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REPORT ON THE CONSERVATION STATUS OF Trisetum orthochaetum, A CANDIDATE ENDANGERED SPECIES

Taxon name:	<u>Trisetum orthochaetum</u> Hitchcock
Common name:	Missoula County oats, Bitterroot trisetum
Family:	Poaceae (Gramineae)
State where taxon occurs:	U.S.A., Montana
Current federal status:	USFWS Notice of Review, Category 2*
Recommended federal status:	USFWS Notice of Review, Category 2
Author of Report:	J. Stephen Shelly
Original date of report:	31 October 1986
Date of most recent revision:	N/A
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1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. This is essential for ensuring transparency and accountability in the organization's operations.

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I. SPECIES INFORMATION

1. Classification and nomenclature.

A. Species.

1. Scientific Name.

a. **Binomial:** Trisetum orthochaetum A. S. Hitchcock.

b. **Full bibliographic citation:** Hitchcock, A. S. 1934. New species, and changes in nomenclature, of grasses of the United States. Amer. J. Bot. 21: 134-135.

c. **Type specimens:** Holotype: Boggy meadow, Bitterroot Mountains, alt. 1200 meters, near Lolo Hot Springs, Missoula County, Montana, July 23, 1908, Agnes Chase 5129, US (1535753).

Topotype: Boggy meadow, Lolo Hot Springs, elev. 1220 m, Missoula Co., Montana, July 9, 1951, LeRoy H. Harvey 4461, MONTU (MONT 36626).

2. **Pertinent synonyms:** None.

3. **Common names:** Missoula County oats, Bitterroot trisetum.

4. **Taxon codes:** PMP0A690A0 (Montana Natural Heritage Program).

5. **Size of genus:** About 75 species, in the temperate to cold regions of both hemispheres; nine species are reported for the United States (Gould and Shaw, 1983).

B. Family classification.

1. **Family name:** Poaceae.

2. **Pertinent family synonym:** Gramineae.

3. **Common name for family:** Grass Family.

C. **Major plant group:** Monocotyledoneae.

D. **History of knowledge of taxon:** Prior to 1986, Trisetum orthochaetum had been collected only twice, first in 1908, and subsequently in 1951. The first collection was made near Lolo Hot Springs, in Missoula County, Montana, by Agnes Chase; this specimen became the holotype when A. S. Hitchcock described it as a new species in 1934. Dr. LeRoy H. Harvey made the next

collection, again from the vicinity of Lolo Hot Springs, in 1951. In a note written to the University of Montana Herbarium (P. Lesica et al.; Appendix A, p. 33) on 13 January 1986, Dr. Harvey related the following:

I had the advantage of talking to both Mrs. Chase and the man who guided her on that trip on which the holotype of this species was collected. Their information was very general to wit - boggy meadow, Lolo Hot Springs. My specimen came from the north side of the road about 1000 yds. above the swimming pool in an area which was destroyed not more than a few years later when some construction was done nearby.

Since this last collection, the Lolo Hot Springs area has been extensively developed, and despite intensive searching in the immediate area, the taxon has not been relocated there. The Lolo Hot Springs area has been searched by a number of botanists, including Dr. C. Leo Hitchcock, Klaus Lackschewitz, Peter Lesica, and Dr. Thomas Watson. Some of these searches also included the meadow areas just south of the hot springs, and areas in the nearby Lee Creek and E. Fork Lolo Creek drainages (P. Lesica, pers. comm.). Hitchcock et al. (1969) speculate about the possible extinction of the taxon: "(a)ttempts to recollect this plant have been unsuccessful, and it is assumed that the "boggy meadow" in which it was collected has been so altered that other plants of this nature (if such ever existed) have been destroyed." Thus, Trisetum orthochaetum has been listed by the U.S. Fish and Wildlife Service (U.S. Department of Interior, 1985) as a C2* taxon (Category 2 taxon which is possibly extinct).

In 1985, the Montana Natural Heritage Program (MTNHP) was contracted by the U.S. Fish and Wildlife Service, with funds appropriated under Section 15 of the Endangered Species Act, to conduct a status survey of this taxon (Order No. 60181-2197-5). In July, 1986, field surveys were conducted by the author, with assistance from Ginger V. King, a volunteer for MTNHP. [Areas surveyed included the Lolo Hot Springs vicinity, and meadow areas in four adjacent drainages: East Fork Lolo Creek, West Fork Lolo Creek, Lee Creek, and Granite Creek, all in Missoula County, Montana. In addition, two areas in the Packer Meadows vicinity, in adjacent Idaho County, Idaho, were surveyed. Though not relocated near Lolo Hot

paper

3.5-5.0

Springs, Trisetum orthochaetum was rediscovered in the Granite Creek drainage, in an area approximately 2.2-3.1 air miles southwest of Lolo Hot Springs. All data and photos are from 1986, except where noted.

- E. **Comments on current alternative taxonomic treatments:** There are no current alternative taxonomic treatments.
2. **Present legal or other formal status.**
- A. **International:** None.
- B. **National.**
1. **United States.**
- a. **Present designated or proposed legal protection or regulation:** U.S. Fish and Wildlife Service: Currently, the taxon is under notice of review for listing as an endangered species under the U.S. Endangered Species Act of 1973-1983 (U.S. Department of Interior, 1985). Specifically, it is listed in Category 2* (taxa for which information now in possession of the Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threats are not currently known or on file to support the immediate preparation of rules, and which are possibly extinct).
- b. **Other current formal status recommendations:** The taxon is currently listed as "critically endangered throughout range, with taxonomic questions/problems involved" (global rank = G1Q) (MTNHP, 1986). Listed as "Endangered" by Ayensu and DeFilippis (1978).
- c. **Review of past status:** The taxon was originally listed as "Probably Extinct" by the U.S.F.W.S. (U.S. Department of Interior, 1975). It was subsequently listed as Category 2* in the earlier Notice of Review (U.S. Department of Interior, 1980).

C. State.

1. Montana.

- a. Present designated or proposed legal protection or regulation: None.
- b. Other current formal status recommendations: The taxon is currently listed as "critically endangered in Montana, with taxonomic problems/questions involved" (state rank = S1Q) (MTNHP, 1986).
- c. Review of past status: Previously listed as "extinct" by the Montana Rare Plant Project (Lesica et al., 1984).

3. Description.

- A. General nontechnical description: A slender grass, about 3 feet tall, with floral parts which are greenish in color, and which often have a purplish tinge. The plants have a flowering head which is narrow and slightly arching, or occasionally somewhat open, and about 5 1/4 - 6 1/2 inches long. Usually growing in clumps of 2-15 stems, but occasionally found as single-stemmed plants. The leaf blades are about 1/8 - 5/16 inches wide. Spikelets generally have 2 or 3 florets, and are about 1/4 - 7/16 inches long. Awns are present on the florets, and are about 1/8 - 3/16 inches long. Flowers during July, with spikelets persisting into the first half of August.
- B. Technical description: Perennial; caespitose and short-rhizomatous, or culms solitary, erect, slender, about 3-noded, 8-11 dm tall; sheaths glabrous to scabridulous above, often with a ring of short, white hairs (sometimes obscure) just above the nodes; blades flat, rather thin, scabrous, 8-20 cm long, 3-7 mm broad; ligules thin, truncate or rounded, erose-ciliolate and slightly pubescent, 3-5 mm long; panicle long-exserted, nearly upright to somewhat nodding, narrow to slightly open, 13-18 cm long, pale green, slightly tinged with purple, the axis glabrous below, scabrous above, the branches scabrous, filiform, loosely ascending, in somewhat distant fascicles, naked below, as much as 8 cm long; spikelets short-pedicled and somewhat appressed along the branches, usually 3-flowered (the third floret sometimes reduced), 8-9 mm long excluding awns, the rachilla appressed-silky, often continued beyond the third floret; glumes

acuminate, scabrous on the keel, the first slenderly acuminate and 5.5-6 mm long, the second broader, about 6.3 mm long, about equalling the first floret but shorter than the second and third; lemmas rounded on the back, obscurely 5-nerved, very minutely scabrous on the upper part, the summit acute or subacute, slightly erose-toothed, about 5-6 mm long, awned from the back about 1-2 mm below the summit, the awn straight or only slightly geniculate, 3-6 mm long; palea narrower and shorter than the lemma; bearding of the callus about 0.5 mm long, that of the rachilla about 1 mm long; the first floret about 6 mm long, the second slightly shorter, the third floret often reduced or absent; anthers about 1 mm long, apparently non-functional (adapted from Hitchcock, 1934; Hitchcock et al., 1969).

- C. **Local field characters:** At every known location, Trisetum orthochaetum is found growing in close proximity with two other Trisetum species: T. canescens and T. wolfii. These taxa are most readily distinguished by awn features; T. wolfii lacks any awns on the lemmas, at least in the region covered in this study, while T. canescens has long awns (ca. 10-14 mm), which are geniculate in maturity. In contrast, T. orthochaetum has awns which are about 3-6 mm long, and are straight or become only slightly geniculate. In addition, T. wolfii most often has only two florets per spikelet in the area of study, while the other taxa generally have three (the third floret is often reduced in T. orthochaetum). A small ring of white hairs can be found on the sheaths, just above the upper nodes, in T. canescens and T. orthochaetum, but is absent in T. wolfii. The inflorescences vary in their degree of arching; T. wolfii generally has a strictly upright inflorescence, while T. canescens has an inflorescence which is often completely nodding. In contrast, the inflorescence of T. orthochaetum is frequently intermediate, being arched but not completely drooping. Distinguishing features of the seedlings of these species, if any, are unknown. These grasses are members of dense graminoid communities, and careful surveys are necessary to locate and identify them.
- D. **Identifying characteristics of material which is in interstate or international trade or commerce:** No interstate or international trade or commerce known.

