Mamestra brassicae

Figure 1. *Mamestra brassicae*, adult (Image courtesy of Malcolm Storey, www.discoverlife.org)

Scientific Name
Mamestra brassicae (Linnaeus, 1778)

Synonyms:
Phalaena brassicae Linneaus, 1758
Phalaena omicron Geoffroy, 1785
Noctua albidilinea Haworth, 1809
Barathra brassicae (Linnaeus, 1821)
Mamestra brassicae var. *andalusica* Staudinger, 1871
Mamestra brassicae var. *decolorata* Staudinger, 1889
Hybobarathra unicolor Marumo, 1917

Common Name
Cabbage moth, Cabbage army moth, Cabbage armyworm, Cabbage owl

Type of Pest
Moth, foliage feeder

Taxonomic Position
Class: Insecta, **Order:** Lepidoptera, **Family:** Noctuidae

Reason for Inclusion in Manual
PPQ Pest of Concern (New Pest Advisory Group)

Pest Description
Eggs: The eggs are 0.6 to 1.2 mm (< $^{1}/_{32}$ to < $^{1}/_{16}$ in.) in diameter, slightly elongate, and ribbed (Sannino and Espinosa, 1999; Devetak et al, 2010). When first laid, the eggs are pale off-white with a darker spot at the apex. As the embryo develops, it appears as a visible rust-colored line (Sannino and Espinosa, 1999). The eggs gradually change to purplish-brown and then darken to grey with two grey spots at the apex a few hours before hatching (Heath and Emmet, 1979; Sannino and Espinosa, 1999). Depending on temperature, females may lay up to 2,000 to 3,000 eggs in a season (Johansen, 1997a and 1997b). The eggs are typically found on the underside of leaves in clutches of 10 to 90 eggs (Injac and Krnjajic, 1989).

Larvae: *Mamestra brassicae* typically undergo six larval instars but can range from five to seven instars (Sannino and Espinosa, 1999; Devetak et al., 2010). First instar larvae are 1.8 mm (approx. $^{1}/_{16}$ in.) long, pale yellow to translucent with a black head capsule (Sannino and Espinosa, 1999; Devetak et al., 2010). Second instar larvae are 3.9 to 4.5 mm (approx. $^{1}/_{8}$ to $^{3}/_{16}$ in.) long, greenish-yellow with yellow head capsule or tan with a light grey or brown back and copper colored head capsule (Sannino and Espinosa, 1999). Third and fourth instar larvae are 7 to 14 mm (approx. $^{1}/_{4}$ to $^{9}/_{16}$ in.) long and are similar in color to the second instar larvae with the addition of a distinct pale line becoming visible just above the spiracles, referred to as the spiracular line (Sannino and Espinosa, 1998). Fifth instar larvae are 1.7 to 2.4 cm (approx. $^{11}/_{16}$ to $^{15}/_{16}$ in.) long, similar in color to the fourth instar larvae, but the head capsule becomes brown with dark maculations (Sannino and Espinosa, 1999). Sixth instar larvae are 3.7 to 4.2 cm (approx. $1^{7}/_{16}$ to $1^{5}/_{8}$ in.) long and highly variable in color: pale green body, yellow spiracular line, and green head capsule; olive green-black, yellow spiracular line, and pale brown head capsule (Fig. 2); or greyish with pink, orange-pink spiracular line, and pale brown head capsule (Carter, 1984; Sannino and Espinosa, 1999).

Figure 2. *Mamestra brassicae* larva (Image courtesy of http://idtools.org/id/leps/lepintercept/brassicae.html)

<u>Pupae:</u> The pupae are elongate, 1.7 to 2.2 cm (approx. $^{11}/_{16}$ to $^{7}/_{8}$ in.) long and 6 to 7 mm wide (approx. ¼ in.), and reddish-brown and glossy (Fig. 3) (Heath and Emmet, 1979; Carter, 1984; Sannino and Espinosa, 1999). The "wing- and limb-cases are finely sculptured; abdominal segments evenly tapering, darker brown and smooth, with finely pitted anterior band on each; segment 8 sharply excavated to a narrowly conical cremaster with two short, apically hooked spines", according to Heath and Emmet (1979). Pupation takes place within flimsy cocoons, 2 to 5 cm (approx. $^{13}/_{16}$ to 2 in.) deep in the soil (Heath and Emmet, 1979; Güçlü et al., 2006; Devetak et al., 2010).

Figure 3. *Mamestra brassicae* pupa (Image courtesy of Steve Ogden, www.wildlifeinsight.com)

<u>Adults:</u> Adults (Fig. 1) vary in size, ranging from 1.5 to 2.2 cm (approx. $^{9}/_{16}$ to $^{7}/_{8}$ in.) in length with a wingspan of 38 to 49 mm (approx. 1 $^{1}/_{2}$ to 2 in.) (Sannino and Espinosa, 1999). "Forewing greyish brown mottled with dark brown; reniform stigma conspicuous,

strongly marked with white; orbicular stigma inconspicuous, ringed with black; broken subterminal line white; terminal line ochreous; cilia dark brown with ochreous streaks; termen slightly crenulate. Hindwing greyish brown, paler towards base; terminal line white. Head and thorax dark greyish brown flecked with white, thorax with slight dorsal crest; abdomen pale greyish brown with darker dorsal tufts (Fig. 4); antennae simple, filiform, of male finely ciliate", according to Carter (1984). As is typical for the genus, the eyes are hairy and there is a large brown or black, slightly curved, apically pointed tibial spur on the forelegs (Fig. 5) (Sannino and Espinosa, 1999).

Figure 4. *Mamestra brassicae* view of dorsal tufts (Image courtesy of Malcolm Storey, www.discoverlife.org)

Biology and Ecology

The developmental timeline, diapause, and number of generations of *Mamestra brassicae* are regulated by temperature and day-length, causing them to vary depending on geographic location and climatic conditions (Johansen, 1997a; Sauer and Grüner, 1988; Øgaard, 1983). In colder, more northern regions, such as Estonia, adults emerge at the end of June or early July (Metspalu et al., 2004). In warmer, more southern regions, such as Italy, the adults may begin to emerge as early as late April to early June (Devetak et al., 2010). The pre-oviposition period varies, lasting 3.3 days at 23°C (73.4°F) to 9.4 days at 11°C (51.8°F) (Johansen, 1997a). After mating, the females lay up to 3,000 eggs in clutches of 10 to 90 eggs on the underside of the host leaves (Injac and Krnjajic, 1989; Johansen, 1997a and 1997b). A laboratory study looking at the influence of temperature on development found that when exposed to temperatures ranging from 18.5 to 10.5°C (65.3 to 50.9°F) the egg development time was 7.6 to 29.5 days and 39.8 to 98.3 days for larvae (Johansen, 1997a). Upon hatching, the larvae remain close together on the same leaf, but within one day begin to spread to other leaves; by day two, some larvae move to neighboring plants (Johansen, 1997b). The larvae remain exposed, feeding on the outermost leaves of the plant, until the fifth instar, when the larvae begin to tunnel into the crown (Johansen, 1997b).

