An Assessment of the Rare Liverwort *Cryptomitrium tenerum* in Oregon

12/15/2016

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Introduction

Cryptomitrium tenerum (CRTE11), a thallose liverwort, is rare in Oregon where it reaches the northern extent of its range in the western portion of the Rogue River basin. It is more commonly distributed in California and occurs down the west coast having been found in Mexico and as far south as South America.

The objective of this assessment is to:

1. Update data on the one known population in Oregon.
2. Seek new habitat and attempt to locate new populations.
3. Develop a population monitoring strategy/protocol.

An expert in this taxa (David Wagner) was contacted by district botany staff and asked to participate by leading staff to the site and developing and testing a monitoring protocol for a very cryptic species.

Background

A population of CRTE11 was first located by Veva Stansell and Dave Wagner on the Gold Beach Ranger District in April of 1994. It was the first and only known population in the state of Oregon. Subsequently the Oregon Biodiversity Information Center (ORBIC) added the species to the state list of rare and little known bryophyte species. It is currently listed as G4, S1 ORBIC List 2 for the state. At the global scale CRTE11 is apparently secure, being known from at least 100 occurrences across the planet. At the state scale the species is considered critically imperiled due to the fact that there is only one population known. ORBIC List 2 species are considered threatened with extirpation in Oregon but considered secure elsewhere. These are species that are often at the periphery of their natural geographic range, such as the case for CRTE11. Based on the listing of this species by ORBIC it was added to the Forest Service region six sensitive plant list in the early 2000's. No new populations have been discovered in the twenty years prior to this assessment.

Methods

The initial step was to relocate the original population and assess its current status. On April 28, 2015 David Wagner led Gold Beach District Botanist Clint Emerson, three Gold Beach District botanical techs, and a B.L.M., Coos Bay District Botanist (Jennie Sperling), down the Rogue River Trail from the trailhead on the west (downstream) side of Agness, Curry County, Oregon. The rare species assessment site is located along the Rogue River Trail in the vicinity of a bridge over a small, unnamed stream drainage less than a half mile from the trailhead.

The field crew was given a training session on learning to identify the major bryophyte species growing with *Cryptomitrium*. Special emphasis was given to developing a sharp ability to discriminate and pick out the *Cryptomitrium* from the similar species. (A technical description of *Cryptomitrium tenerum* and its status as a sensitive species in Oregon is provided in Appendix 1.)

