

Laboratory fecundity and development, field population dynamics, pupal predation and the history of releases of the spurge hawkmoth, Hyles euphorbiae (L.), a biological control agent of leafy spurge, Euphorbia esula L., in Montana

by Noah Holleman Poritz

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Entomology

Montana State University

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Abstract:
Laboratory studies of spurge hawkmoth, Hyles euphorbiae (L.) fecundity, and egg/larval development were conducted in 1984-1985. Average fecundity, determined by direct count of eggs oviposited, was 153.0 eggs per female. The number of eggs oviposited ranged from 3-261 per female. Egg and larval development was studied at three constant temperatures (20, 25 and 30 °C). Theoretical lower temperature thresholds for development of eggs and larvae were estimated to be 6.5 and 12.8 °C, respectively. Behavioral observations of the spurge hawkmoth are discussed.

A complete field census of the spurge hawkmoth, Hyles euohorbiae (L.), established on leafy spurge, Euphorbia esula L, was made near Bozeman, Montana during 1984. The population reached a peak mean density of 0.19 larvae/m2 during late July. Daily monitoring of development for 52 larval cohorts revealed a poor correlation with average temperatures at the site (r = 0.40). Density-independent factors contributed to egg, larval, and pupal mortality of the spurge hawkmoth. Fifty-six percent of the pupae successfully survived the winter. Examination of the distribution of hawkmoth larvae in the Bridger Mountains and Story Hills revealed widespread dispersal from original release sites.

Predation on pupae of the spurge hawkmoth, Hvles euphorbiae (L.), introduced for the biological control of leafy spurge, Euphorbia esula L., was studied in the field near Bozeman, Montana in 1984 and 1985. Exclusion cage treatments were imposed on pupae placed on or below the soil surface to identify the types of predators most responsible for mortality. The use of both sealed and semi-sealed insect cages significantly reduced the levels of pupal mortality compared with open range treatments during both years examined. Small mammals and invertebrate predators were the most important sources of hawkmoth pupal mortality.

Scattered and incomplete records of releases and establishments of the spurge hawkmoth, Hvles euohorbiae (L.) on leafy spurge, Euphorbia esula L., exist for Montana. Efforts to compile previous records, refute or confirm their validity, and examine release sites were made. Through a review of literature,unpublished Canadian and U. S. government records, personal communication and direct field observations, a more clear synthesis of this agent's release and establishment history is provided.

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APPROVAL

of a thesis submitted by

Noah Holleman Poritz

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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ABSTRACT

Laboratory studies of spurge hawkmoth, Hyles euphorbiae (L.) fecundity, and egg/larval development were conducted in 1984-1985. Average fecundity, determined by direct count of eggs oviposited, was 153.0 eggs per female. The number of eggs oviposited ranged from 3-261 per female. Egg and larval development was studied at three constant temperatures (20, 25 and 30 °C). Theoretical lower temperature thresholds for development of eggs and larvae were estimated to be 6.5 and 12.8 °C, respectively. Behavioral observations of the spurge hawkmoth are discussed.

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CHAPTER 1

INTRODUCTION

Biological control is the most promising control tactic available for the perennial weed leafy spurge, Euphorbia esula L. One biological control agent, the spurge hawkmoth Hyles euphorbiae (L.), has been the subject of dozens of releases since its North American introduction during the mid-1960's. In Montana, this insect has a long history of releases by state and federal biological control workers. Unfortunately, no detailed evaluation studies of this agent in Montana were published.

The examination in 1982 of a former release site of Hyles euphorbiae near Bozeman, Montana (Baker 1988, pers. comm.) revealed an established hawkmoth population. Confirmation of establishment was again made during 1983. Detailed field and laboratory studies of this population were implemented during 1984 and 1985.

Questions addressed by the field studies were as follows: 1) What was the population density near the site of the original release; 2) How widely distributed was this population; 3) What were the larval development rates in the field; 4) What mortality factors were associated with the larval and pupal stages of this insect; 5) What was the overwintering survivorship of this agent; 6) Was this insect

established at the other release sites in Montana; and 7) Were techniques available which could enhance the establishment of this agent at new release sites?

Laboratory experiments were developed to examine: 1) Whether laboratory fecundity and development differed from the conclusions published in previous studies; 2) What were the developmental rates for this insect at various temperatures; and 3) How well matched was the low temperature developmental threshold for this insect and the environment of the northern Rocky Mountains and Great Plains?

The conclusions drawn from these studies may help individuals interested in the biological control of leafy spurge and the spurge hawkmoth gain a greater understanding of the complexity of this plant-insect interaction.

Literature Review

Leafy spurge, Euphorbia esula L., is a deep-rooted perennial weed which reproduces by seed and by adventitious root buds which generate new shoots (Figure 1). The biology and ecology of this species have been studied extensively (Hanson and Rudd 1933, Bakke 1936, Croizat 1945, Selleck 1959, Selleck et al. 1962, Morrow 1979, Best et al. 1980, Ebke and McCarty 1983, Watson 1985, Harvey et al. in press, Nowierski at al. submitted).

Leafy spurge, introduced to North America in the early 1900's, now infests over one million ha (Nobel et al. 1979) and is spreading rapidly (Forcella and Harvey 1981). This Eurasian species forms dense

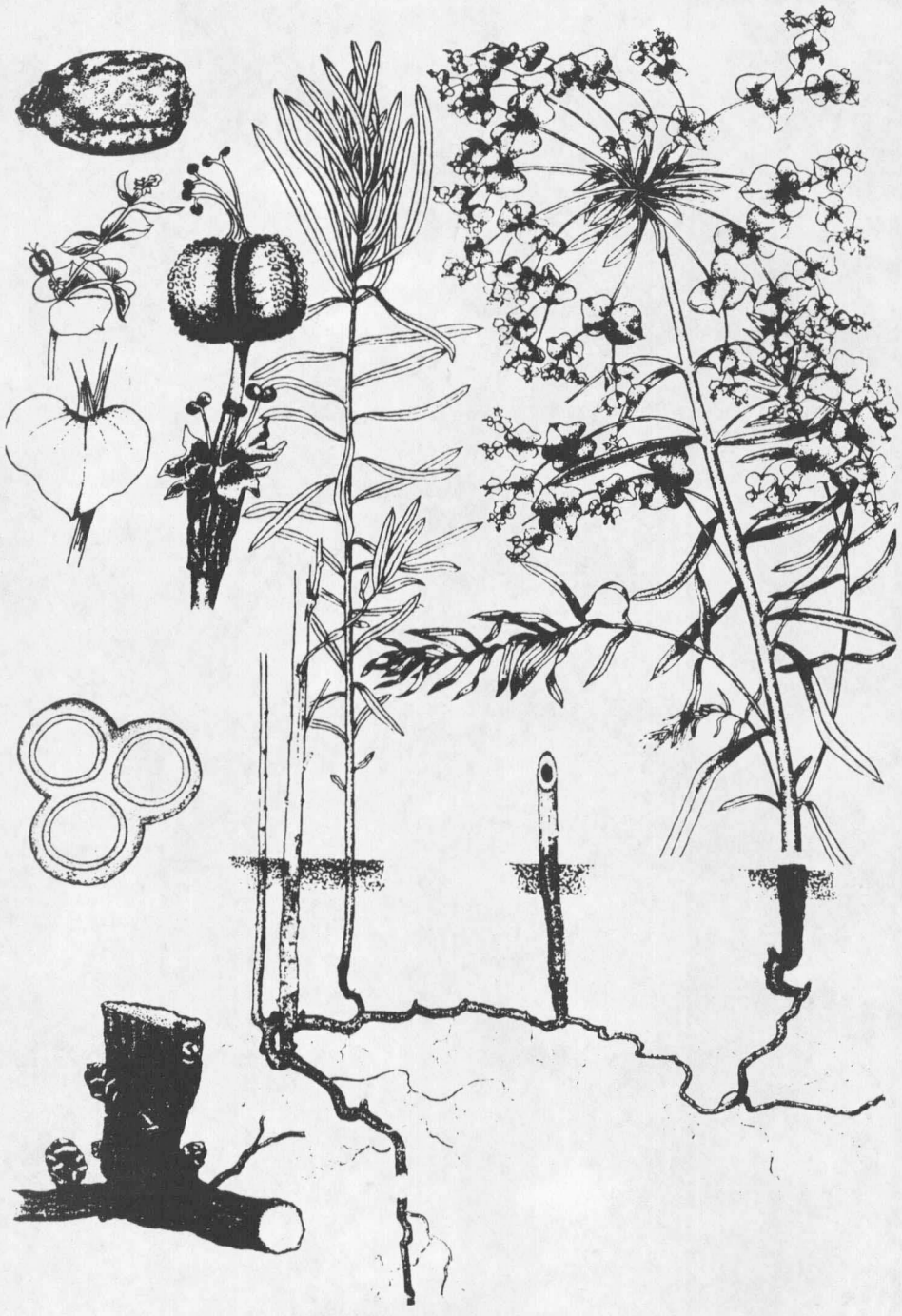


Figure 1. Line illustration of leafy spurge, Euphorbia esula L.

monotypic stands and has demonstrated considerable ecological amplitude, infesting soils from prime agricultural lands to the rocky slopes of low productivity rangelands (Selleck 1959). In Montana, leafy spurge was first collected in the 1920's (Forcella and Harvey 1981) and by 1979 over 200,000 ha were overrun (Nobel et al. 1979).

Herbicide application has been the most widely adopted management tool against leafy spurge. Unfortunately, the marginal economic rewards and inaccessibility of many of the rangelands infested has limited the value of chemical application. The persistent underground root system and the ability of the plant to block translocation of herbicides below the root crown further reduces the effectiveness of chemical control (Lym 1988, pers. comm.). Simultaneously, the elimination of desirable broadleaved species by herbicidal application is a deleterious side effect (Maxwell 1984, Watson 1985). For these reasons, biological control methods are considered by many to be the most promising management tactic for leafy spurge (Alley and Messersmith 1984).

The practice of biological control has been employed, with varying degrees of success, against dozens of exotic weed species worldwide (Delfosse 1981, 1985, Julian 1982). Classical biological control of weeds relies on the introduction of host-specific, plant feeding insects to reduce the competitive advantage of exotic weeds (Huffaker 1957, 1962). The objective is not to kill the plant outright, but rather to stress the plant, allowing more desirable plant species to competitively displace the weed (Harris 1981).

The application of biological control methods against E. esula and cypress spurge, E. cyparissias L., began in 1965 with the introduction and release of the spurge hawkmoth, Hyles euphorbiae (L.) (Lepidoptera: Sphingidae) in Canada (Williamson 1966). Larvae of this Eurasian moth (Figures 2, 3, 4) defoliate a variety of spurges in its native range. The hawkmoth has slowly become established on E. cyparissias in eastern Canada and the United States (Harris and Alex 1971, Batra 1983). On E. esula only tentative establishment has been reported (Story 1979, 1985, Harris 1984).

Laboratory Studies of the Spurge Hawkmoth

The development of the spurge hawkmoth was first studied by House (1965) who documented the effects of low and abnormal nutrient levels on feeding efficiency. His study, utilizing H. euphorbiae as a laboratory animal, reflected the importance of the nutrient content of diet in determining the volume consumed by phytophagous insects. Other studies by Grzelak et al. (1970, 1971, 1973) and Morris et al. (1976) examined biochemical aspects of this species.

As efforts to exploit the biological control potential of the spurge hawkmoth increased, research was initiated to learn more of this insect's biology and life history. New (1971) examined foliage consumption and weight gains of larvae when fed E. cyparissias. Average hawkmoth larval consumption was 2.7 g dry weight of cypress spurge. Forwood (1977) observed similar foliage consumption rates on E. esula, (3.37 g dry weight). Both authors concluded that their

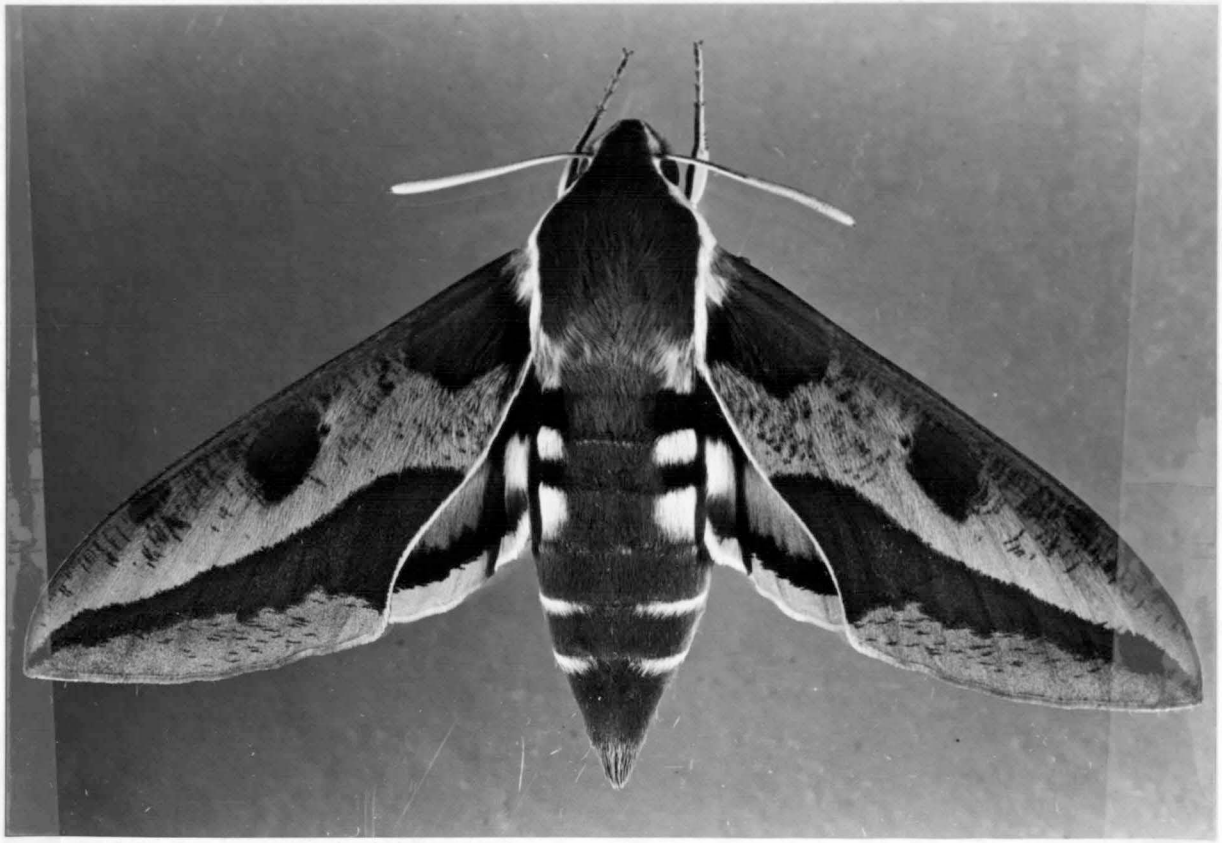


Figure 2. Photograph of spurge hawkmoth, Hyles euphorbiae (L.), adult (Dorsal view).

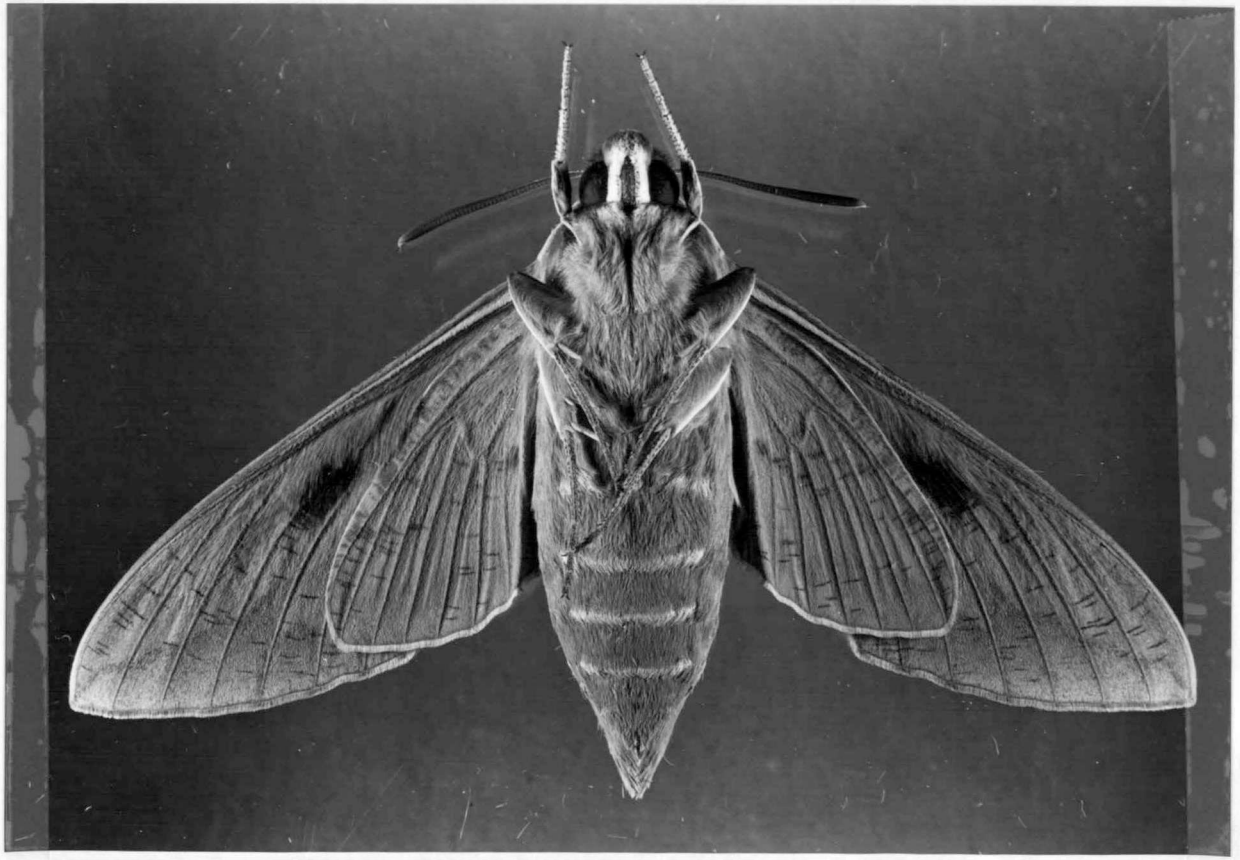


Figure 3. Photograph of spurge hawkmoth, Hyles euphorbiae (L.), adult (Ventral view).



Figure 4. Photograph of spurge hawkmoth, Hyles euphorbiae (L.), fifth instar larva feeding on leafy spurge, Euphorbia esula L.

laboratory feeding results could be extrapolated to the field to determine larval densities needed to provide economic control. For the Ontario, Canada site mentioned by New, a larval density of between 11 and 23/m^2 would be required for economic control (Harris 1984). At the time of New's study the density of that particular hawkmoth population was 1/m^2 (Creelman 1971).

New (1971) also quantified head capsule diameters for each larval instar and found the mean duration for larval development was 21.8 days at 24 °C. Forwood (1977) found that the mean larval development at this same temperature was 18.4 days.

Harris and Alex (1971) examined the effects of subfreezing temperatures on pupal survival. They found that pupal mortality increased linearly with decreasing soil temperature. Exposure of the pupae to -18 °C for one month was found to cause over 80 percent mortality. They concluded that pupal winter kill would be a problem only at the most extreme Canadian prairie release sites.

Field Biology of the Spurge Hawkmoth

Prior field studies of the spurge hawkmoth have focused on documenting its success in the areas where it has become established, or in explaining the difficulties this insect encountered in areas where it failed to establish.

No populations have become established on E. esula in Canada despite extensive release efforts (Harris and Alex 1971, Harris 1984). Intense larval predation by ants, beetles, wasps and mice were the

reasons suggested for this agent's failure to establish. Harris (1984), for example, reported that the percentage of larval survival decreased in linear proportion to the number of ants caught in pitfall traps. In addition, cytoplasmic and nuclear polyhedrosis virus infections were also suggested as a cause of significant mortality (Harris et al. 1985)

In contrast, at release sites in Ontario where cypress spurge is present, establishment has been common and defoliation extensive. Larval densities as high as $27/m^2$ have been reported and dispersal by this strong flier has also occurred over many square kilometers (Harris 1984).

Batra (1983) has reported that releases made on cypress spurge in New York, from larvae collected in Ontario, have yielded established hawkmoth populations which averaged between 12 - 21 larvae/m^2. Total defoliation of some cypress spurge stands occurred. Mortality of the spurge hawkmoth in New York was attributed to polyhedrosis virus, ants, and even a racoon feeding on pupae. Batra also noted that larger, older instar larvae occasionally consumed the small first instar larvae coincidental to their feeding upon the foliage.

Hawkmoth release efforts in Nebraska by Forwood and McCarthy (1980a, 1980b) on leafy spurge failed to produced an established population. These authors reported larval and pupal predation by ants, beetles and mice as significant causes of mortality.

Summary

Leafy spurge is an aggressive exotic weed that has become established in many areas of the United States and Canada. It reduces forage productivity in pastures and rangelands of the Rocky Mountains and Great Plains.

Herbicidal control has been marginally successful but it has not been cost effective. Biological control, using co-evolved, host specific insects, may be a more promising means of controlling leafy spurge.

