From left: Photo 1. Open panicles of narrow manna grass (*Glyceria leptostachya*). Photo 2. The structural properties of manna grass provide shelter and substrate for organisms, such as damselflies.

SPECIES SPOTLIGHT: *by Jeffery T. Wilcox*[1] *Photos courtesy of the author*

The Sweet Green of Narrow Manna Grass (*Glyceria leptostachya*)

When I first read that the late 19th century botanist Joseph Burtt-Davy collected narrow manna grass (*Glyceria davyi* or Davy manna grass, now *Glyceria leptostachya*) in a marsh near Guerneville in 1899 (Baldwin et al. 2012), I wondered if his attention had been caught by one of the few green things growing in mid-summer. Long before 1893, when Davy arrived from his native England to study botany at University of California, Berkeley (Gunn 1940), California's native grasslands had been largely subsumed by alien annual species brought here by early European settlers. In much of California, the month of May brings a transition from green spring landscapes to the golden browns of summer, evidence of the senescence of these invasive annual grasses.

In 1896, Davy took a job as the botanist for the Agricultural Experiment Station at Berkeley where, over the next 5 years, he conducted an extensive survey of rangelands in northwestern California. The areas he surveyed included the immediate San Francisco Bay Area, along with Lake, Mendocino, Humboldt, Trinity, and parts of Siskiyou counties. Davy reported rangelands impoverished by overstocking and injudicious grazing methods, consisting primarily of alien annuals such as soft chess (*Bromus hordeaceus*), wild oat (*Avena* spp.), and alfilaria (now filaree; *Erodium* spp.), but noted that these species seemed to provide decent forage. Only in protected areas did he observe native ryes (*Elymus* spp.), bromes (*Bromus* spp.), hair grasses (*Deschampsia* spp.), June grasses (*Koeleria* spp.), and fescues (*Festuca* spp.) (Lamson-Scribner and Merrill 1900). Narrow manna grass would have been one of the few and brightest green sights during a long, hot summer.

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Narrow Manna Grass *continued*

Davy may also have been drawn by familiarity when he discovered manna grass. The *Glyceria* genus is well-represented in Europe and Asia, and it is likely that Davy came to know it when he was employed at Kew Gardens early in his career (Gunn 1940). The seeds of several species of manna grass were harvested for food throughout Europe during the middle ages, but due to their small size and labor-intensive harvesting, they were never developed as commercial crops. Nevertheless, sweet manna grass (*Glyceria fluitans*) was so prized in Europe that it was still gathered and traded, or presented as tribute, until the early 20th century. Sweet manna — as in "manna from heaven"— grass seeds contain approximately 75% carbohydrates. They were typically served as a dessert (the groats boiled into a sweet gruel), often with milk and cinnamon added (Luczaj et al. 2012).

Narrow manna grass is a perennial that grows in or near coastal wetlands and waterways from Alaska to California (Darris 2008). It has erect to low-lying stems 60–110 cm tall, with flat leaf blades (3–7 mm wide) that roll slightly inward and are rough on both sides (Baldwin et al. 2012). The flowerhead (panicle) is open (Photo 1), 20–40 cm long, with a few branches pressed close to the main axis (Darris 2008). In moist soils around seeps and springs, individual plants often retain a typical bunchgrass appearance, but manna grass produces rhizomes and stolons that sprout roots and, when plants are submerged in ponds or streams, floating leaves (Calflora 2018).

Here on the Mitsui Ranch, in the Coast Range of Sonoma County and approximately 25 miles from Guerneville, summers are hot and dry once June has passed. Most remaining green vegetation is a suite of invasive weeds, along with rushes, sedges, and manna grass in the wet areas. Grazing animals are attracted to these wet areas not only for water, but also for the green vegetation. Even the genus and species names for narrow manna grass (*Glyceria*, meaning "new, sweet from the taste of grain," and *leptostachya*, "thin ear of corn") promise a reward beyond succulence. In the spring of 2013 on the Mitsui Ranch, we collected random grass samples from several locations in pasture adjacent to two water bodies, Turtle Pond and Copeland Creek. We then collected manna grass samples from the edges of the same two water bodies. The pasture samples were dominated by varying combinations of Italian rye grass (*Festuca perennis*), soft chess, ripgut brome (*Bromus diandrus*), foxtail barley (*Hordeum murinum*), and seaside barley (*H. marinum*). In all nutritional categories except percent fiber, values for narrow manna grass collected in Turtle Pond and Copeland Creek were higher than those of traditional forage plants (Table 1).