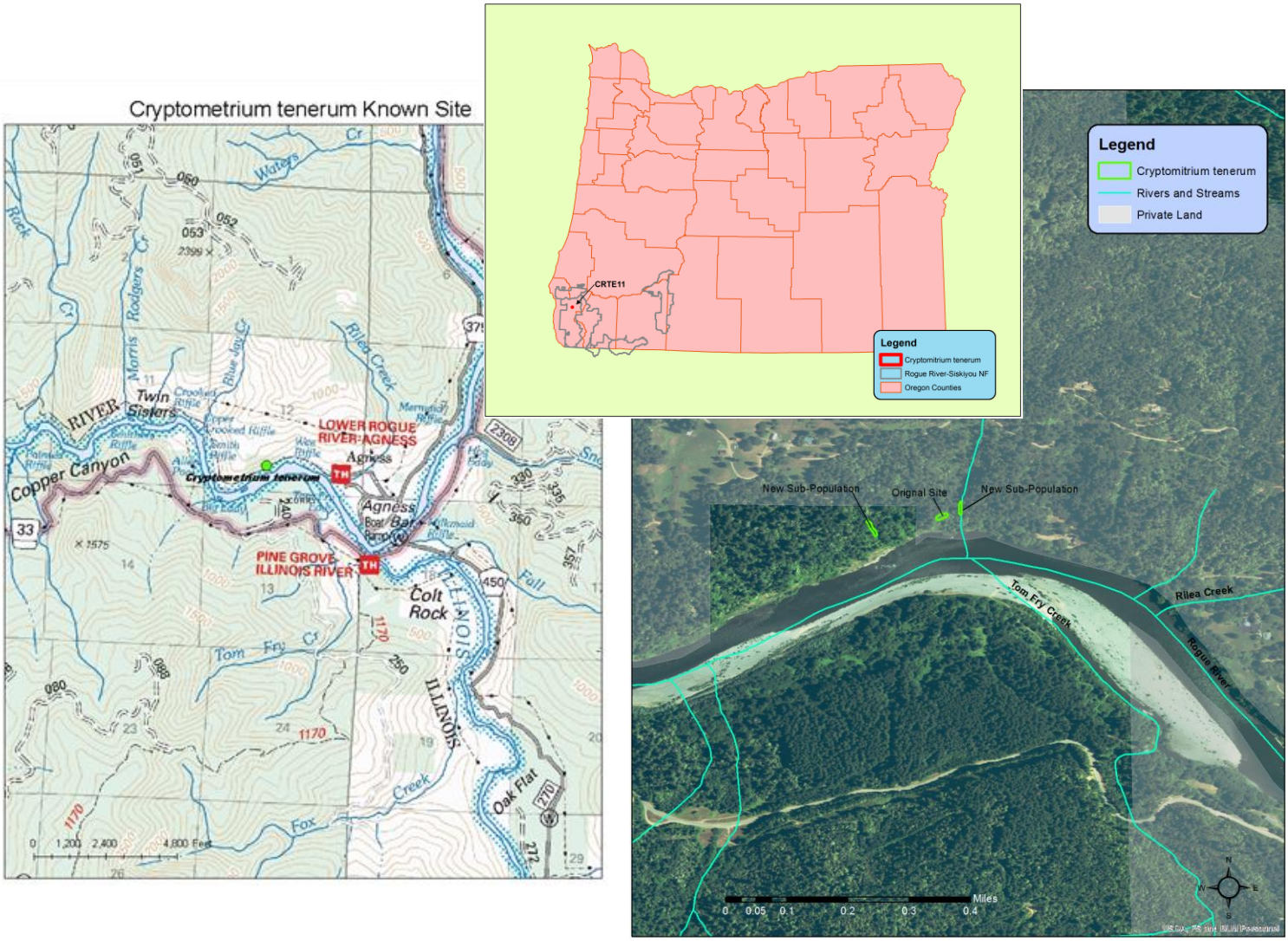

Figure 1. Topo, aerial and statewide overview map showing the location of the one known population of *Cryptomitrium tenerum* in Oregon.

The CRTE11 population was thoroughly searched to locate every single patch of the species, in order to establish microplots for each patch, and complete a 100% inventory of the site.

Discovering, circumscribing, and marking the patches was given careful attention. Every patch of *Cryptomitrium* was assigned a microplot number. Each microplot was marked with a numbered tag, photographed with a field calibration scale, and located along a transect by measuring the distance along a tape originating from an easily relocated geopoint. A total of 36 microplots were defined and processed for analysis.

There are three subpopulations at this locality. The primary, trailside population (Subpop 1. Lat. 42º 33' 30' N; Long. 124º 4' 40" W) is the one first discovered in 1994. It is on the upper side of the trail just past the trail bridge over an unnamed stream in a deep stream valley. It is a stable, compact soil slope that erodes at a rate just fast enough to exclude seed plants but encourage growth of ephemeral bryophytes. The second subpopulation (Subpop 2. Lat. 42º 33' 31' N; Long. 124º 4' 38" W) is on the west side of the creek bank beginning under and extending up the creek from the bridge. This subpopulation was discovered during the thorough inventory conducted at the site. The third subpopulation (Subpop 3. Lat. 42º 33' 28' N; Long. 124º 4' 43"

W) was discovered during a reconnaissance visit to the site on March 2, 2015. It is located on the east side of a small unnamed stream channel that transects the trail about 50 meters downriver from Subpop 1. It extends less than ten meters up the stream from the trail. Results of the microplot inventory are given below.

