SISKIYOU, SIUSLAW, AND
UMPQUA NATIONAL FORESTS

Calendar Year 1973

PACIFIC NORTHWEST REGION
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Vegetation Management
with Herbicides
REPLY TO: 1940 Environmental Statements

SUBJECT: USDA Final Environmental Statement on Siuslaw, Umpqua and Siskiyou National Forests CY 1973 Vegetation Management Project Using Selective Herbicides

TO: Honorable Russell E. Train, Chairman Council on Environmental Quality

THROUGH: T. C. Byerly, Coordinator of Environmental Quality Activities

Enclosed are ten copies of the Final Environmental Statement on Siuslaw, Umpqua and Siskiyou National Forests Calendar Year 1973 Vegetation Management Project Using Selective Herbicides issued by Forest Service Regional Forester, Pacific Northwest Region.

The responsible official is Regional Forester T. A. Schlapfer, Pacific Northwest Region.

Enclosures
U.S.D.A. FOREST SERVICE ENVIRONMENTAL STATEMENT

CALENDAR YEAR 1973 ZONE VEGETATION MANAGEMENT

PROJECT USING SELECTIVE HERBICIDES

ENVIRONMENTAL STATEMENT

USDA FOREST SERVICE, R-6

SIUSLAW, UMPQUA AND SISKIYOU NATIONAL FORESTS

PREPARED IN ACCORDANCE WITH

SECTION 102(2) (c) of P.L. 91-190

TYPE OF STATEMENT:

FINAL

SUBMITTED TO CEQ: FEB 22 1973

TYPE OF ACTION ADMINISTRATIVE

RESPONSIBLE OFFICIAL:

THEODORE A. SCHLAPFER
Regional Forester
Pacific Northwest Region
Portland, Oregon
Summary Sheet

I. Final Statement

II. Administrative

III. The action covered by this environmental statement involves the use of herbicides 2,4-D, 2,4,5-T, 2,4,5-TP, Amitrole-T, Atrazine, Picloram, and Dicamba to reduce the volume of native vegetation where it hampers forest management activities. The zone lies in two States, Oregon and California; and in thirteen Counties, namely: Benton, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Polk, Tillamook, and Yamhill in Oregon, also Del Norte and Siskiyou in California.

The herbicides are used in reforestation site preparation, release of conifers, right-of-way maintenance, maintenance of physical facilities, range improvement work, thinning and weeding of conifer plantations.
IV. Summary of environmental impact and adverse environmental effects.

1. The vigor of target and non-target terrestrial vegetation susceptible to the herbicide formulation at the time of application will be decreased. In most cases, susceptible plants will be killed or top killed. Plants not seriously affected will usually increase in vigor and attain a growth advantage over the susceptible species. After a few years, some susceptible plant species recover and occupy a subordinate position in the plant community.

2. Wildlife populations may increase as a result of the herbicide use. There is no proven instance on the three National Forests where past herbicide treatments have had an adverse effect on wildlife populations.

3. Literature indicates that indirect effects of nitrate poisoning in livestock and other ruminants is a possible threat when auxin herbicides are applied to nitrate accumulating plants.

4. There is no evidence to indicate that the herbicides, applied at the recommended rates, will have significant adverse effects on soil microbial populations.

5. There is no evidence that past herbicide treatments on the three National Forests have significantly affected aquatic life. Rigid application controls have kept herbicide levels in Forest waters well below toxic levels. Numerous water analysis following herbicide treatments on the Forests in the past have shown water contamination with the herbicides as used to be negligible, usually below 5 ppb.

6. The impact of the herbicide use on man is highly variable and depends upon the philosophy, convictions and values of the individuals and groups involved. No Forest personnel, herbicide applicators, or local Forest residents have incurred health problems attributed to the use of herbicides during the past two decades. Dead vegetation results in a short-term aesthetic deterioration of treated tracts.

V. Alternatives to herbicide use considered are mechanical and hand vegetation control and no vegetation control.
VI. Comments on the Draft Environmental Statement on herbicide use on the Siskiyou, Siuslaw, and Umpqua National Forests have been received from the following Federal, State, and local agencies, groups, and individuals.

1. Federal Agencies

Department of Agriculture - Agricultural Marketing Service
Department of Agriculture - Soil Conservation Service
Department of the Army - Corps of Engineers
Department of Health, Education and Welfare
Department of Housing and Urban Development
Department of Transportation - Federal Highway Administration
Environmental Protection Agency

2. State Agencies

Oregon, comments received through the Assistant to the Governor for Natural Resources - State Water Resource Board - Game Commission

3. Local Agencies

Agricultural Commission - Del Norte County, California

4. Groups

Huxley College of Environmental Studies
Mazamas
Western Forest Industries Association

5. Individuals

Dr. Jean Anderson
Ugo E. Pezzi

VII. The Draft Statement was made available for CEQ and the public on October 5, 1972.

The Final Statement was made available for CEQ and the public on Febr. 22, 1973.
U.S.D.A. FOREST SERVICE ENVIRONMENTAL STATEMENT
SIUSLAW, UMPQUA AND SISKIYOU NATIONAL FORESTS CALENDAR YEAR
1973 VEGETATION MANAGEMENT PROJECT USING SELECTIVE HERBICIDES

Prepared in Accordance with
Section 102(2)(C) of P.L. 91-190

January 1973

Type of Statement: Final

Date of Transmission to CEQ: FEB 22, 1973

Type of Action: Administrative

Responsible Official: T.A. Schlapfer, Regional Forester
Pacific Northwest Region

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SIUSLAW, UMPQUA AND SISKIYOU NATIONAL FORESTS
CALENDAR YEAR 1973 VEGETATION MANAGEMENT
PROJECT USING SELECTIVE HERBICIDES

I. DESCRIPTION

Purpose: The purpose of the program is to reduce the volume of native vegetation where it hampers forest management activities. Vegetation modification is needed in a variety of situations, such as:

1. Site preparation to reduce competition for moisture and soil nutrients from native vegetation prior to planting tree seedlings.

2. Plantation release to reduce competition for light, moisture and nutrients between shrubs and conifer seedlings.

3. Right-of-way maintenance to retard vegetative encroachment which reduces safe visibility on road curves, creates hazards under powerlines, invades canal banks and physically blocks foot trails.

4. Maintenance of physical facilities where poisonous plants and other problem vegetation invades campgrounds, seed orchards and administrative sites.

5. Range improvement work when weeds reduce grazing capacity by crowding out desirable plants or noxious species present a hazard livestock.

6. Thinning and weeding conifer plantations to reduce overstocking and promote vigorous growth of crop trees.

Scope: Administration of the Siuslaw, Umpqua and Siskiyou National Forests encompasses 2,688,221 acres in several counties of western Oregon and northern California as shown in Figure 1. Vegetation modification will be done on less than 2 per cent of the total area.
<table>
<thead>
<tr>
<th>NATIONAL FOREST</th>
<th>COUNTY</th>
<th>ACRES (as of 6/30/71)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siuslaw</td>
<td>Benton, Oregon</td>
<td>18,021</td>
</tr>
<tr>
<td></td>
<td>Coos, Oregon</td>
<td>8,992</td>
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<tr>
<td></td>
<td>Douglas, Oregon</td>
<td>65,793</td>
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<tr>
<td></td>
<td>Lane, Oregon</td>
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<td></td>
<td>Lincoln, Oregon</td>
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<td></td>
<td>Polk, Oregon</td>
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<td></td>
<td>Tillamook, Oregon</td>
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<td></td>
<td>Yamhill, Oregon</td>
<td>25,400</td>
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<tr>
<td></td>
<td>SUB-TOTAL</td>
<td>620,361</td>
</tr>
<tr>
<td>Umpqua</td>
<td>Douglas, Oregon</td>
<td>821,660</td>
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<tr>
<td></td>
<td>Jackson, Oregon</td>
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<tr>
<td></td>
<td>Lane, Oregon</td>
<td>152,142</td>
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<tr>
<td></td>
<td>SUB-TOTAL</td>
<td>984,411</td>
</tr>
<tr>
<td>Siskiyou</td>
<td>Coos, Oregon</td>
<td>68,365</td>
</tr>
<tr>
<td></td>
<td>Curry, Oregon</td>
<td>607,528</td>
</tr>
<tr>
<td></td>
<td>Josephine, Oregon</td>
<td>375,176</td>
</tr>
<tr>
<td></td>
<td>Siskiyou and Del Norte, Calif.</td>
<td>32,380</td>
</tr>
<tr>
<td></td>
<td>SUB-TOTAL</td>
<td>1,083,449</td>
</tr>
</tbody>
</table>

1/ From Summary of National Forest Acreages, 5400, 6/30/71
Treatments will occur on widely scattered tracts of various sizes as described further in the appendix.

Materials Used: Selective herbicides will be applied in accordance with uses for which they have been registered by State and Federal agencies. The herbicides include 2,4-D; 2,4,5-T; Amitrole-T; atrazine, silvex, picloram and dicamba. Number 2 diesel oil and water will be used as carriers for the various formulations. Low volatile esters of 2,4-D and 2,4,5-T registered for use on forest lands will be used.

Background statements for herbicides included in this report are included in the appendix. The background statements will be updated as new information becomes available.

The following summary is from Ron Stewart, Research Silviculturist, Pacific Northwest Forest and Range Experiment Station:

"The herbicides 2,4-D; 2,4,5-T; Amitrole-T; atrazine, and silvex were chosen because they are: (1) selective, (2) relatively non-persistent, (3) do not accumulate in the environment, (4) relatively nontoxic, and (5) relatively inexpensive. In addition, extensive research and field experience over the last two decades has shown these herbicides to be the most effective available for the majority of herbaceous or woody plant competitors on the three National Forests (Gratkowski 1959, Gratkowski 1971, Lauterbach 1961, Theisen 1967, Newton 1967). With proper selection of application rate, timing, and carrier these herbicides will not damage desirable conifers (Gratkowski 1961, Gratkowski 1971, Newton 1967).

These studies and field observations indicate that susceptibility to herbicides varies by species, herbicide, timing, application rate, and carrier. Therefore, in multi-species communities where herbicides are used; some plants will be killed, some will be top killed but will resprout, and others will be unaffected. Herbicidal treatments are selected to produce maximum effect on undesirable species and minimum effects on desirable conifers and other vegetations."

Where special drift control techniques are needed, certain additives will be included in the herbicide formulations. Examples of these are the particulating agent Norbak, the thickening agents Vistik and Dacagen, or Accutrol foam adjuvant.

Appendix tables give specific data on rates of application and formulations.

Methods: Herbicide application techniques are based on 20 years of research and experience and will be selected to produce the maximum benefits using the least amount of chemical. Treatments are varied depending upon terrain, vegetation, weather, and location of sensitive areas.
The individual project areas are shown on maps included in the appendix. Minor adjustments in individual treatment areas will be made up until time of application to insure that continual evaluation of the environmental impacts can be provided. A minor number of treatment areas will be deleted and other treatment areas may be included that have been identified as having a higher priority need for treatment and do not present any significant hazard to nontarget species.

Site preparation and plantation release are customarily done by aerial application because of inaccessibility, cost, and steep mountainous terrain. To insure maximum placement control and aircraft safety, helicopters are used. Agricultural aircraft hardware designed for herbicide spraying is specified and the work is done by private contractors.

Right-of-way maintenance spraying is accomplished largely by vehicle-mounted compression equipment using either hand-held spray guns or fixed agricultural spray booms. Areas not accessible to ground vehicles are treated aerially or by hand placement depending on the size of the treatment area.

Control of range weeds and undesirable plants in campgrounds and other facilities is a spot treatment using pressurized back-pack sprayers in the same manner as a home gardener controls lawn weeds. Control of the spray nozzle is manual.

Thinning and weeding of conifer plantations is accomplished by the "hack and squirt" system. Axe cuts in the stem of the tree to be removed are treated with herbicide from a hand-held squirt bottle which meters out a predetermined quantity of chemical.

Controls: In addition to achieving satisfactory herbicide results, a major objective of this program is to minimize the amount of herbicide which enters the environment. A variety of controls and checks are planned, which, based on past experience, will provide the desired protection.

The basic policy in Region 6 of the Forest Service on the use of chemicals, including herbicides, is as follows:

1. Chemicals may be used to enhance National Forest resources when no significant hazard to the environment is created.

2. Usage will be based on a biological-economic analysis. Long-term ecological and biological impact, as well as immediate economic gain, will be considered.

3. Only materials and methods will be used which are effective and have the least potential hazard to man, his animals, wildlife and other nontarget components of the environment.
4. The lowest effective dosage of the least hazardous effective material will be used.

5. Possible hazards to the biota will be identified and precautions taken to prevent adverse effects.

6. Only materials registered for the specific use intended will be used and they will be applied in accordance with label directions. The Forest Service will require additional restrictions on specific projects as deemed necessary to protect other resource values.

7. Application of chemicals and poisons will be done only by properly trained and authorized personnel.

8. Federal and State agencies with responsibilities and concern for the environment, public health, fish and wildlife will be informed in advance of our programs. Where appropriate, consultations and reviews with them will be held. These should be documented. Written comments are desired.

From: The Forest Service and Herbicides by Benton Howard.

October, 1970.

When herbicides are applied to National Forest land in Oregon, a Forest Service representative will monitor or supervise the project. This representative will be licensed as a "Special Applicator" by the State of Oregon. Work done by contractors will be carried out by firms having a State operator's license. The contractor's employees actually operating application equipment will have a State applicator's license. Each type of licensing requires successful completion of a written technical examination. Work done in California will also meet all State licensing requirements and will be under the control of a qualified Forest Service employee.

Various controls will be in effect during aerial application. To minimize drift and volatilization, spraying is normally confined to periods when wind speed is less than 6 MPH, air temperature is under 70 degrees F., relative humidity is over 50 percent, vegetation is free of snow or ice, rainfall is not occurring and air turbulence is not adequate to affect normal spray patterns. Frequent measurements of the weather conditions listed above are made at the spray site during operations. Helicopters spray from approximately 50 feet above the vegetation which is considered the minimum safe height for the characteristically steep, broken terrain containing occassional high obstructions.

Helicopter-mounted spray equipment is selected and positioned to achieve maximum effectiveness with minimum spray drift. Satisfactory results from phenox herbicides require a deposit of about 75 drops per square inch of plant surface, Behrens (1957)(1). Increasing droplet size does not produce proportionately better results but does require greater amounts of herbicide. Excessive drift may become a problem when drop size is less than 200 microns MMD (mass median diameter), Akesson (1971)(2). See Table 2. If droplet size exceeds 800 microns MMD, total gallons applied must be increased to provide an adequate number of drops per square inch, USFS (1972)(5).
Spray equipment used in aerial application will deliver spray droplets having a mass median droplet size exceeding 200 microns.

All aerial nozzles are equipped with automatic shut-off devices to prevent loss of herbicide along non-spray flight routes.

Where particularly sensitive conditions are identified near spray areas, special drift control measures will be used. These may consist of a thickening agent or foam spray types of drift reduction.

During Forest Service air operations a radio network is maintained with all parts of the project. Various radio traffic and flight logs document activities as they occur. Where needed direct radio communications between spray aircraft and ground observers is established. Pre-spray reconnaissance flights are made to orient pilots when sensitive areas adjoin spray targets.

Herbicide application with vehicle-mounted pressure sprayers or backpack equipment involves different technical controls than aerial operations. Normal "good housekeeping" practices include prevention of plumbing leaks, safe handling and mixing of chemicals, control of application rate and supervision by licensed personnel.

During herbicide application, a variety of water quality protection measures are used. If water is drawn from natural supplies to mix herbicides, the source is protected by one or more of the following three practices:

1. A gravity flow is established so the source is above the mixing tank.
2. An intermediate reservoir is used. Water from the source is pumped into the reservoir, then pumped from the reservoir into the mixing tank.

3. An air-gap is established between the source and the mixing tank such as the air space between a hose nozzle and an opening on top of the tank.

Unsprayed buffer strips are left adjacent to live streams and bodies of water:

- Width of aerial spraying buffer strips is 100 feet.
- Width of buffers for vehicle sprayers is 50 feet.
- Width of buffers for hand sprayers is 25 feet.

Buffer widths are based on recommendations in the January 10, 1972 policy statement of the Oregon Department of Environmental Quality which is enclosed in the appendix H of this report.

Based upon the recommendations of the Working Group on Pest Management of the Subcommittee on Pesticides of the Cabinet Committee on the Environment, an untreated buffer strip of at least 100 feet will be left adjacent to streams and bodies of water when either dicamba or picloram are to be used.

A water quality monitoring program is carried out during the herbicide treatment season. Water samples are collected at various downstream points and a herbicide analysis is made by the State of Oregon Department of Agriculture. The extent and nature of sampling varies with the location, sensitivity and local characteristics of the work area. As an example of water monitoring practices, the procedures prescribed for the Siskiyou National Forest are included in the appendix of this report. The Siuslaw and Umpqua Forests use similar practices suiting their local conditions. Past results in water monitoring on herbicide projects are described under environmental impacts later in this report.

Safety

A safety plan is prepared in conjunction with each project. (A sample of such a plan is included in appendix G.)

