BIOLOGICAL OPINION

ON THE USDA FOREST SERVICE APPLICATION OF FIRE RETARDANTS

ON NATIONAL FOREST SYSTEM LANDS

This document is the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the continued aerial application of fire retardants on National Forest System (NFS) Lands and its effects on threatened and endangered species and designated critical habitat in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). Your request for formal consultation was received by us on June 29, 2007. We requested additional information which we received on August 29, 2007. With that information, consultation was initiated effective that date.

This consultation is programmatic in scope and does not evaluate site specific impacts that may occur as a result of the use of eight long-term fire retardant chemicals ("long-term" fire retardants are those that continue to retard burning even after the water content has evaporated), nor does it attempt to quantify or authorize any take of threatened or endangered species that may result from the proposed Federal action or adverse modification of critical habitat. These impacts will be analyzed and quantified through subsequent emergency consultations pursuant to 50 CFR 402.05. This consultation reviews fire retardant use at the national programmatic level with that specificity and analysis that can be predicted considering the nature of the Proposed Action. Fire retardants are typically used under emergency conditions (i.e., fire), a situation commonly addressed under emergency consultation procedures, which provide for a site-specific consultation on actual application. This consultation does not address the application of fire retardant foams or other methods of application of any fire retardant chemicals since these were not proposed as part of the Federal action.

The FWS recognizes the importance of the use of fire retardants in responding to wildland fires. This biological opinion in no way constrains the USFS' ability to defend human life or property during an emergency.

This biological opinion has been prepared in accordance with section 7(b)(4) of the Endangered Species Act, as amended (16 U.S.C. 1531 et seq.) is based on information provided in the final Aquatic Report/Biological Assessment, the final Environmental Assessment, the final Hydrology Report, numerous meetings and telephone conversations with personnel from the U.S.D.A. Forest Service (USFS) and National Marine Fisheries' Service (NMFS), and other sources of information. A complete administrative record of this consultation is on file at 4401 N. Fairfax Dr, room 420, Arlington, VA 22203 and available for viewing by appointment.

Consultation History

<u>Background</u>

In April 2000, the USFS, with the U.S. Fish and Wildlife Service (FWS) and NMFS developed the *Guidelines for Aerial Application of Fire Retardant and Foams in Aquatic Environments* (2000 Guidelines; App. A). These guidelines established a buffer area of 300 feet adjacent to waterways in which no retardant is to be applied, except in the case of certain specified exceptions. Implementation of the Guidelines is intended to minimize instances of retardant entering aquatic systems.

In 2003, the USFS was sued by Forest Service Employees for Environmental Ethics for failure to comply with the National Environmental Policy Act (NEPA) and the Endangered Species Act. On September 30, 2005, Judge Molloy ruled that the USFS must complete an Environmental Assessment (EA) or Environmental Impact Statement (EIS) and begin formal consultation with FWS. Later, on February 9, 2006, the judge ruled that the USFS must comply with NEPA by no later than August 8, 2007, which was later extended to October 15, 2007. The FWS initially advised the Court that it would complete consultation by January 15, 2008, but later advised that it would require additional time.

<u>History of this Consultation:</u>

On October 30, 2006, FWS and NMFS (hereafter collectively referred to as the Services) were contacted by the USFS to begin discussion/informal consultation on the continued aerial application of fire retardants.

A conference call was held on November 16, 2006, and included personnel from USFS, FWS, and NMFS. The discussion included information that after the 2007 fire season, the USFS would no longer buy or use retardant formulations containing sodium ferro-cyanide and the USFS's intent to use the section 7 process to assist in making a NEPA decision on retardant use and the significance of environmental impacts; use section 7 to guide future use of retardant in ways that minimize risks to threatened and endangered species; and comply with a court order to comply with the Endangered Species Act. In this call, the USFS informed the Services that due to a court decision in 2005, consultation on this issue needed to be complete by August 8, 2007. The USFS informed the Services that a draft environmental assessment (EA) would be provided by December 1, 2006. At this time the USFS also provided a spreadsheet with information on fish kills caused by unintentionally introducing retardants to rivers between 2001 and 2005.

On December 8, 2006, the USFS provided a draft Aquatics Report to the Services and stated that a draft of the NEPA document would be provided on December 28, 2006. The draft Aquatics Report concluded that since the fire retardants "are typically never intentionally applied to waterways, the 300 foot buffer should suffice in keeping retardant chemicals out of the aquatic environment."

On January 23, 2007, the USFS provided draft versions of the first and second chapters of the EA to FWS and NMFS.

On February 6, 2007, the Services and the USFS held a conference call to discuss several outstanding issues including the scope of the proposed action. The Services believed that the scope of the proposed action should include not only the general authorization of use of retardants, but also a programmatic review of the use of retardant chemicals, as could be accomplished at the programmatic level. USFS initially had defined the scope more narrowly, but ultimately agreed that the consultation should proceed on the basis of the proposed action including the authorization of the use of retardants, the actual use of retardants and the permanent adoption of the 2000 Guidelines.

On March, 20, 2007, and March 23, 3007, respectively, the USFS provided the Services with the draft EA and a draft Aquatics Report and requested any additional comments be provided promptly so they could make any changes that would be necessary. The draft EA initially concluded that the proposed action (identified as allowing future nationwide aerial application of fire retardant on NFS lands using the 2000 Guidelines) "would have No Effect on aquatic species and their habitats, as the Proposed Action does not require the application of retardant." The draft Aquatics Report also initially concluded that the 2000 Guidelines would prevent any intentional drop of fire retardant in waterways, therefore the Proposed Action was "No Effect."

On April 20 the FWS provided informal comments addressing the draft EA. In our comments, we informed the USFS that a No Effect determination was inappropriate because the agency action must include the authorization and use of retardant, and also because we did not agree that the 2000 Guidelines would always avoid entry of retardant into waterways. We also requested an analysis of potential effects to upland vegetation.

On June 12, 2007, FWS provided comments on the revised draft Aquatics Report and included some additional literature, and a map from USGS of nationwide alkalinities to assist the USFS in determining differing toxicities of various fire retardant chemicals at different pH levels.

On June 28, 2007, the USFS formally requested initiation of consultation pursuant to section 7 of the ESA.

On July 10, the USFS sent several documents to the FWS via email, including the final EA, final Aquatics Report, and final Hydrology Report. These documents did not analyze any of the chemicals proposed for use, but did note that if retardant entered water, adverse effects to aquatic species could be possible. The EA also stated that there were no direct or indirect adverse impacts to upland ecosystems.

On July 13, 2007, a conference call was held between the Services and the USFS. The main concern was that the chemical composition of retardants had not been analyzed and the Services did not know if some retardants may pose more risk than others in various regions of the country. The other question was regarding how the decision to use certain chemicals for certain fires was reached.

On July 30, 2007, FWS received an updated Aquatics Report with a revised finding that the Proposed Action would be “may effect, likely to adversely affect, making note of the fact that if retardants get into higher pH streams, the chance of a fish kill is greater. The updated Aquatic Report did not provide further details on this issue since it was not USFS’ intention to introduce any retardants to any streams.

On August 29, 2007, the USFS sent the Services a combined Aquatics Report and Biological Assessment. The report provided a “programmatic analysis of effects to aquatic species, habitat, and upland vegetation.” Despite concerns that the effects of the proposed action required a more comprehensive evaluation, the Services agreed to initiate consultation without responses to the all requested information in an effort to meet the USFS’s deadline for completing its NEPA process of October 15, 2007.

On September 25, the Services met with the USFS to discuss the project and possible RPAs pursuant to NMFS’ determination of jeopardy to 26 fish species. The USFS provided additional information to the Services, including some information on decision making and post-fire evaluation processes that was apparently standard within the USFS, but had not been provided to the Services. The FWS requested a written description of these processes.

On September 28, 2007, USFS detailed three biologists to the FWS Washington Office to assist in providing supplemental information as part of the Biological Assessment and other reports. With their assistance, the FWS continued to receive additional information from the USFS, including information regarding historical retardant use per Forest and estimates of amount of retardant carried per tanker.

On October 10, 2007, the FWS sent a letter to the USFS stating that the consultation was initiated effective August 28, 2007, and that we expected to deliver the finished biological opinion by January 15, 2008. We also stated that due to the scope and complexity of this consultation, we might need an extension.

On December 31, 2007, the FWS sent a letter to the USFS and advised the Court that FWS needed an extension until March 15, 2008 in order to complete the biological opinion. However, after the court set a hearing in the matter, USFS requested FWS to expedite completion. FWS delivered a draft Biological Opinion to USFS on February 12, 2008. This final biological opinion completes consultation.

BIOLOGICAL OPINION

Description of the Proposed Action

The USFS has requested programmatic consultation on their continued aerial application of eight long-term fire retardants specifically on National Forest System (NFS) lands. Long-term fire retardants are those that continue to retard burning even after the water content has evaporated. Foams, other chemical fire suppressants, other types of application of retardant, or the use of retardant by other agencies on lands beyond the NFS lands were not included in this request, and consequently are not analyzed in this biological opinion. The proposed action would adopt the current interim "Guidelines for Aerial Delivery of Retardant or Foam near Waterways" (App. A) as permanent. These guidelines, herein referred to as the 2000 Guidelines, define a waterway as any body of water including lakes, rivers, streams and ponds whether or not they contain aquatic life. The 2000 Guidelines, established by the USFS, Bureau of Land Management, National Park Service and U.S. Fish and Wildlife Service were implemented to reduce the possibility of the application of fire retardant into waterways. This proposed action will not result in a requirement to apply retardant, nor does it compel the use of retardant at a later time or place. Rather, the proposed action will allow the Incident Commanders and fire managers to use retardant consistent with the 2000 Guidelines, as deemed necessary.

The USFS approves fire retardants for use after the products and their ingredients have been evaluated by the Wildland Fire Chemical Systems (WFCS) to determine whether they meet USFS needs, as described in the *US Dept of Agriculture, Forest Service Specifications 5100-304c, Long-term Retardant Wildland Firefighting, June 1, 2007*. According to the USFS website (http://www.fs.fed.us/rm/fire/wfcs/index.htm), WFCS is "…a part of Missoula Technology and Development Center and is located at the Missoula Technology & Development Center in Missoula, Montana. (WFCS) provides National Resource Agencies with detailed information promoting safe and effective Fire Suppression Chemicals and Aerial Delivery Systems." Once approved, the WFCS maintains the Qualified Products List (QPL), which presently includes eight long-term fire retardants, although after 2010 five of those formulations will no longer be used. The decision to approve particular chemicals as a Qualified Product is made at the Washington Office of the USFS.

A list of the approved fire retardants is provided in the Aquatics Report and Biological Assessment (BA) for this consultation. Each chemical is listed at a specific mix ratio and for use only in qualified applications. Additional information on these chemicals can be found at the website cited above. The trade names of the eight retardants are: Phos-Chek D75-R, Phos-Chek D75-F, Phos-Chek 259-R, Phos-Chek 259-F, Phos-Chek G75-F, Phos-Chek G75-W, Phos-Chek LV-R, and Phos-Chek LC-95A-R. In general, all eight fire retardants approved for use are ammonium phosphate compounds and a gum thickener and bactericide. The precise chemical composition was not provided for review in this consultation; therefore, we are unable to evaluate the specific chemical effects of each formulation on threatened and endangered species.

Method of Application

This consultation addresses only the aerial application of the eight fire retardant products described above. The USFS uses three primary kinds of firefighting aircraft to dispense these eight fire retardants: multi-engine airtankers, single engine airtankers, and helicopters.

- Multi-engine airtankers are comprised of ex-military and retired commercial transport aircraft. They carry 800 to 3,600 gallons of retardant. The speed, range, and retardant delivery capacity of the large (2,000 to 3,000 gallon) airtankers make them very effective in both initial attack and support to large fires. These airtankers typically make retardant drops from a height of 150 to 200 feet above vegetation and terrain. They move at airspeeds of 125 to 150 knots. Large fixed-wing airtankers have complex, computer controlled retardant dispersal systems capable of both precise incremental drops and long-trailing drops one-fourth of a mile or more in length. Retardant flow rates are controlled to vary the retardant coverage level. Retardant is dispersed as needed after consideration of a fire's intensity/behavior and the vegetative fuel type(s) involved. Large airtankers can load or reload retardant at established or temporary bases, which are located strategically across the country. Normally, large airtankers can be loaded within a 10-minute period.

- Single engine airtankers (SEATS) are small, fixed-wing aircraft that carry from 400 to 800 gallons of foam or retardant. SEATS can operate from remote airstrips and open fields or closed roads, reloading at portable retardant bases. SEATS are predominately modified agricultural aircraft although some have been designed specifically for wildland firefighting. SEATS are most effective in initial attack of small wildfires within 50 miles of a reload base where turn-around times are short and repetitive drops can be made.

- Small, medium and large helicopters carry from 100 to 3,000 gallons of water, foam, or retardant. This can be carried either in buckets slung beneath the aircraft or in mounted (fixed) tanks. Large heli-tankers can be very cost effective, making rapid, multiple drops of 2,000 gallons or more on escaping wildfires by refilling at nearby water sources or at portable retardant bases. They also provide a unique capability to those urban/wildland interface situations near water sources where they can bring to bear a combination of rapid revisit times and precision drops. Small and medium helicopters are most effective in the direct support of firefighters on the ground where they are directed to specific targets.

Decision Making and Use of Retardants

During a wildfire, events may unfold quickly and require rapid response and wide discretionary decision-making. Therefore, the decision where and when to use an aerial application of fire retardant is left to the discretion of the Incident Commander and other USFS personnel (FS 5100 Manual), and is informed by policy and guidance set by the Washington Office and appropriate Regional Office of the USFS, as well as procedures required by the FS 5100 Manual.

