Managing Fireweed on Problem Coastal Sites

INTRODUCTION
Fireweed (Epilobium angustifolium) can be detrimental to crop tree growth and survival because it competes with crop trees for light, moisture, nutrients, and root space.

At higher densities, it can cause physical damage through vegetation press. This paper describes:
- the way in which fireweed grows and invades an area
- the sites on which it can be a problem
- the management activities that aggravate fireweed competition
- the management strategies that can reduce competition to acceptable levels.

AUTECOLOGY

Colonization
Unlike many other species, fireweed can quickly and effectively dominate a cutblock, often to the exclusion of other species. Colonies are initially established from seed. A single plant can produce 20,000 – 80,000 seeds or more per year. The seeds are plumed and dispersed by wind throughout the late summer and fall. They can travel for long distances, sometimes up to 300 km.

Fireweed seeds normally germinate within the first year but can remain viable up to 2 years. They require specific conditions to germinate:
- the stimulation of light and a chilling period
- an optimal temperature of 15 - 35°C
- a seed depth that is at or near soil surface
- a seedbed with moist conditions and exposed mineral soil or well-decomposed or burned humus.

Once established, a colony is perpetuated primarily by vegetative reproduction from widely spreading rhizomes (an underground spreading root-like stem which produces roots from its lower surface and aerial stems from its upper surface). Limited research results indicate a
lateral spread rate of approximately 1 m per year. Distribution is initially clumped, but as site occupancy increases, competition forces a more uniform distribution. On most sites, maximum densities are reached 2-5 years after disturbance.

Fireweed colonies can survive for several decades. However, on areas where shrubs and trees have become established, it is easily shaded out and may dominate for only 2 or 3 years. The rate at which other vegetation develops determines the length of time fireweed maintains its dominance.

**GROWTH AND REPRODUCTION OF FIREWEED ON A DISTURBED SITE**

<table>
<thead>
<tr>
<th>Spring March-May</th>
<th>Summer June-July</th>
<th>Fall August-Sept.</th>
<th>Winter Sept.-April</th>
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<tbody>
<tr>
<td><strong>New Colony</strong></td>
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<td></td>
<td><strong>SEED DISPERSAL</strong></td>
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<td></td>
<td>- 20,000-80,000</td>
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<td></td>
<td>- viable for 18-24 months</td>
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<td></td>
<td><strong>SPRING GERMINATION</strong></td>
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<td></td>
<td>- rapid development begins</td>
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<td></td>
<td><strong>FALL GERMINATION</strong></td>
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<tr>
<td></td>
<td>- shoot buds produced along the root</td>
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<td></td>
<td><strong>GROWTH</strong></td>
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<td></td>
<td>- stem develops (maximum cover and height reached after 6 weeks)</td>
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<td></td>
<td>- extensive root development</td>
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<td></td>
<td><strong>FLOWERING</strong></td>
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<td>- may occur</td>
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<td></td>
<td><strong>OVERWINTER</strong></td>
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<td></td>
<td>- new shoot buds overwinter just below the soil surface 5-20 cm</td>
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<td><strong>Established Colony</strong></td>
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<td></td>
<td><strong>ROOT INITIATION</strong></td>
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<td></td>
<td>- roots grow before shoot buds emerge</td>
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<td></td>
<td><strong>SHOOT INITIATION</strong></td>
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<td></td>
<td>- shoots emerge</td>
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</tr>
<tr>
<td></td>
<td><strong>FLOWERING</strong></td>
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<td></td>
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<tr>
<td></td>
<td><strong>SEED DISPERSAL</strong></td>
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<tr>
<td></td>
<td><strong>OVERWINTER</strong></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>- all stems are dead</td>
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<td></td>
<td>- snow presses previous year's shoots to the ground</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>- shoot buds overwinter</td>
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</tbody>
</table>

**Growth and Development**

Each spring, fireweed shoots emerge from the soil (late April to early June). Depending on site conditions, shoots can reach heights of 1.5 - 2 m in 6 weeks. Cutting or damage to the stem during the growing season results in rapid regrowth and the plant can attain its original height again in as little as 3 weeks.

As the fireweed stem develops it thickens (0.5 - 1.5 cm) and in late summer seed production begins. Mature stems die and begin to desiccate from late July to early
October. Seed dispersal continues after the aerial shoots have withered. Dead stems can remain erect for several months depending on climatic conditions.

