



## *Noctua pronuba* (Lepidoptera: Noctuidae): An Outbreak in Emails

Christina DiFonzo<sup>1</sup> and Howard Russell<sup>2</sup>

<sup>1</sup>Department of Entomology, Michigan State University, 243 Natural Science Building, East Lansing, MI 48824 (e-mail: difonzo@msu.edu).

<sup>2</sup>Diagnostic Services, Michigan State University, East Lansing, MI 48824.

J. Integ. Pest Mngmt. 1(1): 2010; DOI: 10.1603/IPM10005

**ABSTRACT.** *Noctua pronuba* (L.) is one of the most common Noctuid moths in Europe. The first moths collected in North America were found in Nova Scotia in 1979, and this species has since spread across Canada and the United States. *N. pronuba* caterpillars, sometimes called winter cutworms, are cold tolerant and remain active during the winter months in the northern part of its range. *N. pronuba* has not been previously reported as a crop pest in Canada or the U.S. This article documents an outbreak in 2007–2008 in Michigan that included crop damage to alfalfa and small grain fields, destruction of turf, and pet illness. This is the first confirmation of damage by this cutworm to commercial field crops in North America.

**Key Words:** *Noctua pronuba*; winter cutworm; large yellow underwing; alfalfa; small grains

*Noctua pronuba* (L.) (Lepidoptera: Noctuidae), the large yellow underwing, is one of the most common Noctuid moths in Europe and the type species for the family Noctuidae. In Europe, it is a minor pest of ornamental plantings and gardens (Wright and Neil 1983, Neil and Specht 1987). Adults are easily recognized by a showy orange hind wing bordered by a black bar (Fig. 1A). Younger larvae are green, but last-instars are brown with two angled dark bars on the head (Fig. 1B). Mature larvae range from 4 to 5 cm in length with an off-white sub-dorsal stripe, topped on each abdominal segment by a black crescent (Fig. 1C). When viewed from above, this gives the appearance of two rows of black dashes running the length of the body (Fig. 1D).

The first *N. pronuba* moths found in North America were collected in Nova Scotia in 1979 (Neil 1981). Adults are strong fliers, thus this non-native species spread rapidly across Canada into neighboring provinces (Morris 1985, 1987), then to the west coast of Canada

(Copley and Cannings 2005), and southwest into the United States as far as Texas (Wagner 2005). In Michigan, adults were first collected in 1998 (Michigan State University A.J. Cook Arthropod Collection records), and moths are now captured regularly around lights between June and October.

Although Wright (1987) reported that larvae principally feed on grasses, the host range of *N. pronuba* is broad, including beets, cabbage, carrot, grape, lettuce, potato, strawberry, tomato, numerous horticultural plants, and weed species (Passoa and Hollingsworth 1996, Copley and Cannings 2005). Caterpillars are active in the fall, with a portion of the population entering winter as last-instars (pupating in early spring) and the remainder entering as earlier instars (continuing to feed in spring) (Wright 1987). *N. pronuba* caterpillars are usually noticed as they crawl around buildings and on lawns well after other insects have died or overwintered. In Michigan, Michigan State University Diagnostic Services, a laboratory that provides insect