Associated Species

The forested vegetation at this site is dominated by myrtlewood (*Umbellularia californica*) and tanoak (*Notholithocarpus densiflorus*) which form a dense canopy in the overstory that allows very little light to penetrate through to the moist soil banks that this species colonizes. There are scattered Douglas fir (*Pseudotsuga menziesii*) and an occasional black oak (*Quercus kelloggii)* in the vicinity. The understory is dominated by swordfern (*Polystichum munitum*), fragile fern (*Cystoperis fragilis*) and false brome (*Brachypodium sylvaticum)*. Young myrtlewood sprouts are common in the understory as well. Fragile fern and false brome are prevalent along the moist soil banks directly associated with the CRTE11 population. Of concern is the dramatic increase in false brome documented along the entire Rogue and Illinois Rivers within the past five years. There is potential for this invasive grass species to colonize existing and potential substrate where CRTE11 occurs.

More bryophytes are associated with *Cryptomitrium tenerum* on the trail bank than in the stream bank sites. A list was made and abundance of each species recorded:

MOSSES
Claopodium whippleanum (A)*
Atrichum selwynii (F)
Fissidens crispus (O)
Leucolepis acanthoneura (F)
Scleropodium touretii (O)
Timmiella crassinervis (O)
LIVERWORTS
Lunularia cruciata (O)
Asterella bolanderi (S)
Targionia hypophylla (S)
HORNWORTS
Phaeoceros pearsonii (S)
Anthoceros fusiformis (S)
Phymatoceros bulbiculosus (S)
(*Abundance codes: T=trace; S=sparse; O=occasional; F=frequent; A=Abundant)

Figure 2. General habitat photo

Small samples of difficult to identify species were collected for microscope study in the laboratory. For such species the samples were required for positive identification. Curated voucher specimens will be deposited in the herbarium of Oregon State University.

Additional Inventories

Two days were spent searching for potential habitats and giving a closer examination of those sites believed to be potential habitats. The first day was focused on the Rogue River Trail upstream from Agness, which we considered the most likely place to find additional populations of *Cryptomitrium*. Dave Wagner had explored downstream some years earlier and no potential

habitat was encountered in that direction. Exploring south towards California, where the species is more common, was the objective of the second day.

April 29, 2015 was spent hiking up the Rogue River Trail above Agness, beginning at the Foster Bar Trailhead. The trailside was examined carefully in promising sites, along the ±2.5 miles above the trailhead. Five side stream valleys were searched thoroughly within varying distances above and below the trail. They are located on the map below, indicated by numbers in pink dots, in order of our travel. Three important bryophyte sites are also plotted on the map, indicated by collection number over a pink dot.