The first efforts at biological control of leafy spurge began in the 1960's with the introduction of the spurge hawkmoth, a defoliator. Field studies of this biological control agent have documented the successful establishment on E. cyparissias in eastern North America and to a limited degree on E. esula in Montana. Difficulties in establishment in the northern Great Plains have been attributed to larval and pupal predation and diseases. Most authors have concluded that the hawkmoth has been only marginally successful at stressing leafy spurge; others have considered it an outright failure.

CHAPTER 2

LABORATORY FECUNDITY AND DEVELOPMENT OF THE SPURGE HAWKMOTH, Hyles euphorbiae (L.) (LEPIDOPTERA: SPHINGIDAE), ON LEAFY SPURGE, Euphorbia esula L.

Introduction

Prior studies of the spurge hawkmoth, Hyles euphorbiae (L.) have examined fecundity (Moscardini 1947). This work was conducted on European populations of the moth. Additional studies (New 1971, Forwood 1977) examined larval development. New (1971) utilized hawkmoth larvae feeding on cypress spurge (E. cyparissias L.) and Forwood (1977) had very few individuals in his sample size.

The objectives of this portion of this thesis were to determine spurge hawkmoth fecundity and egg and larval developmental rates at three constant temperatures on leafy spurge, E. esula L. This information will add to our understanding of this agent's biology at field sites in western North America. Behavioral aspects of this insect's biology are also discussed.

Materials and Methods

Larvae of the spurge hawkmoth were collected from a field site 3.2 km NE of Bozeman, Gallatin County, Montana in 1983. Larvae were fed fresh leaves grown on live potted E. esula plants until they

completed their development and pupated. Pupae were placed in an incubator at 4 °C for a minimum of 60 d to complete diapause. Pupae were then removed from cold storage and placed in a 1.2 x 1.2 x 3.2 m screened cage inside a greenhouse (25 °C, 16 h photoperiod). Flowering E. esula plants were placed in the screened cage and watered as necessary to provide a nectar source and oviposition sites for adult hawkmoths.

Observations pertaining to adult emergence, feeding, mating, and fecundity were recorded on a daily basis. At the time of oviposition, plants receiving eggs were immediately placed in an incubator operating at one of three temperatures: 20, 25, or 30 °C with a 16 h photoperiod.

Upon eclosion each newly emerged first instar larva was removed from its original host plant and placed on its own individual spurge plant. Before complete defoliation occurred, each larva was transferred to a new, vigorously growing plant. Information on adult oviposition behavior, the duration of development of eggs and each larval instar, adult and larval feeding behavior, and their mortality was recorded. Fecundity was determined by direct counts of eggs oviposited and by dissection of females dying after oviposition.

Results and Discussion

H. euphorbiae adults emerged three to four weeks after their removal from cold storage. Once free of their pupal case, adult hawkmoths climbed upon the nearest vertical object and expanded their wings with hemolymph. After a period of inactivity, hawkmoths usually

took flight within the rearing cage, often imbibing nectar from spurge extrafloral nectaries while in flight. Similar feeding behavior was observed throughout the adult lifestage.

Hawkmoths mated nocturnally; copulation being abdomen to abdomen with the male abdomen not being twisted (Chapman 1971). Females oviposited on spurge leaves, bracts, stems and occasionally on cage walls. Eggs were laid singly, in pairs, and in masses containing up to fifty eggs.

The mean number of eggs laid by female hawkmoths was 153 (± 7.2 SEM) and the mean number retained at death was 30.1 (± 6.4 SEM). The range of the number of eggs oviposited was 3 to 261. This finding differs from the range of 70 to 110 eggs reported for this species by Moscardini (1947). All oviposited eggs were viable.

Within each of the laboratory temperature regimes, egg development was constant and decreased linearly between each increasing temperature treatment (Table 1). Egg development ranged from 7 days at 20 °C to 4 days at 30 °C. The minimum threshold for development was estimated to be 6.5 °C and is presented in Figure 5 (Andrewartha and Birch 1954, Nowierski et al. 1983).

Upon eclosion, newly emerged first instar larvae frequently consumed their egg case. Following this, they crawled to the top of the umbel and began consuming its floral bracts. If floral bracts were lacking, larvae would begin eating the apical meristem and the youngest leaves atop the plant.

Table 1. Laboratory development time of eggs and larvae of H. euphorbiae at three constant temperatures.

	Mean development time (± SEM) in days		
	Temperature °C		
Lifestage	20 n = 21	25 n = 22	30 n = 39
Egg	7.0 (0.00)	5.0 (0.00)	4.0 (0.00)
I	4.7 (0.10)	3.4 (0.10)	1.9 (0.06)
II	4.1 (0.07)	4.5 (0.10)	2.3 (0.08)
III	7.7 (0.15)	3.5 (0.10)	3.2 (0.07)
IV	5.5 (0.11)	2.7 (0.22)	2.5 (0.10)
V	11.2 (0.33)	7.4 (0.22)	4.3 (0.10)
I - V	33.2 (0.41)	21.5 (0.35)	14.3 (0.11)
Egg - V	40.2 (0.41)	26.5 (0.35)	17.9 (0.11)

The larvae fed gregariously, and while frequent sibling encounters were observed, little disturbance in larval feeding was noted in the first through third instars. Sibling encounters were tolerated less passively by the larger, older larvae, which would often flinch and flail their heads when disturbed while feeding. When larvae were transferred to new plants, the agitated animals would often regurgitate saliva and freshly masticated spurge leaves. These diematic behaviors may have adaptive significance both in predator and parasitiod defense and in partitioning food intraspecifically (Edmunds 1974) Larval development exhibited a slightly greater temporal variability than egg development but also decreased linearly with increasing temperature (Table 1). The calculated minimum threshold for larval development was 12.8 °C (Figure 6). An upper developmental threshold was not established because the spurge plants began to exhibit water stress at temperatures above 30 °C.

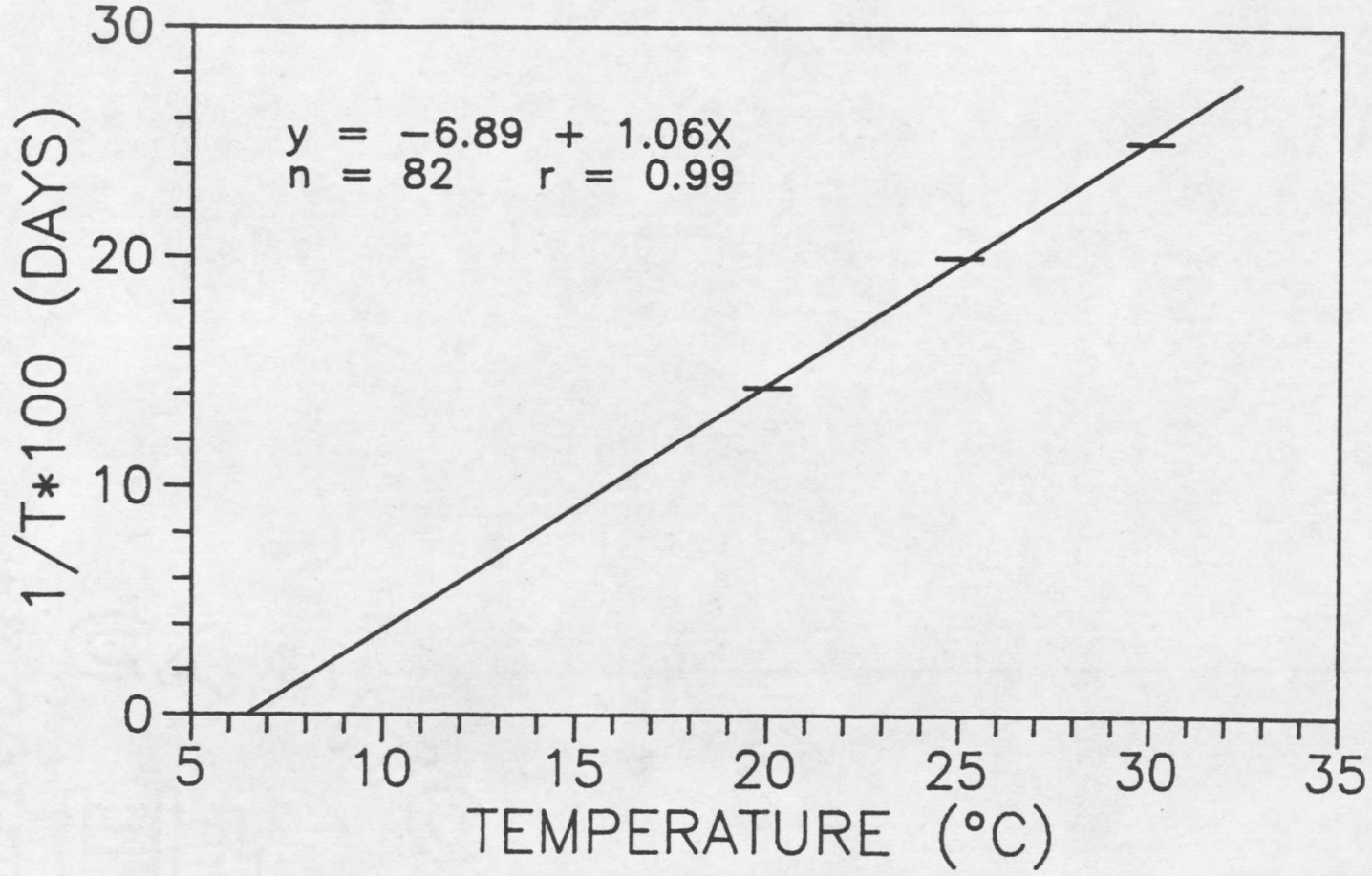


Figure 5. Reciprocal of mean laboratory egg development time (x 100) for Hyles euphorbiae (L.) regressed against temperature. Error bars represent SEM.

Upon completion of feeding, 5th instar larvae enter a prepupal period. It is during this stage that larvae in the field disperse and seek out a suitable site in or on the soil in which to pupate. In the laboratory, these dispersing larvae would ambulate for hours around the circumference of the potted spurge plant. A considerable caloric expenditure appears to occur at this pre-pupal stage. In the laboratory all larvae were able to successfully pupate and no mortality was observed.

The duration of larval development at 24 °C (22.2 days; n = 82, extrapolated from the regression equation in Figure 6) was greater than that reported by New (1971) on cypress spurge (21.8 days; n = 50) and Forwood (1977) on leafy spurge (18.4 days; n = 21). Two reasons for this reported difference may be their use of small plastic enclosures to rear the larvae, possibly increasing the effective temperature. Second, there may have been different selection pressures operating on the H. euphorbiae prior to the initiation of the respective development studies. Insects in this study were obtained from a field population established in a cool climate. In contrast, larvae in the other studies originated from laboratory colonies (New 1971, Forwood and McCarty 1980a).

This study and those of others (New 1971, Forwood 1977, Forwood and McCarty 1980a, 1980b) have shown that H. euphorbiae requires relatively warm temperatures for egg and larval development. Based on the heat accumulation required for larval eclosion and development, it is anticipated that this insect will exhibit a poor temporal synchrony with its weedy host in the climatic region of the Rocky Mountains and

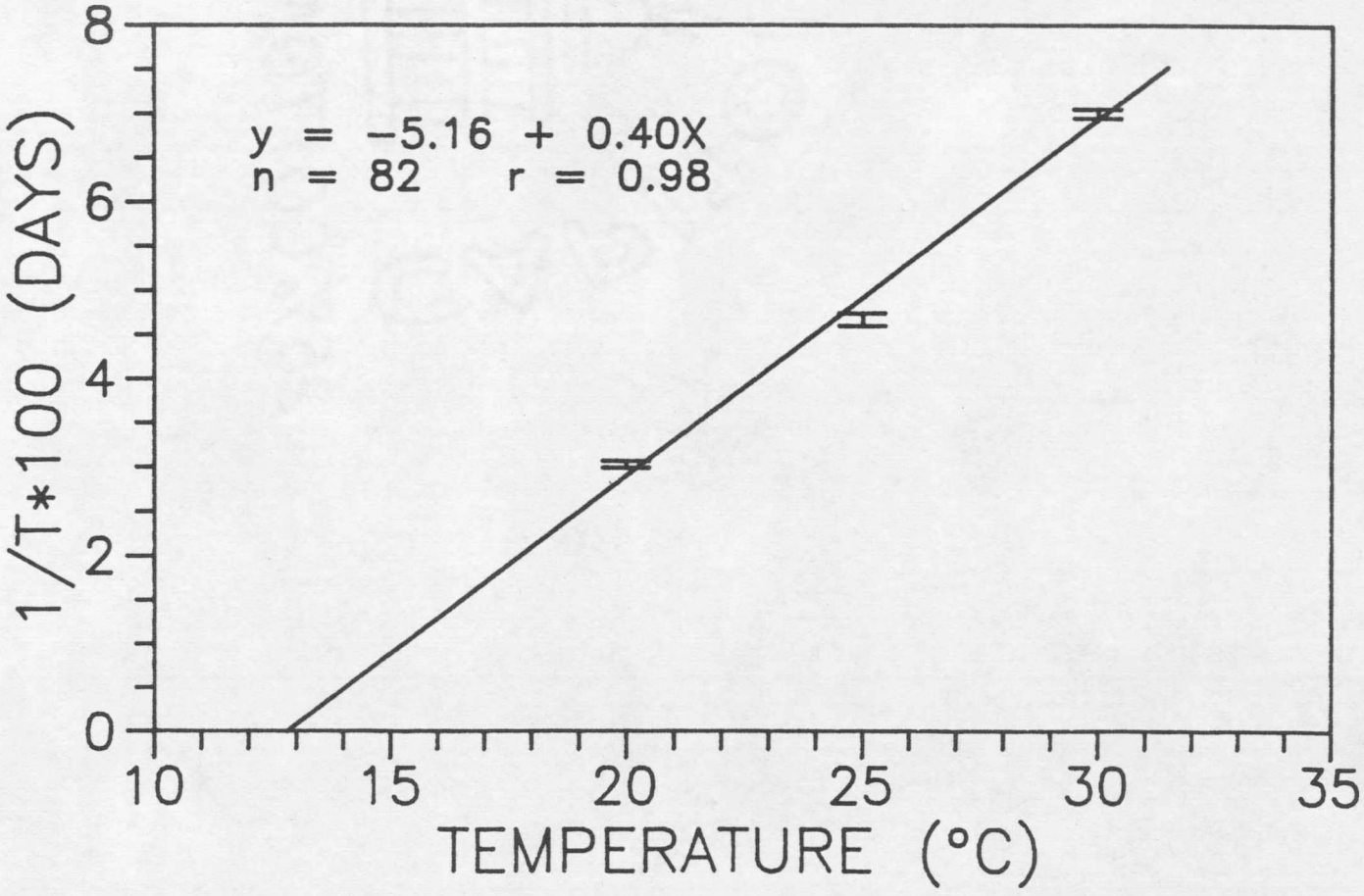


Figure 6. Reciprocal of mean laboratory larval development time (x 100) for Hyles euphorbiae (L.) regressed against temperature. Error bars represent SEM.

northern Great Plains. For defoliation to provide the most effective sexual reproductive stress on leafy spurge it should occur early in the season. However, late-season defoliation could affect plant carbohydrate reserves and reduce the competitive advantage of the weed by influencing regrowth the following year.

CHAPTER 3

POPULATION DYNAMICS OF THE SPURGE HAWKMOTH, *Hyles euphorbiae* (L.) (LEPIDOPTERA: SPHINGIDAE), ON LEAFY SPURGE, *Euphorbia esula* L.

Introduction

Biological control efforts against leafy spurge, *Euphorbia esula* L., and cypress spurge, *E. cyparissias* L. began in 1965 with the introduction and release of the spurge hawkmoth, *Hyles euphorbiae* (L.), in Canada (Williamson 1966). This was the first of numerous attempts to establish this Eurasian defoliator on these exotic weeds in North America. Of the field studies which followed, most have centered on documenting the success of the insect in the few areas where it has become established or in explaining the difficulties this insect has encountered in areas where it failed to establish.

The objectives of this section of this thesis were to: 1) conduct a complete field census of the hawkmoth population; 2) quantify rates of larval development in the field; 3) determine the larval soil excavation capability prior to pupation; 4) estimate pupal overwintering survival; and 5) assess the local distribution of the first established spurge hawkmoth population on *E. esula* in North America.

Materials and Methods

The field research site was established in 1984, 3.2 km NE of Bozeman on the gently sloping, SW facing, foothills of the Bridger mountain range (elevation 1540 m.) A four ha site was delimited and consisted of a formerly plowed area (dominated by Bromus inermis Leys. and Melilotus officinalis [L.] Lam.) and an unplowed native grassland (a Festuca idahoensis Elmer/Agropyron spicatum [Pursh.] Scribn. & Smith habitat type; Mueggler and Stewart 1980; Figure 7). The field site was in the vicinity of the 1966 release of 290 H. euphorbiae larvae (See Chapter 5). Leafy spurge was abundant at the site in the form of isolated clones as well as larger coalesced areas. Each spurge clone or patch was measured with a metric tape, length by width, to determine the area of the sample unit. Every clone was assigned a number and a metal identification tag was nailed to the soil on the north side of each. Large patches were arbitrarily sectioned into smaller units with surveyors tape for identification and measurement. In conjunction with ground measurements, an aerial photograph was taken of the site and each sample unit was outlined on the image (Figure 8). A continuous record of temperature and humidity data was obtained from a hygrothermograph installed inside a standard weather instrument enclosure at the center of the site.

A complete population census of hawkmoth larvae was initiated upon completion of the mapping. First, the number of larvae, their instar stage, and the clone they were associated with was recorded in

the mapped area on a weekly basis. Second, a developmental survey was implemented in which cohorts of first instar larvae were counted and their developmental phenology recorded on a daily basis. The overall census was essential in locating new cohorts for daily developmental monitoring. Third, a visual examination of larval presence or absence in patches of leafy spurge in the foothills of the Bridger Mountains and the adjacent Story Hills was performed. This sampling provided an indication of the present geographical distribution of the spurge hawkmoth near Bozeman, Montana.

An additional field experiment was also conducted. The first phase of this experiment (1984) determined the capacity of the larvae to excavate a pupation site in the hard soil. Groups of 40 fifth instar larvae (120 larvae total) were placed within 3 plastic arenas. Arenas measured 10 x 8 x 3 dm and were covered by a 3.2 x 2 x 2 m screened cage to discourage avian predation. Arenas were used to eliminate invertebrate and vertebrate predators and to confine the larvae. The second phase of this cage study involved the monitoring of the arenas during the spring of 1985 to measure adult hawkmoth emergence and overwintering mortality of the pupae.

Results and Discussion

A total of 140 leafy spurge sample units were identified. The total of the spurge infested area was 10637 m^2 or 26 percent of the four ha site. The mean sample unit was 77.6 m^2 (± 7.3 SEM) with the range being three to 530 m^2.

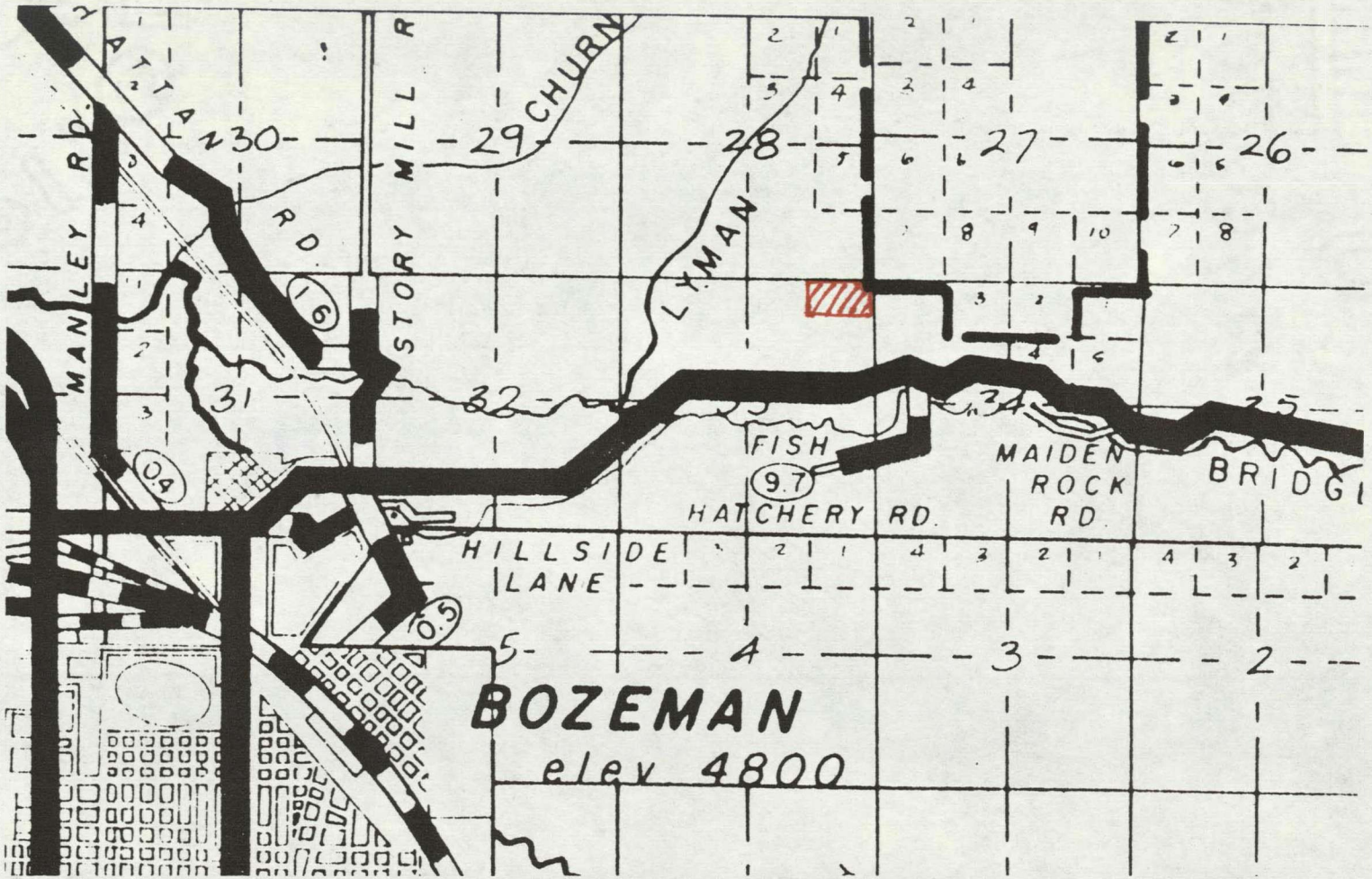


Figure 7. Location of Bridger foothills Hyles euphorbiae (L.) research site 3.2 km NE of Bozeman, Gallatin County, Montana. Scale: 2.3 cm = 1 km (1.5 in = 1 m.).

