DRAFT, Version 1.1

Draft Management Recommendations for Green bug moss *Buxbaumia viridis* (DC.) Moug. & Nestl.

Version 1.1
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EXECUTIVE SUMMARY

Species: *Buxbaumia viridis* (DC.) Moug. & Nestl. (Green bug moss)

Taxonomic Group: Bryophyte: Moss

ROD Components: Protection Buffer Species (ROD, p. C-27)

Other Management Status: none

Range: In our area, *Buxbaumia piperi* ranges from northern California to British Columbia. It is known from Deschutes, Lane, Linn counties in Oregon and Clallam, Pierce, Whatcom counties in Washington, and Mendocino county in California. It is known from Mt. Rainier, Olympic, and North Cascades National Parks and from the Deschutes, Willamette, Gifford Pinchot, and Mt. Baker Snoqualmie National Forests.

Specific Habitat: *Buxbaumia viridis* occurs on rotten stumps and logs and on mineral or organic soil in cool, shaded, humid locations at middle elevations. Floodplains and stream terraces are favorable habitats because of the large amount of decayed wood available in old growth, but the species can be found on almost any landform as long as microclimatic conditions are favorable. A number of specimens have been found growing on shaded cutbanks of trails and roads. Elevations of known sites range from 1165 to 1525 m (3500 to 5000 feet).

Threats: *Buxbaumia viridis* is sensitive to changes in light level and microclimate caused by removal or thinning of the canopy and is dependent upon adequate amounts of coarse woody debris in the appropriate decay classes. Most of the known sites occur near trails and may be subject to recreational impacts.

Management Recommendations:
A closed canopy provides the necessary microclimate for species occurring on decaying wood and humic duff. Input of large woody debris in various decay classes is necessary for long-term viability. Known sites of *Buxbaumia viridis* should be managed as prescribed in the Record of Decision (USDA and USDI 1994, p. C-27): Maintain decay class 3, 4, and 5 logs, leaving windfalls in place to provide structurally diverse habitat and maintain a dense overstory to maintain humidity, with greater than 70 percent closed-canopy forest for shade.

Support ongoing Density Management Studies of bryophyte diversity and response to management on Bureau of Land Management, Salem and Eugene Districts (Muir and McCune 1994) and apply results to adaptive management.

Monitor response of *Buxbaumia viridis* to management within the Demonstration of Ecosystem

Management Options study areas, on the Gifford Pinchot National Forest.

Information Needs:
Appropriate questions to aid in management for *Buxbaumia viridis* include: How is this species dispersed? What role do small mammals and fungi play in its life cycle? What site characteristics are most favorable to colonization? What is the degree of association with coarse woody debris substrate? At what decay stage does *Buxbaumia viridis* colonize?

I. Natural History

A. Taxonomic/Nomenclatural History

Buxbaumia viridis (DC.) Moug. & Nestl. was described in 1823. It had previously been treated as a variety of *B. aphylla*. It is placed in the order Buxbaumiales, family Buxbaumiaceae.

SYNONOMY:
Buxbaumia viridis (DC.) Moug. & Nestl., Stirp. Crypt. Vog. Rhen. fasc. 8: n. 724. 1823
Buxbaumia aphylla var. *viridis* DC. *in* Lam. & DC., Fl. France ed. 3(6):227. 1815
Buxbaumia indusiata Brid., Bryol. Univ. 1:331. 1826.

B. Species Description

1. Morphology (Lawton, 1971: 29)

The gametophytes of *Buxbaumia viridis* are very small and inconspicuous, seemingly leafless, but with a few vanishing leaves. The large, distinctive sporophytes are comprised of a seta 5-8 mm long, from a bulbous base and a non glossy greenish yellow capsule that becomes yellow brown. It is 5-6 mm by 2.3-3 mm in size, flattened on the dorsal side and rounded on the ventral; stomata are immersed and composed of one cell with the capsule wall consisting of 3-4 layers of cells. The cuticle of the outer layer splits longitudinally to irregularly on the dorsal side and is incurved when dry and recurved or rolled back when wet. The peristome consists of about 3 circles of strongly papillose teeth.