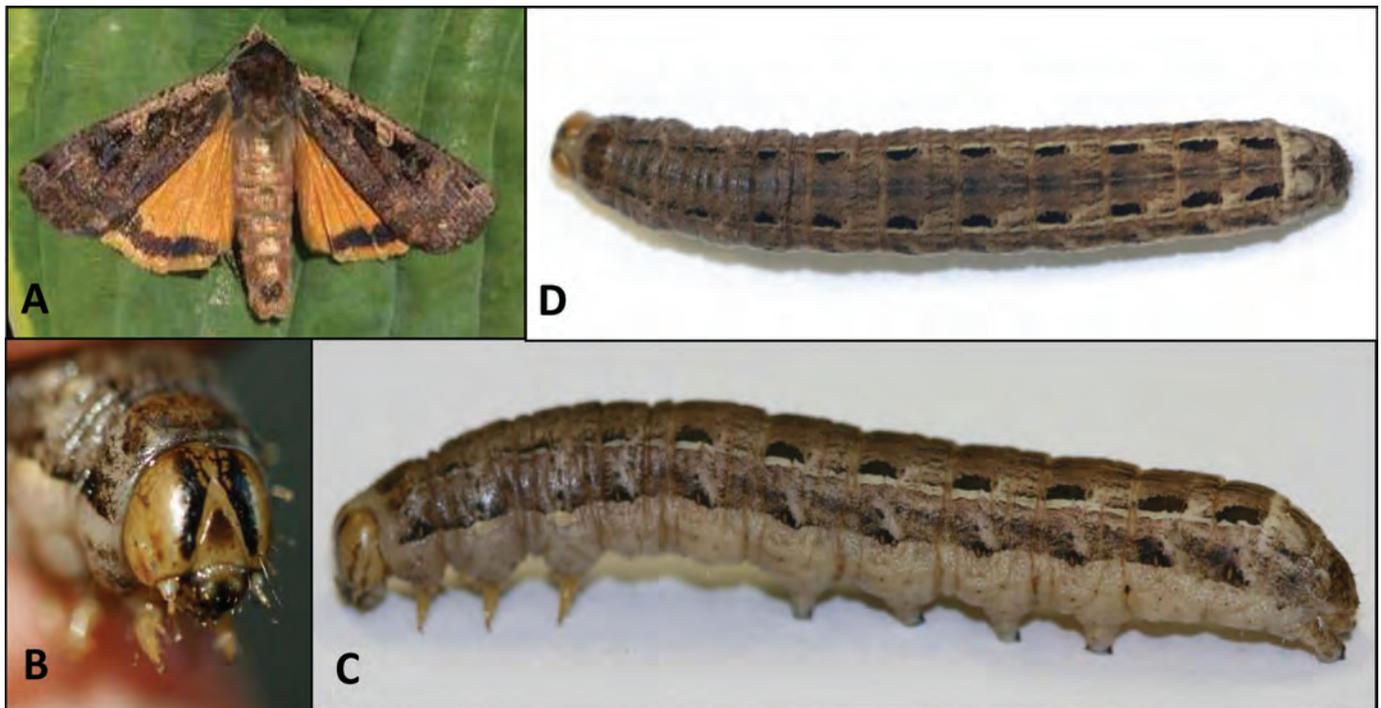
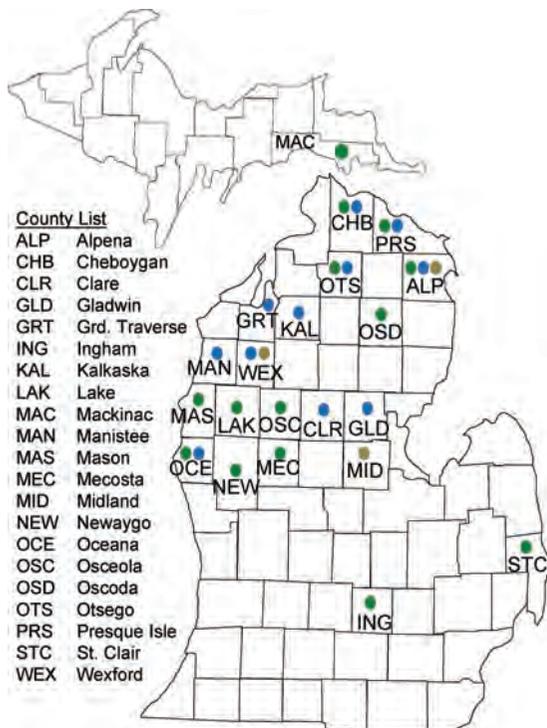


Fig. 1. *Noctua pronuba* adult wing pattern (A), larval head capsule (B), side-view (C), and dorsal-view (D). (Credit: C. DiFonzo)



**Fig. 2.** Map of Michigan showing the locations of *Noctua pronuba* observations and complaints between fall 2007 and spring 2008. Colored dots indicate the type of report: green, feeding on agricultural crops; blue, homeowner complaints and turf damage; brown, pet illness.

identifications for the general public, has received specimens from concerned homeowners every fall since the early 2000s. This apparent cold tolerance has earned the larval stage of *N. pronuba* the unofficial common name ‘winter cutworm’ in Michigan. Despite this activity in the fall, *N. pronuba* is not considered a serious pest in Europe and was not reported to cause economic damage in Canada or the U.S. Therefore, it was not a candidate for a damaging insect outbreak.

