

STATUS REVIEW OF *CLARKIA RHOMBOIDEA* IN MONTANA

Prepared by:

Jim Vanderhorst
Montana Natural Heritage Program
State Library
1515 East Sixth Avenue
Helena, Montana 59620-1800

Prepared for:

Kootenai National Forest
506 U.S. Highway 2 West
Libby, Montana 59923

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SUMMARY

There are now 12 recently surveyed populations and one historical record of the sensitive annual plant *Clarkia rhomboidea* known in Montana. These are confined to the extreme northwestern part of the state in Sanders and Lincoln Counties. Sites are known on the Kootenai and Lolo National Forests and on state land. The species grows in undisturbed native habitat on steep, unstable, south facing slopes sparsely forested by Douglas fir and ponderosa pine. A few populations are found on road cutbanks and in logged areas. The primary threat to this species in Montana is encroachment of its open habitats by exotic weeds.

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A. CLASSIFICATION

1. FAMILY: Onagraceae, The Evening Primrose Family
 2. GENUS: *Clarkia*, a genus of about 33 species of annual herbs, 32 species endemic to western North America, and one to South America. In the past, *Clarkia* has been included in *Oenothera* and split between *Clarkia*, *Eucharidium*, *Godetia*, and *Phaeostoma*. The genus is divided into 10 sections which have a reticulate relationship connected by polyploid species of hybrid origin. (Lewis and Lewis 1955)
 3. SPECIES: *Clarkia rhomboidea* Douglas. It is given the common name "common" clarkia (Hitchcock and Cronquist 1973), a misnomer for the species in Montana where it is rare, it is also called rhombic petaled clarkia. Synonyms (Lewis and Lewis 1955) include *Oenothera rhomboides* Lev., *Phaeostoma rhomboides* Nels., *Clarkia gauroides* Dougl. in Sweet, *Godetia latifolia* Nels. & Kennedy, and *Phaeostoma atropurpureum* Heller. Lewis and Lewis (1955) include *Clarkia rhomboidea* in their section Myxocarpa and have demonstrated that the species is an allotetraploid derived from a hybrid between *C. mildredae* and *C. virgata*, both species confined to California.

B. PRESENT LEGAL OR OTHER FORMAL STATUS

1. FEDERAL STATUS
 - a. U.S. FISH AND WILDLIFE SERVICE: none
 - b. U.S. FOREST SERVICE: Sensitive in Region 1 (U.S. Forest Service 1994)
 - c. BUREAU OF LAND MANAGEMENT: none
2. STATE: The Montana Natural Heritage Program ranks the species G4 and S1 (Heidel 1996) signifying that it is apparently secure rangewide but critically imperiled because of extreme rarity in Montana. Discovery of several populations in 1995 and 1996, some relatively large, would ordinarily be the basis for changing the rank to S2 except that populations of annuals are intrinsically unstable from year to year, and there are only a few known large populations in undisturbed native habitat that are likely to have high viability.

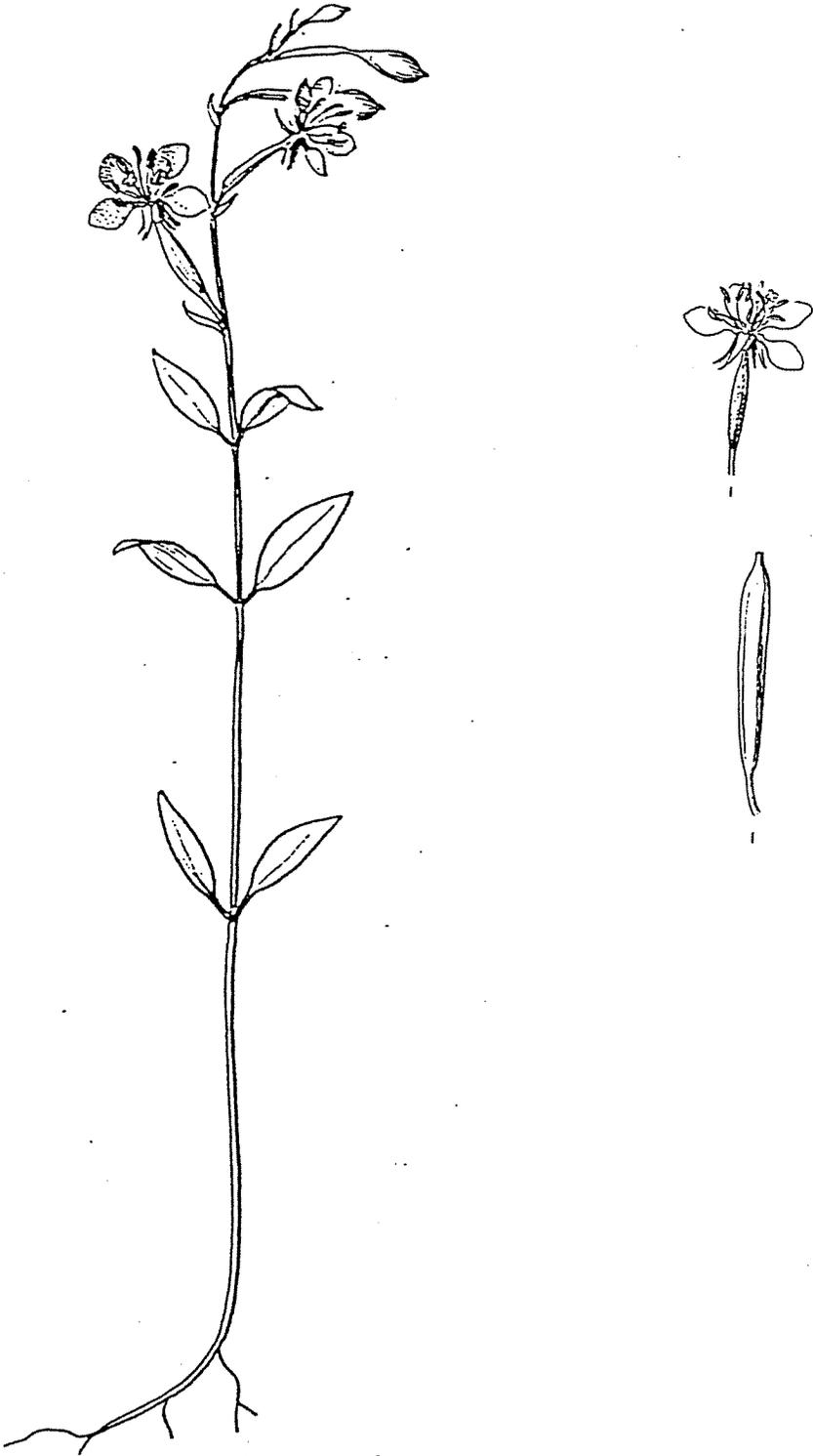
C. DESCRIPTION

1. GENERAL NONTECHNICAL DESCRIPTION: *Clarkia rhomboidea* is an herbaceous annual dicot ranging in size from less than six inches up to about three feet tall. Small plants may be unbranched and have only one flower, while larger plants may be branched and have several flowers. The elliptical shaped, stalked leaves are borne nearly opposite each other on the stems and there are usually branchlets with smaller leaves in the axils of the large leaves. The flowers are nodding in bud and become erect in bloom, are about the size of a dime and have four lavender-pink stalked petals and four green or purplish, reflexed sepals. The fruits develop below the petals and sepals, and when mature open by four valves and contain numerous small seeds. Figure 1 is a line drawing of the plant, and photographic slides of plants, including close-ups of the leaves, flowers, and fruits are provided in Appendix C.
2. TECHNICAL DESCRIPTION: Annual herb, 1-10 dm tall, simple or branched; leaves subopposite, puberulent to subglabrous, petiolate, the blades up to 6 cm long, 3.2 cm wide, ovate, ovate-lanceolate, or elliptic. Flowers short-pedicellate, nodding in bud, erect at anthesis, borne in bracteate terminal racemes; hypanthium 1-3 mm long; four sepals 5-9 mm long, green or purplish, reflexed at anthesis; four petals 6-12 mm long, 3-7 mm broad, clawed, the limb lanceolate to rhomboid, entire to obscurely 3 lobed, pinkish-lavender, sometimes with darker spots; eight stamens 1-4 mm long; ovary inferior, 4 loculed, stigma 4 lobed; fruit a straight or curved beaked capsule, 1-3 cm long, opening by 4 valves; seeds 1-1.5 mm, without hairs. (adapted from Lewis and Lewis 1955 and Welsh et al. 1987)
3. LOCAL FIELD CHARACTERS: *Clarkia rhomboidea* can be distinguished from *C. pulchella*, the only other species of the genus in Montana, by 1) lanceolate to elliptic, petiolate leaves vs. linear, sessile leaves of *C. pulchella*, 2) nodding flower buds vs. erect buds of *C. pulchella*, and 3) smaller, entire limbed petals vs. the larger petals of *C. pulchella* which have dramatically lobed limbs. *Clarkia rhomboidea* also resembles some species of *Epilobium*, from which it is distinguished by lacking a tuft of hairs on the tip of the seeds. *Clarkia rhomboidea* has larger flowers than *Epilobium minutum* and *E. paniculatum*, and smaller plants and flowers than *E. angustifolium*. Other species of *Epilobium* in Montana are plants of wetlands.

D. GEOGRAPHIC DISTRIBUTION

1. RANGE: Southern British Columbia south, east of the Cascades in Washington, but east and west of the Cascades in Oregon, to southern California, east to Montana, Utah, and Arizona (Hitchcock and Cronquist 1973 and Montana records).

Figure 1. Line drawing of *Clarkia rhomboidea* (from Hitchcock and Cronquist 1961)



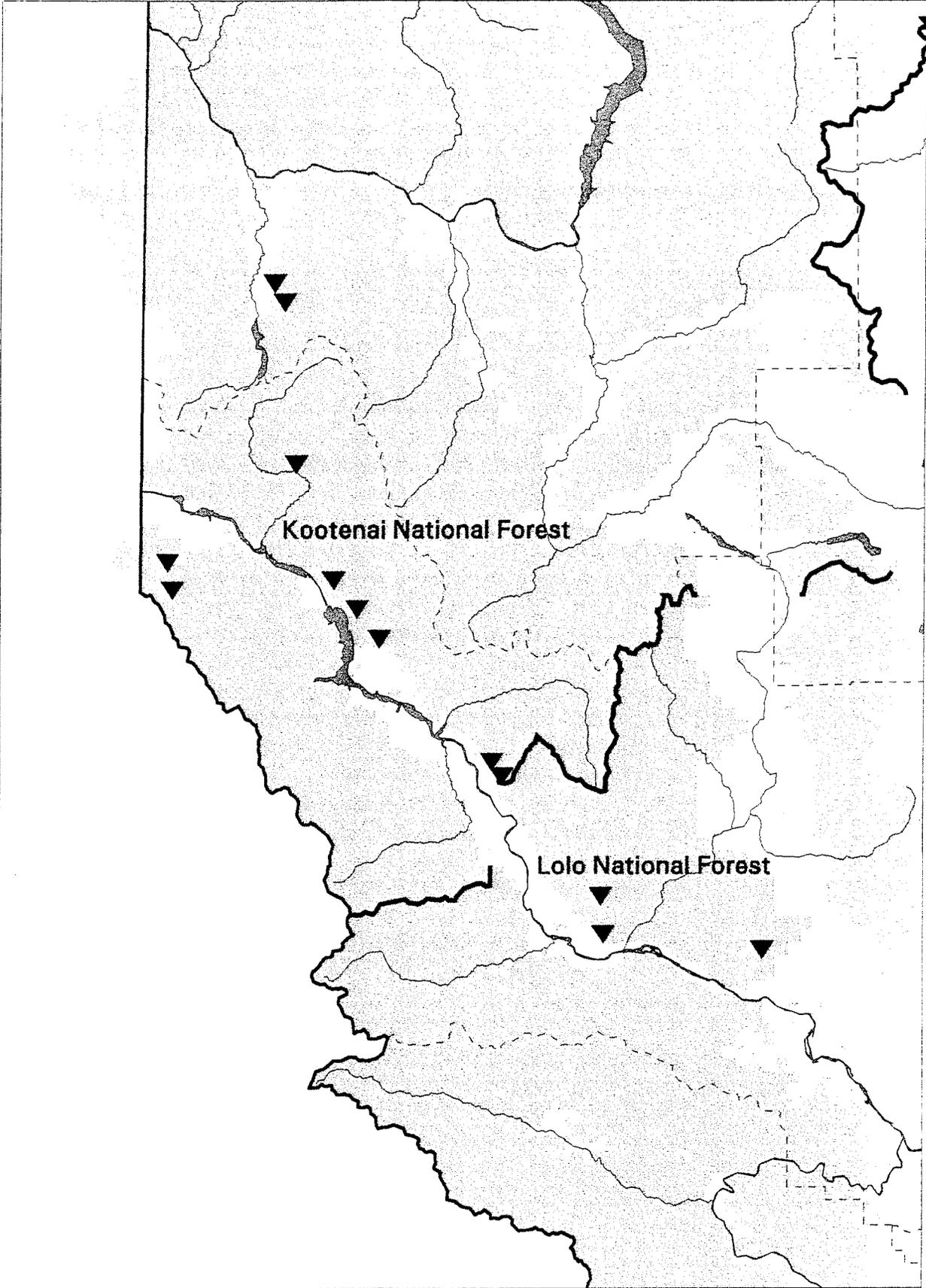
2. MONTANA DISTRIBUTION

- a. **CURRENT SITES:** There are 12 recently surveyed occurrences, all in northwest Montana in Lincoln and Sanders Counties. Peter Lesica made the first recent collection of the species on state land near Thompson Falls in 1989. The first occurrence on the KNF was found by Jack Triepke on the Cabinet district in 1993. In 1995 additional KNF populations were located on the Cabinet and Three Rivers districts and in 1996 an additional population was found on each district. The species was also found on the Lolo National Forest for the first time in 1996 by Anne Dalton. Table 1 gives land ownership and population estimates of all known Montana occurrences. Figure 2 is a map showing the approximate locations of *Clarkia rhomboidea* occurrences in Montana. Appendix A contains Element Occurrence Records giving precise locations and for all known sites in the state and topographic maps showing the locations are included in Appendix B.

Table 1. Element Occurrences (EO's) of *Clarkia rhomboidea* in Montana giving estimated population numbers in the year of discovery and subsequent years. ns = not surveyed, nf = survey conducted but no plants found.