The genus *Buxbaumia* is highly distinctive. Gametophytes are essentially absent. The characteristic slipper-shaped, papillose sporophyte, suggests the common name "bug on a stick". Three species of *Buxbaumia* have been documented from the Pacific Northwest. *Buxbaumia viridis* has a cuticle on the upper surface of the capsule that splits longitudinally and curls back laterally. *Buxbaumia aphylla* has broadly ovate, glossy capsules that are reddish-brown when dry. *Buxbaumia piperi* has narrowly ovate, yellowish tinged capsules that are not at all glossy. The cuticle rolls back from the mouth after the operculum is shed and the capsule is dry.

It is worth noting that several of the collections in herbaria were misidentified. Where material is sufficient to allow collection of small voucher specimens, it is recommended that questionable material be sent to a bryologist for verification.

Figure 1. *Buxbaumia* viridis (line drawing from Lawton 1971) (to be added).
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2. Reproductive Biology

Buxbaumia viridis is dioicious, with male and female reproductive structures borne on separate plants. Like all bryophytes, it requires water for reproduction.

3. Ecology

Plants consist mostly of a persistent mat of protonema, and virtually lack a leafy gametophyte. Sporophytes are relatively large and very distinctive. *Buxbaumia viridis* may be closely associated with mycorrhizal or decomposer fungi.

The related *B. aphylla* is described by Crum (1976) as a pioneer species of disturbed sandy or clayey soil, often in association with logs or stumps. Based on habitat information, *B. viridis* is a rare species which occupies older stands, but may occur on soil near trails. At one site, it was reported from a subsoil on a road cut.

C. Range, Known Sites

This species ranges from northern California to British Columbia, and is known from Montana. Reports from eastern North America are incorrect (Crum and Anderson 1981). It also is known from Europe, Scandinavia, and Russia. It is widespread but uncommon at middle elevations throughout the region, and appears considerably more rare than related species, *B. piperi*. It is known from a total of ten collections in Deschutes, Lane, Linn counties in Oregon and Clallam, Pierce, Whatcom counties in Washington, and Mendocino county in California. It is known from Mt. Rainier, Olympic, and North Cascades National Parks and from the Deschutes, Willamette, Gifford Pinchot, and Mt. Baker Snoqualmie National Forests.

Figure 2. Known sites of *Buxbaumia viridis* (to be added).

D. Habitat Characteristics and Species Abundance

Buxbaumia viridis occurs on rotten stumps and logs and on mineral or organic soil, in cool, shaded, humid locations at low to middle elevations. Floodplains and stream terraces are favorable habitats because of the large amount of decayed wood available in old growth, but the species can be found on almost any landform as long as microclimatic conditions are favorable. A number of specimens have been found growing on shaded cutbanks of trails and roads. Elevations of known sites range from 1165 to 1525 m (3500 to 5000 feet).

Associated conifers include mountain hemlock (*Tsuga mertensiana*), western redcedar (*Thuja plicata*), and silver fir (*Abies amabilis*).

II. Current Species Situation

A. Why Species is Listed under Survey and Manage Standards and Guidelines

Buxbaumia viridis was included in the list of species covered by Mitigation Step 5 of the Scientific Analysis Team Report (Thomas et al. 1993). Mitigation activities prescribed in this document include surveying to determine presence and distribution, and where located, maintaining decay class 3, 4, and 5 logs and greater than 70 percent closed-canopy forest habitats for shade. Shelterwood and thinning prescriptions for timber harvest may impact populations, as logs dry out under the changing microclimate regime.

As part of the mitigation, it was recommended that Regional ecologists or botanists 1) maintain a spatially explicit database of all known sites and 2) develop species or area management plans.

The panels convened by the Forest Ecosystem Assessment Team (FEMAT) included *Buxbaumia viridis* in the group of less common decaying wood species. Their viability ratings under the original Option 9 indicated a high level of confidence that this group would remain well distributed throughout their range. However, in the Record of Decision, the species referenced in the Mitigation Measure Step 5 from the Scientific Analysis Team Report were included as "Protection Buffer Species", with the above mitigation reiterated.

B. Major Habitat and Viability Considerations

Buxbaumia viridis requires continued input of coarse woody debris in various decay classes and diameters as a substrate on which to grow.

