What is a masticator?
When is mastication a good option?
What are the elements that influence cost?
How do I determine which masticator to use?
<table>
<thead>
<tr>
<th>Vertical Shaft</th>
<th>Horizontal Shaft</th>
</tr>
</thead>
<tbody>
<tr>
<td>disk or mower</td>
<td>Horizontal shaft or drum</td>
</tr>
<tr>
<td>fixed teeth or blade</td>
<td>Fixed teeth,</td>
</tr>
<tr>
<td></td>
<td>swinging hammers, or</td>
</tr>
<tr>
<td></td>
<td>ax/knife blade</td>
</tr>
<tr>
<td>Boom or front end mounted</td>
<td></td>
</tr>
<tr>
<td>Vegetation</td>
<td>Trees 6 to 8” diameter when boom mounted</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>Vertical Shaft</td>
<td>![Vertical Shaft Image]</td>
</tr>
<tr>
<td>Harvest slash and shrubs</td>
<td></td>
</tr>
</tbody>
</table>
### Piece size and post-treatment condition

<table>
<thead>
<tr>
<th>Large pieces</th>
<th>Chunks and shreds</th>
<th>Small pieces</th>
<th>Chips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaves ragged stumps</td>
<td></td>
<td>Leaves clean cut stumps</td>
<td></td>
</tr>
</tbody>
</table>

### Carrier Machines

Excavators, skid steers, tractors (hydraulic and power take-off)
<table>
<thead>
<tr>
<th>Within stand topography</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vertical Shaft</strong></td>
</tr>
<tr>
<td>Broken or dissected slopes</td>
</tr>
<tr>
<td>Diversity of angles and aspects</td>
</tr>
<tr>
<td>Boom mounted provides more options</td>
</tr>
<tr>
<td>Front end mounted visit every tree</td>
</tr>
<tr>
<td><strong>Horizontal Shaft</strong></td>
</tr>
<tr>
<td>Continuous or similar slope angle and aspect</td>
</tr>
</tbody>
</table>
What is a masticator?

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How do I determine which masticator to use?
Works best for altering biomass for fuels and site preparation!

Photographs from: Scott and Burgan 2005, portland.indymedia.org, Jain
Cutting Head

Moist Mixed Conifer

Average surface area (cm²)

- 1 h Vertical shaft
- 1 h Horizontal shaft
- 10 h Vertical shaft
- 10 h Horizontal shaft
- 100 h Vertical shaft
- 100 h Horizontal shaft

Legend:
- a
- b
Site Preparation Forest Floor Substrate

Masticated Blackened

Organic Mineral

Haig et al. 1941
Forest Floor Establishment

Chi-square
P=0.0001

Species abundance (%)

Mastication
Organic
Pile&burn
Under burn

Western Larch
Douglas-Fir
Western Hemlock
Western White Pine
Grand Fir
Western Redcedar
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### Cost

It Depends

300 to 400/acre

<table>
<thead>
<tr>
<th>Increase Cost</th>
<th>Adjust Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine size ↑</td>
<td>Cheaper than slash, pile, burn</td>
</tr>
<tr>
<td>Tree size ↑</td>
<td>One entry vs multiple entries</td>
</tr>
<tr>
<td>Fuel load ↑</td>
<td>Avoids removal costs</td>
</tr>
<tr>
<td>Complex site conditions</td>
<td>Unable to burn</td>
</tr>
<tr>
<td>Creating small pieces</td>
<td>Large pieces</td>
</tr>
<tr>
<td>Operator experience</td>
<td>Spot mastication</td>
</tr>
</tbody>
</table>
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Series of Decisions

Decision Tree 1
The influence of slope when selecting treatment options

What is the slope percent of your project?

Ground slope < 40%:
- Treatment options: 1) Hand thin, 2) Mechanical, 3) Prescribed fire, 4) No treatment
- Go to decision tree 2

Ground slope > 40%:
- Treatment options: 1) Hand thin, 2) Prescribed fire, 3) Mechanical equipment designed for steep slopes, 4) No treatment
Decision Tree 2
Treatment options for slopes < 40%

- **Is the unmerchantable biomass created from a commercial harvest?**
  - **No**
    - Are there > 100 stems/acre that need to be treated?
      - **Yes**
        - Option: Mastication Go to decision tree 3)
      - **No**
        - **Option: Prescribed fire Mastication Slash, pile, burn**
          - Does the surface vegetation need treatment?
            - **Yes**
              - **Options: Mastication Go to decision tree 3**
            - **No**
              - **Options: Slash, grapple pile and burn Prescribed fire**
          - **Is smoke production limited?**
            - **Yes**
              - **Option: Prescribed fire Mastication Slash, pile, burn**
            - **No**
              - Are residual trees fire resistant?
                - **Yes**
                  - **Option: Prescribed fire Mastication Slash, pile, burn**
                - **No**
                  - Does the surface vegetation need treatment?
                    - **Yes**
                      - **Options: Mastication Go to decision tree 3**
                    - **No**
                      - **Options: Slash, grapple pile and burn Prescribed fire**
Decision tree 3
Mastication Combinations

Is Soil prone to compaction?
- YES: Tracked carrier
- NO: Wheeled carrier

Is the terrain broken or uniform?
- Broken: Boom-mounted masticator
- Uniform: Front-end attached masticator

Is there more than 4 ha (10 ac) to masticate?
- YES: Are their homes or other sensitive areas?
  - YES: Small masticator
  - NO: Large masticator
- NO: Small masticator

Is the desired outcome chunks or mulch?
- Chunks: Vertical shaft rotary masticator head
- Mulch: Horizontal drum masticator head
Important Incidentals

Vegetation
• When depth of masticated biomass > 4” vegetation establishment diminished
• Nonnative plant establishment
  Grasslands>shrublands>woodlands>forests

Wildlife
• Effects to wildlife depends on the habitat needs
Important Incidentals

Soils
- No negative effects on soil erosion, compaction, or nutrition.
- Insulated soil decreasing temperature extremes
- Soil moisture was higher

Decomposition
- **Very resistant**: Pacific yew, red mulberry, old redwoods, cedars
- **Moderate resistant**: Douglas-fir, western larch, young redwoods
- **Slightly resistant**: firs, aspen, elms, maples, sweetgum, pines