Economic Analysis:

The total cost of aerial herbicide application, including all the controls and water monitoring, ranges from $15.00 to $20.00 per acre. Hand cutting was recently completed on two separate one-acre tracts on the Siskiyou National Forest. The first attempt cost $400.00 and the second cost $148.50. On a large scale program these costs would probably be lower, but unlikely to fall below $100.00 per acre.
Section III of this report cites the example that without brush control, the annual timber harvest on the Siuslaw Forest would be 200 million board feet which is 300 million board feet below the full biological potential of 500 million board feet. Adams and Hamilton (1967)(6), report that employment requirements for west coast lumber manufacturing are 8.01 to 9.76 man-hours per thousand board feet of logs. Plywood manufacture requires 15.85 man-hours per thousand board feet of logs. Using a conservative average of 7 man-years per million board feet, the productivity at stake for the Siuslaw National Forest only, equals 2100 jobs in direct manufacturing employment.

The 300 million board feet would bring an annual stumpage revenue to the federal government of $6,000,000 to $10,000,000 dollars. Each dollar of stumpage price generates $18.00 of gross national product as well as secondary employment.

Mechanical mowing of roadside vegetation on the Siskiyou and Umpqua National Forests costs $350.00 per mile. A herbicide treatment achieves the same results for $215.00 per mile and lasts 3 years. Where roadside aesthetics are sensitive, mowing plus spraying can be done for a total cost of $565.00 per mile with results good for 3 years.

| Table 3 |
| Economic Analysis |
| Comparative Cost/Acre |

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Mechanical</th>
<th>Hand</th>
<th>Fire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Preparation</td>
<td>$20</td>
<td>$55 1/</td>
<td>$120</td>
</tr>
<tr>
<td>Release</td>
<td>20</td>
<td>N/A 3/</td>
<td>70</td>
</tr>
<tr>
<td>Thinning</td>
<td>60</td>
<td>N/A 4/</td>
<td>70 5/</td>
</tr>
<tr>
<td>Roadside Veg. Maint.</td>
<td>54 6/</td>
<td>88</td>
<td>150</td>
</tr>
<tr>
<td>R/W Veg. Maint.</td>
<td>20 7/</td>
<td>35</td>
<td>70</td>
</tr>
<tr>
<td>Improvement Maint.</td>
<td>50 8/</td>
<td>N/A</td>
<td>120</td>
</tr>
</tbody>
</table>

1/ Applicable to gentle topography, less than 30 percent side slope.
2/ Many brushy areas will not burn unless treated with herbicides prior to burning.
3/ & 4/ Mechanical methods would damage residual stand.
5/ Fire hazard in thinning slash may preclude use.
6/ Four acres per mile of road.
7/ Ten acres per mile of R/W.
8/ Spot treatment.
II. ENVIRONMENTAL IMPACTS

This assessment of the environmental impacts of chemical brush control has been made, utilizing the most significant and best available research in the field, as it pertains to herbicide use in the Pacific Northwest. Much of the research has been conducted on or adjacent to the Siuslaw, Siskiyou, and Umpqua National Forests. The results of such research are thereby judged to be particularly applicable to the ecosystems which exist in the three National Forests. Norris (1971)(7) in his paper Chemical Brush Control: Assessing the Hazard, Journal of Forestry, Vol. 69, No. 10, October 1971, contributed one of the most important and applicable documents available. Because of its significance, a reprint is included in appendix E.

The environmental impacts were evaluated on the following ecosystem components:

A. Vegetation
B. Wildlife
C. Domestic Livestock
D. Soil Microorganisms
E. Aquatic Life
F. Forest Waters
G. Man

Effects of these impacts are set forth below.

A. EFFECTS ON VEGETATION

The basic objective of vegetation management is to favor those species of plants that are of benefit to man, and to reduce competition of the "weed" species that flourish at the expense of the desirable.

Moore (1954)(8) defined a weed as:

"A plant which interferes with man's utilization of land for a specific purpose."

Stearn (1956)(9) comments:

"Taken as a whole, weeds are not so much a botanical as a human psychological category within the plant kingdom, for a weed is simply a plant which at a particular place and at a particular time arouses human dislike and attempts are made at its eradication or control, usually because it competes with more desirable plants. Sometimes because it serves as a host to their pests and diseases, or is unpalatable or dangerous to domestic beasts."
Thousands of species of plants can be found on the Siuslaw, Siskiyou and Umpqua National Forests, Franklin and Dryness (1969)(10). Of this vast quantity, only a small number adversely affect the establishment and growth of coniferous species. Usually, only a few competitive species will be found on any one tract of land.

Foresters have found selective herbicides to be an effective and economical way to modify composition of plant communities. Hank Gratkowski (1967 Ecological Considerations in brush control. Symposium Proceedings: Herbicides and vegetative management) points out that "success is dependent upon a knowledge of the ecology of competing vegetation, without such knowledge and a conscious effort to apply it, we may succeed in eliminating one or more undesirable species only to have their space occupied by even less desirable ones. Or we may remove preferred browse or forage plants, only to have the animals turn to conifers as a substitute. Or we may change microclimate conditions and make the site even less suitable for regeneration of conifers than it was originally." Herbicide application must be designed to minimize the negative effects of competition, and to improve site conditions to a degree that will allow reforestation or improve growth of existing conifers on the site. We especially want to increase the amount of light, soil moisture, and nutrients that are available to conifers.

Stewart (1972)(11) points out "In selecting a herbicidal treatment, the formulation to be applied to any given site must be keyed to the species composition and designed to achieve the desired silvicultural result. The Pacific Northwest presents an unusually large variety of topographic, geographic, and climatic conditions. This great diversity in site conditions is reflected in the vegetation complexity. The silviculturist must select the herbicidal treatment that will be most effective in controlling the target species, without doing permanent damage to the desirable species."

It is obvious that an application of a herbicide formulation will adversely affect some species of nontarget plants. Small plants not overtopped by larger shrubs will receive direct spray application. The degree of susceptibility varies widely between species and the type of herbicide being used. Herbicide selectivity is often influenced by time of application. Plants that are dormant will not usually be affected, while growing plants may be susceptible.

Undoubtedly some nontarget species will be adversely affected if they are subjected to direct herbicide application. There is little hazard to plants located outside of the target area, if drift control procedures are used to insure positive placement of the herbicide. Rare and unusual plant species, located in the wilderness areas, natural areas, and other special interest areas, are not endangered by the program.
House et al. (1967)(12) explains that when herbicides are applied to control vegetation some species will be killed and others will be suppressed, while others will remain unaffected. Thus when dealing with a plant community, herbicidal control, like other methods of vegetation control such as fire, mechanical removal, or biological control, usually results in the following:

1. Simplification of the plant community.

2. Setting the community back to a subclimax or unstable condition in which some ecological niches will be temporarily vacant.

3. Altering or reducing the competition within the treated area.

Stewart (11) provides a summary by Gratkowski (1967) of ecological considerations in brush control: "Foresters must consider the silvicultural benefits of brush species in particular situations before control operations are undertaken. In most cases, brush encroachment is probably detrimental to optimum development of conifers. However, brush communities serve an important function as wildlife habitat, and particular species have value as animal browse, as protection for erodible sites, and as nurse crops for conifers on hot, dry sites. Nitrogen fixing species such as red alder, *Alnus rubra*, and *Ceanothus* spp., may also increase soil fertility or reduce the incidence of soil pathogens. In addition, some species such as rhododendron, *Rhododendron macrophyllum*, have an important aesthetic value, and should receive consideration along main highways and in areas with recreational use."

Each of the herbicides to be used is selective in its effectiveness. Each one controls some but not all plants. For example, large groups of plants, such as grasses, ferns and mosses are unaffected by 2,4-D and 2,4,5-T. Shrubs like salal, *Gaultheria shallon*, rhododendron, *Rhododendron macrophyllum*, and big leaf maple, *Acer macrophyllum*, are notably resistant. There are a number of nontarget plants including legumes which are sensitive to the phenoxy herbicides.

The treatment objective is temporary reduction of selected competitive species.

B. EFFECTS ON WILDLIFE

1. Toxicity to Wildlife

It has been found that the herbicides 2,4-D, 2,4,5-T, 2,4,5-TP, Amitrole -T, dicamba, and picloram are not highly toxic to wildlife, Rudd and Genelly (1956)(14), Springer (1957)(15), Mellanby (1967)(16), Tucker and Crabtree (1970)(17), and Montgomery and
Norris (1970)(18). Their studies have shown that it would be highly improbable for an animal to ingest toxic levels of herbicide from treated forage, that the herbicides being used are not retained in the tissues or organs of animals, and that these herbicides are rapidly and efficiently eliminated with body wastes.

The primary exposure of wildlife to herbicides will be through consumption of treated vegetation. Montgomery and Norris (18) explained the probable animal consumption of 2,4,5-T on treated forage as follows:

"It is evident from the way 2,4,5-T is used and its behavior in the forest environment that the primary exposure of animals to this chemical will be through consumption of treated vegetation. Let us consider the amounts of 2,4,5-T which might be ingested from the highest residues found (300 ppm) in the study by Morton et al. (1967). A high milk-producing animal might consume up to 10 percent of its body weight in green forage per day. A 1,000 pound animal consuming 100 pounds of forage containing 300 ppm of 2,4,5-T would ingest 30 milligrams of 2,4,5-T per kilogram of body weight; well below the toxic level. This is a maximum exposure and would be received only when ingesting forage grasses shortly after treatment. If residue levels drop to less than 10 ppm a few weeks after treatment (Morton et al. 1967), the ingestion level of 2,4,5-T will be no more than 1 mg/kg."

Springer (15) found that test animals are usually repelled by herbicide residues on their natural foods, and will not eat freshly treated vegetation if other food sources are available. When cottontail rabbits *Sylvilagus* spp., were given a choice of either 2,4,5-T treated vegetation or untreated, the rabbits consumed almost none of the treated vegetation. This would reduce the possibility of animals consuming toxic amounts of herbicide in their diet when untreated vegetation is available.

Herbicide residues in black-tailed deer, *Odocoileus hemionus columbianus*, were studied by Newton and Norris (1968)(19). They found that deer feeding on the treated vegetation did not accumulate significant amounts of herbicide when exposed to maximum field application rates of atrazine, 2,4-D, and 2,4,5-T. Residues of 2,4-D and 2,4,5-T herbicides in the muscle tissue of deer after 43 days of exposure, was found to be 0.006 ppm. Atrazine could not be detected after 44 days of exposure. These minute traces of herbicide would not contaminate the meat for human consumption.

Feeding studies with various animals have shown that some herbicides are rapidly excreted. Fisher et al. (1965)(20) mixed a solution of picloram with grain to leave a residue of 5 ppm
on it. This was fed to a cow and 97.7 percent of the herbicide administered was recovered unchanged in the urine. Similar results were obtained by Erne (1966)(21) using 2,4,5-T on pigs, calves, and rats.

Dicamba (Banvel D) was fed continuously to rats for 2 years at dietary levels of 5, 50, 100, 250, and 500 ppm. There was no observable or measurable effect on survival, body weight, food consumption, or other observable body functions when compared to control animals (1971)(22).

Tucker and Crabtree (17) reported that herbicides are not highly toxic to birds. Large doses of Amitrole, atrazine, Tordon, and 2,4-D were administered to mallard ducks by stomach tube. The LD$_{50}$ was reported to be in excess of 2,000 mg/kg for these herbicides. They also studied the acute toxicity of diesel oil and reported the LD$_{50}$ to mallard ducks, *Anas Platyrhynchos*, in excess of 20 ml/kg. They explained that this is far more than a bird is likely to come into contact with in normal herbicide applications, as a 10 gallon/acre spray solution will result in approximately 1 ml/sq. ft.

Tschirley, et. al. (23) found the acute oral toxicity to domestic chicks to be low, when fed 2,4-D daily at a dosage of 280 mg/kg for 28 days, no effects could be detected. A subacute oral toxicity experiment on Japanese quail, *Coturnix coturnix*, showed that 100 and 1,000 ppm of picloram in their diet for 2 weeks had no ill effects as judged by their appearance, behavior, egg production and egg hatchability, Lynn (1965) (24).

The effect of herbicides on the native insect population is unstudied. Palmer-Jones (1964)(25) applied 2,4-D dust directly to honey bees, and also placed it in the hive entrance so the bees would crawl in it. Neither the adult bees nor the brood were adversely affected. Beilmann (1950)(26) suggests that the control of brush with 2,4-D may actually improve the bee pasture. He cites an incidence where the clover increased after treatment. Glynne Jones and Connel (1954)(27) classed 2,4-D as a stomach/contact poison of low toxicity to bees, with LD$_{50}$ values of 0.105 mg/kg. Compared to insecticides in the range 0.00004 to 0.002 mg/kg. Byrdy (1962)(28) on the other hand, reported total mortality of bees within four days after feeding 30 micrograms of 2,4-D and 10 percent mortality within three days, rising to 20 percent in five days of feeding 20 micrograms (Note: 1 gram = 1,000,000 micrograms). Johansen (1959)(29) reported that 2,4-D and related compounds were not toxic to bees, except when formulated as alkanolamine salt or the isopropyl ester.

\[1/\] Median lethal dose of a toxicant which kills 50 percent of the test organisms, see Table 5.
Herbicides will affect insects if they kill the plants on which the insects feed. In general it appears that there may be a hazard to bees and possibly other nectar feeding insects that could result when the insects drink water trapped in flower parts that contain concentrated herbicide residues. Otherwise there is little hazard to insects from direct toxicity of the compounds at normal application rates. The timing of herbicide treatment will also influence the effect on insects. Adams (1960)(30) suggests that some insects may be more susceptible at particular stages of their life cycle than at others. Dormant spray applications made in the early spring and prior to the active periods for these insects will probably not be detrimental.

Research data on the effects of herbicides on reptiles, amphibians, and other lesser known creatures is lacking. There is no evidence of possible harm to rare and endangered species.

Indirect toxicological effects on wildlife through destruction of food-chain organisms have received little study. This has been a problem in the case of chlorinated insecticides such as heptachlor or DDT, where birds were affected after eating earthworms that concentrated the insecticide and magnified the concentrations received by the birds. We do not anticipate a food-chain problem with these herbicides, due to the fact that studies with test animals have indicated that they are rapidly eliminated with body wastes, that they are not concentrated in tissues or organs, and that they are rapidly degraded in the forest environment.

Wildlife nutritionists are presently beginning to investigate the effects of pesticide-containing forage on the rumen fermentations of deer. Barber and Nagy (1971)(31) studied the effects of several classes of fungicides, insecticides and herbicides on the rumen microflora of mule deer, Odocoileus hemionus hemionus. Rumen fluid was inoculated with 2,4-D and they found that concentrations of 1,000 ppm caused significant decreases in the numbers of rumen bacteria after 48 hours of exposure. At 100 ppm, 2,4-D still remained inhibitory on some types of bacteria. At 1 ppm the 2,4-D did not affect the total bacteria count.

This study demonstrates that high concentrations of 2,4-D can adversely affect ruminant bacteria. Barber and Nagy concede that additional research is needed to correlate between field application levels of herbicides and levels of toxicants within the rumen of animals ingesting treated forage.
2. Effects on Wildlife Habitat

When the habitat requirements of Roosevelt elk, *Cervus canadensis nelsoni*, and black-tailed deer, *Odocoileus hemionus columbianus*, are examined closely, we find that their populations are directly associated with the early stages of forest succession. Harper (1971)(32), Brown (1961)(33), Rutske (1969) (34), and Hooven (1968)(35) have all reported that deer and elk populations in continuous stands of mature forests are at low ebb. Deer and elk are especially productive in areas that contain various stages of forest succession where they can easily find both food and cover. It must be pointed out that the dense, tall brush fields to be found on the coastal Forests, are producing only a fraction of the wildlife habitat, that would be available in the earlier successional stages.

Herbicides and all other vegetation control methods usually set the evolving, dynamic ecology back to an earlier sere.(12) Manipulation of the vegetation compositions by way of herbicide treatments suggest a potential reduction in available food supply; however, wildlife biologists agree that temporary retardation of the browse plants is usually beneficial in that many of these plants respond with an abundance of succulent sprouts which are more palatable than the older sprouts. The new growth is also kept within the reach of animals. The food supply of small mammals such as mice and other rodents, which have limited home range may be adversely affected.

Seldom does a herbicide application kill all the browse vegetation on areas treated to release conifers. In most cases, the growth of the browse species is retarded temporarily, but the browse species usually have abundant basal sprouting the following spring. The project areas represent only a small percent of the total wildlife habitat. The units are small in size and scattered over a large area.

Bramble and Byrnes (1958)(36) reported that the use of herbicides on power line rights-of-way improved the habitat for ruffed grouse, *Bonasa umbellus*. The grouse were concentrated within 150-200 feet of the edge effect created by the right-of-way. They also found that deer and rabbits utilized the treated areas heavily the year following treatment.

All fauna, which of necessity must depend either directly or indirectly upon plants for their food, are affected by the disturbance of their natural habitat and food plants. The degree of this effect is normally related to the degree of disturbance and change. If 10 percent of the total food and cover potential for a particular bird, animal, etc. is removed, the population of that species could be reduced by 10 percent, in one way or another.(12) If the food potential is increased by 10 percent due to the change in available plants, the population could increase by 10 percent. What may be of benefit to
one wildlife species, may be to the detriment of another. For example, what may benefit elk populations may be detrimental to rabbits. Black (1970)(37) studied the effect of herbicide-caused vegetation changes on wildlife. He reports fewer small mammals on treated areas after vegetation was decreased by herbicides. Mice were most affected. Deer were found to use the sprayed areas more than unsprayed areas the summer following a spring treatment.