C. Threats to the Species

Because this species generally occurs at elevations higher than *Buxbaumia piperi*, and a large percentage of known sites occur in Congressionally withdrawn areas, the threat of timber harvest is less significant for *Buxbaumia viridis*. However, slower growth rates of trees and lower decomposition rates of coarse woody debris elevate the importance of leaving adequate future substrate for rotting wood-inhabiting bryophytes in harvested strands. Impacts from recreation may threaten *Buxbaumia viridis*; nearly all known sites occur along trails.

D. Distribution Relative to Land Allocations

Of the ten known sites, one is located in the Three Sisters Wilderness Area, three are within Mt. Rainier National Park, one is within Olympic National Park, one is in North Cascades National Park, and one is most likely in the Mt. Baker Wilderness (based on limited information available). One is on Deschutes National Forest, one on Willamette National Forest, and one is on State Land (Jackson Demostration State Forest). Seven of the ten known sites are within Congressionally designated reserves.

III. Management Goals and Objectives

A. Management Goals for the Taxon

The goal for the management of *Buxbaumia viridis* is to assist in maintaining species viability.

B. Specific Objectives

- Maintain decay class 3, 4, and 5 logs, leaving windfalls in place to provide structurally diverse habitat at known sites.
- Maintain a dense overstory to maintain humidity, with greater than 70 percent closed-canopy forest for shade at known sites.

IV. Habitat Management

A. Lessons from History

There is a considerable literature on the declines of bryophytes in Europe. Rapid decreases and fragmentation of primeval forests have caused a serious threat to bryophytes that grow on decaying wood (Laaka 1992). In addition, air pollution (particularly sulphur compounds in combination with low pH) and acid rain are implicated in declines of bryophytes (Hallingbäck 1992, Rao 1982). The extinction rate and rates of decline are high in areas where trends are documented (Greven 1992, Hallingbäck 1992). Factors associated with logging that cause declines in bryophytes include the temperature extremes and the drying effect of increased wind, the lowering of surface water, and drying of logs, reduction in amount of coarse woody debris substrate, increased dispersal distance between fragments of primeval forest (Laaka 1992). Lack of suitable substrate is the main reason for rarity of threatened epixylic (decaying wood inhabiting) species in managed forests.

Several studies are underway that may provide valuable insights in to future management for this species, including the Demonstration of Ecosystem Management Options study on the Gifford Pinchot National Forest.

B. Identification of Habitat Areas for Management

The number of known sites of this species is limited to ten; therefore all known sites on Federal lands are to be managed according to the specifications below.

C. Management within Habitat Areas

A closed canopy provides the best microclimate for optimal development of species occurring on decaying wood and humic duff. Input of large woody debris in various decay classes is also necessary for long-term viability. Known sites of *Buxbaumia viridis* should be managed as prescribed in the Record of Decision: Maintain decay class 3, 4, and 5 logs, leaving windfalls in place to provide structurally diverse habitat and maintain a dense overstory to maintain humidity, with greater than 70 percent closed-canopy forest for shade.

Support ongoing Density Management Studies of bryophyte diversity and response to management on Bureau of Land Management, Salem and Eugene Districts (Muir and McCune 1994) and apply results to adaptive management.

Monitor response of *Buxbaumia viridis* to management within Demonstration of Ecosystem

Management Options study areas, on the Gifford Pinchot National Forest.

D. Other Management Issues and Considerations

No other management issues are identified at this time.

V. Research, Inventory and Monitoring Needs

A. Data Gaps and Information Needs

Many of the known sites are historic localities that should be revisited to determine if they are still occupied. Insufficient information exists on the habitat requirements of *Buxbaumia viridis* to effectively manage for this species. More specific information on substrate (e.g., decay class), microclimate, and ecological tolerances will aid in developing more specific management guidelines.

B. Research Questions

Appropriate questions to aid in management for *Buxbaumia viridis* include:

- How is this species dispersed?
- What role do small mammals and fungi play in its life cycle?
- What site characteristics are most favorable to colonization?
- What is the degree of association with coarse woody debris substrate?
- How substrate specific is *Buxbaumia viridis*?
- Does it actually occur on mineral soil, or is there always coarse woody debris required for its establishment?
- At what decay stage does *Buxbaumia viridis* colonize down wood?

C. Monitoring Needs and Recommendations

Monitor the response of *Buxbaumia viridis* to mitigation measures implemented as part of the Demonstration of Ecosystem Management Options study on the Gifford Pinchot National Forest.

Monitor recreational impacts, if populations along trails are subject to disturbance by hikers.

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