Narrow manna grass, in addition to its nutritive and succulent value to a host of animals, provides another, less-considered benefit: an important structural element in the landscape for shelter, cover, thermoregulation, and attachment substrate for many living organisms (Photo 2). Consider Turtle Pond on the Mitsui Ranch: a small, deep, perennial pool that by July resembles an emerald ring floating amid a sea of dry grass (Photo 3). Much of the ring is composed of narrow manna grass, some growing on the bank, some rooted in the mud left after the water has receded. A night-time walk around the shoreline reveals a busy insect community. Stretch spiders (*Tetragnatha* spp.) anchor their webs between stalks and leaves of overhanging manna grass, extending their webs over the water to catch flying insects that hunt or feed at the surface or insects feeding directly on the manna grass, such as caterpillars and true bugs like leafhoppers. Lurking in the water below the overhanging manna grass, frogs await the same suite of insects — and often make a meal of the stretch spiders as well (Photo 4). When we examined the stomach contents of a bullfrog (*Lithobates catesbeianus*) that had been stationed under a ceiling of manna grass, it contained the remains of 13 stretch spiders (Alvarez and Wilcox, unpublished data).

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Photo 3. Narrow manna grass forms a ring of green around Turtle Pond, Mitsui Ranch, Sonoma County, California.

Table 1. Some standard nutritional values for narrow manna grass (*Glyceria leptostachya*); the mean values of eight (mixed) alien annual grass samples; Medusa head (*Elymus caput-medusae*); and yellow star thistle (*Centaurea solstitialis*). ENE (estimated net energy) is the energy leftover after metabolism and heat loss, and NEL (net energy for lactation) is the energy leftover after a cow's maintenance needs for supporting a fetus.

	Crude Protein	Fiber	Nitrogen	Phosphorus	Calcium	% Digestible Nutrients	NEL	ENE
Manna grass	14.69	31.26	2.35	0.45	0.37	67.53	0.7	57.6
Annual grasses	9.3	44.7	1.5	0.2	0.5	52.6	0.5	43.8
Medusa head	7.19	40.1	1.15	0.145	0.45	57.79	0.59	48.63
Yellow star thistle	8.88	40.43	1.42	0.2	1.36	57.33	0.58	48.21

Narrow Manna Grass *continued*

Islands of manna grass can form in a pond when rhizomes and stolons sprout roots offshore. These islands provide a different structural habitat altogether for pond-dwelling creatures. Under the water surface, amidst the stolons, microorganisms feed on spent plant parts and on algae that grows on the underside of the submerged plant. In turn, microorganisms provide food for scuds (Amphipoda family), small, shrimp-like creatures that forage among the stolons and lay eggs on the surface of submerged vegetation. Scuds are prey for larger aquatic insects, as well as for frogs and salamanders. In Turtle Pond, scuds are the primary food source for a robust population of rough-skinned newts (*Taricha granulosa*), and manna grass is the scud nursery.

Narrow manna grass is an important structural feature in streams as well. Copeland Creek is an intermittent creek that drains much of the Mitsui Ranch property. Narrow manna grass overhangs the edges of runs and pools and even grows into the flowing water. Rhizomes that anchor between the cobbles of the streambed (Photo 5) provide a substrate in the current. Often the anchorage is so firm that rhizomes and stolons hold fast through the high flows of winter, even as the plants lose their leaves. These solid tangles in midstream in turn provide holdfasts for organisms to grasp — or anchor their eggs to — to avoid being swept away. One benefiter is the California red-legged frog (*Rana draytonii*), a native frog in decline throughout its historic range, and listed as "threatened" by the U.S. Fish and Wildlife Service. During their breeding period in late winter, California red-legged frogs attach their egg masses to aquatic vegetation to prevent them being swept away (Alvarez et al. 2013, Wilcox et al. 2017). Ponds are a recent geographic feature in California; most were constructed in the past century for flood control, recreation, or to water livestock and crops. Prior to this, the frogs must have used streams for breeding (see Alvarez et al. 2013), but biologists have wondered how large egg masses could survive running water. This past winter provided a clue. For the first time in six years of annual surveys, we discovered a red-legged frog egg mass in a run in Copeland Creek, firmly attached in a tangle of stolons of narrow manna grass.

Photo 4. A California red-legged frog (*Rana draytonii*) lies in ambush under the leaves of narrow manna grass at Turtle Pond, Mitsui Ranch, Sonoma County, California.

In our evolutionarily recent time on the planet, humans have counted on grasses for our very survival. Some provide us food (corn, rice, wheat, barley, etc.); some, shelter (thatched roofs, bamboo flooring); some, once we started raising food animals, livestock feed. The same is true for wild organisms that coevolved with uncultivated

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Narrow Manna Grass *continued*

grasses. They use grass for food, for shelter, or simply for infrastructure to support critical behavior such as egg-laying. Narrow manna grass appears to have comprehensive value in its native range, well beyond being a rare green sight in the heat of summer.

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Photo 5. Narrow manna grass stolons (center of channel), after high-velocity stream flows in Copeland Creek wash the leaves off. Individual plants on shore remain intact (center right). These tangles of stolons are sometimes attachments sites for the egg masses of California red-legged frogs.