In the northern coastal environment, early, wet snowfalls and strong winds can cause most stems to bend and break. In dense colonies, broken stems may form a thick matt which can smother seedlings. With the added weight of snow, these seedlings are sometimes flattened to the ground and become physically damaged. Although fireweed litter decomposes rapidly, the production of new shoots every year perpetuates the problem.

COMPETITION

Competition Thresholds

While they are actively growing, dense colonies compete for moisture, nutrients, root space, and light. At the same time, dead fallen stems interfere with new growth by covering seedlings, reducing light, and sometimes causing bending and breakage. An acceptable level of competition depends on many variables, such as moisture, nutrient availability, shade tolerance, crop tree health, and vigor. While these relationships are not yet quantified or fully understood, some trends are clear:

- Crop trees flush in mid- to late May. Fireweed sprouts in late April and reaches full leaf cover in mid-June. Seedlings therefore often enjoy a competition-free growth period of only 2 weeks. A management objective should be to extend this window.

- Light regimes of less than 5% of full sunlight have been recorded under dense fireweed. At these low light levels conifer growth is reduced and mortality may occur.

- There are few data on the moisture and nutrient relations between fireweed and conifers, but problem sites are perceived to be those where moisture and nutrients are relatively abundant. It is probable, therefore, that competition for light or root space is the limiting factor on most fireweed complexes.

- Fireweed competition significantly reduces diameter growth of conifers and increases their susceptibility to bending and breakage.

- Although few data are available, current research provides some tentative guidelines on the levels of competition crop trees can sustain:
  - Diameter growth reduction becomes significant at about 30% cover (28 stems per square metre).
  - Some mortality begins in the first 2 years of crop establishment at densities over 50% cover (44 stems per square metre).
  - Competition levels are probably acceptable for shade-tolerant species if fireweed cover is < 50% and acceptable for shade-intolerant species when cover is < 30%.

Problem Sites

Vigorous, dense colonies of fireweed develop best on moist, open sites with medium to coarse-textured soils in the CWHvm, CWHws, and MH biogeoclimatic units. It is critical that these sites be identified in the pre-harvest silviculture prescription before logging takes place. Once potential problem sites have been identified, appropriate management strategies can be planned. The following is
a summary of the site characteristics associated with
vigorous fireweed colonies found in the northern coastal
areas:

Site associations
- subhygic to hygic

Aspect
- variable; prefers sunny or south-facing slopes

Slope
- wide range; 0 - 70%

Elevation
- low to high elevations

Soil condition
- wide variety (organic to sand); however, best
  on sandy loam to loamy soils

Nutrient concentration and pH values
- wide tolerance, but seems to grow best where
  nutrients are abundant

Seepage
- moderately abundant

The vigor and abundance of a fireweed colony are best
correlated with site association and soil texture. Forest
management activities also directly affect colony de-
velopment.

Management Factors

In general, management activities which provide
• a suitable seedbed, or
• an environment free from light competition
are going to favor fireweed establishment and growth.
There are four types of treatments promoting coloniza-
tion and growth: clear cutting, ground skidding, low
impact mechanical site preparation, and burning. Moder-
ate to high impact burns are particularly well correlated
with heavy fireweed development.

MANAGEMENT OPTIONS

Options for reducing fireweed competition fall into two
general categories: 1) to minimize colonization; and
2) to reduce cover and vigor of an established colony. The
first category includes the use of appropriate reforesta-
tion techniques and the use of replacement vegetation.
The second category includes the production of an unfa-
orable seedbed, rhizome reduction, removal of photo-
synthetic stems, and depletion of root reserves. Each is
described below and in the Summary of Management
Options on page 7.

Appropriate Reforestation Techniques

Options
- Protect advance regeneration during logging;
  plant large caliper stock; minimize regeneration
delay.

Mode of Action
- To protect advance regeneration, minimize
disturbance during logging (e.g., by winter
logging) and avoid site preparation.
- Use large caliper stock, which is best suited to
  resisting physical damage.
- Use suitable advance regeneration or taller stock
  planted immediately after logging or site
  preparation to increase the competition-free
  window.

Cautions
- Advance regeneration and/or planted stock
  must be ecologically suited to the site.
- Stock must be available (and therefore needs to
  be identified before harvest).