Figure 5. *Mamestra brassicae* tibial spur (Image courtesy of Malcolm Storey www.discoverlife.org)

Larvae in crowded or harsh environments (e.g., low humidity or temperature) exhibit phase polymorphism, becoming dark or melanized in the fifth and sixth instars (Goulson, 1994; Goulson and Cory, 1995). Solitary larvae may remain lighter in color (Kazimírová, 1992). However, a larger proportion of larvae become melanized when exposed to cold conditions, compared to crowding (Goulson, 1994). Melanization enables the larvae to absorb radiant heat more efficiently, promoting survival and may be an adaptive strategy (Goulson, 1994; Goulson and Cory, 1995). Dark colored larvae are typically smaller, have elevated body temperature, and develop more rapidly than their lighter colored counterparts (Goulson, 1994; Goulson and Cory, 1995). Color variation observed in the same population may be due to fluctuating weather conditions (Goulson, 1994).

Mature larvae drop to the soil to pupate in thin cocoons at a depth of 2 to 5 cm (approx. $^{13}/_{16}$ to 2 in.) (Heath and Emmet, 1979; Güçlü et al., 2006; Devetak et al., 2010). Diapause is facultative and largely regulated by temperature and photoperiod (Øgaard, 1983; Sauer and Grüner, 1988). Depending on environmental conditions, pupal growth can present in three different ways: 1) Dormancy-free development is triggered by day-lengths exceeding 16 hours and 20 minutes. Populations undergoing dormancy-free development are typically bivoltine and, occasionally, trivoltine (Sauer and Grüner, 1988). 2) Aestivation or summer diapause is a typical response to drought conditions and is initiated by high temperature and long day-length. Aestivation is a state that can be quickly reversed as conditions change (Sauer and Grüner, 1988). 3) Winter diapause is triggered by low temperature and decreasing day-length (Sauer and Grüner, 1988). It can limit population growth, reducing the level of damage caused by *Mamestra brassicae* (Øgaard, 1983). Depending on temperature (23 to 11°C (73.4 to 51.8°F)) and other environmental conditions, pupation may take 18.2 to 96.9 days (Sauer and Grüner, 1988; Johansen, 1997a). In bivoltine populations, the second generation typically enters winter diapause, emerging as adults the following spring (Devetak et al., 2010).

Damage

Cabbage:

Young larvae feed on the outer leaves until the fifth instar, when they begin to tunnel into the head toward the heart of the cabbage (Fig. 6). Large infestations can destroy the head; however, product loss is typically due to secondary fungal and bacterial infections and aesthetic damage caused by the amount of frass produced by the larvae (Heath and Emmet, 1979).

Figure 6. *Mamestra brassicae* damage on *Brassica oleracea* convar. *capitata* var. *sabauda* (Photo courtesy of Groene savooiekool schade van kooluil, commons.wikimedia.org)

Broccoli/Cauliflower:

"In cauliflower and broccoli, the larvae also feed on the inflorescence, where they chew more or less deep holes. Small larvae live well hidden between the flower stems and may pass sorting procedures, contaminating processed products." (CABI, 2015)[1]

[1] A direct source for this information could not be found. See CABI (2015).

Collard/Kale:
Larvae feed on the leaves, causing large holes, reducing the crop's value. The damaged leaves cannot be sold for human consumption and are instead used for livestock feed (Cartea et al., 2009b).

Other Hosts:
- In *Allium* spp. (garlic, onions, etc.), the larvae feed on the leaves and occasionally within the bulb (Hill, 1987).
- In apples, the leaves become skeletonized and the larvae may feed on carpels, reducing fruit yield (Castellari, 1970).
- Larvae may feed on the leaves, buds, and petals of *Chrysanthemum* (daisy), *Dahlia*, and *Rosa* spp. (roses) (Carter, 1984). In *Chrysanthemum*, the larvae prefer older leaves compared to younger ones (Fung et al., 2002).
- In tomato, the larvae may bore into the fruits (Carter, 1984).
- In soybean, the leaves may be skeletonized and larvae may feed on the pods and seeds, distorting the growth (Lihnell, 1940).
- In sugar beet, larvae feed on the young leaves at the center of the plant (Lilley et al., 1997).

Pest Importance
Mamestra brassicae is consistently a serious pest of *Brassica* spp. crops (Heath and Emmet, 1979; Øgaard, 1983; Injac and Krnjajic, 1989). In regions that support two generations, the greatest damage is caused by the second generation's larvae, which are often more numerous than the first generation (Kahrer, 1984; Injac and Krnjajic, 1989). In regions where only a single generation occurs, *M. brassicae* populations may never reach pest levels (Øgaard, 1983; Johansen, 1997b).

According to CABI (2015):

> "In cabbage crops in Germany, *M. brassicae* is a main pest with regular occurrence. In field experiments, 27 to 98% of the plants in different cabbage crops were infested (Hommes, 1983). According to Filippov (1982), larval infestation of cabbage in Moldavia led to harvest losses of 8 to 80%. In a study of white cabbage in Norway, weight losses due to larval damage were 10 to 13% (Rygg and Kjos, 1975). In Belgium, insecticides are often applied to Brussels sprouts every 2 to 3 weeks to control *M. brassicae* larvae (Van de Steene, 1994). Because of the tunneling action of the larvae, they are often sheltered from any insecticide application."

Known Hosts
Mamestra brassicae is considered highly polyphagous, infesting over 70 species in 22 plant families but shows a strong preference for species in the Brassicaceae plant family (Heath and Emmet, 1979; Finch and Thomson, 1992; Popova, 1993).