EO Number and Name	Owner	1989	1993	1995	1996
001 "Mt. Silcox"	?				
002 Calvin Wilson Ranch	State	11-50	ns	ns	ns
003 Lost Cabin Gulch	KNF D7		20	ns	ns
004 Grimes Gulch	KNF D7			100-200	ns
005 Spring Gulch	KNF D7			1000's	1000's
006 Green Mountain	KNF D7			>500	ns
007 Rock Creek	KNF D7			1000-1500	1000-1500
008 W. F. Elk Creek	KNF D7			16	2
009 Spring Creek	KNF D4			30	94
010 Noxon Reservoir	KNF D7			>500	nf (0?)
011 Berray Mountain	KNF D7				200
012 Teepee Ridge	LNF				8
013 Camp Creek	KNF D4				10

Figure 2. *Clarkia rhomboidea* Distribution in Montana



- b. HISTORICAL SITES: Lewis and Lewis (1955) list a *Clarkia rhomboidea* collection (Butler coll. # 5091) from Mt. Silcox, Montana (001). The location and date of the specimen are not known; this is apparently the basis for the inclusion of the species in Dorn's (1984) flora of the state. Lesica's rediscovery of *Clarkia rhomboidea* in Montana in 1989 was near Mt. Silcox, but it is not known if this is precisely the same location.
- c. UNVERIFIED/UNDOCUMENTED REPORTS: none
- d. LAND OWNERSHIP: Ten sites are Kootenai National Forest (KNF) lands, one is Lolo National Forest land, and one site is Montana State land.
- e. AREAS SURVEYED BUT SPECIES NOT FOUND: I spent approximately eight field days in late June and early July, 1996 searching for new occurrences of *Clarkia rhomboidea*. My surveys were confined to the southwestern part of the Kootenai National Forest, and represent a sampling of potential habitat mostly distributed across the previously known range of the species on the Forest. The habitat surveyed was extremely steep with loose substrate, making access extremely difficult and at times dangerous, thus many gaps in the survey remain. A need for further survey was identified by Jack Triepke in the vicinity of the Lost Cabin Gulch occurrence (003); an attempt was made to access this population but was prevented by road washouts and posted private property. Lolo National Forest lands on the Thompson Falls district also remain as a large gap in survey for the species to date. The following areas on the Kootenai National Forest were identified by landtype, aspect, and vegetation as potential habitat for *Clarkia rhomboidea* and were surveyed but the species was not found:

Cabinet District

Beaver Creek: T23N R31W S32 SE 1/4, S33 S 1/2, T22N R31W S6 NW 1/4

Berray Mountain: T27N R33W S1 NE 1/4 (uphill from population found on lower slope)

Big Eddy Creek: T27N R34W S25

Blacktail Creek: T25N R32W S28 NW 1/4

Bull River: T26N R33W S3 SW 1/4, T27N R33W S24 NE 1/4

Kirby Gulch: T24N R30W S31 NE 1/4, S32 NW 1/4

Marten Creek: T25N R32 W S32 NE 1/4, S33 NW 1/4, S 28 SW 1/4

Pilgrim Creek: T26N R33W S28 SE 1/4

Pilgrim Creek (West Fork): T26N R33W S30 S 1/2

Vermillion River: T24N R31W S1 SW 1/4, S11 NW 1/4, S12 NE 1/4, S14 NE 1/4, T24N R30W S7 NW 1/4
Water Hill: T24N R31W S23 N 1/2, S24 SW 1/4
White Pine Creek: T23N R31W S14 NE 1/4, NW 1/4, S15 NE 1/4

Three Rivers District

Dry Creek: T29N R33W S9 NW 1/4
Keeler Mountain: T29N R34W S1 SE 1/4
Kootenai Falls: T31N R33W S12 SW 1/4, S13 NW 1/4, S14 NE 1/4
Lime Butte: T30N R34W S13 SE 1/4
Ross Creek Quarry: T28N R33W S7 NE 1/4
Spring Creek: T29N R33W S4 NW 1/4, NE 1/4 (forested slopes nearby known population on road cutbank)
Yaak River: T33N R33W S19 NW 1/4

E. HABITAT

1. ASSOCIATED VEGETATION: Lewis and Lewis (1955) describe the habitat of *Clarkia rhomboidea* across its range as "open, dry sites at the lower margins of the montane forest or sometimes in adjacent woodland." In Arizona it grows in oak woodland (Lewis and Lewis 1955) and in Utah it is associated with "mountain brush communities" (Welsh et al. 1987).

In Montana, *Clarkia rhomboidea* grows on slopes sparsely forested by *Pseudotsuga menziesii* and *Pinus ponderosa* and on the cutbanks of roads through these habitats. Vegetation at most sites is probably best classified as the *Pseudotsuga menziesii*/*Physocarpus malvaceus* habitat type (Cooper et al. 1991), but canopy cover is usually lower than described for that type and the dominant shrub is often *Holodiscus discolor*. Graminoid cover by *Elymus spicatus* often exceeds shrub cover and at least one site is a *Pseudotsuga menziesii*/*Elymus spicatus* (*Agropyron spicatum*) habitat type (Cooper et al. 1991). Many sites approach the scree habitat type (Cooper et al. 1991). These habitat types have low to moderate timber productivity and may present significant reforestation problems (Cooper et al. 1991). In spite of this they are sometimes logged because they often develop large old growth trees.

Montana *Clarkia rhomboidea* habitats are relatively stable disclimaxes controlled by topoedaphic and fire influences. Most sites have sparse to moderate undergrowth due to dry, unstable substrates which limit establishment of many native perennials. At least three *Clarkia rhomboidea* sites on the KNF have indications of past fires, including snags, deep fire scars on large *Pinus ponderosa*, and light burn on the downhill side of large *Pseudotsuga menziesii*.

Control of wildfires may result in increased cover by forest canopies, shrubs, and herbaceous perennials. These open habitats host many native annual plant species and are prone to invasions by exotic annual and perennial weeds. Establishment of noxious weeds may result in increased competition and soil stabilization. Wildfire control and weed infestations may allow vegetation succession to proceed and make the habitat unsuitable for *C. rhomboidea* and other native annuals.

At several sites *Clarkia rhomboidea* grows in needle litter just downhill from a large tree, a microhabitat which is shared with the native annual forb *Montia perfoliata* and the exotic annual grass *Bromus tectorum*. This microhabitat preference may be due to microclimatic influences, dispersal agents, or disturbance history (e.g. game bedding or fire) associated with understories of large trees.

At three Montana sites *Clarkia rhomboidea* grows with *Clarkia pulchella*, which is more abundant and has a broader distribution in the state. The two species have similar habitat preferences, and the latter may be used as an indicator of potential habitat for the rare species.

The following vascular plant species were observed at *C. rhomboidea* sites in Montana:

Native trees: *Pinus ponderosa*, *Pseudotsuga menziesii*

Native shrubs: *Acer glabrum*, *Amelanchier alnifolia*, *Holodiscus discolor*, *Menziesia ferruginea*, *Paxistema myrsinites*, *Philadelphus lewisii*, *Physocarpus malvaceus*, *Prunus virginiana*, *Rosa gymnocarpa*, *Rosa woodsii*, *Salix scouleriana*, *Shepherdia canadensis*, *Symphoricarpos albus*

Native perennial forbs and subshrubs: *Achillea millefolium*, *Agoseris glauca*, *Apocynum androsaemifolium*, *Balsamorhiza sagittata*, *Calochortus* sp., *Castilleja* sp., *Fragaria vesca*, *Heuchera cylindrica*, *Lonicera ciliosa*, *Mahonia repens*, *Penstemon* sp., *Penstemon wilcoxii*, *Phacelia heterophylla*, *Sedum lanceolatum*

Native perennial graminoids: *Carex geyeri*, *Calamagrostis rubescens*, *Elymus spicatus*, *Festuca idahoensis*, *Festuca occidentalis*

Native annual forbs: *Clarkia pulchella*, *Collinsia parviflora*, *Collomia linearis*, *Collomia grandiflora*, *Cryptantha affinis*, *Epilobium minutum*, *Epilobium paniculatum*, *Madia minima*, *Madia exigua*, *Microsteris gracilis*, *Montia perfoliata*, *Polygonum douglasii*

Native annual graminoids: *Festuca octoflora*

Native ferns: *Aspidopsis densa*, *Cryptogramma achrostichoides*, *Pteridium aquilinum*, *Woodsia scopulina*

Exotic perennial forbs: *Centaurea maculosa*, *Dianthus armeria*, *Hypericum perforatum*, *Tragopogon dubius*, *Trifolium repens*, *Verbascum thapsus*

Exotic perennial grasses: *Phleum pratense*

Exotic annual forbs: *Arenaria serpyllifolia*

Exotic annual grasses: *Bromus tectorum*

Moss cover is essentially non-existent but cover by soil crustose lichens is conspicuous at some sites.

Photographic slides showing vegetation at undisturbed sites at Berray Mountain (011) and Rock Creek (007) are provided in Appendix C.

2. TOPOGRAPHY: All known Montana occurrences of *Clarkia rhomboidea* are in the Cabinet and Bitterroot Mountains on steep slopes with southerly aspects at elevations ranging from 2,400 to 4,200 feet (730-1,280 meters). Two populations (Spring Gulch .005 and Spring Creek .009) are at least partially on cutbanks of roads which cross these slopes. Populations are usually in mid-slope positions on slopes ranging from 35-80% with aspects ranging from south-southeast to southwest. Slope and aspect are dominant influences on the soils, microclimates, and vegetation of the sites. The sites were probably not directly affected by glaciation but mountain glaciers were present at higher elevations and continental glaciation extended south in the valleys below the most northern occurrences.
3. SOIL RELATIONSHIPS: In Montana, *Clarkia rhomboidea* grows in droughty, gravelly, poorly developed soils associated with steep south aspects with rock outcrops. On the KNF, the soils are classified as inceptisols and include map units 201, 353, 355, 502, 503, and 555 (Kuennen and Nielsen-Gerhardt 1995). The soils have a high fraction of gravel and small rocks weathered from metasedimentary rocks of the Belt Supergroup. At two sites which were sampled, the reddish argillites and quartzites of the Pritchard Formation (identified by L. Kuennen) make up a large part of the rock fraction; this is a dominant rock type in the area (Alt and Hyndman 1986). Wildfire control and invasion of the sites by exotic weeds may hasten soil development by stabilizing the substrate and adding organic matter.

4. **CLIMATE FACTORS:** Data from the climatological stations at Trout Creek Ranger Station and Thompson Falls (National Oceanic and Atmospheric Administration 1982) characterize the macroclimate of the Montana range of *Clarkia rhomboidea*. From 1951 to 1980 the monthly mean temperature normals ranged from 26.4 degrees F in January to 68.2 degrees F in July at Thompson Falls and from 24.1 degrees F in January to 65.0 degrees F in July at Trout Creek. Normal annual precipitation was 22.77 inches at Thompson Falls and 30.49 inches at Trout Creek. July is the hottest and driest month of the year, coinciding with the flowering period of *Clarkia rhomboidea*. Peak precipitation at both stations is during the winter months in the form of snow, but abundant rainfall occurs in both the fall and the spring, both possible periods for seed germination. Annual precipitation at Trout Creek is the second highest of stations in Montana.

The Cabinet and Bitterroot Mountains receive high precipitation, but the population sites are droughty by mid-summer. The south facing slopes are hot and dry compared to adjacent aspects, creating habitats with sparse vegetation. Annuals are adapted to these conditions by remaining dormant, as seeds, during the driest part of the season. Lewis and Lewis (1955) found that high temperatures promote flowering in *Clarkia* species, but that seed germination requires cooler temperatures. The tendency of plants to grow under large trees may be related to microclimate influences on seedling germination and survival. Canopies reduce rainfall but also reduce evaporative loss at ground level, they reduce solar radiation in the daytime and also reduce radiation loss at night; these interacting effects result in a microsite which is relatively droughty and free from competition but also with relatively stable moisture and temperature regimes. Litter accumulation under the trees may also influence soil surface moisture and temperature.

F. POPULATION DEMOGRAPHY AND BIOLOGY

1. **PHENOLOGY:** In Montana, *Clarkia rhomboidea* has been observed flowering from mid-June to mid-August. Peak flowering is probably in early July at most sites in most years, but an indeterminate inflorescence may result in prolonged flowering in favorable years. Small plants were the first to flower in populations observed in 1996. *Clarkia rhomboidea* blooms at about the same time as *C. pulchella*, or slightly earlier, and the more common species can be used as an indicator for timing surveys for the rare plant. Fruit have been observed as early as July 1. One population visited on October 1, 1996 had plants with dehiscent fruits and most seeds dispersed, except for a few in the bottoms of the uppermost capsules of large plants.

It is not known when seed germination takes place in Montana. Lewis and Lewis (1955) studied species of *Clarkia*, including *C. rhomboidea*, in the garden in Los

Angeles, California and made some generalizations concerning phenology of the genus. Seeds germinated in November and flowering occurred in April-May depending on the species. The plants were thus grown as winter annuals. Seeds planted in January or February produced smaller, later flowering plants. Controlled experiments showed that flowering was promoted by long daylight and high temperatures, but seed germination was prevented by high temperatures. In England they grew species of *Clarkia* as summer annuals. Some seeds of predominantly fall germinating annuals may germinate in spring (Nilsson 1995), and this characteristic is likely to be under selection pressure. It is possible that, in nature, *Clarkia rhomboidea* behaves as a winter annual over some of its range and as a summer annual in other areas. Because of severe winters, there may be selection for spring germination in Montana. This hypothesis could be tested by conducting searches for seedlings in both fall (October-November) and spring (March-April). Seedlings were not found in the *Clarkia rhomboidea* population area at Berray Mountain when visited on October 1, 1996. Timing of seed germination may have management implications in timing weed control or prescribed burns.

2. **POPULATION SIZE AND CONDITION:** Reported population numbers in Montana range from a couple to over a thousand plants. The Rock Creek (007) occurrence is the largest reported with estimates of 1000-1500 plants in six subpopulations covering 125 acres; many particularly large plants were observed in this population. "Thousands of plants" were also reported at Spring Gulch (005), but most plants are confined to a small area of road cutbank. At some sites only a few plants were found in spite of extensive surveys. These numbers do not include the number of seeds which remain dormant or the number of seedlings which die. Most populations censused in 1995 and 1996 had similar number of plants in both years. This may indicate that climate in both years was favorable for the species; both years had abundant moisture early in the growing season.

I could not relocate the Noxon Reservoir (010) occurrence in 1996, originally found by Mike Leigh in 1995 and estimated to have over 500 plants. It is possible that I did not look in the right location or that the population has undergone drastic decline or extirpation. The habitat is very weedy, and competition may have interfered with seed production or germination and survival.