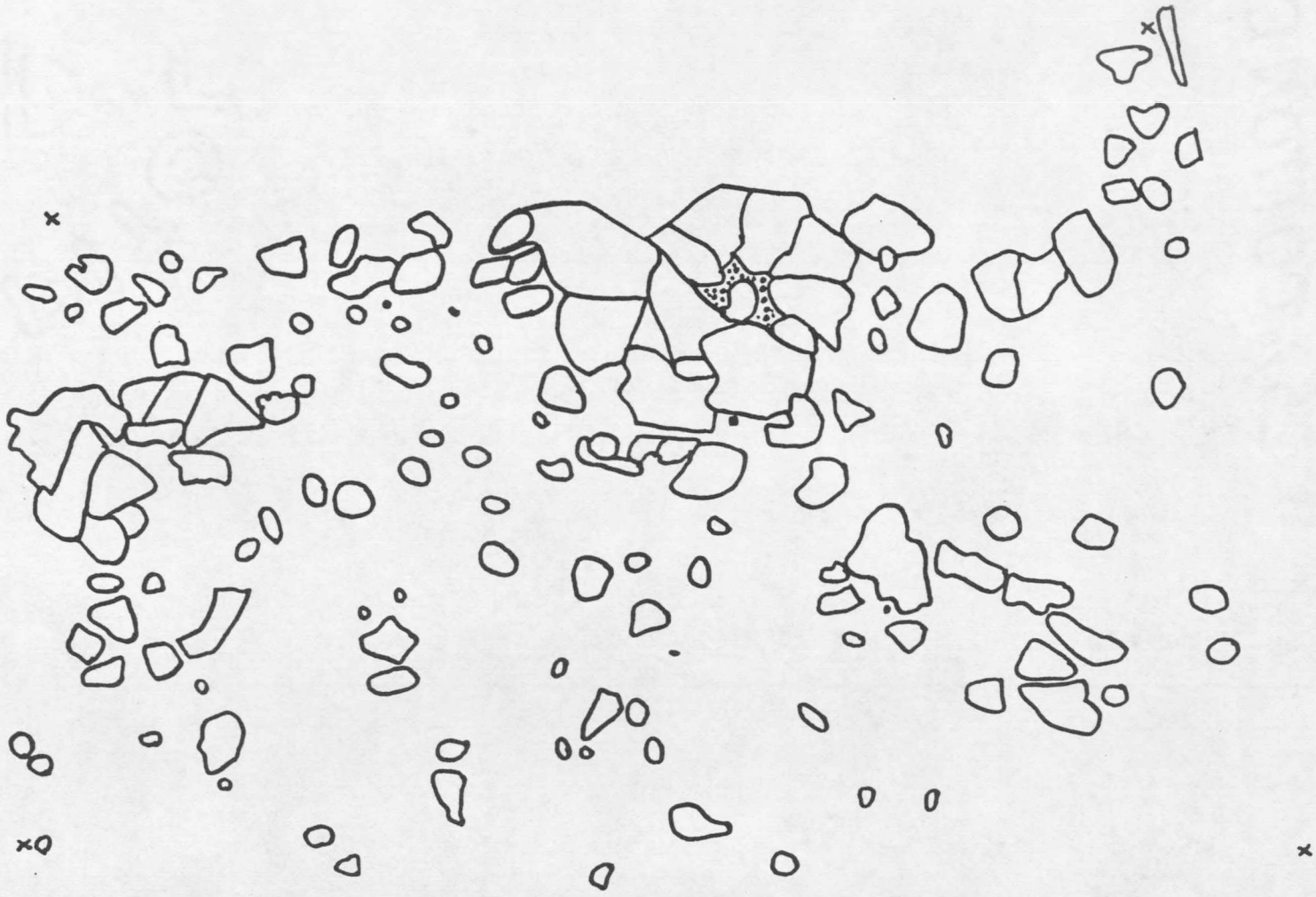


Figure 8. Euphorbia esula L. clone location map at Bridger foothills Hyles euphorbiae (L.) research site. 140 spurge clones totaling 10637 m^2 were delimited on the four ha site.

The population census of the four ha site revealed that a well-established hawkmoth population existed in the area of the first releases of this agent. At the height of the population a total of 1643 larvae were counted (Figure 9). This translates to approximately 0.19 larvae for every m^2 (± 0.015 SEM) of leafy spurge (range = 1.035 larvae/100 m^2 to 1.04 larvae/m^2).

Figure 10 illustrates the lack of correlation ($r = -0.197$, $P = 0.029$) between clone area and the density of hawkmoth larvae for every m^2 of leafy spurge. This suggests that adult hawkmoth oviposition was not influenced by the size of the spurge clone.

Although the larval population was readily apparent during this study, the moth was undetected for many years after the initial 1966 release. This species was considered not to have established in Montana until 1982 (Story 1985). A plausible explanation for this agent's enigmatic establishment is that this insect exhibited an eclipse phase in which it existed for years at low numbers before rapidly increasing (Murry 1985). If this was the case, it is possible that the larvae went unobserved. Early instars (1-3) are small, blend well with the green vegetation, and are difficult to see even by an experienced observer. Fourth and fifth instar larvae are larger and more visible (red and black aposomatic coloration; Figure 4), but still may have been missed if observations were not made during the proper time during the summer.

The age-structure and seasonal phenology of the spurge hawkmoth are shown in Figure 11. First instar larvae were very small and difficult to detect, hence their low numbers. All other instars were

well represented. As time proceeded, and heat units accumulated (Higley et al. 1986), the phenology of the population shifted to second, third, fourth, and fifth larval instar developmental stages. It is important to note that due to an extended period of adult oviposition, all larval instars were represented in the field at one time.

Prior work by Harbich (1976) revealed that a daylength exceeding 16 h during the final two larval instars causes non-diapause pupae and multivoltine behavior in this species. The Julian dates corresponding to the 16 h photoperiod at this site were 160 to 190, suggesting that this population (Julian dates = 190 to 240) did not contribute to a second generation.

Daily monitoring of 52 individual cohorts totaling 123 larvae revealed considerable variation in the mean developmental rate for a particular mean temperature. Figure 12 illustrates a loose correlation ($r = 0.40$, $P = 0.037$) between rate of cohort development and average temperature. Due to this poor correlation, a minimum developmental threshold could not be determined from the field data. Estimates of temperature from the single weather station at the site likely contributed to the poor relationship found between larval development and temperature. Perhaps there were enough microsite differences to thwart an accurate estimation of temperatures experienced by the larva. Other reasons for the variable rates may include actual developmental variation due to disease or plant nutrient quality.

Causes for mortality of the spurge hawkmoth in the field were also studied. During the egg stage, wind, rain, and hail were observed

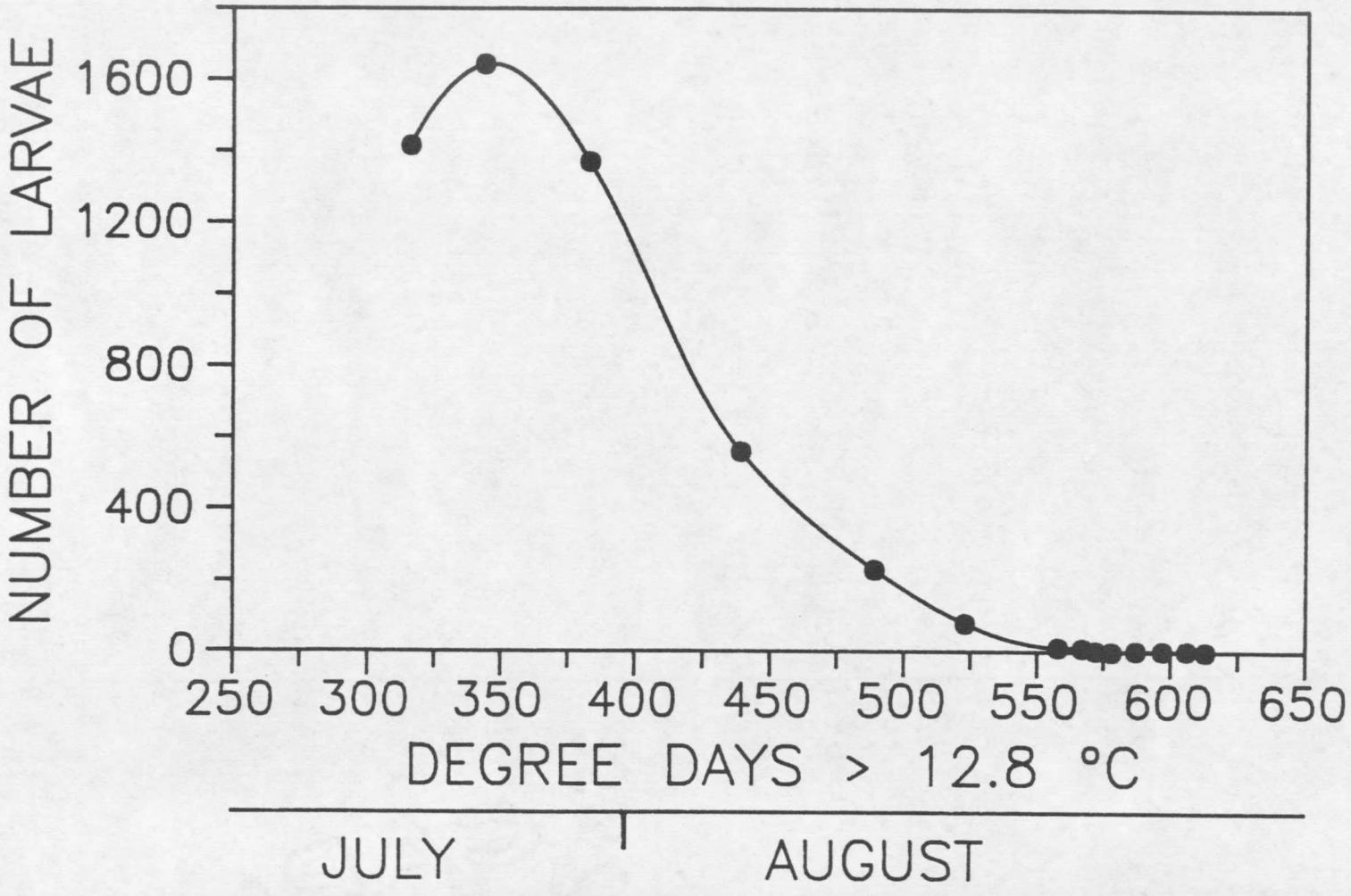


Figure 9. Hyles euphorbiae (L.) field population census (all larval instars combined) from the Bridger foothills research site (1984). Degree days calculated from Higley et al. (1986) sine wave method.

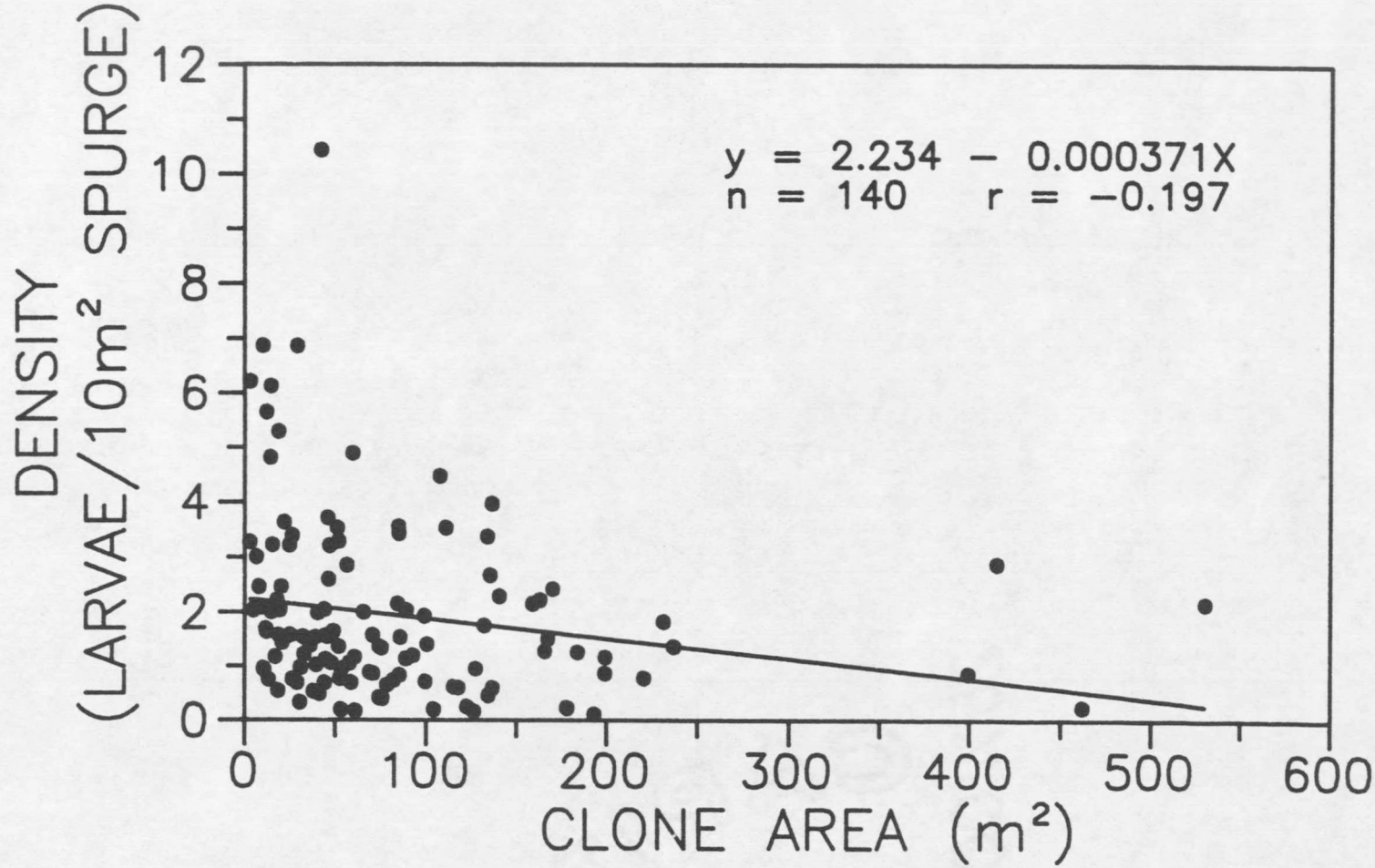


Figure 10. Relationship of Hyles euphorbiae (L.) larval density (during peak population, July 1984) to Euphorbia esula L. clone area at the Bridger foothills research site.

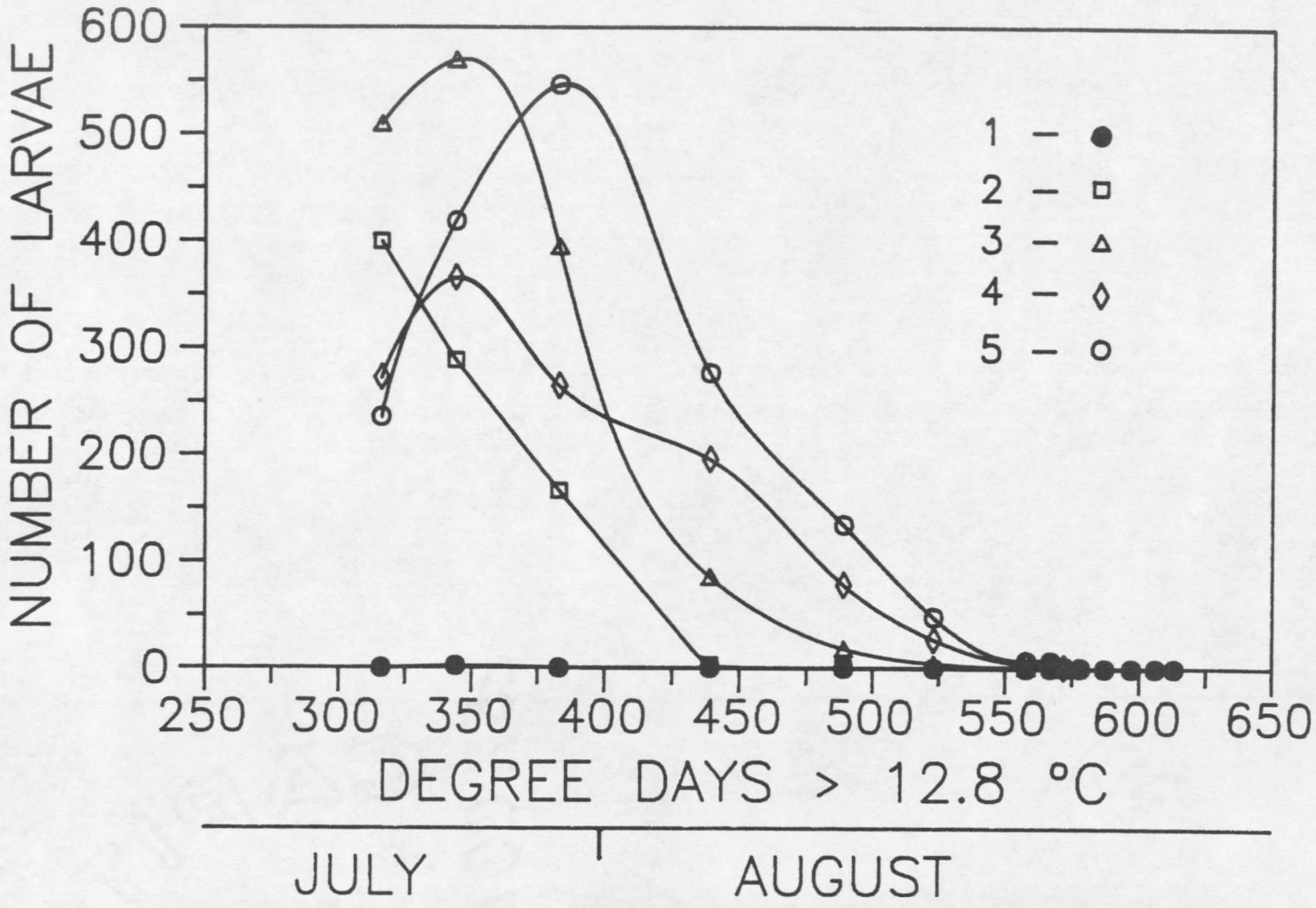


Figure 11. Hyles euphorbiae (L.) field population census (instars 1-5) from the Bridger foothills research site (1984). Degree days calculated from Higley et al. (1986) sine wave method.

to dislodge eggs from spurge plants. It is not known whether these eggs successfully developed after being dislodged.

Larval performance was also affected by both abiotic and biotic influences. Larvae stopped feeding when exposed to low temperatures and their exposed position on the host plant made them vulnerable to freezing. Symptoms of disease became evident in the field during these periods of low temperature. Other mortality factors included larvae that were found on the ground being preyed upon by ants and carabid beetles. Some larvae were observed with wounds on their dorsal surface as if they had escaped avian predators.

Results from the caged arenas in which late 5th instar larvae were placed revealed that all 120 larvae were able to successfully excavate a pupation site in or on the soil surface. In spring of the following year, this cage was monitored closely and observations revealed that of the 120 larvae that were installed only 67 adults emerged. This translates to an overwintering mortality of 44%. It is important to note that this degree of pupal survival (56%) was attained only with the exclusion of the larger vertebrate pupal predators. Pupal desiccation (frequently observed in the laboratory) and invertebrate predators (See Chapter 4) may have contributed to this overwintering pupal mortality.

A visual survey of spurge patches throughout the Bridger foothills and Story Hills revealed that the insect has dispersed over 5 km in the last 20 years. Nearly every spurge patch that was examined was occupied by the hawkmoth. At some sites, hawkmoth larval densities exceeded $1/m^2$; at other sites, only a few larvae/ha could be found.

