The comparison of recent versus historical accounts of this species fails to document a decline. Although Stutz and Chu (1993) indicated that they could not find the species at any of the historical sites, it has since been rediscovered in Merced and Tulare Counties. Nevertheless, much suitable habitat of this species throughout the Central Valley has no doubt been lost or degraded, due to the same primary factors that have reduced populations of various other vernal pool-related species addressed earlier in this document.

One specific continuing threat is altered hydrology, which threatens the survival of *Atriplex persistens* in the East Grasslands of Merced County, where vernal pools have been flooded illegally for use as duck ponds (J. Silveira *in litt.* 2000).

e. Conservation Efforts

Atriplex persistens has no official Federal or State status. However, the California Native Plant Society has added it to List 1B of the sixth edition of their *Inventory of Rare and Endangered Vascular Plants of California* (California Native Plant Society 2001), indicating that they view the species as endangered throughout its range.

Although *Atriplex persistens* has not been the subject of focused survey efforts, it has been discovered during general surveys for vernal pool plants (Stutz and Chu 1993, Silveira 1996, D. Taylor *in litt.* 1997). Of the 29 *A. persistens* populations currently known to be extant, 19 (66 percent) are on public land or in nature preserves. However, no specific measures have been undertaken to conserve or manage for this species on these or other sites. The occurrences in public ownership include 11 on the Sacramento National Wildlife Refuge and 4 in Merced County: 2 in San Joaquin Grasslands State Park, and 1 each on the Arena Plains Unit of the Merced National Wildlife Refuge and the North Grasslands Wildlife Management Area. The two nature preserves where *A. persistens* occurs are the Jepson Prairie in Solano County and the Pixley Vernal Pool Preserve in Tulare County (Stutz and Chu 1993, D. Taylor *in litt.* 1997, California Natural Diversity Data Base 2001).

4. *ERYNGIUM SPINOSEPALUM* (SPINY-SEPALED BUTTON-CELERY)

a. Description and Taxonomy

Taxonomy.—Spiny-sepaled button-celery is a member of the carrot family Apiaceae. The scientific name first used for spiny-sepaled button-celery was *Eryngium globosum* (Jepson 1922). However, the name *Eryngium globosum* had already been used to represent an entirely different species, so Mathias (1936) changed the name of spiny-sepaled button-celery to *Eryngium spinosepalum*.

Hoover (1937) decided that this taxon was more appropriate at the rank of variety than species and thus suggested the name *Eryngium vaseyi* var. *globosum* in his thesis. Hoover's thesis did not meet the requirements for official publication of a scientific name; Mathias and Constance (1941) later properly published Hoover's combination *Eryngium vaseyi* var. *globosum*. That name remained in use until Sheik (1978) decided that spiny-sepaled button-celery deserved the rank of species and returned to the scientific name *Eryngium spinosepalum*, which remains in use (Constance 1993). However, some vernal pool experts (J. Stebbins *in litt.* 2000*a*) question whether spiny-sepaled button-celery should be considered a species due to the presence of intermediate forms. Other common names for this plant are spiny-sepaled coyote-thistle (Smith *et al.* 1980) and spiny coyote-thistle (EIP Associates 1994). The type locality of spiny-sepaled button-celery is Exeter, in Tulare County (Jepson 1922).