The USFS provides guidance for fire suppression activities through its Land Management Planning process. Land management plans have been completed for each National Forest and include guidance on fire management planning, but do not mandate specific decisions. Rather, this guidance consists of a compilation of existing direction readily accessible to practitioners and managers in the event of an unplanned ignition.

In the event that fire suppression decisions are deemed necessary, a WFSA (Wildland Fire Situation Analysis) is prepared. This is required when one of the following conditions has occurred:

- Wildland fire escapes initial actions or is expected to exceed initial actions
- A wildland fire being managed for resource benefits exceeds prescription parameters in the fire management plan
- A prescribed fire exceeds its prescription and is declared a wildland fire.

WFSA is a decision support process that provides an analytical method for evaluating alternative suppression strategies that are defined by different goals and objectives, suppression costs, and impacts on the land management base. A WFSA alternative describes a suppression strategy consistent with the "delegation of authority," (a set of instructions) communicated from a land unit administrator to an incoming incident commander. The "delegation" identifies what is important to protect, and may also establish cost targets. The FS 5100 Manual requires that the Agency Administrator ensures that a WFSA is prepared when the conditions exist and that all decisions are documented.

The generalized WFSA process is as follows:

1. Upon determination that one of the above-mentioned conditions has occurred, the Agency Administrator or designated staff prepare a preliminary WFSA document (App.B). This document is constantly reviewed and refined as necessary throughout the fire and includes concerns and constraints, such as the presence and locations of threatened or endangered species, designated critical habitat or other important resources. It may also specify particular fire suppression tactics that can or cannot be used.
2. A Resource Advisor (RA) is assigned to the fire and assists in the development of the WFSA document. The RA also works with the Incident Commander (IC) and the Incident Management Team daily to provide information on all important resources that may be affected by the fire.
3. In addition to the WFSA document, the USFS Administrator provides the IC with a Delegation of Authority letter, which allows the IC to act on their behalf and meet the expectations of the Administrator in implementing the selected alternative(s) from the WFSA. This letter will also include locations and concerns associated with any designated critical habitat, threatened and endangered species, cultural artifact concerns, or any other special direction that needs to be communicated to the IC and the Incident Management Team.

On October 9, 2007, NMFS issued its biological opinion on the USFS's proposal to aerially apply eight fire retardants to USFS lands. They concluded that the USFS's proposed action was likely to jeopardize the continued existence of 26 threatened and endangered species and to adversely modify the designated critical habitat of these species. Their Reasonable and Prudent Alternatives were accepted by the USFS and are now a part of the USFS's proposed action.

Reasonable and Prudent Alternatives (quoted from NMFS' Biological Opinion)

"The USFS must:

1. Provide evaluations on the two fire retardant formulations, LC 95-A and 259R, for which acute toxicity tests have not been conducted, using standard testing protocols. Although direct fish toxicity tests have not been conducted on three additional formulations, G75-W, G75-F, LV-R, studies are not warranted in light of the fact the USFS intends to phase out their use of these formulations by 2010. All formulations expected to be in use beyond 2010 shall be evaluated using, at a minimum, the established protocols to assess acute mortality to fish. Evaluations must be completed and presented to NMFS no later than two years from the date of this Opinion. Depending on the outcome of these evaluations and after conferring with NMFS, the USFS must make appropriate modifications to the program that would minimize the effects on NMFS' listed resources (e.g., whether a retardant(s) should be withdrawn from use and replaced with an alternative retardant(s)).

2. Engage in toxicological studies on long-term fire retardants approved for current use in fighting fires, to evaluate acute and sublethal effects of the formulations on NMFS'listed resources. The toxicological studies will be developed and approved by both the USFS and NMFS. The studies should be designed to explore the effects of fire retardant use on: unique life stages of anadromous fish such as smolts and buried embryo/alevin life stages ranging in development from spawning to yolk sac absorption and the onset of exogenous feeding (approximately 30 days post-hatch);
and anadromous fish exposed to fire retardants under multiple stressor conditions expected during wildfires, such as elevated temperature and low DO. Within 12 months of accepting the terms of this Opinion, USFS provide NMFS with a draft research plan to conduct additional toxicological studies on the acute and sublethal effects of the fire retardant formulations. Depending on the outcome of these studies described per the research plan and after conferring with NMFS, the USFS must
make appropriate modifications to the program that would minimize the effects on NMFS' listed resources (e.g., whether a retardant(s) should be withdrawn from use and replaced with an alternative retardant(s)).

3. Develop guidance that directs the US Forest Service to conduct an assessment of site conditions following wildfire where fire retardants have entered waterways, to evaluate the changes to on site water quality and changes in the structure of the biological community. The field guidance shall require monitoring of such parameters as macroinvertebrate communities, soil and water chemistry, or other possible surrogates for examining the direct and indirect effects of fire retardants on the biological community within and downstream of the retardant drop area as supplemental to observations for signs of dead or dying fish. The guidance may establish variable protocols based upon the

volume of retardants expected to have entered the waterway, but must require site evaluations commensurate with the volume of fire retardants that entered the waterway.

4. Provide policy and guidance to ensure that USFS local unit resource specialist staff provide the local NMFS Regional Office responsible for section 7 consultations with a summary report of the site assessment that identifies: (a) the retardant that entered the waterway, (b) an estimate of the area affected by the retardant, (c) a description of whether the retardant was accidentally dropped into the waterway or whether an exception to the 2000 Guidelines was invoked and the reasons for the accident or exception, (d) an assessment of the direct and indirect impacts of the fire retardant drop, (e) the nature and results of the field evaluation that was conducted following control and abatement of the fire, and any on site actions that may have been taken to minimize the effects of the retardant on aquatic communities.

5. Provide NMFS Headquarter's Office of Protected Resources with a biannual summary (every two years) that evaluates the cumulative impacts (as the Council on Environmental Quality has defined that term pursuant to the National Environmental Policy Act of 1969) of their continued use of long-term fire retardants including: (a) the number of observed retardant drops entering a waterway, in any sub-watershed and watershed, (b) whether the observed drops occurred in a watershed inhabited by NMFS' listed resources, (c) an assessment as to whether listed resources were affected by the misapplication of fire retardants within the waterway, and (d) the USFS' assessment of cumulative impacts of the fire retardant drops within the subwatershed and watershed and the consequences of those effects on NMFS' listed resources. The evidence the USFS shall use for this evaluation would include, but is not limited to: (i) the results of consultation with NMFS' Regional Offices and the outcome of the site assessment described in detail in the previous element of this RPA (Element 4) and (ii) the results of new fish toxicity studies identified within Element 2; and (d) any actions the USFS took or intends to take to supplement the 2000 Guidelines to minimize the exposure of listed fish species to fire retardants, and reduce the severity of their exposure."

Action Area

The section 7 implementing regulations define the "Action Area" of a federal action as all areas to be affected, directly or indirectly, and not merely the immediate area involved in the action (50 CFR 402.02). This biological opinion assesses the consequences of the USFS's continued use of eight fire retardants for potential use on any USFS lands across the United States and its territories. According to the USFS, the National Forest System consists of 192 million acres of National Forests and National Grasslands across 42 states and 1 territory. In all, this amounts to 155 National Forests, 22 National Grasslands, 6 National Monuments, 20 National Recreational Areas, 9 National Scenic Areas, and 1 National Preserve, of which 403 are designated wilderness units and river reaches that are designated as Wild and Scenic Rivers.

Based on our assessment we have determined that the direct and indirect effects of the USFS' use of the fire retardants may extend beyond NSF lands due to interrelated and interdependent actions, or due to indirect effects of fire retardant application. Though we expect that the USFS would typically conduct fire suppression activities primarily on NSF lands, we understand that it is likely that the USFS may fight fires along the interface between federal lands and other landholders where the effects of fire retardants extend beyond USFS jurisdiction. Consequently, we are broadly characterizing the Action Area as all NSF lands (excluding the Caribbean National Forest, where fire retardant is not used), plus a reasonable "buffer" area immediately adjacent to NSF lands. The size of this buffer is dependant upon the species in question and the likelihood of said species being exposed to fire retardant when applied on NSF lands.

Consultation Methods

This consultation is programmatic in scope and addresses impacts to 387 species found on or immediately adjacent to USFS lands (see Table 1). The consultation addresses the Forest Service's authorization and use of the aerial application of fire retardants which contain ammonium salts on National Forest lands throughout the United States, with the exception of the Caribbean National Forest, where fire retardants are not used. Because of the programmatic nature of this consultation, our purpose is not to attempt to quantify take, but rather to determine whether the proposed action is likely to jeopardize the continued existence of any listed species or result in adverse modification of critical habitat. We expect that take may occur as a result of the use of fire retardant. Quantification and authorization of take resulting from a specific use of fire retardant, cumulative effects, as well as any compensatory measures required to offset any such take, will be conducted at the local level via the emergency consultation process as outlined in 50 CFR 402.05.

Our analysis took place in two parts.

<u>Part one</u>: the FWS Washington Office (WO) conducted an analysis based upon the literature and the information on the species that was available to us. That species information consisted of listing packages, critical habitat designation packages, recovery plans, five-year reviews, petition findings and information from NatureServe. Using this information, the FWS made a preliminary "not likely to be jeopardized" determination for 181 of the species subject to this consultation.

<u>Part two</u>: the remaining 206 species belonged to taxonomic groups that the WO identified as being potentially vulnerable to jeopardy resulting from the effects of exposure to long-term fire retardants and which required closer analysis using specialized and current information that is housed in our Regions and Field Offices (RO/FO), including current status of these species, recent studies, species survey reports, and protective measures included in local agreements with other agencies or jurisdictions. Therefore, the FWS' RO/FOs conducted a second focused analysis of these species, utilizing current information regarding the status of the species, current studies, and

where applicable, any protective measures or agreements that have been developed at the local level.

Table 1. List of all species included in this consultation. The Scientific Name column provides a hyperlink to each species' profile in the Service's Threatened and Endangered Species System online database that can also be accessed by searching for the Scientific Name or the Common Name in the Threatened and Endangered Species System database that is available online at http://ecos.fws.gov.

	Common Name	Federal Status	Scientific Name
	Plants		
1.	San Diego Thorn-mint	T	*Acanthomintha ilicifolia*
2.	Northern Wild Monkshood	T	*Aconitum noveboracense*
3.	Sensitive Joint-vetch	T	*Aeschynomene virginica*
4.	Munz' Onion	E	*Allium munzii*
5.	Little Amphianthus	T	*Amphianthus pusillus*
6.	Price's Potato-bean	T	*Apios priceana*
7.	McDonald's Rock-cress	E	*Arabis mcdonaldiana*
8.	Shale Barren Rock-cress	E	*Arabis serotina*
9.	Cumberland Sandwort	E	*Arenaria cumberlandensis*
10.	Marsh Sandwort	E	*Arenaria paludicola*
11.	Bear Valley Sandwort	T	*Arenaria ursina*
12.	Sacramento Prickly-poppy	E	*Argemone pleiacantha ssp. pinnatisecta*
13.	Mead's Milkweed	T	*Asclepias meadii*
14.	Hart's Tongue Fern	T	*Asplenium scolopendrium var. americanum*
15.	Cushenbury Milk-vetch	E	*Astragalus albens*
16.	Applegate's Milk-vetch	E	*Astragalus applegatei*
17.	Braunton's Milk-vetch	E	*Astragalus brauntonii*
18.	Desert Milkvetch	T	*Astragalus desereticus*
19.	Coachella Milk-vetch	E	*Astragalus lentiginosus var. coachellae*
20.	Heliotrope Milk-vetch	T	*Astragalus montii*
21.	Osterhout's Mik-vetch	E	*Astragalus osterhoutii*
22.	Tripleribed Milk-vetch	E	*Astragalus tricarinatus*
23.	Encinitas Baccharis	T	*Baccharis vanessae*
24.	Nevin's Barberry	E	*Berberis nevinii*
25.	Virginia Round-leaf Birch	T	*Betula uber*
26.	Florida Bonamia	T	*Bonamia grandiflora*
27.	Thread-leaved Brodiaea	T	*Brodiaea filifolia*
28.	Capa Rosa	E	*Callicarpa ampla*
29.	Mariposa Pussypaws	T	*Calyptridium pulchellum*
30.	Ashgray Paintbrush	T	*Castilleja cinerea*
31.	California Jewelflower	E	*Caulanthus californicus*
32.	Vail Lake Ceanothus	T	*Ceanothus ophiochilus*