Most studies have shown that herbicides are not directly destructive to wildlife, but indirect effects may be of benefit or harm (15). The Oregon State Game Commission in their study of the Ecology of Roosevelt Elk (32) reported the following summary on herbicide use:

"Herbicides can be both advantageous and a detriment to elk forage production. If ground forage is removed by chemicals, elk will be affected adversely. Conversely, if herbicides are used to open up closed brush canopies, production of ground forage may be increased and stump sprouting of browse plants may occur. The result will be increased animal-use in an area that had nearly grown out of elk forage production."

The effect of herbicides on Roosevelt elk and black-tailed deer are of particular concern to the public, due to their value as big game animals. Black-tailed deer are found throughout the three National Forests. The range of Roosevelt elk is more limited, but is being expanded by an active transplanting program. The primitive range of Roosevelt elk covered all of western Oregon, west of the crest of the Cascade Mountains. Figure (2) shows the present range of Roosevelt elk and the Oregon State Game Commission transplant sites.

C. EFFECTS ON DOMESTIC LIVESTOCK

Grazing of livestock on the proposed treatment areas is limited to a few isolated tracts. Label registrations for each of the various herbicides, clearly point out the restrictions to be followed in allowing domestic animals to graze treated areas and these restrictions will be followed. Individual permittees who may possibly have livestock in the vicinity of these areas will be informed of the restrictions.

Herbicides have been used extensively in range management work, without harmful effects to the animals nor to milk or meat products. Palmer (1963)(38). Strach and Botiosiewiez (1964)(39), Bjorklund and Erne (1966)(40), Lynn, G. E. (1965)(24), Clarke et. al. (1964) (41), and others have fed high doses of various herbicides to sheep, cattle, swine and other animals to determine acute and chronic
Sites where Roosevelt elk have been transplanted in western Oregon, 1947-1971.
toxicity. They have determined that there is no significant hazard to domestic animals that might graze areas treated with the herbicides, provided that normal application rates were used, Way (1969)(42).

Indirect effects of herbicides on grazing animals (domestic and wild) have been associated with increased toxicity of noxious plants, increased palatability of normally nonpalatable toxic plants, and increased toxicity in normally nontoxic plants (e.g. temporary increases in nitrate content).

Willard (1950)(43) gives examples of cattle eating wild cherry, *Prunus* spp., of pigs eating cocklebur, *Xanthium* spp. and of lambs eating thistles, *Cirsium* spp. after herbicidal treatment. Nitrate in plants is generally present in the form of potassium nitrate, and increases in nitrate content have been associated with drought conditions and high soil nitrogen, Gilbert et. al. (1946)(44), Case (1957)(45). Sund et. al. (1960)(46) noted a high nitrate content in *Urtica* spp. and *Rubus* spp. after heavy rains, followed by preferential grazing of these and other weed species by cattle. A number of abortions in these cattle were correlated with occurrences of high nitrate rather than grazing of the weed species per se.

Fertig (1953)(47) claimed that up to 1953 in America, in all cases where poisoning of livestock from herbicides had been reported, the effects noted could be attributed to some other cause. Warren (1967)(48) summarized this potential hazard as follows:

"Reports of higher HCN content in leaves of wild cherry sprayed with 2,4-D and 2,4,5-T were refuted by Linn and Barrons (1952). Williams and Cronin (1963) reported increased alkaloids in tall larkspur from treatments with silvex and 2,4,5-T as oil soluble amines at 2 to 8 pounds per acre. The increased bitterness, however, may make the forage more unpalatable. There are numerous poisonous weeds in pastures and range (Beath et. al., 1953; Gilkey, 1958). The toxic ingredients differ, but it seems that the influence of any herbicide on the content or form of these natural toxins would be minor compared to the recognized 5 to 10 percent loss occurring annually from uncontrolled poisonous plants (Alley, 1962). Actually, during the 20 years of intensive and increasing use of many different herbicides in range or pasture or on right-of-way, not one authenticated case of direct damage to livestock from eating forage treated with the organic herbicides has been found. A few cases of nitrate poisoning still have a suspicion of indirect cause from herbicide treatments."

Most researchers now agree that nitrate poisoning in animals does occur from time to time, and that it is possible for the hazard to be increased by application of auxin herbicides to nitrate-accumulating plants.
D. EFFECT ON SOIL MICROORGANISMS

Microorganisms in the soil, particularly the bacteria, fungi, and the actinomycetes, play a vital role in the destruction of excess plant and animal waste materials, and convert them into carbon dioxide, water, and plant nutrients. The three main types of processes occurring and which improve the fertility of the soil are (1) nitrification, (2) ammonification, and (3) nitrogen fixation(12).

An application of herbicide, formulated at 3 pounds per acre will result in about 9 ppm of herbicide residue in the top inch of soil (7). There is no evidence to indicate that the herbicides, applied at the recommended rates, will have adverse effects upon soil microbial populations and with the vital role they play in the degradation of waste material and the improvement of soil fertility.

Apparently the phenoxy herbicides have little effect on the nitrification of ammonia. Flieg (1952)(49) reports that normal concentrations of 2,4-D do inhibit the nitrification reaction in the laboratory; however, the addition of soil to his system permitted nitrification to proceed normally. Slepecky and Beck (1950)(50) also found that 50 ppm of 2,4-D gave inhibition of the nitrification reaction, but that inhibition disappeared rapidly during percolation. Flieg (49) was not able to detect any inhibitory effect of 10,000 ppm of 2,4-D on the ammonification process.

Whiteside and Alexander (1960)(51) measured oxygen consumption of soil organisms in silt loam as an indication of the effect of herbicides on the microflora. The study shows that 2,4-D and 2,4,5-T concentrations up to 10 ppm did not affect respiration. Studies by Kratochivil (1962)(52) show no significant effect on microorganisms in a silt loam soil when 2,4-D was applied at rates of one to four pounds per acre and 2,4,5-T was applied up to 16 pounds per acre.

Volk and Eno (53) report that atrazine has little affect on the microflora and that microbe activity utilizing atrazine as a source of energy appears to be the main cause of the decomposition of this herbicide in the soil.

Baldacci and Amici (1954)(54) measured the effect of 2,4-D on actinomycete soil microorganisms and found some strains were adversely affected by a 400 ppm concentration. Tu and Bollen (1969)(55) studied the effect of picloram on soil microorganisms in three Oregon soils, and they found that picloram had little obvious effect at concentrations up to 1,000 ppm on ammonification, nitrification, sulfur oxidation, and organic matter decomposition.

The importance of soil microorganisms in the breakdown of these herbicides is well known from the work of Audus (1964)(56) and others. Bollen (1961)(57) concluded that auxin herbicides were
the most susceptible to breakdown. Norris (1970)(58) established that 2,4-D, 2,4,5-T, Amitrole-T, and picloram are all degraded in forest litter, but at markedly different rates. At 35 days, 2,4-D recovery had dropped to 6 percent and that of Amitrole-T to 20 percent. In contrast 2,4,5-T required 120 days to reach a recovery level of 13 percent. After 180 days, 65 percent of picloram remained in the litter. Dicamba is also subject to biological and chemical degradation and is reported to be relatively nonpersistent in the soil (22). Boning et al. (1965)(59) measured penetration of C\textsubscript{14} diesel oil in loam soils. Most of the oil applied was retained in the upper few inches of soil. After two years, most of the C\textsubscript{14} activity occurred in the humic acid fraction, and no effects of the oil on soil microorganisms was observed. Application rates were up to 24 times that normally used in aerial spraying operations.

It is apparent from these studies that soil organisms utilize the herbicides as a food source, and thereby reduce their exposure to other components of the ecosystem.

E. EFFECT ON AQUATIC LIFE

The Siuslaw, Siskiyou, and Umpqua National Forests all have important anadromous fish streams. The protection and maintenance of these streams as spawning habitat is of great importance to the economy of the Pacific Northwest. In addition there are significant populations of resident trout in the rivers, streams and fresh water lakes. Other important fish species also thrive in these waters. Of particular importance are fish hatcheries operated by the State of Oregon which require special considerations in planning herbicide treatment projects.

Trout are normally regarded as being among the most sensitive fish to water pollution. Alabaster (1958)(60) has given median tolerance limits for 24 and 48 hour exposures of rainbow trout, Salmo gairdneri, to 2,4-D or 2,4,5-T or to mixtures of these two compounds and found the LC\textsubscript{50} was 9.5 ppm to 250 ppm, depending upon formulation. Young silver salmon, Oncorhynchus kisutch, exposed to a combination of 2,4-D and 2,4,5-T at concentrations of 50 ppm or more, were observed to be "immediately distressed and would snap their jaws, dart about the aquarium and leap out of the water before loss of equilibrium and death, Holland (1960)(61). Kenaga (1970)(62) reported that all derivations of picloram exhibit low acute toxicity to fish when recommended use directions are followed. There is low potential hazard, if any, to fish from terestrial runoff water or from direct accidental contamination of water. Kenaga tested Tordon 101 on rainbow trout and found the LC\textsubscript{50} for a 24 hour exposure to be 8.6 ppm. Amitrole was found to be even less toxic to silver salmon. The LC\textsubscript{50} for a 48 hour exposure was 325 ppm (1967)(63). The LC\textsubscript{50} of dicamba on rainbow trout for a 96 hour exposure was found to be in excess of 28 ppm (22).

\textsuperscript{1/} Median lethal concentration of a toxicant which kills 50 percent of test organisms.
An aerial application of a herbicide, formulated at 3 pounds acid equivalent per acre, evenly applied to pure water three inches deep on an acre of land, could result in a maximum concentration of 4.5 ppm in the water. Since the herbicides will not be applied to water, any accidental herbicide contamination of water should be significantly lower. (Based on a personal communication with Norris who has reported that during 8 years of monitoring he has never detected concentrations of herbicides greater than 1 ppm in western Oregon streams.)

The toxicity of herbicide to fish food organisms is of concern to land managers who use herbicides. Atrazine has proved to be somewhat toxic to bottom fauna. Walker (1966)(64) applied atrazine at rates varying from 0.2 to 610 ppm to water and noted a 50 percent drop in total numbers of mayflies, caddis flies, Gastropods, and leeches. Amitrole is one of the least toxic herbicides now in use. At concentration of 23 ppm amitrole immobilizes the waterflea, Daphnia magna, an important fish food (12). Hardy (1966)(65) reported that picloram at 1 ppm did not affect the reproduction of Daphnia magna and there was no buildup of picloram in the tissues. Guppies kept in water with 1 ppm of picloram and fed Daphnia magna reared in water containing 1 ppm of the herbicide appeared normal in development, behavior, and reproduction. Butler (1963)(66) reported that the exposure of brown shrimp, Penaeus aztecus, to 1.0 ppm of 2,4,5-T for 48 hours had no noticeable effects. He also found that oysters, Crassostrea virginica, when exposed to 2.0 ppm of 2,4,5-T for 96 hours did not exhibit any adverse effects on shell growth.

Table 4 was developed by Walker (1962)(67). It depicts the effects of large concentrations of 2,4-D on bottom organisms over a long period of time. It demonstrates that at concentrations 10-100 times greater than the maximum values reported for short durations in Forest streams, 2,4-D has the potential of adversely affecting bottom organisms.
TABLE 4

AVERAGE NUMBERS OF BOTTOM ORGANISMS PER SQUARE FOOT FOLLOWING
APPLICATION OF 2,4-D RANGING FROM 1 to 4 PPM
IN SIX PLASTIC ENCLOSURES, 1958-1959

<table>
<thead>
<tr>
<th>Taxonomic Group</th>
<th>Control</th>
<th>One Week</th>
<th>Six Weeks</th>
<th>12 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayfly nymphs</td>
<td>4.00</td>
<td>0.17</td>
<td>0.17</td>
<td>--</td>
</tr>
<tr>
<td>Horsefly larvae</td>
<td>12.44</td>
<td>4.50</td>
<td>4.50</td>
<td>3.67</td>
</tr>
<tr>
<td>Common midges</td>
<td>17.11</td>
<td>4.50</td>
<td>1.50</td>
<td>0.33</td>
</tr>
<tr>
<td>Mosquitoes</td>
<td>0.44</td>
<td>0.33</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Phantom midges</td>
<td>3.00</td>
<td>1.00</td>
<td>3.33</td>
<td>0.33</td>
</tr>
<tr>
<td>Biting midges</td>
<td>1.22</td>
<td>0.33</td>
<td>0.50</td>
<td>--</td>
</tr>
<tr>
<td>Caddis fly larvae</td>
<td>2.78</td>
<td>1.33</td>
<td>0.17</td>
<td>0.33</td>
</tr>
<tr>
<td>Damselfly nymphs</td>
<td>0.22</td>
<td>0.17</td>
<td>--</td>
<td>0.67</td>
</tr>
<tr>
<td>Water beetles</td>
<td>0.02</td>
<td>--</td>
<td>0.17</td>
<td>3.33</td>
</tr>
<tr>
<td>Aquatic worms</td>
<td>24.11</td>
<td>10.00</td>
<td>4.50</td>
<td>1.67</td>
</tr>
<tr>
<td>Leeches</td>
<td>0.11</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Clams</td>
<td>5.44</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Snails</td>
<td>5.67</td>
<td>0.50</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Total numbers</td>
<td>76.56</td>
<td>22.83</td>
<td>14.83</td>
<td>10.33</td>
</tr>
<tr>
<td>Total weight</td>
<td>1.299</td>
<td>0.733</td>
<td>0.175</td>
<td>0.127</td>
</tr>
</tbody>
</table>


Mullison (1970) reviewed the literature on the effects of herbicides on aquatic organisms and concluded that from the evidence at hand, there are few signs of either a contamination problem or an accumulation in water of presently available herbicides when used according to label directions.

F. EFFECT ON FOREST WATERS

Water is the lifeblood of the land. The Forests protect watersheds that provide important supplies of water for domestic, industrial, and irrigation uses. In addition, the water systems are used by fish, wildlife, and domestic livestock.

In all herbicide application projects, the contamination of water is to be avoided. Standard precautions in areas adjacent to water are:

1. An unsprayed buffer strip will be left on either side of streams.
2. Thickened sprays will be used near especially sensitive waterways to reduce the possibility of drift.

3. Application will be made only under ideal weather conditions. (No wind, rain, or turbulent conditions.)

Past stream monitoring of herbicide concentrations indicates that under normal application procedures, stream herbicide content is negligible.

Tarrant and Norris (1967) (69) sampled stream water after 2,4,5-T and 2,4-D had been applied to adjacent brush stands. Herbicide was detected at rates of 0.5 ppb to 70 ppb and fell below detectable levels a few days after spraying. In 1963, 600 acres were sprayed in the Wilson River Watershed in western Oregon with 1 pound of 2,4-D and 1 pound of 2,4,5-T per acre. Salmon fry and stream-bottom organisms in live cages were unaffected. This study clearly demonstrates that under proper application techniques the hazard to aquatic life is minimal when safeguards are used to prevent direct application to water systems.

Thofern (1962) (70) applied diesel oil to forest areas at rates up to 20 gallons per acre. No trace of diesel oil could be detected in adjacent streams, using analytical methods sensitive to 1 ppb. From a review of research findings, Burchel (1963) (71) concluded that diesel oil as a herbicide carrier will not pollute forest waters, so long as prescribed rates are applied.

Montgomery and Norris (18) report in their studies, concentrations of herbicide in sampled streams never exceeded 0.1 ppm and did not exceed 0.01 ppm for more than one day after treatment close to the spray unit. The herbicide was rapidly diluted with downstream movement.

The following 6 pages are reproduced from a study made by Dr. Logan Norris (1967) (72). The study areas mentioned are located in the Siuslaw National Forest.
STREAM CONTAMINATION

Stream contamination is the most important expression of environmental contamination in the forest because the water is the habitat for many biological communities and because water represents a critical commodity to downstream water users for domestic, commercial, industrial and agricultural purposes. Consequently, studies of stream contamination have constituted a major portion of the research effort.

The purpose of these monitoring studies is to determine the range of herbicide concentrations and the length of herbicide persistence in streams as a function of type of treatment, time after treatment, geographical location of the treatment area, the chemical used, rainfall patterns and the distance downstream from the spray units. In all cases sampling was in connection with regularly scheduled operational spray projects.

Phenoxy Herbicides -- Western Oregon

In 1964, eleven sampling stations were located in the lower Alsea River basin of Oregon and in three additional stations in a small drainage basin near Eddyville, Oregon, in the Yaquina watershed. The areas were treated with 2,4-D, 2,4,5-T or a combination of the two herbicides as low volatile esters applied in diesel oil by helicopter. Applications were made in late March and early April. Check samples were taken prior to treatment and samples collected for eight months after treatment. Herbicides were determined by gas chromatography. The analytical method permits quantitative determinations to less than 0.5 parts per billion acid equivalent in the water.

Figure 6 shows the lower Alsea Basin and the location of smaller watersheds in which treatment areas were located. The location of a downstream sampling point (sampling point 10) is also indicated.