### Fall 2007 Outbreak

In early October 2007, Michigan State University Extension (MSUE) offices in two different counties sent routine emails to Diagnostic Services. In hindsight, these two innocuous messages foreshadowed an *N. pronuba* outbreak. The outbreak, as well as aspects of *N. pronuba* biology, is documented in this article using original emails and pictures sent by first responders between fall 2007 and spring 2008. The emails began with a message from Oceana County, followed closely by a message from nearby Wexford County (Fig. 2). We had a big problem with cutworms getting into homes and garages last fall. I had a call from a chemical dealer already this fall and it sounds like the same problem, only this time it is at one of our larger food processors (N. Myers, Oceana County MSUE, personal communication, October 1, 2007).

This lady brought these [caterpillars] in today and she said they are EVERYWHERE . . . she’s being overtaken by them. She doesn’t understand where they are coming from, as she doesn’t have any trees close to her home. She says they are on her deck, driveway and the side of her house and there are hundreds and thousands of them. (Secretary, Wexford County MSUE, personal communication, October 3, 2007) (Fig. 3).

Diagnostic Services asked Myers to collect and preserve larvae. “Mission accomplished. I collected 100+ from the floor of a young cherry orchard. The processor showed me one of his migrant houses where the insects clustered in what were probably the millions before it was treated.” (N. Myers, Oceana County MSUE, personal commu-



**Fig. 3.** *N. pronuba* caterpillars gathered on a cement pad near a door frame of a home in October, 2007, Wexford County, MI. (Credit: J. O’Donnell)

nication, October 5, 2007). Several hundred larvae from Myers’ sample were sent to Dr. Steve Passoa, a USDA–APHIS–PPQ lepidopterist based at the Ohio State University Museum of Biological Diversity. Dr. Passoa confirmed that the specimens were *N. pronuba*. That same week, the Student Organic Farm on the MSU campus in Ingham County found large numbers of *N. pronuba* feeding on Swiss chard in a hoop house; the chard was unmarketable. This extended reports of caterpillars to three counties.

By mid-October, Diagnostic Services received numerous reports of thousands of caterpillars in yards and on the sides of homes. The reports were not necessarily a surprise, given the public’s concern in general with insects around the home. However, caterpillar numbers soon were beyond anything previously experienced. “I live in Fife Lake Michigan and my home, garage and pole barn are being invaded by caterpillars. They are in the grass by the thousands. I feel like I’m in a B-movie. What can be done about these bugs? They’ve eaten what was left of my hostas and we have ten acres of hardwoods. I would hate to see these guys kill my maples and beeches. What can I do?” (concerned homeowner, Kalkaska County, personal communication, October 23, 2007). Homeowners and educators reported two sizes of caterpillars, some nearly 5 cm in length and others measuring only 2 cm, confirming Wright’s (1987) observations that both last-instars and earlier-instars were present in late fall.