Populations of annuals often undergo dramatic fluctuations in size from year to year. Lewis (1962) reported that peripheral populations of *Clarkia* species are subject to extinction or near extinction in climatically unfavorable years and this phenomenon has played a role in speciation of the genus. Fluctuations in size of Montana *Clarkia rhomboidea* populations and their relationship to climatic fluctuations has not been determined or studied.

3. **REPRODUCTIVE BIOLOGY:** *Clarkia rhomboidea* is a predominantly self-pollinating allotetraploid annual. It has small flowers with the style receptive at anthesis and proximal to the stamens, unlike its outcrossing diploid parents *C. mildrediae* and *C. virgata* which have protandrous flowers with the style held away from the stamens (Lewis and Lewis 1955). Bees have been observed visiting the flowers in Montana and may facilitate some cross pollination. Plants commonly have three to five flowers.

A single capsule is estimated to produce an average of 50 seeds (Lewis 1953, and Montana specimens). The small seeds have no known specialized dispersal mechanism but may be dispersed by birds, mammals, water, or disturbance of the unstable scree substrate. The occurrence of *Clarkia rhomboidea* along trails at some sites is consistent with seed dispersal by game although herbivory of fruits has not been observed. Lewis (1962) reported dispersal of intact fruits of *Clarkia* species by rodents. The fruits of *Clarkia rhomboidea* become soft and slimy as they mature (Lewis and Lewis 1955), and this could play a role as an animal deterrent or attractant.

The role of a seed bank in the population biology of *Clarkia rhomboidea* is not known. Lewis (1962) found no evidence of dormancy in seeds of *Clarkia* species and believed this is why no desert members of the genus have evolved. Seeds were found to be viable for up to five years, but germinate freely. One possible short term dormancy mechanism may be retention of a few seeds overwinter in the erect capsules (Lewis 1962); a few seeds were found remaining in capsules at Berry Mountain (011) in October 1996.

As a species, *Clarkia rhomboidea* has become more widespread (more reproductively successful) than either of its diploid, outcrossing parents. This may be in part due to its genetic and breeding systems. Polyploidy can impart heterosity and homeostasis to an organism which may have adaptive value and is a means of breeding true a desirable hybrid genotype (Grant 1981). There is a correlation between allopolyploidy and autogamy (selfing) in annual plants (Grant 1981). The ability to self also confers colonizing advantage by allowing a population to be founded by introduction of a single seed.

G. POPULATION ECOLOGY

1. BIOLOGICAL INTERACTIONS

- a. **COMPETITION:** *Clarkia rhomboidea* grows in open habitats where competition from native perennials is limited by a harsh, unstable environment. In Montana habitats with few introduced plants it coexists with a number of native annuals, but overall cover and biomass are very

small. Differences in annual plant species dormancy strategies and adaptations to small scale disturbance may explain their coexistence in patchy landscapes (Lavorel et al. 1994).

Introductions of exotic species may increase cover and biomass of sites, and increase competition from biennial and perennial forbs. Some Montana noxious weeds are highly adapted to south facing slopes with open vegetation and loose substrate. Much of the potential habitat identified and surveyed in 1996 that turned out not to have *C. rhomboidea* was heavily infested by weeds. Weeds are present at most *C. rhomboidea* sites, but infestations were light in most populations surveyed in 1996. The species has been observed in Montana growing in close association with high densities of cheatgrass (*Bromus tectorum*) at Berray Mountain (011) and spotted knapweed (*Centaurea maculosa*) at Spring Creek (009) but long term effects of competition from weeds has not been studied. At Spring Creek the co-occurrence with knapweed was observed by Leslie Ferguson in 1995, but this relationship was not apparent to the author in 1996. The population of *Clarkia rhomboidea* at Noxon Reservoir (010) was reported to consist of several hundred plants in 1995, but no plants were found in 1996 when this extremely weedy habitat was resurveyed by the author. It is possible that *C. rhomboidea* was excluded from the immediate areas by competition from knapweed. Spotted knapweed has been shown to interfere with growth and survival of *Lesquerella carinata* var. *languida*, a short-lived perennial of open south slopes in Granite County, Montana, and infestations of the weed are thought to be the major threat to that rare species (Greenlee 1994, Vanderhorst 1995). Competition for water and other nutrients is the most likely mechanism for these adverse effects.

- b. HERBIVORY: Herbivory has not been reported in Montana, but the occurrence of *Clarkia rhomboidea* along trails may indicate seed dispersal by game. The mucilaginous fruits may serve as a deterrent or attractant to herbivores. The habitats away from trails on steep, unstable slopes are little visited by game.

H. ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

1. THREATS TO CURRENTLY KNOWN POPULATIONS: The most pervasive and probably most severe threat to *Clarkia rhomboidea* populations in Montana is encroachment of its habitat by exotic weeds. Weeds are found at most Montana occurrences, but at present, sites with intact native vegetation have only light to moderate infestations. The slopes which host the large *Clarkia rhomboidea* population at Rock Creek (007) are almost weed free. It is not known if *Clarkia*

rhomboidea once inhabited other weedy habitat where it is absent today. Unlike habitats with high canopy and ground cover, open habitats are predisposed to colonization by exotic weeds without human caused disturbance. Weed infestations often proceed uphill from disturbed areas onto undisturbed slopes with open vegetation.

The primary threats from logging and road building are indirect, from increased spread of weeds. Removal of large trees may also eliminate the preferred microhabitat of *Clarkia rhomboidea* under their canopies. All known populations on the Kootenai National Forest are within management areas 10 and 11 (big game winter range). All of the known populations with undisturbed native plant communities (Berray Mountain .011, Camp Creek .013, Grimes Gulch .004, Lost Cabin Gulch .003, Rock Creek .007, West Fork Elk Creek .008) are in management area 10 which is considered unsuitable timberland, probably because of steepness and low productivity. Road building through these habitats and logging of adjacent slopes is likely to result in introductions of exotic weeds which may threaten the rare plant populations and reduce useable forage for big game. Populations in disturbed habitats (Green Mountain .006, Noxon Reservoir .010, Spring Creek .009, Spring Gulch .005) are all within management area 11 which is deemed suitable timberland, and the sites are along roads or in logged areas. The occurrence of *C. rhomboidea* at these sites is likely to be ephemeral and related to the disturbance event. *Clarkia rhomboidea* has not been found in forests with high canopy cover.

Control of wildfires may also pose a long-term threat to populations of *Clarkia rhomboidea* by allowing canopy closure and vegetation succession to proceed. There are indications that steep south facing slopes are naturally prone to frequent low intensity surface fires which may reduce litter and duff, and kill lower layer perennials and tree seedlings but leave large trees.

2. **MANAGEMENT PRACTICES AND RESPONSE:** *Clarkia rhomboidea* has been observed growing on road cutbanks and on previously logged slopes. Two of the Montana occurrences (Spring Creek .009, Spring Gulch .005) are primarily on cutbanks and the former is apparently confined to the cutbank. These are usually treated as D-ranked Element Occurrences because they do not represent the species in stable habitats and thus do not contribute directly to its conservation. Relatively large populations of *C. rhomboidea* were reported in 1995 from Green Mountain (006) and Noxon Reservoir (010) in areas which were previously logged and had heavy weed infestations. The Noxon Reservoir population could not be relocated by the author in 1996 and may have undergone a decline or been extirpated. The species has not been found on slopes with closed canopies, thus its occurrence in recently logged areas is likely to be a recent and ephemeral phenomenon. Elsewhere it has been seen growing on ground

recently disturbed by game and erosion. Evidence of past fire is present at three sites or more. The species is adapted to colonizing disturbed sites, however, data on its persistence and interactions with exotic weeds at these sites is lacking.

3. **MANAGEMENT SUMMARY:** It is recommended that Forest Service Region 1 sensitive status and Montana Natural Heritage Program S1 rank be retained for *Clarkia rhomboidea*. Although ten occurrences have been discovered in the last two years, only three populations in Montana (Berray Mountain .011, Grimes Gulch .004, Rock Creek .007) consist of more than 100 plants in natural habitat, and its persistence in weedy, disturbed habitats has not yet been demonstrated. If it is found to be abundant on the Lolo National Forest where survey gaps remain, and is proved to persist on road cutbanks and in weedy clearcuts, then delisting as sensitive may then be appropriate.

The nature of threats to *Clarkia rhomboidea* populations are long term and indirect, thus project clearances and assessments which consider only the area of project activity are inadequate. For example, the proposed Rock Creek mine is not likely to directly affect the nearby population of *C. rhomboidea*, but increased ground disturbance and traffic of large trucks is likely to result in weed infestations which may then spread to the population site uphill. Population downtrends resulting from weed encroachment and vegetation succession are likely to be slow and will not be apparent without long term monitoring. Because the threats are indirect, proactive efforts may be required to avert population declines.

Focused weed control is needed in population areas in native habitat with light infestations (Rock Creek, Berray Mountain) and efforts should be made to reduce weed seed sources from adjacent and nearby disturbed habitats. Weeds should be controlled with methods which do not harm the rare species or other native plants (hand pulling or selective backpack spraying), and should be timed for maximum effectiveness and minimum impact. Human disturbance (i.e. walking, herbicide use, etc..) in population areas should be minimized when plants are in stages of active growth. Proposals for management activities (e.g. timber sales, road building, vehicle travel, mining) in the vicinity of *Clarkia rhomboidea* populations must address the threat of increased moderate distance dispersal of noxious weed seeds.

At least some of the *Clarkia rhomboidea* populations in Montana grow in habitats influenced by past fires and fire may be important for maintaining habitat and/or creating new habitat for the species. Natural and controlled burns should be managed to protect and improve habitat for *C. rhomboidea*. Fires occurring in or near populations should be monitored to determine seed bank mortality, colonization, and recolonization of burned areas by *C. rhomboidea* and other

native and exotic plants. Large populations should be protected from wildfires which threaten the entire population area, but some patchy, light surface fires may be allowed in population areas so that fire relations can be studied.

Additional research is proposed to define biological evaluation standards for *Clarkia rhomboidea*. We recommend: 1) three or more permanent ecodata plots be established at population centers at Rock Creek (at least two plots) and Berray Mountain (at least one plot) to document long term population viability, weed invasion, and vegetational succession at these undisturbed sites. 2) a permanent belt transect (Lesica 1987) be established at the population center along the trail at Berray Mountain with revisits made the following October and May to search for seedlings. Determining timing of seedling establishment is important for timing conservation management efforts as well as activities which may have adverse effects on populations. 3) Once timing of seedling establishment is determined, an experimental burn and control should be considered in the extensive Rock Creek population area, designed to have the least impact on germination, to make initial evaluations on the effects of fire. This is needed to establish prescribed burn and wildfire control standards to complement species conservation. 4) Revisit the known sites with disturbed habitats (Calvin Wilson Ranch .002, Green Mountain .006, Noxon Reservoir .010, Spring Creek .009, Spring Gulch .005) to determine if populations are persistent in these habitats.

Montana's *Clarkia rhomboidea* populations are peripheral to the rather broad contiguous range of the species and may be evolutionarily important because they face ecological extremes and may be subject to high selection pressures. Lewis (1962) hypothesized a mode of speciation in *Clarkia* involving "catastrophic selection", in which peripheral populations may undergo near extinction, followed by regeneration by one or a few adapted individuals with aberrant genotypes. Hybridization, chromosome anomalies, polyploidy events, and the annual habit have allowed rapid, "quantum" speciation to occur in *Clarkia* (Grant 1981, Lewis and Lewis 1955, Lewis 1962). Although polyploidy may be seen as a deterrent to speciation events (Grant 1981), the occurrence of hexaploid species in the genus demonstrates the potential for future evolution in the lineage of *C. rhomboidea* and the peripheral populations in Montana, even small ones, may play an important role in this process.

The habitats occupied by *Clarkia rhomboidea* are relatively stable disclimaxes resulting from topoedaphic and fire influences (Cooper et al. 1991, Pfister et al. 1974). Such "pioneer" habitats have been sites where rapid speciation of many annual plants has taken place (Stebbins 1974). Another annual which is rare in Montana and which shares many of the genetic, evolutionary, and ecological traits of *C. rhomboidea* is *Madia minima*. This species, a Montana Species of Special Concern ranked S1 (Heidel 1996), was found in 1996 near a previously reported

Clarkia rhomboidea site and is known from a few other nearby sites. Preservation of habitat for *Clarkia rhomboidea* will also benefit other native annual species. However, open habitats are presently threatened by introduction of adapted exotic species and interference with naturally occurring ecosystem processes such as fire. These indirect human-caused effects may result in canopy closure and soil stabilization and development, thus allowing vegetation succession to proceed, closing the habitat for pioneer annuals. Maintaining native vegetation and rare plants in open habitats is a major challenge which will require proactive efforts and looking beyond project boundaries.

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APPENDIX A: Element Occurrence Records

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLARKIA RHOMBOIDEA
Common Name: COMMON CLARKIA

Global rank: G4 Forest Service status: SENSITIVE
State rank: S2 Federal Status:

Element occurrence code: PDONA050X0.001

Element occurrence type:

Survey site name:

EO rank:

EO rank comments:

County: SANDERS

USGS quadrangle: MOUNT HEADLEY

Township: Range: Section: TRS comments:

022N 029W 26

Precision: M

Survey date: Elevation: 6800 -

First observation: Slope/aspect:

Last observation: Size (acres):

Location:

"MT. SILCOX."

Element occurrence data:

UNKNOWN.

General site description:

WOODS AND SLOPES.

Land owner/manager:

LOLO NATIONAL FOREST, PLAINS/THOMPSON FALLS RANGER DISTRICT

Comments:

LOCATION AS GIVEN BY DORN (1984).

Information source: DORN, R. D. 1984. VASCULAR PLANTS OF MONTANA.

MOUNTAIN WEST PUBLISHING, CHEYENNE, WYOMING. 276

PP.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLARKIA RHOMBOIDEA
Common Name: COMMON CLARKIA

Global rank: G4 Forest Service status: SENSITIVE
State rank: S2 Federal Status:

Element occurrence code: PDONA050X0.002

Element occurrence type:

Survey site name: CALVIN WILSON RANCH

EO rank:

EO rank comments: NO RANK; FULL SURVEY NEEDED.

County: SANDERS

USGS quadrangle: THOMPSON FALLS

Township: Range: Section: TRS comments:

021N 029W 11 NE4

Precision: S

Survey date: Elevation: 3000 - 3100

First observation: 1989-05-30 Slope/aspect: 35+% / SE

Last observation: 1992-06-08 Size (acres): 1

Location:

NORTH SIDE OF CLARK FORK RIVER CANYON, CA. 3 AIR MILES EAST OF
THOMPSON FALLS, 1.93 AIR MILES NORTH OF CLARK FORK; ON STEEP SLOPES
EAST OF MICROWAVE TOWER.