Description and Identification.—*Eryngium spinosepalum* has stout, branching, hairless stems 30 to 75 centimeters (11.8 to 29.5 inches) tall. The terrestrial leaves consist of a short petiole (less than 2 centimeters [0.8 inch] long) and a spiny-toothed or deeply-lobed blade 9 to 35 centimeters (3.5 to 13.8 inches) long. The flower heads of *E. spinosepalum* are spherical or egg-shaped, 0.8 to 2 centimeters (0.3 to 0.8 inch) in diameter, and contain more than 10 flowers each. Each flower head is on a stalk 2 centimeters (0.8 inch) long or less. The narrow bracts are spiny on the margin and on the underside, and typically protrude beyond the flower heads. Conversely, most bractlets are shorter than the flower head; each has a broad, papery margin at the base and only a few spines. The individual flowers of *E. spinosepalum* are tiny, with white petals and distinctive sepals. The sepals are 3.5 to 4.5 millimeters (0.14 to 0.18 inch) long, egg- or lance-shaped, and deeply divided into 3 to 8 spiny lobes or teeth. The fruits of *E. spinosepalum* are oblong to egg-shaped and 2.5 to 3 millimeters (0.10 to 0.12 inch) long (Jepson 1922, Abrams 1951, Mason 1957, Constance 1993). The diploid chromosome number of *E. spinosepalum* is 32 (Constance 1993).

Unlike *Eryngium constancei*, *E. spinosepalum* lacks hairs, has more than 10 flowers per head, the main stems are stout, and the stems supporting the flower heads are short. *Eryngium spinosepalum* is similar to both *E. castrense* and *E. vaseyi*, but both have narrower flower heads (no more than 15 millimeters [0.59 inch] in diameter) than *E. spinosepalum*. *Eryngium castrense* also has more deeply lobed leaves than *E. spinosepalum*, bracts and bractlets that are similar to each other and densely covered with spines, and bractlets that protrude well beyond the flower heads. *Eryngium vaseyi* also has deeply lobed leaves; the bracts and bractlets are similar to those of *E. spinosepalum*, but the sepals of the former are entire and shorter (2 to 3 millimeters [0.08 to 0.12 inch]) than those of *E. spinosepalum*.

Many plants found in nature are intermediate between *Eryngium spinosepalum* and either *E. castrense* or *E. vaseyi* in the size of the heads, length of the bractlets, and shape of the sepal margin. Moreover, individual plants and even single heads of *E. spinosepalum* may have both entire and toothed sepals (Hoover 1937, R. Stone *in litt.* 1992). The intermediate forms are thus difficult to classify, leading to uncertainties about the range of each taxon.

b. Historical and Current Distribution

Historical Distribution.—Typical *Eryngium spinosepalum* was known historically from the Southern Sierra Foothills Vernal Pool Region (Keeler-Wolf *et al.* 1998) in Fresno and Tulare Counties (**Figure II-26**). Hoover and others collected typical *E. spinosepalum* specimens from Orange Cove (Hoover 1937), east of Minkler, Sand Creek Basin, north of Sanger, and Squaw Valley, all in Fresno County (California Natural Diversity Data Base 2001). Specimens were collected from the following Tulare County sites between 1902 and 1954: Exeter, "Kaweah," Lemon Cove, Redstone Park near Visalia, west of Springville, and Woodlake (Jepson 1922, Hoover 1937, California Natural Diversity Data Base 2001). The exact location of Redstone Park (Hoover 1937) is not certain because it is not shown on maps, but it could possibly be in the San Joaquin Valley Vernal Pool Region rather than the Southern Sierra Foothills Vernal Pool Region. Plants intermediate between *E. spinosepalum* and *E. castrense* or *E. vaseyi* were found in the Central Coast, Livermore, and San Joaquin Valley vernal pool regions. The five westernmost locations were in Contra Costa, Merced, San Joaquin, and Stanislaus Counties (Hoover 1937). Additional sites farther east included at least three in Kern County (Hoover 1937, Twisselmann 1967) and one in Fresno County, where specimens were collected in 1971 (California Natural Diversity Data Base 2001).