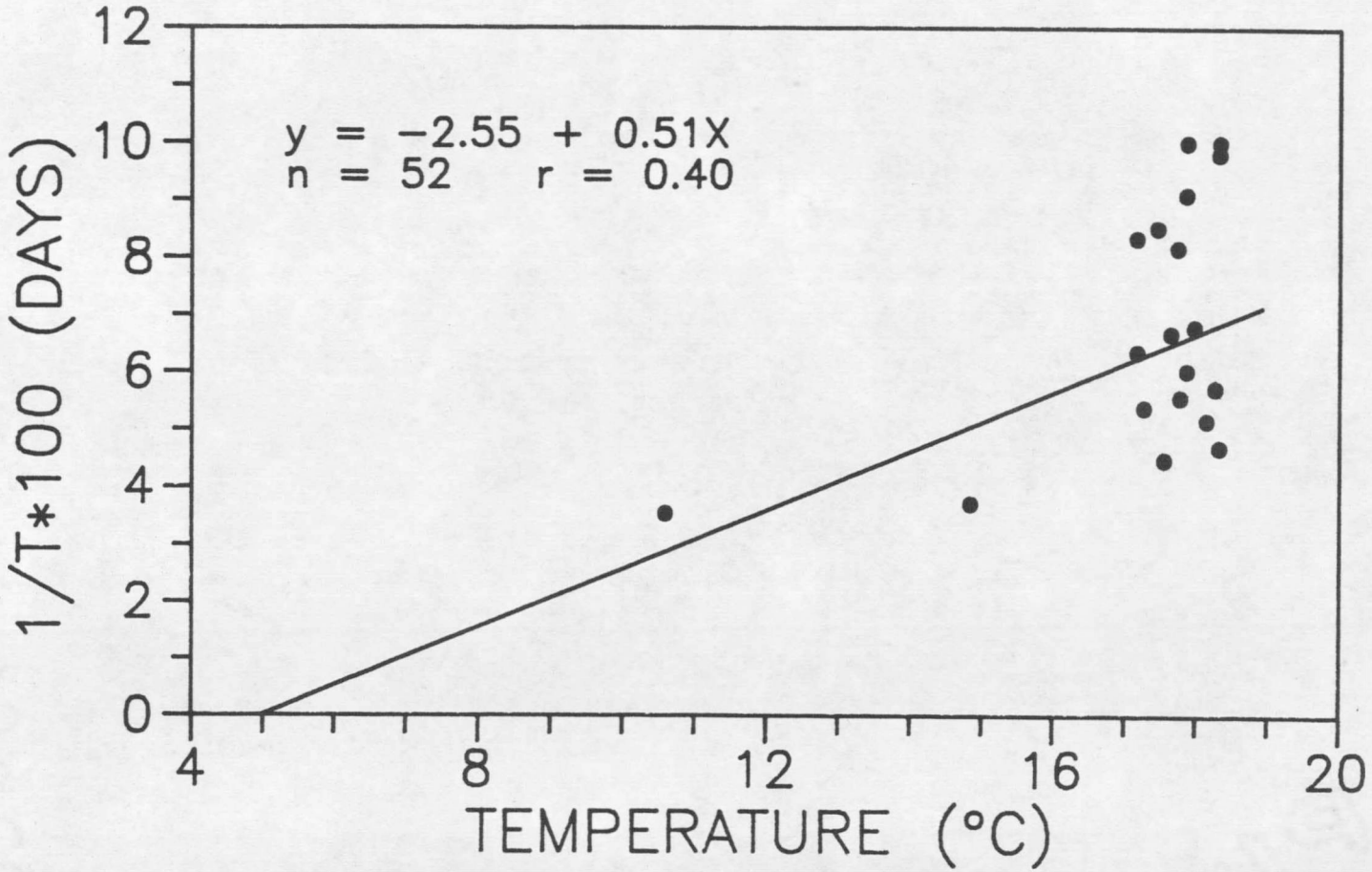


Figure 12. Reciprocal of mean larval development time (x 100) for field cohorts of Hyles euphorbiae (L.) regressed against temperature.

Despite the 20 years since the spurge hawkmoth was first released at this site, it has not yet attained a population density necessary to substantially stress this perennial weed. It appears that the population levels attained by this species have had little impact on weed density and may fit the model proposed by Briese (1985) in which an agent's population density stabilizes below that which impacts the target weed. Defoliation by this insect upon its host is ill-timed to interrupt the plant's sexual reproduction. As larvae begin to feed on the foliage, the plant is already producing seed. For defoliation to be an effective sexual reproductive stress, it should occur earlier in the plant's phenology. The defoliation caused by this insect undoubtedly reduces plant biomass and carbohydrate reserves. Information needs to be gathered which examines to what extent this late defoliation reduces regrowth and reproduction in the following year.

While the reproductive capacity and dispersal capabilities of the hawkmoth are adequate, there are four negative factors which reduce its control value. 1) The poor synchrony of the hawkmoth with its host was mentioned above; 2) The ubiquitous presence of a disease in this population may dampen the effectiveness of the hawkmoth in the field and reduce the value of this insect when rearing it in the laboratory for redistribution and field release; 3) The presence of native natural enemies may continue to adversely effect hawkmoth establishment and population buildup; 4) Finally, the presence of newly introduced agents (Harris et al. 1985, Pemberton 1985, Rees et al. 1986), potentially more stressful on the target plant, support the conclusion that the

spurge hawkmoth may only be effective when used in conjunction with additional introduced agents.

CHAPTER 4

PUPAL PREDATION OF THE SPURGE HAWKMOTH, Hyles euphorbiae (L.) (LEPIDOPTERA: SPHINGIDAE), AN INTRODUCED BIOLOGICAL CONTROL AGENT OF LEAFY SPURGE, Euphorbia esula L.

Introduction

Mortality of the spurge hawkmoth (Hyles euphorbiae [L.]), an introduced biological control agent of the perennial weedy spurges (Euphorbia esula L. and E. cyparissias L.), has been reported by a number of researchers in North America. These studies have included pupal mortality due to subfreezing temperatures (Harris and Alex 1971), and larval and pupal predation by vertebrates (mice and raccoons) and invertebrates (ants, beetles and wasps; Harris and Alex 1971, Harris 1984, Forwood 1977, Forwood and McCarthy 1980a, Batra 1983). Observations of the symptoms associated with polyhedrosis virus infection have been reported in Canada and the United States (Baker 1973, Batra 1983, Harris 1987, pers. comm.).

Studies of predation of pupae of phytophagous biological control agents have generally been qualitative (Forwood 1977, Batra 1983). However, researchers in other fields have measured the pupal mortality rates of forest insect pests (Buckner 1959a, 1959b, 1966, Schoenfelder et al. 1978, Campbell and Torgersen 1983, Campbell et al. 1983), agricultural insect pests (sorghum, Temerak 1979; corn, Young 1985; apples, Hagley et al. 1982; cabbage, Strandberg 1981) and rangeland

pests (Bellows et al. 1982). Other studies have examined pupal predation of some non-pest species (Nielsen 1977, Young 1982, Wiklund and Sillen-Tullberg 1985). Diseases, such as infection of pupae by nematodes (Kaya and Hara 1980) may also control insect pest populations.

The purpose of this portion of this thesis was to measure the levels of predation on spurge hawkmoth pupae near Bozeman, Montana during a two year period. The implications of pupal predation were also examined in the context of release and redistribution of this biological control agent.

Materials and Methods

The Bozeman study site had an extensive infestation of E. esula and was located 3.2 km NE of Bozeman, Montana in the SW facing foothills of the Bridger Mountain range, elevation 1540 m (See Chapter 3). The site had an established H. euphorbiae population present.

Pupae of the spurge hawkmoth were obtained by rearing field-collected, fifth instar larvae by two methods: 1) larvae were provided freshly cut spurge bouquets placed in one liter plastic bottles containing fresh water, spaced at 0.5 m intervals, inside a caged-sandbox outdoors; 2) larvae were placed on bouquets of leafy spurge in plastic tubs containing sand in the laboratory. After pupation, the sand from both methods was gently sifted to locate the pupae. These were collected and held in a incubator operating at 4 °C for later use in the field studies.

The experimental design was adapted from Buckner's (1959b) study on pupal predation of the larch sawfly. Six treatments were employed which involved the alternate placement of 50 viable hawkmoth pupae on the soil surface and 50 buried 4 cm below the surface (Figure 13). This was done on the open range and within two 3.2 x 2 x 2 m screened cages. Cages were either completely sealed at the base (by packing soil around the base) or semi-sealed (by loosely placing soil around the base). The open treatments allowed all predators to have access to pupae. The semi-sealed cage treatments were employed to eliminate vertebrate predators (avian predators and large mammals) and the sealed cage attempted to eliminate all predators except small invertebrates. The study was conducted in 1984 and 1985. Pupae in the open treatments were spaced at one and three m intervals during the first and second years of study, respectively. The distance of three meters was chosen because it closely approximated the mean hawkmoth larval density at this site. Analysis of the percentage of pupae surviving for each treatment on each sampling date was performed. Each treatment percentage value was normalized using an arcsine transformation (Zar 1984) and then tested for significance among treatments using an analysis of variance and a Newman-Keuls sequential studentized range test (Snedecor and Cochran 1967).

Results and Discussion

The first year of study (1984) revealed a very rapid decline in the number of pupae surviving the open treatments (Figure 14).

All pupae in the open-surface and open-buried treatments were consumed during the first six and thirteen days, respectively.

A rapid decline in pupal survival was also observed in the semi-sealed-surface treatment. In contrast, pupal mortality was less severe in the semi-sealed-buried treatment. These buried pupae (within the semi-sealed cage) must have been less detectable than the surface pupae, resulting in lower mortality. The sealed cage produced the highest survival rates at the conclusion of the first year's study.

Comparison of the mean proportion of pupae (buried and surface combined) surviving the open range, semi-sealed cage, and sealed cage treatments illustrated the vulnerability of the pupae to predation and the importance of predator exclusion (Table 2).

During 1984, pupae in the open treatments exhibited 100 percent mortality within thirteen days. Significant differences were observed among all treatments on every sampling date ($p<0.05$). Highly significant differences were observed among treatments on the sixth through the sixteenth days of pupal exposure ($p<0.01$). Survival in the sealed cage, which attempted to exclude all predators, was significantly greater than the open and semi-sealed treatments throughout 1984 ($p<0.01$). As was expected for the semi-sealed treatments, pupal survivorship occurred at levels between the other treatments.

During 1985 pupal predation continued to remain high, particularly for the open treatments (Figure 15). The open surface and open buried treatments again exhibited the highest levels of predation, but the degree and rate of mortality was less severe than during 1984.

OPEN RANGE										SEALED AND SEMI-SEALED CAGES									
S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B
B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S
S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B
B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S
S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B
B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S
S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B
B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S
S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B
B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S

Figure 13. Diagramatic representation of the placement of surface (S) and buried (B) Hyles euphorbiae (L.) pupae to examine predation. Spacing of pupae in open range treatments was 1 m and 3 m in 1984 and 1985, respectively. Spacing of pupae in the Sealed and Semi-sealed treatments was 1 dm both years.

Increasing the spacing of the pupae from one to three meters may have contributed to the reduction in mortality in the open range treatments.

Table 2. Mean proportion of H. euphorbiae pupae surviving predation under three treatments (1984)[1].

DAYS EXPOSED	OPEN RANGE n = 200	SEMI-SEALED CAGE n = 100	SEALED CAGE n = 100
2	78.0 (0.47)a	85.0 (0.21)b	97.0 (0.10)c
4	64.0 (0.74)a	72.0 (0.38)b	96.0 (0.11)c
6	24.5 (0.60)aa	68.0 (0.39)bb	92.0 (0.15)cc
7	8.5 (0.28)aa	59.0 (0.46)bb	89.0 (0.19)cc
10	0.5 (0.05)aa	36.0 (0.42)bb	89.0 (0.19)cc
13	0.0 (0.00)aa	24.0 (0.33)bb	87.0 (0.23)cc
16	0.0 (0.00)aa	15.0 (0.30)bb	87.0 (0.23)cc
18	0.0 (0.00)a	11.0 (0.26)b	83.0 (0.23)c
20	0.0 (0.00)a	11.0 (0.26)b	83.0 (0.23)c
26	0.0 (0.00)a	8.0 (0.19)b	80.0 (0.24)c

[1]Values [means ±(SE)] followed by a different letter within a row were significantly different ($p<0.05$). Double letters imply highly significant differences ($p<0.01$).

A comparison of the mean proportion of pupae (buried and surface combined) surviving the open range, semi-sealed cage, and sealed-cage treatments during 1985 again documented the high degree of pupal predation in the open field and a reduction in mortality within the caged treatments (Table 3). While pupae in the open treatments suffered significantly more predation than the other two treatments on all dates ($p<0.01$), little difference was observed between the sealed and semi-sealed cages ($p>0.05$, Table 3), except on one sampling date, eleven days after exposure ($p<0.05$).

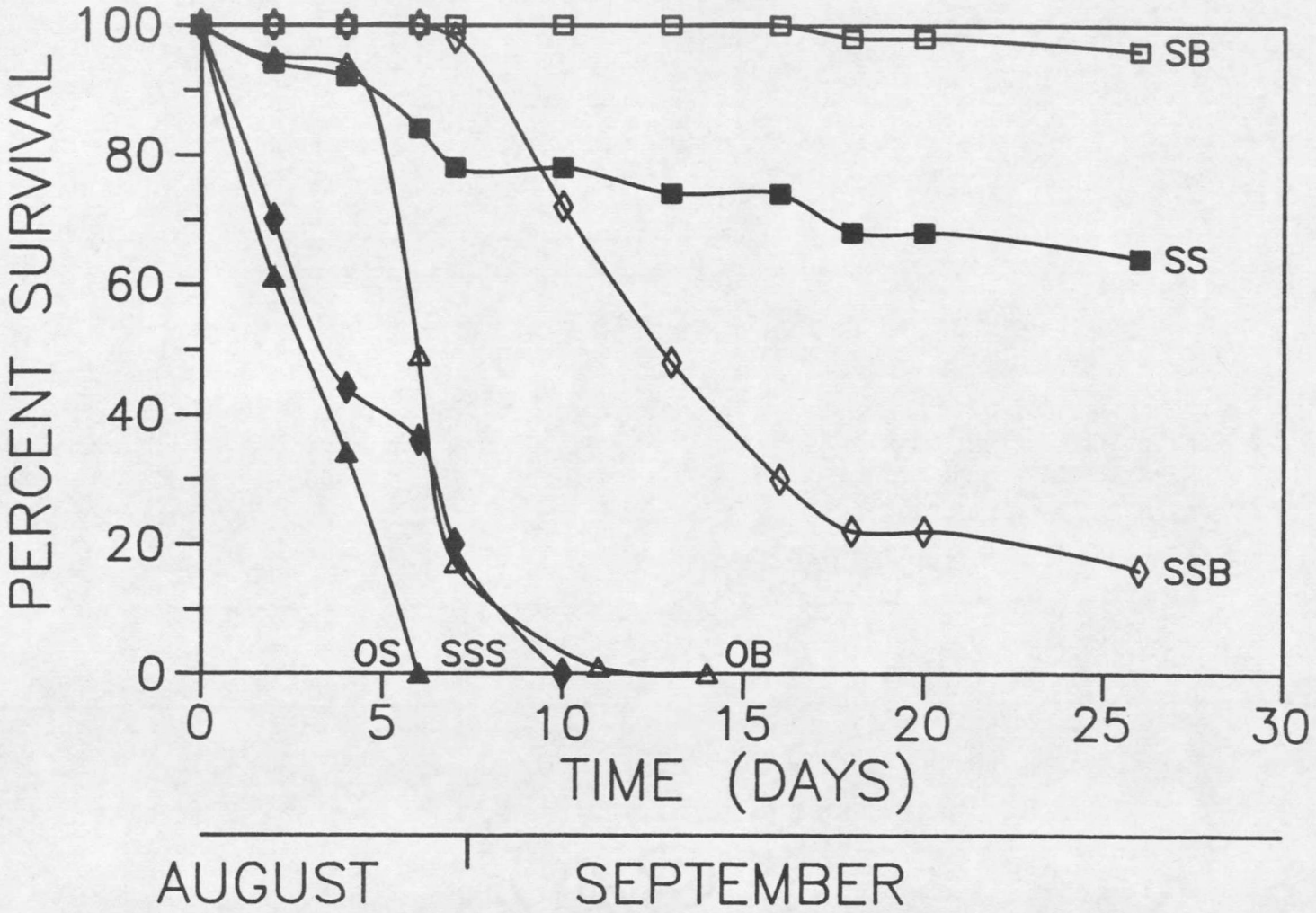


Figure 14. Hyles euphorbiae (L.) pupal survival (percent) through time. Pupal treatments: Open range surface (OS) and buried (OB); Semi-sealed cage surface (SSS) and buried (SSB), Sealed cage surface (SS) and buried (SB); 1984.

Unfortunately, the sealed cage did not exclude small ants (ca. 1-2 mm in size) and fortuitously had higher predation levels than the semi-sealed treatment. However, this difference was not significant (Table 3).

Table 3. Mean proportion of H. euphorbiae pupae surviving predation under three treatments (1985)[1].

DAYS EXPOSED	OPEN RANGE n = 200	SEMI-SEALED CAGE n = 100	SEALED CAGE n = 100
3	40.0 (0.25)a	98.0 (0.06)b	99.0 (0.05)b
5	34.0 (0.34)a	98.0 (0.06)b	99.0 (0.05)b
7	25.5 (0.37)a	96.0 (0.09)b	99.0 (0.05)b
9	20.5 (0.35)a	94.0 (0.10)b	97.0 (0.08)b
11	16.0 (0.28)a	90.0 (0.15)b	97.0 (0.08)c
15	13.5 (0.31)a	89.0 (0.15)b	83.0 (0.23)b
18	11.5 (0.26)a	85.0 (0.17)b	77.0 (0.30)b
20	11.5 (0.26)a	85.0 (0.32)b	85.0 (0.29)b
28	10.5 (0.24)a	84.0 (0.18)b	76.0 (0.29)b

[1]Values [means ±(SE)] followed by a different letter within a row were significantly different ($p<0.05$).

Additional comparisons revealed that buried pupae had a longer duration of survival and significantly greater overall survivorship than the corresponding surface treatment for all dates in 1984 ($p<0.01$, Table 4). This suggests that one of the best defenses for the cryptically colored pupa is to be buried in the soil.

Similar trends in pupal survival were obtained in 1985 (Table 5). Significant differences ($p<0.05$) were observed between buried versus pupae that were placed on the soil surface on all sampling dates except day fifteen ($p>0.05$).

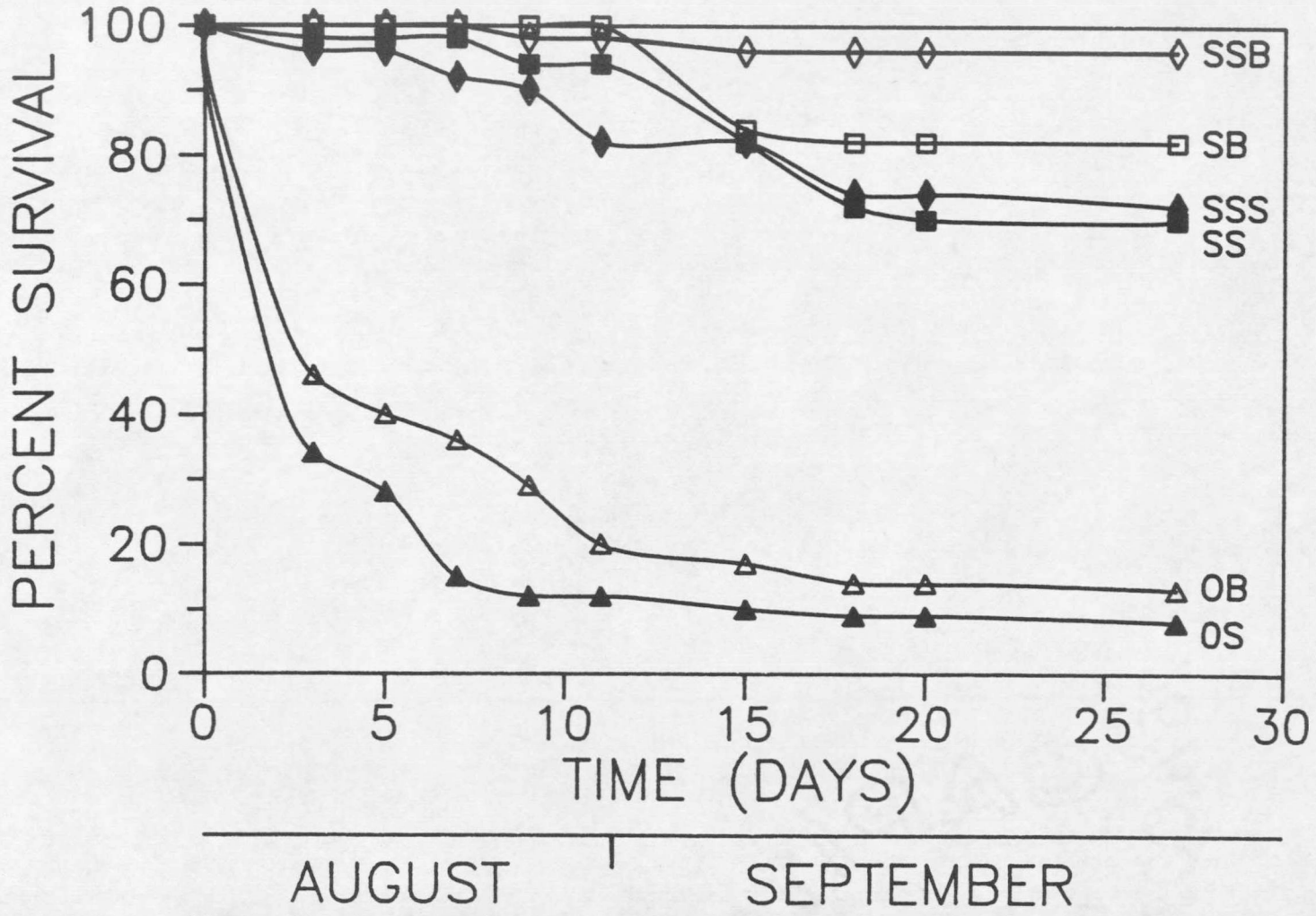


Figure 15. Hyles euphorbiae (L). pupal survival (percent) through time. Pupal treatments: Open range surface (OS) and buried (OB); Semi-sealed cage surface (SSS) and buried (SSB), Sealed cage surface (SS) and buried (SB); 1985.