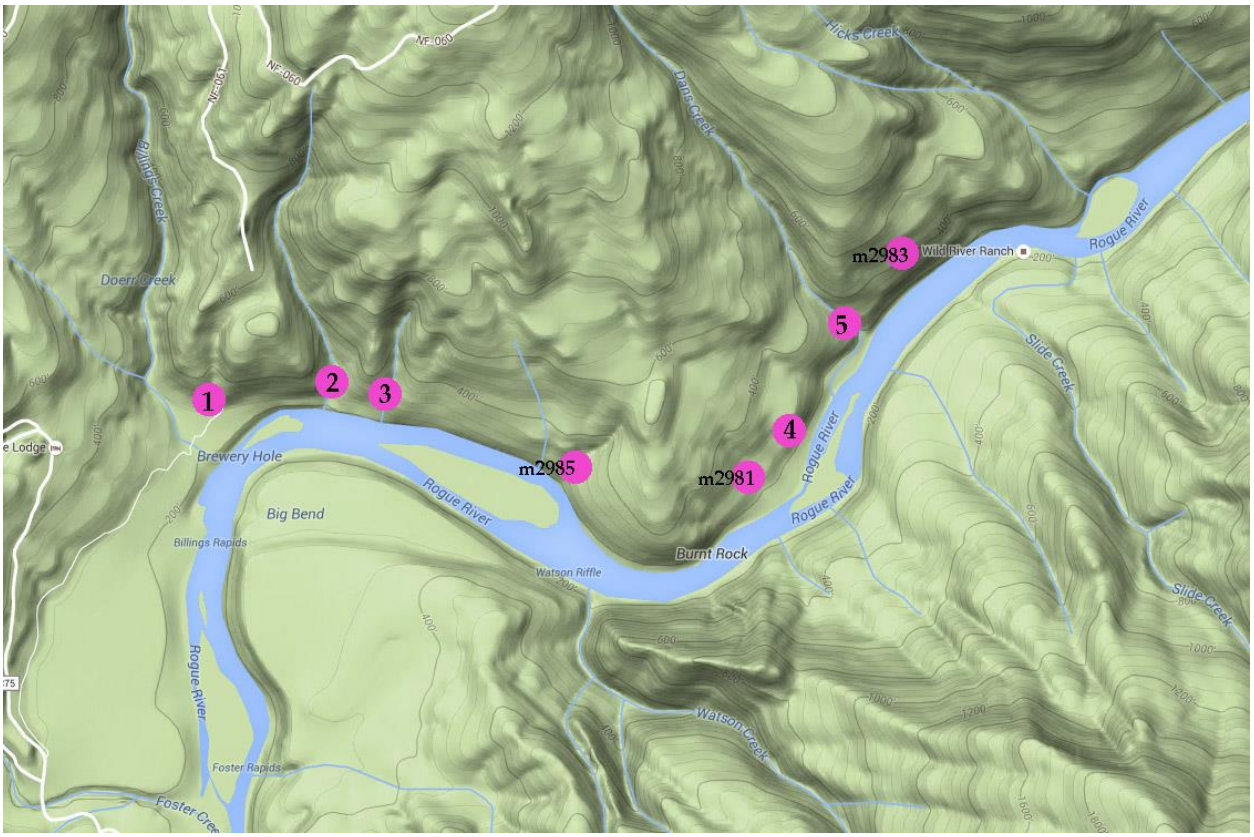

Figure 3. Additionally surveyed areas above Agness, Oregon along the Rogue River

The character of the five streams searched, with comments are:

1. Small, open valley with very little bare stream bank. Searched up ~ 25 meters.
2. Fairly wide valley, again with little soil banks. Searched ~ 50 meters above trail.
3. Promising looking stream, searched ~ 70 meters above trail and 20 m below trail. Good habitat along trail side here, too.
4. Small, steep stream valley. Searched 25 meters above trail.
5. Dans Creek, a major tributary named on map. Searched ~75 m upstream.

The three interesting collections of rare plants, listed by Wagner collection number, are:

m2981 *Riccia californica*. This is very rare in Oregon, with only one, unvouchered, historical record from the state.

m2983 *Asterella bolanderi*. This rare species had been previously known only from a Veva Stansell collection from along the Rogue River Trail a short distance downstream from Marial and a D. Stone collection from Klamath County. We found that it occurs at the *Cryptomitrium tenerum* site and also along the trail between that site and Agness.

m2985 *Phymatoceros bulbiculosus*. This is a rare hornwort listed as sensitive by the Oregon Biodiversity Information Center. It was found also at the *Cryptomitrium* site, adding another significant element to the site.

Figure 4. *Riccia californica* All photos here by Dave Wagner

Figure 5. *Asterlla bolanderi* carpocephalum

Figure 6. *Riccia californica* spores

Figure 7. *Phymatoceros bulbiculosis*

Our search up the Rogue River Trail ended on the ridge overlooking Hicks Creek, where it became clear that further hiking involved steep up and down stretches through habitat not promising.