Current Distribution.—The California Natural Diversity Data Base (2005) currently includes 59 extant occurrences of *Eryngium spinosepalum* and 4 that are known or presumed extirpated; it does not include intermediate populations. In addition, three of the typical populations reported historically are not included in the California Natural Diversity Data Base (2005), but could still be extant. Thus, 66 typical populations have been reported, of which 62 may remain extant. Thirty-three populations presumed to be extant are in Merced County, 14 are in Tulare County, 6 are in Fresno County, 3 are in Madera County 2 in Tuolumne County, and 1 in Calaveras County (Jepson 1922, Hoover 1937, California Natural Diversity Data Base 2005). Thirty of the Merced County

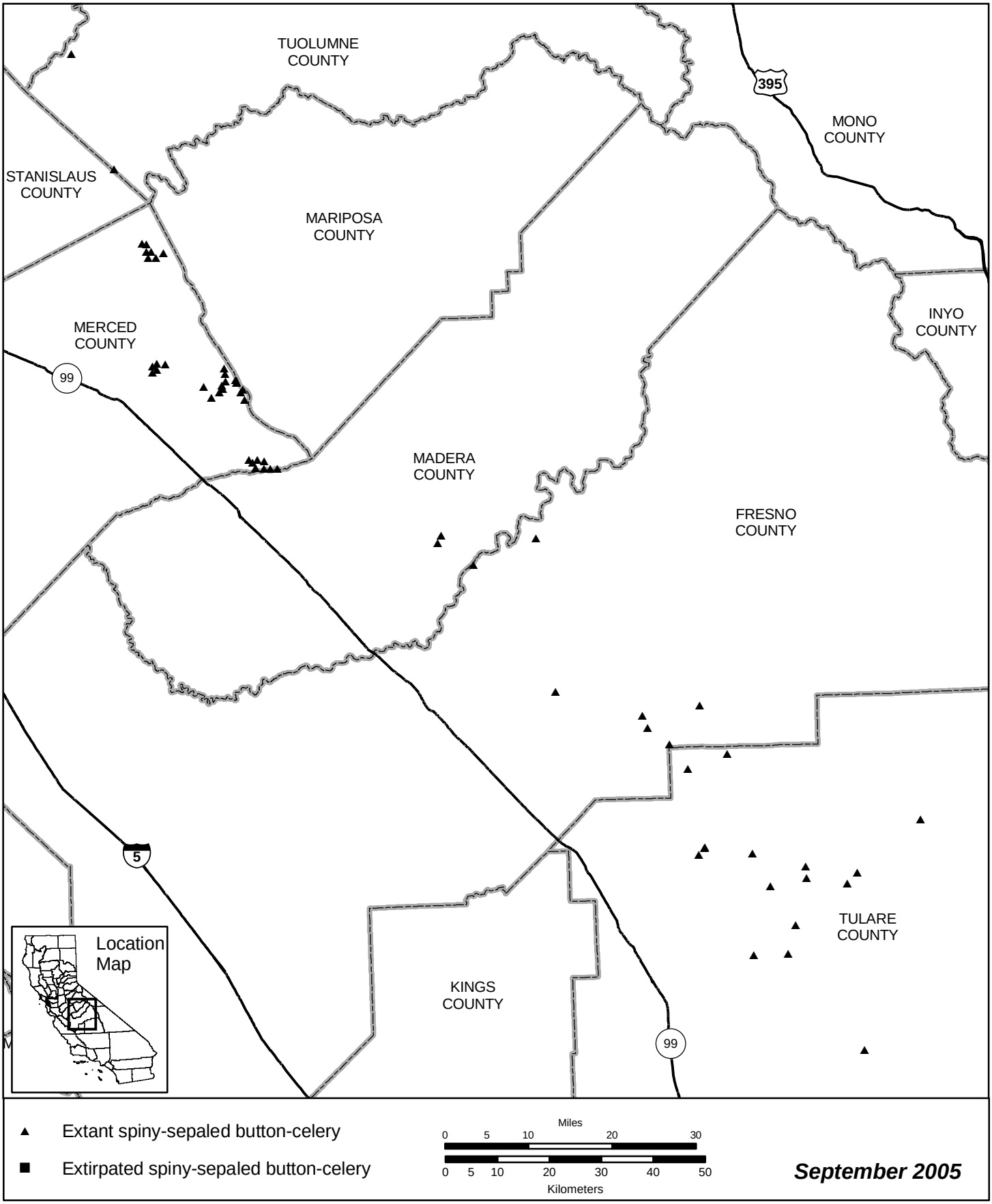

Figure II-26. Distribution of *Eryngium spinosepalum* (spiny-sepaled button-celery).