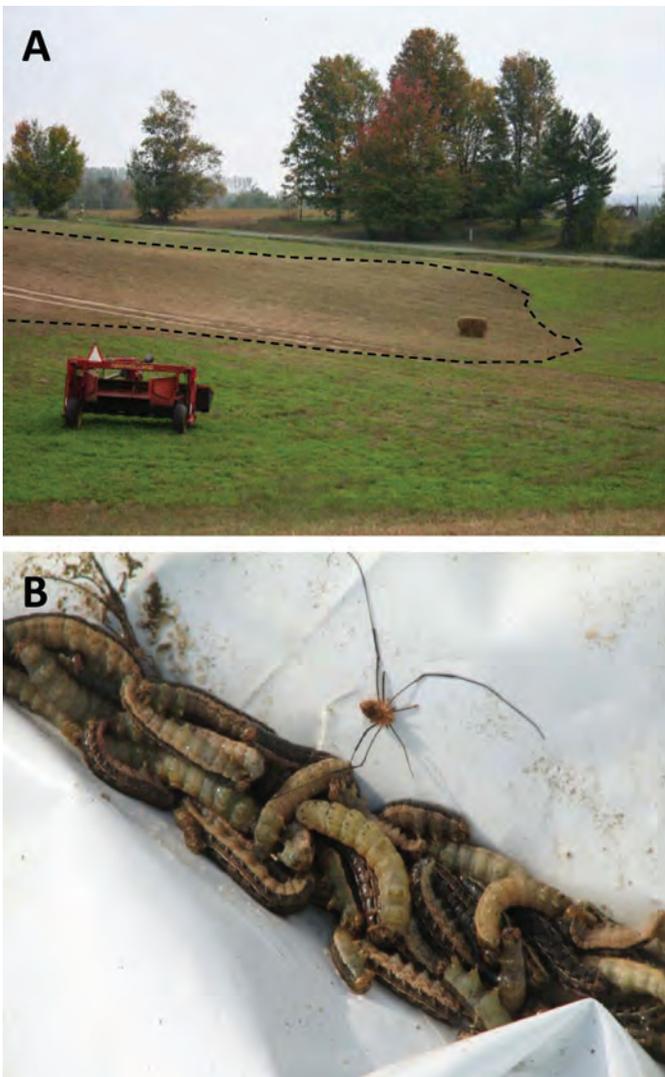
Homeowners were not the only ones facing caterpillar problems. Myers, who originally brought the outbreak to our attention, reported the first widespread feeding in a commercial production field. “Today I had my first report from a crops farmer where they were eating a hay field. . . They act much like an armyworm, showing up literally in the millions and moving en masse from one area to another. I am a little concerned that they represent a threat to emerging winter wheat if this is more than an outbreak in an isolated area.” (N. Myers, Oceana County MSUE, personal communication, October 8, 2007). This was the first confirmation, to our knowledge, of damage by *N. pronuba* to commercial field crops in North America. Wright (1987) anticipated *N. pronuba*’s pest potential when he stated “careful studies of hayfield yields may reveal considerable losses due to these cutworms.”

As extension educators made farm visits, they observed that fields with low, wet margins were at greater risk; larvae moved out of these low areas into fields to feed. Larvae also appeared to have a host preference. “I went out this afternoon and looked at two hay fields. . . I can say this, *Noctua pronuba* definitely prefers alfalfa to grass. The orchardgrass in the stand was only slightly touched and the alfalfa was stripped down to the ground.” (N. Myers, Oceana County MSUE, personal communication, October 12, 2007). This observation differed from earlier reports that larvae preferred grasses (Wright 1987).

In alfalfa fields, caterpillars climbed up plants to feed first on leaves, then on small stems, resulting in heavily defoliated crowns



**Fig. 4.** *N. pronuba* feeding on alfalfa in October, 2007, Oceana County, MI. Caterpillars climbed plants (A) to feed on leaves and small petioles, stripping plants bare (B). (Credit: N. Myers)



**Fig. 5.** *N. pronuba* caterpillars moved as a wave across this alfalfa field in Lake County, MI (A), defoliating a large area (dashed outline). Although appearing dead, larvae trapped at night on a plastic silage bag near the field (B) recovered when the sun came out. (Credit: J. Lindquist)

(Fig. 4). “The picture (Fig. 5A) shows feeding damage on the edge of an adjoining field of alfalfa and volunteer oats that they started to move into. The farmer said within a day of moving into this field, they reversed course and headed to his white plastic Ag-Bags of stored silage (Fig. 5B) and either died on the surface, or disappeared. We had temperatures down to 28°F on Saturday night, so when I was there on Monday there were few live larvae still visible. I did notice a large flock of ≈100 crows that seemed to be feeding in the cut hay fields on the remaining worms on Monday.” (J. Lindquist, Osceola County MSUE, personal communication, October 16, 2007). However, the assumption that larvae were killed by exposure to cold temperatures was wrong. Caterpillars only looked dead, but they recovered and crawled away when held the hand or warmed by the sun.