Table 4. Mean proportion of H. euphorbiae pupae surviving predation under two treatments (1984)[1].

DAYS EXPOSED	BURIED n = 200	SOIL SURFACE n = 200
2	98.3 (0.04)aa	75.0 (0.18)bb
4	98.0 (0.04)aa	56.6 (0.29)bb
6	83.0 (0.23)aa	40.0 (0.34)bb
7	71.6 (0.36)aa	32.6 (0.33)bb
10	57.6 (0.39)aa	26.0 (0.35)bb
13	49.3 (0.40)aa	24.6 (0.34)bb
16	43.3 (0.42)aa	24.6 (0.34)bb
18	40.0 (0.42)aa	22.6 (0.31)bb
20	40.0 (0.42)aa	22.6 (0.31)bb
26	37.3 (0.40)aa	21.3 (0.29)bb

[1]Values [means ±(SE)] followed by a different double letter within a row were highly significantly different ($p<0.01$).

Table 5. Mean proportion of H. euphorbiae pupae surviving predation under two treatments (1985)[1].

DAYS EXPOSED	BURIED n = 200	SOIL SURFACE n = 200
3	82.0 (0.23)aa	76.0 (0.28)bb
5	80.0 (0.27)a	74.0 (0.31)b
7	78.6 (0.29)aa	68.3 (0.35)bb
9	75.6 (0.32)aa	65.3 (0.36)bb
11	72.6 (0.35)aa	62.6 (0.34)bb
15	65.6 (0.35)a	58.0 (0.34)a
18	64.0 (0.35)a	51.6 (0.33)b
20	64.0 (0.35)aa	51.0 (0.32)bb
28	63.6 (0.36)aa	50.0 (0.32)bb

[1]Values [means ±(SE)] followed by a different letter within a row were significantly different ($p<0.05$). Double letters imply highly significant differences ($p<0.01$).

Predators responsible for pupal mortality included birds, ants, grasshoppers and small mammals. Birds were observed to move both the buried and surface pupae to adjacent areas for consumption. Ants and grasshoppers often internally mined the pupal case and consumed its contents, while small mammals tended to devour the entire pupa leaving only parts of the cuticle remaining.

While it is doubtful that the predators responsible for pupal loss exhibited a numerical response (Solomon 1949) to the univoltine prey, a functional response is a likely possibility. As in the case of the 1984 open and semi-sealed treatments, vertebrate predators may have exhibited their capacity for learning and search image development (Holling 1961) resulting in the loss of 276 pupae in 13 days.

Results from this study show that predation of H. euphorbiae pupae represents a significant proportion of the total mortality of this insect. Similarly, research on pupal predators of forest insect pests have revealed their importance in reducing population size (Kelly and Regniere 1985), this being suggested as the critical regulating influence for certain defoliator species (Campbell and Torgersen 1983).

Efforts to establish new populations of this agent would therefore benefit greatly if larvae, and the resulting pupae, were protected from predation. Methods which reduce predation, such as placing the larvae inside a screened cage or surrounding them by a plastic arena inside a cage, would be recommended. Without such protection, the high levels of pupal mortality suffered by this insect reduce the opportunity for a large population buildup.

It has been 20 years since the first release of 290 larvae at this site and each year intense selection pressure has taken its toll on the population. Perhaps, we need to be patient and wait for this insect to reach a new equilibrium which is less affected by the negative influence of pupal predation reported in this study.

CHAPTER 5

HISTORY OF RELEASES OF THE SPURGE HAWKMOTH, Hyles euphorbiae (L.), A BIOLOGICAL CONTROL AGENT OF LEAFY SPURGE, Euphorbia esula L., IN MONTANA, U. S. A.

Introduction

Beginning in 1965, multiple releases of the spurge hawkmoth, Hyles euphorbiae (L.) have occurred in North America (Williamson 1966, 1967, 1968, 1980a, 1980b; USDA Unpublished Records). Releases were made in an attempt to control the exotic perennial weeds leafy spurge, Euphorbia esula L., and cypress spurge, E. cyparissias L. (Harris and Alex 1971).

In Montana, leafy spurge infests over 220,000 ha (Nobel et al. 1979) and is economically damaging in 23 of 54 counties (Dunn 1979). Numerous releases of this biological control agent have occurred in Montana (Baker and Anderson 1974, Story 1979, Appendix). Unfortunately, neither release records for this insect nor its present status in Montana have been collectively summarized.

The purpose of this chapter of this thesis was to provide a complete summary of the origin and releases of H. euphorbiae in Montana and the status of establishment where known.

Materials and Methods

Information on the importation, release and status of H. euphorbiae in Montana was obtained from review of literature, unpublished Canadian and U. S. government records, personal communication, and direct observation of release sites.

Results and Discussion

The first importation of H. euphorbiae into Montana consisted of 500 eggs and 410 larvae. This was provided by Agriculture Canada to Montana State University in 1965 (Williamson 1966). This shipment was placed in a greenhouse unknowingly on insecticide-treated leafy spurge plants, resulting in the death of all larvae (Baker 1988, pers. comm., Harris 1987, pers. comm.).

In 1966 a second shipment of 290 larvae was made to M. S. U. (Williamson 1967) and was field released 3.2 km NE of Bozeman (Baker 1988, pers. comm.). The vicinity of this release site currently supports the largest known population of H. euphorbiae on E. esula in North America (Chapter 3). Shipments in 1965 and 1966 originated from a European laboratory colony of H. euphorbiae (Williamson 1967).

In 1973, the U.S.D.A./A.R.S Biological Control of Weeds Laboratory, in Albany, CA (B.C.W.L.) hand carried 100 hawkmoth larvae to Montana (Appendix). Seventy-nine larvae were released along the Madison River, 30 km W of Bozeman (Baker 1973, Appendix).

Confirmation of establishment was made near this site in 1986 by the author. Additional releases of 100 larvae were made 3.2 km NE of Bozeman and at the N edge of Missoula, Missoula County in 1973 (Baker 1973). The source of this material was pupae provided by the Commonwealth Institute of Biological Control and Agriculture Canada.

In 1974 the U.S.D.A. (B.C.W.L.) again hand carried 1500 larvae to Bozeman, Montana (Appendix). These larvae were split into three releases: 500 were released along the Madison River (30 km W of Bozeman), 500 were released at the site of the 1966 release 3.2 km NE of Bozeman, and 500 were released at the M. S. U. Red Bluff Experiment Station Ranch, 24 km W of Bozeman. Establishment of the hawkmoth at all three sites was confirmed by visual observation in 1984 and 1985. A second shipment of 1391 H. euphorbiae eggs was sent to M. S. U. in 1974 (Appendix). Of these, 635 larvae hatched and were released along the Teton River, 0.6 km SW of Choteau, Montana. Examination of this site in 1983 and 1984 revealed that this release failed to establish. The last shipment received by M. S. U. in 1974 consisted of 1286 eggs. A portion of this shipment was released S of Belt, Cascade County (Baker 1988, pers. comm.). Story and Baker (1987, 1988, pers. comm.) reported that a release was made on Waterworks Hill, Missoula, Montana that year and again in 1976. A sparsely established population now exists at that site. All releases in 1974 originated from the foothills of the Swiss Alps near Liechtenstein.

The first pupal release was made by the Western Agricultural Research Center in 1978 near Lolo, Montana (Appendix). Of the 174 pupae which were released, only 3 adults were reported to have emerged

(Story 1987, pers. comm.). This material originated from Ontario, Canada populations established on cypress spurge. In addition, 450 hawkmoth larvae were released at that same site in 1978.

During 1980 the Western Agricultural Research Center received 37 larvae from Canadian sources via U.S.D.A. (B.C.W.L.). This material was used to begin a laboratory colony for future release efforts (Appendix).

Shipment of 700 eggs and 800 larvae was made in 1983 by the U.S.D.A. (B.C.W.L.) to the U.S.D.A.'s Rangeland Insect Laboratory (R.I.L.) at Bozeman, Montana (Appendix). This shipment was divided into three lots of 375 larvae for field release and one lot for laboratory study. Field releases were made at three locations in Stillwater County, Montana. These releases (of Hungarian origin) produced a sparsely established population at one site, Columbus, Montana. Another release of 22 pupae was made later in 1983. This was made by the U.S.D.A. (R.I.L.) in Richland County, Montana and has established (Crutchfield 1987, pers. comm.).

Redistribution of larvae and pupae by M. S. U. personnel from the established Bozeman field population began in 1983. Releases of 87 larvae and 100 pupae was made to a location along the Teton River, 20 km W of Choteau, Teton County, Montana. This site was treated with a herbicide the following spring. Establishment was doubtful.

A second shipment of 111 pupae was received from Hungary in 1984 (Appendix). A portion of the progeny of the adults which emerged were released by the U.S.D.A. (R.I.L.) at three sites in Montana, two in Richland County and one in Sweetgrass County. Only one of the

Richland county sites now supports an established H. euphorbiae population (Crutchfield 1987, pers. comm.). Montana State University also released 225 larvae from that Hungarian shipment in Carter County, Montana. Establishment has been tentatively confirmed at this site (Nowierski 1987, pers. comm.). Also in 1984, the laboratory colony established by the Western Agricultural Research Center was used in the redistribution of 400 larvae to the Lolo, Montana site and 1300 to three sites near Missoula (Story 1987, pers. comm.).

Redistribution of hawkmoth larvae continued in 1985. Personnel from Montana State University used an established population near Bozeman (See Chapter 3) to redistribute approximately 5000 hawkmoth larvae (Nowierski 1987, pers. comm.). A typical release consisted of 100 fourth and fifth instar larvae. These were provided to individuals in the five states of Montana, Wyoming, North Dakota, South Dakota, Colorado, and the Canadian province of Alberta. Detailed release records were available for only 20 of these releases (Appendix). Tentative establishment has been reported from three of these releases (Nowierski 1987, pers. comm.).

Also during the 1985 redistribution, 900 hawkmoth larvae were brought from a population on cypress spurge in New York by the U.S.D.A.'s Beneficial Insect Introduction Laboratory to Montana (Appendix). These larvae were distributed with the larvae originating from Montana.

At the site near Ekalaka, Carter Co., Montana, releases by M.S.U. of 400 larvae and 200 pupae, 200 larvae, and 1155 larvae during 1985, 1986, and 1987, respectively, have reinforced the established

population at this site (Nowierski 1987, pers. comm.).

Since the first shipment in 1965, there have been numerous individuals and agencies active in the release and redistribution of the spurge hawkmoth. In most instances, release documentation appeared accurate and straightforward; in a few cases, documentation was relegated to the memory of one or more individuals. For the satisfactory completion of evaluation studies on any biological control agent, written documentation is essential (Dysart 1981, Klingman and Coulson 1983).

CHAPTER 6

SUMMARY

Laboratory studies of the spurge hawkmoth revealed that relatively warm temperatures were required for eclosion and larval development. The calculated minimum thresholds for egg and larval development were 6.5 and 12.8 °C, respectively. The cumulative duration of larval development in the laboratory ranged from 33.2 days (± 0.41), 21.5 days (± 0.35), and 14.3 days (± 0.11) at 20, 25 and 30 °C, respectively. These characteristics suggest that this agent may have a poor temporal synchrony with its cold hardy, early-season-developing host, leafy spurge. For defoliation to provide the most effective sexual reproductive stress on leafy spurge it should occur early in the season.

Field population studies near the first releases of the moth showed a well-established population. Larval densities on leafy spurge ranged from 0.01 larvae/m^2 to 1.04 larvae/m^2. Only the highest larval densities were able to completely defoliate the host. At most densities, larvae caused minimal defoliation. Larval density and spurge clone size were weakly correlated ($r = -0.197$, $P = 0.029$), which implied that adult hawkmoth oviposition was not influenced by the size of the spurge clone. Hawkmoth foliage feeding in the field began after the initiation of seed production. This poor timing with the

weed's sexual reproductive phenology was expected, based on laboratory developmental studies.

Biotic and abiotic hawkmoth mortality was observed in the field. Predation on pupae appeared to be the most important source of hawkmoth mortality. Field observations suggest that predators such as ants, grasshoppers, birds and mice were responsible for pupal mortality. Exclusion cages which selectively eliminated these predators made significant reductions in pupal mortality, while unprotected pupae on the open range were subjected to extreme mortality. Overwintering mortality was 44 percent.

In the 20 years since its first release, the spurge hawkmoth had dispersed over five km. Larval densities in the adjacent foothill E. esula infestations ranged from over $1/m^2$ to 1/ha.

Examination of former hawkmoth release sites throughout Montana revealed established populations at a number of sites. Unfortunately it appears that the population levels attained by this species have had little impact on weed density and may fit the model proposed by Briese (1985) in which an agent's population density stabilizes below that which impacts the target weed.

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APPENDIX

APPENDIX

CHRONOLOGICAL RELEASE RECORDS FOR *Hyles euphorbiae* (L.) IN MONTANA.

These records were provided with permission for use by the United States Department of Agriculture, Agricultural Research Service, Biological Control of Weeds Laboratory, Albany, CA and the U. S. D. A., A. R. S., Rangeland Insect Laboratory, Bozeman, MT. Records have been transcribed from the original handwritten forms for legibility.

INSECT RELEASE RECORD

Date: 6/11/73

Insect species: Celerio euphorbiae

Host weed species: Euphorbia esula

Number released: 20

Stage of insect: Larvae

Location of release: Greenhouse, Montana State University

Name and affiliation of person making release: L. Baker, Montana State University

Name of Shipper: L. A. Andres, U.S.D.A., Albany, CA (Hand Carry)

Notes: Larvae reared from pupae from Schroder (Europe) and Harris (Canada). All in good condition. Later saw one larva darkened - asked Baker to hold it separate - although it was healthy. (Balance of larvae released at Grey Cliff - see card dated 6/12).

INSECT RELEASE RECORD

Date: 6/12/73

Insect species: Celerio euphorbiae

Host weed species: Euphorbia esula

Number released: 79

Stage of insect: Larvae

Location of release: Grey Cliff Fishing Access, Madison River, Gallatin Co., Montana.

Name and affiliation of person making release: L. Baker, Montana State University, Jess Hodgson, U.S.D.A., Bozeman, MT, L. A. Andres, U.S.D.A., Albany, CA.

Name of Shipper: Andres (Hand Carry)

Notes: Larvae from pupae -> adults received Schroder (Europe) and Harris (Canada). All looked in good condition (except one - returned to Bud Thomas (U. C.) for disease check). 20 larvae placed on plantsin greenhouse (Baker) at University (see other card).

Released Celerio on Madison River at Grey Cliff Fishing Access Area. Approximately 25 miles W of Bozeman. 74 larvae placed under 6 x 6 x 12 foot Saran screen cage. 8:30 AM. Number of plants in cage and adjacent. Plants in blossom. Saw ant eating one larvae within several minutes. Could find no other ants under cage.

6/15 - checked release site - larvae looked OK. 60 larvae in view- appear full sized. Ants on plants. Larvae apparently can get rid of ants. Pictures. Drove to Hamilton.

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – QUARANTINE FACILITY

(Shipment/Consignment from Quarantine)

48. FINAL DETERMINATION-Gen., sp., subsp., auth. | M | NC | 48a. V.S. (see files)
a | ☐ | ☐ | a ☐
b | ☐ | ☐ | b ☐

SECTION I – REPORT OF MATERIAL SHIPPED, CONSIGNED or RELEASED

1. FROM (Quarantine facility-name and address)
Paul H. Dunn
U.S.D.A.-A.R.S.-Biological Control of Weeds Laboratory
1050 San Pablo Avenue
Albany, CA 94706

2. ORGANISM SHIPPED-A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
R. W. Hodges

C. Determined by (names & affiliations)

3. QUARANTINE FILE NO.
74 - 1 & 2

4. TYPE OF ORGANISM-explain MI & OT in blk. 20
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher

5. NOS. & STAGES SHIPPED (see codes)
[Est] 1000 L
[Est]
[Est]
TOTAL:

6. DATES TRANSFORMED TO STAGES SHIPPED (month, day, year)
8 - 17 June 1974

☐ Shipped directly ☐ Emerged in Quarantine

7. MATING OBSERVED
☐ Yes _____ % ☐ No

8. HOST / PREY / PEST MATERIAL PRESENT
☒ Beneficial with host/prey
☐ Host/prey/pest only ☐ None

9. DATES ORIGINALLY FIELD COLLECTED (m,d,y)
Reared in lab on Swiss stock

10. LOCATION-Country & Province/State of Origin
Originated in Rafis, Switzerland 75 km E-SE of Zurich near Buchs, Elevation 450 m

11. ORIGINAL COLLECTORS (names & affiliations)
Alfred Hoffmanner

12. FOREIGN/OVERSEAS SOURCE FILE NOS.

16. LAB CULTURED (F_1 +)
☐ Overseas ☐ No
☒ In Quarantine _____ (number of generations)

13. ORIGINAL HOST/PREY-Gen., sp. (or other food source)
Euphorbia cyparissias

14. STAGE/PART OF HOST/PREY ATTACKED

15. ORIGINAL FOOD SOURCE OF HOST/PREY

17. LAB HOST/PREY-Gen., sp. (if different from blk. 13)
Euphorbia oblongata, E. peplus

18. INTENDED HOST/PREY-Gen., sp. (if different from blk. 13)
Euphorbia esula L.

19. SHIPPED/CONSIGNED TO
Hand Carried to:
L. O. Baker
Montana State University
Bozeman MT

20. REMARKS

21. DATE shipped/consigned (m,d,y,)
17-18 June

22. REPRESENTATIVE SPECIMENS RETAINED [Yes] number:

23. PACKING/HANDLING
☒ Usual ☐ Other (explain in blk. 20)

24. SHIPPED VIA
Hand Carried

25. SCREENED OR PACKAGED BY

SECTION II – REPORT OF RECEIPT AND INTENDED USE

26. DATE OF RECEIPT (m,d,y)
17 June 1974

27. DATE OPENED (m,d,y)
17 June 1974

28. CONDITION RECEIVED
A. Container: Intact
B. Contents: Good

29. REPORTED OR EXAMINED BY

30. INVENTORY OF MATERIAL RECEIVED (use codes)

A. Number and stages received (blk. 2)		B. Number Emerged (stages)			
		Beneficials		Host/Prey	
Alive	Dead	Alive	Dead	Alive	Dead
1000					
TOTALS [E]	[E]	[E]	[E]	[E]	[E]

31. OTHER SPECIES INCLUDED OR EMERGED

A. Order: Family and Genus, species, author, if known	B. Determined by (name & affiliation)	C. No. and Stages (use codes)

32. REMARKS

33. SPECIMENS FROM SHIPMENT RETAINED BY RECEIVER
☐ Yes _____ number ☐ No

34. INTENDED USE
A. ☒ Immediate release (complete Sec. III)
Lab culture/study
B. ☐ Release intended
C. ☐ No release intended

35. INTENDED LAB HOST/PREY - Gen., sp.
Euphorbia esula L.

SECTION III – REPORT OF RELEASE

	SITE 1	SITE 2	SITE 3
36. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
37. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-942A for more details)	Bozeman, MT, Poverty Ranch near Big M	Fish and Game Refuge Madison River, 30 miles from Bozeman	
38. Number and stages released. (see codes)	[Est] 500 (+)	[Est] 500(+)	[Est]
39. Dates of release (m,d,y)	17 June 1974	18 June 1974	
40. Target hosts/prey at release A. Primary - Genus, species	E. esula	E. esula	
B. Other - Genus, species			
C. Families			
41. Food (plant/animal/other) of target host/prey at release.			
42. Released by (Name & affiliation)	Paul Dunn, L. O. Baker,	Norm Anderson	

43. REMARKS (use AD-942A for more details)
Site 1: Insects caged in 20'x20'x3' cage Released during warm weather. Site 2: Insects released in open.