ACTIVITIES THAT AGGRAVATE FIREWEED COMPETITION

<table>
<thead>
<tr>
<th>Activity</th>
<th>Promotes:</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Colonization</strong></td>
<td>(X)</td>
</tr>
<tr>
<td>Clearcutting</td>
<td>X</td>
<td>- Exposes surface mineral soil horizons, creating a favorable seedbed (except for logging on frozen soils or snowpack).</td>
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<tr>
<td>Ground skidding</td>
<td>X</td>
<td>- Exposes surface mineral soil horizons, creating a favorable seedbed.</td>
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<tr>
<td>Low impact MSP</td>
<td>X</td>
<td>- Reduces organic horizons and produces a blackened surface, creating an ideal seedbed.</td>
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<tr>
<td>Burning</td>
<td>X</td>
<td>- Stimulates rhizome production.</td>
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<td></td>
<td>X</td>
<td>- Produces early nutrient flush (Assart effect).</td>
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</tbody>
</table>
Replacement Vegetation

Options
- Broadcast seed a grass/legume mix.

Mode of Action
- Because fireweed does not tolerate competition, use a well-established grass/legume crop to prevent seed-in.

Cautions
- Replacement vegetation option is based on limited research; site specific control plots should be established for future reference.
- A mix must be chosen which prevents fireweed colonization but does not impede the growth of seedlings through competition or mechanical damage. This treatment requires scarification or burning before seeding.
- Rodent populations can increase following the establishment of a grass cover.
- Planting and seeding should occur in the same year (preferably in the spring or early summer) to minimize the effects of grass competition on the seedlings.
- Seeding should occur immediately following harvest or site preparation.

Create an Unfavorable Seedbed

Options
- No site preparation.
- Mounding.
- Replacement vegetation (see above).

Mode of Action
- Use no site preparation so that existing established vegetation is maintained, making it difficult for fireweed to invade the site.
- Create mineral mounds, which make a drier, less favorable seedbed for fireweed, thus possibly providing the seedling with 2 - 3 years of reduced competition.

Cautions
- When no site preparation is conducted, existing vegetation can compete with the crop tree.
- Site preparation may be necessary to create planter access or to increase the number of plantable spots.
- Mounding can be very expensive.
Reduce Rhizomes

Options
- Herbicide treatments, mounding.
- Less effective options include disc trenching, deep scarification, and manual screeing.

Mode of Action
- Apply herbicides, which translocate to roots and rhizomes, killing the plant and preventing resprouting.
- Use mechanical site preparation and manual screeing to remove rhizomes physically and again prevent resprouting. Mounding can actually bury rhizomes and provide a rhizome-free cap.

Cautions
- Crop tree damage can result with herbicide treatments conducted before mid-August. However, treatments conducted after fireweed stems begin to desiccate and seed-in begins are ineffective.
- Mounding is site-specific (moist, deep soils) and expensive (~$600/ha). The size of the mound (≥1 m²) and the type of capping material (mineral soil) are important in determining the length of time fireweed competition is reduced.
- Manual screeing is expensive.
- Both manual screeing and trenching provide only short-term relief (1-2 years) because seed and rhizomes from neighboring plants quickly reinvade the area.

Deplete Root Reserves

Options
- Sheep grazing.
- Manual cutting is a less effective option.

Mode of Action
- Use repeated grazing or cutting to eliminate competition in the year of treatment and deplete root reserves, eventually killing the plant. Because fireweed can attain its original height in as little as 3 weeks when cut, the treatment should be conducted twice in 1 year to effectively reduce competition in the year of treatment. Up to 70% mortality may occur and plant vigor will be seriously reduced on remaining plants for the following season.

Cautions
- Manual cutting is very expensive ($300 - 400/ha per single treatment) and can result in up to 20% seedling mortality (from accidental cutting).
- While grazing is less expensive than manual cutting ($150 - 250/ha per year), there are several operational constraints with this option:
  - Only smaller blocks (< 40 ha) are feasible (preferably a series of blocks within 20 km of each other).
  - A relatively large sheep herd must be available (> 500 head).
  - There must be a nearby source of water.
  - The area must be reasonably accessible (on a road or trail within ~2 km of vehicle access).
  - Constant on-site supervision is required.
  - The plantation should be at least 2 years old before grazing is allowed.
  - Slash must not be excessive.
  - Grizzly bear populations in the area must be low.
  - The area treated cannot contain a domestic water supply.
  - A comprehensive grazing plan should be established.