E. **Photographs and line drawings:** Figure 1 provides copies of the illustrations of this taxon, taken from Hitchcock (1950) and Hitchcock *et al.* (1969). The color slides (p. 8) are duplicates of those taken at the Granite Creek South site (occurrence no. 002). Additional slides of the Lolo Hot Springs area, and of *Trisetum wolfii* and *T. canescens*, are housed at the MTNHP office in Helena, MT.

4. Significance.

A. **Natural:** Though taxonomically distinct in its characteristics, the evolutionary significance of *Trisetum orthochaetum* has been, and remains, obscure. This is owing to the apparently hybrid nature of the taxon, which is discussed at length in the appropriate section (p. 20). The taxon does not appear to have any peculiar ecological adaptations or structures; nor does it have any apparent obligate relationships with other species, or roles in stabilizing landforms. Although currently known only from a very limited geographic area, it is reasonable to speculate that the taxon may occur in other locales where the putative parents are biotically sympatric. The ranges of those two *Trisetum* species (*T. canescens* and *T. wolfii*) overlap in a broad area over much of the Pacific Northwest (Hitchcock, 1950).

B. **Human:** *Trisetum orthochaetum* is of potential scientific significance in any study of the biosystematic relationships among congeneric taxa, especially the relationships of the two putative parental species. The probable hybrid origin of *T. orthochaetum* provides a way of studying the degree of genetic divergence among the related taxa. Questions addressing possible polyploidy among these taxa would also be of scientific interest. Otherwise, *T. orthochaetum* has no agricultural, economic, horticultural, or other currently known human uses or significance, owing to its rarity and relative obscurity.

5. Geographical distribution.

A. **Geographical range:** *Trisetum orthochaetum* is known, historically and currently, only from a small area in extreme southwestern Missoula County, Montana, U.S.A. (Figure 2, p. 9). Two previous collections (1908, 1951) were in close proximity to Lolo Hot Springs (occ. no. 001). The currently known sites (consisting of eight small clusters) are grouped into three occurrences (002-004), all of which are in the Granite Creek



FIGURE 388.—*Trisetum orthochaetum*. Panicle, X 1; glumes and floret, X 5. (Type.)

From Hitchcock (1950).

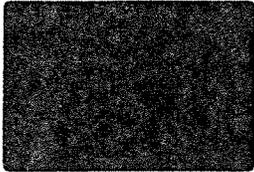


T. orthochaetum

Floret (left), spikelet (right); from Hitchcock et al. (1969).

FIGURE 1.

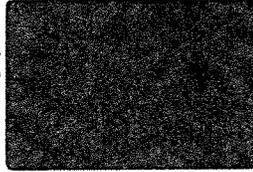
Kodak
COLOR SLIDE DUPLICATE



MTNHP
RMP0A69ΦAΦ
ΦΦ2

PROCESSED BY
Kodak

Kodak
COLOR SLIDE DUPLICATE



MTNHP
RMP0A69ΦAΦ
ΦΦ2

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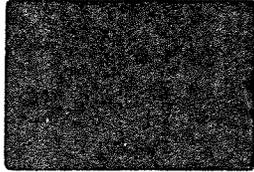
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MTNHP
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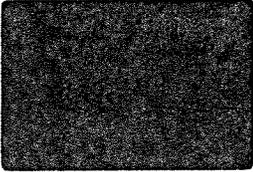
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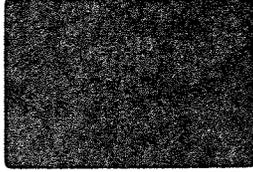
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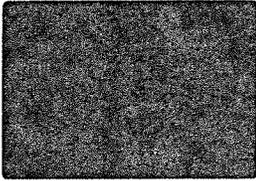
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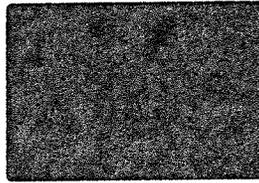
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STEVE SHELLY OCT 86P16
TRISETUM ORTHOCHAETUM



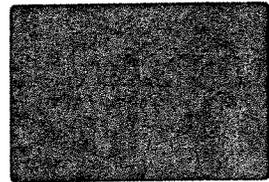
GRANITE CREEK SOUTH
T11N R24W S15

STEVE SHELLY OCT 86P16
TRISETUM ORTHOCHAETUM



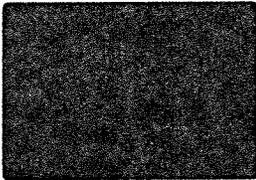
GRANITE CREEK SOUTH
T11N R24W S15

STEVE SHELLY OCT 86P16
TRISETUM ORTHOCHAETUM



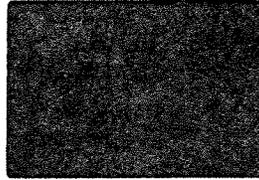
GRANITE CREEK SOUTH
T11N R24W S15

STEVE SHELLY OCT 86P16
TRISETUM ORTHOCHAETUM



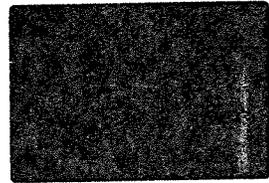
GRANITE CREEK SOUTH
T11N R24W S15

STEVE SHELLY OCT 86P16
TRISETUM ORTHOCHAETUM



GRANITE CREEK SOUTH
T11N R24W S15

STEVE SHELLY OCT 86P16
TRISETUM ORTHOCHAETUM

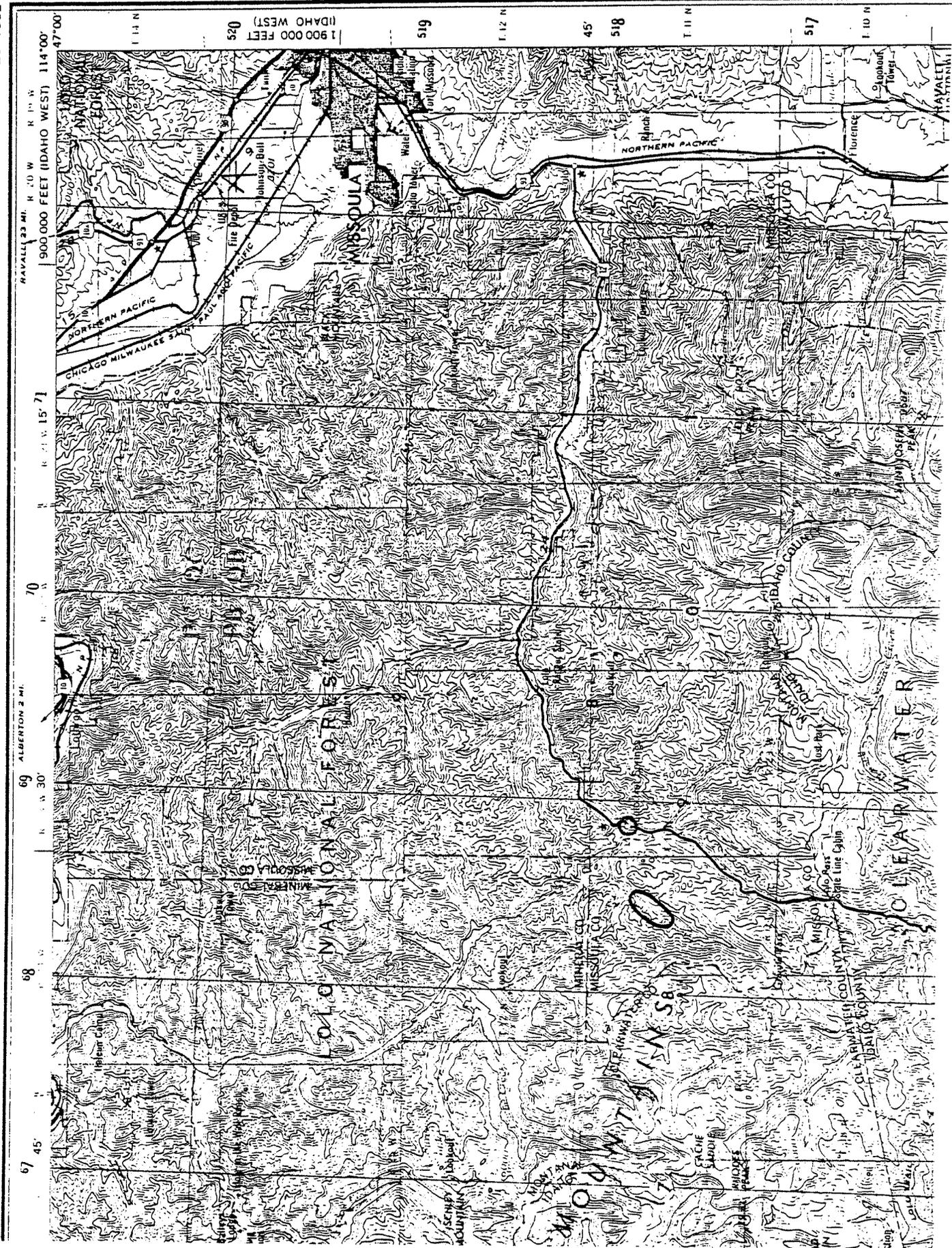


GRANITE CREEK SOUTH
T11N R24W S15

FIGURE 2. Geographic range of Trisetum orthochaetum A.S. Hitchcock, Montana, U.S.A.