33.	Purple (=Camatta Canyon) Amole	T	*Chlorogalum purpureum*
34.	La Graciaosa Thistle	E	*Cirsium loncholepis*
35.	Pitcher's Thistle	T	*Cirsium pitcheri*
36.	Sacramento Mountain Thistle	T	*Cirsium vinaceum*
37.	Springville Fairyfan	T	*Clarkia springvillensis*
38.	Alabama Leather Flower	E	*Clematis socialis*
39.	Pigeon Wings	T	*Clitoria fragrans*
40.	Apalachicola Rosemary	E	*Conradina glabra*
41.	Cumberland Rosemary	T	*Conradina verticillata*
42.	Pima Pineapple Cactus	E	*Coryphantha scheeri var. robustispina*
43.	Leafy Prairie Clover	E	*Dalea foliosa*
44.	Slender-horned Spineflower	E	*Dodecahema leptoceras*
45.	Santa Monica Mountains Dudleya	T	*Dudleya cymosa ssp. ovatifolia*
46.	Smooth Purple Coneflower	E	*Echinacea laevigata*
47.	Kuenzler Hedgehog Cactus	E	*Echinocereus fendleri var. kuenzleri*
48.	Arizona Hedgehog Cactus	E	*Echinocereus triglochidiatus var. arizonicus*
49.	Kern Mallow	E	*Eremalche kernensis*
50.	Giant Woolystar	E	*Eriastrum densifolium ssp. sanctorum*
51.	Maguire Daisy	T	*Erigeron maguirei*
52.	Parish's Fleabane Daisy	T	*Erigeron parishii*
53.	Zuni Fleabane	T	*Erigeron rhizomatus*
54.	Southern Mountain Buckwheat	T	*Eriogonum kennedyi var. austromontanum*
55.	Scrub Buckwheat	T	*Eriogonum longifolium var. gnaphalifolium*
56.	Cushenbury Buckwheat	E	*Eriogonum ovalifolium var. vineum*
57.	Uvillo	E	*Eugenia haematocarpa*
58.	Penland Alpine Fen Mustard	T	*Eutrema penlandii*
59.	Mexican Flannelbush	E	*Fremontodendron mexicanum*
60.	Gentner's fritillary	E	*Fritillaria gentneri*
61.	Colorado Butterfly Plant	T	*Gaura neomexicana var. coloradensis*
62.	Geocarpon	T	*Geocarpon minimum*
63.	Spreading Avens	E	*Geum radiatum*
64.	Gymnoderma lineare	E	*Gymnoderma lineare*
65.	Showy Stickweed	E	*Hackelia venusta*
66.	Harper's Beauty	E	*Harperocallis flava*
67.	Todsen's Pennyroyal	E	*Hedeoma todsenii*
68.	Roan Mountain Bluet	E	*Hedyotis purpurea var. montana*
69.	Virginia Sneezeweed	T	*Helenium virginicum*
70.	Eggert's Sunflower	T	*Helianthus eggertii*
71.	Schweinitz's Sunflower	E	*Helianthus schweinitzii*
72.	Swamp Pink	T	*Helonias bullata*
73.	Dwarf-flowered Heartleaf	T	*Hexastylis naniflora*

74.	Water Howellia	T	*Howellia aquatilis*
75.	Mountain Golden Heather	T	*Hudsonia montana*
76.	Lakeside Daisy	T	*Hymenoxys herbacea*
77.	Cuero de Sapo	E	*Ilex sintenisii*
78.	Peter's Mountain-mallow	E	*Iliamna corei*
79.	Holy Ghost Ipomopsis	E	*Ipomopsis sancti-spiritus*
80.	Dwarf Lake Iris	T	*Iris lacustris*
81.	Louisiana Quillwort	E	*Isoetes louisianensis*
82.	Small Whorled Pogonia	T	*Isotria medeoloides*
83.	San Joaquin Wooly-Threads	E	*Lembertia congdonii*
84.	Babyfoot Orchid	E	*Lepanthes eltoroensis*
85.	Missouri Bladder-pod	E	*Lesquerella filiformis*
86.	San Bernardino Mountains Bladderpod	E	*Lesquerella kingii ssp. bernardina*
87.	Lyrate Bladderpod	T	*Lesquerella lyrata*
88.	White Bladderpod	E	*Lesquerella pallida*
89.	Heller's Blazing Star	T	*Liatris helleri*
90.	Huachuca water-umbel	E	*Lilaeopsis schaffneriana var. recurva*
91.	Western Lily	E	*Lilium occidentale*
92.	Butte County Meadowfoam	E	*Limnanthes floccosa ssp. californica*
93.	Pondberry	E	*Lindera melissifolia*
94.	Cook's Lomatium	E	*Lomatium cookii*
95.	Kincaid's Lupine	T	*Lupinus oreganus var. kincaidii*
96.	Rough-leaf Loosestrife	E	*Lysimachia asperulaefolia*
97.	White Bird-in-a-nest	T	*Macbridea alba*
98.	Mohr's Barbara's Buttons	T	*Marshallia mohrii*
99.	Macfarlane's Four-O'Clock	T	*Mirabilis macfarlanei*
100.	Britton's Beargrass	E	*Nolina brittonia*
101.	Bakersfield Cactus	E	*Opuntia treleasei*
102.	Slender Orcutt Grass	T	*Orcuttia tenuis*
103.	Canby's Dropwort	E	*Oxypolis canbyi*
104.	Cushenbury Oxytheca	E	*Oxytheca parishii var. goodmaniana*
105.	Fassett's Locoweed	T	*Oxytropis campestris var. chartacea*
106.	San Rafael Cactus	E	*Pediocactus despainii*
107.	Winkler Cactus	T	*Pediocactus winkleri*
108.	Blowout Penstemon	E	*Penstemon haydenii*
109.	Clay Phacelia	E	*Phacelia argillacea*
110.	Yreka phlox	E	*Phlox hirsuta*
111.	Texas Trailing Phlox	E	*Phlox nivalis ssp. texensis*
112.	Godfrey's Butterwort	T	*Pinguicula ionantha*
113.	Ruth's Golden-aster	E	*Pityopsis ruthii*
114.	Rough Popcorn Flower	E	*Plagiobothrys hirtus*
115.	Eastern Prairie White-fringed Orchid	T	*Platanthera leucophaea*
116.	Western Prairie Fringed Orchid	T	*Platanthera praeclara*

117.	Chupacallos	E	*Pleodendron macranthum*
118.	San Bernardino Bluegrass	E	*Poa atropurpurea*
119.	Lewton's Polygala	E	*Polygala lewtonii*
120.	Maguire Primrose	T	*Primula maguirei*
121.	San Joaquin Adobe Sunburst	T	*Pseudobahia peirsonii*
122.	Harperella	E	*Ptilimnium nodosum*
123.	Arizona Cliffrose	E	*Purshia subintegra*
124.	Miccosukee Gooseberry	T	*Ribes echinellum*
125.	Gambel's Watercress	E	*Rorippa gambellii*
126.	Bunched Arrowhead	E	*Sagittaria fasciculata*
127.	Kral's Water Plantain	T	*Sagittaria secundifolia*
128.	Green Pitcher Plant	E	*Sarracenia oreophila*
129.	Alabama Canebrake Pitcher Plant	E	*Sarracenia rubra alabamensis*
130.	Mountain Sweet Pitcher Plant	E	*Sarracenia rubra ssp. jonesii*
131.	American Chaffseed	E	*Schwalbea americana*
132.	Northeastern Bulrush	E	*Scirpus ancistrochaetus*
133.	Unita Basin Hookless Cactus	T	*Sclerocactus glaucus*
134.	Florida Skullcap	T	*Scutellaria floridana*
135.	Large Flowered Skullcap	T	*Scutellaria montana*
136.	Leedy's Roseroot	T	*Sedum integrifolium leedyi*
137.	San Francisco Peaks groundsel	T	*Senecio franciscanus*
138.	Layne's Butterweed	T	*Senecio layneae*
139.	Keck's Checker Mallow	E	*Sidalcea keckii*
140.	Nelson's Checker Mallow	T	*Sidalcea nelsoniana*
141.	Wenatchee Mountains Checker Mallow	E	*Sidalcea oregana var. calva*
142.	Bird-footed Checkerbloom	E	*Sidalcea pedata*
143.	Spalding's Catchfly	T	*Silene spaldingii*
144.	White Irisette	E	*Sisyrinchium dichotomum*
145.	White-Haired Goldenrod	T	*Solidago albopilosa*
146.	Houghton's Goldenrod	T	*Solidago houghtonii*
147.	Blue Ridge Goldenrod	T	*Solidago spithamaea*
148.	Virginia Spiraea	T	*Spiraea virginiana*
149.	Canelo Hills Ladies Tresses	E	*Spiranthes delitescens*
150.	Ute Ladies'-tresses	T	*Spiranthes diluvialis*
151.	Navasota Ladies'-tresses	E	*Spiranthes parksii*
152.	Palo de Jazmin	E	*Styrax portoricensis*
153.	California Dandelion	E	*Taraxacum californicum*
154.	Palo Colorado	E	*Ternstroemia luquillensis*
155.	Unknown Common Name	E	*Ternstroemia subsessilis*
156.	Howell's Spectacular Thelypody	T	*Thelypodium howellii spectabilis*
157.	Slender-petaled mustard	E	*Thelypodium stenopetalum*
158.	Alabama Streak-Sorus Fern	T	*Thelypteris pilosa var. alabamensis*
159.	Kneeland Prairie Pennycress	E	*Thlaspi californicum*

160.	Last Chance Townsendia	T	*Townsendia aprica*
161.	Running Buffalo Clover	E	*Trifolium stoloniferum*
162.	Persistent Trillium	E	*Trillium persistens*
163.	Relict Trillium	E	*Trillium reliquum*
164.	Greene's Tuctoria	E	*Tuctoria greenei*
165.	Tennessee Yellow-eyed Grass	E	*Xyris tennesseensis*
	Invertebrates		
166.	Cumberland Elktoe	E	*Alasmidonta atropurpurea*
167.	Dwarf Wedgemussel	E	*Alasmidonta heterodon*
168.	Appalachian Elktoe	E	*Alasmidonta raveneliana*
169.	Fat Three-Ridge Mussel	E	*Amblema neislerii*
170.	Tumbling Creek Cave Snail	E	*Antrobia culveri*
171.	Ouachita Rock Pocketbook	E	*Arkansia wheeleri*
172.	Uncompahgre Fritillary Butterfly	E	*Boloria acrocnema*
173.	Conservancy Fairy Shrimp	E	*Branchinecta conservatio*
174.	Longhorn Fairy Shrimp	E	*Branchinecta longiantenna*
175.	Vernal Pool Fairy Shrimp	T	*Branchinecta lynchi*
176.	A Crayfish	E	*Cambarus aculabrum*
177.	Hell Creek Cave Crayfish	E	*Cambarus zophonastes*
178.	Fanshell	E	*Cyprogenia stegaria*
179.	Valley Elderberry Longhorn Beetle	T	*Desmocerus californicus dimorphus*
180.	Dromedary Pearlymussel	E	*Dromus dromas*
181.	Lacy Elimia	T	*Elimia crenatella*
182.	Purple Bankclimber Mussel	T	*Elliptoideus sloatianus*
183.	Cumberlandian Combshell	E	*Epioblasma brevidens*
184.	Oyster Mussel	E	*Epioblasma capsaeformis*
185.	Curtis Pearlymussel	E	*Epioblasma florentina curtisi*
186.	Yellow Blossom (Pearlymussel)	E	*Epioblasma florentina florentina*
187.	Tan Riffleshell	E	*Epioblasma florentina walkeri*
188.	Upland Combshell	E	*Epioblasma metastriata*
189.	Purple Cat's Paw Pearlymussel	E	*Epioblasma obliquata obliquata*
190.	Southern Acornshell	E	*Epioblasma othcaloogensis*
191.	Green Blossom (Pearlymussel)	E	*Epioblasma torulosa gubernaculum*
192.	Northern Riffleshell	E	*Epioblasma torulosa rangiana*
193.	Tubercled-blossom Pearlymussel	E	*Epioblasma torulosa torulosa*
194.	Turgid Blossom	E	*Epioblasma turgidula*
195.	Smith's Blue Butterfly	E	*Euphilotes enoptes smithi*
196.	Quino Checkerspot Butterfly	E	*Euphydryas editha quino*
197.	Kern Primrose Sphinx Moth	T	*Euproserpinus euterpe*
198.	Shiny Pigtoe	E	*Fusconaia cor*
199.	Finerayed Pigtoe	E	*Fusconaia cuneolus*

200.	Cracking Pearlymussel	E	Hemistena lata
201.	Pawnee Montane Skipper	T	Hesperia leonardus montana
202.	Koster's tryonia snail	PE	Juturnia kosteri
203.	Pink Mucket	E	Lampsilis abrupta
204.	Finelined Pocketbook	T	Lampsilis altilis
205.	Orangenacre Mucket	T	Lampsilis perovalis
206.	Arkansas Fatmucket	T	Lampsilis powelli
207.	Shinyrayed pocketbook	E	Lampsilis subangulata
208.	Carolina Heelsplitter	E	Lasmigona decorata
209.	Birdwing Pearlymussel*	E	Lemiox rimosus
210.	Scaleshell Mussel	E	Leptodea leptodon
211.	Round rocksnail	T	Leptoxis ampla
212.	Painted rocksnail	T	Leptoxis taeniata
213.	Flat pebblesnail	E	Lepyrium showalteri
214.	Cylindrical lioplax	E	Lioplax cyclostomaformis
215.	Karner Blue Butterfly	E	Lycaeides melissa samuelis
216.	Louisiana Pearlshell	T	Margaritifera hembeli
217.	Alabama Moccasinshell	T	Medionidus acutissimus
218.	Coosa Moccasinshell	E	Medionidus parvulus
219.	Ochlockonee Moccasinshell	E	Medionidus simpsonianus
220.	Noonday Globe	T	Mesodon clarki nantahala
221.	Magazine Mountain Shagreen	T	Mesodon magazinensis
222.	Spruce-fir Moss Spider	E	Microhexura montivaga
223.	Mitchell's Satyr	E	Neonympha mitchelli mitchelli
224.	American Burying Beetle	E	Nicrophorus americanus
225.	Ring Pink (Mussel)	E	Obovaria retusa
226.	Shasta Crayfish	E	Pacifastacus fortis
227.	Littlewing Pearlymussel	E	Pegias fabula
228.	Clubshell	E	Pleurobema clava
229.	James Spinymussel	E	Pleurobema collina
230.	Southern Clubshell	E	Pleurobema decisum
231.	Dark Pigtoe	E	Pleurobema furvum
232.	Southern Pigtoe	E	Pleurobema georgianum
233.	Ovate clubshell	E	Pleurobema perovatum
234.	Rough Pigtoe	E	Pleurobema plenum
235.	Oval Pigtoe	E	Pleurobema pyriforme
236.	Heavy Pigtoe	E	Pleurobema taitianum
237.	Fat Pocketbook	E	Potamilus capax
238.	Heavy Pigtoe	E	Potamilus inflatus
239.	Triangular Kidneyshell	E	Ptychobranchus greenii
240.	Laguna Mountains Skipper	E	Pyrgus ruralis lagunae
241.	Rough Rabbitsfoot	E	Quadrula cylindrica strigillata
242.	Cumberland Monkeyface (pearlymussel)	E	Quadrula intermedia
243.	Appalachian Monkeyface	E	Quadrula sparsa
244.	Hine's Emerald Dragonfly	E	Somatochlora hineana