Figure 7 is an enlargement of the Cascade Creek watershed and shows the locations of sampling points 3, 4 and 5. Streams sampled at points 4 and 5 do not enter but run adjacent to the treated area. Point 3 samples a small stream from a 5-acre watershed which was completely sprayed. The results of analyses for herbicide residues in samples collected at points 3, 4 and 5 are in Table 1.

The drainage basin at point 3 was characterized by a large slump and marshy area which indicate a high water table. The peak of concentration occurred shortly after application started, but low concentrations were found up to 16 weeks later. At points 4 and 5 however, quite a different situation prevailed. Only low levels of herbicide were found, and these persisted for less than one day. Data from points 4 and 5 reflect the small area of the watershed treated as well as the location of the treatment unit boundaries with respect to the sampled stream.

Table 2 shows the concentration of herbicide in samples collected at point 10 which is downstream from several treatment units. The runoff from 249 treated acres (0.3 percent of the total watershed) passes this point. The importance of downstream movement in reducing the concentration of contaminants is illustrated here since some upstream points had concentrations of herbicide 10 or more times greater.
Figure 6. The lower Alsea Basin.

Figure 7. Cascade Creek treatment area watershed. 65 acres (2 percent) of a 3450 acre watershed was treated with 2 lb/A 2,4,5-T.
Table 1. Contamination in the Cascade Creek Unit

<table>
<thead>
<tr>
<th>Hours after spraying</th>
<th>Sample Point 3</th>
<th>Sample Point 4</th>
<th>Sample Point 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>0</td>
<td>0.17</td>
<td>0.27</td>
</tr>
<tr>
<td>0.62</td>
<td>16</td>
<td>1.33</td>
<td>1.40</td>
</tr>
<tr>
<td>1.28</td>
<td>7</td>
<td>2.2</td>
<td>2.0</td>
</tr>
<tr>
<td>2.0</td>
<td>4</td>
<td>3.9</td>
<td>3.9</td>
</tr>
<tr>
<td>4.0</td>
<td>4</td>
<td>5.4</td>
<td>0</td>
</tr>
<tr>
<td>5.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>74.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1Entire watershed feeding sampled stream was sprayed.
2Herbicide was detected for 16 weeks at sample point 3.

Table 2. Contamination in Five Rivers at Point 10

<table>
<thead>
<tr>
<th>Hours after spraying</th>
<th>ppb 2, 4-D</th>
<th>ppb 2, 4, 5-T</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.71</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10.1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>14.3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>23.6</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>26.0</td>
<td>T</td>
<td>0</td>
</tr>
<tr>
<td>28.9</td>
<td>T</td>
<td>0</td>
</tr>
<tr>
<td>32.3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

1249 acres treated with 2 lbs/acre 2, 4, 5-T or 1 lb/acre each 2, 4-D and 2, 4, 5-T.

The results for Cascade Creek were representative of the data obtained in the lower Alsea Basin study area. In most cases the spray units were oriented such that large streams were not included in the treatment area, although these streams frequently formed one of the unit boundaries.

Figure 8 shows a treatment area in the Yaquina watershed near Eddyville, Oregon, where the sampled streams were included within the spray unit. The consequence of this practice is illustrated by data in Table 3.

Considerably higher concentrations were found at Eddyville than in the Alsea Basin. This is attributed to the higher rate of application, a larger percentage of the watershed being treated, and the fact that all of the sampled streams flowed from or through the treated area. Note, however, that the peak of concentration occurred shortly after application and fell rapidly.

Norris 111
Figure 8. Eddyville treatment area watershed. 71 acres (10 percent) of a 710 acre watershed was treated with 2, 4-D at rates ranging from 2.2 to 3.0 lb/A.

Table 3. Contamination in the Eddyville Unit

<table>
<thead>
<tr>
<th>Sample Point 12</th>
<th>Sample Point 13</th>
<th>Sample Point 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours after spraying</td>
<td>ppb 2,4-D</td>
<td>Hours after spraying</td>
</tr>
<tr>
<td>0.83</td>
<td>33</td>
<td>1.33</td>
</tr>
<tr>
<td>1.83</td>
<td>13</td>
<td>2.3</td>
</tr>
<tr>
<td>2.8</td>
<td>13</td>
<td>3.3</td>
</tr>
<tr>
<td>53.5</td>
<td>9</td>
<td>4.3</td>
</tr>
<tr>
<td>53.6</td>
<td>25</td>
<td>53.6</td>
</tr>
</tbody>
</table>
Sampling in both the Yaquina and Alsea watersheds continued through the summer and into the fall of 1964. With the exception of point 3 on Cascade Creek, no herbicides were detected after the last sampling time listed. Extremely heavy rains in the fall and early winter did not introduce detectable quantities of herbicide into these streams. This is extremely important because it points out that the only measurable contamination of streams encountered was in connection with the actual application of herbicide. As these and other data will show, contamination from the application can be influenced by placement of spray unit boundaries.

**Amitrole -- Western Oregon**

Amitrole is used for the control of a species which grows on the lower slopes and along creek bottoms. Consequently, treatment areas must be oriented such that streams are frequently included in the spray unit.

A study of the stream contamination resulting from the use of amitrole-T was made in 1965 near Hebo, Oregon. The herbicide was applied by helicopter in June at a rate of 2 pounds amitrole per acre in a water carrier. Control samples were collected prior to spraying and sampling continued for several weeks after treatment. The analytical method used to determine amitrole is sensitive to one part per billion of amitrole in the water.

Figure 9 shows the orientation of two spray units in a small watershed near Hebo. Notice the shape of the units and their relation to the stream. The data from this study area are in Table 4.

![Diagram](image)

**Figure 9. Wildcat Cabin treatment area watershed. 14 acres treated with 2 lb/A amitrole-T.**
Table 4. Contamination in the Wildcat Cabin Unit.

<table>
<thead>
<tr>
<th>Hours after spraying</th>
<th>ppb</th>
<th>ATA</th>
<th>ppb</th>
<th>ATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.17</td>
<td>422</td>
<td></td>
<td>8.9</td>
<td>6</td>
</tr>
<tr>
<td>0.42</td>
<td>292</td>
<td></td>
<td>9.9</td>
<td>4</td>
</tr>
<tr>
<td>0.67</td>
<td>265</td>
<td></td>
<td>10.9</td>
<td>3</td>
</tr>
<tr>
<td>0.92</td>
<td>141</td>
<td></td>
<td>11.6</td>
<td>3</td>
</tr>
<tr>
<td>1.33</td>
<td>91</td>
<td></td>
<td>21.5</td>
<td>20</td>
</tr>
<tr>
<td>1.84</td>
<td>50</td>
<td></td>
<td>26.3</td>
<td>5</td>
</tr>
<tr>
<td>2.2</td>
<td>35</td>
<td></td>
<td>30.3</td>
<td>3</td>
</tr>
<tr>
<td>6.1</td>
<td>12</td>
<td></td>
<td>48.0</td>
<td>2</td>
</tr>
<tr>
<td>6.9</td>
<td>8</td>
<td></td>
<td>71.5</td>
<td>0</td>
</tr>
<tr>
<td>7.9</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The concentration of herbicide was considerably higher than encountered with the phenoxy herbicides. The length of persistence of chemical at the sampling point was short however, with a 100-fold decrease in concentration occurring in 10 hours. These results reflect the orientation of the spray unit to the stream.

In a nearby area several units were treated in one watershed. Figure 10 shows the Wildcat Creek watershed, the location of the spray units and sampling points 2, 3, 4 and 5. Observe that in each case the spray unit includes a live stream. Data from points 2, 3 and 4 are in Table 5. The pattern of contamination was the same as seen in Table 4. A peak of contamination occurred shortly after the start of spraying followed by a fairly rapid decline.

At point 5, which was located about one mile below point 4, only one sample, collected 27 hours after the start of spraying, contained a measurable concentration of amitrole. The volume of the stream between points 4 and 5 does not change appreciably, and yet a 40-fold decrease in concentration resulted in this short distance. Dilution and adsorption of the amitrole on colloids and organic matter along the stream bed are believed to account for these reductions in concentration. Additional studies are planned since it is of considerable importance in determining the danger which might exist to downstream water users where fairly high concentrations of herbicide occur near the treatment area.
G. EFFECT ON MAN

1. Toxicity to Man

We assume that man can be directly affected by the proposed herbicide treatment through his intake of forest water, wild fruit and berries, and/or direct contact. Protective procedures are incorporated into the program to insure that contact with humans is kept to an absolute minimum. Probably the most susceptible are those people associated with the application. Toxic levels of the specified herbicides in man are unknown, but can be projected from LD₅₀ data conducted on dogs and rodents.

The following table is summarized information on the toxicity of the herbicides being used, Heikes (1967)(73).

<table>
<thead>
<tr>
<th>Common Name or Designation</th>
<th>Some Common Trade Names</th>
<th>LD₅₀ Mg/Kg</th>
<th>Toxicity Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,4,5-T</td>
<td>Various</td>
<td>300</td>
<td>3</td>
</tr>
<tr>
<td>2,4-D</td>
<td>Various</td>
<td>500</td>
<td>4</td>
</tr>
<tr>
<td>Aspirin</td>
<td>(For comparison)</td>
<td>750</td>
<td>4</td>
</tr>
<tr>
<td>Dicamba</td>
<td>Banvel-D</td>
<td>1,040</td>
<td>4</td>
</tr>
<tr>
<td>Atrazine</td>
<td>Atrazine</td>
<td>3,080</td>
<td>4</td>
</tr>
<tr>
<td>Table salt</td>
<td>(For comparison)</td>
<td>3,320</td>
<td>4</td>
</tr>
<tr>
<td>Amitrole-T</td>
<td>Amitrol-T, Cytrol</td>
<td>5,000</td>
<td>4-5</td>
</tr>
<tr>
<td>Picloram</td>
<td>Tordon</td>
<td>8,200</td>
<td>5</td>
</tr>
</tbody>
</table>

Toxicity Rating

1. Extremely toxic
2. Very toxic
3. Moderately toxic
4. Slightly toxic
5. Nontoxic
6. Nontoxic

LD₅₀

<table>
<thead>
<tr>
<th>LD₅₀ Mg/Kg</th>
<th>Probable Lethal Dose for 150-lb Man</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5</td>
<td>A taste (less than 7 drops)</td>
</tr>
<tr>
<td>5-49</td>
<td>7 drops - 1 teaspoonful</td>
</tr>
<tr>
<td>50-499</td>
<td>1 teaspoonful - 1 ounce</td>
</tr>
<tr>
<td>500-4,999</td>
<td>1 ounce - 1 pint (1 lb)</td>
</tr>
<tr>
<td>5,000-14,999</td>
<td>1 pint - 1 quart</td>
</tr>
<tr>
<td>15,000 &amp; above</td>
<td>More than 1 quart</td>
</tr>
</tbody>
</table>

Montgomery and Norris (18) evaluated the hazards of 2,4,5-T in the environment, and point out that "the hazard of a chemical to an organism is composed of two components. One is the likelihood the organism will be exposed to the chemical. The second is the inherent toxicity of the chemical to the organism. The hazard is small if either likelihood of exposure or toxicity of the chemical is low." They also concluded that a 150 pound man would have to drink 179 gallons of water containing 0.1 ppm 2,4,5-T to ingest one 1/100 of the LD50, as projected from data for rodents. Therefore, acute toxicity to man is not expected to be a problem and the short persistence of the herbicide in waters makes chronic exposure unlikely.

2. Teratogenic and Carcinogenic Potential

The use of 2,4,5-T and amitrole have been the cause of considerable controversy concerning their reported teratogenic and carcinogenic effects on test animals. The present status of information on this subject for each of the herbicides is as follows:

a. Amitrole

Teratogenicity: No teratogenic effects have been noted on hens' eggs, Dunaehic and Fletcher (1966)(74).

Carcinogenicity: "In 1959, the observation of rats fed with 100 ppm of the compound for two years developed a significant number of thyroid adenomas and adenocarcinomas," as well as the demonstration of residues of aminotriazole in marketed cranberries (Science 1959), caused prohibition of cranberries and cranberry products of the 1958 and 1959 crops from certain parts of the United States. Furthermore, it resulted in an official announcement from the Secretary of Health, Education, and Welfare that the reason for the prohibition was 'possible contamination by a chemical weed killer, aminotriazole, which caused cancer of the thyroid in rats.' (Fleming 1959). In the ensuing discussion, doubts were raised as to whether the marked antithyroid action of aminotriazole can justly be characterized as carcinogenic (Astwood, 1960 and Jukes and Shaffer, 1960)" From House et. al. (12).

Amitrole has been determined to be an antithyroid agent and has been tested for controlling hyperthyroidism. The stimulation of abnormal growth of the thyroid gland after feeding high dosages of amitrole has been construed to be evidence of carcinogenicity. In chronic feeding studies involving exaggerated rates fed over a long period of time, thyroid tumors began appearing in rats fed at 100 ppm for 68 weeks, USFS (1972)(75). Thyroid size returns to normal within two weeks following removal from exposure.
In spite of the "cranberry scare," House et. al. (12), expressed the opinion that amitrole has not proved to be carcinogenic and its use does not represent any unusual hazard.

Amitrole is presently registered for non-crop land use including forests and rights-of-way. The FDA has declined to set a tolerance in food or feed.

b. 2,4,5-T

A proper evaluation of teratogenic and carcinogenic hazards of this herbicide is more complex. The following general conclusions and recommendations for the use of 2,4,5-T are from the Report of the Advisory Committee on 2,4,5-T to the Administrator of the Environmental Protection Agency, submitted May 7, 1971, Wilson, et. al. (1971)(76). This clearly spells out the possible hazards of 2,4,5-T and recommendations for future use. Dr. Theodor D. Sterling, a member of the Advisory Committee on 2,4,5-T did not fully agree with the majority committee report. However, he did recommend that the use of 2,4,5-T be permitted under certain conditions for uses in forestry and rights-of-way management.

**GENERAL CONCLUSIONS**

The Advisory Committee on 2,4,5-T has accepted as its primary objective the evaluation of hazards to human reproduction of continued use, under appropriate regulations, of the herbicide 2,4,5-T. Toward this end it has examined all available information pertinent to a scientific consideration of the subject.

The level of human exposure depends on rate of application of the herbicide, balanced against the rate at which it is removed from the environment. Current patterns of usage of 2,4,5-T and its known fate in various compartments of the environment, including the plant and animal foods of man, are such that any accumulation that might constitute a hazard to any aspect of human health is highly unlikely.

Special note has been taken of the toxic contaminant TCDD. The limited data now available indicate that this dioxin is not as rapidly degraded in the environment as is 2,4,5-T, but modern methods for the manufacture of the herbicide are capable of routinely producing a product with such a low level of contamination as to eliminate the likelihood of human toxicity from exposure to TCDD. Manufacturing standards must, however, be subject to continued monitoring.

Much of the general toxicity attributed to 2,4,5-T in the past now appears to have been caused by the contaminant TCDD. The herbicide, when essentially free of this contaminant, e.g., 1 ppm, has relatively low toxicity for all animal forms in which it has been tested.
Particular attention was given to the teratogenic potential of both 2,4,5-T and TCDD. Acceptable data are now available on the embryo-toxicity of 2,4,5-T in 6 mammalian species, mouse, rat, hamster, rabbit, sheep and rhesus monkey. None of these showed adverse effects at dosage of 40 mg/kg/day of maternal weight.

The mouse appears to be more sensitive than the other forms studied in that it shows a low level of teratogenicity (cleft palate) at 100 mg/kg/day given throughout organogenesis, whereas hamster and rat required higher dosage to obtain comparable effects. It is likely that all species could be caused to show some embryotoxicity if 2,4,5-T dosage were raised high enough, a fact already well known for many prevalent environmental chemicals such as aspirin, caffeine, nicotine and organic mercury.

The dioxin contaminant TCDD also has been shown to have a low teratogenic potential at doses in excess of 0.001 mg/kg, but this dosage level is virtually impossible with currently produced 2,4,5-T. No evidence has been found of significant potentiative interaction between 2,4,5-T and TCDD.

No evidence has been found of adverse effects on human reproduction in three separate locations, namely Vietnam; Globe, Arizona; and Sweden, where pregnant women have allegedly been exposed to high levels of 2,4,5-T.

On the basis of these observations, it is concluded that, as presently produced and as applied according to regulations in force prior to April 1970, 2,4,5-T represents no hazard to human reproduction.

RECOMMENDATIONS

The Advisory Committee on 2,4,5-T after careful consideration of available information on potential hazards to man, particularly as regards reproductive functions, of continued, regulated use of 2,4,5-T, recommends the following:

1. That registration for use of 2,4,5-trichlorophenoxyacetic acid and its esters be restored to the status existing prior to April 1970, with the following exceptions.

2. That certain specific limitations and qualifications be added to the previously existing registration, as follows:

   a. A permissible residue of not more than 0.1 ppm of 2,4,5-T on the edible parts of food products and in potable water for human consumption be accepted. It is recognized that very few foods tested to date have contained this level of residue, but it is probable that some of the reports of no residue in the past were due to limited sensitivity of the analytical method. In view of recent and future advances in methodology, which tend to make zero residues of anything increasingly unlikely, a more realistic policy would be the setting of safe tolerance limits at this time.
b. A limit of 0.5 ppm of contamination with 2,3,7,8-tetrachlorodibenzo-p-dioxin be set for existing inventories of 2,4,5-T, except as specified in item c below, and a limit of 0.1 ppm of contamination with this dioxin be established in all future production of 2,4,5-T. Surveillance should be maintained by requiring that a manufacturer submit a reference sample and a certified analysis of each future production lot to the Environmental Protection Agency.

c. All formulations to be used around the home and in recreational areas as of present date should be limited to 0.1 ppm of the dioxin, TCDD, and also should bear a conspicuous warning, e.g., "This compound may be dangerous to pregnant women and animals and its use must be such as to reduce the possibility of exposure to an absolute minimum."