NL 11-6
SERIES V502

EDITION 3



drainage, southwest of Lolo Hot Springs.

B. Precise occurrences.

1. Populations currently known extant (Figure 3, p. 10a).

- a. Granite Creek South (occ. no. 002)
 - 1. Montana, Missoula County.
 - 2. 46°42'26"N, 114°35'35"W, 4480 ft.
 - 3. T11N, R24W, Section 15, E½SE¼.
 - 4. USGS Quad: Lolo Hot Springs (7.5 minute series, 1964).
 - 5. Granite Creek drainage, ca. 3.1 air mi. sw. of Lolo Hot Springs, 0.13-0.15 air mi. e. of Granite Creek Rd. (Lolo N.F. Rd. 9942), ca. 2 mi. s. of jct. with Rd. 4209.

- b. Granite Creek Central (occ. no. 003)
 - 1. Montana, Missoula County.
 - 2. 46°42'47"N, 114°35'20"W, 4460 ft.
 - 3. T11N, R24W, Section 14, W½NW¼.
 - 4. USGS Quad: Lolo Hot Springs (7.5 minute series, 1964).
 - 5. Granite Creek drainage, 2.8 and 2.6 air mi. wsw. of Lolo Hot Springs, 0.21 and 0.16 air mi. e. of Granite Creek Rd. (Lolo N.F. Rd. 9942), ca. 1.3-1.7 mi. s. of jct. with Rd. 4209.

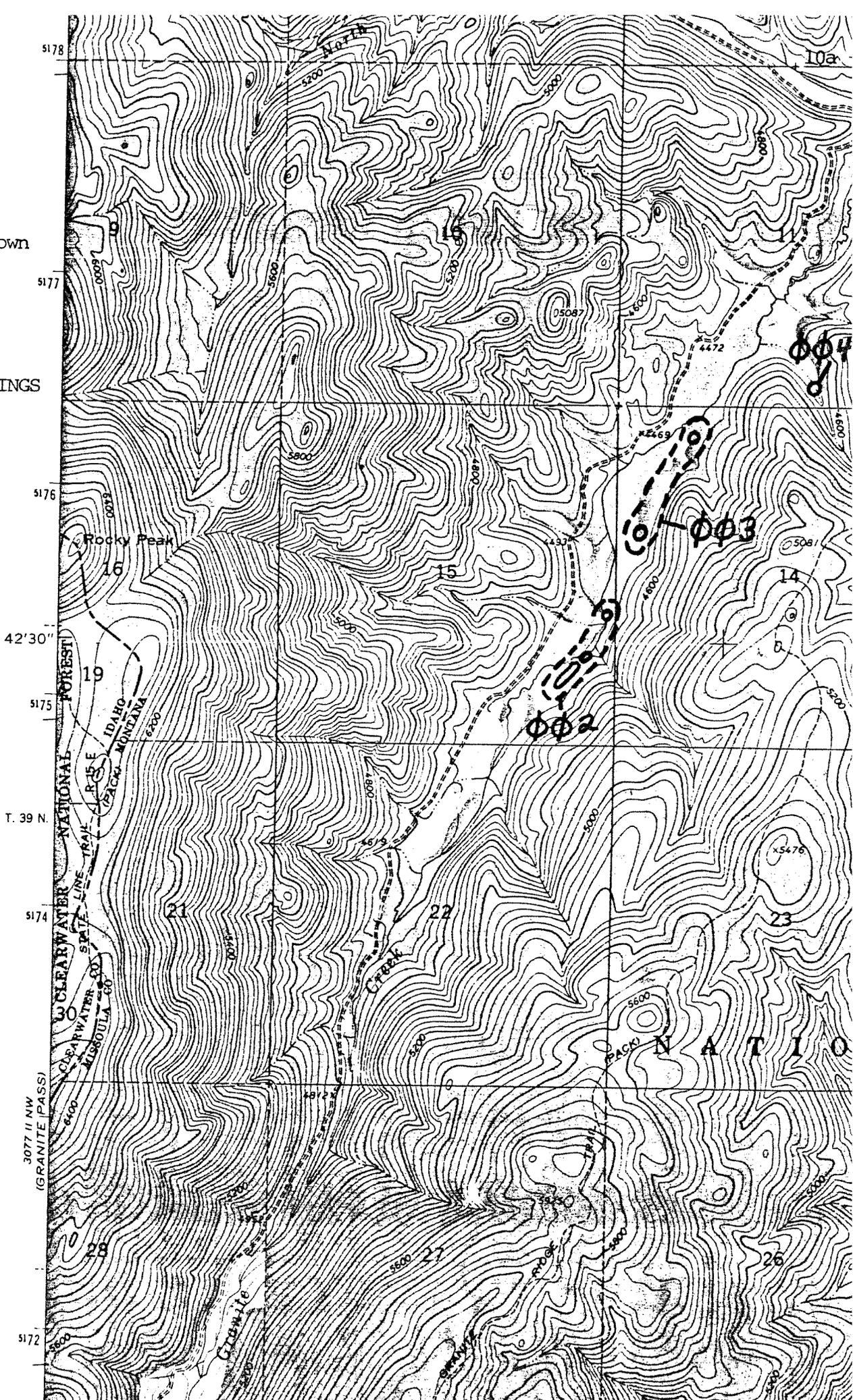
- c. Granite Creek North (occ. no. 004)
 - 1. Montana, Missoula County.
 - 2. 46°43'11"N, 114°34'41"W, 4510 ft.
 - 3. T11N, R24W, Section 11, SW¼SW¼.
 - 4. USGS Quad: Lolo Hot Springs (7.5 minute series, 1964).
 - 5. Granite Creek drainage, 2.2 air mi. wsw. of Lolo Hot Springs, 0.40 air mi. e. of Granite Creek Rd. (Lolo N.F. Rd. 9942), ca. 0.9 mi. s. of jct. with Rd. 4209.

2. Populations known or assumed extirpated (Figure 4, p. 11).

- a. Lolo Hot Springs (occ. no. 001)
 - 1. Montana, Missoula County.
 - 2. 46°43'29"N, 114°31'54"W, 4180 ft.
 - 3. T11N, R23W, Section 07, E½.
 - 4. USGS Quad: Lolo Hot Springs (7.5 minute series, 1964).
 - 5. Lolo Hot Springs, Bitterroot Mountains (U.S. Hwy. 12, ca. 26 mi. w. of Lolo).

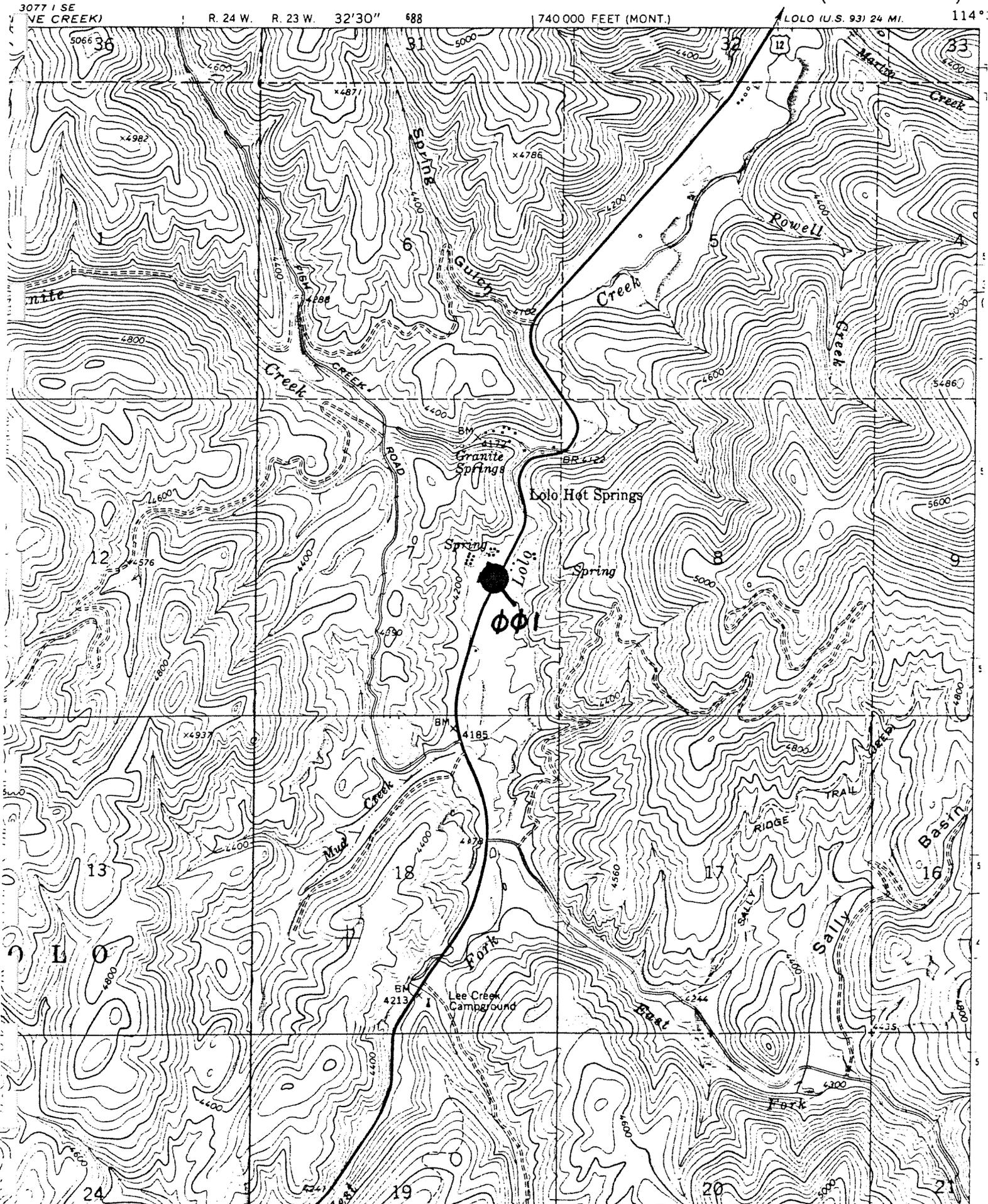
FIGURE 3.
Populations
currently known
extant.

