

*colusana*. He collected the type specimen near the town of Princeton in Colusa County, but soon realized that the name *Stapfia* had already been assigned to a genus of green algae, and thus changed the scientific name to *Neostapfia colusana* (Davy 1899). Two other taxonomists proposed alternate Latin names for the genus in the same year, but neither is accepted today. There are no other known species of *Neostapfia* (Reeder 1982, 1993).

Currently, CNDDDB (2002) considers 41 occurrences of *Neostapfia colusana* to be extant and 19 other occurrences to no longer exist or to be possibly extirpated. Of the 41 extant occurrences, 23 occurrences of *N. colusana* are found in Merced County and 14 occurrences exist east of Hickman in Stanislaus County. Two occurrences each are found in southeastern Yolo County in central Solano County (Stone *et al.* 1988; Keeler-Wolf *et al.* 1998; CNDDDB 2002). This species has been extirpated from Colusa and Glenn Counties (CNDDDB 2002).

*Neostapfia colusana* occurs on the rim of alkaline basins in the Sacramento and San Joaquin Valleys, as well as on acidic soils of alluvial fans and stream terraces along the eastern margin of the San Joaquin Valley and into the adjacent foothills (Stone *et al.* 1988). *Neostapfia colusana* has been found in Northern Claypan and Northern Hardpan vernal pool types (Sawyer and Keeler-Wolf 1995) within rolling grasslands (Crampton 1959). This species typically grows in the deepest portion of the pool (Crampton 1959), but may also occur on the margins (Hoover 1937; Stone *et al.* 1988). Deeper pools are most likely to provide the long inundation period required for germination (EIP Associates 1999). It appears to favor somewhat larger vernal pools that are shallower as compared to other vernal pool plants. *Neostapfia colusana* occurrences vary in elevation from near 16 ft (5 m) to near 350 ft (100 m).

Vernal pool complexes that provide habitat for this species include two different physiographic and edaphic settings: (1) claypan soils of saline-alkali basins and remnant alluvial fans and (2) old stream terrace areas with strongly acidic, gravelly, and cobbly soils having an iron-silica cemented hardpan and shallow, slightly acidic residual soils of the Pentz series underlain by cemented tuffaceous alluvium. Additional settings for *Neostapfia colusana* are found in vernal pool complexes where resistant beds of tuffaceous deposits are exposed along intermittent drainages and, in Stanislaus County, neutral-to-slightly-alkaline claypan soils on dissected alluvial fans. Not all areas of *N.*

*colusana* have been identified as to the specific soil series or soil mapping units where they occur. However, in Merced County, *N. colusana* occurs on clay soils on Merhten and Laguna formations and Riverbank, North Merced gravels. Of the Orcuttiae grasses, *N. colusana* inhabits the widest range of vernal pool sizes, with the smallest being 1,075 ft<sup>2</sup> (100 m<sup>2</sup>) and the largest 618 ac (250 ha).

Solano and Yolo County sites where *Neostapfia colusana* grows contain vernal pools formed by soils in the Pescadero series, whereas those in central Merced County are formed by soils in the Landlow and Lewis series. The eastern Merced County and Stanislaus County sites include vernal pool habitats formed by the Bear Creek, Corning, Greenfield, Keyes, Meikle, Pentz, Peters, Raynor, Redding, and Whitney series (Stone *et al.* 1988; EIP Associates 1999; CNDDDB 2002). The type and composition of impermeable layers underlying occupied vernal pools also vary, ranging from claypan in the Sacramento Valley to lime-silica cemented hardpan in the San Joaquin Valley basins, to iron-silica cemented hardpan in the eastern margin of the San Joaquin Valley. Tuffaceous alluvium underlies some eastern San Joaquin Valley pools and intermittent streams where *N. colusana* grows (Stone *et al.* 1988).

Further discussion on the life history and habitat characteristics of *Neostapfia colusana* can be found in the final rule to list the species (62 FR 14338).

#### *Tuctoria greenei*

George Vasey (1891) originally assigned this species the name *Orcuttia greenei*. Edward Greene had collected the type specimen in 1890 (Vasey 1891), presumably in Butte County (Hoover 1941; Crampton 1959). Citing differences in lemma morphology, arrangement of the spikelets, and other differences, Robert Reeder (1982) segregated the genus *Tuctoria* from *Orcuttia* and created the new scientific name *Tuctoria greenei* (Greene's *tuctoria*).

*Tuctoria greenei* is an erect-to-low-growing annual with fragile stems that easily break apart at the nodes, which are often purplish. The leaves are flat and curve outward and the plants are sparsely hairy. The inflorescence is crowded near the tip, with the lower spikelets more or less separated. Optimum germination of *T. greenei* seed occurs when the seed is exposed to light and anaerobic (lacking oxygen) conditions after a cold period of time (stratification) (Keeley 1988). Germination occurs several months after initial inundation (Keeley 1998a).

*Tuctoria* seedlings do not develop floating juvenile leaves as does *Orcuttia* (Griggs 1980; Keeley 1998a). *Tuctoria greenei* flowers from May to July (Skinner and Pavlik 1994), with peak flowering in June and July (Griggs 1981; Broyles 1987).

*Tuctoria greenei* is known from 21 extant widely separated occurrences in Butte, Merced, Shasta, and Tehama Counties. Sixty percent of the extant occurrences of *T. greenei* are in the Vina Plains area of Tehama and Butte Counties. Eastern Merced County has about 30 percent of the known occurrences. Other occurrences are located in Glenn (Oswald and Silveira 1995) and Shasta Counties (CNDDDB 2002). *Tuctoria greenei* has been extirpated from Fresno, Madera, San Joaquin, Stanislaus, and Tulare Counties (Stone *et al.* 1988; Skinner and Pavlik 1994; CNDDDB 2002).

*Tuctoria greenei* has been found in three types of vernal pools: Northern Basalt Flow, Northern Claypan, and Northern Hardpan (Stone *et al.* 1988; Sawyer and Keeler-Wolf 1995). Occupied pools are (or were) underlain by iron-silica cemented hardpan, tuffaceous alluvium, or claypan (Stone *et al.* 1988). Of pools where the species was known to be extant in 1987, the median size was 1.5 ac (0.6 ha), with a range of 0.01 ac (50 m<sup>2</sup>) to 8.4 ac (3.4 ha) (Stone *et al.* 1988). Stone *et al.* (1988) noted that *T. greenei* grew in shallower pools than other members of the tribe or on the shallow margins of deeper pools, but they did not quantify pool depth. At the Vina Plains, *T. greenei* grew in pools of "intermediate" size, which dried in April or early May of 1995 (Alexander and Schlising 1997). The Central Valley pools containing *T. greenei* are (or were) in grasslands; the Shasta County occurrence is surrounded by pine forest (CNDDDB 2002). Occupied pools in the Central Valley are (or were) at elevations of 110 to 440 ft (33.5 to 134 m) (Stone *et al.* 1988), whereas the Shasta County occurrence is at 3,500 ft (1,067 m) (CNDDDB 2002).

In Tehama and Butte Counties, *Tuctoria greenei* grows mostly on Anita clay and Tuscan loam soils, with one occurrence on Tuscan stony clay loam. Soil types are not certain for several other occurrences in this region; one is on either the Rocklin or the San Joaquin series, and the others are unknown. On the eastern margin of the San Joaquin Valley, *T. greenei* is known to grow on a number of different soil series, including Archerdale, Bear Creek, Exeter, Meikle, Ramona, Raynor, Redding, and San Joaquin.

Further discussion on the life history and habitat characteristics of *Tuctoria*