Major Hosts

Beta vulgaris var. *vulgaris* (sugar beet),[2] *Brassica* spp., *Brassica napus* (rape), *Brassica oleracea* (cabbages, cauliflowers), *Brassica oleracea* var. *acephala* (collard), *Brassica oleracea* var. *botrytis* (cauliflower), *Brassica oleracea* var. *capitata* (cabbage), *Brassica oleracea* var. *gemmifera* (Brussels sprouts), *Brassica rapa* subsp. *pekinensis* (Pe-tsai), and *Pisum sativum* (pea) (Dunn and Kempton, 1976; Theunissen et al., 1985; Metspalu et al., 2004, 2013).[2]

Minor Hosts

Allium cepa (onion),[2] *Allium sativum* (garlic), *Amaranthus retroflexus* (redroot), *Aquilegia vulgaris* (European columbine), *Betula pendula* (European white birch), *Bryonia alba* (white bryony), *Calendula* spp. (calendula), *Callistephus chinensis* (China aster), *Cannabis sativa* (hemp), *Capsella bursa-pastoris* (shepherd's purse), *Capsicum* spp. (peppers), *Capsicum annuum* (bell pepper), *Chenopodium album* (lambsquarters), *Chenopodium giganteum* (tree spinach), *Chrysanthemum* spp. (daisy), *Cucurbita pepo* (squash), *Dahlia* spp. (dahlia), *Daucus carota* (carrot), *Dianthus caryophyllus* (carnation), *Epilobium* spp. (fireweed), *Fagus* spp. (beech), *Fallopia convolvulus* (=*Polygonum convolvulus*) (wild buckwheat), *Fragaria* spp. (strawberry), *Geum rivale* (purple avens), *Gladiolus* spp. (gladiolus), *Glycine max* (soybean), *Helianthus annuus* (sunflower), *Humulus lupulus* (hop), *Hyoscyamus niger* (black henbane), *Hyssopus officinalis* (hyssop), *Ipomoea batatas* (sweet potato), *Lactuca sativa* (lettuce), *Lamprocapnos spectabilis* (=*Dielytra spectabilis*) (seal-flower), *Larix* spp. (larch), *Linum usitatissimum* (flax), *Lupinus* spp. (lupine), *Malus domestica* (apple), *Malus sylvestris* (European crab apple), *Medicago sativa* (alfalfa), *Nicotiana* spp., *Nicotiana tabacum* (tobacco), *Papaver somniferum* (poppy), *Pelargonium* spp. (geranium), *Phaseolus* spp. (beans), *Phaseolus vulgaris* (common bean), *Potentilla anserina* (silverweed), *Prunus padus* (European bird cherry), *Prunus persica* (peach), *Prunus salicina* (Japanese plum), *Quercus* spp. (oak), *Quercus cerris* (European turkey oak), *Quercus robur* (English oak), *Rhaphanus sativus* (radish), *Rheum rhabarbarum* (rhubarb), *Rosa* spp. (roses), *Rubus idaeus* (raspberry), *Rudbeckia* spp. (coneflower), *Salix* spp. (willow), *Salix caprea* (goat willow), *Sambucus racemosa* (red elderberry), *Senecio vulgaris* (groundsel), *Silene chalcedonica* (=*Lychnis chalcedonica*) (maltesecross), *Silene latifolia* subsp. *alba* (=*Melandrium album*), *Solanum lycopersicum* (tomato), *Solanum melongena* (eggplant), *Solanum tuberosum* (potato), *Spinacia oleracea* (spinach), *Trifolium repens* (white clover), *Vicia faba* (broad bean), *Vicia sativa* (vetch), *Vitis vinifera* (grape), and *Zea mays* (corn) (Carter, 1984; USDA, 1986; Hill, 1987; Metspalu et al., 2013).

Pathogens or Associated Organisms Vectored

Mamestra brassicae is not a known vector and does not have any associated organisms.

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[2] While capable of causing economic damage on this crop, the larval development is long and pupal weight is comparatively low, often resulting in higher mortality during pupation, which limits population growth. *Mamestra brassicae* may only reach pest levels on an infrequent basis in this host (Metspalu et al., 2013).

Known Distribution

Asia: Armenia, Azerbaijan, China, Georgia (Republic of), India, Iran, Japan, Kazakhstan, Korea (DPR), Korea (Republic of), Kyrgyzstan, Lebanon, Mongolia, Pakistan, Syria, Taiwan, Turkey, Uzbekistan; **Africa:** Canary Islands (Spain) Libya; **Europe:** Austria, Belarus, Belgium, Bulgaria, Czech Republic, Demark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Malta, Moldova, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, Ukraine (Tóth et al., 2004; Metspalu et al., 2010; CABI, 2015)

Potential Distribution within the United States

The species is not present in America or Oceania (APPPC, 1987; Zhang, 1994). The predicted range for *M. brassicae* based on habitat suitability includes 8 USDA plant hardiness zones (3-10). Major hosts of *Mamestra brassicae* are found in the highest density on the West Coast and the northeastern United States (USDA CPHST, 2016a). These hosts are also grown in many other U.S. states in low to moderate density.

A recent combined host density map for *Mamestra brassicae* developed by USDA-APHIS-PPQ-CPHST (Fig. 7) identifies areas of high host acreage based on the combined acreage of broccoli, Brussels sprouts, cabbage, cauliflower, and Chinese cabbage (acreage of kohlrabi was not available). Individual host maps are available at the end of the datasheet as an appendix.

Host distribution maps are based on county level data. To combine host data for pest-specific analyses, CPHST normalizes the data by dividing the total host present in a county by overall county area (acres of host in county/ total acres of county). This yields host by county area and allows CPHST to properly combine host distributions without the skewing effects of overall county size. For example, 500 acres of broccoli grown in Tulare County, CA can now be compared to 500 acres of broccoli grown in Scott County, AR.