Early in the outbreak, a pressing question was if fall-feeding on alfalfa caused economic damage. The initial recommendation, before we fully understood the level of cold tolerance of *N. pronuba* caterpillars, was to suggest no action on the part of farmers, letting a hard freeze take care of the problem. However, reports of caterpillar activity in fields persisted into late October, even when nighttime temperatures were well below 0°C. Because defoliation potentially reduced above-ground biomass protecting alfalfa crowns from winter kill, the recommendation shifted to spraying heavy infestations of caterpillars. Growers were encouraged to spray when the air temper-



**Fig. 6.** *N. pronuba* defoliation of a rye cover crop in late October, 2007. (Credit: J. Lindquist)



Fig. 7. *N. pronuba* caterpillars infest a home lawn in October 2007 (A). By April 2008, defoliated turf was dead (B). (Credit: J. O'Donnell)



Fig. 8. Why did the cutworm cross the road? The question remains unanswered, but the end result was numerous smears on the asphalt in Presque Isle County, MI. (Credit: M. Tulgestke)

ature was over 10°C (50°F) to increase insecticide effectiveness. Pyrethroids such as permethrin were very effective, although growers also reported using chlorpyrifos and carbaryl.

In early October, Myers expressed concern about damage to winter wheat. That concern was well-founded. By late October, commercial winter wheat fields, as well as rye and oat cover crops, were completely defoliated in Alpena, Cheboygan, Lake, Mason, Oceana, and Osceola counties (Fig. 2). “I have been hearing stories of *Noctua pronuba* feeding on cereal grains, but now I have proof. This is a rye field adjacent to an alfalfa field (Fig. 6). The worms ate the alfalfa and moved into the rye.” (N. Myers, Oceana County MSUE, personal communication, October 26, 2007). “I got a rye call this morning as well. This was a rye field for wildlife viewing. The field was sown last fall and the headed rye was mowed down in August of this year to reseed it. The field was not tilled this summer, so the cutworms emerged, fed in October, devoured the field, and are now moving onto the homeowner’s lawn in a feeding wave.” (J. Lindquist, Osceola County MSUE, personal communication, October 29, 2007). In small grain fields, caterpillars fed lower on the plant, at and just below the

soil surface. One educator coined the term ‘scalping’ to describe this feeding. Larvae usually fed in the evening. “During the day they hide under corn stalks or leaves. They feed from 4 p.m. to 4 a.m. In the morning they are as big and fat as a man’s little finger. But by afternoon they shrink in size.” (P. Durst, Oscoda County MSUE, personal communication, November 14, 2007).

As in the case of alfalfa, caterpillar-feeding on small grains did not stop despite hard nighttime freezes and daytime temperatures in the single degrees C. As insects fed, they moved in a wave from field to field. Some producers limited insecticide applications to the forward edge of the moving infestation, killing the majority of larvae. Growers applied pyrethroids well into November and reported excellent control. Caterpillars moved en masse from agricultural fields into home lawns (Fig. 7A). Pyrethroids and carbaryl registered for turf were used in November to reduce defoliation of lawns and as barrier treatments around homes.

Caterpillars also crossed roads in large numbers (Fig. 8). “I got a call from a sales rep near Alpena. He was driving down the road and noticed all these bugs crossing the road ... he got out and saw that they were the winter cutworm.” (G. Brinkmann, Pioneer HyBred Agronomist, personal communication, November 1, 2007). A farmer reported that his tractor tires were ‘actually starting to spin because of the slippery larvae-covered pavement.’ Another farmer in Presque Isle County timed a caterpillar’s progress over a highway at eight inches per minute, or 40 feet per hour.

By the middle of November, things took a bizarre turn when *N. pronuba* was linked to pet illness. On November 12 the MSU County Extension Director for Alpena County was at a local veterinarian’s office when a frantic pet owner brought in a bag of dog vomit. The Extension Director identified 40–50 *N. pronuba* caterpillars as the culprit of the dog’s indigestion. *N. pronuba* was confirmed, or in some cases presumed to be, the cause of pet illness as the only species still active in November. “A report of a second dog getting sick by consuming winter cutworms has come in. A black lab in the Midland area was vomiting blood, went off of feed, and after a week was passing whole cutworms in her stool. The veterinarian diagnosed it as a potential parasite problem, sent a stool sample to Cornell’s Parasite Diagnostic Lab and they identified it as armyworm. The dog owner called me after a TV news spot on cutworms and I am quite sure cutworms are what the dog ate. The dog owner from Midland County says now whenever the dog goes into their large lawn and adjoining



**Fig. 9.** A boxelder bug, *B. trivittata* with its proboscis inserted into a moribund *N. pronuba*. (Credit: E. Elsner)

two acres of un-mown turf, her nose is to the ground and she is in an aggressive hunting mode...” (J. Lindquist, Osceola County MSUE, personal communication, November 16, 2007).

