA 1993).

Although glyphosate has a low propensity for leaching, it can enter water bodies by other means, such as overspray, drift, and erosion of contaminated soil. Once in water, glyphosate is strongly adsorbed to any suspended organic or mineral matter and is then broken down primarily by microbes. Sediment adsorption and/or biodegradation represents the major dissipation process in aquatic systems. Half-lives in pond water range from 12 days to 10 weeks (Extoxnet 1996c).

Evidence from studies suggest that glyphosate levels first rise and then fall to a very low, or even undetectable level, in aquatic systems. After glyphosate was sprayed over two streams in rainy British Columbia, levels in the streams rose dramatically after the first rain event, 27 hour post-application, and fell to undetectable levels 96 hours post-application. The highest glyphosate residues were found in sediments, indicating strong adsorption characteristics of this herbicide. Residues persisted for the entire 171-day monitoring period. It was found that suspended sediment is not a major mechanism for glyphosate transport in rivers (NIH 2002c).

Questions have been raised about the role photodegradation plays once glyphosate is in a waterbody, particularly when laboratory versus field conditions are involved. The EPA states in the Registration Eligibility Document (1993) that glyphosate is stable to photodegradation in pH 5, 7, and 9 buffered solutions under natural sunlight.

Sulfometuron-methyl - Methyl 2-[[[[(4,6-dimethyl-2-pyrimidinyl) amino] caronyl] amino] sulfony] benzoate, commonly known as Oust®. Oust® is registered by the EPA as a GUP in the U.S. and is used for the control of annual and perennial grasses and broad leaved weeds in non-crop lands. It is also used to control woody tree species in many forested areas. Oust® is typically applied either post-or pre emergent and works by blocking cell division in the active growing regions of stems and root tips (meristematic tissues) (Extoxnet 1996d). The registered use rate is up to 8.0 ounces of a.i./A (USFS 1995c). Oust®, can be applied as a stand alone herbicide, however, most applications are in combination with other herbicides such as diuron, glyphosate, or hexazinone (SERA 1998).

Sulfometuron-methyl is a member of the sulfonylurea herbicide class. High pH soils increase the persistence of the chemical. Only biodegradation occurs in high pH soils, whereas soils with lower pH allow for both chemical degradation and biodegradation to occur, speeding inactivation (Ross and Childs 1996).

The formulation of Oust® contains 75% sulfometuron-methyl and 25% inert ingredients. None of the inert ingredients have currently been released to the EPA.

The SERA (1998) assessment concluded that “there is no evidence that concentrations of sulfometuron-methyl in the range of those likely found in ambient water after any plausible application program or those that might occur after a spill will cause adverse (lethal) effects in fish or aquatic invertebrates." However, potential sub-lethal effects of sulfometuron methyl on listed fish, and potential lethal or sub-lethal effects of Oust® on listed fish and other aquatic organisms are largely unknown.

Lethal effects in fish are thought to be unlikely at concentrations less than or equal to 150 mg/L. The lowest reported concentrations at which mortality was observed in any tested species of fish was 1.25 mg/L (SERA 1998). Mortality of 1/10 bluegill sunfish was reported at this level, however, during the same study using 12.5 mg/L no mortality was reported on 10 bluegill sunfish (SERA 1998). Based on a chronic daphnid study, the longer term reproductive NOEL (no observable effect level) is approximately 100 mg a.i./L, while the highest concentration level tested for effects on egg and fry, 1.17 mg a.i./L, had no effect on hatchability, growth, or survival in fish (SERA 1998). The potential lethal and sub-lethal effects from the product formulation used in Oust have currently not been evaluated for salmonids.

Monitored levels of sulfometuron methyl in ambient water after a rainfall event were reported by Neary and Michael (1989) to be 0.02 mg/L (range 0.005-0.04 mg/L), resulting from an application rate of 0.36 lbs a.i./acre. At the proposed application rate of 0.0625 lbs a.i./acre (1.0 ounce a.i./acre), under conditions to those in the Neary and Michael (1989) study, the expected levels of sulfometuron methyl in ambient water would be 0.0009 - 0.007 mg/L, which is three orders of magnitude below the lowest concentrations where mortality was reported in SERA (1998).

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