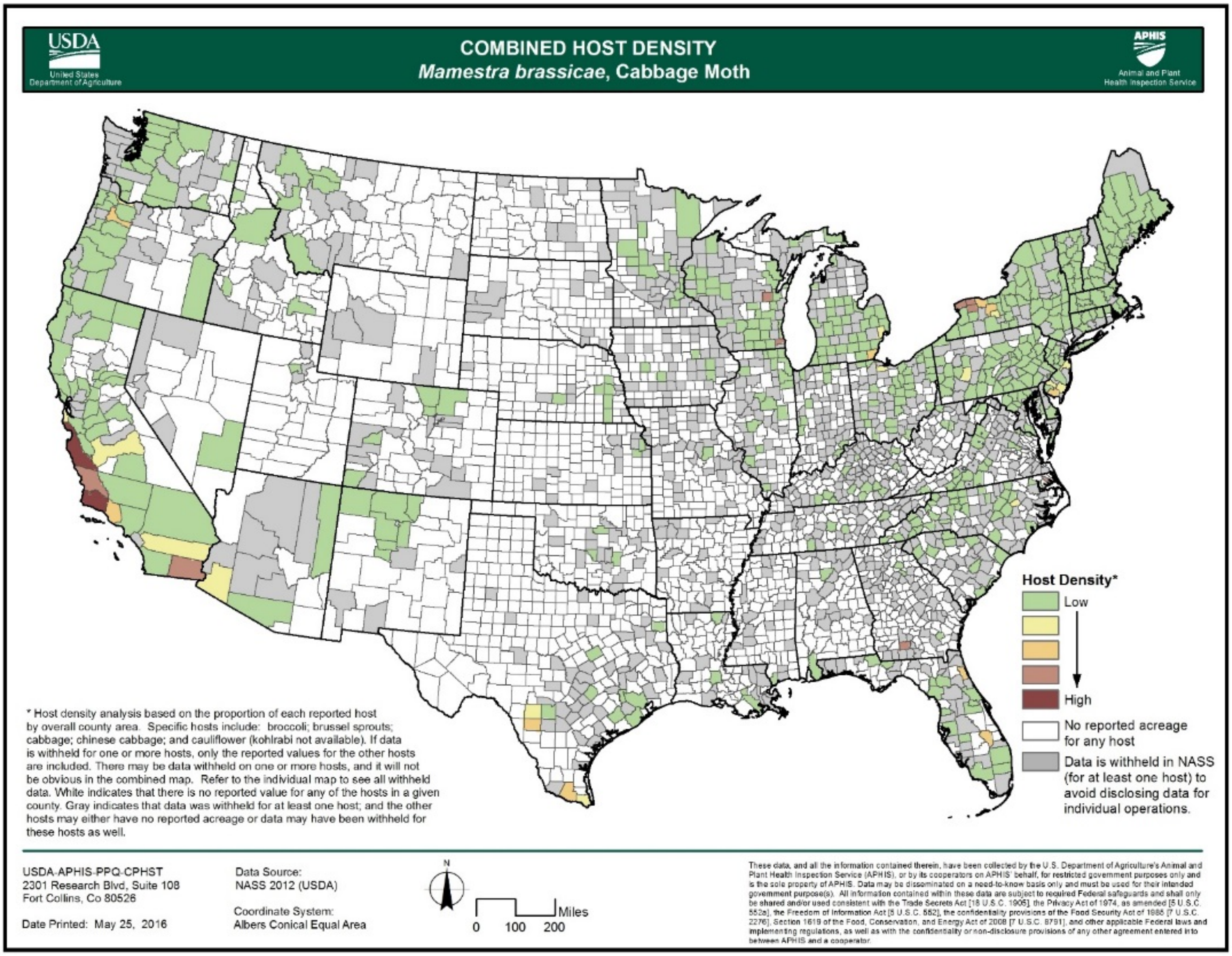

Figure 7. Combined distribution map for *Mamestra brassicae* within the continental United States. Values represent combined host density low to high (broccoli, Brussels sprouts, cabbage, cauliflower, and Chinese cabbage). Map courtesy of USDA-APHIS-PPQ-CPHST.

Pathway

Mamestra brassicae could potentially move through international trade. This species has been intercepted at U.S. ports of entry over 1,360 times since 1984. Most of these interceptions originated on material from the Netherlands (1,232), as well as France (26), Italy (28), and Israel (19). Many interceptions occurred on host material including *Delphinium* sp. (370), *Aconitum* spp. (164), *Brassica* spp. (123), *Amaranthus* spp. (81), *Anemone* spp. (45), and *Alstroemeria* sp. (43). Infested material was found in permit cargo (1,183), general cargo (89), baggage (52), and stores (34). Most material was for consumption (1,322) while the rest was for non-entry and propagation (35 and 8) (AQAS, 2016, March 29, 2016).

Survey

Approved Methods for Pest Surveillance*:

The Approved Method is a trap and lure combination. The preferred trap type is a plastic bucket trap. The lure is effective for 84 days (12 weeks).

IPHIS Survey Supply Ordering System Product Names:

1) Plastic Bucket Trap
2) *Mamestra brassicae* Lure

The Plastic Bucket Trap is also known as the unitrap. The trap has a green canopy, yellow funnel, and white bucket and is used with a dry kill strip. See the Plastic Bucket Trap Protocol (Brambila et al., 2014) for instructions on using the plastic bucket trap.

IMPORTANT: Do not include lures for other target species in the trap when trapping for this target.

Trap spacing: When trapping for more than one species of moth, separate traps for different moth species by at least 20 meters (65 feet).

Survey Site Selection:
Traps should be placed in plantings of major hosts.

Trap placement:
In field studies in Slovenia, traps were fixed on wooden sticks, approximately 1.5 m (approx. 5 ft) above the ground (Devetak et al., 2014). Traps were placed on the outer borders of the host fields (Devetak et al., 2014).

Time of year to survey:
In central and western Slovenia, where two generations per year occur, the adults are observed from April through September (Devetak et al., 2014). In northwestern Spain, where two generations per year occur, traps are placed from May until November (Cartea et al. 2009a). For CAPS surveys, since the number of generations of this pest can vary based on climate, traps may be placed any time the major hosts of the pest are present.

*For the most up-to-date methods for survey and identification, see Approved Methods for Pest Surveillance on the CAPS Resource and Collaboration Site, at https://caps.ceris.purdue.edu/approved-methods.

Literature-Based Methods:

Trapping: Adults can be detected with pheromone or light traps. The main sex pheromone component for *Mamestra brassicae* has been identified as Z11-hexadecenyl. Other components have been identified in laboratory settings. However, in field trials, these components have not increased attraction of *M. brassicae* when combined with Z11-hexadeceny or when used alone.

Visual inspection: In areas where this pest is known to occur, visual inspection is used for pest monitoring. Egg batches and small larvae (less than about 1.5 cm) are found mostly on the undersides of the larger external leaves. Eggs are located on the underside of leaves, petioles, or stems. Feeding perforations from the smallest larvae are difficult to detect. Large larvae are found between the internal leaves in the heart of plants, in tunnels or cavities in cabbage heads, flowers, buds or fruits. Other signs of infestation include entrance holes and feces. Larvae are active at night and often curl up when disturbed. Larvae can easily be observed when cabbages are cut open.

In regions where the pest is established, crop scouting is conducted on a weekly basis and begins 1 to 2 weeks after the first adults are caught in the traps. Scouting methods have been developed and are recommended when the moth is known to be present (Kahrer, 1984; Freuler, 1992; Planteforsk and ITAS, 1997).

