PRAIRIE GROMWELL IN KENTUCKY

Notes by
Julian Campbell

Front cover: largest known population of gromwell in Kentucky, cultivated by the author on Greentree Road, Lexington, Fayette Co. [1].
Above, close-up of flowers [2].
Upper right, seeds [3].
Lower right, fruiting plant [4].
Back cover: habitat in Ohio [6]; habit in Va. [7].
Photos 2-6 are by Steve Wilson (Adams Co., Ohio).

Prairie Gromwell in Kentucky: the ecology of *Onosmodium* [Boraginaceae].
Notes by Julian Campbell, Aug 2012; http://bluegrasswoodland.com/Notes_on_Species.html

Taxonomic Notes. *Onosmodium* is a North American genus of the 'comfrey family' (Boraginaceae). Some recent authors have replaced these plants into *Lithospermum*, a much more widespread genus of temperate regions (Weakley et al. 2011). The common name 'gromwell' [possibly from 'crane's millet' in old English or Latin] has been applied to species of both genera. In both, seeds form within smooth glossy 'nutlets' that are 1-5 mm long—an unusual type of fruit resembling only *Scleria* ('nut-rushes') in the Kentucky flora. These seeds have led to the common names 'stone-seed' (*Lithospermum*) or 'marble-seed' (*Onosmodium*). Both occur mostly in thin woods and grassland on dry rocky sites, especially on base-rich soils. *Onosmodium* tends to be taller and more concentrated in open areas, especially where there is a history of larger herbivores. In Kentucky, there is little overlap of habitats between native species of the two genera.

Consensus on taxonomic treatment of *Onosmodium* has been lacking; see Campbell & Medley (2012) for detailed notes—nomenclature below for all vascular plants follows that source. Seven to ten taxa are recognized in the genus, largely occupying different geographic ranges. These are treated here as species, but several authors have preferred subspecific ranks. There are no reports of more than one species occuring at the same locality—within 10 miles or so of each other, at least in Kentucky and Tennessee (D. Estes, pers. comm.). Within the '*bejariense*/*molle*-group' there may be some intergradation between taxa, and identification of disjunct records has been controversial or uncertain in some cases (Baskin et al. 1983, Turner 1995, Weakley 2011). In Kentucky, most collections are *O. hispidissimum* [*O. molle* var.

hispidissimum], a taxon centered in states east of the Mississippi River. The two western-most collections—from Livingston and Crittenden Counties (Figure 1)—have been referred to *O. occidentale* [*O. molle* var. *occidentale*]—a taxon centered in the northern Great Plains. However, using Turner's key and current revision by D. Estes and T. Whitsell (pers. comm.), those two plants now appear to be *O. bejariense*—a taxon centered from the southern Great Plains to the Mississippi River. A few collections from the Big Barrens region—at least Logan County—have been referred to *O. molle* [sensu stricto], which is largely restricted to the Nashville Basin. These collections may be intermediate between *molle* and *hispidissimum*.

Imperiled Status. *Onosmodium* is not common anywhere, and it is threatened or endangered in several regions (NatureServe 2012). It remains secure in much of the Great Plains (mostly as *occidentale* to north or *bejariense* to south) and in the Ozark region (mostly as *subsetosum*). On the southeastern Coastal Plain (mostly as *virginianum*), it is secure in the Gulf States but "vulnerable" to extinct in mid-Atlantic states. Narrow endemics that are probably not secure occur in Alabama (*decipiens*), Texas (*helleri*) and Mexico (3 species). In more northeastern regions, from the inner Coastal Plain to the Great Lakes, the genus (mostly as *hispidissimum*) is generally vulnerable to endangered. Among all states, *hispidissimum* may be secure only in West Virginia and Virginia, where it occurs in old pastures of the Ridge-and-Valley region.