LOLO HOT SPRINGS
QUADRANGLE



LOLO HOT SPRINGS QUADRANGLE
MONTANA-IDAHO 11
7.5 MINUTE SERIES (TOPOGRAPHIC)

FIGURE 4. Population known or assumed
extirpated.



6. Explanation: This site is the type locality for the taxon. Since 1951, the area has been extensively developed (see I.1.D., p. 1), including construction of a campground, restaurant, rodeo ground, large parking areas, swimming pool, etc. Only small meadows are still present in the area, and these are largely dominated by introduced species now (i.e., Phleum pratense). The taxon has been intensively searched for in the vicinity, as discussed, but has never been relocated. Owing to these factors, it is highly likely that the plants were originally very rare at this location, and were extirpated during the course of development and highway construction over the last 35 years.
3. Historically known populations where current status not known: None.
 4. Locations not yet investigated believed likely to support additional natural populations: Montane meadows similar to those with which Trisetum orthochaetum is currently known to be associated are frequent in western Montana. It is possible that broader surveys of such meadows will reveal additional populations. However, studies regarding the apparent hybrid nature of this taxon should be pursued further before any additional extensive surveys are conducted.
 5. Reports having ambiguous or incomplete locality information: None.
 6. Locations known or suspected to be erroneous reports: None.
- C. Biogeographical and phylogenetic history: Owing to the obscure nature of Trisetum orthochaetum, it is not possible to provide an accurate account of the biogeographical or phylogenetic history of the taxon at this time. Because the taxon is apparently of hybrid origin, the hybridization events leading to its formation at the currently known locations may have been relatively recent. Such events are probably also sporadic in nature; they may have occurred, as yet undetected, at

other areas within the region where the ranges of the putative parents overlap.

6. **General environment and habitat description.**

A. **Concise statement of general environment and habitat:** All known clusters of Trisetum orthochaetum occur along the margins of moist to boggy montane meadows, at elevations of 4460-4510 ft. Along these margins, the plants occur under the partial cover of Pinus contorta, Picea engelmannii, and/or Abies lasiocarpa. The soil varies from saturated to slightly drained. The meadows are all undisturbed, except for some impacts by moose movement along Granite Creek (habitat slides included on p. 8).

B. **Physical characteristics.**

1. **Climate.**

a. **Koppen climate classification:** Type Dfb, with average January temperature below 0°C (32°F), average temperature of warmest month above 10°C (50°F) and under 22°C (71.6°F), with no dry season, and the driest month of summer receives more than 3 cm (1.2 in.) of rain (Visher, 1954).

b. **Regional macroclimate:** The nearest principal climatological stations in Montana are located at Missoula (approximately 34 air miles ENE, 3190 ft. elevation) and Stevensville (approximately 28 air miles SE, 3370 ft. elevation). Data for the period 1941-1970 are provided by the U.S. Department of Commerce (1973). At Missoula, the mean annual precipitation was 13.34 inches; the mean annual temperature was 43.7°F, and the mean July temperature was 66.6°F. At Stevensville, the mean annual precipitation was 13.33 inches; the mean annual temperature was 44.3°F, and the mean July temperature was 65.5°F. Precipitation was doubtlessly greater in the Bitterroot Mountains near the known sites, where the elevation is about 4500 ft. Also, it is likely that mean temperatures were lower.

c. **Local microclimate:** No quantitative information available. The meadow margin habitats are generally exposed to

some direct sunlight in the late afternoon, but are partially to fully shaded during the morning and early afternoon. It is expected that temperature would vary accordingly with changes in light intensity.

2. **Air and water quality requirements:** Unknown; it is possible that the taxon may require areas in montane meadows where water quality is not degraded. Such degradation, or other alterations of local hydrology, may have been contributing factors in the extirpation of the taxon from the Lolo Hot Springs vicinity.
3. **Physiographic province:** Within the Northern Rocky Mountains Province mapped by Fenneman (1931); within the Rocky Mountain System, Rocky Mountains in Montana and Canada Province, mapped by Hunt (1974).
4. **Physiographic and topographic characteristics:** Occurs within the area of the granitic Idaho Batholith, a large region of intrusive igneous rocks which came into place during the early Tertiary Period; this batholith makes up the Bitterroot Range, southwest of Missoula (Perry, 1962).

Known sites occur at elevations of 4460-4510 ft. This portion of the Bitterroot Range consists of a low series of mountains, with summits in the immediate area ranging from ca. 4880-6500 ft. All sites are associated with four level to very gently sloping meadow openings along Granite Creek; they occur on the eastern edges of these meadows, where the slight aspect is northwest.

Specifically, the clusters occur at the bases of adjacent steeper, northwest-facing hillsides. Water seepage from the bases of these slopes was noted at the Granite Creek South and Central sites.

Granite Creek is a tributary of Lolo Creek; the latter, in turn, flows into the Bitterroot River just south of Missoula. The sites are within Hydrologic Unit No. 17010205, as mapped by the United States Geological Survey (1980).

5. **Edaphic factors:** All known sites of Trisetum orthochaetum are associated with poorly to slightly drained loam soils. It is assumed that these soils have been derived from the parent materials comprising the granitic Idaho Batholith. Only at the Granite Creek North site is the soil slightly better drained; all clusters at the other sites occur in soils which are of a boggy muck nature. The sites occur in an area of Chryochrept-Ustochrept-Cryorthent Inceptisols (moderately sloping to very steep soils on mountains), as mapped by Montagne et al. (1982).
6. **Dependence of this taxon on natural disturbance:** Trisetum orthochaetum does not appear to depend on natural disturbance or other dynamic aspects of its physical habitat. The level meadow areas and adjacent slopes are stable landforms.
7. **Other unusual physical features:** At the Granite Creek South and Central sites, Trisetum orthochaetum is associated with seepage areas at the bases of the adjacent slopes. The extent to which the taxon depends on this water flow, if at all, is unknown.

C. Biological characteristics.

1. **Vegetation physiognomy and community structure:** Associated with open graminoid meadow communities, which contain a small percentage of forb species. These meadows are surrounded by temperate evergreen conifer forests, dominated by trees with more or less conical crowns. The known sites are on the ecotonal margins of these meadows, where some tree invasion is occurring.
2. **Regional vegetation type:** Mapped as Western spruce-fir forest (Picea-Abies) by Kuchler (1964). Occurs near the border between two "Climax Forest Types" mapped by Ross and Hunter (1976): a.) Subalpine Fir/Douglas-fir/Ponderosa Pine, and b.) Subalpine Fir.
3. **Frequently associated species:**
Pinus contorta Dougl. ex Loud.

Picea engelmannii Parry ex Engelm.
Abies lasiocarpa (Hook.) Nutt.
Carex rostrata Stokes ex With.
Deschampsia cespitosa (L.) Beauv.
Trisetum canescens Buckl.
Trisetum wolfii Vasey
Melica subulata (Griseb.) Scribn.
Lupinus polyphyllus Lindl.
Habenaria saccata Greene
Ledum glandulosum Nutt.
Polemonium occidentale Greene
Mimulus guttatus DC.