44. REPORTED BY
A. Name Paul Dunn
B. Date (m,d,y) _____

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – QUARANTINE FACILITY

(Shipment/Consignment from Quarantine)

46. FINAL DETERMINATION - Gen., sp., subsp., auth.	M	NC	48. V.S. (see files)
a	☐	☐	a ☐
b	☐	☐	b ☐

SECTION I – REPORT OF MATERIAL SHIPPED, CONSIGNED or RELEASED

1. FROM (Quarantine facility - name and address)
Paul H. Dunn
U.S.D.A.-A.R.S.-Biological Control of Weeds Laboratory
1050 San Pablo Avenue
Albany, CA 94706

2. ORGANISM SHIPPED - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family

C. Determined by (names & affiliations)
R. W. Hodges

3. QUARANTINE FILE NO.
74 - 5

4. TYPE OF ORGANISM - explain MI & OT in blk. 20
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher

5. NOS. & STAGES SHIPPED (see codes)
[Fst] Eggs and first instar
[Est] eggs= 1391
[Est]
TOTAL:

6. DATES TRANSFORMED TO STAGES SHIPPED (month, day, year)
☐ Shipped directly ☐ Emerged in Quarantine

7. MATING OBSERVED
☐ Yes _____ % ☐ No

8. HOST / PREY / PEST MATERIAL PRESENT
☒ Beneficial with host/prey
☐ Host/prey/pest only ☐ None

9. DATES ORIGINALLY FIELD COLLECTED (m,d,y)
Reared in lab.

10. LOCATION - Country & Province/State of Origin
From: Rafis, Switzerland, 75 km E-SE from Zurich, near Buchs, Elev, 450 m

11. ORIGINAL COLLECTORS (names & affiliations)
Alfred Hoffmanner

12. FOREIGN/OVERSEAS SOURCE FILE NOS.

16. LAB CULTURED (F_1 +)
☐ Overseas ☐ No
☒ In Quarantine _____ (number of generations)

13. ORIGINAL HOST/PREY - Gen., sp. (or other food source)
Euphorbia cyparissias L.

14. STAGE/PART OF HOST/PREY ATTACKED

15. ORIGINAL FOOD SOURCE OF HOST/PREY

17. LAB HOST/PREY - Gen., sp. (if different from blk. 13)

18. INTENDED HOST/PREY - Gen., sp. (if different from blk. 13)
E. esula

19. SHIPPED/CONSIGNED TO
Prof. L. O. Baker
Plant and Soil Science Dept.
Montana State University, Bozeman, MT 59715

20. REMARKS

21. DATE shipped/consigned (m,d,y,)
26 June 1974

22. REPRESENTATIVE SPECIMENS RETAINED ☐ Yes
number:

23. PACKING/HANDLING
☒ Usual ☐ Other (explain in blk. 20)

24. SHIPPED VIA
Airmail Specia

25. SCREENED OR PACKAGED BY

SECTION II – REPORT OF RECEIPT AND INTENDED USE

26. DATE OF RECEIPT (m,d,y)
28 June 1974

27. DATE OPENED (m,d,y)
28 June 1974

28. CONDITION RECEIVED A. Container B. Contents

29. REPORTED OR EXAMINED BY

30. INVENTORY OF MATERIAL RECEIVED (use codes)

A. Number and stages received (blk. 2)		B. Number Emerged (stages)			
		Beneficials		Host/Prey	
Alive	Dead	Alive	Dead	Alive	Dead
756 E		635 L hatched from eggs sent			
TOTALS [E]	[E]	[E]	[E]	[E]	[E]

31. OTHER SPECIES INCLUDED OR EMERGED

A. Order: Family and Genus, species, author, if known	B. Determined by (name & affiliation)	C. No. and Stages (use codes)

32. REMARKS

33. SPECIMENS FROM SHIPMENT RETAINED BY RECEIVER
☐ Yes _____ number ☐ No

34. INTENDED USE
A. ☒ Immediate release (complete Sec. III)
Lab culture/study
B. ☐ Release intended
C. ☐ No release intended

35. INTENDED LAB HOST/PREY - Gen., sp.
E. esula

SECTION III – REPORT OF RELEASE

	SITE 1	SITE 2	SITE 3
36. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
37. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-942A for more details)	1 mile SW of Choteau, Teton County, MT		
38. Number and stages released. (see codes)	[Est] 635 L	[Est]	[Est]
39. Dates of release (m,d,y)	5 July 1974		
40. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
41. Food (plant/animal/other) of target host/prey at release.			
42. Released by (Name & affiliation)	L. Baker and Wm. Richter		

43. REMARKS (use AD-942A for more details) Released in an unused grass - short brush area, 1 mile SW of Choteau.

44. REPORTED BY
A. Name L. Baker
B. Date (m,d,y)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – QUARANTINE FACILITY

(Shipment/Consignment from Quarantine)

OMB NO. 0518-0013 (EXP. 2/28/87)

46. FINAL DETERMINATION - Gen., sp., subsp., auth. | M | NC | 46a. V.S. (see files)
a ☐ ☐ a ☐
b ☐ ☐ b ☐

SECTION I – REPORT OF MATERIAL SHIPPED, CONSIGNED or RELEASED

1. FROM (Quarantine facility - name and address)
Paul H. Dunn
U.S.D.A.-A.R.S.-Biological Control of Weeds Laboratory
1050 San Pablo Avenue
Albany, CA 94706

2. ORGANISM SHIPPED - A. Gen., sp., subsp., auth. [2a]: Hyles euphorbiae (L.)
B. Order: Family:
C. Determined by (names & affiliations): R. W. Hodges, U.S.N.M.

3. QUARANTINE FILE NO.: 74-7

4. TYPE OF ORGANISM - explain MI & OT in blk. 20
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher

5. NOS. & STAGES SHIPPED (see codes)
[Est] 1286 E
[Est]
[Est]
TOTAL:

6. DATES TRANSFORMED TO STAGES SHIPPED (month, day, year)
☐ Shipped directly ☐ Emerged in Quarantine

7. MATING OBSERVED
☐ Yes _____ % ☐ No

8. HOST / PREY / PEST MATERIAL PRESENT
☒ Beneficial with host/prey
☐ Host/prey/pest only ☐ None

9. DATES ORIGINALLY FIELD COLLECTED (m,d,y)
Reared in Lab.

10. LOCATION - Country & Province/State of Origin
From: Rafis, Switzerland, 75 km E-SE Zurich, near Buchs, Elev. 450 m

11. ORIGINAL COLLECTORS (names & affiliations)
Alfred Hoffmanner

12. FOREIGN/OVERSEAS SOURCE FILE NOS.

16. LAB CULTURED (F_1+)
☐ Overseas ☐ No
☒ In Quarantine _____ (number of generations)

13. ORIGINAL HOST/PREY - Gen., sp. (or other food source)
Euphorbia cyparissias

14. STAGE/PART OF HOST/PREY ATTACKED
Leaves

15. ORIGINAL FOOD SOURCE OF HOST/PREY

17. LAB HOST/PREY - Gen., sp. (if different from blk. 13)
E. esula, E. oblongata

18. INTENDED HOST/PREY - Gen., sp. (if different from blk. 13)
E. esula (after eclosion)

19. SHIPPED/CONSIGNED TO
Prof. L. O. Baker
Plant and Soil Science Dept.
Montana State University, Bozeman, MT 59715

20. REMARKS
Because of holiday - 4th July - sent to home 505 South 11th, Bozeman, MT

21. DATE shipped/consigned (m,d,y,)
2 July 1974

22. REPRESENTATIVE SPECIMENS RETAINED [Yes] number:

23. PACKING/HANDLING
☒ Usual ☐ Other (explain in blk. 20)

24. SHIPPED VIA
Airmail Special Delivery

25. SCREENED OR PACKAGED BY

SECTION II – REPORT OF RECEIPT AND INTENDED USE

26. DATE OF RECEIPT (m,d,y)

27. DATE OPENED (m,d,y)

28. CONDITION RECEIVED: A. Container; B. Contents

29. REPORTED OR EXAMINED BY

30. INVENTORY OF MATERIAL RECEIVED (use codes)

A. Number and stages received (blk. 2)		B. Number Emerged (stages)			
		Beneficials		Host/Prey	
Alive	Dead	Alive	Dead	Alive	Dead
TOTALS [E]	[E]	[E]	[E]	[E]	[E]

31. OTHER SPECIES INCLUDED OR EMERGED

A. Order: Family and Genus, species, author, if known	B. Determined by (name & affiliation)	C. No. and Stages (use codes)

32. REMARKS

33. SPECIMENS FROM SHIPMENT RETAINED BY RECEIVER
☐ Yes _____ number ☐ No

34. INTENDED USE
A. ☐ Immediate release (complete Sec. III)
Lab culture/study
B. ☐ Release intended
C. ☐ No release intended

35. INTENDED LAB HOST/PREY - Gen., sp.

SECTION III – REPORT OF RELEASE

	SITE 1	SITE 2	SITE 3
36. Types of release	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
37. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-942A for more details)			
38. Number and stages released. (see codes)	[Est]	[Est]	[Est]
39. Dates of release (m,d,y)			
40. Target hosts/prey at release A. Primary – Genus, species			
B. Other – Genus, species			
C. Families			
41. Food (plant/animal/other) of target host/prey at release.			
42. Released by (Name & affiliation)			

43. REMARKS (use AD-942A for more details)

44. REPORTED BY
A. Name
B. Date (m,d,y)

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – QUARANTINE FACILITY

(Shipment/Consignment from Quarantine)

48. FINAL DETERMINATION - Gen., sp., subsp., auth. | M | NC | 49. V.S. (see files)
a | ☐ | ☐ | a ☐
b | ☐ | ☐ | b ☐

SECTION I – REPORT OF MATERIAL SHIPPED, CONSIGNED or RELEASED

1. FROM (Quarantine facility - name and address)
P. Dunn
U.S.D.A.-A.R.S.-Biological Control of Weeds Laboratory
1050 San Pablo Avenue
Albany, CA 94706

2. ORGANISM SHIPPED - A. Gen., sp., subsp., auth. [M]: Hyles euphorbiae (L.)
B. Order: Family
C. Determined by (names & affiliations)

3. QUARANTINE FILE NO.: BCWRL-77-32

4. TYPE OF ORGANISM - explain MI & OT in blk. 20
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher

5. NOS. & STAGES SHIPPED (see codes)
[Est] Pupae
[Est]
[Est]
TOTAL:

6. DATES TRANSFORMED TO STAGES SHIPPED (month, day, year)
☐ Shipped directly ☐ Emerged in Quarantine

7. MATING OBSERVED
☐ Yes _____ % ☐ No

8. HOST / PREY / PEST MATERIAL PRESENT
☐ Beneficial with host/prey
☐ Host/prey/pest only ☐ None

9. DATES ORIGINALLY FIELD COLLECTED (m,d,y): June 1976

10. LOCATION - Country & Province/State of Origin: Release site in Canada

11. ORIGINAL COLLECTORS (names & affiliations): Dunn

12. FOREIGN/OVERSEAS SOURCE FILE NOS.: ALB-76-1

16. LAB CULTURED (F_1 +)
☐ Overseas ☐ No
☒ In Quarantine _____ (number of generations)

13. ORIGINAL HOST/PREY - Gen., sp. (or other food source): Euphorbia esula L.

14. STAGE/PART OF HOST/PREY ATTACKED: Foliage

15. ORIGINAL FOOD SOURCE OF HOST/PREY

17. LAB HOST/PREY - Gen., sp. (if different from blk. 13): Euphorbia oblongata and diet

18. INTENDED HOST/PREY - Gen., sp. (if different from blk. 13): Euphorbia esula L.

19. SHIPPED/CONSIGNED TO
Jim Story
Extension Office, Montana State University
818 Burlington, Missoula, MT 59801

20. REMARKS

21. DATE shipped/consigned (m,d,y): 12 Dec 1977

22. REPRESENTATIVE SPECIMENS RETAINED [Yes] number:

23. PACKING/HANDLING
☒ Usual ☐ Other (explain in blk. 20)

24. SHIPPED VIA: Sp.Del.Air

25. SCREENED OR PACKAGED BY: S. Levinson

SECTION II – REPORT OF RECEIPT AND INTENDED USE

26. DATE OF RECEIPT (m,d,y): 14 Dec 1977

27. DATE OPENED (m,d,y): 14 Dec 1977

28. CONDITION RECEIVED: A. Container: good; B. Contents: good

29. REPORTED OR EXAMINED BY

30. INVENTORY OF MATERIAL RECEIVED (use codes)

A. Number and stages received (blk. 2)		B. Number Emerged (stages)			
		Beneficials		Host/Prey	
Alive	Dead	Alive	Dead	Alive	Dead
174 P					
TOTALS [E] 174 P [E]		[E]	[E]	[E]	[E]

31. OTHER SPECIES INCLUDED OR EMERGED

A. Order: Family and Genus, species, author, if known	B. Determined by (name & affiliation)	C. No. and Stages (use codes)

32. REMARKS

33. SPECIMENS FROM SHIPMENT RETAINED BY RECEIVER
☐ Yes _____ number ☐ No

34. INTENDED USE
A. ☐ Immediate release (complete Sec. III)
Lab culture/study
B. ☒ Release intended
C. ☐ No release intended

35. INTENDED LAB HOST/PREY - Gen., sp.: E. esula L.

SECTION III – REPORT OF RELEASE

	SITE 1	SITE 2	SITE 3
36. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
37. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-942A for more details)	Maclay property, 2 miles S of Lolo, Montana in Missoula County		
38. Number and stages released. (see codes)	[Est] 174 P	[Est]	[Est]
39. Dates of release (m,d,y)	5 June 1978		
40. Target hosts/prey at release A. Primary - Genus, species	E. esula L.		
B. Other - Genus, species			
C. Families			
41. Food (plant/animal/other) of target host/prey at release.			
42. Released by (Name & affiliation)	Jim Story		

43. REMARKS (use AD-942A for more details): Most pupae dead - only 3 emerged, one with deformed wings. P.H.D. as per Story.

44. REPORTED BY
A. Name: Jim Story
B. Date (m,d,y)

U.S. Department of Agriculture

OMB NO. 0518-0013 (EXP. 2/28/87)

BIOLOGICAL SHIPMENT RECORD – QUARANTINE FACILITY

(Shipment/Consignment from Quarantine)

48. FINAL DETERMINATION - Gen., sp., subsp., auth.	M	NC	49. V.S. (see files)
a	☐	☐	a ☐
b	☐	☐	b ☐

SECTION I – REPORT OF MATERIAL SHIPPED, CONSIGNED or RELEASED

1. FROM (Quarantine facility - name and address)
USDA-SEA-AR-WR
Biological Control of Weeds
1050 San Pablo Avenue
Albany, CA 94706

2. ORGANISM SHIPPED - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

3. QUARANTINE FILE NO.
BCWRL-80-57

B. Order: Family

C. Determined by (names & affiliations)
Paul H. Dunn

4. TYPE OF ORGANISM - explain MI & OT in blk. 20
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ Microbial ☐ OTher

5. NOS. & STAGES SHIPPED (see codes)
[Est] L
[Est]
[Est]
TOTAL:

6. DATES TRANSFORMED TO STAGES SHIPPED (month, day, year)
N/A
☐ Shipped directly ☐ Emerged in Quarantine

7. MATING OBSERVED
☐ Yes _____ % ☐ No

8. HOST / PREY / PEST MATERIAL PRESENT
☐ Beneficial with host/prey
☐ Host/prey/pest only ☐ None

9. DATES ORIGINALLY FIELD COLLECTED (m,d,y)

10. LOCATION - Country & Province/State of Origin
Braeside, Ontario, Canada

11. ORIGINAL COLLECTORS (names & affiliations)
J. S. Kelleher

12. FOREIGN/OVERSEAS SOURCE FILE NOS.
CAN-80-1

16. LAB CULTURED (F_1 +)
☐ Overseas ☒ No
☐ In Quarantine _____ (number of generations)

13. ORIGINAL HOST/PREY - Gen., sp. (or other food source)
Euphorbia cyparissias L.

14. STAGE/PART OF HOST/PREY ATTACKED
Leaves

15. ORIGINAL FOOD SOURCE OF HOST/PREY

17. LAB HOST/PREY - Gen., sp. (if different from blk. 13)

18. INTENDED HOST/PREY - Gen., sp. (if different from blk. 13)
Euphorbia esula L.

19. SHIPPED/CONSIGNED TO
Mr. Jim Story
Western Agricultural Research Center
531 Quast Lane, Corvallis, MT 59828

20. REMARKS

21. DATE shipped/consigned (m,d,y,)
16 July 1980

22. REPRESENTATIVE SPECIMENS RETAINED [Yes]
number:

23. PACKING/HANDLING
☒ Usual ☐ Other (explain in blk. 20)

24. SHIPPED VIA
Air Cargo

25. SCREENED OR PACKAGED BY
A. H. Krueger

SECTION II – REPORT OF RECEIPT AND INTENDED USE

26. DATE OF RECEIPT (m,d,y)
17 July 1980

27. DATE OPENED (m,d,y)
18 July 1980

28. CONDITION RECEIVED

A. Container	B. Contents
good	good

29. REPORTED OR EXAMINED BY

30. INVENTORY OF MATERIAL RECEIVED (use codes)

A. Number and stages received (blk. 2)		B. Number Emerged (stages)			
		Beneficials		Host/Prey	
Alive	Dead	Alive	Dead	Alive	Dead
37 L	2 L				
TOTALS					
[E] 37 L	[E] 2 L	[E]	[E]	[E]	[E]

31. OTHER SPECIES INCLUDED OR EMERGED

A. Order: Family and Genus, species, author, if known	B. Determined by (name & affiliation)	C. No. and Stages (use codes)

32. REMARKS

33. SPECIMENS FROM SHIPMENT RETAINED BY RECEIVER
☐ Yes _____ number ☐ No

34. INTENDED USE
A. ☒ Immediate release (complete Sec. III)
Lab culture/study
B. ☐ Release intended
C. ☐ No release intended

35. INTENDED LAB HOST/PREY - Gen., sp.

SECTION III – REPORT OF RELEASE

	SITE 1	SITE 2	SITE 3
36. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
37. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-942A for more details)	Western Agricultural Research Center near Corvallis, MT in Ravalli Co., 531 Quast Lane		
38. Number and stages released. (see codes)	[Est] 37 L	[Est]	[Est]
39. Dates of release (m,d,y)	18 July 1980		
40. Target hosts/prey at release A. Primary – Genus, species	Euphorbia esula L.		
B. Other – Genus, species			
C. Families			
41. Food (plant/animal/other) of target host/prey at release.			
42. Released by (Name & affiliation)	Jim Story		

43. REMARKS (use AD-942A for more details)

44. REPORTED BY
A. Name Jim Story
B. Date (m,d,y)

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – QUARANTINE FACILITY

(Shipment/Consignment from Quarantine)

46. FINAL DETERMINATION - Gen., sp., subsp., auth. | M | NC | 46. V.S. (see files)
a ☐ ☐ a ☐
b ☐ ☐ b ☐

SECTION I – REPORT OF MATERIAL SHIPPED, CONSIGNED or RELEASED

1. FROM (Quarantine facility - name and address)
USDA-ARS-WR
Biological Control of Weeds Lab.
1050 San Pablo Avenue
Albany, CA 94706

2. ORGANISM SHIPPED - A. Gen., sp., subsp., auth. [M]: Hyles euphorbiae L.

B. Order: Family:

C. Determined by (names & affiliations): R. W. Pemberton

3. QUARANTINE FILE NO.: BCWRL-83-14

4. TYPE OF ORGANISM - explain MI & OT in blk. 20
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher

5. NOS. & STAGES SHIPPED (see codes)
[Est] E & L
[Est]
[Est]
TOTAL:

6. DATES TRANSFORMED TO STAGES SHIPPED (month, day, year): July 1983
☐ Shipped directly ☒ Emerged in Quarantine

7. MATING OBSERVED
☐ Yes N/A % ☐ No

8. HOST / PREY / PEST MATERIAL PRESENT
☒ Beneficial with host/prey
☐ Host/prey/pest only ☐ None

9. DATES ORIGINALLY FIELD COLLECTED (m,d,y): June 1983

10. LOCATION - Country & Province/State of Origin: Debrecen, Hungary

11. ORIGINAL COLLECTORS (names & affiliations): A. Rizza & P. Pecora

12. FOREIGN/OVERSEAS SOURCE FILE NOS.: BCWL-E-83-16

16. LAB CULTURED (F_1 +)
☒ Overseas ☐ No
☐ In Quarantine _____ (number of generations)

13. ORIGINAL HOST/PREY - Gen., sp. (or other food source): Euphorbia virgata Waldst. & Kit.

14. STAGE/PART OF HOST/PREY ATTACKED: Leaves

15. ORIGINAL FOOD SOURCE OF HOST/PREY

17. LAB HOST/PREY - Gen., sp. (if different from blk. 13)

18. INTENDED HOST/PREY - Gen., sp. (if different from blk. 13): Euphorbia virgata

19. SHIPPED/CONSIGNED TO
Mr. Norman E. Rees, USDA-ARS-WR
Rangeland Insect Laboratory
Montana State University, Bozeman, MT 59717

20. REMARKS

21. DATE shipped/consigned (m,d,y,): 28 July 1983

22. REPRESENTATIVE SPECIMENS RETAINED [Yes] number:

23. PACKING/HANDLING
☒ Usual ☐ Other (explain in blk. 20)

24. SHIPPED VIA: U.S. Mail

25. SCREENED OR PACKAGED BY: A. H. Krueger

SECTION II – REPORT OF RECEIPT AND INTENDED USE

26. DATE OF RECEIPT (m,d,y): 1 Aug 1983

27. DATE OPENED (m,d,y): 1 Aug 1983

28. CONDITION RECEIVED: A. Container: Good; B. Contents: Good

29. REPORTED OR EXAMINED BY

30. INVENTORY OF MATERIAL RECEIVED (use codes)

A. Number and stages received (blk. 2)		B. Number Emerged (stages)			
		Beneficials		Host/Prey	
Alive	Dead	Alive	Dead	Alive	Dead
700 E					
800 L					
TOTALS [E]	[E]	[E]	[E]	[E]	[E]