In Wisconsin, the general association of *Onosmodium* (as *molle* var. *occidentale*) with old pastures led Williams (1996-2000) to an insightful study of its ecology and entomology. He summarized (1999b): "Among Wisconsin prairie managers, cattle have been taboo. Yet many prairie plants and animals were found on some dry prairie pastures in the course of research during 1993-1996... This research also looked at the land use on *O. molle* sites and other taxa

found on them. The importance of cattle to *O. molle* had been suspected, but the importance of cattle to other rare prairie species was a surprise that forces the reconsideration of how we defend our vanishing dry prairies." The removal of cattle from so-called natural areas has been controversial in Wisconsin and elsewhere, but The Nature Conservancy has recently begun to reincorporate grazing at two sites there. One site has even been named Marbleseed Prairie Unit: "This 40-acre parcel of formerly grazed, unplowed prairie is part of the York Prairie State Natural Area. Despite [or because of] its grazing history, the site has many unique prairie plants including a large population of its namesake marbleseed plant" (WBCI 2004).

In Kentucky, most *Onosmodium* records date from before 1980, and plants have disappeared at several sites checked in recent decades. Post-2000 records are clustered in an east-central region—Fayette, Garrard, Jessamine and Lincoln Counties. It is currently known at only 3-5 sites, none of which have secure populations. Typical habitat appears to be old rocky pastures or roadsides that have not been intensively disturbed by conversion to fescue, other alien pasture plants or crops. *Onosmodium* is clearly dependant on full sun for part of the day. It may survive in thin rocky woods for some years, especially if deer trails maintain some degree of opening. But without regular disturbance from mowing, grazing or burning, plants tend to disappear. *Onosmodium* does not usually survive on truly xeric sites, such as clifftops and glades of bedrock, unless it can root in cracks between rocks. Under xeric conditions, it is often replaced—within Boraginaceae—by *Lithospermum canescens* ('hoary puccoon'). As in Wisconsin, the significance of *Onosmodium* here has often been neglected. For example, old pastures killed with herbicide and converted to prairie grasses are rarely if ever checked for potential presence of *Onosmodium* before treatment. When checked in 1999, the Todd County site appeared to have been converted to planted little bluestem (from field notes of KSNPC).