occurrences were reported in 2001 (Vollmar 2001) from eastern Merced County in the Owens Reservoir/Planada area, south of Le Grand, and in the Snelling area (California Natural Diversity Data Base 2005). Many populations of this species are isolated, but minor areas of concentration are in the vicinity of Lake Kaweah in Tulare County and in the Orange Cove-Kaktus Korner area spanning the Tulare-Fresno County line. Two sites are known near Seville in Tulare County, and two others are in the Four Corners area of Madera County. According to Keeler-Wolf *et al.* (1998), *E. spinosepalum* is restricted to the Southern Sierra Foothills Vernal Pool Region.

Intermediate forms of *Eryngium* and other populations whose identity has not been confirmed have been reported from a total of 15 sites. Seven of these populations are extant: three in Fresno County (S. Snover *in litt.* 1994), three in Madera County (R. Stone *in litt.* 1992), and one in Merced County (Stebbins *et al.* 1993). The eight historical localities of intermediates (Hoover 1937, Twisselmann 1967, California Natural Diversity Data Base 2001) have not been revisited in 30 to 60 years and may or may not be extant.

c. Life History and Habitat

Reproduction and Demography.—Unlike most of the vernal pool plants included in this recovery plan, *Eryngium spinosepalum* is a perennial. *Eryngium spinosepalum* flowers in April and May (Skinner and Pavlik 1994). Its pollinators, seed dispersal agents, and population demographics are unknown. As a perennial, population sizes probably do not fluctuate drastically between years, except in response to major disturbances.

Habitat and Community Associations.—*Eryngium spinosepalum* grows in both Northern Hardpan and Northern Claypan vernal pools (Sawyer and Keeler-Wolf 1995), as well as in roadside ditches (Mason 1957), depressions, and swales in annual grassland and oak woodlands (Twisselmann 1967, California Natural Diversity Data Base 2001). Characteristics of pools supporting *E. spinosepalum* have been described only from the Stone Corral Ecological Reserve in Tulare County. There, the species grew in two "swale-like" Northern Claypan Vernal Pools about 0.5 and 2.4 hectares (1.2 and 6.0 acres) in area, respectively. The smaller pool was about 41 centimeters (16 inches) deep, and the larger was more than 46 centimeters (18 inches) deep. Soil pH ranged from 6.1 to 7.1 at various points below the smaller pool and from 7.0 to 7.5 below the larger pool. Population size was in the thousands in the larger pool and in the hundreds in the smaller one (Stebbins *et al.* 1995). Both pools occur on Lewis clay loam over lime-silica hardpan at the rim of the saline-alkali basin (Stone *et al.* 1988).

Sites from which typical *Eryngium spinosepalum* has been reported range in elevation from 107 meters (350 feet) at Stone Corral Ecological Reserve to about 567 meters (1,860 feet) north of Marshall Hill in Fresno County (California Natural Diversity Data Base 2005). Intermediate forms of *Eryngium* have been reported from elevations of 67 meters (220 feet) in Merced County (Stebbins *et al.* 1993) to about 1,000 meters (3,281 feet) at Lynns Valley in Kern County (Twisselmann 1967).