31. OTHER SPECIES INCLUDED OR EMERGED

A. Order: Family and Genus, species, author, if known	B. Determined by (name & affiliation)	C. No. and Stages (use codes)
None	N/A	

32. REMARKS

33. SPECIMENS FROM SHIPMENT RETAINED BY RECEIVER
☐ Yes _____ number ☐ No

34. INTENDED USE
A. ☒ Immediate release (complete Sec. III)
Lab culture/study: B. ☐ Release intended; C. ☐ No release intended

35. INTENDED LAB HOST/PREY - Gen., sp.: Leafy spurge

SECTION III – REPORT OF RELEASE

	SITE 1	SITE 2	SITE 3
36. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
37. Locations (State, County, nearest town or physical feature, map coordinates) (Use AD-942A for more details)			
38. Number and stages released. (see codes)	[Est]	[Est]	[Est]
39. Dates of release (m,d,y)			
40. Target hosts/prey at release A. Primary – Genus, species			
B. Other – Genus, species			
C. Families			
41. Food (plant/animal/other) of target host/prey at release.			
42. Released by (Name & affiliation)			

43. REMARKS (use AD-942A for more details) As eggs hatch, they will be reared in the laboratory until each Wednesday and then transported to Columbus, MT ~~and released in a 20 X 20 foot cage.~~

44. REPORTED BY
A. Name: Norman E. Rees
B. Date (m,d,y)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – QUARANTINE FACILITY

(Shipment/Consignment from Quarantine)

OMB NO. 0518-0013 (EXP. 2/28/87)

46. FINAL DETERMINATION - Gen., sp., subsp., auth. | M | NC | 46a. V.S. *(see files)*

a ☐ ☐ a ☐

b ☐ ☐ b ☐

SECTION I – REPORT OF MATERIAL SHIPPED, CONSIGNED or RELEASED

1. FROM *(Quarantine facility - name and address)*
USDA-ARS--WR
Biological Control of Weeds Laboratory
1050 San Pablo Avenue
Albany, CA 94706

2. ORGANISM SHIPPED - A. Gen., sp., subsp., auth. [M]: Hyles euphorbiae (L.)

B. Order: Family

C. Determined by *(names & affiliations)*

3. QUARANTINE FILE NO.: BCWRL-83-19

4. TYPE OF ORGANISM - explain MI & OT in blk. 20
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher

5. NOS. & STAGES SHIPPED *(see codes)*
[Est] P
[Est]
[Est]
TOTAL:

6. DATES TRANSFORMED TO STAGES SHIPPED *(month, day, year)*
10 - 15 August 1983
☐ Shipped directly ☐ Emerged in Quarantine

7. MATING OBSERVED
☐ Yes N/A % ☐ No

8. HOST / PREY / PEST MATERIAL PRESENT
☐ Beneficial with host/prey
☐ Host/prey/pest only ☒ None

9. DATES ORIGINALLY FIELD COLLECTED *(m,d,y)*: June 1983

10. LOCATION - Country & Province/State of Origin: Debrecen, Hungary

11. ORIGINAL COLLECTORS *(names & affiliations)*: A. Rizza & P. Pecora

12. FOREIGN/OVERSEAS SOURCE FILE NOS.: BCWLE-83-17

16. LAB CULTURED (F1 +)
☐ Overseas ☐ No
☒ In Quarantine ____ *(number of generations)*

13. ORIGINAL HOST/PREY - Gen., sp. *(or other food source)*: Euphorbia virgata Waldst. & Kit.

14. STAGE/PART OF HOST/PREY ATTACKED: Leaves

15. ORIGINAL FOOD SOURCE OF HOST/PREY

17. LAB HOST/PREY - Gen., sp. *(if different from blk. 13)*

18. INTENDED HOST/PREY - Gen., sp. *(if different from blk. 13)*

19. SHIPPED/CONSIGNED TO
Norman E. Rees, USDA-ARS-WR
Rangeland Insect Laboratory
Montana State University, Bozeman, MT 59717

20. REMARKS

21. DATE shipped/consigned *(m,d,y)*: 2 Sept 1983

22. REPRESENTATIVE SPECIMENS RETAINED [Yes] number:

23. PACKING/HANDLING
☒ Usual ☐ Other *(explain in blk. 20)*

24. SHIPPED VIA: U.S. Mail

25. SCREENED OR PACKAGED BY: G. R. Johnson

SECTION II – REPORT OF RECEIPT AND INTENDED USE

26. DATE OF RECEIPT *(m,d,y)*: 6 Sept 1983

27. DATE OPENED *(m,d,y)*: 6 Sept 1983

28. CONDITION RECEIVED: A. Container: Good; B. Contents: Good

29. REPORTED OR EXAMINED BY: Norman E. Rees

30. INVENTORY OF MATERIAL RECEIVED *(use codes)*

A. Number and stages received *(blk. 2)*		B. Number Emerged *(stages)*			
		Beneficials		Host/Prey	
Alive	Dead	Alive	Dead	Alive	Dead
8 A	2 A				
44 P	1 P				
TOTALS [E]	[E]	[F]	[E]	[E]	[E]

31. OTHER SPECIES INCLUDED OR EMERGED

A. Order: Family and Genus, species, author, if known	B. Determined by *(name & affiliation)*	C. No. and Stages *(use codes)*

32. REMARKS: No.s increase in greenhouse and laboratory

33. SPECIMENS FROM SHIPMENT RETAINED BY RECEIVER
☐ Yes ____ *number* ☐ No

34. INTENDED USE
A. ☐ Immediate release *(complete Sec. III)*
Lab culture/study
B. ☒ Release intended
C. ☐ No release intended

35. INTENDED LAB HOST/PREY - Gen., sp.: E. psudovirgata types

SECTION III – REPORT OF RELEASE

	SITE 1	SITE 2	SITE 3
36. Types of release	☐ Field ☒ Greenhouse ☐ Cage ☒ Other: Laboratory	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
37. Locations (State, County, nearest Town or physical feature, map coordinates) *(Use AD-942A for more details)*			
38. Number and stages released. *(see codes)*	[Est]	[Est]	[Est]
39. Dates of release *(m,d,y)*			
40. Target hosts/prey at release A. Primary – *Genus, species*			
B. Other – *Genus, species*			
C. Families			
41. Food (plant/animal/other) of target host/prey at release.			
42. Released by *(Name & affiliation)*			

43. REMARKS *(use AD-942A for more details)*

44. REPORTED BY
A. Name
B. Date *(m,d,y)*

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – QUARANTINE FACILITY

(Shipment/Consignment from Quarantine)

48. FINAL DETERMINATION - Gen., sp., subsp., auth. | M | NC | 48a. V.S. *(see files)*
a ☐ ☐ a ☐
b ☐ ☐ b ☐

SECTION I – REPORT OF MATERIAL SHIPPED, CONSIGNED or RELEASED

1. FROM *(Quarantine facility - name and address)*
USDA-ARS-WR
Biological Control of Weeds Laboratory
1050 San Pablo Avenue
Albany, CA 94706

2. ORGANISM SHIPPED - A. Gen., sp., subsp., auth. [Au]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by *(names & affiliations)*
A. Rizza - BCWLE

3. QUARANTINE FILE NO.
BCWRL-84-

4. TYPE OF ORGANISM - explain MI & OT in blk. 20
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ Microbial ☐ OTher

5. NOS. & STAGES SHIPPED *(see codes)*
[Est] 111 P
[Est]
[Est]
TOTAL:

6. DATES TRANSFORMED TO STAGES SHIPPED *(month, day, year)*
Oct 1983

7. MATING OBSERVED
☐ Yes N/A % ☐ No

8. HOST / PREY / PEST MATERIAL PRESENT
☐ Beneficial with host/prey
☐ Host/prey/pest only ☒ None

☒ Shipped directly ☐ Emerged in Quarantine

9. DATES ORIGINALLY FIELD COLLECTED *(m,d,y)*
June 1983

10. LOCATION - Country & Province/State of Origin
Debrecen, Hungary

11. ORIGINAL COLLECTORS *(names & affiliations)*
A. Rizza & P. Pecora BCWLE

12. FOREIGN/OVERSEAS SOURCE FILE NOS.
BCWLE-84-6

16. LAB CULTURED (F_1+)
☒ Overseas ☐ No
☐ In Quarantine _____ *(number of generations)*

13. ORIGINAL HOST/PREY - Gen., sp. *(or other food source)*
Euphorbia virgata

14. STAGE/PART OF HOST/PREY ATTACKED
FO

19. ORIGINAL FOOD SOURCE OF HOST/PREY

17. LAB HOST/PREY - Gen., sp. *(if different from blk. 13)*
E. esula / E. characias

18. INTENDED HOST/PREY - Gen., sp. *(if different from blk. 13)*

19. SHIPPED/CONSIGNED TO
Norm Rees, USDA-ARS-WR, Rangeland Insect Lab.
Montana State University, Bozeman, MT 59717

20. REMARKS
Kept 2 at Albany for Voucher Specimens

21. DATE shipped/consigned *(m,d,y,)*
25 June 1984

22. REPRESENTATIVE SPECIMENS RETAINED [Yes] number: 2

23. PACKING/HANDLING
☒ Usual ☐ Other *(explain in blk. 20)*

24. SHIPPED VIA
U.S. Mail

25. SCREENED OR PACKAGED BY
A. H. Krueger

SECTION II – REPORT OF RECEIPT AND INTENDED USE

26. DATE OF RECEIPT *(m,d,y)*
27 June 1984

27. DATE OPENED *(m,d,y)*
27 June 1984

28. CONDITION RECEIVED
A. Container: Good
B. Contents: Good

29. REPORTED OR EXAMINED BY
Linda Thorson

30. INVENTORY OF MATERIAL RECEIVED *(use codes)*

A. Number and stages received *(blk. 2)*		B. Number Emerged *(stages)*			
		Beneficials		Host/Prey	
Alive	Dead	Alive	Dead	Alive	Dead
118 P					
TOTALS [E]	[E]	[E]	[E]	[E]	[E]

31. OTHER SPECIES INCLUDED OR EMERGED

A. Order; Family and Genus, species, author, if known	B. Determined by *(name & affiliation)*	C. No. and Stages *(use codes)*

32. REMARKS
Greenhouse cage release; transfer eggs

33. SPECIMENS FROM SHIPMENT RETAINED BY RECEIVER
☐ Yes _____ number ☐ No

34. INTENDED USE
A. ☐ Immediate release *(complete Sec. III)*
Lab culture/study
B. ☒ Release intended
C. ☐ No release intended

35. INTENDED LAB HOST/PREY - Gen., sp.
Leafy spurge complex

SECTION III – REPORT OF RELEASE

	SITE 1	SITE 2	SITE 3
36. Types of release	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
37. Locations (State, County, nearest Town or physical feature, map coordinates) *(Use AD-942A for more details)*			
38. Number and stages released. *(see codes)*	[Est] ARVIN: I WILL SEND ORIGINAL AFTER RELEASES.	[Est]	[Est]
39. Dates of release *(m,d,y)*			
40. Target hosts/prey at release A. Primary – *Genus, species*			
B. Other – *Genus, species*			
C. Families			
41. Food (plant/animal/other) of target host/prey at release.			
42. Released by *(Name & affiliation)*			

43. REMARKS *(use AD-942A for more details)*

44. REPORTED BY
A. Name
B. Date *(m,d,y)*

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth. | M | NC | 35. V.S. (see files)
a. | ☐ | ☐ | a ☐
b. | ☐ | ☐ | b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS-BZN-85-0

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY(S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. & S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C.

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ $F_1 - F_{10}$ ☐ F_{51+}
☐ $F_{11} - F_{50}$

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species
Euphorbia esula L.

B. Stage/part attacked (see codes)
LV

13. LABORATORY HOST / PREY
A. Genus, species
Euphorbia esula L.

B. Stage/part attacked (see codes)
LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
Susan Reed
c/o Missoula County Weed District
Missoula, MT

VIA :

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 100 L

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
18 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive
[Est] 100 L

B. Emerged (Beneficials)
[Est] 100 L

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☒ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet, use Form AD 943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	Reed Residence, Lolo Creek, Lolo, Missoula Co. MT		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 100 L	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release	Euphorbia esula L.		
31. Released by (Name and affiliation)	R. J. Lundy, Msla. Co. Weed Dist.		

32. REMARKS (Use AD-943A for more details)

33. REPORTED BY
A. Name R. J. Lundy
B. Date (m,d,y) 19 July 1985

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth. — M / NC
a.
b.

35. V.S. (see files)
a ☐
b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS-BZN-85-006

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ Microbial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY(S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. & S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C.

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ F_1 - F_{10} ☐ F_{51} +
☐ F_{11} - F_{50}

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species
Euphorbia esula L.

B. Stage/part attacked (see codes)
LV

13. LABORATORY HOST / PREY
A. Genus, species
Euphorbia esula L.

B. Stage/part attacked (see codes)
LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
Pete Strazdas
Dept. of State Lands
Box 1456
Conrad, MT
VIA:

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 100 L

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☒ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
19 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive
[Est] 100 L

B. Emerged (Beneficials)
[Est]

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☒ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet; use Form AD 943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	Toole County, Montana SE1/4, NE1/4, Sec. 36, T31N, R2W		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 100 L	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 July 1988		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release	Euphorbia esula L.		
31. Released by (Name and affiliation)	Pete Strazdas, DSL		

32. REMARKS (Use AD-943A for more details)
Spurge somewhat drought stressed.

33. REPORTED BY
A. Name Pete Strazdas
B. Date (m,d,y)

OMB NO 0518-0013 (EXP 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth. — M / NC
a.
b.

35. V.S. (see files)
a.
b.

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER/RELEASER FILE NO. (see instructions)
LS-BZN-85-008

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY(S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. &
S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C.

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ $F_1 - F_{10}$ ☐ F_{51+}
☐ $F_{11} - F_{50}$

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species
Euphorbia esula L.
B. Stage/part attacked (see codes)
LV

13. LABORATORY HOST/PREY
A. Genus, species
Euphorbia esula L.
B. Stage/part attacked (see codes)
LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
Larry Nelson
Judith Basin County Weed District
Stanford, MT 59479
VIA:

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 100 L

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
18 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive
[Est] 100 L
B. Emerged (Beneficials)
[Est]

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☐ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST/PREY - Gen., sp.

SECTION III – REPORT OF RELEASE/RECOLONIZATION (See instructions on cover sheet; use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	Montana, Judith Basin Co.. Utica.		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 100 L	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release			
31. Released by (Name and affiliation)	Larry Nelson		

32. REMARKS (Use AD-943A for more details)
Located 20 larvae on 21 July 1985

33. REPORTED BY
A. Name Larry Nelson
B. Date (m,d,y)

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth.	M	NC	35. V.S. (see files)
a.	☐	☐	a ☐
b.	☐	☐	b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS-BZN-85-009

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ Microbial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) **And/Or** Part B. From Laboratory Culture

5. COLLECTION LOCALITY(S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. & S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ $F_1 - F_{10}$ ☐ F_{51} +
☐ $F_{11} - F_{50}$

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species: Euphorbia esula L.
B. Stage/part attacked (see codes): LV

13. LABORATORY HOST/PREY
A. Genus, species: Euphorbia esula L.
B. Stage/part attacked (see codes): LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
Ross Racine
Bureau of Indian Affairs
Blackfeet Agency
Browning, MT 59417
VIA :

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 100 L

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
19 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive: [Est] 100 L
B. Emerged (Beneficials): [Est]

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☐ No
☐ Yes _____ nos.

23. INTENDED USE
A. [X] Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet, use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	[X] Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Caye ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	NW1/4, NE1/4, SW1/4, Sec. 23, T37N, R14W		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 100 L, IV & V instar	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release			
31. Released by (Name and affiliation)	Ross Racine, B.I.A.		

32. REMARKS (Use AD-943A for more details)

33. REPORTED BY
A. Name
B. Date (m,d,y)

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth. | M | NC | 35. V.S. (see files)
a. ☐ ☐ a ☐
b. ☐ ☐ b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS-BZN-85-013

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY (S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. & S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C.

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ $F_1 - F_{10}$ ☐ $F_{51}+$
☐ $F_{11} - F_{50}$

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species
Euphorbia esula L.
B. Stage/part attacked (see codes)
LV

13. LABORATORY HOST/PREY
A. Genus, species
Euphorbia esula L.
B. Stage/part attacked (see codes)
LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
Andrew Kulla
U. S. Forest Service
Lolo National Forest, Superior Ranger Dist.
Box 460
VIA: Superior, MT 59872

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 100 L

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
19 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive: [Est] 100 L
B. Emerged (Beneficials): [Est]

21. RECEIVER'S REMARKS
Released in good condition, no mortality observed.

22. SPECIMENS RETAINED BY RECEIVER
☐ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet, use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	Montana, Missoula County, SE 1/4, SE1/4, SE1/4, Sec. 36, T12N, R20W, P.MM		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 100 L	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	20 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release			
31. Released by (Name and affiliation)			

32. REMARKS (Use AD-943A for more details)
Larvae feeding within one hour of release, leafy spurge abundant

33. REPORTED BY
A. Name Andrew Kulla
B. Date (m,d,y) 20 July 1985

OMB NO. 0518-0013 [EXP. 2/28/87]

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth. | M | NC | 35. V.S. (see files)
a. ☐ ☐ a ☐
b. ☐ ☐ b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS-BZN-85-014

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ Microbial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY (S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. &
S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C.

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ $F_1 - F_{10}$ ☐ $F_{51}+$
☐ $F_{11} - F_{50}$

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species
Euphorbia esula L.
B. Stage/part attacked (see codes)
LV

13. LABORATORY HOST / PREY
A. Genus, species
Euphorbia esula L.
B. Stage/part attacked (see codes)
LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
Rodger Ashley
Roosevelt County Extension Agent
Box 416
Culbertson, MT 59218
VIA :

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 100 L

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☒ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
19 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive
[Est] 100 L
B. Emerged (Beneficials)
[Est]

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☒ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet, use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	Monatana, Roosevelt Co., Culbertson, Sec. 13, T27N, R56E		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 100 L	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	20 July 1985		
29. Target hosts/prey at release A. Primary – Genus, species	Euphorbia esula L.		
B. Other – Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release			
31. Released by (Name and affiliation)	Rodger Ashley, Ext. Agent		

32. REMARKS (Use AD-943A for more details)

33. REPORTED BY
A. Name Roger Ashley
B. Date (m,d,y) 20 July 1985

OMB NO. 0518-0013 [EXP. 2/28/87]

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth.	M	NC	35. V.S. (see files)
a.	☐	☐	a ☐
b.	☐	☐	b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS-BZN-85-015

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) **And/Or** Part B. From Laboratory Culture

5. COLLECTION LOCALITY(S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. & S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C.

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ F_1 - F_{10} ☐ F_{51} +
☐ F_{11} - F_{50}

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species: Euphorbia esula L.
B. Stage/part attacked (see codes): LV

13. LABORATORY HOST / PREY
A. Genus, species: Euphorbia esula L.
B. Stage/part attacked (see codes): LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
Glacier National Park
Resource Management
West Lakes District Office
West Glacier, MT 59936
VIA:

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 450 L

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
19 & 23 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive: [Est] 450 L
B. Emerged (Beneficials): [Est]

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☐ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet; use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	Montana, Flathead Co., Big Prairie, Glacier National Park, UTM: 696.2 X 5410.8		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 450 L	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 and 23 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release			
31. Released by (Name and affiliation)	Maura J. Longden and Dave Lange, Glacier National Park		

32. REMARKS (Use AD-943A for more details)

33. REPORTED BY
A. Name: Maura Longden
B. Date (m,d,y): 10 Aug 1985

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth. | M | NC | 35. V.S. (see files)
a. ☐ ☐ a ☐
b. ☐ ☐ b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS-BZN-85-15,-37,&-38

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY (S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. &
S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C.

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ $F_1 - F_{10}$ ☐ F_{51+}
☐ $F_{11} - F_{50}$

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species
Euphorbia esula L.

B. Stage/part attacked (see codes)
LV

13. LABORATORY HOST / PREY
A. Genus, species
Euphorbia esula L.

B. Stage/part attacked (see codes)
LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
Bill Dopp
Flathead County Weed Control
800 S. Main
Kalispell, MT 59901
VIA :

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 300 L, IV- V instar

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☒ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
18 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive
[Est] 300 L

B. Emerged (Beneficials)
[Est]

21. RECEIVER'S REMARKS
All larvae seem to have made the 20 hour trip in good shape.

22. SPECIMENS RETAINED BY RECEIVER
☒ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release Intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet; use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☒ Other: Pasture	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	MT, Flathead County, Kokanee Bend		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 300 L, IV-V instar	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release	Euphorbia esula L.		
31. Released by (Name and affiliation)	Bill Dopp		

32. REMARKS (Use AD-943A for more details)
All larvae were in good condition.

33. REPORTED BY
A. Name Bill Dopp
B. Date (m,d,y)
19 July 1985

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34 FINAL DETERMINATION - Gen., sp., subsp., auth. | M | NC | 35. V.S. (see files)
a. ☐ ☐ a ☐
b. ☐ ☐ b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS-BZN-85-021

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY(S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. & S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C.