3. That existing deficiencies in information relative to possible accumulation in the soil and possible magnification in the food chain of the dioxin TCDD be rectified by specific research directed to this end, with these questions to be subjected to scientific review within three years of the present date and yearly thereafter until these questions are resolved.

4. That additional post-registration monitoring for adverse effects of agricultural chemicals be established, to include both surveillance for such effects in man and domestic and wild animals, as well as consideration of the applicability of new methodology that may be evolved for specialized testing, e.g., for carcinogenesis, mutagenesis or teratogenesis.

Date: May 7, 1971  Respectfully submitted,

/s/
James G. Wilson, Ph.D.

III. FAVORABLE ENVIRONMENTAL EFFECTS

Fire Control:

The typical stands of mature shrubs common to western Oregon represents a serious fire hazard. The existence of large brushfields is generally a result of wildfires in the late 1800's and early 1900's, prior to fire control efforts by man. The natural shrub composition, characteristic of the area, represents a forest fire fuel type which has a high rate of spread and a high resistance to control. A mature brushfield contains many tons of highly flammable fuel and access for fire fighting is either impossible or extremely hazardous for fire fighters.

Application of herbicides for silvicultural purposes has several distinct fire control benefits. A walk through any area successfully treated with
herbicides readily demonstrates the reduction in total fuel volume existing on the area. With proper herbicide application, individual shrubs will exist as isolated smaller-volume plants, generally with space between individual shrubs. The use of herbicides in silviculture aims at preventing development of massive shrub stands rather than eradication afterwards.

Not only is fuel volume reduced, but fire intensity and energy release would be considerably less than in a natural brushfield. Visibility, access, and overall fire fighting safety are considerably improved in a treated brushfield. It is recognized that for one or possibly two seasons after herbicide spraying, there is an increase in flash fuels. The long term fire control benefits appear to outweigh the short term disadvantage.

On the occasion when wildfire occurs in the forest, existing roads frequently provide effective fire breaks from which fire fighting forces may make a stand against the conflagration. Roadside maintenance which includes brush control, improves the fire break value of roads.

The effect on fire hazard from precommercial thinning conifer stands varies with the size of the conifers being thinned from the forest. The fire hazard increases as the diameter of the trees to be removed increases. The accumulation of felled trees on the ground in a thinning operation can pose fire control problems. If thinning with chemicals is done in larger diameter stands, the excess trees are left standing in place after they have been killed. The result is an accomplishment of the thinning objective, with a minimum adverse impact on fire control activities. Standing dead trees rapidly lose their fine fuel components and do not block visibility, access, and fire fighting safety.

Road Maintenance:

Retarding encroachment of roadside shrubbery with herbicides has several benefits. The traveler's safety is improved by maintaining adequate sight distance on curves, and decreasing the possibility of striking big game which may step out of the dense roadside cover. This advantage would occur with brush control done by any means. An additional safety benefit is achieved through the use of herbicides.

Control of roadside shrubbery by mechanical means requires that heavy equipment be in place and partially block the road at various times.

Under western Oregon climatic conditions trimmed shrubs resprout rapidly, requiring frequent repeated treatments by mechanical methods. The use of herbicides or a combination of herbicides applied after mechanical treatment, decreases the frequency of roadside brush control and minimizes the hazard of road maintenance equipment partially blocking the travel routes. In addition, forest recreation travellers are able to enjoy better viewing from the roadside into the forest, which increases the value of their outdoor experience.
General road maintenance is decreased with proper roadside brush control. Without shrub control, increased amounts of material such as limbs and twigs are washed into culvert openings, increasing the possibility of their malfunction, leading to road washouts. Culvert maintenance is more efficient when intakes are not obscured by shrub growth.

Wildlife:
A common vegetative condition in western Oregon is one in which native shrubs form a dense canopy ten or more feet above the ground. Grasses and forbs and browse are quite scarce under this dense canopy, and wildlife forage is practically unavailable in these areas. Einarson, (1946) (77), found that the nutritive value of plants was much lower beneath a closed canopy than in a young successional stage. Herbicide treatment to increase growing room for conifers, usually improves conditions for grasses and forbs and frequently causes basal sprouting of the hardwoods, with subsequent increase in available game browse. In tall stands of shrubs out of reach of big game forage, it is common after herbicide treatment to observe basal sprouts at ground level being heavily browsed by wildlife. This represents forage not previously available on the area.

Public Recreation:
As described above under fire control benefits, the improved foot travel and visibility conditions resulting from herbicide treatment also benefit big game and bird hunters. General forest recreationists also benefit from the improved conditions of visibility in the forest, improved ease of hiking, and decreased hazard of poison oak, \textit{Rhus spp.} in and adjacent to campgrounds.

Tree Growth and Wood Production:
The temporary reduction of plant volume on a sprayed site, increases available light, moisture and soil nutrients. Lauterbach (1967)(78) reported the effect on Douglas-fir, \textit{Pseudotsuga menziesii}, after herbicide application at several locations in western Oregon. Height growth of the conifers increased 61 percent to 178 percent. In all cases diameter growth increase was comparable.

On a 73 acre tract in the Siskiyou National Forest, diameter growth of conifers increased 329 percent for a seven year period following chemical release from overtopping hardwoods. This informal field measurement probably represents an extreme degree of response with average growth improvement from herbicide treatment being somewhat less.

An example of the benefits to wood fiber production from the use of herbicides, can be demonstrated in the following figures calculated for the Siuslaw National Forest. The Siuslaw Forest has the biological capacity to produce an average of 1,000 board feet per acre per year, on a 100 year rotation. However, this capacity requires that stocking of at least 250 conifers per acre must be established promptly after timber
harvest and that brush competition shall be controlled for at least 6 years to insure freedom for the young trees to grow. Under these conditions and within the guidelines of Multiple Use, the present sustained yield harvest of 348 million board feet per year, can be increased to about 500 million board feet per year.

On the other hand, if shrubs and other vegetation are allowed to totally occupy the land, it is estimated that the sustained yield capacity of the Siuslaw would be reduced to approximately 200 million board feet per year. The value of timber sold from the Siuslaw Forest in 1969 was nearly 20 million dollars. The economic value to industry and the contribution to the gross national product is unestimated, but the community benefit is many times the stumpage value, and may approximate 100 million dollars annually.

Through the inclusion of herbicides in a program of intensive management, the Siuslaw Forest can maintain an annual harvest of about 500 million board feet. Herbicide application one or two times during a 100 year crop rotation on those areas where competing vegetation may retard establishment of conifers is necessary to realize this full potential yield.

IV. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

Most of the potential adverse environmental impacts can be minimized by using proper herbicide formulations and application techniques. The possible adverse effects are summarized as follows:

A. Vegetation

1. Some species of non-target plants may be subject to damage by the herbicides. There will be no herbicide treatment in the several special areas set aside to protect rare plants.

2. Some loss of herbicide due to volatilization, drift, surface runoff and leaching will occur. Use of proper application techniques and avoidance of unfavorable weather conditions can limit chemical loss to tolerable levels. For example, helicopter spraying of a tract under well controlled conditions may unavoidably create a small quantity of droplets under 100 microns in size. These have a capacity to travel several miles before settling to earth, but their total combined volume may be less than a teaspoon, of which only 5 percent is herbicide. This type of herbicide loss does occur in actuality but from a practical standpoint its occurrence is not considered to be environmentally adverse. The use of thickening agents and other drift control techniques does not entirely eliminate this type of spray movement.

B. Wildlife

1. Nectar feeding insects, such as honey bees, may be subject to toxic effects, if they drink water trapped in flower parts that contain concentrated herbicide residues.
2. Small animals that have a limited home range may be without food and cover if their essential habitat is materially changed as a result of a herbicide application.

3. The forage available for big game on a treatment area may be reduced temporarily.

C. **Domestic Livestock**

Indirect effects due to nitrate poisoning in stock and other ruminants is a possible threat when auxin herbicides are applied to nitrate-accumulating plants. (No cases have ever been reported on the three Forests.)

D. **Soil Microorganisms** - No adverse effects are anticipated.

E. **Aquatic Life** - Under normal application procedures, there will be no adverse effects on aquatic organisms.

F. **Forest Waters** - If safeguards are installed to prevent direct application to water, there will be no biologically significant residues in the water.

G. **Man**

1. Acute toxicity and chronic toxicity to man is not anticipated. Herbicide applicators will be subject to maximum exposure. (No adverse effects have been reported on the three Forests.)

2. Indirect effects to man are subject to individual preference. Visual impacts along treated roadsides will be of short duration. Other aesthetic and intangible values associated with a preference for a natural ecosystem, untouched by man, machine, or chemicals, will be considered more desirable by some individuals.

V. **ALTERNATIVES TO THE PROPOSED ACTION**

Three alternatives to herbicide brush control are discussed separately as follows:

A. **Mechanical Treatment** - Machinery is currently used to prepare sites for tree planting where ground conditions permit. The steep, wet coastal terrain precludes the use of mechanical methods of vegetation control on most areas. Soil and watershed damage due to erosion and compaction would be excessive. Interior areas, although drier, are generally steep and rough also. Equipment does not exist which can cultivate the typical mountain slopes of western Oregon without doing serious soil damage. Also, the use of mechanical devises to release suppressed plantations would destroy the crop trees.
Where roads and other types of rights-of-way are accessible to vehicles, some mechanical brush cutting is done. The giant rotary mowers seen along highways are used in the forest where conditions permit. A shrub mowed close to the ground still has a fully developed, viable root system and vigorous sprouting soon reestablishes the plant to its original size. Mowing followed by herbicide application to the cut stumps provides a longer lasting effect without serious aesthetic impact.

B. **Hand cutting** - On most of the herbicide treatment areas, hand cutting is physically impossible because of the great mass of shrub material in place. Interlocked crowns prevent moving the slash once severed and creates a mat of limbs on the ground which prevents tree planting, crushes existing seedlings and makes fire suppression a nightmare. Experience with cutting shrubs in the past has shown that they can respout 6 to 7 feet in height the first growing season.

A large work force would be needed to adequately accomplish the required job. The cost would be approximately ten times higher than that now experienced with aerial application of herbicides. It would take a crew of 10 men, 120 days to do the same job that a helicopter can do in one day. A considerable increase in federal government expenditures would be required to maintain the current level of forestry. Comparative costs are discussed in Part II under economic analysis.

C. **No Treatment** - Without treatment, the establishment and growth of coniferous plantations would be reduced significantly. This would have a long term effect of lowering productivity of National Forest land. It is predicted that abolition of the chemical brush control program would reduce the allowable cut from 350 million board feet per year to 200 million board feet per year on the Siuslaw National Forest alone. This would have a significant effect upon the local economy, which is dependent upon raw forest products. Non-treatment would of course eliminate the use of many forest roads and the powerlines and other rights-of-way through the forest.

**Other Comments** - Using thickened solutions is an alternate method of formulating the herbicide sprays. This would reduce spray drift at an added cost and result in less effective vegetation control, requiring follow-up treatments. Mechanical inverting systems and Amchem's Microfoil boom have the same disadvantages. References cited elsewhere in this statement indicate that drift is not a problem if the herbicide is properly applied using the conventional spray system.

Current application technique and formulations have been developed in conjunction with the Pacific Northwest Forest and Range Experiment Station. They have been refined to provide the degree of vegetation control needed to meet our objectives with a minimum amount of herbicide and impact on the environment. New application techniques and formulations are being used on a trial basis but so far lack the predicability of the conventional systems.
The alternative of growing and harvesting the brush for wood fiber on a short rotation of five to ten years is not economically or environmentally desirable. Markets do not exist for this type of material, the short rotations would accelerate erosion, the large expanses of brushfields would be detrimental to forest recreation, and potential gains in productivity through intensive forest management including genetics would not be realized.

VI. RELATIONSHIP BETWEEN LOCAL SHORT TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

The proposed action to use selective herbicides is not a choice of local short term benefits at the expense of long term environmental quality. Over 95 percent of the proposal is herbicide treatment to adjust vegetative conditions which will favor growth of conifer trees. The final end result will be the same with or without site preparation, conifer release or thinning. The difference lies in the length of time which will elapse before the final result. This time may be from 8 to well over 100 years.

VII. IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

It is not foreseen that there will be irreversible or irretreivable impacts on the environment as a result of the herbicides 2,4-D; 2,4,5-T; Amitrol-T; atrazine; picloram; or dicamba being applied to as little of the forest environment as necessary. No plant or animal species, including target species, is expected to be eradicated. All nontarget species should return to previous levels unless factors not associated with application of herbicide intervene.
VIII. CONSULTATION WITH OTHERS

The Oregon Pesticide Use Clearing House has been established to assist in the review of pesticide use proposals. The following signatory agencies to the Memorandum of Understanding will review the Siskiyou, Siuslaw, and Umpqua National Forests' planned Herbicide use program for 1973:

- Department of Interior - Bureau of Land Management
- Bureau of Sport Fisheries and Wildlife
- Fish Commission of Oregon
- Oregon State of Department of Forestry
- Oregon State Game Commission
- Oregon State Board of Health
- Oregon State Department of Environmental Quality
- Oregon State University Extension Service

The Working Group on Pest Management of the President's Council of Environmental Quality will review the Forests' planned herbicide use for 1973.

The three Forests will furnish local field biologists of State fish and game agencies with detailed maps of its proposed treatment areas. The maps will be available several months in advance to permit field review and comment by the biologists. Where project activity may be of interest to fish hatchery operators, personal visits will be made to consult with the parties concerned. Public news releases will be made prior to starting aerial spray operations.

On the three National Forests, numerous private landowners adjoin federal lands. All private owners in the immediate vicinity of each spray project will be contacted well in advance of herbicide application. Project progress is also publicized by individual contacts and news releases.

The Draft Environmental Statement was sent or given to the following agencies, groups, and individuals:

1. Federal Agencies

   - Department of Agriculture - Agricultural Research Service
   - Soil Conservation Service
   - Consumer and Marketing Service
   - Department of Commerce - Assistant Secretary of
     Environmental Affairs
   - National Marine Fisheries Services
   - Department of the Army - Corps of Engineers
   - Department of Health, Education and Welfare
   - Department of Housing and Urban Development
   - Department of Interior - Office of Environmental Project Review
   - Department of Transportation - Assistant Secretary for Systems
     Development and Technology
   - Federal Highway Administration
2. **State Agencies**

Oregon - Local Government Relations Division
California - Office of Intergovernmental Management

3. **Local Agencies**

Association of Oregon Counties
Boards of County Commissioners of Benton, Coos, Douglas, Lane, Lincoln, Polk, Tillamook, Yamhill, Jackson, Curry, and Josephine Counties in Oregon.
Board of Supervisors of Siskiyou and Del Norte Counties in California.
County Agricultural Commission of Del Norte County, California.

4. **Groups**

American Fisheries Society
American Forest Institute
Federation of Western Outdoor Clubs
Industrial Forestry Association
Izaak Walton League of America
Mazamas
National Wildlife Federation
Northwest Steelheaders - Trout Unlimited
Oregon Cattlemen's Association
Oregon Environmental Council
Oregon Forest Protection Association
Oregon Sheep Growers' Association
Oregon State University, School of Forestry
Oregon Wildlife Federation
Sierra Club
Sierra Club Legal Defense Fund, Inc.
Society for Range Management
The Wildlife Society
Western Forest Industries Association
Western Forestry and Conservation Association
Western Wood Products Association
Wilderness Society
Wildlife Management Institute

5. **Individuals**

Dr. Jean Anderson
Mr. Ugo E. Pezzi
Mr. Jerry Uhrhammer

The Draft Environmental Statement was made available for review by individuals at the Forest Supervisor's Office of the Siskiyou, Siuslaw, and Umpqua National Forests.

No meetings or hearings were held on the Draft Environmental Statement.
Comments on the Draft Environmental Statement were received from the following agencies, groups, and individuals.

1. **Federal Agencies**

<table>
<thead>
<tr>
<th>Agency/Department/Program</th>
<th>Attachment Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Agriculture -</td>
<td></td>
</tr>
<tr>
<td>Agricultural Marketing Service</td>
<td>1</td>
</tr>
<tr>
<td>Soil Conservation Service</td>
<td>2</td>
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<tr>
<td>Department of the Army - Corps of Engineers</td>
<td>3</td>
</tr>
<tr>
<td>Department of Health, Education and Welfare</td>
<td>4</td>
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<tr>
<td>Department of Housing and Urban Development</td>
<td>5</td>
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<tr>
<td>Department of Transportation -</td>
<td></td>
</tr>
<tr>
<td>Federal Highway Administration</td>
<td>6</td>
</tr>
<tr>
<td>Environmental Protection Agency</td>
<td>7</td>
</tr>
</tbody>
</table>

2. **State Agencies**

Oregon, comments received through the Assistant to the Governor for Natural Resources -
- State Water Resource Board                                   | 8                |
- Game Commission                                                | 8                |

3. **Local Agencies**

- Agricultural Commission, Del Norte County, California         | 9                |

4. **Groups**

- Huxley College of Environmental Studies                      | 10               |
- Mazamas                                                       | 11               |
- Western Forest Industries Association                         | 12               |

5. **Individuals**

- Dr. Jean Anderson                                             | 13               |
- Mr. Ugo E. Pezzi                                              | 14               |
1. **Review Summary, U. S. Department of Agriculture, Agricultural Marketing Service**

The Agricultural Marketing Service has no responsibility in this area of work, therefore, no comment.