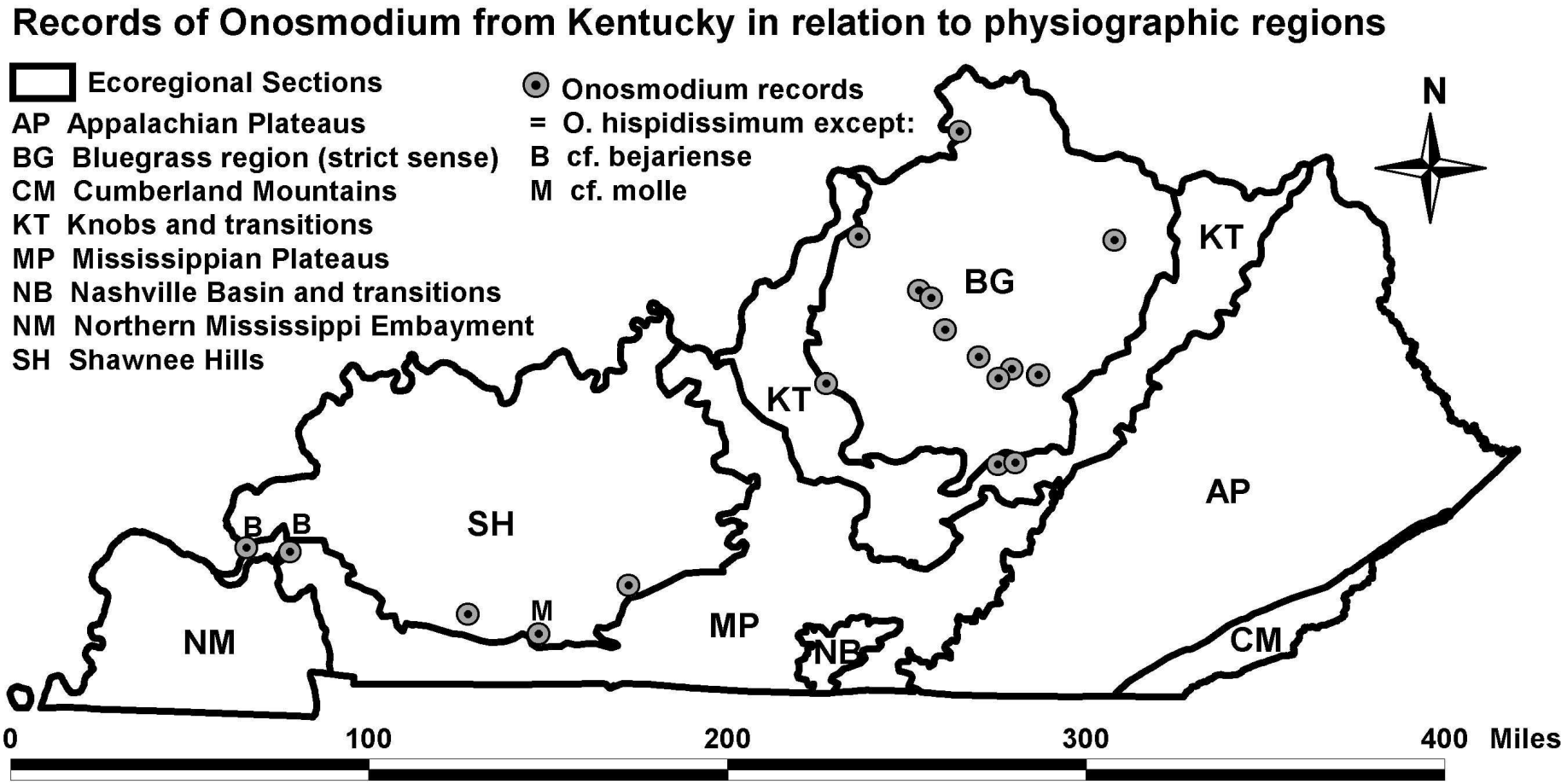

Figure 1. Map of *Onosmodium* records from Kentucky. These have been compiled from Campbell & Medley (2012) and KSNPC (2012), checking their sources where possible. Several of the older records are just 'county records' that are mapped here with low precision in likely localities or near the center of the county. Several identifications remain tentative; see text for taxonomic notes. Not mapped is a 2003 record of KSNPC from McCreary County (in AP near TN state line); a collection has not yet been located for verification.