4. **Dominance and frequency of the taxon:**
Trisetum orthochaetum is very scarce and scattered in the communities with which it is associated, and represents much less than 1% of the cover in these areas.
 5. **Successional phenomena:** The known sites are within the ecotonal areas along meadow margins; some degree of tree invasion into these meadows is occurring. However, the existence of the plants in these ecotones may be more closely tied to the fact that this is where the putative parents most often come into close sympatric contact. Trisetum wolfii is most frequent in the open, wet meadows, while T. canescens is most frequent on slightly better-drained soils on the forest margins.
 6. **Dependence on dynamic aspects of biotic associations and ecosystem features:**
 Unknown; none apparent.
 7. **Other endangered, threatened, rare, or vulnerable species occurring in habitat of this taxon:** During field studies, a site was found for Gentianopsis simplex (A. Gray) Iltis (MTNHP rank = G3G4/S1), in a seep area near the Granite Creek South site. This species has been added to the MTNHP state list of plant species of special concern. No other USFWS Category 2 or state sensitive taxa were found in the areas studied.
7. **Population biology of taxon.**
- A. **General summary:** The known populations consist of eight clusters, which contain one to thirteen stems; some of these clusters may actually be single genetic individuals, arising from a common root system. Sixty-six stems were found during the field studies. All plants observed were

flowering; anthesis occurs in July, and the plants are most conspicuous in the field at that time. The taxon appears to have non-functional anthers. Tetrazolium tests indicated 0-3% production of viable seeds. Thus, Trisetum orthochaetum appears to be a sporadically produced, virtually sterile hybrid.

B. Demography.

1. **Known populations:** Trisetum orthochaetum is known from eight populations, which are herein grouped into three occurrences. These populations are located along a 1.35 mile area on the southeast side of Granite Creek, in association with four meadows along the drainage. The total number of stems observed was 66.

2. General demographic details.

a. Granite Creek South

1. Area: Five populations, occurring along edge of one meadow over ca. 10 acres.
2. Number: 37 stems, all flowering; occurs in clusters of 11, 5, 2, 4 and 15 stems, south to north.
3. Density: Plants very scattered in 5 small clusters.
4. Presence of dispersed seed: Unknown, probably none.
5. Evidence of reproduction: None.
6. Evidence of population expansion or decline: None.

b. Granite Creek Central

1. Area: Two populations, each on edge of one of two meadows, over ca. 12 acres.
2. Number: 24 stems, all flowering; occurs in clusters of 13 (south meadow) and 11 (north meadow) stems.
3. Density: Plants very scattered, in two small isolated clusters.
4. Presence of dispersed seed: Unknown, probably none.
5. Evidence of reproduction: None.
6. Evidence of population expansion or decline: None.

c. Granite Creek North

1. Area: One population, on edge of a single meadow, ca. 10 sq. ft.

2. Number: 5 stems, all flowering; one cluster.
3. Density: Very small, isolated cluster.
4. Presence of dispersed seed: Unknown, probably none.
5. Evidence of reproduction: None.
6. Evidence of population expansion or decline: None.

C. Phenology.

1. **Patterns:** Reaches full anthesis in mid-July; when the Granite Creek South site was re-visited on 6 August, the spikelets had begun to senesce. The taxon is most conspicuous in the field during July. Details of budding, leafing, fruiting and seed dispersal (if any), and germination are unknown.
2. **Relation to climate and microclimate:** Unknown.

D. Reproductive biology: Owing to the apparent hybrid nature of Trisetum orthochaetum, no data or information was collected on the reproductive biology of the taxon, except for tetrazolium tests of seed viability.

1. **Type of reproduction:** Unknown; may be none.
2. **Pollination:** None; the taxon has anthers which appear to be virtually non-functional.
3. **Seed dispersal:** Unknown.
4. **Seed biology:** Tetrazolium tests of seed viability were conducted by the Montana State University Seed Laboratory, Bozeman, MT. Seeds of Trisetum orthochaetum, T. canescens, and T. wolfii from the Granite Creek South site were tested. The results are shown in Table 1, p. 19. Other aspects of seed biology are unknown.
5. **Seedling biology:** Unknown.
6. **Survival and mortality:** Unknown.
7. **Overall assessment of taxon's reproductive success:** Strong evidence suggests that Trisetum orthochaetum is a sporadically produced, virtually sterile hybrid which is

TABLE 1. Percent seed viability* of samples from Trisetum canescens, I. wolfii, and I. orthochaetum, Granite Creek South site, T11N, R24W, Section 15, Missoula Co., Montana; inflorescences collected on 6 August 1986.

<u>Taxon</u>	<u>Sample</u>	<u>Quarter section</u>	<u>Viability (%)</u>
<u>I. canescens</u>	S1C	NE $\frac{1}{4}$ SE $\frac{1}{4}$	76
<u>I. wolfii</u>	S1W	NE $\frac{1}{4}$ SE $\frac{1}{4}$	80
	S2W	SE $\frac{1}{4}$ SE $\frac{1}{4}$	77
<u>I. orthochaetum</u>	S10	NE $\frac{1}{4}$ SE $\frac{1}{4}$	2
	S20	"	3
	S30	"	2
	S40	E $\frac{1}{2}$ SE $\frac{1}{4}$	0
	S50	SE $\frac{1}{4}$ SE $\frac{1}{4}$	0
	S60	E $\frac{1}{2}$ SE $\frac{1}{4}$	0

* - Tests conducted by the Montana State Seed Laboratory, Montana State University, Bozeman, MT; seeds tested with tetrazolium, a chemical stain used to determine the number of viable vs. dead seeds via a reaction with respiring tissue.

incapable of sexual reproduction.

8. Population ecology of taxon.

A. General summary: Trisetum orthochaetum, as discussed above, occurs in small, scattered clusters in meadow-forest ecotone areas. At all known sites it occurs in mixed populations with the two putative parents, T. canescens and T. wolfii. No other specific obligate relationships are known.

B. Positive and neutral interactions: None known.

C. Negative interactions.

1. Herbivores, predators, pests, parasites, and diseases: When the Granite Creek South site was re-visited on 6 August, the majority of the observed inflorescences were infested with aphids (family Aphididae). No other negative interactions were observed.

2. Competition.

a. Intraspecific: No information; the populations are probably too small and scattered for intraspecific competition to be evident or important.

b. Interspecific: No information; the taxon occurs in dense graminoid communities where interspecific competition, especially in the seedling stages, is probably very strong.

3. Toxic and allelopathic interactions: Unknown.

D. Hybridization.

1. Naturally occurring: The possibility that Trisetum orthochaetum is an interspecific hybrid between T. canescens and T. wolfii has long been recognized by several botanists. Hitchcock et al. (1969) stated that "(b)ecause of its apparently non-functional anthers and its morphological intermediacy between T. wolfii and T. canescens, it is difficult not to theorize about the parentage of this peculiar plant." In his letter to the University of Montana Herbarium of 13 January 1986 (Appendix A, p. 33), Dr. LeRoy H. Harvey stated that "(m)y feeling is that this is a hybrid between T. wolfii and T. canescens which

occurs now and then but does not reproduce." As Watson (1976) noted, this hybrid origin has never been experimentally confirmed by crossing the two putative parents. However, field observations and the collection of additional specimens and mature inflorescences during this study provided further material with which this theory can now be more strongly supported. The evidence on which this theory is further based here includes a.) a more detailed morphological comparison of certain characters from the three taxa (Table 2, p. 22), and b.) the results of seed viability tests (Table 1, p. 19). Samples from I. canescens and I. wolfii showed good seed viability (76-80%) for these two species; in contrast, samples from I. orthochaetum revealed very little or no production of viable seed (0-3%). Three inflorescences from one cluster (NE $\frac{1}{4}$ SE $\frac{1}{4}$ Section 15) had a few viable seeds (2-3%), suggesting that the putative parents are slightly more genetically interfertile at that location. The results of these comparisons and tests add further evidence that I. orthochaetum is an interspecific, virtually sterile hybrid between I. canescens and I. wolfii.

2. **Artificially induced:** None known; both Watson (1976) and Harvey (Appendix A) collected the putative parents, but apparently neither was able to produce an F1 hybrid.
 3. **Potential in cultivation:** Unknown, probably good.
- E. **Other factors of population ecology:** None known.
9. **Current land ownership and management responsibility.**
- A. **General nature of ownership:** Private (Granite Creek South and North sites), and United States Government (Granite Creek Central site).
 - B. **Specific landowners:**
 1. Champion International Corporation
 - a. Granite Creek South (portion).
 - b. Granite Creek North (all).
 2. Burlington Northern Railroad
 - a. Granite Creek South (portion).

TABLE 2. Morphological comparison of Irisetum canescens, I. orthochaetum, and I. wolfii, Granite Creek drainage, Missoula Co., Montana.

