

DRAFT, Version 1.1

Draft Management Recommendations for
Awnless wet wavy-cell moss
Racomitrium aquaticum (Schr.) Brid.

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EXECUTIVE SUMMARY

Species: *Racomitrium aquaticum* (Schr.) Brid. (Awnless wet wavy-cell moss)

Taxonomic Group: Bryophyte: Moss

ROD Components: 1,3

Other Management Status: none

Range: Within the area of consideration, *Racomitrium aquaticum* occurs in California, Oregon, and Washington. It has been reported from Benton, Hood River, Lane, Linn, and Multnomah counties in Oregon; Clallam, Pierce, Snohomish, and Whatcom counties in Washington; and Del Norte, Humboldt, and Siskiyou counties in California. On federal land in the range of the northern spotted owl, it is known from the Mt. Hood, Willamette, and Mt. Baker-Snoqualmie National Forests and from the Mt. Rainier and Olympic National Parks.

Specific Habitat: *Racomitrium aquaticum* is often associated with high moisture conditions and substrates. It occurs within forests on moist rocks and boulders in and near streams, springs, waterfalls, on cliff faces and rock outcrops. Rock substrates include granite and basalt. The habitat is shaded, with associated overstory including Jeffrey pine, incense cedar, western hemlock, or oak. It has been reported from elevations between 610 and 1950 m (2,000 and 6,400 ft.).

Threats: Upstream activities that cause excessive siltation could be detrimental to this species where it occurs in water. Erosion and scouring floods could remove this species from its substrate. Recreational activities, such as rock climbing, boating (including kayaking), and gold dredging can also damage mosses in splash zones by abrasion or removal of moss mats. Any activity that would directly disturb the moss or alter the microclimate of the site, including logging and road building would threaten local populations.

Management Recommendations:

- C Minimize disturbance of known sites from boating, mining, and recreation. Avoid locating boat docks, trail crossings, and foot bridges near known sites. Discourage rock climbing in vicinity of populations of *Racomitrium aquaticum*.
- C Maintain riparian buffers as prescribed in the Record of Decision in the vicinity of known populations.
- C Protect known sites from activities which would alter the cool, moist, shady microclimate of the site.
- C Maintain low sediment load in streams with aquatic populations of *Racomitrium aquaticum* to avoid reduction in photosynthesis.

Information Needs:

- C Revisit known sites to verify population status and collect ecological data.
- C Conduct surveys to locate new populations, determine habitat characteristics, and abundance.

I. Natural History

A. Taxonomic/Nomenclatural History

Racomitrium aquaticum (Brid. ex Schard.) Brid. belongs to a large and complex genus that has been treated by several authors (Frye 1917-1918, Lawton 1972). *Racomitrium* is placed within the order Grimmiales, family Grimmiaceae. This species was originally described in 1819 and has an extensive synonymy. Although there are no recent synonyms, a recent alternative spelling for the genus is *Rhacomitrium*.

B. Species Description

1. Morphology (Jones 1933:53, Nyholm 1956:163, Watson 1968:227, Lawton 1971:142, Smith 1978, Noguchi 1988, Christy and Wagner 1996)

Plants of *Racomitrium aquaticum* are erect, 1-10 cm long and branched irregularly. Leaves are green, yellow-green to blackish below, straight or falcate (curved) at shoot tips, imbricate (overlapped) when dry, 2-4 mm long, 0.4-1 mm wide, tapered to a rounded tip, with entire margins. The midrib forms a prominent keel at the back of the leaf, ending before the leaf tips, never forming an awn. Leaf tips are recurved. Leaf cells are multipapillose with sinuose-wavy cell walls. Setae are 4-8 mm long, twisted clockwise when dry. Capsules are 2-3 mm long, cylindrical with peristome teeth 0.5 mm long.

Members of the genus *Racomitrium* are variable and sometimes difficult to identify. A microscope is required to confirm identification. The multipapillose cells, imbricate, strongly keeled and consistently awnless leaves, and bright green to yellow-green color are distinctive. The peristome teeth 1 mm length distinguishes this species from similar *R. varium*, which has peristome teeth 1-1.7 mm long. In addition, at least some of the leaves of *R. varium* typically bear distinct awns. *Racomitrium pacificum* differs in habitat, occurring on dry, rocky substrates and has smooth rather than papillose leaf cells.

Figure 1. Line drawing of *Racomitrium aquaticum* from Nyholm (1956), Watson (1968) and Smith (1978) (to be added). (AWAITING COPYRIGHT APPROVAL)

2. Reproductive Biology

Racomitrium aquaticum is dioicous, bearing male and female reproductive structures on separate plants. It requires water for sexual reproduction. Sporophytes are relatively uncommon (Schofield, pers. comm.).

3. Ecology

Members of the genus *Racomitrium* are typically indicators of acidic conditions (Watson 1971). Despite the rather misleading name, *Racomitrium aquaticum* usually inhabits upland sites away from flowing water. It is typically associated with high moisture and shady conditions. It occurs on rock substrates.

C. Range, Known Sites

Racomitrium aquaticum is a circumboreal and bipolar species. In the Pacific Northwest, it occurs in the Coast and Cascade Ranges and Siskiyou and Klamath Mountains from northern California to Alaska. It has been reported from Benton, Hood River, Lane, Linn and Multnomah counties in Oregon; Clallam, Pierce, Snohomish, and Whatcom counties in Washington; and Del Norte, Humboldt, and Siskiyou counties in California. It is also reported from Europe. On federal land in the range of the northern spotted owl, it is known from the Mt. Hood, Willamette, and Mt. Baker-Snoqualmie National Forests and from the Mt. Rainier and Olympic National Parks.