245.	Oregon Silverspot Butterfly	T	Speyeria zerene hippolyta
246.	Alamosa Springsnail	E	Tryonia alamosae
247.	Tulotoma Snail	E	Tulotoma magnifica
248.	Purple Bean Mussel	E	Villosa perpurpurea
249.	Cumberland Bean Pearlymussel	E	Villosa trabalis
	Fish		
250.	Gulf Sturgeon	T	Acipenser oxyrinchus desotoi
251.	White Sturgeon (Kootenai R. Pop.)	E	Acipenser transmontanus
252.	Modoc sucker	E	Catostomus microps
253.	Santa Ana Sucker	T	Catostomus santaanae
254.	Warner Sucker	T	Catostomus warnerensis
255.	Shortnose Sucker	E	Chasmistes brevirostris
256.	June Sucker	E	Chasmistes liorus
257.	Pygmy Sculpin	T	Cottus paulus
258.	Railroad Valley Springfish	T	Crenichthys nevadae
259.	Blue Shiner	T	Cyprinella caerulea
260.	Beautiful Shiner	T	Cyprinella formosa
261.	Desert Pupfish	E	Cyprinodon macularius
262.	Lost River Sucker	E	Deltistes luxatus
263.	Spotfin Chub	T	Erimonax monachus (Cyprinella monacha)
264.	Slender Chub	T	Erimystax cahni
265.	Etowah Darter	E	Etheostoma etowahae
266.	Duskytail Darter	E	Etheostoma percnurum
267.	Tidewater Goby	E	Eucyclogobius newberryi
268.	Unarmored Threespine Stickleback	E	Gasterosteus aculeatus williamsoni
269.	Owens Tui Chub	E	Gila bicolor snyderi
270.	Humpback chub	E	Gila cypha
271.	Sonora Chub	T	Gila ditaenia
272.	Bonytail Chub	E	Gila elegans
273.	Gila Chub	E	Gila intermedia
274.	Chihuahua Chub	T	Gila nigrescens
275.	Yaqui Chub	E	Gila purpurea
276.	Rio Grande Silveryminnow	E	Hybognathus amarus
277.	Delta Smelt	T	Hypomesus transpacificus
278.	Yaqui Catfish	T	Ictalurus pricei
279.	Little Colorado Spinedace	T	Lepidomeda vittata
280.	Spikedace	T	Meda fulgida
281.	Palezone Shiner	E	Notropis albizonatus
282.	Cahaba Shiner	E	Notropis cahabae
283.	Arkansas River Shiner	T	Notropis girardi
284.	Cape Fear Shiner	E	Notropis mekistocholas

285.	Topeka Shiner	E	*Notropis topeka*
286.	Smoky Madtom	E	*Noturus baileyi*
287.	Yellowfin Madtom	T	*Noturus flavipinnis*
288.	Little Kern Golden Trout	T	*Oncorhynchus aguabonita whitei*
289.	Apache (Arizona) Trout	T	*Oncorhynchus apache*
290.	Lahontan Cutthroat Trout	T	*Oncorhynchus clarki henshawi*
291.	Paiute Cutthroat Trout	T	*Oncorhynchus clarki seleniris*
292.	Greenback Cutthroat Trout	T	*Oncorhynchus clarki stomias*
293.	Gila Trout	E	*Oncorhynchus gilae*
294.	Oregon Chub	E	*Oregonichthys crameri*
295.	Amber Darter	E	*Percina antesella*
296.	Goldline Darter	T	*Percina aurolineata*
297.	Conasauga Logperch	E	*Percina jenkinsi*
298.	Leopard Darter	T	*Percina pantherina*
299.	Roanoke Logperch	E	*Percina rex*
300.	Snail Darter	T	*Percina tanasi*
301.	Blackside Dace	T	*Phoxinus cumberlandensis*
302.	Gila Topminnow	E	*Poeciliopsis occidentalis*
303.	Sacramento Splittail	T	*Pogonichthys macrolepidotus*
304.	Colorado (=squawfish) Pikeminnow	E	*Ptychocheilus lucius*
305.	Kendall Warm Springs Dace	E	*Rhinichthys osculus thermalis*
306.	Bull Trout	T	*Salvelinus confluentus*
307.	Pallid Sturgeon	E	*Scaphirhynchus albus*
308.	Alabama Sturgeon	E	*Scaphirhynchus suttkusi*
309.	Loach Minnow	T	*Tiaroga cobitis*
310.	Razorback Sucker	E	*Xyrauchen texanus*
	Amphibians		
311.	Flatwoods Salamander	T	*Ambystoma cingulatum*
312.	Sonoran Tiger Salamander	E	*Ambystoma tigrinum stebbinsi*
313.	Wyoming Toad	E	*Bufo baxteri*
314.	Arroyo Southwestern Toad	E	*Bufo californicus*
315.	Houston Toad	E	*Bufo houstonensis*
316.	Red hills salamander	T	*Phaeognathus hubrichti*
317.	Cheat Mountain Salamander	T	*Plethodon nettingi*
318.	Shenandoah Salamander	E	*Plethodon shenandoah*
319.	California Red-legged Frog	T	*Rana aurora draytonii*
320.	Mississippi Gopher Frog	E	*Rana capito servosa*
321.	Chiricahua leopard frog	T	*Rana chiricahuensis*
322.	Mt. Yellow-legged frog (So. CA DPS)	E	*Rana muscosa*
	Reptiles		
323.	New Mexico Ridgenose Rattlesnake	T	*Crotalus willardi obscurus*

324.	Eastern Indigo Snake	T	*Drymarchon corais couperi*
325.	Puerto Rican Boa	E	*Epicrates inornatus*
326.	Blunt-nosed Leopard Lizard	E	*Gambelia silus*
327.	Desert Tortoise (Sonoran pop.)	T	*Gopherus agassizii*
328.	Gopher Tortoise	T	*Gopherus polyphemus*
329.	Sand Skink	T	*Neoseps reynoldsi*
330.	Flattened Musk Turtle	T	*Sternotherus depressus*
331.	Giant Garter Snake	T	*Thamnophis gigas*
	Birds		
332.	Florida Scrub Jay	T	*Aphelocoma coerulescens*
333.	Marbled murrelet	T	*Brachyramphus marmoratus*
334.	Western Snowy Plover	T	*Charadrius alexandrinus nivosus*
335.	Piping Plover	T/E	*Charadrius melodus*
336.	Kirtland's Warbler	E	*Dendroica kirtlandii*
337.	Southwestern Willow Flycatcher	E	*Empidonax traillii extimus*
338.	Northern Aplomado Falcon	E	*Falco femoralis septentrionalis*
339.	Whooping Crane	E	*Grus americana*
340.	Mississippi Sandhill Crane	E	*Grus canadensis pulla*
341.	California Condor	E	*Gymnogyps californianus*
342.	Wood Stork	E	*Mycteria americana*
343.	Brown Pelican	E	*Pelecanus occidentalis*
344.	Brown Pelican	E	*Pelecanus occidentalis californicus*
345.	Red-cockaded Woodpecker	E	*Picoides borealis*
346.	Coastal California Gnatcatcher	T	*Polioptila californica californica*
347.	Yuma Clapper Rail	E	*Rallus longirostris yumanensis*
348.	Least Tern	E	*Sterna antillarum*
349.	California Least Tern	E	*Sterna antillarum browni*
350.	Northern Spotted Owl	T	*Strix occidentalis caurina*
351.	Mexican Spotted Owl	T	*Strix occidentalis lucida*
352.	Bachman's Warbler	E	*Vermivora bachmanii*
353.	Black-capped Vireo	E	*Vireo atricapilla*
354.	Least Bell's Vireo	E	*Vireo bellii pusillus*
	Mammals		
355.	Sonoran Pronghorn	E	*Antilocapra americana sonoriensis*
356.	Gray Wolf, Western pop.	T	*Canis lupus*
357.	Gray Wolf, Southwestern pop. Mex.	E	*Canis lupus baileyi*
358.	Ozark Big-eared Bat	E	*Corynorhinus townsendii ingens*
359.	Virginia Big-eared Bat	E	*Corynorhinus townsendii virginianus*
360.	Utah Prairie Dog	T	*Cynomys parvidens*
361.	Giant Kangaroo Rat	E	*Dipodomys ingens*
362.	San Bernardino Kangaroo Rat	E	*Dipodomys merriami parvus*
363.	Fresno Kangaroo Rat	E	*Dipodomys nitratoides exilis*

364.	Tipton Kangaroo Rat	E	*Dipodomys nitratoides nitratoides*
365.	Stephen's Kangaroo Rat	E	*Dipodomys stephensi*
366.	Southern Sea Otter	T	*Enhydra lutris nereis*
367.	Carolina Northern Flying Squirrel	E	*Glaucomys sabrinus coloratus*
368.	Virginia Northern Flying Squirrel	E	*Glaucomys sabrinus fuscus*
369.	Lesser Long-nosed Bat	E	*Leptonycteris curasoae yerbabuenae*
370.	Mexican Long-nosed Bat	E	*Leptonycteris nivalis*
371.	Canada Lynx	T	*Lynx canadensis*
372.	Black-footed Ferret	E	*Mustela nigripes*
373.	Gray Bat	E	*Myotis grisescens*
374.	Indiana Bat	E	*Myotis sodalis*
375.	Bighorn Sheep (Peninsular)	E	*Ovis canadensis pop 2*
376.	Bighorn Sheep (Sierra Nevada)	E	*Ovis canadensis pop 3*
377.	Jaguar	E	*Panthera onca*
378.	Florida Panther	E	*Puma concolor coryi*
379.	Eastern Cougar	E	*Puma concolor couguar*
380.	Woodland Caribou	E	*Rangifer tarandus caribou*
381.	Northern Idaho Ground Squirrel	T	*Spermophilus brunneus brunneus*
382.	Mount Graham Red Squirrel	E	*Tamiasciurus hudsonicus grahamensis*
383.	Florida (West Indian) Manatee	E	*Trichechus manatus*
384.	Louisiana Black Bear	T	*Ursus americanus luteolus*
385.	Grizzly Bear (Lower 48)	T	*Ursus arctos horribilis*
386.	San Joaquin Kit Fox	E	*Vulpes macrotis mutica*
387.	Preble's Meadow Jumping Mouse	T	*Zapus hudsonius preblei*

WO analysis:

Our initial concern was how to manage such a large number of species in order to make a consultation of this size and scope manageable, and to be able to complete this consultation in a timely manner. We determined that the initial steps should be a review of the available literature on the effects of ammonium-based long-term fire retardants on plants, animals and ecological systems and a review of the available biological information of each species, including range distribution, habitat and threats. To obtain the species' information, we examined the listing packages, recovery plans, critical habitat designations, five-year reviews, NatureServe and any petitions, as available for each species.

Taxonomic groupings:

Based on the literature and the biological review, we determined that we could cluster most of the species into taxonomic groupings which could be analyzed as a group. The species were first grouped, as follows: plants, invertebrates, fishes, amphibians, reptiles, birds and mammals. These taxa were further divided as indicated by the literature, which suggested that some groups may be more vulnerable to exposure to long-term fire retardants and therefore, needed a closer analysis. These subgroups were legumes, aquatic invertebrates, freshwater mussels, terrestrial invertebrates, and ruminants.

For example, the best available scientific literature identified no direct effects to mammals after direct exposure to Phos-Chek (Poulton, B., 1997). However, the use of ammonium compounds in long-term fire retardants have been implicated in livestock mortality (Dodge, M., 1970). In particular, ruminants may have an increased vulnerability to nitrate poisoning as an indirect effect of exposure to the ammonium salts which have entered into the soil, been nitrified into nitrates and subsequently being taken up by plants, which were then consumed by the ruminant (Dodge, M., 1970). As a result, we identified ruminants as a subgroup of mammals that would require closer analysis by our Regions.