<u>Character</u>	<u>I. canescens</u>	<u>I. orthochaetum</u>	<u>I. wolfii</u>
<u>Glumes</u>	Both glumes shorter than the first floret. ~1.7	First glume shorter than, and second glume about equalling, the first floret. ~1.5	Both glumes exceeding the first floret. ~1:1
<u>Number of florets</u>	Usually 3.	2 or 3, or the third sometimes greatly reduced.	Usually 2.
<u>Awn length</u>	10-14 mm.	3-6 mm.	Awnless.
<u>Awn angularity</u>	Becoming strongly geniculate at maturity.	Remaining straight, or becoming only slightly geniculate, at maturity.	Not applicable.
<u>Sheath vestiture</u>	Glabrous to sparsely pilose; densely pilose just above (and on) nodes (especially upward).	Glabrous to scabridulous above; sparsely to densely pilose just above nodes (especially upward).	Glabrous to scabridulous above; glabrous just above all nodes.
<u>Panicle</u>	Completely arching.	Slightly arching, sometimes nearly upright.	Often strictly upright, the panicle branches ascending.

ratio of 1st to 2nd glume may also be useful

3. U.S. Forest Service
 - a. Granite Creek Central (all).
 - C. Management responsibility: Lolo National Forest (Granite Creek Central).
 - D. Easements, conservation restrictions, or other special designations: None known.
10. Management practices and experience.
- A. Habitat management.
 1. Review of past management and land-use experiences.
 - a. Trisetum orthochaetum: None.
 - b. Related taxa: Unknown; not reviewed.
 - c. Other ecologically similar taxa: Not reviewed.
 2. Performance under changed conditions: Unknown.
 3. Current management policies and actions: Details unknown; the slopes along both sides of Granite Creek have been heavily logged in many places. Some forested areas along the bottom of the drainage have also been logged. The area is also frequently visited by hunters and other recreationists. None of the landowners are currently aware of the presence and requirements of Trisetum orthochaetum.
 4. Future land use: The area is very valuable for its commercial timber resources. Although the meadow areas generally have not been disturbed, future road building related to further logging could possibly occur in or very near these habitats. There is an abundant moose herd in the drainage, and hunter visitation is likely to continue.
 - B. Cultivation.
 1. Controlled propagation techniques: No experience.
 2. Ease of transplanting: Unknown; individuals of Trisetum canescens and T. wolfii have evidently been successfully transplanted from the field into cultivation (Watson, 1976).

3. **Pertinent horticultural knowledge:** Not reviewed.
 4. **Status and location of presently cultivated material:** No cultivated material currently known.
11. **Evidence of threats to survival.**
- A. **Present or threatened destruction, modification, or curtailment of habitat or range.**
1. **Past threats:** Heavy development of the Lolo Hot Springs area for recreational use has evidently led to the extirpation of the taxon from the immediate vicinity, as discussed above. Other past threats to the currently known sites were not evident in their immediate habitats, but the surrounding slopes have been heavily impacted by selective and clear-cut timber harvesting. There is a logging road through a portion of the meadow at the Granite Creek North site, but the Trisetum orthochaetum site is about 300 yds. away from it.
 2. **Existing threats:** There is a warm spring on the west side of Granite Creek adjacent to the Granite Creek South site. The spring, and the surrounding meadow, are heavily used for camping by hunters and other recreationists. As a result, the vegetation on the west side of the creek has been trampled, and the site is accessed by an unmaintained jeep trail. However, the five clusters of Trisetum orthochaetum are on the east side of the creek, separated in most cases from the undeveloped camping area by a boggy meadow. These meadows are difficult to traverse on foot; thus, the clusters are largely protected by the nature of their habitat. The other two sites are similarly not directly threatened at this time. The two meadows comprising the Granite Creek Central site are the least accessible; they are not visible from the Granite Creek Road.
 3. **Potential threats:** Future increases in timber harvesting in the Granite Creek drainage may impact the known sites and other potential habitat. This would be particularly true if future harvesting continues in the forests along the level drainage bottom. The meadows generally are self-protecting, owing to a.) the

difficulties in building roads through them, and b.) their lack of timber. However, harvesting on the slopes directly adjacent to the sites would be likely to adversely impact them.

- B. **Overutilization for commercial, sporting, scientific, or educational purposes:** No significant past or existing threats known. It is possible that overcollecting for scientific specimens could impact the existence of this taxon, if additional locations are not discovered.
- C. **Disease or predation:** The only observed insect pests were aphids on many of the inflorescences at the Granite Creek South site. The meadows and adjacent woods along Granite Creek are impacted by heavy moose trampling in some areas, but direct impacts on the Trisetum clusters was not observed.
- D. **Inadequacy of existing regulatory mechanisms:** None known.
- E. **Other natural or manmade factors.**
 - 1. **Past threats:** Not known.
 - 2. **Existing threats:** The currently known number of individuals of Trisetum orthochaetum is very low, and the taxon is thus presently threatened by virtue of its scarcity. However, more extensive surveys of similar habitats throughout the Pacific Northwest may yield additional stations.
 - 3. **Potential threats:** No additional threats are presently anticipated.

II. ASSESSMENT AND RECOMMENDATIONS

- 12. **General assessment of vigor, trends, and status:** On the basis of current knowledge gained during this study, Trisetum orthochaetum is a very rare taxon, restricted to an extremely small geographic area. Evidence reviewed above suggests, however, that the taxon is a sporadically produced, virtually sterile, interspecific hybrid between T. canescens and T. wolfii. The taxon does not appear to be in imminent danger of extinction at this time, and more extensive surveys may locate additional sites. However, further biosystematic research remains the first priority, in order to identify the correct taxonomic status of Trisetum orthochaetum.

13. **Recommendations for listing or status change.**
- A. **Recommendation to U.S. Fish and Wildlife Service:**
Owing to the rediscovery of Trisetum orthochaetum, it is recommended that the taxon be removed from Notice of Review Category 2*. Additional detailed information on the biosystematic and taxonomic status of the taxon is still needed, however, and Trisetum orthochaetum should thus remain on the Notice of Review, Category 2.
- B. **Recommendations to other U.S. federal agencies.**
1. **U.S. Forest Service:** The Forest Service should be made aware of the presence of Trisetum orthochaetum on U.S.F.S. lands (Granite Creek Central site). The taxon should be included on the U.S.F.S. Region 1 sensitive plant species list.
- C. **Other status recommendations.**
1. **Counties and local areas:** No need for regulation at the county level is currently seen.
2. **State:** A change of status from SH (historically known in Montana) to S1Q (critically endangered in Montana, with taxonomic problems/questions involved) has been made on the MTNHP list of plant species of special concern.
3. **Other nations:** Not pertinent.
4. **International:** Not pertinent.
14. **Recommended critical habitat:** Owing to the taxonomic questions involved, and the need for more detailed biosystematic research, critical habitat for Trisetum orthochaetum is not being recommended at this time.
15. **Conservation/recovery recommendations:**
- A. **General conservation recommendations.**
1. **Recommendations regarding present or anticipated activities:** Owing to the rarity of Trisetum orthochaetum, and its current scientific significance, some conservation measures should be taken to protect it. To the extent possible, sites should be protected from impacts due to logging activity.

2. **Areas recommended for protection:** The highest priority site for natural area protection is the Granite Creek South site (Section 15). This is owing to the presence of both Trisetum orthochaetum and Gentianopsis simplex along the creek. Strict protection of the other sites is not currently recommended, owing to the doubtful taxonomic status of Trisetum orthochaetum.
 3. **Habitat management recommendations:** No active management recommendations are deemed necessary at this time.
 4. **Publicity sensitivity:** Low, owing to the obscurity of the taxon, and difficulties involved in reaching the sites.
 5. **Other recommendations:** None.
- B. Monitoring activities and further research needed.**

1. The known sites should be re-visited every 1-2 years; because the plants are so rare and scattered, detailed quantitative studies are not currently needed. These monitoring visits could be conducted by MTNHP staff, or other interested persons.
2. Further research on the biosystematic relationships and taxonomic status of Trisetum orthochaetum is needed. Especially useful would be information on chromosome numbers and pollen viability of the taxon and its putative parents. Experimental crossing may also be revealing, though the technicalities would be prohibitive.

Such research is needed in order to further determine whether or not Trisetum orthochaetum is a true biological species, and thus whether or not it meets the definition of a "species" as given in the Endangered Species Act (1983).

The author hopes to conduct these studies, to the extent possible, during 1987 and subsequent field seasons.

16. Interested parties:

Office of Endangered Species
ATTN: Dr. Jim Miller
U.S. Fish and Wildlife Service
Region 6
P.O. Box 25486
Denver Federal Center
Denver, CO 80225

Endangered Species Field Office
ATTN: Carol Taylor
Federal Building, 301 South Park
P.O. Box 10023
Helena, MT 59626

Office of Endangered Species
ATTN: Dr. John Fay
U.S. Fish and Wildlife Service
Washington, D.C. 20240

U.S. Forest Service, Region 1
ATTN: Bill Ruediger
Federal Building
P.O. Box 7669
Missoula, MT 59807

The Nature Conservancy
ATTN: Dr. Larry Morse
1800 N. Kent Street
Arlington, VA 22209

Rocky Mountain Heritage Task Force
ATTN: J. Scott Peterson
The Nature Conservancy
1370 Pennsylvania St., Suite 190
Denver, CO 80203

The Nature Conservancy
ATTN: Dr. Joan Bird
Montana/Wyoming Field Office
P.O. Box 258
Helena, MT 59624

Dr. LeRoy H. Harvey
U.S. National Herbarium
Department of Botany
Smithsonian Institution
Washington, D.C. 20560

↙ Peter Lesica
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University of Montana
Missoula, MT 59812

Dr. Kathleen Peterson
 Department of Botany
 University of Montana
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Dr. John Rumely
 Department of Biology
 Montana State University
 Bozeman, MT 59717

J. Stephen Shelly
 Montana Natural Heritage Program
 State Library
 1515 E. 6th Avenue
 Helena, MT 59620

III. INFORMATION SOURCES

17. Sources of information.

A. Publications.

1. References cited in report: List appended (p. 31).
2. Other publications:
 - a. Popular: Gale, R. 1980. The riddle of existence: Montana's "rare plants." Montana Outdoors 11: 14-16.