Element occurrence data:

1989: 11-50 PLANTS OBSERVED; FULL EXTENT OF POPULATION UNKNOWN;
HABITAT THREATENED BY WEED ENCROACHMENT; AREA USED FOR
LIVESTOCK GRAZING AND TIMBER HARVESTING.

General site description:

LOOSE, STONY SOIL ON STEEP, OPEN SLOPE, IN PSEUDOTSUGA
MENZIESII/PHYSOCARPUS MALVACEUS HABITAT; WITH CRYPTANTHA SP.,
COLLINSIA PARVIFLORA, BROMUS TECTORUM, EPILOBIUM PANICULATUM,
COLLOMIA LINEARIS.

Land owner/manager:

MOUNT SILCOX WILDLIFE MANAGEMENT AREA

Comments:

1989: PLANTS NOT YET IN FLOWER ON SURVEY DATE.

Information source: LESICA, PETER. DIVISION OF BIOLOGICAL SCIENCES,
UNIVERSITY OF MONTANA, MISSOULA, MT 59812. PHONE
406/728-8740.

Specimens: LESICA, P. (4821). 1989. SPECIMEN #113433. MONTU.

LESICA, P. (5676). 1992. SPECIMEN #117238. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLARKIA RHOMBOIDEA
Common Name: COMMON CLARKIA
Global rank: G4 Forest Service status: SENSITIVE
State rank: S2 Federal Status:
Element occurrence code: PDONA050X0.003
Element occurrence type:
Survey site name: LOST CABIN GULCH
EO rank:
EO rank comments:
County: SANDERS
USGS quadrangle: GEM PEAK

Township: Range: Section: TRS comments:
026N 034W 33 NW4NW4 Precision: S

Survey date: Elevation: 3000 -
First observation: 1993-08-05 Slope/aspect: 75% / SOUTH
Last observation: 1993-08-05 Size (acres): 1
Location: FROM HERON, TRAVEL TO EF ELK CREEK RD 2273. GO UP THIS ROAD
AND TRAVEL TO CATTLE GUARD AT BORDER WITH PRIVATE LAND. PARK HERE
AND TRAVERSE AROUND PRIVATE PROPERTY TO LOST CABIN GULCH.

Element occurrence data: CA. 20 PLANTS, 30% FLOWERING, 70% FRUITING.

General site description:

DRY-MESIC, PARTIALLY SHADED, GLACIAL STRUCTURAL LOWERSLOPE.
STONY, SANDY LOAMS, ARGILLITES, SILTITES, AND QUARZITES. ASSOCIATED
SPECIES: AMELANCHIER ALNIFOLIA, ELYMUS SPICATUS, PSEUDOTSUGA
MENZIESII, HOLODISCUS DISCOLOR, SYMPHORICARPOS ALUBS, BERBERIS
REPENS, SALIX SCOULERIANA, FRAGARIA VESCA, LONICERA CILIOSA, ACHILLES
MILLEFOLIUM, PACHISTIMA MYRSINITES, PRUNUS VIRGINIANA, ROSA
GYMNOCARPA, PENSTEMON SPP., CASTILLEJA SPP., SEDUM LANCEOLATUM,
HEUCHERA CYLINDRICA, CAREX SPP., EPILOBIUM PANICULATUM, WOODSIA
SCOPULINA, CRYPTOGRAMMA ACROSTICHOIDES, ASPIDOTIS DENSA.

Land owner/manager: KOOTENAI NATIONAL FOREST, CABINET RANGER DISTRICT

Comments: OBSERVED BY JACK TRIEPKE. FURTHER HABITAT IN AREA SHOULD
BE SURVEYED. ECODATA PLOT #FS01140793DC116.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLARKIA RHOMBOIDEA
Common Name: COMMON CLARKIA

Global rank: G4 Forest Service status: SENSITIVE
State rank: S2 Federal Status:

Element occurrence code: PDONA050X0.004
Element occurrence type:
Survey site name: GRIMES GULCH
EO rank:
EO rank comments:
County: SANDERS
USGS quadrangle: SEVEN POINT MOUNTAIN

Township: Range: Section: TRS comments:
023N 030W 4 NW4NW4
Precision: S
Survey date: Elevation: 4000 - 4160
First observation: 1995-07-01 Slope/aspect: 65% / SOUTH
Last observation: 1995-07-01 Size (acres): 2

Location: CA. 7.5 AIR MILES SOUTHEAST OF TROUT CREEK (TOWN) ON RIDGE ON
SOUTHEAST SIDE OF GRIMES GULCH.

Element occurrence data: 100-200 PLANTS, 85% FLOWERING, 15% FRUITING.

General site description: DRY, PARTIALLY SHADED MIDSLOPE. SILTITE PARENT
MATERIAL, GRAVELLY SOIL. ASSOCIATED SPECIES: FESTUCA IDAHOENSIS,
SYMPHORICARPOS ALBUS, HOLODISCUS DISCOLOR.

Land owner/manager:
KOOTENAI NATIONAL FOREST, CABINET RANGER DISTRICT

Comments:
OBSERVED BY C. WALDRON.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLARKIA RHOMBOIDEA
Common Name: COMMON CLARKIA
Global rank: G4 Forest Service status: SENSITIVE
State rank: S2 Federal Status:
Element occurrence code: PDONA050X0.005
Element occurrence type:
Survey site name: SPRING GULCH
EO rank:
EO rank comments:
County: SANDERS

USGS quadrangle: SEVEN POINT MOUNTAIN
Township: Range: Section: TRS comments:
023N 030W 9 NE4
Precision: S
Survey date: Elevation: 3400 - 3440
First observation: 1995-06-28 Slope/aspect: 30-40% / SOUTH
Last observation: 1996-06-25 Size (acres):

Location: CA. 8.5 AIR MILES SOUTHEAST OF TROUT CREEK (TOWN) ON HILLS ABOVE SPRING GULCH. ACCESS VIA DEEP CREEK ROAD, WHICH COMES OFF OF BLUE SIDE ROAD. POPULATION IS ON BOTH SIDES OF ROAD.

Element occurrence data: 1996: CA. 1000 PLANTS ON ROADCUT, CA. 100 PLANTS ON SLOPE ABOVE ROAD, MOST IN BUD, A FEW IN FLOWER. 28 JUNE 1995: THOUSANDS OF PLANTS, FLOWERING.

General site description: ON SLOPES ABOVE ROAD GROWING IN DRY SPOTS, NEEDLE LITTER UNDER TREES, WITH MONTIA PERFOLIATA, PINUS PONDEROSA, PSEUDOTSUGA MENZIESII, CEANOTHUS SANGUINEUS, PHYSOCARPUS MALVACEUS, APOCYNUM ANDROSAEMIFOLIUM, LUPINUS ARBUSTUS, VERBASCUM THAPSUS, PENSTEMON SPP., COLLOMIA LINEARIS, COLLINSIA GRANDIFLORA, FESTUCA IDAHOENSIS, BROMUS TECTORUM, CENTAUREA MACULOSA.

Land owner/manager: KOOTENAI NATIONAL FOREST, CABINET RANGER DISTRICT

Comments: 1996: SURVEYED BY J. VANDERHORST. 1995: OBSERVED BY E. PFALZER, A. KARSIAN, AND M. LEIGH. SOME DISTURBANCE BY GRAZING.
Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.
Specimens: VANDERHORST, J. (5572). 1996. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLARKIA RHOMBOIDEA
Common Name: COMMON CLARKIA
Global rank: G4 Forest Service status: SENSITIVE
State rank: S2 Federal Status:
Element occurrence code: PDONA050X0.006
Element occurrence type:
Survey site name: GREEN MOUNTAIN
EO rank:

EO rank comments:

County: SANDERS

USGS quadrangle: NOXON RAPIDS DAM

Township: Range: Section: TRS comments:
025N 031W 18 NW4, CENTER

Precision: S

Survey date: Elevation: 3400 - 3900

First observation: 1995-07-17 Slope/aspect: 60% / SW

Last observation: 1995-07-17 Size (acres): 5

Location: CA. 1.5 AIR MILES SOUTH OF SUMMIT OF GREEN MOUNTAIN, CA. 2.2
AIR MILE EAST OF EAST SHORE OF NOXON RESERVOIR. POPULATION ALONG
DIRT ROAD ON SOUTH SLOPE OF GREEN MOUNTAIN.

Element occurrence data: >500 PLANTS, 80% FLOWERING, 20% FRUITING.

General site description: DRY, OPEN MIDSLOPE. ASSOCIATED SPECIES: CENTAUREA
MACULOSA, HYPERICUM PERFORATUM, COLLOMIA SPP., BROMUS TECTORUM,
ACHILLEA MILLEFOLIUM, AGROPYRON SPICATUM, AMELANCHIER ALNIFOLIA,
PSEUDOTSUGA MENZIESII, PINUS PONDEROSA, BALSAMORHIZA SAGITTATA,
TRIFOLIUM SPP.

Land owner/manager: KOOTENAI NATIONAL FOREST, CABINET RANGER DISTRICT

Comments: OBSERVED BY M. LEIGH AND S. JOHNSON. DRY, OPEN FACE WITH
PAST LOGGING. HEAVY NOXIOUS WEED INFESTATION.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLARKIA RHOMBOIDEA
Common Name: COMMON CLARKIA
Global rank: G4 Forest Service status: SENSITIVE
State rank: S2 Federal Status:
Element occurrence code: PDONA050X0.007
Element occurrence type:
Survey site name: ROCK CREEK

EO rank:

EO rank comments:

County: SANDERS

USGS quadrangle: NOXON RAPIDS DAM

Township: Range: Section: TRS comments:

026N 032W 21 S2

Precision: S

Survey date: Elevation: 2460 - 3460

First observation: 1995-07-03 Slope/aspect: 70% / SW

Last observation: 1996-07-19 Size (acres): 125

Location: CA. 2.1 AIR MILES NORTH OF NOXON RAPIDS DAM. FROM ROCK CREEK ROAD (FS RD 150) AND HWY 200, PROCEED WEST CA. 1 MILE. POPULATION LOCATED CA. 1 MILE NORTH OF FS RD 150 UP STEEP HILLSIDE.

Element occurrence data: 1996: 1000+ PLANTS, 90% WITH FRUIT, 10% IN FLOWER, MANY LARGE PLANTS. 1995: 1000-1500 INDIVIDUALS IN 6 SUBPOPULATIONS, 95% FLOWERING, 10% FRUITING.

General site description: MIDSLOPE IN DRY OPENINGS BETWEEN CANOPY-COVERED AREAS. ASSOCIATED SPECIES: PSEUDOTSUGA MENZIESII, PHYSOCARPUS MALVACEUS, PINUS PONDEROSA, AMELANCIER ALNIFOLIA, PRUNUS VIRGINIANA, ACER GLABRUM, AGROPYRON SPICATUM, PHILADELPHUS LEWISII, PRUNUS SPP., ROSA SPP., MENZIESIA FERRUGINEA, SYMPHORICARPOS ALBUS. DENSEST PATCHES OF CLARKIA ARE JUST DOWNHILL FROM LARGE TREES.

Land owner/manager: KOOTENAI NATIONAL FOREST, CABINET RANGER DISTRICT

Comments: 1996: OBSERVED BY J. VANDERHORST. 1995: OBSERVED BY D. LEAVELL AND D. NICHOLLS.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens: VANDERHORST, J. (5602). 1996. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLARKIA RHOMBOIDEA
Common Name: COMMON CLARKIA
Global rank: G4 Forest Service status: SENSITIVE
State rank: S2 Federal Status:
Element occurrence code: PDONA050X0.008
Element occurrence type:
Survey site name: WEST FORK ELK CREEK
EO rank:
EO rank comments:
County: SANDERS
USGS quadrangle: CABINET
Township: Range: Section: TRS comments:
026N 034W 17 SE4
Precision: S
Survey date: Elevation: 3000 -
First observation: 1995-07-12 Slope/aspect: >60% / SOUTH-SSW
Last observation: 1996-06-24 Size (acres):

Location: TAKE COUNTY ROUTE 430 CA. 3.5 MILES SOUTHWEST FROM HERON.
WHERE ROAD FORKS FOR EAST AND WEST FORKS OF ELK CREEK, STAY ON WEST
FORK ROAD FOR 100 YARDS. PARK AND PROCEED NORTH UPHILL TOWARD
TIMBER.

Element occurrence data: 1996: 2 PLANTS IN FULL BLOOM. 1995: 16 PLANTS, 50%
FLOWERING, 50% FRUITING.

General site description: STRAIGHT, OPEN, DRY LOWERSLOPE; DOWNHILL SIDE OF
SMALL DOUGLAS FIR TREE. ASSOCIATED SPECIES: AMELANCHIER ALNIFOLIA,
AGROPYRON SPICATUM, CENTAUREA MACULOSA, HYPERICUM PERFORATUM,
CLARKIA PULCHELLA, COLLOMIA SPP., DIANTHUS SPP., BERBERIS REPENS,
ACHILLEA MILLEFOLIUM, LOMATIUM SPP.

Land owner/manager: KOOTENAI NATIONAL FOREST, CABINET RANGER DISTRICT

Comments: OBSERVED BY M. LEIGH IN 1995 AND J. VANDERHORST IN 1996. LIGHT
EROSION DUE TO ASPECT AND SLOPE.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL
FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLARKIA RHOMBOIDEA
Common Name: COMMON CLARKIA
Global rank: G4 Forest Service status: SENSITIVE
State rank: S2 Federal Status:
Element occurrence code: PDONA050X0.009
Element occurrence type:
Survey site name: SPRING CREEK

EO rank:

EO rank comments:

County: LINCOLN

USGS quadrangle: CROWELL MOUNTAIN

Township: Range: Section: TRS comments:

029N 033W 3 SW4; 4 N2

Precision: S

Survey date: Elevation: 3200 - 3800

First observation: 1995-07-11 Slope/aspect: 60% / SOUTH

Last observation: 1996-07-13 Size (acres):

Location:

TAKE US HWY 56 SOUTH TO CAMP CREEK ROAD 691. PLANTS ARE ON THE CUTBANK OF THE ROAD CA. 3 MILES UP.

Element occurrence data:

ADDITIONAL SUBPOPULATION LOCATED IN 1996. 13 AUGUST: 50% WITH FRUIT, 50% IN FLOWER. (PLANTS IN ONE SMALL PATCH ON ROADCUT). 21 JUNE: 94 PLANTS, SMALL PLANTS IN 30% FULL FLOWER, LARGER PLANTS IN 70% BUD. 1995: 4 SUBPOPULATIONS REPORTED.