The authors developed a two-page diagnostic bulletin for *N. pronuba*, and MSU extension offices provided this handout to veterinarians in northern counties to make them aware of the potential problem. As a result of these contacts, there were additional reports of dogs and cats becoming ill after eating caterpillars. “I took the cutworm handout to the local vet offices so they would know the cutworm if they had any cases. Airport Animal Clinic said they had three cases of dogs eating the worms and becoming sick.” (J. O’Donnell, Wexford County MSUE, personal communication, November 21, 2007). O’Donnell also received a report of cats eating caterpillars and becoming sick.

After coverage of the pet illnesses in newspapers and on television, some poultry growers worried about cutworms around their flocks (“Is the winter cutworm toxic to chickens?” K. Thurlow, Clare County MSUE, personal communication, January 17, 2008). However, extension staff, farmers, and homeowners observed that birds and squirrels feasted on caterpillars in large numbers with no apparent side effects. An alert extension educator even photographed a boxelder bug (*Boisea trivittata* (Say)) apparently feeding on a moribund *N. pronuba* larva (Fig. 9).

A unique feature of *N. pronuba* caterpillars was their ability to feed not only in the fall, but throughout the winter. As stated by Wagner (2005) “if someone brings you a cutworm in the dead of winter—this is it.” In early January 2008, a television news crew from Cadillac, MI, filmed caterpillars crawling on the snow surface when the air temperature was  $-3^{\circ}\text{C}$  ( $26^{\circ}\text{F}$ ). Feeding (or at least larval movement) continued both under, and on top of, the snow on sunny, cold days between January and March. The coldest confirmed observation was on a  $-7^{\circ}\text{C}$  day in northern Michigan (Fig. 10). Thus, homeowners and farmers continued to find caterpillars throughout the winter and into early spring of 2008. “At least once a week all winter long, people would tell they had them on their property...” (J. Lindquist, Osceola County MSUE, personal communication, March 26, 2008).

### Spring 2008 Recovery

In spring 2008, extension staff and producers returned to fields to survey the damage. In locations that experienced total defoliation in the fall, alfalfa fields fared better than small grains. Crowns survived and fields generally recovered, although slowly. In early April, extension educator Myers walked alfalfa fields in western Michigan and reported “Winter cutworm feeding appears to have had the same effect as taking a fourth cutting” (N. Myers, Oceana County MSUE, personal communication, April 2008). Another extension educator in the Upper Peninsula of northern Michigan walked a 1-yr-old seeding and said “The stand doesn’t seem so bad. It’s just way behind and weeds



**Fig. 10.** Cold tolerant *N. pronuba* caterpillars crawl on the snow surface near Buckley in Grand Traverse County, MI, at an air temperature of  $-7^{\circ}\text{C}$  ( $20^{\circ}\text{F}$ ). (Credit: C. DiFonzo)



**Fig. 11.** Damage to an alfalfa field in spring 2008 (A), where the defoliated area was slow to regrow (dashed outline). Although alfalfa crowns survived defoliation, weeds established in the stand to compete with the crop (B). (Credit: J. Isleib)



**Fig. 12.** Severe fall defoliation by *N. pronuba* in a small grain field in Michigan's Upper Peninsula resulted in stand loss in spring 2008. (Credit: J. Isleib).

are going to get a jump on the crop. The field is pretty weedy, with lots of white cockle, dandelion, and yellow rocket.” (J. Isleib, Alger County MSUE, personal communication, May 16, 2008) (Fig. 11). *N. pronuba* caterpillars were still present in this field in the soil and around weed root masses, with “4–8 larvae found under each yellow rocket plant.” Spring regrowth was delayed in defoliated areas and weeds emerged ahead of the crop. While defoliation did not kill alfalfa plants, a short-term reduction in first-cutting yield in 2008 and a long-term negative effect of defoliation and weed competition on stand longevity were suspected, but not confirmed.