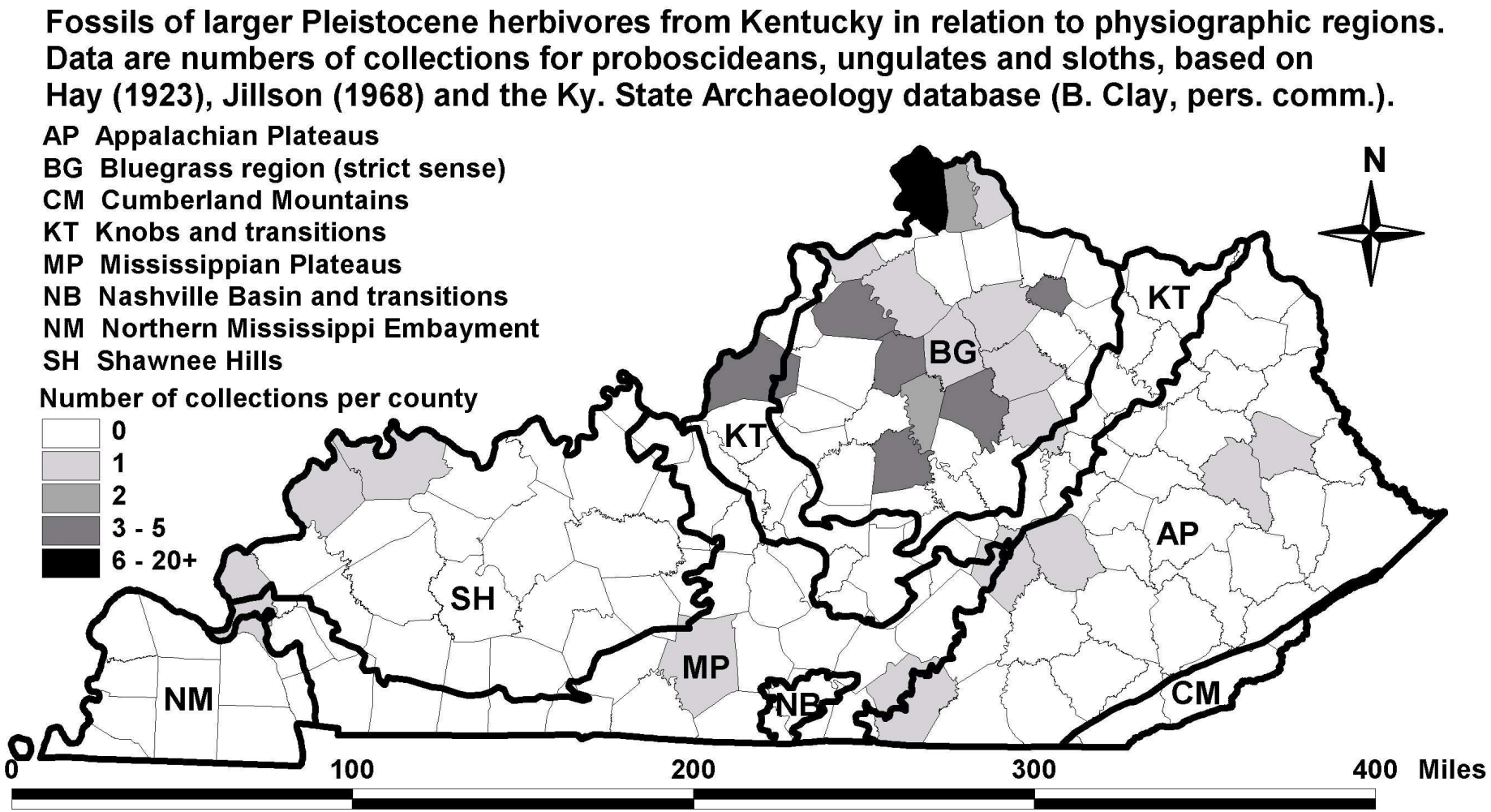

Figure 2. Collection sites for larger Pleistocene herbivores fossils from Kentucky. These data were compiled by Campbell (1984) from Hays (1923), Jillson (1968) and the Kentucky State Archaeology database (B. Clay, pers. comm.). The animals are mastodons, mammoths, elephants, sloths, horses, tapirs, peccaries, bison (extinct forms), musk ox, reindeer, moose, elk and deer. By far the most productive site has been Big Bone Lick (Boone Co.). The few records from southern (MP) or eastern (AP) regions are single finds of mastodons or peccaries.

Ecological Associations. The most interesting ecological aspect of *Onosmodium* is its potential association with grazing history. Fire is beneficial for its habitat in general, but addition of grazing animals may be critical for large secure populations. Without grazing, competition from dense growth of tall grasses and palatable herbs may be excessive. Other plants with similar distribution and ecology that are often found in old dry calcareous pastures include *Apocynum cannabinum, Asclepias tuberosa, A. viridis, Brickellia eupatorioides, Carex* spp. (especially *granularis, meadii, umbellata*), *Cirsium discolor, Eupatorium altissimum, Fragaria virginiana, Lespedeza virginica, Liatris squarrosa, Monarda fistulosa, Sporobolus compositus* (?), *Scutellaria parvula, Senna marilandica, Solidago nemoralis, Symphyotrichum pilosum* (?), *Verbena simplex* and *Verbesina helianthoides* (see also MNFI 2012).