General site description: OPEN, DRY MIDSLOPE WITH CENTAUREA MACULOSA, COLLOMIA GRANDIFLORA, HOLODISCUS DISCOLOR, CLARKIA PULCHELLA, SHEPHERDIA CANADENSIS, PHYSOCARPUS MALVACEUS, CALAMAGROSTIS RUBESCENS, PSEUDOTSUGA MENZIESII, PINUS PONDEROSA.

Land owner/manager: KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments: SURVEYED BY JIM VANDERHORST IN 1996, OBSERVED BY LESLIE FERGUSON IN 1995.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens: VANDERHORST, J. (5603). 1996. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLARKIA RHOMBOIDEA
Common Name: COMMON CLARKIA
Global rank: G4 Forest Service status: SENSITIVE
State rank: S2 Federal Status:
Element occurrence code: PDONA050X0.010
Element occurrence type:
Survey site name: NOXON RESERVOIR

EO rank:
EO rank comments:

County: SANDERS
USGS quadrangle: NOXON RAPIDS DAM
Township: Range: Section: TRS comments:
025N 032W 2 N2
026N 032W 35 SW4SE4

Precision: S
Survey date: 1996 Elevation: 3240 - 3960
First observation: 1995-07-30 Slope/aspect: 60-70% / SW
Last observation: 1995-07-30 Size (acres):

Location: CA. 2.25 AIR MILES EAST OF NOXON RAPIDS DAM. FOLLOW FS RD 2282 TO GATE. ONE POPULATION IN FOREST OPENING IMMEDIATELY BELOW, AND THE OTHER AT SOUTHERNMOST FS RD 2282 SWITCHBACK.

Element occurrence data: 1996: POPULATIONS NOT RELOCATED. 1995: 2 SUBPOPULATIONS. NORTHERN: SEVERAL HUNDRED PLANTS, 25% FLOWERING, 75% FRUITING. SOUTHERN: CA. 150 PLANTS, 80% FLOWERING, 20% FRUITING.

General site description: DRY, OPEN MIDSLOPE. ASSOCIATED SPECIES: CENTAUREA MACULOSA, HYPERICUM PERFORATUM, HOLODISCUS DISCOLOR, AGROPYRON SPICATUM, COLLINSIA GRANDIFLORA, PSEUDOTSUGA MENZIESII, PHILADELPHUS LEWISII, CEANOTHUS VELUTINUS, SPIRAEA BETULIFOLIA, LOMATIUM TRITERNATUM, ACHILLEA MILLEFOLIUM, BROMUS TECTORUM, FESTUCA IDAHOENSIS, PINUS PONDEROSA, COLLOMIA LINEARIS.

Land owner/manager: KOOTENAI NATIONAL FOREST, CABINET RANGER DISTRICT CORPORATE TIMBERLANDS

Comments: OBSERVED BY M. LEIGH. DISTURBANCE BY NOXIOUS WEEDS. AREA SURVEYED IN 1996 BY J. VANDERHORST; POPULATIONS NOT RELOCATED.

Information source: SENSITIVE PLANT COORDINATOR, KOOTENAI NATIONAL FOREST, 506 U.S. HIGHWAY 2 WEST, LIBBY, MT 59923.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLARKIA RHOMBOIDEA

Common Name: COMMON CLARKIA

Global rank: G4 Forest Service status: SENSITIVE

State rank: S2 Federal Status:

Element occurrence code: PDONA050X0.011

Element occurrence type:

Survey site name: BERRAY MOUNTAIN

EO rank: B

EO rank comments: MODERATE-SIZED POPULATION; WEED INFESTATION LIKELY
TO INCREASE.

County: SANDERS

USGS quadrangle: SMEADS BENCH

Township: Range: Section: TRS comments:

027N 033W 1 SE4

Precision: S

Survey date: 1996-06-30 Elevation: 2680 - 2880

First observation: 1996-06-30 Slope/aspect: 60% / SOUTH

Last observation: 1996-06-30 Size (acres): 1

Location: BERRAY MOUNTAIN. FROM TOWN OF BULL RIVER, GO WEST ON HWY 200
CA. 1.5 MILES, THEN TURN NORTH ONTO HWY 56. GO CA. 6 MILES NORTH ON
HWY 56 OFF OF HWY 56, TAKE FS RD 407 TO TRAIL 967. HIKE UP TRAIL PAST
STREAM CROSSINGS. SITE IS THE FIRST OPENING AFTER CROSSINGS ALONG,
ABOVE, AND BELOW THE TRAIL.

Element occurrence data: POPULATION ESTIMATED AT 200 INDIVIDUALS, ONE
SUBPOPULATION, 99% IN BUD, 1% EARLY FLOWERING.

General site description: STRAIGHT, OPEN TO SHADED SCREE MIDSLOPE, DRY SILTY
GRAVEL SOILS, BELT SEDIMENTARY PARENT MATERIAL. ASSOCIATED SPECIES:
PSEUDOTSUGA MENZIESII, ELYMUS SPICATUS, PINUS PONDEROSA, HOLODISUS
DISCOLOR, AMELANCHIER ALNIFOLIA, ACHILLEA MILLEFOLIUM, PENSTEMON
WILCOXII, BROMUS TECTORUM, APOCYNUM ANDROSAEMIFOLIUM, MONTIA
PERFOLIATA.

Land owner/manager: KOOTENAI NATIONAL FOREST, CABINET RANGER DISTRICT
Comments: TRAIL THROUGH POPULATION; A FEW EXOTICS.

Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,
MT 59935.

Specimens: VANDERHORST, J. (5577). 1996. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLARKIA RHOMBOIDEA
Common Name: COMMON CLARKIA
Global rank: G4 Forest Service status: SENSITIVE
State rank: S2 Federal Status:
Element occurrence code: PDONA050X0.012
Element occurrence type:
Survey site name: TEPEE RIDGE

EO rank:

EO rank comments:

County: SANDERS

USGS quadrangle: BIG HOLE PEAK

Township: Range: Section: TRS comments:

021N 027W 13 NWSW

Precision: S

Survey date: Elevation: 3300 -

First observation: 1996-07-11 Slope/aspect: 45% / 185

Last observation: 1996-07-11 Size (acres): 1

Location: DRIVE CA. 8 MILES NORTHWEST OF PLAINS ON HWY 200 TO THE WEEKSVILLE TURNOFF ONTO FS RD 887. GO 2.8 MILES TO JUNCTION WITH FS RD 18253, GO LEFT AT FIRST THEN IMMEDIATELY RIGHT ON FS RD 18253. BEST PARKING IS .35 MILES NORTH. PARK AND GO UP RIDGELINE BETWEEN TEPEE CREEK AND WEEKSVILLE CREEK, .2 TO .3 MILE UP GAME TRAIL, ABOVE LARGE ROCK OUTCROP.

Element occurrence data: EIGHT PLANTS, 20% IN FLOWER, 80% VEGETATIVE ONLY; SMALL SWEAT BEES WERE OBSERVED VISITING BOTH CLARKIA RHOMBOIDEA AND CLARKIA PULCHELLA BLOSSOMS.

General site description: OPEN, EXPOSED, ROCKY, VERY DRY LOWER RIDGE LINE. SOILS TYPIC USTOCHREPTS - ROCK OUTCROP COMPLEX, STREAM BREAKLANDS. ASSOCIATED PLANT SPECIES INCLUDE AGROPYRON SPICATUM, PURSHIA TRIDENTATA, EPILOBIUM SPP., CLARKIA PULCHELLA, AMELANCHIER ALNIFOLIA, PHYSOCARPUS MALVACEUS, PSEUDOTSUGA MENZIESII, PINUS PONDEROSA, BALSAMORHIZA SAGITTATA, FESTUCA OCCIDENTALIS, FESTUCA IDAHOENSIS, PENSTEMON SPP., ACHILLEA SPP., COLLOMIA GRANDIFLORA AND COLLINSIA PARVIFLORA.

Land owner/manager: LOLO NATIONAL FOREST, PLAINS/THOMPSON FALLS RANGER DISTRICT

Comments: CLARKIA RHOMBOIDEA SEEDS WERE POSSIBLY CARRIED TO THE SITE BY DEER OR OTHER WILDLIFE - THIS SMALL POPULATION IS ON A GAME TRAIL, WHILE MUCH OF THE SURROUNDING AREA SUPPORTS C. PULCHELLA. EVIDENCE OF DISTURBANCE INCLUDES LOGGING DEBRIS, BARE SOIL OF GAME TRAILS, ROADS ABOVE AND BELOW SITE AT SOME DISTANCE.

Information source: SENSITIVE PLANT COORDINATOR, LOLO NATIONAL FOREST, BUILDING 24, FORT MISSOULA, MISSOULA, MT 59801.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLARKIA RHOMBOIDEA
Common Name: COMMON CLARKIA
Global rank: G4 Forest Service status: SENSITIVE
State rank: S2 Federal Status:
Element occurrence code: PDONA050X0.013
Element occurrence type:
Survey site name: CAMP CREEK
EO rank: C
EO rank comments: FEW PLANTS, EXTREMELY HOT SITE, RELATIVELY FEW
WEEDS.
County: LINCOLN
USGS quadrangle: CROWELL MOUNTAIN
Township: Range: Section: TRS comments:
030N 033W 33 SW4NW4
Precision: S
Survey date: 1996-07-13 Elevation: 2920 - 3280
First observation: 1996-07-13 Slope/aspect: 60-80% / SOUTH
Last observation: 1996-07-13 Size (acres): 1

Location: FROM TOWN OF BULL RIVER, GO WEST ON HWY 200 CA. 1.5 MILES, THEN
NORTH ON 56 CA. 21 MILES ALMOST TO THE TOWN OF LITTLE JOE. FROM HWY 56,
GO UP FS RD 691 CA. 1 MILE TO A BRIDGE. POPULATION IS ON STEEP ON
SOUTH-FACING SLOPES TO THE NORTH.

Element occurrence data: 10 PLANTS COUNTED; 1 SUBPOPULATION; 70% IN FRUIT, 30%
IN FLOWER, MATURE FRUIT PRESENT.

General site description: OPEN, DRY MIDDLE SLOPE, GRAVELLY-SANDY SOILS, BELT
SERIES PARENT MATERIAL. PSEUDOTSUGA MENZIESII/ELYMUS SPICATUS HT,
WITH HOLODISCUS DISCOLOR, PINUS PONDEROSA, POLYGONUM SP.,
AMELANCHIER ALNIFOLIA, MAHONIA REPENS.

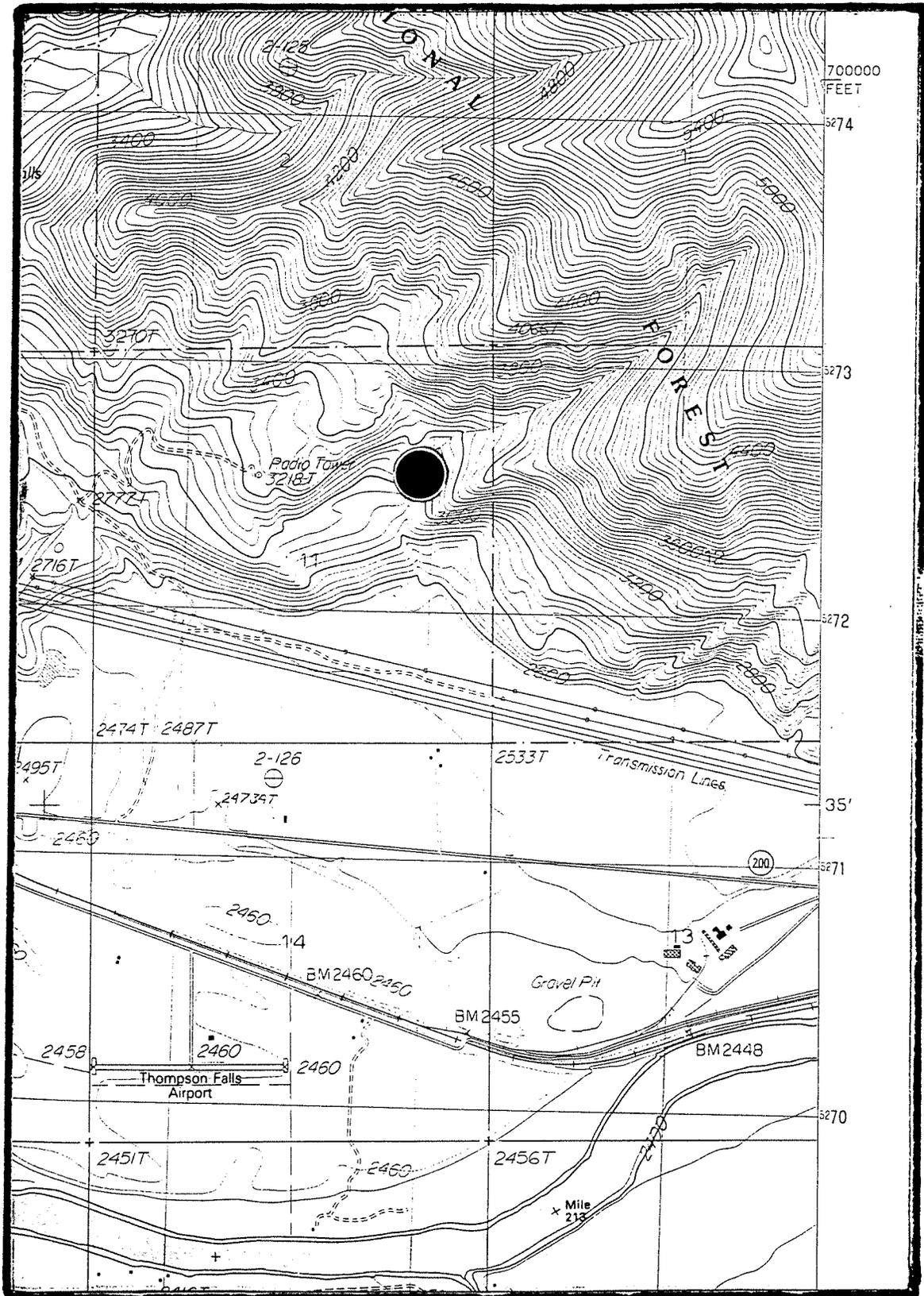
Land owner/manager: KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER
DISTRICT

Comments: FIRE SCARS ON LARGE PINUS PONDEROSA; PLANTS ARE GROWING IN
DISTURBED SOIL.