- B. Museum collections: The topotype specimen (L. H. Harvey 4461) was examined at the University of Montana Herbarium (MONTU). The holotype specimen (A. Chase 5129, US) was not examined.

Voucher specimens collected during this status survey will be deposited as follows:

J.S. Shelly (1230) & G.V. King: MONTU, US.
J.S. Shelly (1232) & G.V. King: MONTU.
J.S. Shelly (1236) & G.V. King: MONTU.

Locations and dates for these collections are given in the computer printouts, Appendix B (p. 34). The specimens are cited in these printouts in the COMMENTS field.

C. Fieldwork.

1. Surveys by the author:
 - 10-11 July 1986: Surveys at and near Lolo Hot Springs; notes, photographs, and herbarium specimens of related taxa.

16-19 July 1986: Surveys in adjacent drainages; notes, photographs, maps, and herbarium specimens of Trisetum orthochaetum and related taxa.

6 August 1986: Seed samples of all three taxa at the Granite Creek South site.

D. Knowledgeable individuals.

Dr. LeRoy H. Harvey
(Address under "Interested parties")

Ginger V. King
P.O. Box 9082
Helena, MT 59604

E. Other information sources: Additional color slides of the Lolo Hot Springs area, and of related taxa, are on file at the Montana Natural Heritage Program (author's address).

18. Summary of materials on file: All detailed field survey forms and field maps are on file at the MTNHP office (author's address). Nearly all items cited in this report are also on file at MTNHP.

IV. AUTHORSHIP

19. Initial authorship: J. Stephen Shelly
Montana Natural Heritage Program
State Library Building
1515 E. 6th Avenue
Helena, MT 59620

(406) 444-3009

20. Maintenance of status report: The Montana Natural Heritage Program will maintain current information, and update the status report as needed.

V. NEW INFORMATION

21. Record of revisions: Not currently applicable.

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APPENDIX A: Pertinent correspondence

LETTER TO THE UNIVERSITY OF MONTANA HERBARIUM (RECEIVED BY PETER LESICA) FROM DR. L.H. HARVEY (U.S. NATIONAL HERBARIUM, DEPARTMENT OF BOTANY, SMITHSONIAN INSTITUTION, WASHINGTON, D.C. 20560), REGARDING THE TYPE LOCALITY OF Trisetum orthochaetum.

13 Jan 1986

I was interested in your letter concerning Trisetum orthochaetum. I had the advantage of talking to both Mrs. Chase and the man who guided her on that trip on which the holotype of this species was collected. Their information was very general to wit - boggy meadow, Lolo Hot Springs. My specimen came from the north side of the road about 1000 yds. above the swimming pool in an area which was destroyed not more than a few years later when some construction was done nearby.

My feeling is that this is a hybrid between T. wolfii and T. canescens which occurs now and then but does not reproduce. I collected both these in this area but never tried to cross them....

Sincerely,
L.H. Harvey (signed)

APPENDIX B: Computer printouts

ELEMENT OCCURRENCE RECORD

EOCODE: PMP0A690A0.001
 NAME: TRISETUM ORTHOCHAETUM
 COMNAME: MISSOULA COUNTY OATS
 MARGNUM: 1 TENTEN: 8,2 IDENT: Y EORANK:
 EORANKCOMM:
 SURVEYDATE: 1986-07-10 LASTOBS: 1951-07-09 FIRSTOBS: 1908 GRANK: G1Q
 SRANK: S1Q STATE: MT COUNTYNAME: MTMISS
 QUADCODE: 4611465
 QUADNAME: LOLO HOT SPRINGS PRECISION: M
 LAT: 464329 LONG: 1143154 S: 0 N: 0 E: 0 W: 0
 TOWNRANGE: 011N023W SECTION: 07 MERIDIAN: PR
 TRSCOMM: E2 PHYSPROV: NR WATERSHED: 17010205
 DIRECTIONS: LOLO HOT SPRINGS, BITTERROOT MOUNTAINS (U.S. HWY. 12, CA. 26
 MI. WEST OF LOLO).

GENDESC: "BOGGY MEADOW;" L.H. HARVEY (IN A LETTER TO P. LESICA DATED
 13JAN86) STATES THAT THE AREA OF HIS COLLECTION "...WAS DE-
 STROYED...WHEN SOME CONSTRUCTION WAS DONE NEARBY" (SEE EF).

ELEV: 4180 SIZE: 1
 EODATA: TWO OTHER TRISETUM SPECIES, T. WOLFII AND T. CANESCENS, ARE
 LOCATED NEAR LOLO HOT SPRINGS; THIS, PLUS THE MORPHOLOGICAL
 INTERMEDIACY AND STERILE ANthers OF T. ORTHOCHAETUM, HAVE
 LED TO THE SUGGESTION THAT TROR MAY BE OF HYBRID ORIGIN.

COMMENTS: VOUCHERS—CHASE, A. (5129), 1908, US; HARVEY, L.H. (4461),
 1951, MONTU 36626 (TOPOTYPE); NOT SEEN SINCE 1951.

MACODE1: MTPRIVATEOWN CONTAINED1: ? MACODE2: CONTAINED2:
 MACODE3: CONTAINED3: ADLMAS: MORELAN: MOREPROT:
 MOREMGMT: SITECODE:
 SITENAME: LOLO HOT SPRINGS
 OWNER: LOLO HOT SPRINGS CORP.
 OWNERCOMM:
 PROTCOMM: TAXON NOT RELOCATED HERE DURING 1986 STATUS SURVEY.
 MGMTCOMM:
 MONITOR: MONITORNUM: -
 BESTSOURCE: HARVEY, L.H. (4461), 1951, MONTU 36626 (TOPOTYPE).

SOURCECODE: S51HARUMMT U76WATO1MT PNDLES01MT PNDLACO1MT F86SHE06MT
 PND8SHE01MT A34HITO1MT B71HITO1MT B69HITO1MT
 DATASENS: N BOUNDARIES: N PHOTOS: N OWNERINFO:
 TRANSCRIBR: 85-12-17 JSS CDREV: Y MAPPER: 85-12-19 JSS QC: Y
 UPDATE: 86-09-04 JSS

ELEMENT OCCURRENCE RECORD

EOCODE: PMP0A690A0.002
 NAME: TRisetum orthochaetum
 COMNAME: MISSOULA COUNTY OATS
 MARGNUM: 2 TENTEN: 3,4 IDENT: Y EORANK: AB
 EORANKCOMM: OCCURS IN 5 SMALL CLUMPS; PRISTINE HABITAT.
 SURVEYDATE: 1986-07-18 LASTOBS: 1986-08-06 FIRSTOBS: 1986 GRANK: G1Q
 SRANK: S1Q STATE: MT COUNTYNAME: MTMISS
 QUADCODE: 4611465
 QUADNAME: LOLO HOT SPRINGS PRECISION: SC
 LAT: 464226 LONG: 1143535 S: 464224 N: 464235 E: 1143526 W: 1143538
 TOWNRANGE: 011N024W SECTION: 15 MERIDIAN: PR
 TRSCOMM: E2SE4 PHYSPROV: NR WATERSHED: 17010205
 DIRECTIONS: GRANITE CREEK DRAINAGE, CA. 3.1 AIR MI. SW OF LOLO HOT
 SPRINGS, 0.13-0.15 AIR MI. E OF GRANITE CREEK RD. (LOLO NF
 RD 9942), CA. 2 MI. SOUTH OF JCT. WITH RD. 4209.
 GENDESC: BOGGY MUCK SOILS, ON EDGE OF WET MEADOW AND ON CREEK BANK;
 WITH PINUS CONTORTA, PICEA ENGELMANNII, CAREX ROSTRATA,
 DESCHAMPSIA CESPITOSA, LUPINUS POLYPHYLLUS.
 ELEV: 4480 SIZE: 10
 EODATA: FIVE SUBPOPULATIONS, CONTAINING A TOTAL OF 37 STEMS; SOME
 CLUMPS MAY BE SINGLE INDIVIDUALS; TRisetum wolfii AND T.
 CANESCENS OCCUR IN BIOTIC SYMPATRY THROUGHOUT THE AREA, AND
 WITH TRisetum orthochaetum AT THIS SITE.
 COMMENTS: VOUCHER-SHELLY, J.S. (1230) AND G.V. KING, 1986, MONTU, US.
 MACODE1: MTPBURLNORTH CONTAINED1: N MACODE2: MTPCHAMPIONI CONTAINED2: N
 MACODE3: CONTAINED3: ADLMAS: MORELAN: MOREPROT:
 MOREMGMT: SITECODE:
 SITENAME: GRANITE CREEK SOUTH
 OWNER:
 OWNERCOMM:
 PROTCOMM: SEE EF FOR EXACT LOCATIONS OF FIVE SUBPOPULATIONS.
 MGMTCOMM:
 MONITOR: MONITORNUM:
 BESTSOURCE: SHELLY, J.S. 1986. FIELD SURVEYS IN MISSOULA COUNTY OF 10-
 11 JULY, 16-19 JULY, AND 6 AUGUST.
 SOURCECODE: F86SHE06MT PNDSE01MT S86SHEUMMT S86SHEUSMT B69HIT01MT
 U76WAT01MT A34HIT01MT B71HIT01MT
 DATASENS: Y BOUNDARIES: Y PHOTOS: Y OWNERINFO:
 TRANSCRIBR: 86-08-18 JSS CDREV: Y MAPPER: 86-08-20 JSS QC: Y
 UPDATE: 86-09-16 JSS