In contrast to alfalfa, small grain fields were seriously impacted by defoliation. “Where the cutworms cut into the nearby rye field, it is a very different story. The fed-on areas are completely dead this spring,

while the rest of the field is coming out of dormancy just fine” (N. Myers, Oceana County MSUE, personal communication, April 9, 2008) (Fig. 12). Small grains in defoliated areas were replaced by weeds. A similar pattern was found in home lawns, where defoliated turf died (Fig. 7B). Interestingly, both green caterpillars and pupae were found in the spring. “The worms were green versus brown, as in the fall, and the farmer believes they are definitely feeding” (B. Robb, Ottawa County MSUE, personal communication, April 21, 2008). This observation matched our assumption that both late and early instars entered the winter, with the last-instars pupating in early spring and the younger (green) larvae continuing to feed on weeds and winter grains into late spring.

From the outbreak in 2007 and 2008, we determined that under heavy infestation, *N. pronuba* is an agricultural pest in alfalfa, mixed hay, and small grain fields. Although a direct negative impact on alfalfa was not proven in replicated studies, the heavy feeding and resulting weed emergence in some fields made it likely that first-cutting yield was less, and stand longevity reduced. Heavy feeding destroyed or severely reduced stands of fall-planted small grains and cover crops. Around homes, caterpillars destroyed turf, created a mess in entryways and garages, and resulted in pet illness. However, insecticides were effective in reducing caterpillar numbers in fields, in turf, and around homes, even under cool conditions. In the end, the outbreak allowed us to make observations on *N. pronuba* biology and pest status that will be useful during the next outbreak. But further, from an outreach standpoint, this experience was a good example of how emails and digital photographs, which are often opened and discarded, may contain valuable information and generate a quick extension response. Without the email outbreak, many facets of the insect outbreak would not have been captured in such detail as it unfolded.

#### Acknowledgments

The authors thank Michigan State University Extension Educators Mary Dunkel, Phil Durst, Duke Elsner, Jim Isleib, Jerry Lindquist, Norm Myers, Jill O'Donnell, Bill Robb, and Kable Thurlow; producer Mike Tulgestke, and Pioneer Agronomist Gary Brinkmann, for use of email correspondence and pictures. Special thanks to Steve Passoa, USDA-APHIS-PPQ and the Ohio State University Museum of Biological Diversity, for confirming the initial identification of *N. pronuba* larvae.

#### References Cited

- Copley, C. R., and R. A. Cannings. 2005. Notes on the status of the Eurasian moths *Noctua pronuba* and *Noctua comes* (Lepidoptera: Noctuidae) on Vancouver Island, British Columbia. *Journal of the Entomological Society of British Columbia* 102: 83–84.
- Morris, R. F. 1985. Large yellow underwing cutworm moth: New to Newfoundland. *Agri-tech*. 3: 9.
- Morris, R. F. 1987. Note on occurrence of the large yellow underwing moth, *Noctua pronuba* (Linnaeus) (Lepidoptera: Noctuidae), in Newfoundland. *Canadian Entomologist* 119: 403–404.
- Neil, K. 1981. The occurrence of *Noctua pronuba* (L.) (Noctuidae) in Nova Scotia: A new North American record. *Journal of the Lepidopterists Society* 35: 238.
- Neil, K. A., and H. B. Specht. 1987. Sixth-instar larvae of *Noctua pronuba* (L.) (Lepidoptera: Noctuidae). *Canadian Entomologist* 119: 209–214.
- Passoa, S., and C. S. Hollingsworth. 1996. Distribution, identification and rate of spread of *Noctua pronuba* (Lepidoptera: Noctuidae) in the northeastern United States. *Entomological News* 107: 151–159.
- Wagner, D. L. 2005. *Caterpillars of Eastern North America*. Princeton University Press, Princeton, NJ.
- Wright, B. 1987. The European yellow underwing, *Noctua pronuba* L. (Lepidoptera: Noctuidae), in the Atlantic Provinces (Canada) and the state of Maine (USA). *Canadian Entomologist* 119: 993–997.
- Wright, B., and K. A. Neil. 1983. *Noctua pronuba*, a European cutworm, established in Nova Scotia (Lepidoptera: Noctuidae). *Canadian Entomologist* 115: 1047–1048.

Received 10 March 2010; accepted 1 July 2010.