**Comment** - No reply necessary.

2. **Review Summary, U. S. Department of Agriculture, Soil Conservation Service**

The Soil Conservation Service points out that soil surveys indicate a large acreage of the Forests are over 30 percent slope with severe erosion potential.

**Comment** - Soil erosion is recognized as a hazard in any program of brush control. House et al. (1967)(12) Explains that erosion hazards are not normally increased by the proper use of herbicides. The dead and partially dead standing brush, undisturbed litter cover, and undisturbed soil generally should not favor erosion on the herbicide treatment areas. The severe erosion potential on the steeper slopes precludes mechanical treatment.

3. **Review Summary, Department of the Army, Corps of Engineers**

The Corps of Engineers had no comments relating to their functional area of responsibility and expertise.

**Comment** - No reply necessary.


The review by the Department of Health, Education and Welfare discerns no adverse health effects that might be of resultant significance where their program responsibilities and standards pertain, provided appropriate guides are followed in concert with state, county, and local environmental health laws and regulations. No specific comments.

**Comment** - No reply necessary.

5. **Review Summary, U. S. Department of Housing and Urban Development**

The Department of Housing and Urban Development has no reservations about the proposed program. They deferred to other agencies to comment on impacts on fish and wildlife, water pollution, air pollution, agricultural lands, vegetation and food products.

**Comment** - No reply necessary.

The review by the Federal Highway Administration states that the combined use of herbicides (in moderation) and mechanical mowing normally achieves the most environmentally acceptable results of controlling roadside vegetation.

**Comment** - No reply necessary.

7. **Review Summary, U. S. Environmental Protection Agency**

The Environmental Protection Agency states as long as label registrations are followed and amitrole, picloram, and dicamba be used only where no other herbicide is available, which is equally effective. Present EPA restrictions are to be followed in application of all herbicides.

**Comment** - Agree, No reply necessary

8. **Review Summary, State of Oregon, Office of the Governor**

The review by the Office of the Governor includes statements by all interested State Agencies and Councils of Government. The Oregon State Game Commission recommends that treatment areas should not exceed 150 acres in size, and that adjacent areas not be sprayed for two years, and that spray combinations not be used that will kill all vegetation on a site. The State Water Resources Board called the statement an "excellent reference for herbicide facts."

**Comments** - Most of the treatment areas are 20 to 40 acres in size. The only areas over 150 acres in size are dense tanoak brushfields on the Siskiyou National Forest which usually support low animal populations. Forage production is low in these brushfields, but should increase rapidly when the canopy cover is reduced by herbicide treatment.

In some cases, adjacent areas are sprayed without a two-year waiting period. Most of the herbicide application is done in the spring and there should be sufficient growing season remaining for the ground forage to respond.

The management objective of herbicide use on National Forests is to control vegetation. We would also consider it undesirable to kill all vegetation on an area with herbicides if such an event were possible.
9. **Review Summary, Agricultural Commissioner, Del Norte County, California.**

The Agricultural Commissioner was concerned about four species of plants in the proposed herbicide treatment areas which he described as rare. He requested more detailed maps of these areas and details on steps to be taken to protect the plants prior to the issuance of any permit.

He pointed out that proper application reports and registration of the Pest Control Operator will have to be made at his office.

**Comment** - The Siskiyou National Forest revised herbicide application plans do not include herbicide application in Del Norte County, California in Calendar Year 1973.

10. **Review Summary, Huxley College of Environmental Studies**

Mr. Newman of the Huxley College of Environmental Studies identified a number of weak areas in the Environmental Statement which he thought should be documented and revised. Major inadequacies identified were:

a. Identification of existing conditions in each of the designated areas. In particular, a list of the flora and fauna found in each area. The presence in or use of the area by unique, rare, or endangered species. Mention of weather conditions (those necessary for spraying in each area; when and how long) and growing seasons for target and non-target plants. Food habits (timing) or major animal groups like elk and deer.

b. General impacts on non-target species is nonexistent; there is no information on reptiles and amphibians; and the tetragenic effect on small mammal populations is overlooked.

c. Secondary impacts are not considered adequately; i.e., what effect will occur on removal of non-target plant species, or what are their ecological relationships.

d. There is sketchy identification of how long impacts will persist. The word "temporarily" (p. 19; p. 61) is ill-defined. How long is temporarily?

e. Inadequate outlining of procedures or controls to insure proper spraying will be done by private contractors.
Comments -

a. It would be impractical to include a detailed list of the flora and fauna to be found on each individual treatment unit. The proposed project areas are numerous, small, and widely scattered over the 2,688,221 acres contained in the three National Forests. Field surveys are made on each treatment area to identify the target and major non-target species that inhabit the site. This information is used to determine the need for vegetation management and to evaluate the impacts on non-target species.

A list of endangered and rare fauna found within the zone of the environmental statement follows:

<table>
<thead>
<tr>
<th>Fish</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oregon Chub (Hybopsis crameri)</td>
<td>Endangered</td>
</tr>
</tbody>
</table>

**Amphibians and Reptiles**

<table>
<thead>
<tr>
<th><em>Amphibians</em></th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Giant Salamander (Dicamptodon ensatus)</td>
<td>Rare</td>
</tr>
<tr>
<td>Roughskinned Newt (Taricha granulosa)</td>
<td>Rare</td>
</tr>
<tr>
<td>Siskiyou Mountain Salamander (Plethodon stormi)</td>
<td>Endangered</td>
</tr>
<tr>
<td>Oregon Slender Salamander (Batrachoseps wrighti)</td>
<td>Endangered</td>
</tr>
<tr>
<td>Tailed Frog (Ascaphus trui)</td>
<td>Rare</td>
</tr>
</tbody>
</table>

**Birds**

<table>
<thead>
<tr>
<th><em>Birds</em></th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Osprey (Pandion haliaetus carolinensis)</td>
<td>Rare</td>
</tr>
<tr>
<td>Northern Bald Eagle - (Haliaeetus Leucocephalus alascanus)</td>
<td>Endangered</td>
</tr>
<tr>
<td>Northern Spotted Owl (Strix occidentalis caurina)</td>
<td>Endangered</td>
</tr>
<tr>
<td>Great Gray Owl (Strix nebulosa nebulosa)</td>
<td>Rare</td>
</tr>
<tr>
<td>Alaska Northern Three-toed woodpecker - (Picoides tridactylus fasciatus)</td>
<td>Rare</td>
</tr>
</tbody>
</table>

Data from Oregon State University Agriculture Experiment Station:

<table>
<thead>
<tr>
<th>I Fishes</th>
<th>Special Report 205 1/66</th>
</tr>
</thead>
<tbody>
<tr>
<td>II Amphibians</td>
<td>Special Report 206 1/66</td>
</tr>
<tr>
<td>III Birds</td>
<td>Special Report 278 7/69</td>
</tr>
</tbody>
</table>

Weather condition requirements for aerial application of herbicide are discussed in detail on page 9 of the Environmental Statement.
Timing of herbicide application is a very important consideration in selecting a herbicide treatment. The growing seasons of target and non-target plants must be known to effectively control the target species with the least possible damage to the non-target species. For example: Red alder starts growing in the spring earlier than Douglas-fir; therefore, during this time period, red alder is susceptible to the phenoxy herbicides and the dormant Douglas-fir is not. After Douglas-fir bud burst, the same herbicide application would damage Douglas-fir trees. Other non-target, and non-crop species occupying the site, may or may not be affected by the herbicide treatment. In any event, these species are occupying a temporary ecological niche that will soon be eliminated when the conifer forest canopy closes and shades out the lower vegetation. The herbicide treatment will not change the natural succession, but it will shorten the brush stage and hasten the development of the coniferous forest.

The feeding habits of deer and elk have been studied, see Harper (32), Brown (33), and Hooven (35). The Oregon State Game Commission has reviewed the Environmental Statement, and have not identified any threat to the resident deer or elk populations.

b. The impact on non-target species is expected to be minor. The volume of native vegetation will be temporarily reduced, but individual plants will rarely be eliminated. It is true that there is no data available for reptile and amphibians as stated, but results of studies conducted on other species would indicate that there will be little or no adverse effect upon these creatures.

The possibility of tetragenic effects on the small mammals are speculative. Research has indicated that such adverse effects could be induced if the small rodents are exposed to large enough doses of many substances. Such adverse effects under natural conditions are unknown. The herbicides proposed for use will be applied at lowest possible rates per acre; they are rapidly degraded in the forest environment, and they will be applied to small, widely scattered tracts of land.

c. A general discussion of the possible secondary impacts are discussed on page 11 of the Environmental Statement.

d. Effects of herbicide treatment on the different plant species persist from one to three years depending on their resistance to the herbicide being used. Few plants are actually killed by the herbicide formulation rates applied.
e. The private contractors are rigidly inspected by trained and licensed Forest Service personnel. The controls are explained in detail in the Environmental Statement on pages 5 - 8.

11. Review Summary, Mazamas

The Mazamas recognize the need for brush control and agree to usage of the chemicals as outlined. They are concerned about rare or outstanding patches of flowering plants which may be growing in areas to be sprayed.

Comment - Plant species composition surveys are taken in conjunction with determining the need for herbicide treatment. If extensive areas of rare or unusual plants occur in or adjacent to treatment areas, care is taken to prevent spray or spray drift from hitting the areas. Rhododendron macrophyllum is the only rare plant found extensively in some spray areas. It is highly resistant to control and usually recovers within one to three years after being sprayed.

12. Review Summary, Western Forest Products Association

The Western Forest Products Association concluded that continuation of the program as proposed will be in the public interest and that reduction of the program below the proposed levels would be harmful. The association sees no adverse environmental impacts of such a nature as would outweigh a decision to continue this vitally important program.

Comment - No reply necessary

13. Review Summary - Jean Anderson, Ph. D., Clinical Psychologist

Dr. Anderson's letter is difficult to reply to because most of her comments tend to be rather general, and often they are related to a larger, more philosophical question about regimes of Forest management and administration that are far beyond the scope and intent of the draft statement.

The specific points that apply to the draft environmental statement are as follows:

Pages 5 - 6: Dr. Anderson is critical of the draft statement in its entirety. She alleges that the statement is inadequate, poorly constructed, self serving, redundant, obfuscating, lacks evidence of awareness of research and opinions of merit, and depends upon partial quotations and highly selective research.
Comment - The Environmental Statement has been reviewed by a number of people who are knowledgeable of or are interested in the use of herbicides and their possible adverse environmental effects. These reviewers represent diverse disciplines and it is from these reviewers that we expect weaknesses in the Environmental Statement to be identified. For example, we rely on the Federal and State Agencies having public health responsibilities to review the adequacy of the statement and program controls where public health is involved.

Pages 5 - 9: A number of errors in literature citation were pointed out by Dr. Anderson.

Comment - It is inevitable that such errors will be found in draft statements. The editorial services provided by Dr. Anderson in pointing out some of the errors is welcome. She is correct on Page 7 of her letter, where she states that the reference "Gutemann, W. H. and D. J. Lisk" is in error. The correct citation is Gutemann, W. H., D. D. Hardee, R. T. Nolland, and D. J. Lisk, 1963 The Appearance of 2, 4-dichlorophenoxyacetic acid in the Dairy Cow. Journal of Dairy Science 46:991-992.

Page 7: Dr. Anderson expressed concern that many of the reference materials cited in the statement are from Forest Service research publications.

Comment - This fact should not be surprising, since much of the research work pertaining to Pacific Coast herbicide use and Forest environment is being done by Forest Service researchers. The Forest Service makes every effort to insure that their scientists retain their objectivity, and that their work is not designed to justify the actions of the National Forest System. The lines of authority for research and the National Forest System do not cross until they get to the Chief of the Forest Service.

Pages 6 - 7: Dr. Anderson questioned the lack of current reference materials from outside the ranks of the Forest Service.

Comment - It is true that there is a vast number of references pertaining to herbicides that have not been cited in the draft statement. Any specific recommendations would be considered for inclusion in the final statement. The date of a publication has in most cases absolutely nothing to do with its adequacy, so long as appropriate methods were used and the data
were analyzed and interpreted correctly. The Item D reference dated 1964, and criticized by Dr. Anderson on page 6 of her letter as being outdated, is a perfectly valid reference even today.

Page 8: Dr. Anderson is critical of the cited references that are published by the manufacturers of the herbicides that are proposed for use.

Comment - Again, this fact should not be surprising when one considers that the manufacturers of the herbicides are required to conduct extensive tests and studies on their product to qualify for EPA label registration.

Page 9 - 11: Dr. Anderson provides comments on the statement summary of environmental impact and adverse environmental effects.

Comment - Disagree with her interpretation of the summary.

Page 11: It is noted that the three prime authors of the Environmental Statement are silviculturists. Dr. Anderson claims that this constitutes "gross bias", as "these men's jobs are concerned with the implementation of the lumbering interests." She also notes that all three "are employees of the Forest Service and could not be expected, thus, to have anything approaching an objective view of what can or might happen in the people's land, the National Forests."

Comment - Theodore A. Schlapfer, Regional Forester, Pacific Northwest Region, is the responsible official. Responsibility for preparing the draft statement follows the delegation of authority specified in Forest Service Manual 1230. Consultation with others has been made to include interdisciplinary expertise involving all environmental aspects of the proposed action. The Forest Service is authorized and directed by the National Environmental Policy Act of 1969 (P.L. 91-190) to prepare environmental statements on proposed Forest Service actions that may effect the environment.

Page 11: Comment on Section I, Project Description, under point 4 (page 1) states "what other problems for which these noxious agents may be applied is not stated."

Comment - Point 4, page 1, of the Environmental Statement concerns maintenance of physical facilities as affected by problem vegetation. Problem vegetation includes poisonous plants, noxious weeds, vegetation which increases fire or safety hazard, etc.
Page 11: The materials to be used were commented on by Dr. Anderson. She notes that the draft statement does not identify the manufacturer of the herbicide to be used. She states that the contractor will supply the herbicide; she also asks how the quality control is guaranteed.

Comment - The Forest Service will supply the herbicide for all Forest Service projects included in the 1973 program. It is Departmental policy to use only those herbicides that are registered for use with the EPA. The Environmental Protection Agency does not register any pesticide until adequate data are submitted showing that the product is effective for the purpose claimed, and that humans, crops, livestock, wildlife, and the environment will be protected when label directions and cautions are followed. The Pesticide Regulation Division of the EPA, as well as the Oregon State Department of Agriculture, checks manufactured pesticides to insure that they meet specifications indicated on their labels. At the present time, we do not know which manufacturer will supply the herbicides, as procurement contracts have not been awarded.

Page 11: Dr. Anderson noted that there was no background statement included for trazine, "perhaps the most dangerous agent of all."

Comment - A background statement for atrazine has been included in the Final Environmental Statement. It was not available at the time the draft statement was prepared.

Page 12: Dr. Anderson comments on the selection of herbicide application techniques as explained under METHODS: (Page 4).

Comment - Disagree with Dr. Anderson's interpretation of this portion of the draft statement.

Page 12 - 13: Dr. Anderson comments on drift of herbicide sprays, and goes to great length to explain how drift could effect non-target objects.

Comment - All of Dr. Anderson's statements are based on the false assumption that the helicopter will be spraying from a height of 235 feet. The information presented in the draft statement on pages 6 - 7 accurately depicts the possibility of drift. Her references to James M. Witt, "Principals of Drift of Pesticide Sprays", are correct.

Page 13: Comments stating that calibration of helicopter spray equipment is not guaranteed in the field, nor is the adequacy of the herbicide mixing which is done at the helispot.
Comment - The helicopter spray equipment is calibrated before spray operations are started, and at regular intervals during the spray operation. The spray solution is batched in a tank truck at or near the helispot under the direction of Forest Service personnel.

Page 13 - 15: Dr. Anderson reviews the section under CONTROLS: (page 5). Her questions and comments are all concerned with the question of who makes these decisions? She has also challenged the statement that "no significant hazard" to the environment will be created, and she states that she is "prepared to show that past applications have indeed not been in accordance with such regulations, and that they probably cannot be when application is by helicopter."

Comment - Disagree with Dr. Anderson's interpretation of this section of the Environmental Statement. The Forest Service, as the administrator of the National Forests, is charged with the responsibility of making the decisions in question. The draft environmental statement is a formalized procedure for considering any environmental hazards that may be pointed out by other agencies, individuals, and groups having expertise or interest in the subject. All suggestions and comments will be considered for inclusion in the final plans and statement for this program.

The Forest Service would like to review any evidence that Dr. Anderson might have, that would demonstrate that past applications have not been in accordance with regulations.

Page 15: Dr. Anderson states that similar guidelines for pesticide use have been established by the Oregon State Department of Agriculture's Advisory Committee on Synthetic Chemicals in the Environment.