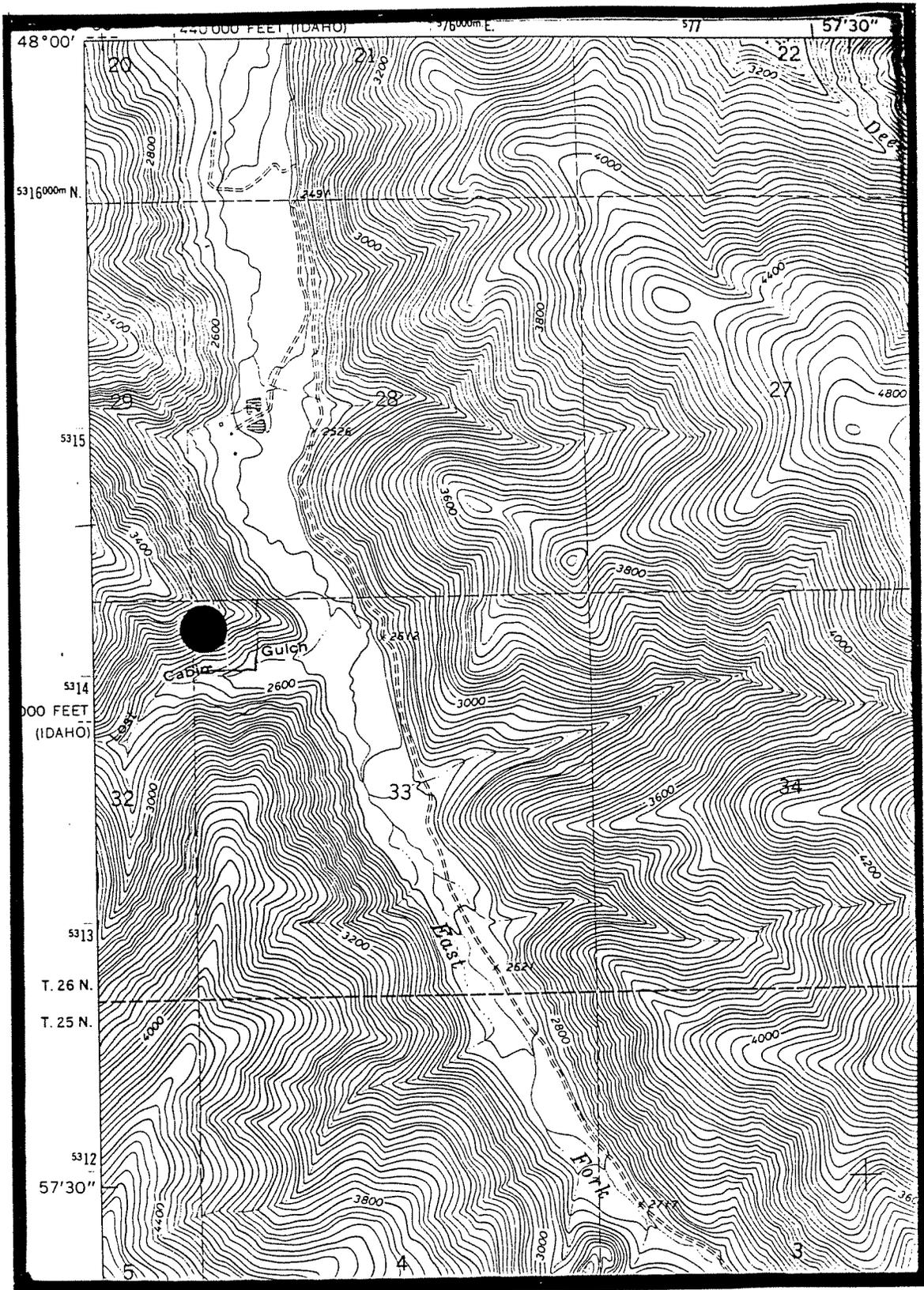
Information source: VANDERHORST, J. [BOTANIST]. P.O. BOX 1026, TROY,
MT 59935.

Specimens:

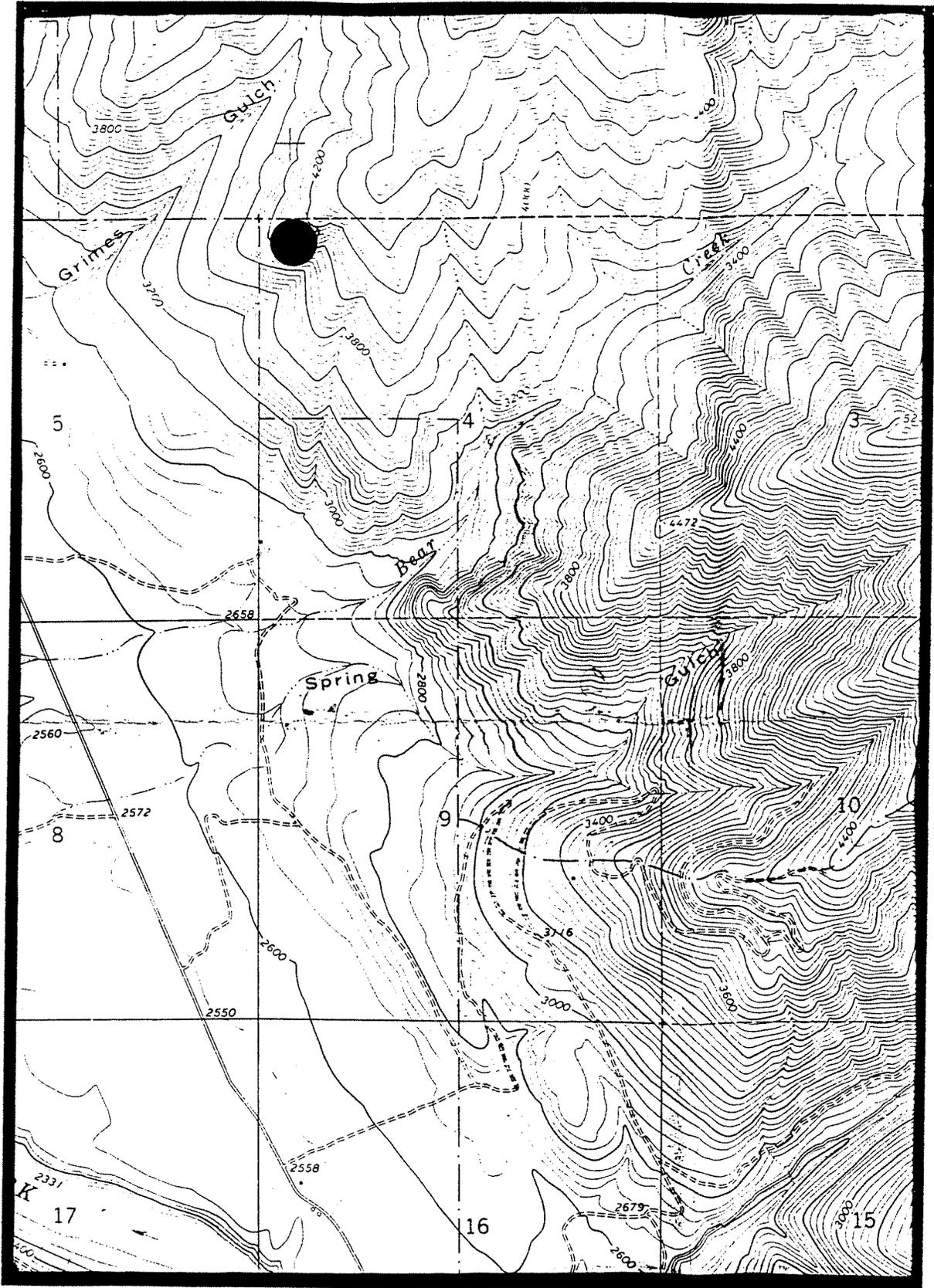
APPENDIX B: Topographic maps showing precise locations of EO's



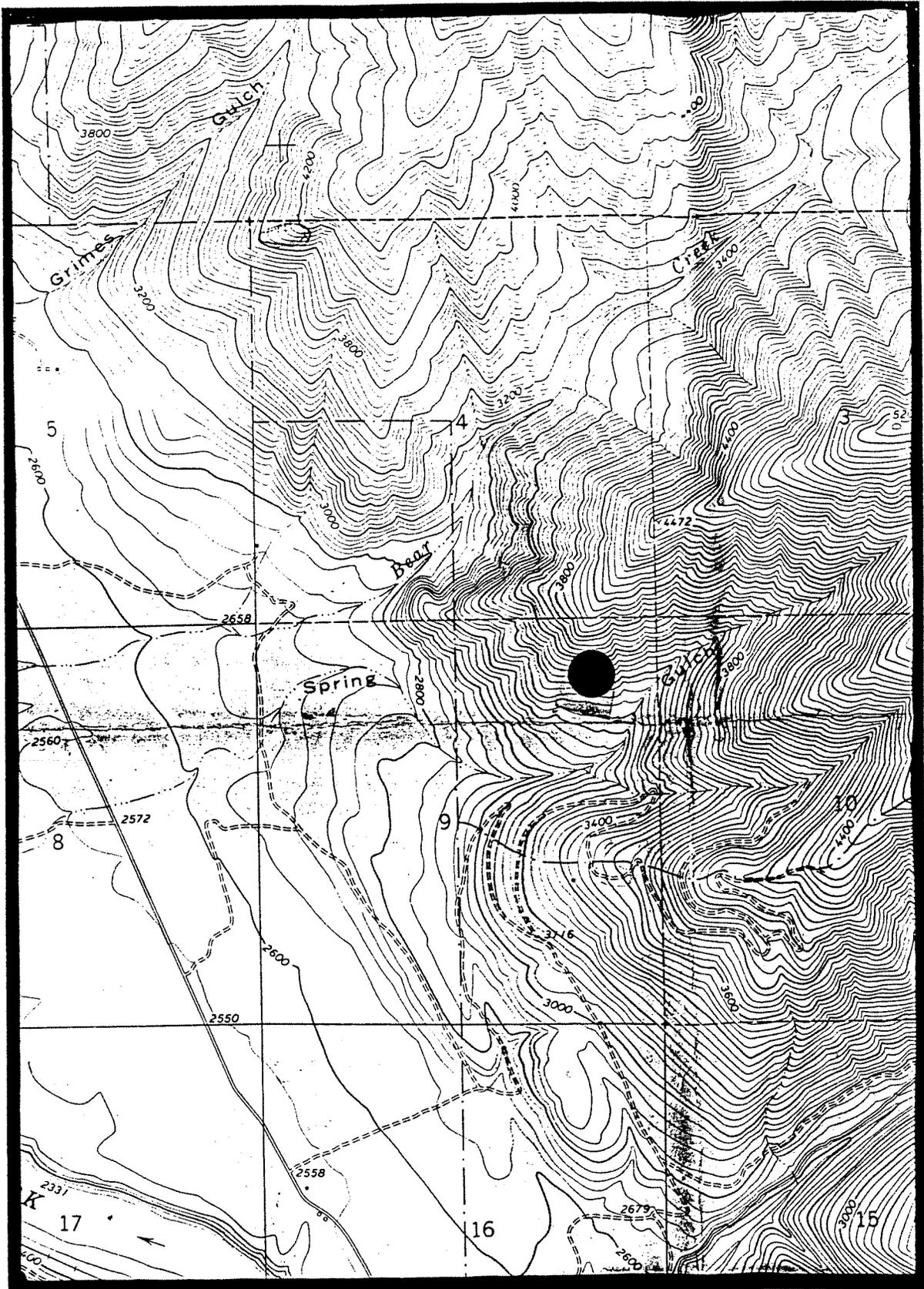
Clarkia rhomboidea; Calvin Wilson Ranch (002)
USGS Thompson Falls 7.5' quadrangle



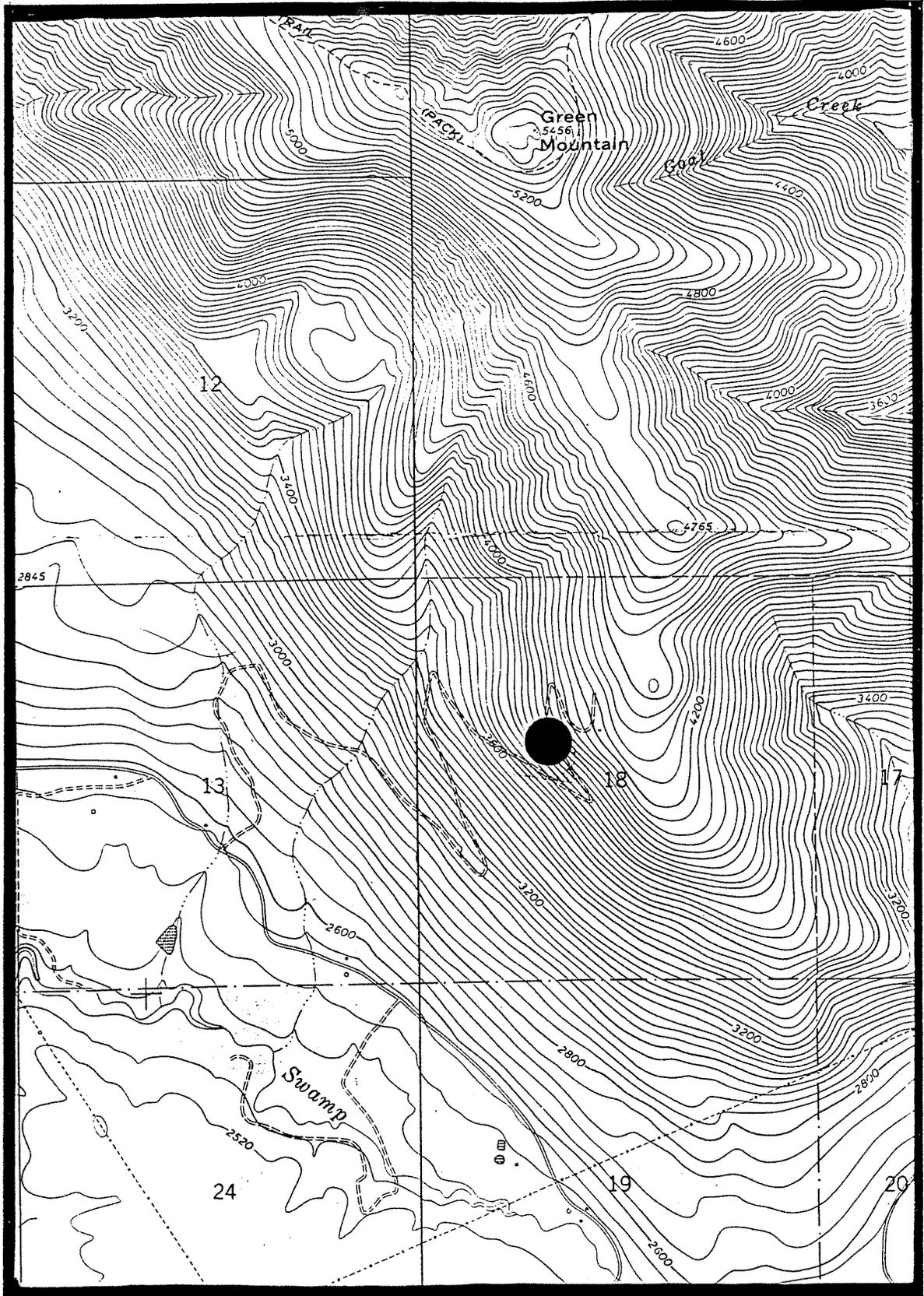
Clarkia rhomboidea; Lost Cabin Gulch (003)
USGS Gem Peak 7.5' quadrangle