These associated species tend to be somewhat unpalatable, but most appear better dispersed than *Onosmodium* and much more common. They can be contrasted with more palatable species that are typical of similar subxeric sites, such as *Andropogon gerardii* (?), *Desmanthis illinoensis*, *Dalea pupurea*, *Desmodium ciliare* (?), *Elymus glabriflorus* (or congeners), *Helianthus hirsutus*, *Nabalus asper*, *Orbexilum onobrychis*, *Silphium terebinthinaceum*, *S. trifoliatum*, *Solidago altissima* (?) and *Symphyotrichum novae-angliae*. In pastured fields, those palatable species are mostly uncommon to absent, but some of them can invade within a few years if grazing and mowing ceases. Alien pasture grasses and weeds are now also a major detrimental factor across the modern landscape.

On the more xeric side of its habitat range, *Onosmodium* in Kentucky and adjacent states is loosely associated—at scales of 100-1000 m—with a few uncommon to rare species typical of thin rocky soils, such as *Bouteloua curtipendula, Dalea candida, Malvastrum hispidum,*

Opuntia cespitosa [“compressa”] and *Satureja glabella*. Such sites are transitional to typical ‘cedar glades’—where large herbivores have often sought shelter in the past. The survival of small *Onosmodium* populations in marginal or irregular habitats may be enhanced by seed dormancy. In typical *molle* from the Cedar Glades of Tennessee, most seed may germinate over 5-8 years in mossy substrate, but a third or so can remain dormant for longer (Baskin & Baskin 1991). Birds and small mammals presumably take seeds. Seed of *occidentale* in Canada was found to be high in oil content and proposed for potential cropping (Gnoss & Dorrell 1975).

The chemistry of *Onosmodium* deserves more attention for several reasons. From general impressions, the *bejariense*/*molle*-group is associated with relative fertile soils—not just base-rich but probably also rich in N and P. Clues come from overall geology and soils, plus association with cattle—which tend to increase nutrient cycling. Like many other Boraginaceae (Van Dam et al. 1995, El-Shazly et al. 1998, Klemow et al. 2002, Oberlies et al. 2004), *Onosmodium* probably produces N-rich pyrrolizidine alkaloids, which are important deterrants to generalist herbivores. Diverse phenolics are also of interest in Boraginaceae, which have been much used for medical purposes (Krenn et al. 1994, Fui et al. 2002). *Onosmodium* has had some medicinal uses, but there has been little or no definitive research on these practices.

The family Boraginaceae has the following fundamental character (apomorphy): “plant ± roughly hairy, hairs with a basal cystolith or cystolith-like body, and/or walls calcified” (Stevens 2001). Yet there has been virtually no published research on the functional significance of these hairs, other than broad hypothetical discussion of probable relationships with herbivores (Gardner 1977). When handling *Onosmodium*, there is a tendency for hairs to stick into skin and irritate. Consumption would be ill-advised.

Research Needs. So is the ecological niche of *Onosmodium*—and indeed many other Boraginaceae—fundamentally tied to association with larger herbivores? This question could be approached from a biogeographic perspective by exploring the fragmentary distribution of *Onosmodium* in more detail. A thorough synthesis of records from across eastern states could show the extent to which these plants are concentrated in regions and habitats where suitable rough pasturing with cattle has been practiced since European settlement, if such land use can be assessed and mapped.

There may also be clues in paleoecological data, such as the distribution of extinct megafauna. Fossils of larger Pleistocene herbivores in Kentucky have been strongly concentrated in the Bluegrass region, with some suggestions of migration routes from the Ohio River to the central Bluegrass (Figure 2). More recently, migration patterns of bison in this region at the time of settlement have been indicated from historical information (Campbell et al. 1989; see also "Herbivore Hypothesis" at http:// bluegrass woodland.com/ Bluegrass_and_ Knobs.html).