Not recommended: For CAPS surveys, pheromone traps are the preferred method due to their efficacy and higher target specificity. In places where the pest is known to occur, visual inspection of eggs and larvae is often conducted. In areas where the pest is not known to be established, unusual damage to hosts can signal a potential infestation.

Key Diagnostics/Identification

Approved Methods for Pest Surveillance*:

Morphological:

Adult: "The subfamily Hadeninae is recognized by the hair on the surface of the eyes. *Mamestra brassicae* has the subterminal line not defined by whitish on the inner side, this separates *brassicae* from *M. configurata* Walker, a U.S. species which has a subterminal line prominently defined by whitish on the inner side; wing expanse of *M. brassicae* is approximately 44 mm" (USDA-APHIS-PPQ, 1986). Dissection of male genitalia is required to distinguish *M. brassicae* from *M. configurata* and *M. curialis*. *Mamestra configurata* is present in the western United States, and *M. curialis* is present in Canada and the northeastern United States.

Larva:

From the Lepintercept *Mamestra brassicae* fact sheet (Gilligan and Passoa, 2014):

- Large retinaculum on the mandible
- SD1 and SD2 on the mesothorax and metathorax connected to a tonofibrillary platelet by a minute dark bar
- Black spots usually surround the abdominal spiracles
- Spinneret about four times as long as first segment of labial palpi
- Abdominal prolegs with a sclerotized shield

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at https://caps.ceris.purdue.edu/approved-methods

Easily Confused Species

It is difficult to distinguish larvae from different noctuid species, especially in the youngest instars. See Heath and Emmet (1979) or Skinner (1998) for a full description.

Larvae of *M. brassicae* can be confused with the domestic *Pieris rapae* (small white butterfly) and the exotic *P. brassicae* (large white butterfly). Larval color varies, but *M. brassicae* larvae have smooth skin and few hairs; while *P. rapae* and *P. brassicae* appear velvety (USDA, 1986). *Orthosia rubescens* larvae have similar black markings surrounding the spiracles (Wagner et al., 2011) but the mouthparts differ; both possess distinct outer teeth, but *Mamestra* have one or two inner teeth and *Orthosia* have "parallel inner ridges" (as described in Godfrey, 1972).

The adults resemble many other dull-colored members of the Noctuidae. *Anarta trifolii* (present in the United States, common in sticky traps for *M. brassicae* in the eastern United States (S. Passoa, personal communication, 2016)) and *Lacanobia w-latinum* and *Mythimna pallens* (both not present in the United States) can be distinguished from *M. brassicae* by the lack of a tibial spur on foreleg.

To differentiate from *Anarta trifolii (Dicestra trifolii)*, from "Screening key for CAPS target Noctuidae in the Eastern and Midwestern United States (males)" Passoa (2009):

> *"Mamestra brassicae:*
> Foretibia with a single large curved claw; subterminal line of forewing, if present, thin and white without a w-shaped marking; genitalia symmetrical;
>
> *Anarta trifolii:*
> Foretibia lacking a single large curved claw; subterminal line of forewing, with a w-shaped marking; genitalia asymmetrical."

Apamea spp. (various species present in the United States) can be distinguished from *M. brassicae* by no tibial spur on foreleg, and glabrous eyes. *Mamestra configurata* and *Mamestra curialis* are morphologically similar to *Mamestra brassicae*, requiring dissection of male genitalia to distinguish between them (for images, please visit download.ceris.purdue.edu/file/2224).

Commonly Encountered Non-targets

The table below lists commonly encountered non-targets from surveys conducted in the northeastern United States (Passoa, 1992).

Family	**Species**	**State collected from**
Noctuidae	*Abrostola urentis*	Northeastern United States
Noctuidae	*Aletia oxygala*	Northeastern United States
Noctuidae	*Amphipoea americana*	NY
Noctuidae	*Amphipoea velata*	NY
Noctuidae	*Anarta trifolii*	MN, NJ, NY, RI
Noctuidae	*Autographa biloba*	NY
Noctuidae	*Autographa californica*	Northeastern United States
Noctuidae	*Autographa precationis*	NY
Noctuidae	*Faronta diffusa*	Northeastern United States
Noctuidae	*Feltia jaculifera*	NY

Noctuidae	*Hypocoena defecta*	NY
Noctuidae	*Oligia modica*	NY
Noctuidae	*Orthodes crenulata*	CT, MN, NJ, NY, RI
Noctuidae	*Orthodes detracta*	Northeastern United States
Noctuidae	*Papaipema birdi*	NY
Noctuidae	*Papaipema marginidens*	WV
Noctuidae	*Papaipema* sp.	MN
Noctuidae	*Plusia contexta*	NY
Noctuidae	*Polia* spp.	Northeastern United States
Noctuidae	*Pseudaletia unipuncta*	MN, NJ, WV
Noctuidae	*Pseudorthodes vecors*	NY
Noctuidae	*Spiramater lutra*	Northeastern United States
Noctuidae	*Spodoptera frugiperda*	NY
Noctuidae	*Zale* sp.	NJ
Pieridae	*Pieris rapae*	NJ, NY
Plutellidae	*Plutella xylostella*	MN
Pyralidae	*Ostrinia nubilalis*	NY
Tortricidae	*Archips purpurana*	NY

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Draft Log
May 2016: Complete update performed.
Original developed April 2007.