Comment - The Agriculture Advisory Committee held hearings on 2,4-D and 2,4,5-T on March 19, 1970. Recommend that Dr. Anderson contact Virgil G. Hiatt, who can provide her with comments on those hearings and the conclusions of the Advisory Committee.

Page 15: Dr. Anderson questions who will supervise on-the-ground spray projects. She specifically asks "Will he supervise from his desk miles away?; Will he supervise from a convenient helispot?; How can he supervise the exact boundaries of the project areas at the exact time of the herbicidal drop?; and indeed, How will he know where the boundaries are?"
Comment - All Forest Service spray operations will be supervised by a Forest Service representative who is licensed as a special applicator with the State of Oregon. He will be with the spray operations in the field whenever herbicide formulations are being applied. He will be assisted by a team of trained Forest Service observers. These observers will be placed in the treatment area to observe boundary locations, weather conditions, etc. They are in constant radio contact with the project supervisor and heliport control center. The supervisor's exact location in the treatment unit may be variable, depending upon ground conditions, but in any event, he is responsible for starting or stopping the spray operations. All boundaries near private property or water sources are carefully watched by ground observers, and in many instances the project supervisor as well. The location of boundaries has never been a problem. In most cases they are obvious, as the treatment area is located in a reforestation project area where the vegetation is of a different size, age, and composition than the adjacent vegetation. In most cases land line locations are determined by surveys conducted prior to timber harvest.

Private boundaries adjacent to treatment areas can be determined accurately if the need arises by survey methods. An untreated buffer strip of at least one hundred feet in width is left between the treatment area and the private property. A much larger buffer strip is usually left adjacent to private property where sensitive agricultural crops are being grown, where domestic animals may be grazing, or if the area is inhabited.

Page 15: Controls outlined on page 6 of the Environmental Statement are discussed by Dr. Anderson. She notes that the word "normally" means that all these logical restrictions may or may not be adhered to. She also wants to know who decides when they will be adhered to.

Comment - Near critical property boundaries, water sources, or other sensitive areas, the controls are often much tighter than specified. The Forest Service project supervisor decides when spraying may proceed.
Page 15: Dr. Anderson asks "How are the ideals to be demonstrated, at how many points surrounding the area to be sprayed must the wind velocity be measured, how is it recorded and proven, and at how many spots must turbulence, humidity, temperature, and rainfall be designated, and how are these records recorded and proven, by whom?"

Comment - A complete record of weather conditions is maintained for each treatment area. The number of points to measure weather will vary with the terrain and location of the treatment area. The Forest Service project supervisor will determine the location and number of weather samples to be taken and recorded prior to spraying. The weather records are maintained along with spray application and flight records in the contract file.

Page 16: Dr. Anderson asks "Is this (diaphragm) shut-off valve guaranteed to have a 100 percent shut-off characteristic, and then, how is it guaranteed that the pilot uses the valve?" She states that she is "prepared to demonstrate that such has not been the case in previous spray projects and that such non-target objects as houses, adults, children, and domestic animals have been sprayed on what was clearly a non-spray route."

Comment - Dr. Anderson does not understand the principle behind the diaphragm shut-off valve. The valve is located on each spray nozzle, and works automatically to keep the spray solution from dripping out when the aircraft is not spraying.

The Forest Service would appreciate having any information that Dr. Anderson might have concerning spraying of non-target objects.

Page 16: The question is asked if one pre-spray reconnaissance flight over a sensitive boundary is sufficient to guarantee no incursions. She also asks "How many ground observers are there, how closely are they spaced, and what proof of their observations is there? Are continuous movie filming made at all points on the ground, or must we rely on speculations of accuracy by observers who are a hired part of the herbicide team?"

Comment - Pre-spray reconnaissance flights are made primarily to orient the pilot with the boundaries, to identify the buffer strips, and to define the spray target area. They are merely one tool that is utilized to avoid spray application errors. Aerial photographs of the treatment area are also used to orient the pilot with the ground features of the spray area and to pinpoint the boundaries.
The number of ground observers and their placement on the ground is determined by the Forest Service supervisor in charge of the operation. Continuous movie filming has not been used as a regular practice, but it would be a good method for documenting spray application on sensitive boundaries. Adjacent private landowners are encouraged to observe the spray operation.

Page 16: Question concerning unsprayed buffer strips that are left untreated adjacent to live streams and bodies of water. She asks "How are these marked and guaranteed when the agent is applied by helicopter?"

Comment - It must be pointed out that the minimum size of an untreated buffer strip between a treatment area and a water source is 100 feet. In many cases a much larger untreated buffer strip is left. The buffer strips are marked on aerial photographs, and they are pointed out to the pilot during reconnaissance flights. If they are not easily discernable from the air, they are marked on the ground with high visibility (fluorescent) paper sheets, balloons or other comparable methods.

Page 16-18: Dr. Anderson describes the documented cases of aircraft accidents involving pesticide applications.

Comment - Agree with the information provided by Dr. Anderson. There have been a large number of aircraft accidents involving aerial pesticide applicators. Most of the accidents that have occurred due to the toxic effects of pesticides on the pilot have been attributed to the organophosphate insecticides. The phenoxy herbicides do not affect humans as do the organophosphate.

In over 25 years of aerial herbicide application on the three Forests involved in this program, there have been no accidents that have caused injury to the pilots, or serious aircraft damage.

Concur that the case described on the Siuslaw National Forest involving Pilot William E. Lackey, employed by Intermountain Helicopters, happened on April 28, 1971. The helicopter had completed spraying and was returning to the helispot when the tip of the boom hit a small snag that was not observed by the pilot. There was minor damage to the spray boom, and the helicopter landed safely. The aircraft was not damaged and there were no injuries to the pilot. The accident was reported to Forest Service air operations in Portland.
Agree with the comment attributed to Paul Smith, M.D. of the FAA that "Every incident ought to be investigated."

Page 18: Dr. Anderson is critical of the water monitoring practices of the Siuslaw National Forest and, she states: "I am prepared to demonstrate that the practices have not been in accordance with the procedures prescribed for the Siskiyou in the Siuslaw National Forest, nor anything approximating them."

Comment - The Forest Service would like to see the evidence to support this statement.

Page 19: Dr. Anderson cites a reference from the American Medical Association that states "collecting and storing equipment should be glass and not plastic. Elements leached from the plastic may give extraneous and at times confusing peaks in gas chromatography or the pesticides may coat the plastic, and thereby, not be detected."

Comment - The citation is correct for those pesticides referenced; however, Alfred Cornwell, State of Oregon Pesticide Residue chemist; and Dr. Logan A. Norris, U.S. Forest Service (PNW) chemist, have both indicated that they are satisfied with the use of plastic containers provided that they contain sodium hydroxide. In their work, they have found that addition of sodium hydroxide to the water sample collection vessels hydrolyzes the phenoxy herbicide esters into a very water soluble form which prevents their adsorption to the plastic containers.

Page 19: Reference is made to the safety plan to be prepared for each application project. She states, that "the crux of the matter is whether each and every item in the safety plan is rigidly adhered to, and it can be shown that such is not the case."

Comment - A safety plan is prepared for each application project with full intention of adhering to all the points contained within the plan. The Forest Service would welcome any evidence that Dr. Anderson might have to the contrary.

Page 20: The economic analysis on page 9 of the statement is questioned by Dr. Anderson.

Comment - Accounting records for the cost of brush control are maintained by the Forest Service. Such records are available for further inspection by Dr. Anderson. The alternative methods are discussed in detail on pages 38 - 39 of the draft statement.
Dr. Anderson questions the productive capacity given for the Siuslaw National Forest described on page 36 of the draft statement. She states, "We are told that vast tracts in the Siuslaw National Forest now lie empty of any reforestation after recent Forest Service-let contracts to harvest."

Comment - The timber management plan for the Siuslaw National Forest is available for review by Dr. Anderson. The 10-year plan documents the productive capacity of the National Forest.

Disagree with her statement concerning the status of reforestation in the Siuslaw National Forest. Every timber harvest area on the Forest has been or will be reforested with funds collected from the sale of the timber products. Prompt reforestation following removal of mature timber is a primary goal of the Siuslaw National Forest.

It should be noted that the primary cause of reforestation failures on the Siuslaw National Forest is due to uncontrolled brush competition.

Dr. Anderson questions the use of research conducted by Forest Service scientists.

Comment - Disagree with her conclusions.

Dr. Anderson reviews the section of the Environmental Statement dealing with the effects on vegetation.

Comment - Disagree with Dr. Anderson's interpretation of this section.

Comments concerning page 12 of the draft statement where it was stated "For example, large groups of plants, such as grasses, ferns and mosses, are unaffected by 2,4-D and 2,4,5-T." She states "This is at odds with other sources of information" and she cites several publications.

Comment - Disagree with her conclusion. White subterranean clover, alfalfa, red clover, and trefoil are susceptible to the herbicides; however, they are not grasses, ferns, or mosses, and there is no contradiction with the information presented in the statement. The references cited are correct. The final statement will be revised to add: "There are a number of plants, including legumes, which are sensitive to the phenoxy herbicides."
Page 23: Dr. Anderson reviews Section B, Effects on Wildlife of the Draft Environmental Statement. She describes this section as "A cleverly contrived gathering of supporting data for the contention that there is no effect from the herbicides on wildlife."

Comment - Disagree with Dr. Anderson's interpretations and comments on this section.

Page 23: Questions concerning the study of Newton and Norris (1968) referenced on page 13 of the draft statement.

Comment - The study by Newton and Norris reports the levels of herbicide residues in a variety of tissues in the deer, but they drew no conclusions about the impact of these residues on the well being of the animals.

Page 23: Dr. Anderson states, "It is important to note that virtually all the studies cited to prove the lack of effect of the herbicides on various control species deal with either acute oral toxicity or with observable physical effects."

Comment - Disagree that virtually all the studies cited to prove the lack of effects deal only with acute oral toxicity or observable physical symptoms. Many studies cited in the background statements are references to studies of chronic toxicity.

Page 23 - 24: Dr. Anderson states that "The matter of toxicity of the herbicides to bees is given short shift."

Comment - Agree that the bee keeping industry is concerned about the impact of pesticides on bees. The citation Dr. Anderson gave as No. 26 is correct; however, the primary concern is for the organophosphate insecticides which are very potent toxins to bees. The effect of herbicides to bees, as described on page 14 of the draft statement, accurately describes the probably impact on honey bees.

Page 24 - 25: The effects on grazing animals (domestic and wild), as described on page 17 of the Environmental Statement, was discussed by Dr. Anderson. The hazards of nitrates to domestic animals was questioned.

Comment - Concur. The hazards of nitrates to domestic animals are well known and documented in publications such as the referenced paper by O'Brien (44).
In O'Brien's paper, "Nitrates in Animal Fertility and Reproduction", Western Livestock Journal, Vol. 50 No. 21, 1972, he covers the sources of nitrate poisoning on page 44, but he does not mention the use of herbicides as being a significant source of nitrate. At the end of O'Brien's article, there is one paragraph that speaks to the point of how ranchers can avoid problems of nitrate. The very last sentence of this paragraph cautions against the indiscriminate use of herbicides. This is the only sentence in the entire paper which mentions herbicides in connection with the nitrate problem.

In the reference cited by Dr. Anderson (64), Stahler and Whitehead, Science 112:749-751, 1950, the authors report the effects of 2,4-D on nitrate levels in sugar beets. A study that followed from the Stahler and Whitehead report was made by Peter A. Frank and B. H. Grigsby entitled "Effect of Herbicidal Sprays on Nitrate Accumulation in Certain Weed Species", in WEEDS 5:206-217, 1957, and reported on the effects of several herbicides on the nitrate accumulation levels in a variety of weed species. They found that ten of the 14 weed species examined contained levels of nitrate in excess of the amount considered safe for livestock consumption prior to treatment. Of these ten weeds, only two species had levels which could be attributed to the effects of the herbicide treatment, while several species show a decline in nitrate concentration after treatment. In no case was the level of nitrate increased from a nontoxic level to a toxic level by treatment with the herbicides 2,4-D, and 2,4,5-T.

On page 10 of Dr. Anderson's letter, she also made the statement that "documentation is available that many species--other than ruminants--may be affected." There is no evidence available to support this statement. C. A. O'Brien writing in the Western Livestock Journal, Volume 50(21):23 indicates that simple stomach animals absorb nitrate in the nonreduced form and it is excreted through the urine with little or no harmful effect on the animals. His point is that the principal danger is to ruminants.

The assessment of the potential hazard of nitrate increases in plants is accurately stated in the draft statement.

Page 26: Dr. Anderson states that "there is a severe danger of contamination of the Forest floor for long periods of time—at least as measured in the life span of these plants and creatures who live off the floor."

Comment - In terms of persistent pesticides, the herbicides involved are rapidly degraded and are relatively nonpersistent materials.
Section E, Effect on Aquatic Life, is discussed by Dr. Anderson. She claims that the use of herbicides are a serious threat to aquatic life.

**Comment** - Disagree with her interpretation of this section of the draft statement. She obviously has parts per million confused with parts per billion, which represents an error of 1,000 percent in her conclusions.

We agree with Holdon (34) that concentrated residues of 2,4-D would be injurious to fish, but under proper application techniques there will be no significant hazard to aquatic life.

Dr. Anderson is disturbed by the findings of Tarrant and Norris (1967) in their study of the Eddyville Unit and Wildcat Cabin Unit that are included in the draft statement.

**Comment** - Dr. Anderson has again confused parts per billion with parts per million. It should be pointed out that no attempt was made to exclude the stream from the treated area during the 1967 application of the Wildcat Cabin Study Unit. Current operating procedures are based on exactly such research findings that have shown that herbicidal contamination of streams can be avoided by not applying herbicide directly to the stream.

Section G, Effects on Man, is discussed by Dr. Anderson. She concludes that one teaspoonful of 2,4-D or 2,4,5-T could be lethal for a 150-pound man.

**Comment** - According to the 1972 Oregon Weed Control Handbook, 2,4-D and 2,4,5-T are classed as moderately toxic with LD50 in the range of 50 to 500 milligrams per kilo, and a probable lethal dose for a 150-pound man is equivalent to one ounce.

An example of a pesticide poisoning accident involving several Forest Service employees is discussed by Dr. Anderson to demonstrate that accidents do occur.

**Comment** - Agree that accidents involving pesticides do occur, but the referenced incident has nothing to do with the draft statement or the herbicides to be used.

Dr. Anderson points out that Dr. Sterling's minority report to the Advisory Committee was an integral part of that report, and should be included in the draft statement.

**Comment** - A statement concerning the minority report has been added to page 32 of the Environmental Statement.
Page 28: It is pointed out that the Advisory Committee recommended that a permissible residue of not more than 0.1 ppm of 2,4,5-T in potable water for human consumption be adopted. She states that "this would suggest that water monitoring should be required at all points in any Forest Service controlled watershed where the streams lead to any domestic use area, and that any indication of any residue be taken as evidence of unacceptable levels and dangerous contamination."

Comment - Concur that the committee made the tolerance recommendations, and that water monitoring is necessary for those streams that have domestic uses. Disagree that any residue be taken as evidence of unacceptable levels and dangerous contamination.

Page 30 - 35: She is generally critical of public health considerations in the draft statement.

Comment - The Federal and State Agencies having public health responsibilities have reviewed the draft environmental statement and have not discerned any significant adverse health effects that might result from the planned brush control programs.

14. Review Summary - Mr. Ugo E. Pezzi, Indian Creek Ranch

Mr. Pezzi objected to past and proposed herbicide treatments on National Forest land located near his Indian Creek Ranch. He expressed concern for the health and safety of his family and for possible adverse effects upon his property and domestic livestock. He explained that he is philosophically opposed to the use of sprays, chemicals, or fertilizers on or adjacent to his property.

Comment - The use of herbicides will be in strict accordance with EPA registration restrictions. EPA does not register any pesticide until adequate data are submitted showing that the pesticide is effective for the purposes claimed and that humans, crops, livestock, wildlife, and the environment will be protected when label directions and cautions are followed.

The proposed project located near the source of Mr. Pezzi's domestic water supply was scheduled for treatment with 2,4-D. The Mapleton District Ranger has agreed to meet with Mr. Pezzi on the ground to discuss the project in detail and to define the precautionary measures that will be followed to protect the water quality and to avoid drift of herbicide onto private property.
Mr. Pezzi's description of the spray incident of April 28, 1971, is incorrect in several respects. The treatment area was located one-fourth mile south of the Indian Creek Ranch, and only 2,4-D was applied. The helicopter was enroute to a new unit when sighted by Mr. Pezzi, and it was not transporting spray solution. It did not fly over his property. Three water samples were taken from the West Fork of Indian Creek at various time intervals following the treatment. The Oregon State Department of Agriculture analyzed the individual samples, and their laboratory analysis report documented the fact that herbicide residue could not be found in the water by analytical methods sensitive to one-part per billion.

Mr. Pezzi's detailed review of the draft environmental statement included numerous other comments and questions that have been carefully considered in the preparation of the final statement. The specific points that apply to the draft statement are as follows:

Page 8: Comments from his November 21, 1972 meeting with John Nesbitt, Mapleton Ranger District Silviculturist, concerning requirements and guidelines for Environmental Impact Statements.