"Coarse filter"

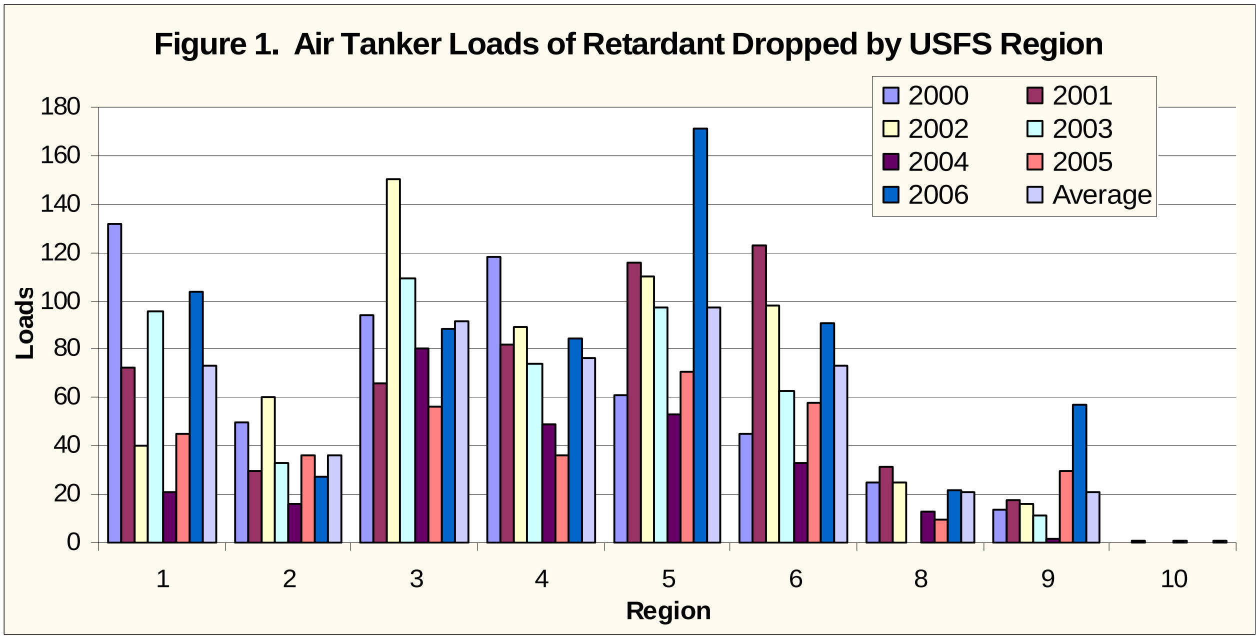
We then established what we informally referred to as a "coarse filter" to see if we could make any preliminary determinations regarding jeopardy or no jeopardy. Our coarse filter consisted of four questions which served to establish a logical thought process for our analysis:

(1) What is the range and distribution of the species?

We determined that while a species that is widely distributed (e.g., its range is spread over a large geographic area) may experience loss of some individuals due to retardant use on a specific fire event, it would be unlikely to be jeopardized unless some aspect of the species' biology or the critical nature of a specific population was compromised by that exposure.

(2) What is the likelihood of exposure of the species to fire retardant during a fire?

The locations and amount of use of fire retardant by the USFS is not uniform across the U.S. The use of retardant over the past seven years (the years for which they have data) was reported to us at the Forest scale by the USFS. A graph was then created to combine and summarize this data. The summary of the amount of retardant use by USFS Region* was plotted (Figure 1). We then estimated the likely concentration of retardant on the ground, based upon the pattern of typical applications (Norris and Webb 1989), the quantity used per retardant tanker and how many tankers might be ordered in a day.



* The USFS Regions are defined at: http://www.fs.fed.us/contactus/regions.shtml

(3) If the species were exposed, would the exposure be likely to result in "take?"

The literature suggests that most taxonomic groups suffer limited direct effects from exposure to long-term fire retardant (Poulton, B. et al., 1977; Labat Environmental 2007; Munk, 1996) with the possible exceptions of certain plants (Larson and Duncan, 1982; Larson and Newton, 1996; Bradstock et al., 1987), ruminants (Dodge, M., 1970) and aquatic species (Augsperger et al., 2003; Poulton et al., 1997; Labat Environmental 2007). We used this information to make general conclusions about which taxonomic groups would be likely to experience take as a direct effect of being exposed to long-term fire retardant.

(4) If take would occur as determined by (3) above, would the "take" rise to such a level that it would be likely to jeopardize the continued existence of the species?

Based upon the best available scientific literature and the other information referenced above, we identified which taxonomic groups, or subgroups would be considered particularly vulnerable to jeopardy due to exposure to long-term fire retardant. Aquatic species appeared at this level of analysis to be the most vulnerable with concerns also being indicated for ruminants and some plants (e.g., legumes, that is, plants belonging to the pea family; and narrow endemics). Jeopardy appeared to be most likely to occur if a species is: a "narrow endemic," that is, a species that solely occupies a small geographic area and no where else; a legume; an aquatic species, particularly invertebrates and certain fishes. We used all of the information in the previous three criteria to make our preliminary determinations of "not likely to jeopardize" the survival and recovery of the species.

By applying the "coarse filter" to each of the taxonomic groups or subgroups that we identified based upon the literature, we made a preliminary determination of "no jeopardy" for 181 species. The remaining 206 species comprised those species for which we could not make a determination. We then distributed these species to the RO/FOs for their analysis. We also included our preliminary determinations so that the RO/FOs could "ground truth" our coarse filter and could re-analyze any of those species, if warranted. Consequently, 11 species for which we had made a preliminary determination of not likely to jeopardize were given additional review by the RO/FOs. After conducting our analysis, the Service determined that 342 species were not likely to be jeopardized by the proposed action (Table 2).

Table 2. List of all species included in this consultation for which the Service reached a determination that the proposed action is neither likely to jeopardize the continued existence of the species nor likely to result in the destruction or adverse modification of critical habitat.

	Common Name	Federal Status	Scientific Name
	Plants		
1.	San Diego Thorn-mint	T	*Acanthomintha ilicifolia*
2.	Northern Wild Monkshood	T	*Aconitum noveboracense*
3.	Sensitive Joint-vetch	T	*Aeschynomene virginica*
4.	Little Amphianthus	T	*Amphianthus pusillus*
5.	Price's Potato-bean	T	*Apios priceana*
6.	McDonald's Rock-cress	E	*Arabis mcdonaldiana*
7.	Shale Barren Rock-cress	E	*Arabis serotina*
8.	Cumberland Sandwort	E	*Arenaria cumberlandensis*
9.	Marsh Sandwort	E	*Arenaria paludicola*
10.	Sacramento Prickly-poppy	E	*Argemone pleiacantha ssp. pinnatisecta*
11.	Mead's Milkweed	T	*Asclepias meadii*
12.	Hart's Tongue Fern	T	*Asplenium scolopendrium var. americanum*
13.	Applegate's Milk-vetch	E	*Astragalus applegatei*
14.	Braunton's Milk-vetch	E	*Astragalus brauntonii*
15.	Desert Milkvetch	T	*Astragalus desereticus*
16.	Coachella Milk-vetch	E	*Astragalus lentiginosus var. coachellae*
17.	Heliotrope Milk-vetch	T	*Astragalus montii*
18.	Osterhout's Mik-vetch	E	*Astragalus osterhoutii*
19.	Encinitas Baccharis	T	*Baccharis vanessae*
20.	Virginia Round-leaf Birch	T	*Betula uber*
21.	Florida Bonamia	T	*Bonamia grandiflora*

22.	Thread-leaved Brodiaea	T	*Brodiaea filifolia*
23.	Capa Rosa	E	*Callicarpa ampla*
24.	California Jewelflower	E	*Caulanthus californicus*
25.	La Graciaosa Thistle	E	*Cirsium loncholepis*
26.	Pitcher's Thistle	T	*Cirsium pitcheri*
27.	Sacramento Mountain Thistle	T	*Cirsium vinaceum*
28.	Springville Fairyfan	T	*Clarkia springvillensis*
29.	Alabama Leather Flower	E	*Clematis socialis*
30.	Pigeon Wings	T	*Clitoria fragrans*
31.	Apalachicola Rosemary	E	*Conradina glabra*
32.	Cumberland Rosemary	T	*Conradina verticillata*
33.	Pima Pineapple Cactus	E	*Coryphantha scheeri var. robustispina*
34.	Leafy Prairie Clover	E	*Dalea foliosa*
35.	Santa Monica Mountains Dudleya	T	*Dudleya cymosa ssp. ovatifolia*
36.	Smooth Purple Coneflower	E	*Echinacea laevigata*
37.	Kuenzler Hedgehog Cactus	E	*Echinocereus fendleri var. kuenzleri*
38.	Arizona Hedgehog Cactus	E	*Echinocereus triglochidiatus var. arizonicus*
39.	Kern Mallow	E	*Eremalche kernensis*
40.	Giant Woolystar	E	*Eriastrum densifolium ssp. sanctorum*
41.	Maguire Daisy	T	*Erigeron maguirei*
42.	Zuni Fleabane	T	*Erigeron rhizomatus*
43.	Scrub Buckwheat	T	*Eriogonum longifolium var. gnaphalifolium*
44.	Uvillo	E	*Eugenia haematocarpa*
45.	Penland Alpine Fen Mustard	T	*Eutrema penlandii*
46.	Mexican Flannelbush	E	*Fremontodendron mexicanum*
47.	Gentner's fritillary	E	*Fritillaria gentneri*
48.	Colorado Butterfly Plant	T	*Gaura neomexicana var. coloradensis*
49.	Geocarpon	T	*Geocarpon minimum*
50.	Spreading Avens	E	*Geum radiatum*
51.	Gymnoderma lineare	E	*Gymnoderma lineare*
52.	Showy Stickweed	E	*Hackelia venusta*
53.	Harper's Beauty	E	*Harperocallis flava*
54.	Todsen's Pennyroyal	E	*Hedeoma todsenii*
55.	Roan Mountain Bluet	E	*Hedyotis purpurea var. montana*
56.	Virginia Sneezeweed	T	*Helenium virginicum*
57.	Eggert's Sunflower	T	*Helianthus eggertii*
58.	Schweinitz's Sunflower	E	*Helianthus schweinitzii*
59.	Swamp Pink	T	*Helonias bullata*

60.	Dwarf-flowered Heartleaf	T	*Hexastylis naniflora*
61.	Water Howellia	T	*Howellia aquatilis*
62.	Mountain Golden Heather	T	*Hudsonia montana*
63.	Lakeside Daisy	T	*Hymenoxys herbacea*
64.	Cuero de Sapo	E	*Ilex sintenisii*
65.	Peter's Mountain-mallow	E	*Iliamna corei*
66.	Dwarf Lake Iris	T	*Iris lacustris*
67.	Louisiana Quillwort	E	*Isoetes louisianensis*
68.	Small Whorled Pogonia	T	*Isotria medeoloides*
69.	San Joaquin Wooly-Threads	E	*Lembertia congdonii*
70.	Babyfoot Orchid	E	*Lepanthes eltoroensis*
71.	Missouri Bladder-pod	E	*Lesquerella filiformis*
72.	Lyrate Bladderpod	T	*Lesquerella lyrata*
73.	White Bladderpod	E	*Lesquerella pallida*
74.	Heller's Blazing Star	T	*Liatris helleri*
75.	Huachuca water-umbel	E	*Lilaeopsis schaffneriana var. recurva*
76.	Western Lily	E	*Lilium occidentale*
77.	Butte County Meadowfoam	E	*Limnanthes floccosa ssp. californica*
78.	Pondberry	E	*Lindera melissifolia*
79.	Cook's Lomatium	E	*Lomatium cookii*
80.	Kincaid's Lupine	T	*Lupinus oreganus var. kincaidii*
81.	Rough-leaf Loosestrife	E	*Lysimachia asperulaefolia*
82.	White Bird-in-a-nest	T	*Macbridea alba*
83.	Mohr's Barbara's Buttons	T	*Marshallia mohrii*
84.	Macfarlane's Four-O'Clock	T	*Mirabilis macfarlanei*
85.	Britton's Beargrass	E	*Nolina brittonia*
86.	Bakersfield Cactus	E	*Opuntia treleasei*
87.	Slender Orcutt Grass	T	*Orcuttia tenuis*
88.	Canby's Dropwort	E	*Oxypolis canbyi*
89.	Fassett's Locoweed	T	*Oxytropis campestris var. chartacea*
90.	San Rafael Cactus	E	*Pediocactus despainii*
91.	Winkler Cactus	T	*Pediocactus winkleri*
92.	Blowout Penstemon	E	*Penstemon haydenii*
93.	Clay Phacelia	E	*Phacelia argillacea*
94.	Yreka phlox	E	*Phlox hirsuta*
95.	Texas Trailing Phlox	E	*Phlox nivalis ssp. texensis*
96.	Godfrey's Butterwort	T	*Pinguicula ionantha*
97.	Ruth's Golden-aster	E	*Pityopsis ruthii*
98.	Rough Popcorn Flower	E	*Plagiobothrys hirtus*
99.	Eastern Prairie White-fringed Orchid	T	*Platanthera leucophaea*
100.	Western Prairie Fringed Orchid	T	*Platanthera praeclara*
101.	Chupacallos	E	*Pleodendron macranthum*
102.	Lewton's Polygala	E	*Polygala lewtonii*

103.	Maguire Primrose	T	Primula maguirei
104.	San Joaquin Adobe Sunburst	T	Pseudobahia peirsonii
105.	Harperella	E	Ptilimnium nodosum
106.	Arizona Cliffrose	E	Purshia subintegra
107.	Miccosukee Gooseberry	T	Ribes echinellum
108.	Gambel's Watercress	E	Rorippa gambellii
109.	Bunched Arrowhead	E	Sagittaria fasciculata
110.	Kral's Water Plantain	T	Sagittaria secundifolia
111.	Green Pitcher Plant	E	Sarracenia oreophila
112.	Alabama Canebrake Pitcher Plant	E	Sarracenia rubra alabamensis
113.	Mountain Sweet Pitcher Plant	E	Sarracenia rubra ssp. jonesii
114.	American Chaffseed	E	Schwalbea americana
115.	Northeastern Bulrush	E	Scirpus ancistrochaetus
116.	Unita Basin Hookless Cactus	T	Sclerocactus glaucus
117.	Florida Skullcap	T	Scutellaria floridana
118.	Large Flowered Skullcap	T	Scutellaria montana
119.	Leedy's Roseroot	T	Sedum integrifolium leedyi
120.	San Francisco Peaks groundsel	T	Senecio franciscanus
121.	Layne's Butterweed	T	Senecio layneae
122.	Keck's Checker Mallow	E	Sidalcea keckii
123.	Nelson's Checker Mallow	T	Sidalcea nelsoniana
124.	Wenatchee Mountains Checker Mallow	E	Sidalcea oregana var. calva
125.	Spalding's Catchfly	T	Silene spaldingii
126.	White Irisette	E	Sisyrinchium dichotomum
127.	White-Haired Goldenrod	T	Solidago albopilosa
128.	Houghton's Goldenrod	T	Solidago houghtonii
129.	Blue Ridge Goldenrod	T	Solidago spithamaea
130.	Virginia Spiraea	T	Spiraea virginiana
131.	Canelo Hills Ladies Tresses	E	Spiranthes delitescens
132.	Ute Ladies'-tresses	T	Spiranthes diluvialis
133.	Navasota Ladies'-tresses	E	Spiranthes parksii
134.	Palo de Jazmin	E	Styrax portoricensis
135.	Palo Colorado	E	Ternstroemia luquillensis
136.	Unknown Common Name	E	Ternstroemia subsessilis
137.	Howell's Spectacular Thelypody	T	Thelypodium howellii spectabilis
138.	Alabama Streak-Sorus Fern	T	Thelypteris pilosa var. alabamensis
139.	Kneeland Prairie Pennycress	E	Thlaspi californicum