The effect of sheep grazing.
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Replacement vegetation</th>
<th>Appropriate reforestation</th>
<th>Unfavorable seeded</th>
<th>Rhizome reduction</th>
<th>Root depletion</th>
<th>Technique</th>
<th>Timing</th>
<th>Efficacy &amp; duration</th>
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</thead>
<tbody>
<tr>
<td><strong>During harvesting</strong></td>
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<td>- log on snowpack or use high lead systems to preserve advance regen</td>
<td>N/A</td>
<td>- medium to good 2+ years</td>
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<td>Use advance regen.</td>
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<td><strong>Before planting</strong></td>
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<td>- avoid site prep on sites with deep, well decomposed duff or well-developed grass or herb layer</td>
<td>N/A</td>
<td>- poor to medium 1+ years</td>
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<tr>
<td>No site preparation</td>
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<td><strong>Patch scarification</strong></td>
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<td></td>
<td>- rhizomes reduced in patch</td>
<td>in autumn after seedfall</td>
<td>- variable 1+ years</td>
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<tr>
<td><strong>Breaking plow</strong></td>
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<td></td>
<td>- patch sizes dictates degree of success</td>
<td>in autumn after seedfall</td>
<td>- medium 1+ years</td>
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<tr>
<td><strong>Disc trenching</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>- may create favorable or unfavorable seedbed depending on soil properties</td>
<td>immediately after disturbance</td>
<td>- poor to medium 1-2 years</td>
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<td></td>
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<td>in autumn after seedfall</td>
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<td><strong>Mounding</strong></td>
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<td>- skidder with powered or passive trencher</td>
<td>immediately after harvest</td>
<td>- medium to good 2-3 years</td>
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<tr>
<td><strong>Mixing</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>autumn</td>
<td>- medium to good 1-2 years</td>
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<tr>
<td><strong>Windrow/pile</strong></td>
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<tr>
<td><strong>Herbicides</strong></td>
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<td></td>
<td>- removal of rhizomes</td>
<td>in autumn subject to trafficability</td>
<td>- poor to medium 1+ years</td>
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<tr>
<td><strong>Seed grass/legume mix</strong></td>
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<td>- severe treatment may result in site degradation</td>
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<td><strong>Planting</strong></td>
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<td></td>
<td>- glyphosate (backpack spray or aerial) 1.5 - 2.2 kg a.i./ha in 50 - 100 L of water</td>
<td>after fireweed establishment (June)</td>
<td>- medium to good 2-3 years</td>
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<td>Large planting stock</td>
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<td>- hexazinone (spay or spot gun, 4.3 kg a.i./ha, @ 5000-10 000 spots/ha)</td>
<td>after fireweed establishment (June)</td>
<td>- medium 1 year</td>
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<td><strong>After planting</strong></td>
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<td>- seed grass/legume mix (e.g., 50% white dutch clover/40% perennial rye grass/7% creeping red clover/3% Kentucky blue grass)</td>
<td>immediately after scarification or burning</td>
<td>- medium to good (further research required)</td>
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<td><strong>herbicides</strong></td>
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<td>- 6 - 30 kg/ha</td>
<td>spring or fall plant the same year</td>
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<td><strong>Grazing</strong></td>
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<td></td>
<td>- primarily helicopter application</td>
<td>immediately after disturbance</td>
<td>- medium 2+ years</td>
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<td><strong>Manual cutting</strong></td>
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<td>- spruce, subalpine fir, amabilis fir PSB 415, 615, 2+1 PBR</td>
<td>-</td>
<td>- medium 2+ years</td>
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<td></td>
<td>- glyphosate (backpack spray or aerial) 1.5 - 2.0 kg a.i./ha in 50 - 100 L of water</td>
<td>August (after bud set)</td>
<td>- good to medium 2-3 years</td>
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<td></td>
<td>- 300-500 sheep days/ha per year</td>
<td>June and late July</td>
<td>- good 3+ years</td>
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<td>- 2 grazing treatments in one year or 1 treatment/year for 2 consecutive years</td>
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<td>- brush saw (3-tine blade), brush hook, or knife</td>
<td>June and late July</td>
<td>- medium (fireweed &gt;1 m tall) - poor (&lt; 1 m tall) 2+ years</td>
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<td></td>
<td>- clear 1-m² radius around seedling</td>
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</table>
Fireweed does not have to be a problem. Rapid coloniza-
tion by fireweed may capture available nutrients released
following harvesting and burning - nutrients which might
otherwise be lost through leaching. An effective manage-
ment strategy starts with pre-harvest recognition of the
potential for fireweed development. On susceptible sites,
completion of logging in 1 year followed by rapid refo-
restation with healthy, sturdy stock can eliminate the need
for more expensive and risky follow-up treatments de-
scribed above. As is often the case in forestry, taking
preventative action is more effective than dealing with an
established problem.

FOR MORE INFORMATION

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