There is a curious linear cluster of *Onosmodium* records from northwest to southeast across the Bluegrass region (Figure 1). Could this cluster be linked with patterns of bison migration? Further west, there is a also strip of records along the northern edge of the former 'Big Barrens'—an extensive zone with much grassland before settlement (see notes on "Big Barrens" at http://bluegrasswoodland.com/Shawnee_Hills_and_Plains.html). Most of the karst plains that supported those barrens have been converted to farmland, but until recently *Onosmodium* survived in rockier pastures just outside the zone of most intensive conversion.

The ecology of *Onosmodium* could also be studied directly through experiments. Plants could be grown from seed and established in plots for different treatments with or without animals—at least in simple exclosures from grazing. In a broader context, there is a critical need to investigate the overall effects of grazing on biodiversity of native grasslands and woodlands. As noted above, mowing or burning alone may not be optimal for the types of eutrophic vegetation where *Onosmodium* occurred before settlement. Simple experiments with these plants could help unveil important new avenues for understanding the original vegetation dynamics, and such work would be important for guiding management.

There has been demographic research on one of the most common species of Boraginaceae in woodlands of eastern states—*Cynoglossum virginanum*, 'wild comfrey' (Whigham et al. 1993, Cipollini et al. 1993). Gaps in the canopy cause temporary increases in flowering and seed production. But seed dispersal—often on fur of larger mammals—or dormancy is then important for seedlings to avoid competition in the dense vegetation that develops in gaps. That species is also grazing-resistant, and tends to increase in areas with dense deer populations (e.g. Griggs et al. 2006). In Europe, *C. germanicum* has also been shown to increase in association with deer (Boulanger et al. 2011). Study of similarities and contrasts between the ecologies of *Onosmodium* and *Cynoglossum* would be instructive.

In Wisconsin, Illinois and other mid-western states in the grassland-woodland transition, there has been some detailed research into interactions of native vegetation with deer (e.g. Anderson et al. 2005) and cattle (e.g. Harrington & Kathol 2009). There is an urgent need to extend such work on suitable sites throughout east-central states, with a particular focus on exploring ways to manage ungulates for enhanced native biological diversity in the vegetation.

From Steve Wilson: unknown insect larva on *Onosmodium*; see footnote under sources [5].

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SOURCES FOR PHOTOGRAPHS

The excellent photographs of Steve Wilson are used here provisionally, without permission, pending more work in Kentucky [2 to 6].

[1] Author's photo: gromwell is squeezed here between the more colorful (also palatable) Hibiscus and the road; a few hundred plants have been raised in my nearby garden.

[2] http://vaplantatlas.org/index.php?do=plant&plant=330

[3] http://bluejaybarrens.blogspot.com/2010/10/onosmodium-seeds.html

[4] http://1.bp.blogspot.com/ _ptWUooLvw14/TL9ClyfYeHI/ AAAAAAAAHG0/N6B2HThrIhw/s1600/5.JPG

[5] http://2.bp.blogspot.com/_ptWUooLvw14/TFSoRtMFg7I/ AAAAAAAAF7w/ ztExXHZULaI/ s1600/1.jpg. Steve Wilson (2010 Aug 01): "At this time of year, I become most curious about the identity of this particular insect. I've mentioned this larva before. It feeds on the False Gromwell... and travels through web tubes that it constructs on the plant. I've never found anything laying eggs on the plant. The larva apparently leaves the plant to pupate, since I've never found pupae or pupal skins in the web tunnels. Larvae raised indoors will pupate on the plant, but I've had no luck producing adults from the pupae. Netting the wild plants has only resulted in dead larvae in the bottom of the net. I suspect the wild larvae may pupate on or in the ground. I've raised False Gromwell in pots with the thought that I could cage the entire pot once larvae appeared on the plant, but none of my potted plants has ever hosted larvae. I'd really like to see an adult."

[6: next page] http://1.bp.blogspot.com/_ptWUooLvw14/TL9CoUsGppI/ AAAAAAAAHHU/jUD2FV2Bjoo/s1600/1.JPG

[7: next page] http://vaplantatlas.org/index.php?do=plant&plant=330