ELEMENT OCCURRENCE RECORD

EOCODE: PMPOA690A0.003
 NAME: TRisetum orthochaetum
 COMNAME: MISSOULA COUNTY OATS
 MARGNUM: 3 TENTEN: 3,3 IDENT: Y EORANK: AB
 EORANKCOMM: OCCURS IN 2 SMALL CLUMPS, BUT HABITAT IS PRISTINE.
 SURVEYDATE: 1986-07-19 LASTOBS: 1986-07-19 FIRSTOBS: 1986 GRANK: G1Q
 SRANK: S1Q STATE: MT COUNTYNAME: MTMISS
 QUADCODE: 4611465
 QUADNAME: LOLO HOT SPRINGS PRECISION: SC
 LAT: 464247 LONG: 1143520 S: 464245 N: 464302 E: 1143508 W: 1143522
 TOWNRANGE: 011N024W SECTION: 14 MERIDIAN: PR
 TRSCOMM: W2NW4 PHYSPROV: NR WATERSHED: 17010205
 DIRECTIONS: GRANITE CREEK DRAINAGE, 2.8 AND 2.6 AIR MI. WSW OF LOLO HOT
 SPRINGS, 0.21 AND 0.16 MI. E OF GRANITE CREEK RD. (LOLO NF
 RD 9942), CA. 1.3-1.7 MI. SOUTH OF JCT. WITH ROAD 4209.
 GENDESC: BOGGY MUCK SOILS, ON EDGES OF WET MEADOWS; WITH PINUS
 CONTORTA, PICEA ENGELMANNII, CAREX ROSTRATA, DESCHAMPSIA
 CESPITOSA, LUPINUS POLYPHYLLUS, HABENARIA SACCATA.
 ELEV: 4460 SIZE: 12
 EODATA: TWO SUBPOPULATIONS, CONTAINING 13 (SOUTH MEADOW) AND 11
 (NORTH MEADOW) STEMS; SOME INDIVIDUALS MAY BE MULTI-STEMMED;
 T. WOLFII AND T. CANESCENS OCCUR IN BIOTIC SYMPATRY THROUGH-
 OUT THE AREA, & WITH TRisetum orthochaetum IN THESE MEADOWS.
 COMMENTS: VOUCHER-SHELLY, J.S. (1232) AND G.V. KING, 1986, MONTU.
 MACODE1: MTFFSNFLOLO1 CONTAINED1: Y MACODE2: CONTAINED2:
 MACODE3: CONTAINED3: ADLMAS: MORELAN: MOREPROT:
 MOREMGMT: SITECODE:
 SITENAME: GRANITE CREEK CENTRAL
 OWNER:
 OWNERCOMM:
 PROTCOMM:
 MGMTCOMM:
 MONITOR: MONITORNUM:
 BESTSOURCE: SHELLY, J.S. 1986. FIELD SURVEYS IN MISSOULA COUNTY OF 10-
 11 JULY, 16-19 JULY, AND 6 AUGUST.
 SOURCECODE: FB6SHE06MT PNDSEHO1MT SB6SHEUMMT U76WATO1MT A34HITO1MT
 B71HITO1MT B69HITO1MT
 DATASENS: Y BOUNDARIES: Y PHOTOS: N OWNERINFO:
 TRANSCRIBR: 86-08-18 JSS CDREV: Y MAPPER: 86-08-27 JSS QC: Y
 UPDATE: 86-09-16 JSS

ELEMENT OCCURRENCE RECORD

EOCODE: PMPOA690A0.004
 NAME: TRisetum orthochaetum
 COMNAME: MISSOULA COUNTY OATS
 MARGNUM: 4 TENTEN: 4,3 IDENT: Y EORANK: BC
 EORANKCOMM: VERY SMALL POPULATION, ADJACENT AREAS DISTURBED.
 SURVEYDATE: 1986-07-19 LASTOBS: 1986-07-19 FIRSTOBS: 1986 GRANK: G1Q
 SRANK: S1Q STATE: MT COUNTYNAME: MTMISS
 QUADCODE: 4611465
 QUADNAME: LOLO HOT SPRINGS PRECISION: SC
 LAT: 464311 LONG: 1143441 S: 0 N: 0 E: 0 W: 0
 TOWNRANGE: 011N024W SECTION: 11 MERIDIAN: PR
 TRSCOMM: SW4SE4 PHYSPROV: NR WATERSHED: 17010205
 DIRECTIONS: GRANITE CREEK DRAINAGE, 2.2 AIR MI. WSW OF LOLO HOT SPRINGS,
 0.40 AIR MI. E OF GRANITE CREEK ROAD (LOLO NF RD 9942), CA.
 0.9 MI. S OF JCT. WITH RD 4209.
 GENDESC: MOIST, LOAM SOILS, ON EDGE OF MOIST TO BOGGY CAREX ROSTRATA/
 DESCHAMPSIA CESPITOSA MEADOW; WITH PICEA ENGELMANNII, ABIES
 LASIOCARPA, PINUS CONTORTA, ALNUS.
 ELEV: 4510 SIZE: 1
 EODATA: FIVE STEMS OBSERVED; TRisetum canescens AND T. WOLFII OCCUR
 IN A MIXED POPULATION WHICH CONTAINS THE 5 INDIVIDUALS OF T.
 ORTHOCHAETUM.
 COMMENTS: VOUCHER-SHELLY, J.S. (1236) AND G.V. KING, 1986, MONTU.
 MACODE1: MTPCHAMPIONI CONTAINED1: Y MACODE2: CONTAINED2:
 MACODE3: CONTAINED3: ADLMAS: MORELAN: MOREPROT:
 MOREMGMT: SITECODE:
 SITENAME: GRANITE CREEK NORTH
 OWNER: CHAMPION INTERNATIONAL, INC.
 OWNERCOMM:
 PROTCOMM:
 MGMTCOMM:
 MONITOR: MONITORNUM:
 BESTSOURCE: SHELLY, J.S. 1986. FIELD SURVEYS IN MISSOULA COUNTY OF 10-
 11 JULY, 16-19 JULY, AND 6 AUGUST.
 SOURCECODE: F86SHE06MT P86SHE01MT S86SHEUMMT U76WAT01MT A34HIT01MT
 B71HIT01MT B69HIT01MT
 DATASENS: Y BOUNDARIES: Y PHOTOS: N OWNERINFO:
 TRANSCRIBR: 86-08-19 JSS CDREV: Y MAPPER: 86-08-27 JSS QC: Y
 UPDATE: 86-09-16 JSS

APPENDIX C: Status summary (Watson, 1976)

TAXON: Trisetum orthochaetum A. S. Hitchc.

COMMON NAME: None

FAMILY: Poaceae

STATUS: ENDANGERED

Habitat: in a boggy meadow

Distribution: Known only from the type locality at Lolo Hot Springs,
Bitterroot Mts., Missoula Co., Montana.

Nature of Endangerment: This elusive grass has been sought in vain over several years by Dr. C. L. Hitchcock, by Dr. L. H. Harvey and by myself. Dr. Harvey has on occasion taken agrostology classes to the type locality in search of T. orthochaetum. In 1951, Dr. Harvey found a single plant at this site which resembles the species. Similar plants have not since been collected. I have spent 30 hours over the past three years searching this area with negative results. The type locality has been altered drastically since the taxon was originally collected (in 1908). Where once there was a boggy meadow, there is now a paved highway, a swimming pool, parking lots, a bar, and a campground. The habitat and the species may have been extirpated as a result of construction.

Trisetum orthochaetum is thought to be a hybrid between T. wolfii and T. canescens due to its intermediate morphology and apparent sterility (i.e., the type specimen has abortive anthers). However, the hybrid origin has never been confirmed. During my field studies, the putative parents were found in an intermixed population along the margins of a

meadow near Lolo Hot Springs. Intermediates, which would suggest hybridization, were not found in this zone of sympatry. This suggests that hybridization does not occur between T. wolfii and T. canescens or that gene exchange between the two is a rare event.

Until artificial synthesis of the F_1 hybrid can be performed and the F_1 plants compared with the type of T. orthochaetum, the origin and taxonomic status of the latter cannot be resolved. Thus for the present, it seems advisable to retain T. orthochaetum on the endangered species list so as to protect any plants that may be later discovered.

I have the putative parents in cultivation and will attempt cross-pollinations as soon as the plants can be induced to flower. Production of an F_1 hybrid will take at least two years because of the slow growth-rate of these perennials.