140.	Last Chance Townsendia	T	*Townsendia aprica*
141.	Running Buffalo Clover	E	*Trifolium stoloniferum*
142.	Persistent Trillium	E	*Trillium persistens*
143.	Relict Trillium	E	*Trillium reliquum*
144.	Greene's Tuctoria	E	*Tuctoria greenei*
145.	Tennessee Yellow-eyed Grass	E	*Xyris tennesseensis*
	Invertebrates		
146.	Cumberland Elktoe	E	*Alasmidonta atropurpurea*
147.	Dwarf Wedgemussel	E	*Alasmidonta heterodon*
148.	Appalachian Elktoe	E	*Alasmidonta raveneliana*
149.	Fat Three-Ridge Mussel	E	*Amblema neislerii*
150.	Tumbling Creek Cave Snail	E	*Antrobia culveri*
151.	Ouachita Rock Pocketbook	E	*Arkansia wheeleri*
152.	Uncompahgre Fritillary Butterfly	E	*Boloria acrocnema*
153.	Conservancy Fairy Shrimp	E	*Branchinecta conservatio*
154.	Longhorn Fairy Shrimp	E	*Branchinecta longiantenna*
155.	Vernal Pool Fairy Shrimp	T	*Branchinecta lynchi*
156.	A Crayfish	E	*Cambarus aculabrum*
157.	Hell Creek Cave Crayfish	E	*Cambarus zophonastes*
158.	Fanshell	E	*Cyprogenia stegaria*
159.	Valley Elderberry Longhorn Beetle	T	*Desmocerus californicus dimorphus*
160.	Dromedary Pearlymussel	E	*Dromus dromas*
161.	Lacy Elimia	T	*Elimia crenatella*
162.	Purple Bankclimber Mussel	T	*Elliptoideus sloatianus*
163.	Cumberlandian Combshell	E	*Epioblasma brevidens*
164.	Oyster Mussel	E	*Epioblasma capsaeformis*
165.	Curtis Pearlymussel	E	*Epioblasma florentina curtisi*
166.	Yellow Blossom (Pearlymussel)	E	*Epioblasma florentina florentina*
167.	Tan Riffleshell	E	*Epioblasma florentina walkeri*
168.	Upland Combshell	E	*Epioblasma metastriata*
169.	Purple Cat's Paw Pearlymussel	E	*Epioblasma obliquata obliquata*
170.	Southern Acornshell	E	*Epioblasma othcaloogensis*
171.	Green Blossom (Pearlymussel)	E	*Epioblasma torulosa gubernaculum*
172.	Northern Riffleshell	E	*Epioblasma torulosa rangiana*
173.	Tubercled-blossom Pearlymussel	E	*Epioblasma torulosa torulosa*
174.	Turgid Blossom	E	*Epioblasma turgidula*
175.	Smith's Blue Butterfly	E	*Euphilotes enoptes smithi*

176.	Kern Primrose Sphinx Moth	T	_Euproserpinus euterpe_
177.	Shiny Pigtoe	E	_Fusconaia cor_
178.	Finerayed Pigtoe	E	_Fusconaia cuneolus_
179.	Cracking Pearlymussel	E	_Hemistena lata_
180.	Pawnee Montane Skipper	T	_Hesperia leonardus montana_
181.	Koster's tryonia snail	PE	_Juturnia kosteri_
182.	Pink Mucket	E	_Lampsilis abrupta_
183.	Orangenacre Mucket	T	_Lampsilis perovalis_
184.	Arkansas Fatmucket	T	_Lampsilis powelli_
185.	Shinyrayed pocketbook	E	_Lampsilis subangulata_
186.	Carolina Heelsplitter	E	_Lasmigona decorata_
187.	Birdwing Pearlymussel*	E	_Lemiox rimosus_
188.	Scaleshell Mussel	E	_Leptodea leptodon_
189.	Round rocksnail	T	_Leptoxis ampla_
190.	Painted rocksnail	T	_Leptoxis taeniata_
191.	Flat pebblesnail	E	_Lepyrium showalteri_
192.	Cylindrical lioplax	E	_Lioplax cyclostomaformis_
193.	Karner Blue Butterfly	E	_Lycaeides melissa samuelis_
194.	Louisiana Pearlshell	T	_Margaritifera hembeli_
195.	Ochlockonee Moccasinshell	E	_Medionidus simpsonianus_
196.	Noonday Globe	T	_Mesodon clarki nantahala_
197.	Magazine Mountain Shagreen	T	_Mesodon magazinensis_
198.	Spruce-fir Moss Spider	E	_Microhexura montivaga_
199.	Mitchell's Satyr	E	_Neonympha mitchelli mitchelli_
200.	American Burying Beetle	E	_Nicrophorus americanus_
201.	Ring Pink (Mussel)	E	_Obovaria retusa_
202.	Shasta Crayfish	E	_Pacifastacus fortis_
203.	Littlewing Pearlymussel	E	_Pegias fabula_
204.	Clubshell	E	_Pleurobema clava_
205.	Dark Pigtoe	E	_Pleurobema furvum_
206.	Ovate clubshell	E	_Pleurobema perovatum_
207.	Rough Pigtoe	E	_Pleurobema plenum_
208.	Oval Pigtoe	E	_Pleurobema pyriforme_
209.	Heavy Pigtoe	E	_Pleurobema taitianum_
210.	Fat Pocketbook	E	_Potamilus capax_
211.	Heavy Pigtoe	E	_Potamilus inflatus_
212.	Rough Rabbitsfoot	E	_Quadrula cylindrica strigillata_
213.	Cumberland Monkeyface (pearlymussel)	E	_Quadrula intermedia_
214.	Appalachian Monkeyface	E	_Quadrula sparsa_
215.	Hine's Emerald Dragonfly	E	_Somatochlora hineana_
216.	Oregon Silverspot Butterfly	T	_Speyeria zerene hippolyta_
217.	Alamosa Springsnail	E	_Tryonia alamosae_

218.	Tulotoma Snail	E	*Tulotoma magnifica*
219.	Purple Bean Mussel	E	*Villosa perpurpurea*
220.	Cumberland Bean Pearlymussel	E	*Villosa trabalis*
	Fish		
221.	Gulf Sturgeon	T	*Acipenser oxyrinchus desotoi*
222.	White Sturgeon (Kootenai R. Pop.)	E	*Acipenser transmontanus*
223.	Modoc sucker	E	*Catostomus microps*
224.	Warner Sucker	T	*Catostomus warnerensis*
225.	Shortnose Sucker	E	*Chasmistes brevirostris*
226.	June Sucker	E	*Chasmistes liorus*
227.	Pygmy Sculpin	T	*Cottus paulus*
228.	Railroad Valley Springfish	T	*Crenichthys nevadae*
229.	Beautiful Shiner	T	*Cyprinella formosa*
230.	Desert Pupfish	E	*Cyprinodon macularius*
231.	Lost River Sucker	E	*Deltistes luxatus*
232.	Spotfin Chub	T	*Erimonax monachus (Cyprinella monacha)*
233.	Slender Chub	T	*Erimystax cahni*
234.	Duskytail Darter	E	*Etheostoma percnurum*
235.	Tidewater Goby	E	*Eucyclogobius newberryi*
236.	Humpback chub	E	*Gila cypha*
237.	Bonytail Chub	E	*Gila elegans*
238.	Gila Chub	E	*Gila intermedia*
239.	Chihuahua Chub	T	*Gila nigrescens*
240.	Yaqui Chub	E	*Gila purpurea*
241.	Rio Grande Silveryminnow	E	*Hybognathus amarus*
242.	Delta Smelt	T	*Hypomesus transpacificus*
243.	Yaqui Catfish	T	*Ictalurus pricei*
244.	Palezone Shiner	E	*Notropis albizonatus*
245.	Cahaba Shiner	E	*Notropis cahabae*
246.	Arkansas River Shiner	T	*Notropis girardi*
247.	Cape Fear Shiner	E	*Notropis mekistocholas*
248.	Topeka Shiner	E	*Notropis topeka*
249.	Smoky Madtom	E	*Noturus baileyi*
250.	Yellowfin Madtom	T	*Noturus flavipinnis*
251.	Apache (Arizona) Trout	T	*Oncorhynchus apache*
252.	Lahontan Cutthroat Trout	T	*Oncorhynchus clarki henshawi*
253.	Gila Trout	E	*Oncorhynchus gilae*
254.	Oregon Chub	E	*Oregonichthys crameri*
255.	Goldline Darter	T	*Percina aurolineata*
256.	Leopard Darter	T	*Percina pantherina*
257.	Roanoke Logperch	E	*Percina rex*
258.	Snail Darter	T	*Percina tanasi*

259.	Blackside Dace	T	*Phoxinus cumberlandensis*
260.	Gila Topminnow	E	*Poeciliopsis occidentalis*
261.	Sacramento Splittail	T	*Pogonichthys macrolepidotus*
262.	Colorado (=squawfish) Pikeminnow	E	*Ptychocheilus lucius*
263.	Bull Trout	T	*Salvelinus confluentus*
264.	Pallid Sturgeon	E	*Scaphirhynchus albus*
265.	Alabama Sturgeon	E	*Scaphirhynchus suttkusi*
266.	Razorback Sucker	E	*Xyrauchen texanus*
	Amphibians		
267.	Flatwoods Salamander	T	*Ambystoma cingulatum*
268.	Sonoran Tiger Salamander	E	*Ambystoma tigrinum stebbinsi*
269.	Wyoming Toad	E	*Bufo baxteri*
270.	Arroyo Southwestern Toad	E	*Bufo californicus*
271.	Houston Toad	E	*Bufo houstonensis*
272.	Red hills salamander	T	*Phaeognathus hubrichti*
273.	Cheat Mountain Salamander	T	*Plethodon nettingi*
274.	Shenandoah Salamander	E	*Plethodon shenandoah*
275.	California Red-legged Frog	T	*Rana aurora draytonii*
276.	Mississippi Gopher Frog	E	*Rana capito servosa*
277.	Chiricahua leopard frog	T	*Rana chiricahuensis*
	Reptiles		
278.	New Mexico Ridgenose Rattlesnake	T	*Crotalus willardi obscurus*
279.	Eastern Indigo Snake	T	*Drymarchon corais couperi*
280.	Puerto Rican Boa	E	*Epicrates inornatus*
281.	Blunt-nosed Leopard Lizard	E	*Gambelia silus*
282.	Desert Tortoise (Sonoran pop.)	T	*Gopherus agassizii*
283.	Gopher Tortoise	T	*Gopherus polyphemus*
284.	Sand Skink	T	*Neoseps reynoldsi*
285.	Flattened Musk Turtle	T	*Sternotherus depressus*
286.	Giant Garter Snake	T	*Thamnophis gigas*
	Birds		
287.	Florida Scrub Jay	T	*Aphelocoma coerulescens*
288.	Marbled murrelet	T	*Brachyramphus marmoratus*
289.	Western Snowy Plover	T	*Charadrius alexandrinus nivosus*
290.	Piping Plover	T/E	*Charadrius melodus*
291.	Kirtland's Warbler	E	*Dendroica kirtlandii*
292.	Southwestern Willow Flycatcher	E	*Empidonax traillii extimus*