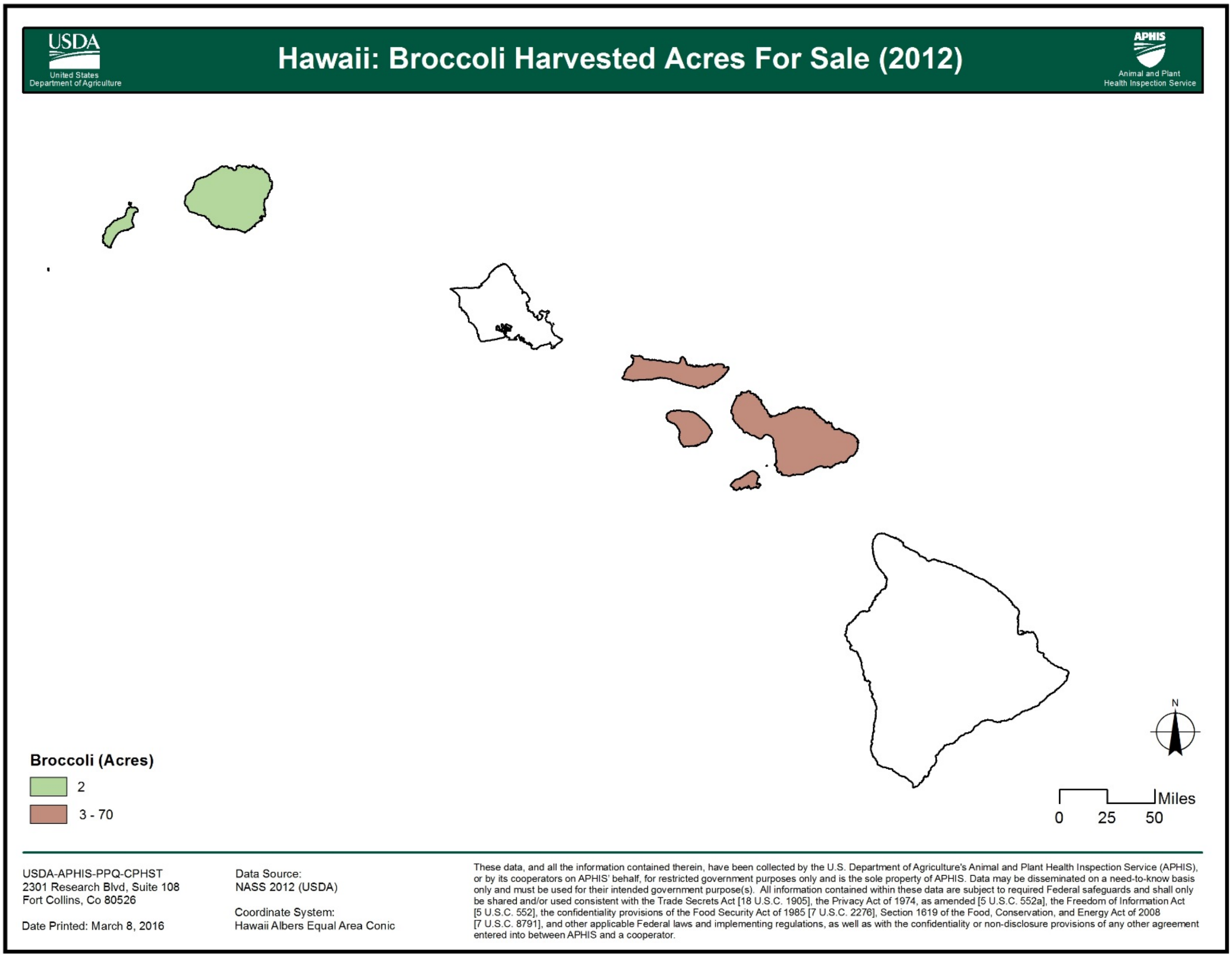
Revisions
May 2016
1) Revised the **Pest Description** section.
2) Revised the **Biology and Ecology** section.
3) Revised the **Pest Importance** section.
4) Revised the **Damage** section.
4) Revised the **Known Hosts** section.
5) Revised the **Known Distribution** section.
6) Revised the **Potential Distribution within the United States** section. Added a newly created map for the “Combined Host Density Map for *Mamestra brassicae* within the continental United States.”
7) Revised the **Pathway** section.
8) Revised the **Key Diagnostics/Identification** section. Section reviewed by subject matter experts.
9) Added the **Commonly Encountered Non-targets**. Section reviewed by subject matter experts.
10) Added the Appendix, **Individual Host Maps for *Mamestra brassicae***, with host maps for all major hosts.

Reviewers

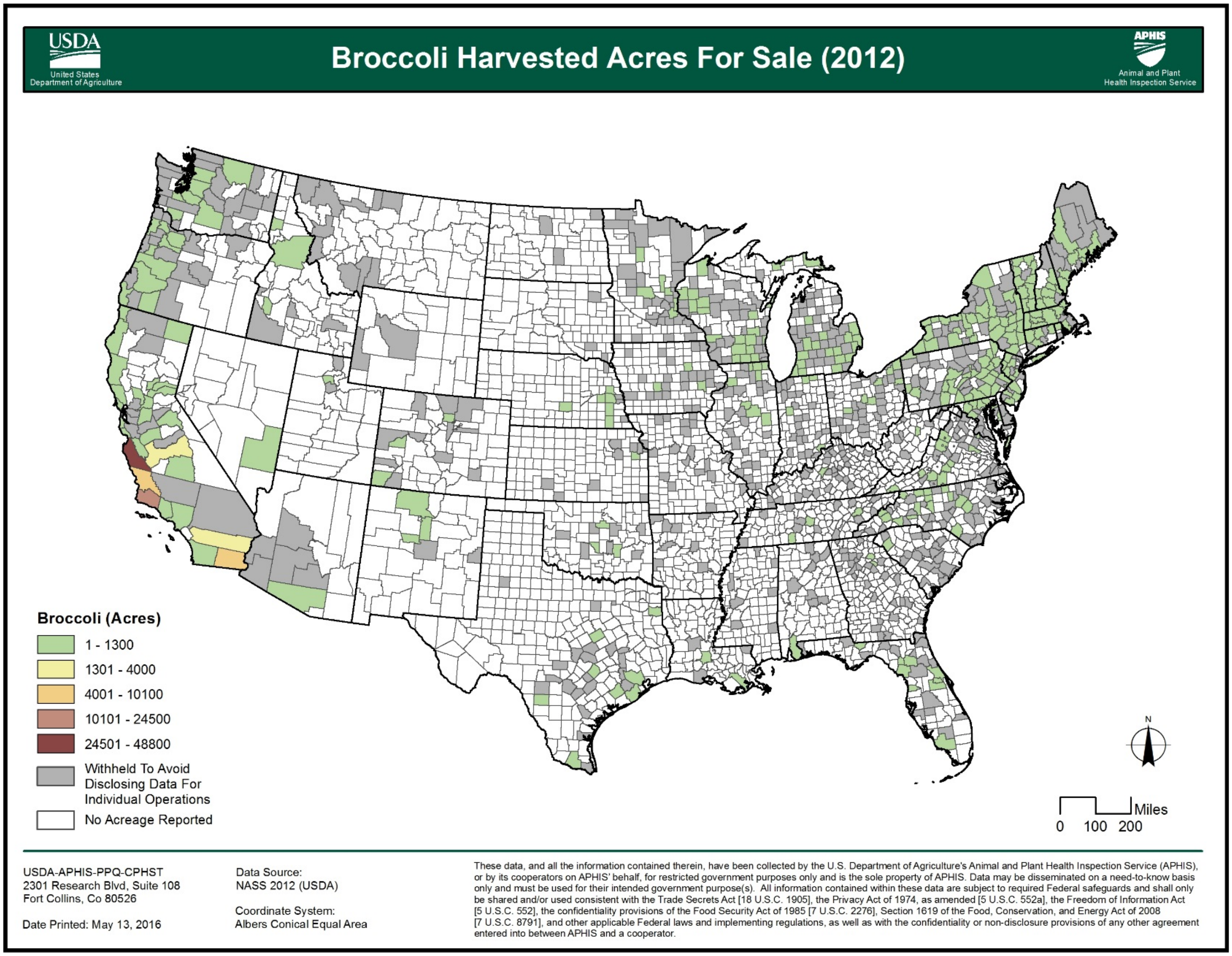
June 2016
Julieta Brambila, USDA-APHIS-PPQ, Gainesville, Florida
Steve Passoa, The Ohio State University Museum of Biodiversity, Columbus, Ohio