On April 30, 2015 areas in the Winchuck River area were explored for potential new sites. It was felt that this part of the state, between the Rogue River *Cryptomitrium* locality and the California state line, might be likely to harbor other populations of *Cryptomitrium*. We wanted to explore the trail along Wheeler Creek, a tributary to the Winchuck River, but unfortunately it proved to be impassable beyond a quarter of a mile or so because of a massive slide and tree fall that blocked the trail. After returning to the Winchuck River road we walked up that road for some distance above Wheeler Creek before concluding that suitable habitat was not likely to be found in that vicinity. The forested hillsides did not display any of the open, grassy slopes that were characteristic of the habitats along the Rogue River. The only significant find was a healthy population of *Scouleria siskiyouensis* in the streambed of Wheeler Creek near our farthest reach. This moss is a recently described endemic of southwestern Oregon.

The results of the explorations were negative in that no additional populations of *Cryptomitrium* were found on either expedition. The most likely prospect for finding new populations appears to be exploring further up the Rogue River Trail from Agness to Marial.

Monitoring

Microplot establishment was briefly described above. Location of the microplots within Subpop 1 were recorded by distance from the closest corner of the bridge adjacent to the site. The closest corner (SW corner) of the bridge was used because of the ease in relocating and re-measuring. Microplots of Subpop 2 were recorded by distance along a tape originating on the upstream edge of the bottom of the bridge. Microplots of Subpop 3 were measured from the middle of a single large alder at trailside next to the stream crossing.

Photographs of 36 microplots were taken. Data analysis images were prepared from the best images, in some cases by merging separate images after adjusting scales to match. A protocol for preparing an image of each microplot for analysis was developed and applied using PhotoShop:

1. Crop the picture to get the field scale, or at least half of it, parallel with a border of the image. A larger scale was then pasted into the image after calibrating it with the field scale.
2. A pink dot was placed on every fruiting stalk that could be reliably identified. A count of carpocephala should be a good way of accessing reproduction in the population. It shows differences in reproductive capacity of the various subpopulations. Only carpocephala which could be recognized fairly well in the photographs were marked. The count will be an underestimate as field tallying would give higher numbers by including ones which were not clear in the photographs.
3. Draw a yellow circle that outlines the extent of the colony. The outline is fairly generous because it is hard to always be sure what's *Cryptomitrium* and what are thalli of other species. The idea was to overestimate rather than underestimate the aerial extent of the colonies. This outline could be used with software that calculates aerial extent of irregular shapes. The experience of Dave Wagner was relied upon to distinguish between *Cryptomitrium* thalli and thalli of other liverworts, such as *Asterella*, *Targionia*, and *Lunularia,* and various hornworts.