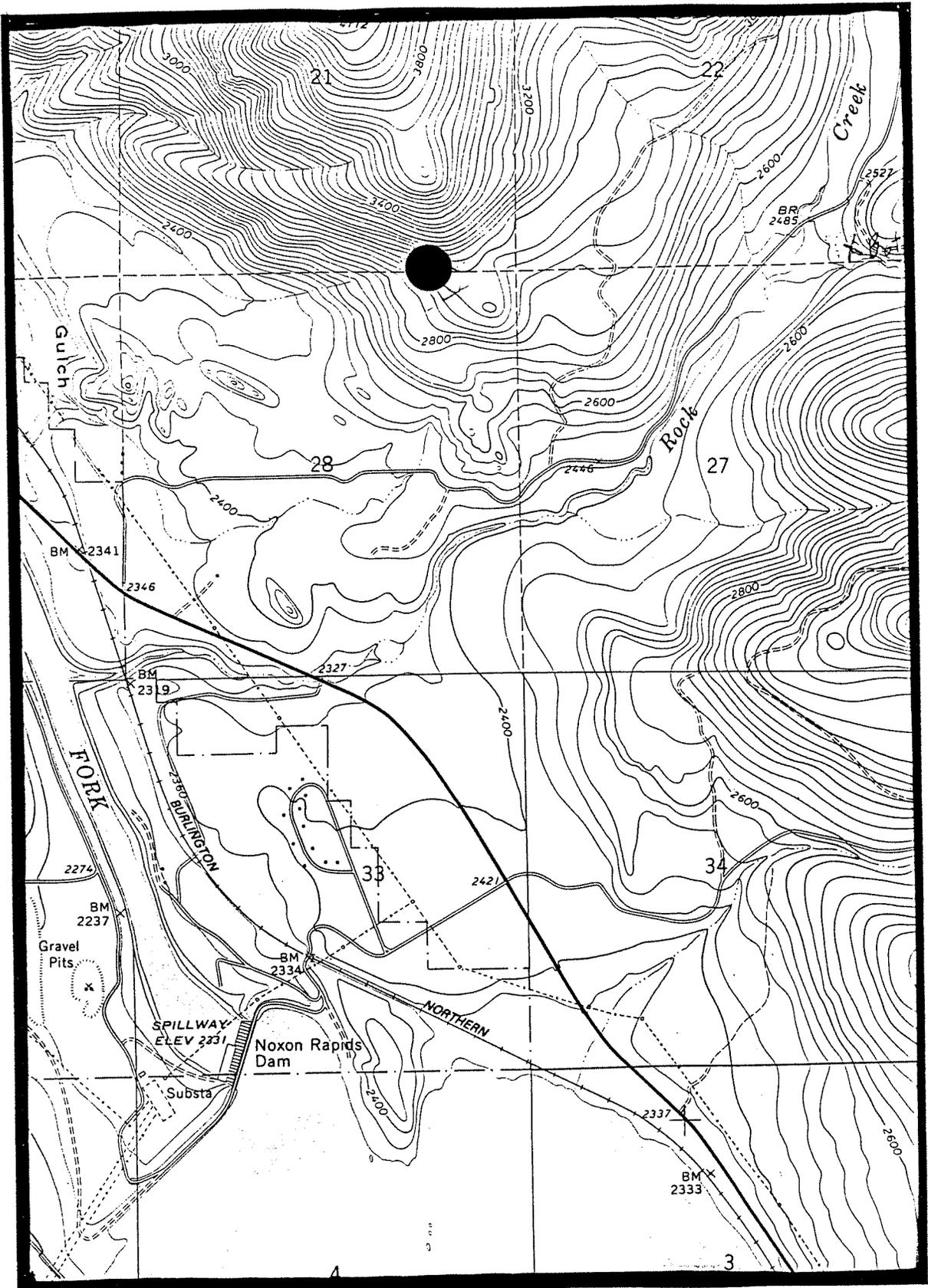
Clarkia rhomboidea; Grimes Gulch (004)
USGS Seven Point Mountain 7.5' quadrangle



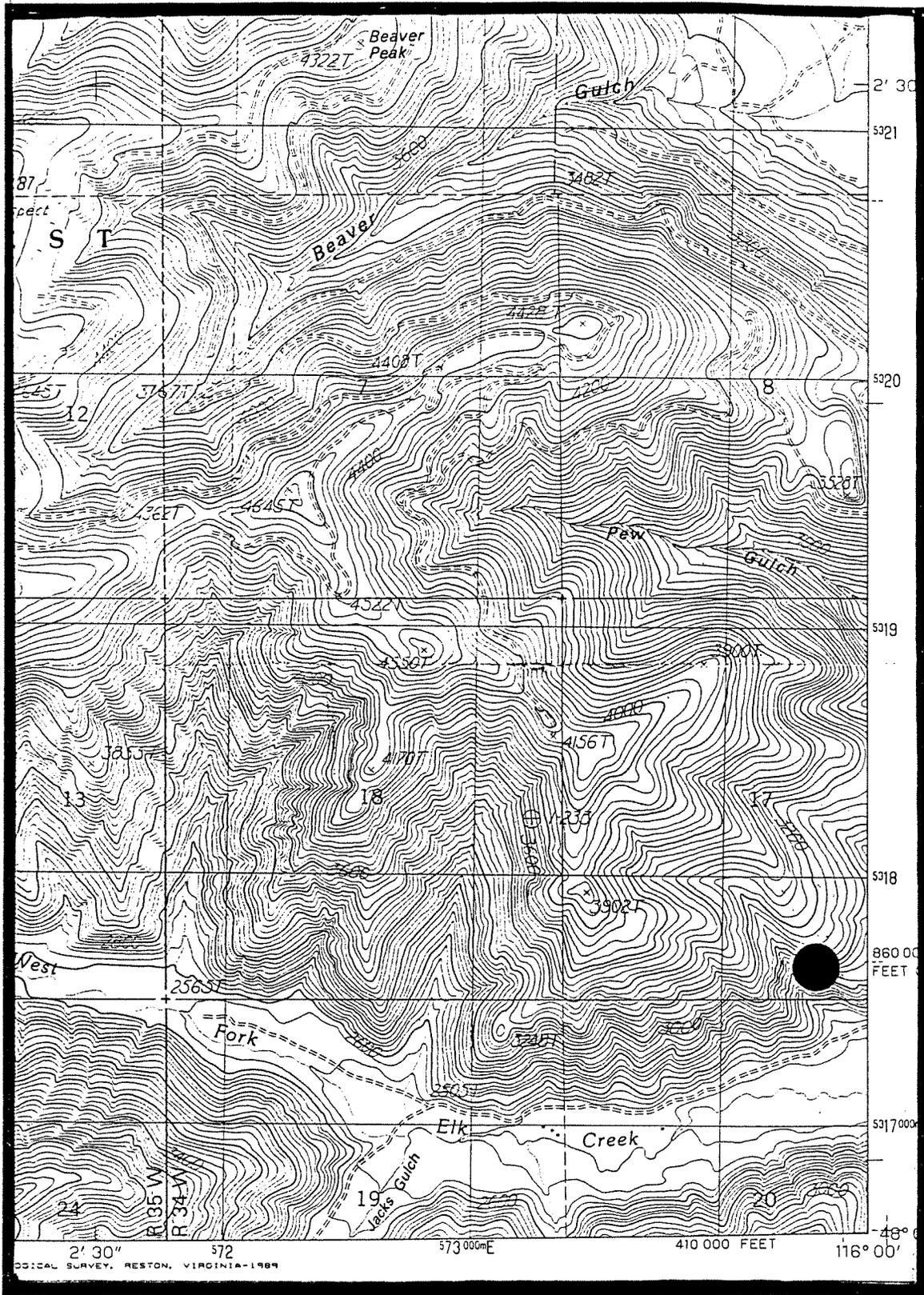
Clarkia rhomboidea; Spring Gulch (005)
USGS Seven Point Mountain 7.5' quadrangle



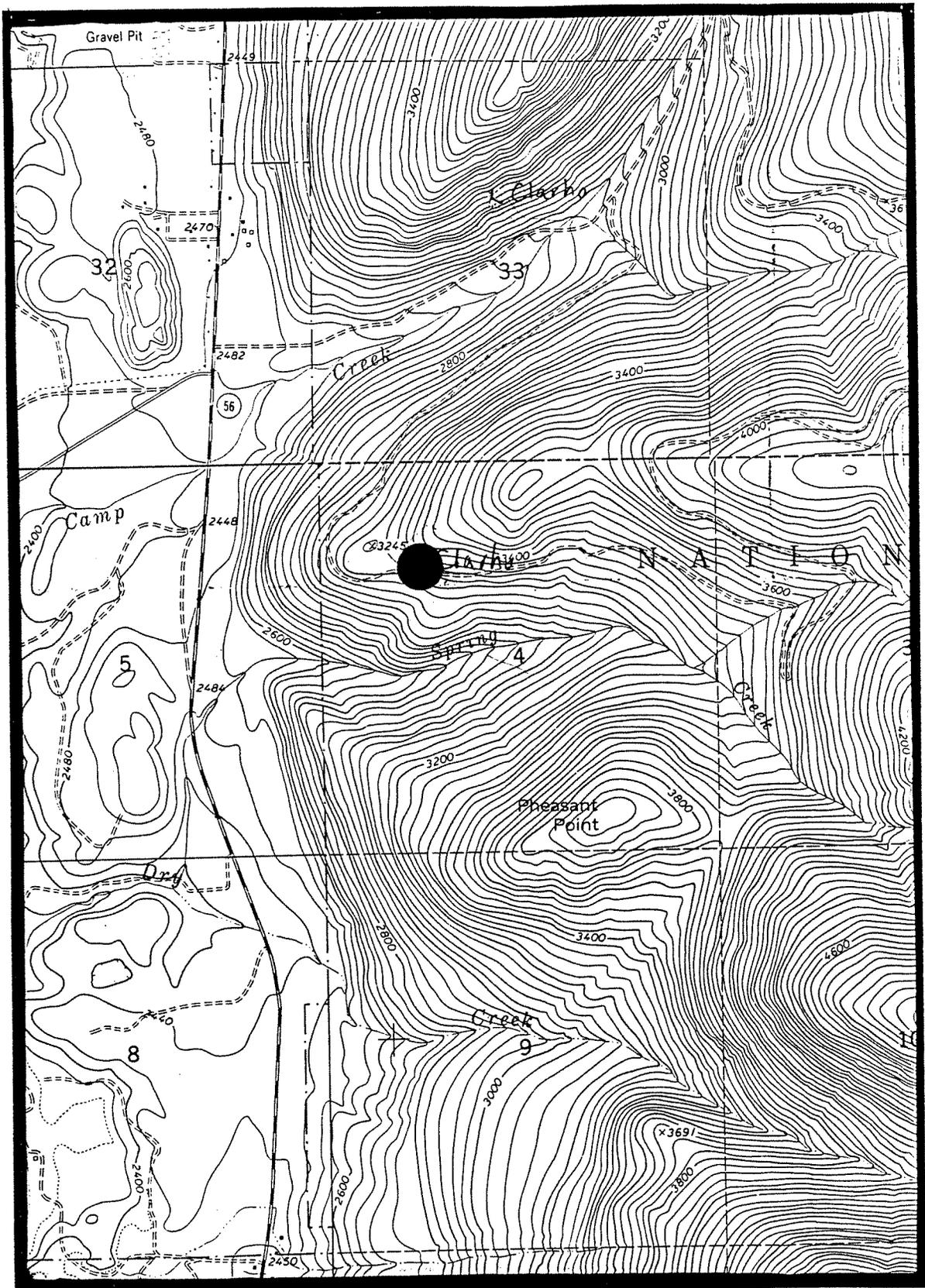
Clarkia rhomboidea; Green Mountain (006)
USGS Noxon Rapids Dam 7.5' quadrangle



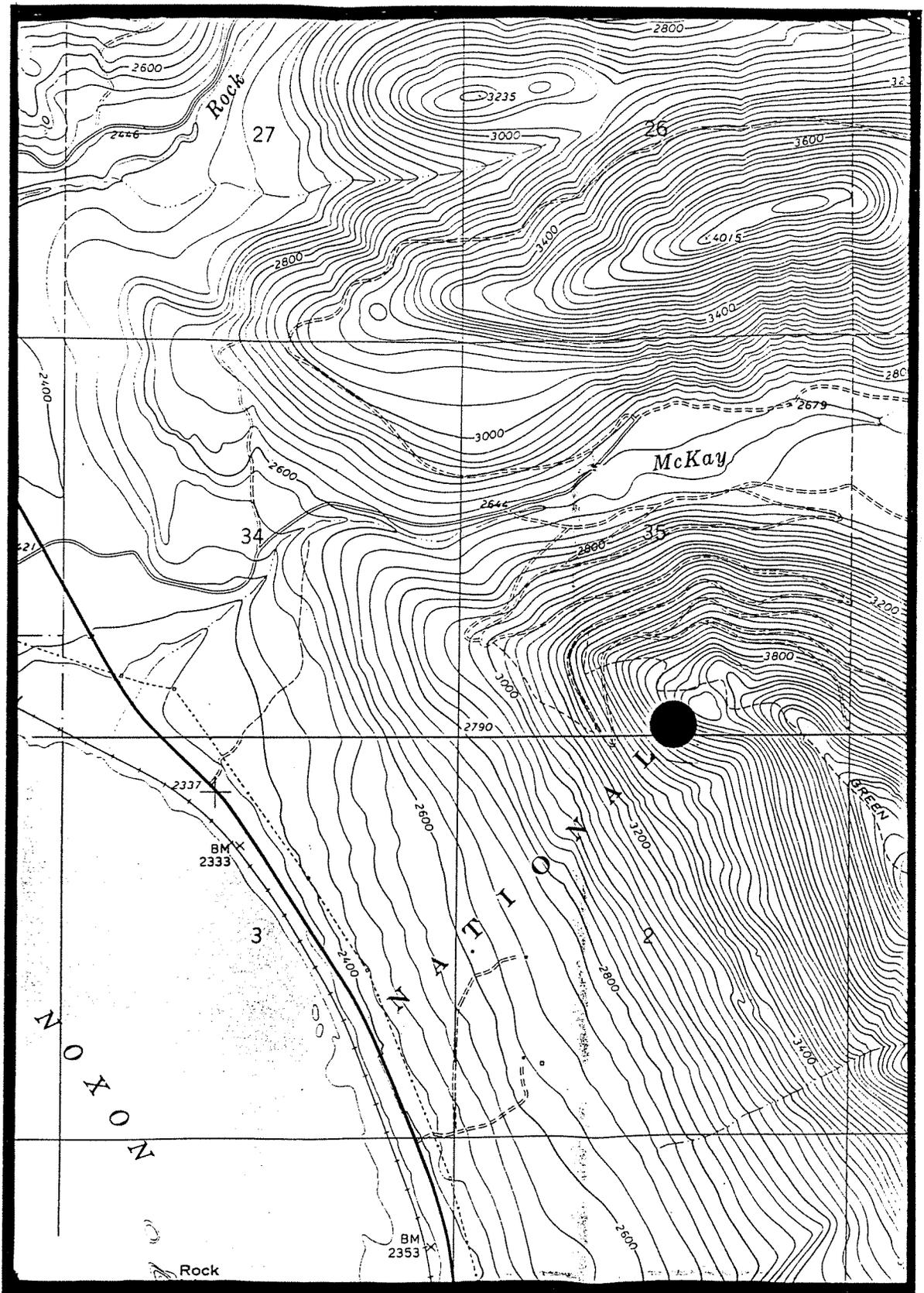
Clarkia rhomboidea; Rock Creek (007)
 USGS Noxon Rapids Dam 7.5' quadrangle