Appendix 1: Individual Host Maps for *Mamestra brassicae*

Individual host maps were prepared for the major hosts of *Mamestra brassicae*, including broccoli, Brussels sprouts, cabbage, cauliflower, and Chinese cabbage (acreage of kohlrabi was not available).



Appendix 1 (continued)



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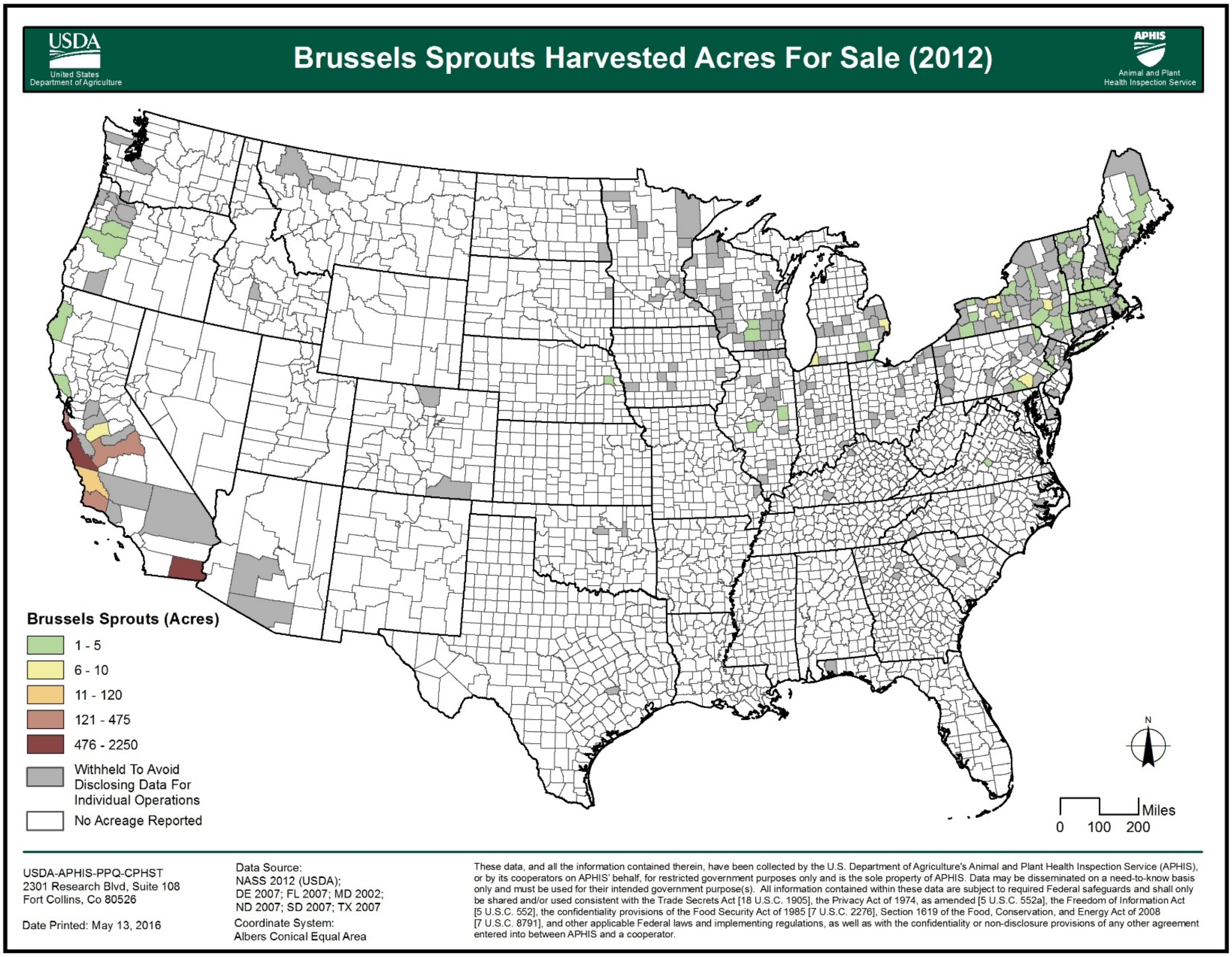