293.	Northern Aplomado Falcon	E	*Falco femoralis septentrionalis*
294.	Whooping Crane	E	*Grus americana*
295.	Mississippi Sandhill Crane	E	*Grus canadensis pulla*
296.	California Condor	E	*Gymnogyps californianus*
297.	Wood Stork	E	*Mycteria americana*
298.	Brown Pelican	E	*Pelecanus occidentalis*
299.	Brown Pelican	E	*Pelecanus occidentalis californicus*
300.	Red-cockaded Woodpecker	E	*Picoides borealis*
301.	Coastal California Gnatcatcher	T	*Polioptila californica californica*
302.	Yuma Clapper Rail	E	*Rallus longirostris yumanensis*
303.	Least Tern	E	*Sterna antillarum*
304.	California Least Tern	E	*Sterna antillarum browni*
305.	Northern Spotted Owl	T	*Strix occidentalis caurina*
306.	Mexican Spotted Owl	T	*Strix occidentalis lucida*
307.	Bachman's Warbler	E	*Vermivora bachmanii*
308.	Black-capped Vireo	E	*Vireo atricapilla*
309.	Least Bell's Vireo	E	*Vireo bellii pusillus*
	Mammals		
310.	Sonoran Pronghorn	E	*Antilocapra americana sonoriensis*
311.	Gray Wolf, Western pop.	T	*Canis lupus*
312.	Gray Wolf, Southwestern pop. Mex.	E	*Canis lupus baileyi*
313.	Ozark Big-eared Bat	E	*Corynorhinus townsendii ingens*
314.	Virginia Big-eared Bat	E	*Corynorhinus townsendii virginianus*
315.	Utah Prairie Dog	T	*Cynomys parvidens*
316.	Giant Kangaroo Rat	E	*Dipodomys ingens*
317.	San Bernardino Kangaroo Rat	E	*Dipodomys merriami parvus*
318.	Fresno Kangaroo Rat	E	*Dipodomys nitratoides exilis*
319.	Tipton Kangaroo Rat	E	*Dipodomys nitratoides nitratoides*
320.	Stephen's Kangaroo Rat	E	*Dipodomys stephensi*
321.	Southern Sea Otter	T	*Enhydra lutris nereis*
322.	Carolina Northern Flying Squirrel	E	*Glaucomys sabrinus coloratus*
323.	Virginia Northern Flying Squirrel	E	*Glaucomys sabrinus fuscus*
324.	Lesser Long-nosed Bat	E	*Leptonycteris curasoae yerbabuenae*
325.	Mexican Long-nosed Bat	E	*Leptonycteris nivalis*
326.	Canada Lynx	T	*Lynx canadensis*
327.	Black-footed Ferret	E	*Mustela nigripes*
328.	Gray Bat	E	*Myotis grisescens*
329.	Indiana Bat	E	*Myotis sodalis*
330.	Bighorn Sheep (Peninsular)	E	*Ovis canadensis pop 2*
331.	Bighorn Sheep (Sierra	E	*Ovis canadensis pop 3*

	Nevada)		
332.	Jaguar	E	*Panthera onca*
333.	Florida Panther	E	*Puma concolor coryi*
334.	Eastern Cougar	E	*Puma concolor couguar*
335.	Woodland Caribou	E	*Rangifer tarandus caribou*
336.	Northern Idaho Ground Squirrel	T	*Spermophilus brunneus brunneus*
337.	Mount Graham Red Squirrel	E	*Tamiasciurus hudsonicus grahamensis*
338.	Florida (West Indian) Manatee	E	*Trichechus manatus*
339.	Louisiana Black Bear	T	*Ursus americanus luteolus*
340.	Grizzly Bear (Lower 48)	T	*Ursus arctos horribilis*
341.	San Joaquin Kit Fox	E	*Vulpes macrotis mutica*
342.	Preble's Meadow Jumping Mouse	T	*Zapus hudsonius preblei*

Effects of the Action

We believe that the likelihood of adverse impacts to threatened and endangered species resulting from the use of retardants is greater than as set forth in USFS's analysis and so have proceeded to analyze those greater impacts. Our reasons are cited in the discussion below.

Aquatic

Overview. The proposed action includes the USFS application and use of eight approved long-term retardants (that do not contain sodium ferrocyanide or YPS) on USFS land. The trade names of the eight retardants are: Phos-Chek D75-R, D75-F, 259-R, 259-F, G75-F, G75-W, LV-R, and LC-95A-R. Since Phos-Chek does not contain YPS, the constituents of the different formulations that could cause toxicity are different ammonia formulations (diammonium sulfate, etc.), nitrates/nitrites, guar gum (<10 percent of the total composition), performance additives (proprietary information, but could include surfactants), clay, and iron oxide or other coloring agents. Most scientific studies of Phos-Chek have focused on the function of ammonia as the potentially toxic agent. The Phos-Chek retardants in this consultation do not list nitrates or nitrites in their ingredient list, but MacDonald et al. (1995) found nitrate-nitrogen concentrations from 0.41-0.88 mg/L (ppm; the range is from soft to hard water) and nitrite-nitrogen concentrations from 0.2-0.22 mg/L. Performance additives constitute up to 10 percent of the total composition when it is used. Clay is used as a thickening agent in these long-term retardants and constitutes less than 5 percent of the total composition when it is used. Coloring agents typically comprise less than 5 percent of the total composition when it is used. No toxicity information is available for guar gum, performance additives, clay, or coloring agents. These ingredients may have toxic potential.

When these retardants are released into the environment by helicopters or airplanes, the potential exists for these chemicals to enter into aquatic systems such as lakes, ponds, or streams and affect aquatic organisms. As described in the proposed action, retardants could enter a waterway through accidental delivery, drift, and surface run-off.

Accidental delivery is an application of retardant into a waterway that does not follow the exceptions outlined in the "Guidelines for Aerial Delivery of Retardant or Foam near Waterways". Of the three examples listed above, accidental delivery into a waterway has the highest potential for adverse effects to aquatic organisms. Several laboratory studies concluded that the exposure of fish and other aquatic organisms to ammonia can result in mortality (Little and Calfee 2000, 2004, and 2005, Buhl and Hamilton 2000). Gaikowski et al. (1996) studied Phos-Chek D75-F and concluded that if we consider the concentration of the retardants used in field mixtures, which is much higher than the lab studies, an accidental spill in a waterway would lead to substantial mortality. We recognize that other factors should be considered when analyzing the possible adverse effects of an accidental delivery, as discussed below.

Drift occurs after the retardant has been released from the aircraft and wind directs particles of the retardant into a waterway. Environmental conditions, such as wind direction and speed are evaluated as part of the "Guidelines for Aerial Delivery of Retardant or Foam near Waterways" when retardant drops occur beyond the 300-foot buffer. However, drift from an accidental retardant drop within the 300-foot buffer (but outside of a waterway) should be considered. The effect of drift is not as significant to aquatic organisms as accidental delivery but adverse effects such as mortality are likely to occur. Several environmental factors such as wind speed and direction, amount of retardant dropped from the aircraft, topography, the type of waterway (pond vs. stream), and dilution should be considered when analyzing the level of toxicity in a waterway.

Surface run-off occurs after the retardant is applied to the ground outside of the 300-foot waterway buffer and is carried into a waterway by stormwater runoff. Retardant applied outside of the 300-foot waterway buffer may have adverse effects to aquatic organisms; however, the level of toxicity depends on the surface or soil type (rock, sand, soils with high or low organic matter, etc), persistence in the environment, timing of a rainfall event, and the amount of retardant on the ground. Little and Calfee (2005) found that the substrate upon which the chemicals are applied are important when assessing the resultant environmental persistence. In a study where fire chemicals (including D75-R) were weathered on non-porous surfaces at recommended application levels, fire retardants remained toxic for more than 21 days. Additional tests showed the persistence of toxicity was dependent on soil type and quality and that toxicity was often eliminated on soils with high organic content (Little and Calfee 2002). Although the highest toxicity was in formulations that included cyanide, D75-R caused up to 20% mortality in fathead minnows, depending on soil surface, after 21 days of weathering (Little and Calfee 2002). Because of the large area covered by the proposed action, it is likely that various soil types, and therefore various toxicities, will result from the proposed action.

Effects to Fish

The following discussion includes the possible effects to fish after the long-term retardant has entered a waterway. The delivery of retardant (from accidental delivery, drift, or surface run-off) into a waterway occupied by threatened and endangered fish species can cause mortality by exposing fish to ammonia (Little and Calfee 2000, 2004, and 2005, Buhl and Hamilton 2000). Fish may avoid chemicals as they enter a waterbody, as has been documented in recent studies. Little et al. (2006) studied the avoidance/attractance behavior of rainbow trout to Phos-Chek D75-R and found that avoidance of the retardant was significant at low concentrations and that the magnitude of rainbow trout avoidance response also showed an increase with an increase of the D75-R concentration. The study concluded that when rainbow trout were presented with a choice between the treated (D75-R) and untreated water the trout were able to detect and avoid the contaminated water (Little et al. 2006). The interpretation of these avoidance tests should consider field variables such as water temperature, water quality, pH, hardness, and dissolved carbon content, which can influence the response by altering the sensory stimuli of the chemical substance (Little et al. 2006). Although avoidance of the retardant is possible in flowing streams, avoidance may not be possible in bodies of water where there is no running water.

Avoidance of retardant chemicals is possible when drift occurs but is less likely with accidental delivery into a waterway. Both scenarios must consider the amount of retardant dropped from the aircraft, the height at which the retardant was dropped, the wind direction and speed, and size of the waterbody in order to make an appropriate effects determinations as these factors play a significant roll in determining the level of toxicity and the potential dilution factor in a waterbody. In most cases, fish may be able to detect and avoid ammonia in a waterway as a result from drift but given the environmental variables specific to each waterway the potential for mortality still exists. On the other hand, accidental delivery of retardants into a waterway could account for greater than 800 gallons of retardant per second (in medium to heavy fuel types) being released from the aircraft. In this circumstance, avoidance behavior of fish may be more effective downstream but the initial drop site will result in mortality. The level of mortality downstream is uncertain and will depend on the field variables mentioned above and the type of waterbody that is affected.

The delivery of retardant outside the 300-foot buffer of a waterway (except for drift mentioned above) will not cause adverse effects to fish; however, effects from ammonia are likely to result from surface run-off during a rainfall event. As stated above, Little and Calfee (2002) found that on a non-porous surface fire retardants remained toxic for more than 21 days. Again the environmental factors such as surface or soil type (rock, sand, soils with high or low organic matter, etc), persistence in the environment, timing of a rainfall event, and the amount of retardant on the ground play a significant role in determining adverse effects to fish. While Little et al. (2006) determined that rainbow trout may avoid D75-R contaminated water; it is not clear how other fish species will react to such contamination. Given the significant morphological differences of Arizona native fish species to rainbow trout, the number of field variables that may influence response behavior, as well as the effects of fire within the watershed (input of ash that clogs gill membranes, increased turbidity, and stream temperature, and obstruction of water flow by addition of debris) that could cause disruptions in aquatic habitats (Little et al. 2006), we can not be certain the avoidance behaviors to the Phos-Chek retardants demonstrated by rainbow trout will affectively reduce or preclude mortality in Arizona native fish species, particularly those in pools or tanks. Also if there is run-off, it may reconnect intermittent streams and provide significant dilution. In rough water, aeration may also help to reduce ammonia levels during the flooding event.

Effects to Algae and Benthic Macroinvertebrates

Algae and benthic macroinvertebrates are important because of the role each plays in the aquatic ecosystem. Model organisms are commonly used in toxicity studies. Organisms used as models easily reproduce in the laboratory, are easy to manipulate and count, and are representative of their ecological niche. *Daphnia magna*, an aquatic macroinvertebrate, *Hyalella azteca*, a benthic macroinvertebrate, and *Selenastrum capricornutum*, an algae, were used in some toxicity studies on long-term retardants. Daphnids are invertebrates that live in the water column and feed on primary producers such as algae and bacteria. Hyalella azteca is an amphipod that primarily lives in the surface of freshwater sediments. An algal model is useful because it represents the base of the aquatic food web.

One study was conducted using the indigenous aquatic invertebrates which would only be found in Arizona in perennial waters. Mayflies (*Epeorus (Iron) albertae*) were consistently more sensitive to Phos-Chek D75-F than stoneflies (*Hesperoperla pacifica*) (Poulton et al. 1997). The LC_{50}[1] for mayflies exposed to Phos-Chek D75-F for 3 hours was 1,033 mg/L (Poulton et al. 1997). This concentration is similar to the field concentration that would result from drift or run-off but is almost 10 times lower than the concentration expected if an accidental drop occurred. Mayflies were less sensitive to Phos-Chek D75-F when compared to trout or fathead minnows (Poulton et al. 1997). It is possible that in Arizona's streams, Phos-Chek D75-F would be more directly toxic to fishes that to the fish food items, such as mayflies.

Most toxicity studies have been conducted with Phos-chek D75-F. This formulation is only one of the eight formulations being considered in this consultation; wide variation may exist between the toxicity of the D75-F formulation and the other formulations.

Water hardness can alter the toxicity of the Phos-Chek formulations. The toxicity of Phos-Chek D75-F was increased in soft water compared to hard water (MacDonald et al. 1995, Poulton et al. 1997). Water hardness ($CaCO_3$) on Forest Service lands in Arizona range from 96-150 mg/L near the Coronado National Forest (USGS gauge on the Santa Cruz near Nogales) to 580-1,200 mg/L near the Kaibab National Forest (USGS gauge at Kanab Creek near Fredonia) (USGS 2008).

The most toxic portion of the long-term retardants like Phos-Chek is ammonia (MacDonald et al. 1995). Un-ionized ammonia is more toxic to aquatic organisms than total ammonia (MacDonald et al. 1995, Poulton et al. 1997). Nitrates and nitrites could

[1] LC_{50} –is the concentration lethal to 50% of the test organisms.

contribute to the toxicity of long-term retardants, but did not appear to influence the toxicity of Phos-Chek D75-F to daphnids. MacDonald et al. (1995) found that nitrate-nitrogen concentrations in the Phos-Chek toxicity tests were 75-160 times less than those reported to be toxic to freshwater invertebrates. Nitrite-nitrogen concentrations in a Phos-Chek D75-F toxicity study on crayfish were also 30 times less than the crayfish 96-hour LC50 (Gutzmer and Tomasso 1985).

EPA (1986) reported that macroinvertebrates are more tolerant to ammonia than fish. Also, toxicity to ammonia is species-specific for invertebrates. In their toxicity studies with Phos-Chek D75-F, MacDonald et al. (1995) found that their un-ionized ammonia concentrations were lower than toxic concentrations reported in other studies. They believed that other constituents (such as some of the proprietary chemicals) contributed to the toxicity they observed.

