

surface hydrologic conditions due to the increased watering of the ballfield upslope from the preserve; changes in surface water quality due to the application of fertilizers, herbicides, and pesticides on the ballfield and adjacent areas up slope from the preserve; an increase in the number of nonnative plant species that will likely invade from adjacent newly altered areas; and an increase in the amount of soil erosion, soil compaction, and disturbance to the soil crust caused by the increased numbers of students, pets, and bicycles coming into the preserve from adjacent areas. The nature of the thin soils and the crusts of mosses and lichens they support make them particularly vulnerable to any form of surface disturbance (Belknap 1990).

The Scotts Valley Water District constructed a series of pipelines, maintenance roads, and tanks to distribute recycled water in the northern Scotts Valley area (EMC Planning Group 1998; Scotts Valley Water District 1998). One pipeline and an all-weather maintenance road pass through the southwestern corner of the preserve and continue to the north and west onto a parcel owned by the Salvation Army where a water tank would be installed. As originally proposed, this route was to come within 23 m (75 ft) of the colonies of *Polygonum hickmanii* on the Salvation Army parcel and within 18 m (60 ft) of the endangered *Chorizanthe robusta* var. *hartwegii* (K. Lyons, pers. comm., 1998). However, when road grading was initiated in July 1999, grading plans were not followed closely. Moreover, measures to minimize and mitigate impacts to sensitive resources included in the approved project were not implemented. As a result, road grading came to within 3 m (10 ft) of *P. hickmanii* and to within 6 m (20 ft) of *C. r.* var. *hartwegii* on the Salvation Army parcel; on the adjacent high school preserve, individuals of *C. r.* *hartwegii* were destroyed. (Vince Cheap, California Native Plant Society, *in litt.* 1999; V. Cheap, *in litt.* 2001).

The kinds of habitat alteration that are anticipated to impact *Polygonum hickmanii* from the Water District's project include changes in surface hydrology due to the placement of the road upslope from the colonies; changes in surface water quality due to the application of herbicides, pesticides, and tackifiers (dust reducing substances) on the road and roadsides upslope from the colonies; an increase in the amount of soil siltation from the upslope roadbank; soil erosion, soil compaction, and disturbance of the soil crust; and an increase in the number of

nonnative plant species that will likely invade from the road.

A visit to the Glenwood site confirmed that the nonnative plant *Genista monspessulana* (French broom) has invaded to within a few feet of one of the colonies of *Polygonum hickmanii* in the last few years (Carole Kelley, Friends of Glenwood, pers. comm., 1998). If not controlled, this invasive plant could quickly eliminate habitat for the *P. hickmanii*. French broom is considered a pest species, which in some places forms impenetrable thickets that displace native vegetation and lower habitat value for wildlife (Habitat Restoration Group, no date; Bossard, *et al.* 2000).

A housing development proposed for the Polo Ranch site includes 30 to 40 housing units clustered on 7.3 of 47.0 ha (18 of 116 ac), with the remaining 38 ha (95 acres) kept as open space (City of Scotts Valley 1998). At the time the proposed rule to list *Polygonum hickmanii* was prepared, the proposed development placed houses and roadways within 18 m (60 ft) or closer to five out of six colonies of *P. hickmanii* and separated the colonies from each other, with three of the six colonies isolated on all sides either by existing or proposed dwellings and roadways. As of 2002, the planned layout of houses has been modified to include a 31-m (100-ft) setback from all but one of the colonies (M. Fodge, Planning Department, City of Scotts Valley, pers. comm., 2002; G. Deghi, consultant, pers. comm., 2002).

Alterations of habitat for *Polygonum hickmanii* that are likely to occur as a result of the Polo Ranch development are changes in surface hydrologic conditions due to the grading of roads and lots; soil erosion, soil compaction, and disturbance of the soil crust by humans, pets, and bicycle traffic; inadvertent (*i.e.*, aerial drift) and intentional application of herbicides, pesticides, and fertilizers on roadsides and yards; inadvertent introduction of nonnative species (both weedy and ornamental); and dumping of yard wastes. Examples of alteration of habitat that have occurred on grasslands north of the backyards of existing housing along Navarra Drive (along the south edge of the Polo Ranch property) include gates and pathways leading from backyards onto the grassland, ivy creeping over fences and onto the grassland, oaks (*Quercus* sp.) planted within the grassland, and shade created by planted backyard trees (K. Lyons, pers. comm., 1998).

Although two of the projects (high school and recycled water distribution system) include plans for conservation

of *Polygonum hickmanii* through development-related mitigation, and the third project (Polo Ranch) would be expected to do so as well, the successful implementation of these mitigation plans has not been demonstrated. In particular, the size and characteristics of preserve areas and open spaces and the management actions prescribed through the environmental review process (see Factor D) are unlikely to be biologically adequate to ensure the long-term conservation of *P. hickmanii* and its habitat. In addition, since *P. hickmanii* colonies will be in preserves or open spaces that are small in area, support small numbers of individuals, and consist of degraded habitat, or that continue to receive secondary effects of adjacent human activities, they become more vulnerable to extirpation from naturally occurring events (see Factor E).

All habitat for *Polygonum hickmanii* is also threatened in general by the encroachment of nonnative grasses from the surrounding grasslands. Although several species of nonnative grass (*e.g.*, *Vulpia myuros*) grow within the wildflower fields, these patches for the most part do not support the abundant growth of nonnative grasses (*Bromus* sp.) that occur on the adjacent, more mesic grassland habitat. These nonnative grasses on the mesic grasslands do not compete with *P. hickmanii* in the classic sense (competition for light, water, nutrients). However, the tall culms (stems) of nonnative grasses can physically drape over patches of wildflower field habitat, particularly the smaller patches, and deposit a mat of litter (thatch) that physically prohibits the species within the wildflower field from appearing. Because nonnative grasses and herbs produce more biomass than their native counterparts, they also produce more litter (Belknap *et al.* 2001). Although decomposition rates for nonnative species are likely no slower than those of native species, their faster rate of biomass production results in a greater accumulation of litter. Other cases of native species being overtaken by litter accumulation produced by nonnatives have been noted in desert ecosystems (Jayne Belknap, Biological Resources Division, pers. comm., 1998) and on the California Channel Islands (Rob Klinger, The Nature Conservancy, pers. comm., 1998).

In summary, habitat alteration and destruction, including urban development, road construction, and their attendant secondary impacts (including increased trampling from humans, pets, bicycles, and installation and maintenance of landscaped areas),