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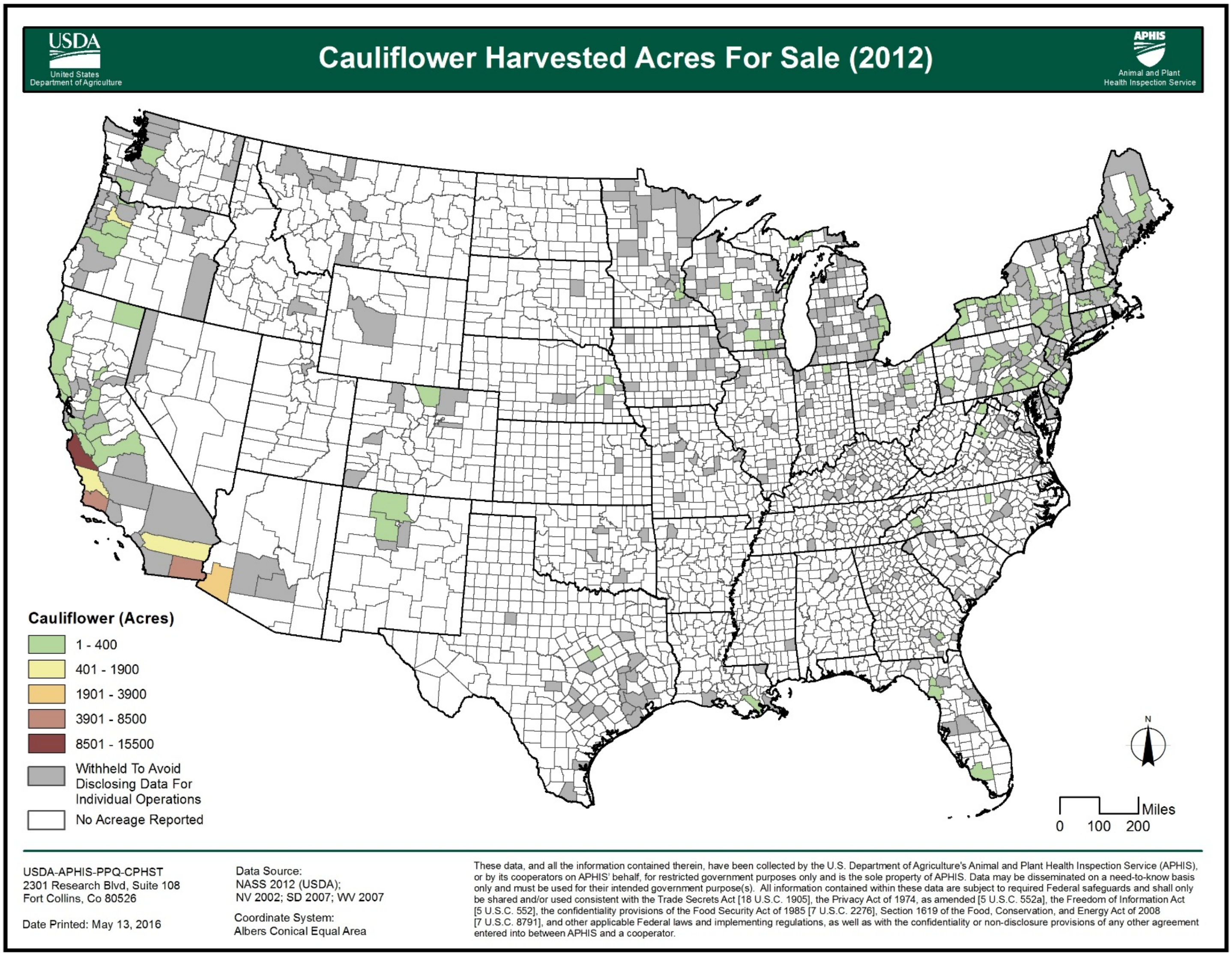
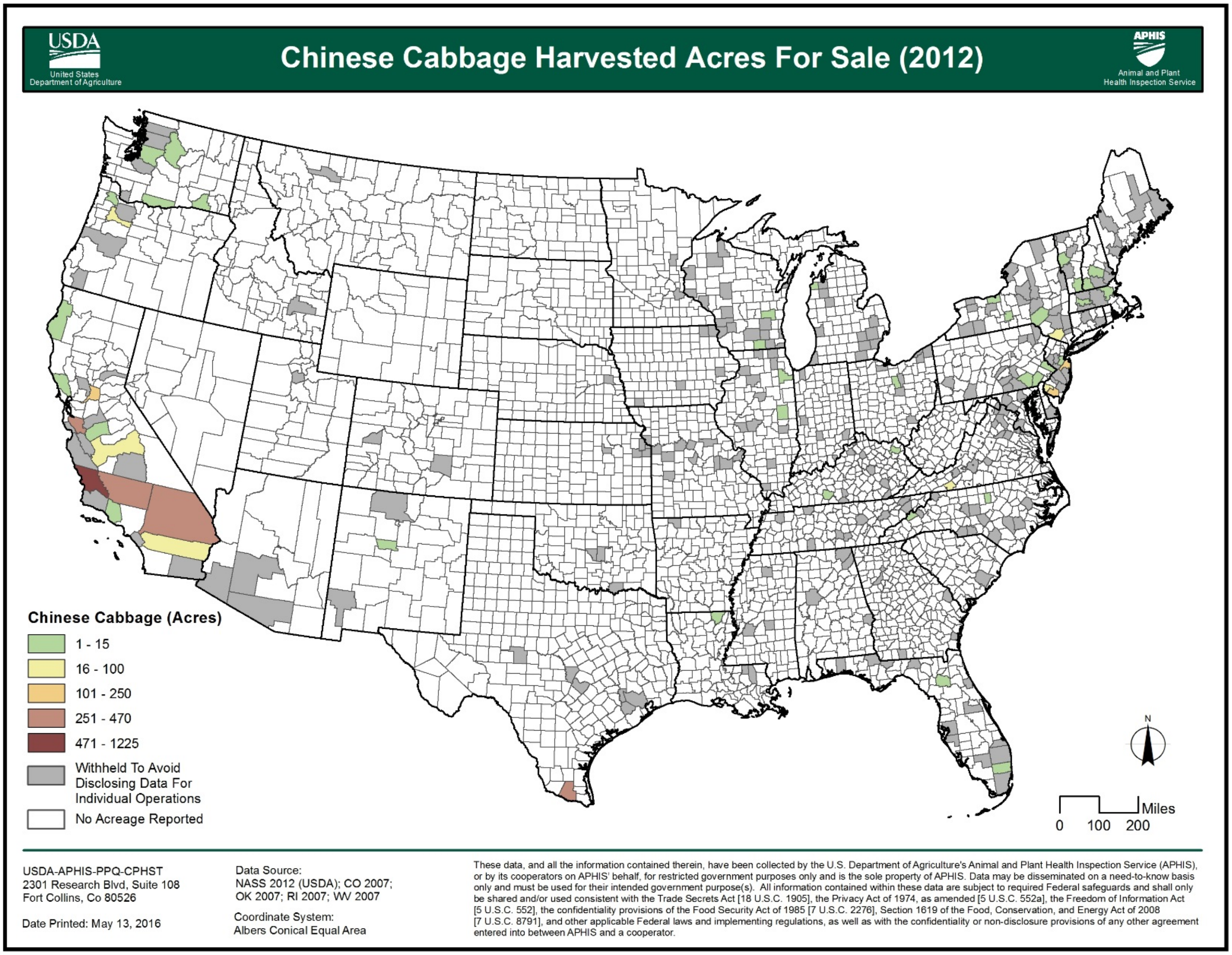


Appendix 1 (continued)



Appendix 1 (continued)