A total of sixteen sites for *Racomitrium aquaticum* are known, with most based on collections made during the 1960's and 1970's. Only two collections have been made within the last fifteen years.

Figure 2. Known sites of *Racomitrium aquaticum* (to be added).

D. Habitat Characteristics and Species Abundance

Racomitrium aquaticum is often associated with high moisture conditions and substrates. It occurs within forests on moist rocks and boulders in and near streams, springs, waterfalls, on cliff faces and rock outcrops. Although it is often reported from the splash zone, it has also been reported from seasonally dry cliffs and on boulders within forests. Rock substrates include granite and basalt. It occurs in shaded sites, with overstory species including Jeffrey pine, incense cedar, western hemlock, or oak. Within our range, it has been reported from elevations between 610 and 1950 m (2,000 and 6,400 ft.). In British Columbia, *Racomitrium aquaticum* occurs on outcrops and boulders near streams throughout the coastal coniferous forest from sea-level to subalpine elevations (Schofield 1976).

Lawton (1971) considered this species to be rare and Schofield (1976) reports it as infrequent in British Columbia. It is probably undercollected (Schofield, pers. comm.).

II. Current Species Situation

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

Insufficient information was available to rate *Racomitrium aquaticum* at the time of the bryophyte viability panel during the Forest Ecosystem Management Analysis Team assessment. Information available indicated that it was rare in the Pacific Northwest. This species was listed under Survey and Manage Strategies 1 and 3 in the Record of Decision (USDA and USDI 1994) with the goal to maintain viability at known sites and conduct inventories to learn more about the actual extent of its range, abundance, and associations.

B. Major Habitat and Viability Considerations

The major viability considerations for *Racomitrium aquaticum* are loss of populations due to management activities which directly impact the habitat or the population and recreation or human impacts. Widescale flooding, such as that which occurred during the winter of 1995-1996 could scour populations from their rock substrates and the resulting siltation may result in population declines.

C. Threats to the Species

Any upstream activities that could cause siltation could be detrimental to this species where it occurs in water. Erosion and scouring floods could remove species from its substrate. Recreational boating (including kayaking) and recreational gold dredging can also damage mosses in splash zones by abrasion or removal of moss mats. Downstream areas are mostly privately owned, and protection cannot be assured.

D. Distribution Relative to Land Allocations

Two known sites occur within Olympic and Mt. Rainier National Parks. Additional sites are known from the Mt. Hood, Willamette, and Mt. Baker-Snoqualmie National Forests. Further analysis will be necessary to determine the distribution relative to land allocations.

III. Management Goals and Objectives

A. Management Goals for the Taxon

The goal for the management of *Racomitrium aquaticum* is to assist in maintaining species viability.

B. Specific Objectives

- C Maintain integrity of habitat for *Racomitrium aquaticum* at known sites, including moist, shaded conditions and avoid disturbance to rocks, boulders, and cliffs.
- C Maintain high water quality at known sites and avoid burial or coating of leaves by siltation for populations in streams or susceptible to flooding.
- C Minimize recreation-related impacts to known populations.

IV. Habitat Management

A. Lessons from History

The most recent lesson relevant to this species was that provided by the flood of 1995-1996 in the Pacific Northwest. While the impact of these floods on *Racomitrium aquaticum* may remain unknown, it is important to consider stochastic events when developing management guidelines for rare species. If we focus on a minimum number of populations necessary to maintain viability and fail to consider the possible loss of populations due to natural events in as we prepare management prescriptions, extinction probability may be greatly increased. Because this species is known from a broad elevational band, over a large geographic area, it is likely to be less vulnerable to natural stochastic events than a narrow endemic.

B. Identification of Habitat Areas for Management

Most of the known sites have not been visited in the last fifteen years, so it is unknown which sites have viable populations of *Racomitrium aquaticum*. Until populations have been verified, habitat areas for management cannot be prioritized. Until habitat areas are identified, all known sites with either intact habitat suitable for this species and/or living plants of *Racomitrium aquaticum* should be managed according the following guidelines.

C. Management within Habitat Areas

- C Discourage activities that directly disturb or indirectly impact *Racomitrium aquaticum* (e.g., cause sedimentation that could impair photosynthesis). Minimize disturbance of known sites by boaters and miners. Avoid locating boat docks, trail crossings, and foot bridges near known sites. Discourage rock climbing and hiking in the vicinity of known sites.
- C Maintain riparian buffers as prescribed in the Record of Decision in the vicinity of known populations.
- C Maintain microclimate (cool, moist, shaded conditions) of the known sites.
- C Maintain low sediment load in streams with aquatic populations of *Racomitrium aquaticum* to avoid reduction in photosynthesis.

D. Other Management Issues and Considerations

Decline in the water quality may adversely affected aquatic and riparian bryophyte species, such as *Racomitrium aquaticum*. Release of zinc, which is toxic to bryophytes, from galvanized culverts may make habitat inhospitable. Siltation from erosion may also impact aquatic and riparian populations.

V. Research, Inventory and Monitoring Needs

A. Data Gaps and Information Needs

Known populations should be visited and verified. Survey suitable habitat to find new populations on federal land and determine distribution, abundance, and habitat characteristics.

B. Research Questions

- C What is the distribution of *Racomitrium aquaticum*, *R. varium* and *R. pacificum*?
- C Does silt, zinc from culverts, and aquatic pollutants affect growth, reproduction, and mortality of *Racomitrium aquaticum*?

C. Monitoring Needs and Recommendations

Periodically revisit known sites to evaluate population status and document habitat changes that could affect *Racomitrium aquaticum*.

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