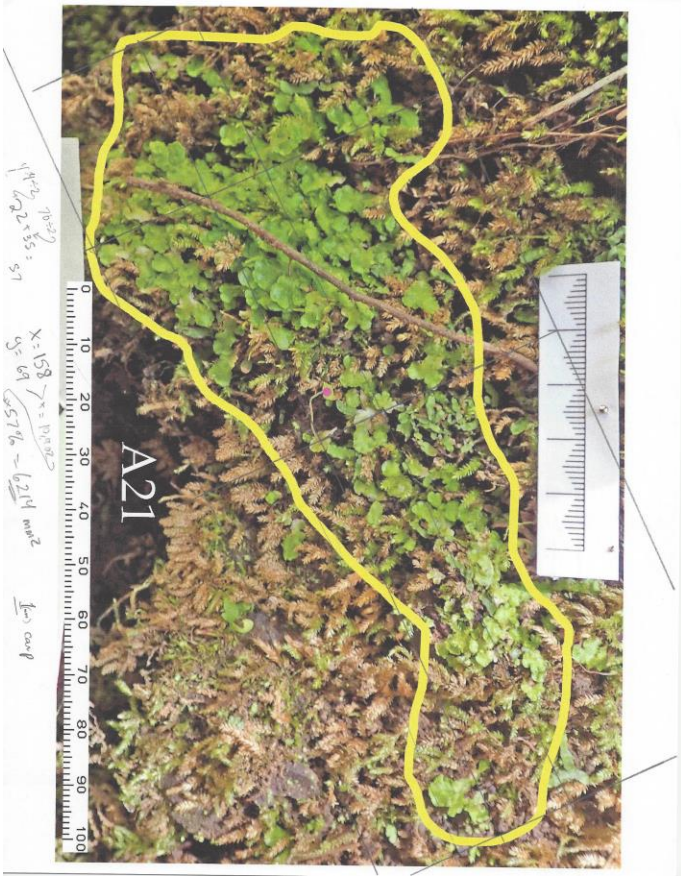

Figure 8. Examples of microplot images that were analyzed
Photos: Dave Wagner

Calculations were made using a print of each microplot. A rectangular box was drawn around each colony outline. The length and width of each box was measured and recorded in millimeters. Area of the box was calculated and multiplied by an estimate of the percent of the box occupied by the outline. Computer software that calculates area of irregular shapes will give more accurate results but the estimates should be useful with only a small margin of error. In some cases several outlines were made on a single microplot. In these cases the sum of all outlines was recorded. An excel table was populated with the data from all 36 individual microplots. The data is included in this report in Appendix 2.

Summary of the microplot data:

	Microplots	Area in mm^2	Carpocephala
Subpop 1	14	79,085	107
Subpop 2	13	70,179	92
Subpop 3	7	39,677	6

Conclusion

These data show that the total aerial extent of *Cryptomitrium* in Oregon, adding together all microplot coverage calculations, would cover an area no more than 0.18 square meter, or less than two square feet. The highest concentration of fruiting structures (carpocephala) is greatest

in Subpop 1, the sunniest of the subpopulations. This monitoring data is a testament to how rare this thallose liverwort appears to be within the state.

It seems likely that more populations will be found in the SW corner of the state where a Mediterranean driven climate persists. Unfortunately no new populations of CRTE11 were discovered during this assessment, although several other rare liverworts and hornworts were incidentally found. All new sites were entered into the TESP-IS database and serve as a permanent record for these populations.

The Rogue River-Siskiyou National Forest botany staff will attempt to replicate the monitoring protocol established through this assessment no later than 2020. Additional inventory work will occur as funding and time permit

Appendix 1. In depth description of *Cryptomitrium tenerum* (Hooker) Austin and its habitat

Recent synonyms: none
Common name: flying saucer liverwort
Summary — A ribbon-like thalloid liverwort with several chloroplasts per cell and heterogenous thallus tissues. Terrestrial.
Diagnostic characters: *Cryptomitrium tenerum* is distinguished by its (1) thalloid habit, (2) small size and habitat on bare soil, (3) receptacles that are hemispheric when young but spread out into flat discs when mature, and (4) spherical sporangium opening by a distinct operculum.
Technical description

THALLOID LIVERWORT. **Plants** pale green on dorsal surface, thin and delicate, 0.5–1.5 cm long, 3–10 mm wide, dichotomously branched; margins undulate and upcurved when dry; dorsal surface with pattern of irregular polygons, pores to air chambers inconspicuous, epidermal cells without thickenings at corners (trigones); ventral surface dark purple and shiny at margins, green medially; ventral scales small, dark purple, poorly developed at maturity; oil bodies occasional, scattered in isolated cells. Gemmae lacking.

Paroicous. Male ostioles (tubular neck with opening of the antheridial cavity) sessile, posterior to archegoniophores. Archegoniophore elongating after fertilization to 1.5–3 cm tall, somewhat grooved, transparent to brownish purple at base. Carpocephalum a circular disc to 5 mm in diameter, convex, hemispheric when very young but expanding to a flat, crenulate or irregularly undulate margined disc as it develops, then becoming rounded and puffy below as sporangia mature. Sporangia 3–7 per receptacle, spherical, brown, with very short setae, opening by a distinct operculum.