Species most frequently associated with *Eryngium spinosepalum* include *Psilocarphus brevissimus*; upland grasses such as *Bromus* spp., *Hordeum marinum* ssp. *gussoneanum* (Mediterranean barley), and *Lolium multiflorum* ; unidentified species of *Plagiobothrys*; and other species of *Eryngium* (California Natural Diversity Data Base 2001). Listed vernal pool plants with which *E. spinosepalum* grows are *Chamaesyce hooveri* and *Orcuttia inaequalis*, both at the Stone Corral Ecological Reserve complex (Stone *et al.* 1988, California Natural Diversity Data Base 2005). An intermediate form of *Eryngium* also grows with *O. inaequalis* in Madera County (R. Stone *in litt.* 1992, J. Stebbins *in litt.* 2000*a*). *Brodiaea insignis* (Kaweah brodiaea), a State-listed endangered species that does not occur in vernal pools, grows with typical *E. spinosepalum* at three sites near Lake Kaweah (California Natural Diversity Data Base 2001).

d. Reasons for Decline and Threats to Survival

Most species addressed in this recovery plan are threatened by similar factors because they occupy the same vernal pool ecosystems. These general threats, faced by all the covered species, are discussed in greater detail in the Introduction section of this recovery plan. Additional, specific threats to *Eryngium spinosepalum* are described below.

One former population of *Eryngium spinosepalum* in Fresno County was extirpated by conversion to an orange grove. Another in Tulare County was in an area that has been developed for urban and agricultural uses (California Natural Diversity Data Base 2001).

Specific continuing threats include proposed construction of a new dam at Lake Kaweah, which would inundate one occurrence of *Eryngium spinosepalum* at the east end of the lake (U.S. Army Corps of Engineers 1996, California Natural Diversity Data Base 2005). Road construction and maintenance threaten one Fresno County occurrence and the two in Madera County. A development has been proposed for the single Tuolumne County site (California Natural Diversity Data Base 2005). In addition, many of the other occurrences representing typical *E. spinosepalum* face potential threats. Fourteen of the extant occurrences are threatened by conversion to intensive agriculture, particularly to citrus groves, or

by development for residential or urban uses. Although the pollinating agents for *E. spinosepalum* have not yet been determined, if insects are the pollinators a decline in their populations due to habitat loss is a potential problem.

e. Conservation Efforts

Eryngium spinosepalum has no formal protection at either the Federal or State level. This species was a Federal Category 2 candidate for listing (U.S. Fish and Wildlife Service 1985*c*) until we eliminated that classification (U.S. Fish and Wildlife Service 1996*a*). The California Native Plant Society has considered *E. spinosepalum* to be rare for many years (Smith *et al.* 1980) and currently includes this species on its List 1B, noting that it is endangered in a portion of its range (California Native Plant Society 2001). This species has not been targeted for any particular conservation efforts. The only protected occurrence of *E. spinosepalum* is at the California Department of Fish and Game's Stone Corral Ecological Reserve (Stebbins *et al.* 1995). Three other occurrences are on public land owned by the U.S. Army Corps of Engineers or the California Department of Transportation, but they are not free from threats (California Natural Diversity Data Base 2005).

5. *GRATIOLA HETEROSEPALA* (BOGGS LAKE HEDGE-HYSSOP)

a. Description and Taxonomy

Taxonomy.—Boggs Lake hedge-hyssop has been known by only one scientific name, *Gratiola heterosepala*, since it was first named by Mason and Bacigalupi (1954). The type locality is Boggs Lake, in Lake County (Mason and Bacigalupi 1954). This species is a member of the figwort family (Scrophulariaeceae).

Description and Identification.—*Gratiola heterosepala* is an erect annual with hollow stems 2 to 10 centimeters (0.8 to 3.9 inches) tall. The stems are mostly hairless, except for a few glandular hairs in the inflorescence. The leaves are opposite and have entire margins. Leaves near the base of the stem are 1 to 2 centimeters (0.4 to 0.8 inch) long and lance-shaped, but the leaves become shorter, wider, and blunt-tipped farther up on the stem. The 6 to 8 millimeters (0.23 to 0.31 inch) long flowers are borne singly in the upper leaf axils. Each corolla has two lips; the tube and upper lip are yellow, whereas the lower