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ F_1 - F_{10} ☐ F_{51} +
☐ F_{11} - F_{50}

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species
Euphorbia esula L.

B. Stage/part attacked (see codes)
LV

13. LABORATORY HOST/PREY
A. Genus, species
Euphorbia esula L.

B. Stage/part attacked (see codes)
LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
U. S. Forest Service
91 N. Frontage Road
Deer Lodge, MT 59722

VIA: Errol Hammond

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 100 L, III & IV instar

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
18 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive
[Est] 100 L

B. Emerged (Beneficials)
[Est]

21. RECEIVER'S REMARKS
All but two survived. 98 OK.

22. SPECIMENS RETAINED BY RECEIVER
☒ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
B. ☐ Release intended
C. ☐ No release intended
Lab culture/study (complete Blk. 24)

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet; use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	Montana, Deer Lodge County, Lost Creek, R11W, T5N, Sec. 14, NENW		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 100 L, III & IV instar	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release			
31. Released by (Name and affiliation)	Wm. Baumgartner, U.S.F.S.		

32. REMARKS (Use AD-943A for more details)

33. REPORTED BY
A. Name Wm. Baumgartner
B. Date (m,d,y) 19 July 1985

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth.	M	NC	35 V S. (see files)
a.	☐	☐	a ☐
b.	☐	☐	b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS- BZN-85-024

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher
(Explain MI or OT).

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) **And/Or** Part B. From Laboratory Culture

5. COLLECTION LOCALITY (S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. & S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ $F_1 - F_{10}$ ☐ $F_{51}+$
☐ $F_{11} - F_{50}$

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species: *Euphorbia esula* L.
B. Stage/part attacked (see codes): LV

13. LABORATORY HOST / PREY
A. Genus, species: *Euphorbia esula* L.
B. Stage/part attacked (see codes): LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
D. A Finnicum
Dawson County Weed District
207 W. Bell
Glendive, MT 59330
VIA CAR

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 100 L

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☒ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
18 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive: [Est] 100 L
B. Emerged (Beneficials): [Est]

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☐ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture / study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet, use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	Montana, Dawson Co., 9 miles S of Glendive, MT, NENW, Sec.20, T14N, R55E		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 100 L, III-V instar	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	*Euphorbia esula* L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release	*Euphorbia esula* L.		
31. Released by (Name and affiliation)	Dave Finnicum, Dawson Co. Weed. Dist.		

32. REMARKS (Use AD-943A for more details)
Larvae were in very good conditionat the time of release.

33. REPORTED BY
A. Name D. A. Finnicum
B. Date (m,d,y) 19 Aug 1985

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth.	M	NC	35. V.S. (see files)
a.	☐	☐	a ☐
b.	☐	☐	b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS-BZN-85-032

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ Microbial ☐ OTher
(Explain M1 or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY (S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943; Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. &
S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C.

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ F_{1} - F_{10} ☐ F_{51} +
☐ F_{11} - F_{50}

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species
Euphorbia esula L.
B. Stage/part attacked (see codes)
LV

13. LABORATORY HOST/PREY
A. Genus, species
Euphorbia esula L.
B. Stage/part attacked (see codes)
LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
Duane Halverson
Box 35
Pendroy, MT 59467

VIA :

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 100 L

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
18 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive
[Est] 25 L
B. Emerged (Beneficials)
[Est]

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☐ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet, use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details, see instructions on cover sheet)	Montana, Teton Co., Pendroy or Bynum T27, R6W, Sec. 33		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 25 L	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	18 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release			
31. Released by (Name and affiliation)	Duane Halverson		

32. REMARKS (Use AD-943A for more details)

33. REPORTED BY
A. Name Duane Halverson
B. Date (m,d,y)
24 July 1985

OMB NO 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth.	M	NC	35. V.S. (see files)
a.	☐	☐	a ☐
b.	☐	☐	b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS-BZN-85-033

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ Microbial ☐ OTher
(Explain M or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY(S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. & S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C.

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ $F_1 - F_{10}$ ☐ $F_{51}+$
☐ $F_{11} - F_{50}$

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species
Euphorbia esula L.
B. Stage/part attacked (see codes)
LV

13. LABORATORY HOST / PREY
A. Genus, species
Euphorbia esula L.
B. Stage/part attacked (see codes)
LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
Gerald Wendt
1209 E. 5th Street
Anaconda, MT 59711

VIA :

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 100 L

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
18 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive
[Est] 100 L
B. Emerged (Beneficials)
[Est]

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☐ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet, use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	Montana, Deer Lodge Co., Sec. 30, T4N, R10W, near Anaconda.		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 100 L	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	18 July 1985		
29. Target hosts/prey at release A. Primary – Genus, species			
B. Other – Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release			
31. Released by (Name and affiliation)	Gerald Wendt		

32. REMARKS (Use AD-943A for more details)

33. REPORTED BY
A. Name Gerald Wendt
B. Date (m,d,y)
19 July 1985

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth.	M	NC	35. V. S. (see files)
a.	☐	☐	a ☐
b.	☐	☐	b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS-BZN-85-034

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ Microbial ☐ OTher
(Explain M or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY(S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. & S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C.

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ $F_1 - F_{10}$ ☐ F_{51+}
☐ $F_{11} - F_{50}$

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species: Euphorbia esula L.
B. Stage/part attacked (see codes): LV

13. LABORATORY HOST/PREY
A. Genus, species: Euphorbia esula L.
B. Stage/part attacked (see codes): LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
Don Berry
Berry Ranch
H. C. 58 Box 18
Bainville, MT 59212
VIA :

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 100 L

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
19 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive: [Est] 100 L
B. Emerged (Beneficials): [Est]

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☐ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet, use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details, see instructions on cover sheet)	Montana, Roosevelt Co., Snowden, SE1/4, SW1/4, Sec. 35, T27N, R59E		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 100 L	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release			
31. Released by (Name and affiliation)	Susan Berry		

32. REMARKS (Use AD-943A for more details)
Moth appears to have established on host

33. REPORTED BY
A. Name: Don Berry
B. Date (m,d,y): 23 July 1985

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth.	M	NC	35. V. S. (see files)
a.	☐	☐	a ☐
b.	☐	☐	b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS-BZN-85-036

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY(S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. &
S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C

12. NO. LAB GENERATIONS (At shipper/ releaser location)
☐ $F_1 - F_{10}$ ☐ $F_{51}+$
☐ $F_{11} - F_{50}$

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species: Euphorbia esula L.
B. Stage/part attacked (see codes): LV

13. LABORATORY HOST/PREY
A. Genus, species: Euphorbia esula L.
B. Stage/part attacked (see codes): LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
Hank McNeel, Agronomist
Bureau of Land Management, MCDO
P.O. Box 940
Miles City, MT 59301
VIA :

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 100 L

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
19 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive [Est]
B. Emerged (Beneficials) [Est]

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☒ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet, use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details, see instructions on cover sheet)	Montana, Custer Co., Knowlton, T6N, R53 E, Sec. 2, S1/2, SE1/4, SW1/4, SE1/2.		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 98 L	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release			
31. Released by (Name and affiliation)	Hank McNeel, BLM		

32. REMARKS (Use AD-943A for more details) Release in Fleming Reservoir Wildlife Exclosure. Number of grasshoppers present. Fence down, cattle in exclosure.

33. REPORTED BY
A. Name
B. Date (m,d,y)

OMB NO. 0518-0013 [EXP. 2/28/87]

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth. | M | NC | 35. V.S. (see files)
a. ☐ ☐ a ☐
b. ☐ ☐ b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, MT 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
R. M. Nowierski

3. SHIPPER / RELEASER FILE NO. (see instructions)
LS-BZN-85-039

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY (S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
2 Miles NE of Bozeman, Gallatin County, Montana

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN
Delmont, Switzerland VIA Braeside, Ontario Canada, & Albany, California, USA

6. DATES OF COLLECTION (m,d,y)
July 15 & 16, 1985

7. COLLECTORS (Names and affiliations)
Nowierski, R. M. &
S. J. Harvey, M.S.U.

11. ORIGINAL COLLECTORS (Names and affiliations)
Schroder, D., C.I.B.C.

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ $F_1 - F_{10}$ ☐ F_{51+}
☐ $F_{11} - F_{50}$

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species
Euphorbia esula L.
B. Stage/part attacked (see codes)
LV

13. LABORATORY HOST/PREY
A. Genus, species
Euphorbia esula L.
B. Stage/part attacked (see codes)
LV

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
David Hein
SE Ranch
Grass Range, MT 59032

VIA :

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 100 L

16. DATE SHIPPED (m,d,y)
July 18, 1985

17. SHIPPER'S REMARKS
Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)
18 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive
[Est] 100 L
B. Emerged (Beneficials)
[Est]

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☐ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet; use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	Montana, Fergus Co., Tyler, T13N, R23E.		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 100 L	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release			
31. Released by (Name and affiliation)	David Hein, Univ. of Wyoming		

32. REMARKS (Use AD-943A for more details)

33. REPORTED BY
A. Name David Hein
B. Date (m,d,y) 19 July 1985

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth.	M	NC	35 V.S. (see files)
a.	☐	☐	a ☐
b.	☐	☐	b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)

Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, Montana 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]

Hyles euphorbiae (L.)

B. Order: Family

Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)

S. D. Hight, USDA:ARS:BIIL

3. SHIPPER / RELEASER FILE NO. (see instructions)

LS-BZN-85-061

4. TYPE OF BENEFICIAL

☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) **And/Or** Part B. From Laboratory Culture

5. COLLECTION LOCALITY(S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)

Chesterton, New York
a) Dynamite Hill Ski Area, 1.1 miles E of I-87
b) Median of I-87, 0.7 miles N of intersection of I-87 and Route 8

9. SOURCE FILE NOS.

☒ AD-942, AD-943; Nos. See: BIIL-(SDH)-85-7
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN

6. DATES OF COLLECTION (m,d,y)

July 12-14,1985

7. COLLECTORS (Names and affiliations)

S. D. Hight, B.I.I.L

11. ORIGINAL COLLECTORS (Names and affiliations)

12. NO. LAB GENERATIONS (At shipper/releaser location)

☐ $F_1 - F_{10}$ ☐ $F_{51}+$
☐ $F_{11} - F_{50}$

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species Euphorbia esula (L.) & Euphorbia cyparissias L.

B. Stage/part attacked (see codes)

LV

13. LABORATORY HOST/PREY
A. Genus, species

B. Stage/part attacked (see codes)

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)

George Hirschenberger
Bureau of Land Management
Butte, MT

VIA :

19. NO. & STAGES SHIPPED (use codes on reverse)

[Est] 100 L

16. DATE SHIPPED (m,d,y)

18 July 1985

17. SHIPPER'S REMARKS

Hand Carried

18. SPECIMENS RETAINED BY SHIPPER

☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)

18 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive [Est] 100 L
B. Emerged (Beneficials) [Est]

21. RECEIVER'S REMARKS

Added fresh cold packs and forage

22. SPECIMENS RETAINED BY RECEIVER

☒ No
☐ Yes _____ nos.

23. INTENDED USE

A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST/PREY - Gen., sp.

SECTION III – REPORT OF RELEASE/RECOLONIZATION (See instructions on cover sheet; use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	Montana, Silver Bow Co. near Silver Star, MT T1S, R6W, Sec. 12, SENW		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 100 L	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Local spurge		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release	Local spurge		
31. Released by (Name and affiliation)	George Hirschenberger and	Brad Birford	

32. REMARKS (Use AD-943A for more details)

33. REPORTED BY
A. Name
B. Date (m,d,y)

OMB NO 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth.	M	NC	35. V.S. (see files)
a.	☐	☐	a ☐
b.	☐	☐	b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)
Stephen D. Hight
USDA-ARS-NER
Beneficial Insect Introduction Lab.
Building 264, BARC- East
Beltsville, MD 20705

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]
Hyles euphorbiae (L.)

B. Order: Family
Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)
S. D. Hight

3. SHIPPER / RELEASER FILE NO. (see instructions)
BIIL-(SDH)-85-7

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ Microbial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) **And/Or** Part B. From Laboratory Culture

5. COLLECTION LOCALITY(S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
Chestertown, N.Y.
a) Dynamite Hill Ski Area, 1.1 miles E of I87
b) Median of I87 0.7 miles N of intersection of I87 and Route 8

9. SOURCE FILE NOS.
☐ AD-942, AD-943: Nos.
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN

6. DATES OF COLLECTION (m,d,y)
July 12-14, 1985

7. COLLECTORS (Names and affiliations)
S. D. Hight

11. ORIGINAL COLLECTORS (Names and affiliations)

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ $F_1 - F_{10}$ ☐ $F_{51}+$
☐ $F_{11} - F_{50}$

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species
Euphorbia esula (L.) &
Euphorbia cyparissias L.

B. Stage/part attacked (see codes)
LV

13. LABORATORY HOST / PREY
A. Genus, species

B. Stage/part attacked (see codes)

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)
Mr. N. E. Rees
USDA-ARS-Rangeland Insect Laboratory
c/o Montana State University
Bozeman, MT 59717
VIA:

15. NO. & STAGES SHIPPED (use codes on reverse)
[Est] 1129 L

16. DATE SHIPPED (m,d,y)
16 July 1985

17. SHIPPER'S REMARKS

18. SPECIMENS RETAINED BY SHIPPER
☐ No
☒ Yes 241 nos.

19. DATE RECEIVED (m,d,y)

20. NO. & STAGES (use codes)
A. Rec'd. Alive [Est]
B. Emerged (Beneficials) [Est]

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☐ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☐ Immediate release (complete Sect. III)
Lab culture / study (complete Blk. 24)
B. ☐ Release Intended
C. ☐ No release Intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet, use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)			
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est]	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)			
29. Target hosts/prey at release A. Primary - Genus, species			
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release			
31. Released by (Name and affiliation)			

32. REMARKS (Use AD-943A for more details)

33. REPORTED BY
A. Name
B. Date (m,d,y)

OMB NO. 0518-0013 (EXP. 2/28/87)

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth. | M | NC | 35. V.S. (see files)
a. ☐ ☐ a ☐
b. ☐ ☐ b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)

Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, Montana 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]: Hyles euphorbiae (L.)

B. Order: Family: Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known): S. D. Hight, USDA:ARS:BIIL

3. SHIPPER / RELEASER FILE NO. (see instructions)

4. TYPE OF BENEFICIAL
☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ Microbial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY(S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)
Chesterton, New York
a) Dynamite Hill Ski Area, 1.1 miles E of I-87
b) Median of I-87, 0.7 miles N of intersection of I-87 and Route 8

9. SOURCE FILE NOS.
☒ AD-942, AD-943: Nos. See: BIIL-(SDH)-85-7
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN

6. DATES OF COLLECTION (m,d,y): July 12-14,1985

7. COLLECTORS (Names and affiliations): S. D. Hight, B.I.I.L

11. ORIGINAL COLLECTORS (Names and affiliations)

12. NO. LAB GENERATIONS (At shipper/releaser location)
☐ F_{1} - F_{10} ☐ F_{51} +
☐ F_{11} - F_{50}

8. U.S. FIELD HOSTS/PREY AT COLLECTION
A. Genus, species: Euphorbia esula (L.) & Euphorbia cyparissias L.
B. Stage/part attacked (see codes): LV

13. LABORATORY HOST/PREY
A. Genus, species
B. Stage/part attacked (see codes)

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)

Dave Phillips
Fergus Co. Extension Service
Lewistown, MT

VIA :

15. NO. & STAGES SHIPPED (use codes on reverse): [Est] 100 L, III-IV instar

16. DATE SHIPPED (m,d,y): 16 July 1985

17. SHIPPER'S REMARKS: Hand Carried

18. SPECIMENS RETAINED BY SHIPPER
☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y): 18 July 1985

20. NO. & STAGES (use codes)
A. Rec'd. Alive: [Est] 100 L
B. Emerged (Beneficials): [Est]

21. RECEIVER'S REMARKS

22. SPECIMENS RETAINED BY RECEIVER
☒ No
☐ Yes _____ nos.

23. INTENDED USE
A. ☒ Immediate release (complete Sect. III)
Lab culture/study (complete Blk. 24)
B. ☐ Release intended
C. ☐ No release intended

24. INTENDED LAB HOST / PREY - Gen., sp.

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet, use Form AD-943A for more details)

	SITE 1	SITE 2	SITE 3
25. Types of release	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Caye ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	Grass Range, MT NW1/4,SW1/4, Section 22, T15N, R23E		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 100 L, III-IV instar	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula(L.)		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release	Euphorbia esula (L.)		
31. Released by (Name and affiliation)	Dave Phillips		

32. REMARKS (Use AD-943A for more details)

33. REPORTED BY
A. Name: Dave Phillips
B. Date (m,d,y): July 1985

OMB NO. 0518-0013 [EXP. 2/28/87]

U.S. Department of Agriculture

BIOLOGICAL SHIPMENT RECORD – NON-QUARANTINE

34. FINAL DETERMINATION - Gen., sp., subsp., auth.	M	NC	35. V.S. (see files)
a.	☐	☐	a ☐
b.	☐	☐	b ☐

SECTION I – REPORT OF MATERIAL RELEASED OR SHIPPED

1. FROM (Name & address of Shipper/Releaser)

Robert M. Nowierski
409 L. Johnson Hall
Department of Entomology
Montana State University
Bozeman, Montana 59717

2. BENEFICIAL - A. Gen., sp., subsp., auth. [M]

Hyles euphorbiae (L.)

B. Order: Family

Lepidoptera: Sphingidae

C. Determined by (Name and affiliation if known)

S. D. Hight, USDA:ARS:BIIL

3. SHIPPER / RELEASER FILE NO. (see instructions)

4. TYPE OF BENEFICIAL

☐ PArasite ☒ WEed feeder
☐ PRedator ☐ POllinator
☐ MIcrobial ☐ OTher
(Explain MI or OT):

Part A. From U.S. Field Collection (Collected for field to field recolonization or laboratory culture) And/Or Part B. From Laboratory Culture

5. COLLECTION LOCALITY(S) - State, County, nearest Town (If more than 2 collection sites, give State & County only)

Chesterton, New York
a) Dynamite Hill Ski Area, 1.1 miles E of I-87
b) Median of I-87, 0.7 miles N of intersection of I-87 and Route 8

9. SOURCE FILE NOS.

☒ AD-942, AD-943: Nos. See: BIIL-(SDH)-85-7
☐ Part A ☐ Other:

10. COUNTRIES/REGION/STATE OF ORIGIN

6. DATES OF COLLECTION (m,d,y)	7. COLLECTORS (Names and affiliations)	11. ORIGINAL COLLECTORS (Names and affiliations)	12. NO. LAB GENERATIONS (At shipper/releaser location)
July 12-14,1985	S. D. Hight, B.I.I.L		☐ F_1 - F_{10} ☐ F_{51} + ☐ F_{11} - F_{50}

8. U.S. FIELD HOSTS/PREY AT COLLECTION A. Genus, species	B. Stage/part attacked (see codes)	13. LABORATORY HOST/PREY A. Genus, species	B. Stage/part attacked (see codes)
Euphorbia esula (L.) & Euphorbia cyparissias L.	LV		

SECTION II – REPORT OF SHIPMENT

14. SHIPPED TO (Name & address)

Bill Otten
Missoula County Weed District
Missoula, MT

VIA :

15. NO. & STAGES SHIPPED (use codes on reverse)

[Est] 80 L

16. DATE SHIPPED (m,d,y)

18 July 1985

17. SHIPPER'S REMARKS

Hand Carried

18. SPECIMENS RETAINED BY SHIPPER

☐ No
☐ Yes _____ nos.

19. DATE RECEIVED (m,d,y)	20. NO. & STAGES (use codes) A. Rec'd. Alive	B. Emerged (Beneficials)	21. RECEIVER'S REMARKS
18 July 1985	[Est] 80 L	[Est] 80 L	

22. SPECIMENS RETAINED BY RECEIVER	23. INTENDED USE	Lab culture/study (complete Blk. 24)	24. INTENDED LAB HOST / PREY - Gen., sp.
☒ No ☐ Yes _____ nos.	A. ☒ Immediate release (complete Sect. III)	B. ☐ Release intended C. ☐ No release intended	

SECTION III – REPORT OF RELEASE / RECOLONIZATION (See instructions on cover sheet; use Form AD-943A for more details)

25. Types of release	SITE 1	SITE 2	SITE 3
	☒ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:	☐ Field ☐ Greenhouse ☐ Cage ☐ Other:
26. Locations (State, County, nearest Town or physical feature, map coordinates) (Use AD-943A for more details; see instructions on cover sheet)	Missoula County, MT T13, R19, S13 SE corner		
27. Number & stages released (Use codes; see instructions for recording multiple releases.)	[Est] 80 L, I-III instar	[Est]	[Est]
28. Dates of releases (m,d,y) (See instructions for recording multiple releases.)	19 July 1985		
29. Target hosts/prey at release A. Primary - Genus, species	Euphorbia esula L.		
B. Other - Genus, species			
C. Families			
30. Food (plant/animal/other) of target host/prey at release	Euphorbia esula L.		
31. Released by (Name and affiliation)	Bill Otten		

32. REMARKS (Use AD-943A for more details)

33. REPORTED BY
A. Name
B. Date (m,d,y)

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