Similar species — Other medium-sized thalloid liverworts such as *Asterella*, *Mannia*, and *Reboulia* all have thicker thalli and lobed receptacles.
Ecology — *Cryptomitrium tenerum* occurs in Mediterranean climates with cool wet winters and dry summers and forms small to locally extensive mats on bare and usually shaded humid soil on hillsides, rock outcrops, and streambanks. In Oregon, *C. tenerum* is known from between sea level and 1,000 feet in elevation and in California usually below 2,500 feet, although known from sites up to 3,900 feet. Root balls and cutbanks are favored forest habitats, with forest types ranging from *Abies amabilis, Pseudotsuga menziesii*, and *Tsuga heterophylla* associations. *Cryptomitrium tenerum* is reportedly a calciphile (Doyle and Stotler 2006). Some habitat disturbance is probably necessary to maintain open conditions and reduce competition from vascular plants. Wild fires are suspected to play a role in maintaining habitat. Capsules develop in late winter to early spring, depending on elevation. It is a poor competitor with vascular plants and populations tend to disappear as succession progresses.
Distribution — *Cryptomitrium tenerum* is known from Asia and North and South America. In western North America, it is known from Oregon, California, and Mexico. In Oregon, ORBIC reports *C. tenerum* from Curry County within the Klamath Mountain ecoregion.
References with descriptions and/or illustrations — Doyle and Stotler (2006, p. 104), Wilson (2005), Schofield (2002, p. 93), Frye and Clark (1937, p. 69), Clark and Frye (1928, p. 16), Evans (1923, p. 46).
Reference with photos — Wagner (2014).
Extracted from: "Rare Bryophytes of Oregon." by Ron Exeter, Judy Harpel, and David Wagner; anticipated publication in late 2015.

Appendix 2. Microplot data for *Cryptomitrium tenerum* monitoring.

Microplot	Area (mm^2)	Carpocephala	Tape position	Tape position notes
Subpop 1				
A1	49	1	11.450	From bridge end
A2	739	3	16.520	From bridge end
A3	8730	32	16.950	From bridge end
A4	2209	9	17.000	From bridge end
A5	1306	14	17.000	From bridge end
A6	10751	5	18.150	From bridge end
A7	6413	7	15.650	From bridge end
A8	450	2	19.190	From bridge end
A9	9860	7	19.200	From bridge end
A10	1148	1	19.200	From bridge end
A11	1521	3	11.250	From bridge end
A12	565	1	11.250	From bridge end
A13	1395	2	14.000	ditto, above trail ~12 m
A14	33540	17	8.055	From bridge end
A15	410	3	19.750	From bridge end
subtotal	**79086**	**107**		
Subpop 2				
A16	976	5	-0.350	under bridge
A17	5490	5	-0.250	under bridge
A18	10489	3	0.000	edge of bridge
A19	11375	7	0.550	upstream from bridge
A20	3367	5	0.700	upstream from bridge
A21	6214	1	0.850	upstream from bridge
A22	4036	18	0.900	upstream from bridge
A23	3105	5	0.780	upstream from bridge
A24	6648	8	1.050	upstream from bridge
A25	4617	8	1.500	upstream from bridge
A26	10710	21	1.800	upstream from bridge
A27	157	2	6.140	upstream from bridge
A28	2995	4	2.000	upstream from bridge
subtotal	**70179**	**92**		
Subpop 3				
A30	4090	0	3.500	from middle of trailside alder
A31	2142	0	3.610	from middle of trailside alder
A32	3240	0	5.070	from middle of trailside alder
A33	8452	1	5.780	from middle of trailside alder
A34	3444	0	6.060	from middle of trailside alder
A35	17079	4	7.400	from middle of trailside alder
A36	1230	1	0.000	from middle of trailside alder
subtotal	**39677**	**6**		
Grand Total	**188942**	**205**		