Comment - The National Environmental Protection Act of 1969 (P.L. 91-190), Section (2)(c), requires environmental statements on proposed Federal actions affecting the environment. CEQ guidelines for statements on proposed Federal actions affecting the environment can be found in the Federal Register, Vol. 36, No. 79, April 23, 1971, Part II.

Page 9: Quote attributed to John Nesbitt concerning the use and disposition of Amitrole-T on the Mapleton Ranger District.

Comment - At the present time Cytrol Amitrole-T liquid weed killer, manufactured by the American Cyanamid Company, is registered for weed control in forest plantations - (EPA 241-60-AA).

Page 10: Mr. Pezzi alleges that there is a large discrepancy in the numbers, acreage, and locations of units to be sprayed in 1973, as described in the impact statement and as shown to him by Mr. Nesbitt.

Comment - There will be some changes in individual treatment areas. Mr. Pezzi and Mr. Nesbitt discussed spray plans for 1973, 1974, and 1975, which may have caused some confusion on this point. Minor adjustments will be needed in the CY 1973 program to delete those areas that may not be ready for treatment, or are of environmental concern; and to include other treatment areas that may be identified as having a high priority for treatment.
Weather conditions affecting aerial application were commented on by Mr. Pezzi. He asked what would be the meaningful criteria for limiting spraying, measured by when, where, and how? He also asked what would happen if there were a fairly steady 3 to 4 mph wind with occasional 7 to 8 mph gusts. If the ship were in the air, would it be called down, and how?

Comment - Each of the weather conditions listed on page 6 of the draft statement are meaningful criteria for limiting spraying. The weather conditions are measured by Forest Service personnel administering the contract. In sensitive areas, weather conditions will be taken at several points on a unit, at the top of a ridge or saddle, at the heliport, and at the bottom of the unit, etc. Forest Service observers are placed at various points in the treatment area that are believed to be most sensitive by the project leader. The weather conditions are measured by the use of a hand-held wind gauge, a thermometer, a sling psychrometer, and by personal observation of rain, ice, fog, and vegetation conditions. The observations are radioed into the heliport control center and are used by the Forest Service project leader in determining if spraying can proceed. If there were a fairly steady wind of 3 to 4 mph, with occasional gusts of 7 to 8 mph, spraying would not be attempted if there was a possibility of drift onto private property or into water sources. If the ship were in the air, it would be called down by radio contact with the pilot.

Mr. Pezzi stated that although the 1971 and 1972 herbicide programs were within the parameters set by the guidelines, they were marginal at best. He implies that the lateness of the season created a great deal of pressure to complete the spraying program with a resultant increase in carelessness and overlooking of guidelines.

Comment - Mr. Pezzi was invited to observe spray operations on two occasions in April of 1972. On both of these days the spraying was shut down due to adverse weather conditions. There is certainly a great deal of pressure to get the job done, but many Forest Service spray contracts have been terminated prior to completion due to adverse conditions.

Reference was made to a helicopter accident that occurred on the Siuslaw National Forest on April 28, 1971. He asked what provisions are made to prevent accidental spills in case of damage to booms, and what would be the result if the pilot himself were suffering from the toxic effects of the herbicides.

Comment - On April 28, 1971, a helicopter, owned by Intermountain Helicopters, had completed spraying and was returning to the heliport. The boom tip hit a small snag that was not observed by the pilot. There was minor damage to the spray
Mr. Pezzi asks what would be the effect of EPA or CEQ rejection or suggestions for modification of the Environmental Statement plans if they are only theoretical and how could the Forest Service modify a situation that does not exist.

Comment - The environmental impacts and precautionary measures described in the impact statement apply to all treatment areas to be included in the 1973 program.

Spraying techniques and controls outlined on pages 4 - 6 of the draft statement were questioned. Mr. Pezzi states that they are fine in principal, but much too general and undefined to have specific meaning. On page 12, he states that he felt that the 1971 and 1972 herbicide programs were within the parameters set by the guidelines.

Specific herbicide application controls and specifications are prepared for each Forest Service spray contract. Copies of these contracts are available at the Ranger District offices. The Forest Service will consider any suggestions for specific spraying techniques or controls that Mr. Pezzi might have.

Mr. Pezzi asked what constituted a "significant hazard", who determines it, and what assurance is there of implementing such a determination by a review board such as EPA or CEQ. He also asks if the possibility of poisoning a domestic water supply would constitute a significant hazard.

Comment - The question of hazard is reviewed in appendix E of the Environmental Statement. The draft environmental statement is a formalized procedure for considering any hazards that may be pointed out by other agencies, individuals, and groups having expertise or interest in the subject. If a review board such as EPA or CEQ determined that a significant hazard should exist, the Forest Service would most certainly accept such a determination and modify plans accordingly.

Mr. Pezzi comments that he is distressed by the lack of unified operations between Districts of the same Forest and between Forests of the same Region.

Comment - All Forest-wide contracts are administered by a Forest Service representative who is licensed as a special applicator with the State of Oregon. He is responsible for coordinating and administering the herbicide application on each Ranger District involved in the contract. Regional instructions and sample contracts exist to guide Region 6 National Forests in the use of pesticides.
boom, and the helicopter landed safely. The aircraft was not damaged and there were no injuries. This accident was reported to Forest Service Air Operations in Portland. No herbicide solution was spilled in this incident.

The possibility of accidental spills that may occur due to a helicopter accident cannot be entirely eliminated. Helicopters carrying herbicide formulations are required to fly over the target area, and the heliports are located either within the treatment area or as close as ground conditions will permit. To our knowledge no aircraft accidents have occurred where the pilot has been overcome by toxic effects of the herbicides included in the draft statement.

Page 14: Water monitoring procedures, field sampling techniques, and laboratory analysis for herbicide content were questioned by Mr. Pezzi.

Comment - The primary purpose of water monitoring is to detect and correct developing problems before they become serious. Composite samples are those composed of equal parts from each of the individual samples taken from a sample point following treatment. The composite samples are mixed by Forest Service personnel who are trained to prepare the sample without contamination. The remainder of the samples are retained for possible later analysis. The citation given by Mr. Pezzi concerning glass containers is correct for those herbicides referenced; however, Alfred Cornwell, State of Oregon Pesticide Residue Chemist, and Logan Norris, U. S. Forest Service (PNW) Chemist, have both indicated that they are satisfied with the use of plastic containers provided they contain the sodium hydroxide. Mr. Cornwell has stored samples in plastic containers containing sodium hydroxide for six months without loss of any herbicide residue that may be present.

Pages 15 - 16: Mr. Pezzi expressed concern about a number of unexplained illnesses and deaths to his livestock. He suspects that there is a possibility that at least some of the incidents might be related to the use of herbicides near his property.

Comment - Several incidents were related in your letter involving illness, death, low fertility, abortion and abnormal growth of cattle and horses which you suspect is linked to the application of herbicides on adjacent National Forest lands. I can fully appreciate the normal tendency to suspect herbicides as the responsible agent in view of your inability to pinpoint an undisputable cause for any of the maladies experienced. However, with no pretentiousness intended, I think it only fair that it be recognized that there
are many known and suspected agents, including numerous species of poisonous plants, which have the potential to precipitate nearly all of the maladies described in your letter. For instance, certain toxic species, when consumed in sufficient quantities, have clinically demonstrated a capacity for causing abortion, malformed and/or stillborn offspring, malfunction of the nervous system and other vital processes and abrupt death of animals some of which had an outward appearance of good health.

Tansy ragwort is acknowledged in your letter as occurring in your area. Though it would be improper and unscientific to assume it is the villain, this plant is known to result in irreversible liver damage and acute poisoning. It is also considered capable of subacute poisoning, whereby, an animal's ability to metabolize certain nutrients could be markedly influenced and its ability to withstand stresses appreciably diminished. In this respect, subacute tansy poisoning and associated liver degeneration is suspected to possibly result in an abnormal accumulation of copper, vitamin A and even selenium in the animal's system, all of which can cause death when tolerance levels are exceeded. Likewise, the nervous system disorder described for the horse owned by you might conceivably be linked to tansy poisoning. According to published information, tansy is reputed to cause nervous system malfunction in horses which can lead to misdiagnosis of encephalitis or rabies. Poisonous plants might also conceivably cause abnormal growth of calves through adverse effects on vital biological processes, similar to the effects ascribed to nitrate poisoning. In fact, in comparing the symptoms related by you to those ascribed to "nitrate poisoning", I would be highly suspicious that a nitrate accumulating plant (or plants) might be present in the pasture forage mixture. Future biopsies on lost animals might well consider it.

Not meaning to belabor the point, but I believe it might be both wise and fair to search more deeply for the real villain causing livestock losses. None of the maladies described have been linked to the indicated herbicides by valid research or clinical demonstration. I am the first to concede, however, that these chemicals are, as are most chemicals, potentially harmful if misused. I can assure you, we will follow manufacturer's label directions and take all necessary steps to insure the herbicide solution is confined to the treatment area, thereby eliminating all nitrate poisoning potential founded in the possible effects of auxin herbicides on susceptible plant species except, of course, on the treated area itself from which grazing will be excluded.
Pages 16 - 17: Comments on an alleged spray incident where Mrs. Jacqueline Wilkinson was sprayed by a helicopter while standing in her driveway. He also claims that Mrs. Wilkinson suffered from Jaundice, extreme fatigue, muscular aches and pains, and periods of depression. He states that she has been under medical care since that time and has been examined by several physicians, all of whom stated they were unable to determine the nature of her illness.

Comment - During an interview with Mr. and Mrs. Wilkinson, it was established that they were both in a Forest Service spray unit hunting rabbits in 1969 when the unit was treated with 2,4-D. They wandered into the area while hunting cross country and were not observed by personnel working on the spray project. The incident was not reported to the Forest Service.

Mrs. Wilkinson became ill six-months to a year after exposure to the herbicide. She did not attribute her illness to the herbicide.

Page 17: Mr. Pezzi questions the objectivity of research conducted by Dr. Logan Norris of the U.S. Forest Service Pacific Northwest Forest and Range Experiment Station considering his relationship with the Forest Service.

Comment - The Forest Service makes every effort to insure that scientists retain their objectivity. Research is not conducted to justify National Forest programs. The line of authority for research and the National Forest system do not cross until they get to the Chief of the Forest Service. Dr. Logan Norris is a recognized authority in his field.

Pages 17 - 18: Comments concerning effects on vegetation. Mr. Pezzi thinks that this section of the statement is too generalized.

Comment - 2,4-D is injurious to white subterranean clover, alfalfa, red clover, and trefoil. The statement has been revised to add: "that there are a number of plants, including legumes, which are sensitive to the phenoxy herbicides.

Pages 18 - 19: The hazards of nitrates to domestic animals were discussed in detail by Mr. Pezzi.

Comment - The hazards of nitrates to domestic animals are well known and documented in publications such as the referenced article by O'Brien, C. A., "Nitrates in Animal Fertility and Reproduction", Western Livestock Journal, Vol. 50 No. 21, 1972.
On page 44 of O'Brien's article he covers the known sources of nitrate poisoning, but he does not mention the use of herbicides as being a significant source of nitrate. At the end of O'Brien's article, there is one paragraph that speaks to the point of how ranchers can avoid problems with nitrates. The very last sentence of that paragraph cautions against the indiscriminate use of herbicides. This is the only sentence in the entire article which mentions herbicides in connection with the nitrate problem. It is important to keep in mind that there are a whole variety of environmental factors which will influence the levels of nitrate in plants.

Pages 19 - 20: The proposed spray programs within the Rogers and Maria Creek watersheds were considered by Mr. Pezzi to be unwise and counter-productive to good management techniques. He believes that most of the herbicide will end up in the bottom lands and the creek.

Comment - The proposed units in question are capable of growing trees. The herbicide treatments will not affect the perennial grass species and will affect only a minor number of the shrub species. Sufficient ground cover will be left to protect the site from soil erosion.

The reference made to Harvey, W. A., "Effects of Weed Control on the Environment", Trees and Turf, 1972, is correct. Herbicides may persist in bottom mud for longer periods due to the lack of the particular microbes responsible for decomposition of the herbicide. Norris (1971)(7) recommends that special care be taken to avoid herbicide treatment of marshy areas near streams to avoid long persistence of chemical residues in nearby streams.

Numerous steep areas such as these have been treated with herbicides previously without significant contamination of the streams or marshy areas located at the bottom of steep slopes, provided that an untreated buffer strip at least 100-feet wide is left between the spray area and the stream bottom.

Page 21: Wildlife and fishery resources of the Rogers and Maria Creek watershed area are discussed. It is pointed out that a herd of 36 - 40 elk are known to use these areas for calving and that the calving time will coincide with some of the scheduled spray programs.
Comment - The treatment areas represent only a small percentage of the land area of the two drainages. The Oregon State Game Commission has reviewed the draft environmental statement, and they have not considered the proposed herbicide treatment to be a threat to the resident elk population.

Pages 21 - 22: Mr. Pezzi points out that Oregon State University has selected the Rogers and Maria Creek Watershed areas as a location for a trial program of intensive management of the cinnabar moth, *Cydia jacobaeae*, for the control of tansy ragwort, *Senecio jacobaeae*, and that this badly needed research should be allowed to proceed without the additional threat of damage by toxic sprays.

Comment - Mr. Dennis Isaacson, Entomologist at Oregon State University, has stated that cinnabar moth pupae will be released on Mr. Pezzi's property during the spring of 1973. This will be one of several sites that has been selected by Oregon State University to introduce the cinnabar moth into areas heavily infested with tansy ragwort. The Forest Service will also be involved in this cooperative research program on other selected release sites in Oregon.

Mr. Isaacson did not know the sensitivity of the cinnabar moth to the phenoxy herbicide sprays. It is realized that biological control programs are often difficult to evaluate, and if a viable biological control of tansy ragwort could be based on the cinnabar moth, it would be prudent to delay herbicide operation in the immediate vicinity of the release area to accommodate the research.

The Siuslaw National Forest will pursue this matter further with Oregon State University researchers and Mr. Pezzi.

Page 23: Mr. Pezzi asks how the Forest Service determines the exact location of property boundary lines. He states that the last official survey was run in 1891 and many of the old marks have been obfuscated by time and the elements.

Comment - I am deeply concerned that you apparently feel the Forest Service is indifferent to the State-wide tansy ragwort control program called for by Governor McCall. Please let me assure you that the opposite is true and I offer the following information to apprise you of our involvement in the tansy ragwort control program:

a. A member of my staff participated on the Governor's Task Force and will continue to function as liaison officer between the Forest Service and the State Department of Agriculture, Oregon State University and other State agencies in the anticipated coordinated control program to be established by proposed legislation during the current legislative session. We intend to extend full cooperation to the limits of available Federal funding and environmental and land use constraints.

b. It is anticipated that the integrated control program (involving chemical, biological and cultural attacks) recommended in the "Governor's Tansy Ragwort Task Force Report" will be developed on a local and fully coordinated basis to avoid the possible conflict between chemical and biological control facets of the program such as that related in your letter. In keeping with this objective, upon learning of the Oregon State University cinnabar moth test program in the Rogers and Maria Creek watersheds, we promptly abandoned any plans for selective control of tansy ragwort in these areas using 2,4-D. We are in complete agreement that the control program must be fully coordinated between all participants. At the same time, I am sure you are aware that some private landowners and County governments have been highly critical of the Forest Service for not taking more aggressive action to effect the control of tansy in many areas where it is felt National Forest lands represent a reservoir of unwanted seed for infestation and reinfection of adjoining private lands. To be perfectly honest, our very limited chemical control program for tansy ragwort (severely limited by lack of weed control funding) has evolved because of public demand, that control be exacted and because of our desire to be a good neighbor to others who are spending money for control on their lands.

c. Commencing in July, 1973, we have plans to establish at least two colonies of cinnabar moth larvae on National Forest lands in collaboration with the Cooperative Extension Service and the Department of Entomology, OSU.
Tentative plans are to make one of the releases on the Siuslaw National Forest. Our release sites will probably be situated at elevations above existing colonies in the hope that more might be learned about climatological limitations (as influenced by elevation) on the potential range, and adaptability, of the cinnabar moth.
REFERENCES


(5) Anonymous. 1972. Background Information for the Phenoxy Herbicides, 2,4-D; 2,4,5-T; and 2,4,5-TP. Unpublished Data, U.S.F.S.


(49) Flieg, O. 1952. Soils and Fert. 15 1455.


Note: See Siskiyou NF Program Summary in the Appendix. References 81, 82, and 83.
APPENDIX CONTENTS

A. Amitrole - Background Information (14 pages)
B. Dicamba - Background Information (27 pages)
C. Phenoxy Herbicides - Background Information (165 pages)
D. Picloram - Background Information (43 pages)
E. Chemical Brush Control: Assessing the Hazard (6 pages)
   By Logan A. Norris
F. Illustrative Photos (4 pages)
G. Safety Plan, Siskiyou NF (11 pages)
H. Department of Environmental Quality Suggestions (1 page)
I. Sample - Siskiyou NF Use of Herbicides Supplement (8 pages)
J. Program Summary and Maps of Herbicide Projects on Siuslaw NF,
   C.Y. 1973 (42 pages)
K. Program Summary and Maps of Herbicide Projects on Siskiyou NF,
   C.Y. 1973 (15 pages)
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M. Atrazine - Background Information (19 pages)
N. Attachments 1 through 14 (69 pages)