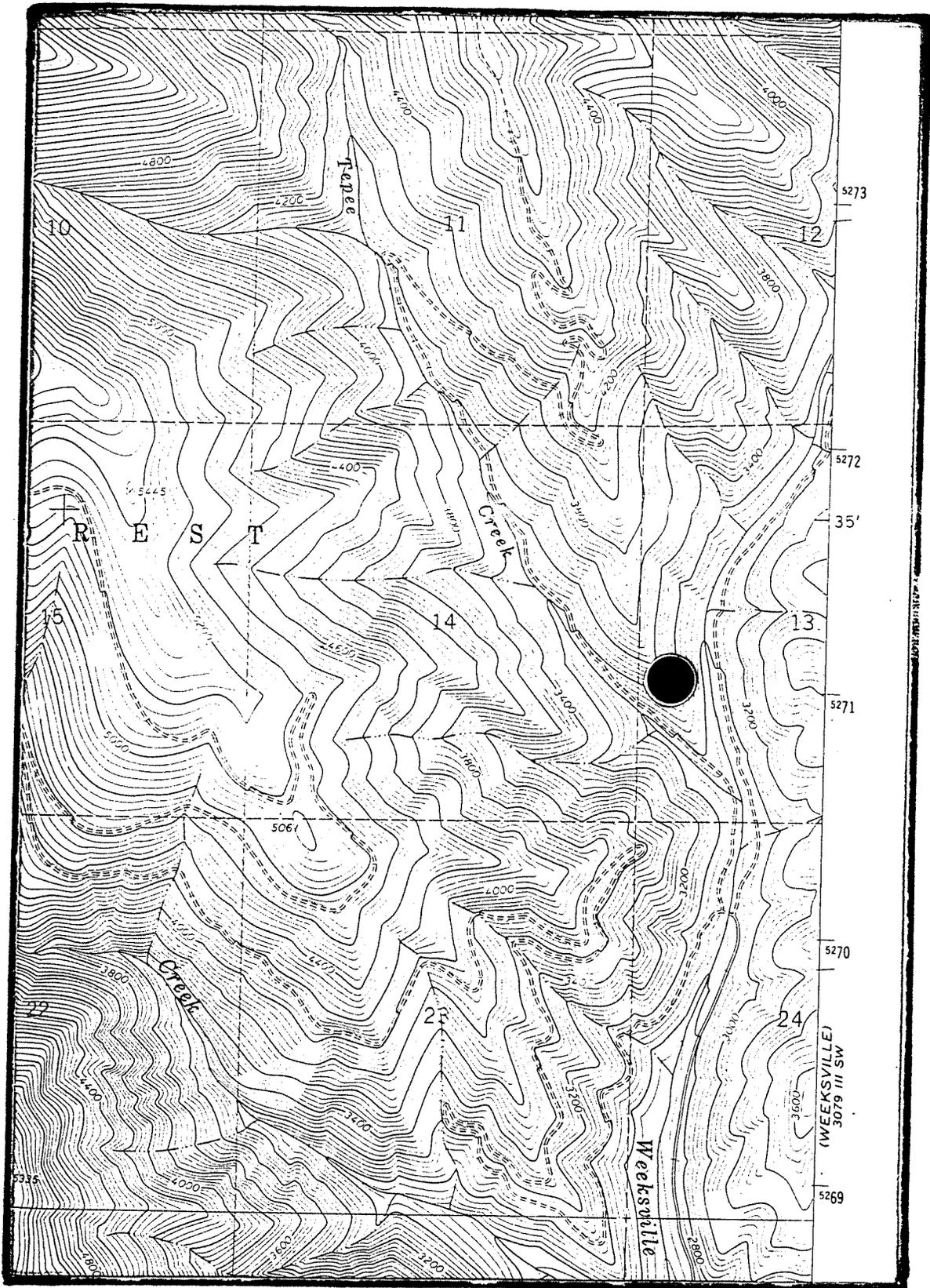
Clarkia rhomboidea; West Fork Elk Creek (008)
 USGS Cabinet 7.5' quadrangle



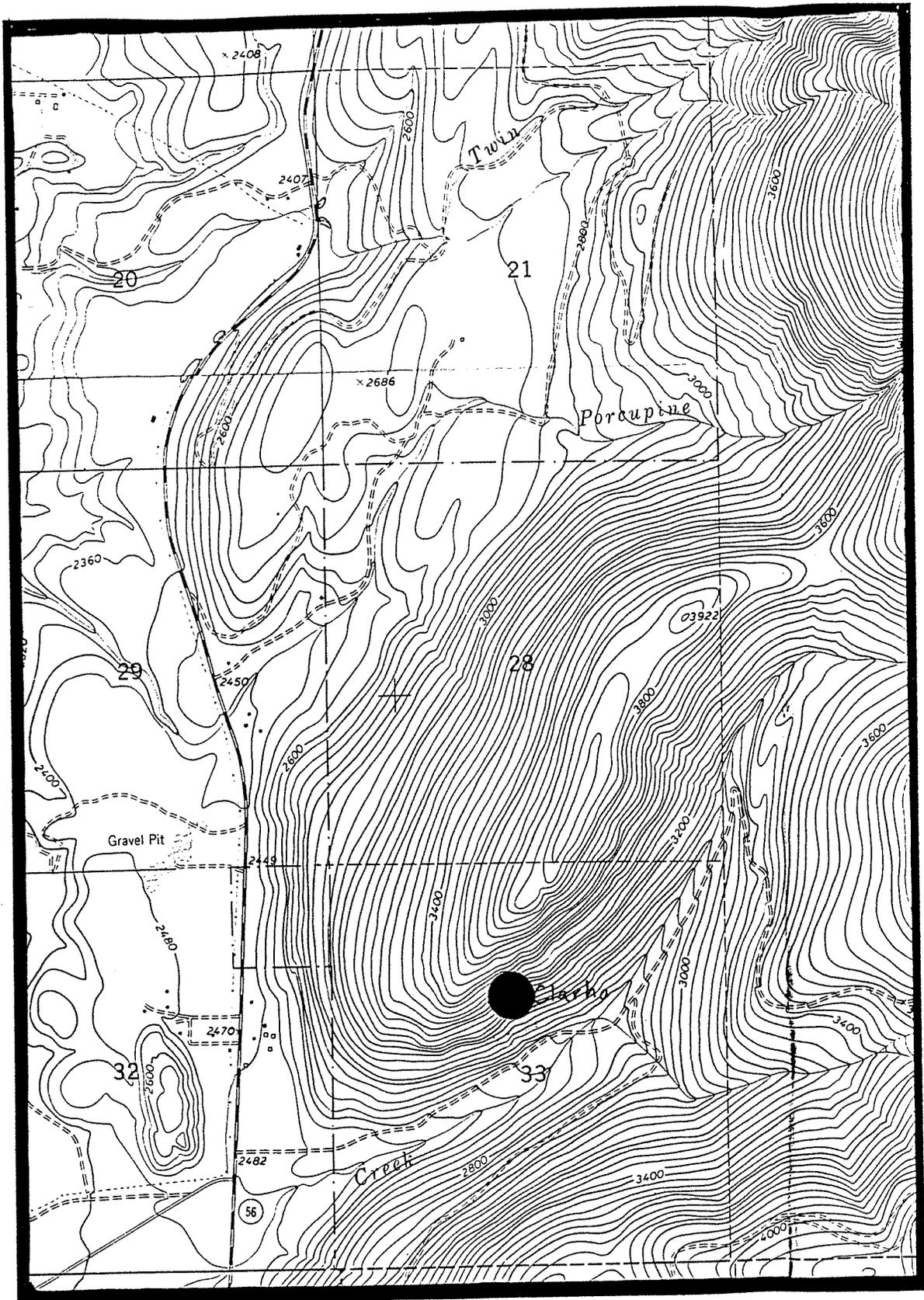
Clarkia rhomboidea; Spring Creek (009)
USGS Crowell Mountain 7.5' quadrangle



Clarkia rhomboidea; Noxon Reservoir (010)
USGS Noxon Rapids Dam 7.5' quadrangle



Clarkia rhomboidea; Teepee Ridge (012)
 USGS Big Hole Peak 7.5' quadrangle



Clarkia rhomboidea; Camp Creek (013)
USGS Crowell Mountain 7.5' quadrangle

APPENDIX C: Photographic slides. All pictures were taken by Jim Vanderhorst.

1. Plant in bud, 6/30/96 (Berray Mountain)
2. Plant with lateral flower and terminal flower bud, 7/19/96 (Rock Creek)
3. Close-up of flower, 7/19/96 (Rock Creek)
4. Close-up of fruit, 7/19/96 (Rock Creek)
5. Close-up of leaves, 7/19/96 (Rock Creek)
6. Habitat under *Pseudotsuga menziesii* at Berray Mountain, 6/30/96
7. Habitat under *Pseudotsuga menziesii* at Rock Creek, 7/19/96
8. Habitat in small opening at Rock Creek, 7/19/96

APPENDIX D. Close-up and Habitat shots of *Clarkia rhomboidea*

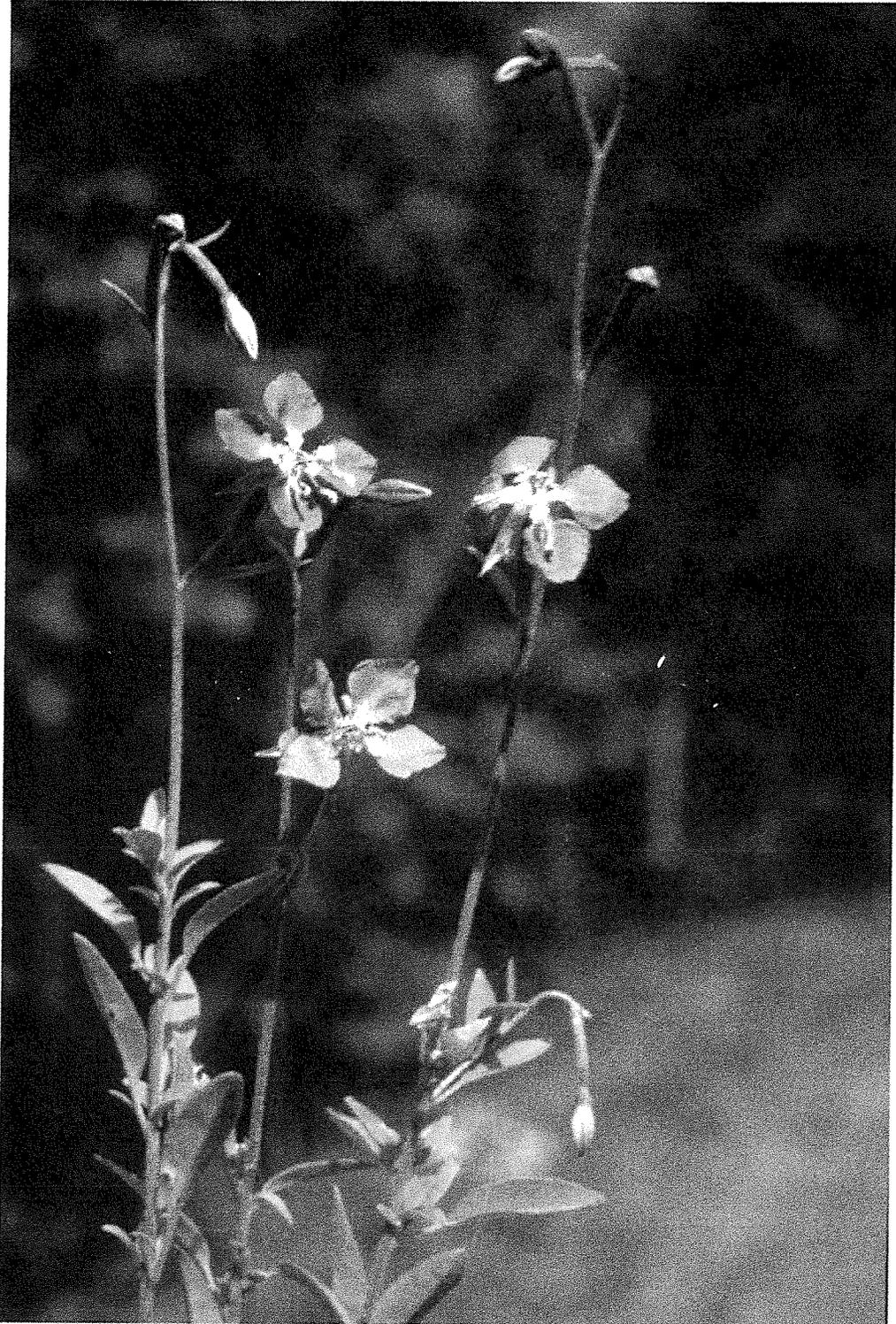


Photo by Dee Strickler

Clarkia rhomboidea - Closeup



Photo by Jim Vanderhorst

Clarkia rhomboidea - Habitat