Ammonia toxicity to plants is influenced by pH. At neutral pH, Phos-Chek D75-F formed little un-ionized ammonia. Therefore, MacDonald et al. (1995) concluded that some factor other than ammonia influenced its toxicity. Although little un-ionized ammonia was formed during the Phos-Chek D75-F toxicity tests to *Daphnia*, concentrations of un-ionized ammonia were still greater than the EPA recommended concentration of 0.02 mg/L below which all aquatic life may be protected (MacDonald et al. 1995). For only Phos-Chek D75-F, nitrate and nitrite concentrations are not toxic to aquatic invertebrates.

Phos-Chek D75-F exposures to mayflies, stoneflies, trout, *Daphnia*, and fathead minnows indicated that mayflies and stoneflies were much less sensitive to Phos-Chek when compared to the trout (Poulton et al. 1997). This study was conducted using stream water in Nevada in both a mobile laboratory and an artificial channel to more accurately assess real-world conditions. Two in-stream exposures were also conducted. Macroinvertebrate species may respond to disturbance by allowing themselves to enter the water column and “drifting” away from the disturbance. In this study, in-stream “drift” response after exposure to Phos-Chek D75-F was measured on five invertebrate taxa. Taxa richness and total number of organisms in the drift was low during the 30 minutes prior to the exposures and increased during the 30 minute period of the dose (Poulton et al. 1997). Drift of Ephemeroptera, Plecoptera, and Trichoptera during the first Phos-Chek D75-F exposure period returned to zero at the lower dose but did not return to zero in the second exposure at the higher dose (Poulton et al. 1997). Given these results and the unknown toxicity of the other 7 Phos-Chek formulations, adverse effects are likely to result from 660 mg/L Phos-Chek D75-F in stream systems (Poulton et al. 1997). This dose was comparable to the concentration expected from a surface run-off event.

The rate of Phos-Chek degradation in-stream was accelerated in areas with elevated organic matter (Poulton et al. 1997). Half-life for long-term fire retardants in-stream was 14 to 22 days. In the in-stream test, nitrates were elevated after Phos-Chek D75-F exposure when compared with controls, but not above toxic concentrations and ammonia concentrations were not elevated (Poulton et al. 1997). Overall, Poulton et al. (1997) determined that Phos-Chek D75-F is not highly mobile.

Trophic Interaction
The ammonia component in long-term fire retardants may cause an increase in primary producers which would benefit primary consumers. However, other components of long-term fire retardants could produce toxic effects to primary consumers. Or, for example, since algae appeared to be more sensitive to long-term fire retardants, daphnids could suffer from a poor quality food source at lower concentrations than were directly toxic to the daphnids (MacDonald et al. 1995). Although the exact species used in these toxicity studies may or may not be present in Arizona, adverse effects of long-term retardant chemicals such as Phos-Chek D75-F on primary producers and on aquatic invertebrates in the ecosystem could lead to altered biodiversity and shifts in trophic dynamics (MacDonald et al. 1995).

Other Considerations
There are many variables present in field applications of long-term fire retardants (temperative, wind speed and direction, relative humidity, etc.) that may influence the delivery of the retardant to its target. However, it must be noted that the concentrations of Phos-Chek D75-F used in toxicity studies were substantially lower (500 times in *Daphnia* studies and 3,000 times in algae studies) than the field concentrations.

Discussion. As described above, aquatic systems and species have been subjected to a number of studies and have identified acute toxic effects to a number of fish species and to aquatic invertebrates as a result of exposure to ammonium compounds. Ultimately, toxicity to aquatic organisms in the field is dependant upon the inherent sensitivity of the species and the concentration of ammonia in the water. Though concentrations in waterbodies will vary with the circumstances of the individual application and the environmental factors of the site, aquatic die-offs documented from previous use of retardants considered in this assessment demonstrate that concentrations of these compounds can reach levels high enough to cause acute toxicity. We can generally predict that ammonia concentrations following an application will be greater in small waterbodies and waterbodies with low or no flow, where dilution and dissipation will be reduced. This is demonstrated in the risk assessment prepared by Labat Environmental (2007), which predicted increased risk to sensitive amphibian and fish species in small streams as compared to large streams. Threatened and endangered species that inhabit these vulnerable habitats thus will experience increased risk of acute toxicity.

Little attention has been paid to the indirect effects of these chemicals. For example, the EA cites studies that found that juvenile rainbow trout were able to avoid areas of high concentration of fire retardant by swimming away (Little and Calfee, 2002), but does not consider the possible indirect effects to this species due to the interruption of sheltering, feeding or breeding activities. For example, Wells et al. (2004) comments that while the avoidance behavior demonstrated by fish may be advantageous in the short term, it may also result in displacement of fish into less advantageous areas and may also disrupt essential migratory behaviors and could affect the stability of viable populations of these species. The EA also does not take into consideration situations where there is little or no area for the fish to swim away. For example, the Kendall Warm Springs dace

(*Rhinichthys osculus thermalis*) is limited to one small stream approximately 328 yards (300 meters) in length that originates at a series of thermal springs near the base of a bluff in Sublette County, Wyoming and exists nowhere else. In the case of a misapplication of retardant into these areas, it is unlikely that the dace would be able to swim away from the exposure.

Invertebrates which are immobile have no such avoidance capability. Augsperger et al., (2003) concluded that freshwater mussels are particularly sensitive to exposure to ammonia. The Aquatics Report and Biological Evaluation cites studies (Hermanutz et al., 1987) showing that macroinvertebrate species respond to physical disturbance by entering drift, thereby being carried downstream of the disturbance, but such behavior does not occur in adult mussels. Adult mussels are filter feeders that attach themselves to aquatic substrates and siphon food and oxygen from the water column and interstitial spaces ("pores") between sediment particles, and cannot exhibit the avoidance behaviors such as swimming or drifting away, as mentioned above. In fact, Augsperger et al., (2003) state that ammonia levels are a limiting factor in the survival of these species and also note that the ammonia concentrations within the sediment pores is typically higher than the overlying water. Entry of ammonia into waterways containing these species could have a severe effect.

The EA and Aquatics Report and Biological Evaluation cite one study (Norris et al., 1991) that states that the retardant breaks down within 24 hours, leaving only chemicals of "low toxicity." However, another study cited elsewhere in the EA (Little and Calfee, 2002) demonstrated that retardant, including Phos-Chek D75-R, can remain toxic enough to kill fish for up to 21 days.

Another study provided to the FWS by the USFS, though not cited in the EA, stated that "rainwater runoff from watersheds treated with recommended mixed retardant concentrations may pose environmental hazard for weeks after application (Little and Calfee, 2002b)." A rain event during this time could expose aquatic organisms to potentially lethal levels of ammonia. They also found that the level of toxicity was highly dependant upon the presence of organic content. Substrates with high organic content virtually eliminated toxicity, whereas retardant dropped on those with little or no organic content such as sand or gravel maintained their toxicity for an extended period. This same study also found that the responses of subject fish exposed to "ammonia concentrations in aqueous D75-R solutions were within the lethal range after 7 days of weathering but declined to sublethal concentrations thereafter. These results suggest that the decomposition of D75-R occurs after 7 days of weathering." This suggests that at least under some conditions, the ammonia concentration from fire retardant in water can remain toxic to fish even after seven days.

The EA also cites Labat Environmental (2007) and states that "any risks that exist are minor, small in scale, and unlikely to affect more than a few individuals at a time." However, the cited paper also states in the "Ecological Risk Summary and Discussion (page 45)" that in the case of accidental application across streams, "all retardant …

present risk to survival of populations or individuals of one or more aquatic species if applied across a small stream."

The EA states that by following the 2000 Guidelines, "aerial delivery of retardant to a waterway would normally not occur (page 15)." However, in addition to the eleven incidents of accidental application of retardant identified by the USFS in their EA, NMFS identified several more instances, including some with mortality to listed fish that were unreported by the USFS (NMFS, 2007) and were not addressed by emergency consultation.

The FWS has also identified additional misapplications of retardant into waterways:

In 2003 retardant was misapplied into Copper Creek during the Snowbank/Talon fire. In the case of Copper Creek, USFS personnel were unable to get to the site until three days after the drop due to safety concerns and were unable to conduct an in depth analysis until eight days after the misapplication, which suggests that in such cases it is likely that an assessment may not be possible while the effects are detectable. We are also aware of additional misapplications on the Nine Mile Complex on the Lolo NF in 2000 and the Brown Canyon fire on the Sawtooth NF in 2006.

We also note that there have been instances where USFS personnel has not recognized an accidental drop (the Cannon fire, included on the USFS' Misapplication List), or has determined an incident not to be a misapplication where they did not actually document adverse effects to fish though the drop was within the buffer zone (the 2006 Rush and Titus fires on the Klamath NF). It therefore appears that USFS does not have a systematic procedure for identifying and monitoring impacts resulting from accidental exposure to fire retardant; it is likely that other incidents have occurred but gone unreported, and we have adjusted our analysis accordingly.

While we agree that the 2000 Guidelines are a useful tool in minimizing impacts to aquatic species due to the application of fire retardant, it is not a guarantee that no impacts will occur. For example, the 2000 Guidelines direct pilots to avoid visible water. However, small streams, streams underneath tree canopies or seasonal bodies of water such as vernal pools could be have retardant dropped into them simply because the pilot was unable to see them, especially under smoky conditions. As NMFS points out in their biological opinion, such an accidental application would be unexpected and therefore, unlikely to be reported or monitored. We believe that it is unrealistic to expect a pilot to always precisely adhere to the 2000 Guidelines when his/her primary concern is emergency response. Additionally, the 2000 Guidelines do allow the intentional application in waterways in situations as explained in the exceptions (see App. A). While we acknowledge that the USFS will not intentionally drop retardant into recognizable waterways except as stated in the 2000 Guidelines, we do not concur that retardant is unlikely to enter waterways; rather, we believe that it will sometimes be unavoidable due to circumstances mentioned above.

Terrestrial.

The available literature contains little information as to the toxicity of long-term fire retardants on terrestrial species. Only a few studies have investigated the direct impacts on terrestrial systems (Poulton, B. et al., 1997; Bell, 2003; Hopmans and Bickford 2003; Dodge, M., 1970) and almost none have evaluated any indirect effects.

Terrestrial species.

Among taxonomic groups, little seems to be known about the direct and indirect effects of the use of aerial fire retardant on most terrestrial species. A few studies have shown indirect effects (e.g., nitrate poisoning or behavioral disruption) to some aquatic organisms (see discussion and citations above) and domestic livestock (Dodge, M., 1970). Parallels to the findings of any of these studies are difficult given the differing biological and ecological processes and requirements of widely divergent species. Based upon what information does exist, it would be reasonable to assume that the use of fire retardant would not have large scale direct effects to most terrestrial species and therefore would not contribute to jeopardy of these species. However, as discussed below, our analysis demonstrated specific taxonomic groups that appeared to be at some risk from the use of retardants.

Mammals

Herbivores and particularly ruminants may be indirectly exposed to nitrate poisoning, due to feeding on plants with elevated levels of nitrate within plant tissues (Dodge, M., 1970). However, the literature suggests that multiple factors must converge for this to happen. The likelihood of these factors occurring with respect to threatened and endangered species was determined by the RO/FO local analysis.

Plants.

We do not concur with the EA's assessment of potential impacts to upland vegetation. For example, in the EA, page 18, the USFS states that "the application of retardant may have a beneficial effect on vegetation because the main ingredient of retardant is agricultural fertilizer," and cites Labat Environmental (2007). In fact, in the cited study the authors noted that previous studies in both North America and Australia had found a change in species richness after exposure to long-term fire retardant. Particularly, Labat noted that: "in the North Dakota prairie ecosystem, species richness was reduced in plots exposed to both retardant and foam regardless of whether the plot was burned or unburned. All plots were dominated by *Poa pratensis*, which clearly gained a competitive advantage from retardant application and crowded out other species. Investigations in the Great Basin shrub steppe ecosystem also showed that plots treated with fire chemicals experienced initial declines in species richness; however, differences among plots were undetectable after a year. Depression of species richness was most pronounced in the riparian corridor." Additionally, two studies (Larson and Duncan, 1982; Bradstock et al., 1987) have shown short-term leaf death and mortality in leguminous shrubs and forbs after retardant application.

The EA also did not address indirect effects to terrestrial plant species. Indirectly, retardant can affect plant communities and rare plants by facilitating the invasion of non-native species (Bell 2003, Larson and Newton 1996). Retardant application can also affect plant communities and rare plants indirectly by attracting more herbivore and browsers to an application site (Larson and Duncan 1982), presumably because of the increased quality of the forage or an increase of biomass. Increases in biomass (Bell 2003, Larson and Newton 1996, Larson and Duncan 1982), and decreased plant diversity (Larson and Newton 1996, Bradstock et al 1987) have also been noted in the literature but these effects may only last for one year (Bell 2003, Larson and Newton 1996). For example, a study by Labat Environmental (2007) which is cited in the EA, also stated that "similar to the effects of fertilizers, fire retardants may encourage growth of some plant species and giving them a competitive advantage over others, thus resulting in changes in community composition and species diversity (Tilman 1987, Wilson and Shay 1990). Bell et al. (2005) recorded enhanced weed invasion in an Australian heathland ecosystem, particularly in areas receiving high concentrations of Phos-Chek D75R."

This is of concern because invasion of non-native weeds is the most likely effect of the use of fire retardant on threatened or endangered plants. While those plant species that are widely distributed are not likely to be jeopardized by the application of retardant on a single fire, of greatest concern are those plants which are considered "narrow endemics," that is, species that occupy a small geographic area and no where else. Consequently, terrestrial plants with a narrow distribution were among those that were sent to the Regions for localized analysis.