# Spotted/Diffuse Knapweed

*Urophora quadrifasciata* adult

## Insect Species and Descriptions

*U. quadrifasciata* (seed head gall fly) adults are about 1/8th of an inch long, and have a dark "UV" pattern on their wings.

*U. affinis* (seed head gall fly) adults are about 1/8th of an inch long, black and have faint horizontal bands on their wings.

## What to Look for to Determine the Presence of the Insect

The presence of the fly is determined by looking for galls made by the fly larvae in knapweed seed heads during October through May. This is done by carefully peeling the seed head bracts (outer coverings) away from the seed head. The sweep net method in summer may be the easiest way to determine presence of adult flies.

*Urophora affinis* adult

## Time of the Year to Collect

Collection of knapweed stems with attached seed heads from fly infested sites should be done in May. The collected stems are tied in bundles and promptly attached to a fence post or similar vertical structure in the new release site. To prevent premature emergence of the adults, the bundles should not be held in a heated environment (house, car, etc.) for more than one day. It is a good idea to shake the seed heads at the collection site so as not to dislodge any remaining seeds and infest any new areas.

Spotted knapweed flower

## Number of Insects Needed for a Release

A release should involve a minimum of 500 galls. To estimate the fly population in an area:

**1)** count the number of galls in 100 randomly-collected seed heads to determine the average number of larvae per seed head, **2)** count the number of knapweed seed heads in 10 randomly-placed 1 1/2 x 1 1/2 foot squares in the field to develop an estimate of the number of seed heads per unit area in the field, then **3)** multiply the average number of larvae per head by the average number of seed heads per unit area. Monitoring/collection procedures are identical for *U. affinis* and *U. quadrifasciata*.

Diffuse knapweed flower

## Site Selection for New Release

The site selection for the release of these two insects is not critical, but there needs to be a sufficient population of spotted or diffuse knapweed to support the insect population. To ensure security of release sites, cooperation from the landowner is important, so that the release area may be protected and monitored for future collections with the landowner's permission.

## Equipment Needed to Collect

1. Sharp knife, scissors or shears.
2. Twine or string to tie the plants into a bundle.
3. Pickup with a topper to transport the bundles of plants to keep seeds from blowing out of the vehicle.

** photo reference points should be taken at the same time, location and direction each year to determine success or failure of the insects. Materials needed include a camera, extra film, and notebook.*

# Spotted/Diffuse Knapweed

## Insect Species and Descriptions

*Cyphocleonus achates* adult

*Cyphocleonus achates* (root weevil) - adults are usually a little more than 1/2 of an inch long.

## What to Look for to Determine the Presence of the Insects

Presence of this weevil is determined by examination of roots and by searches for adults. The initial technique is to search for larvae in the roots during May or June when the overwintering larvae are fully developed. The white, slightly-curved, legless larvae are typically found in the center of the root. The stalks of heavily infested plants will often break off at the root crown if pulled. Larvae are more likely to be found on large plants. The larva will be found in the upper 4 inches of the root.

Adults can be monitored by visual surveys. The adults can be found on the upper parts of knapweed plants and other vegetation in the afternoon on hot, calm days in August. During the morning and during cool weather, the adults may be found on or near the ground on root crowns and on the underside of basal leaves.

Count the adults in ten 1 1/2 x 1 1/2 foot plots. Use the average to estimate population size throughout the site.

## Time of the Year to Collect

The insect is best collected by hand picking from the plants in warm afternoons in August.

## Number of Insects Needed for a Release

The recommended minimum number for a release is 50 adults.

## Site Selection for New Release

Release sites should be dry areas with large, scattered knapweed plants in lower elevation areas. To ensure security of release sites, cooperation from the landowner is important, so that the release area may be protected and monitored for future collections with the landowner's permission.

## Equipment Needed to Collect

1. Collected by hand (fingers).
2. Coolers with frozen Blue Ice or similar material.
3. Unwaxed paper containers.

** photo reference points should be taken at the same time, location and direction each year to determine success or failure of the insects. Materials needed include a camera, extra film,and notebook.*

# Spotted/Diffuse Knapweed

*Agapeta zoegana* adult

## Insect Species and Descriptions

*Agapeta zoegana* (root moth) - adults are about 1/2 inch long and have bright yellow wings with brown markings.

## What to Look for to Determine the Presence of the Insect

Presence of this insect is determined by using several techniques. The initial technique is to search for larvae in the roots during June when overwintering larvae are fully developed. The white larvae are found in tunnels on the outer edge of the root, and are more likely to be found in large roots. A quick field assessment of the larvae is done by peeling the "bark" or outer tissue off the root and splitting the root. The larvae will be found in the upper 4 inches of the root.

Adults can be monitored by visual surveys or by the use of a night light in the field. A visual survey should be conducted in the afternoon on warm, calm days in late July and August. The survey is conducted by slowly walking in a straight line through a length of a release site and noting the adult moths within about 3 feet on either side of the line. Detection of 5 moths in 10 minutes during a daytime visual survey probably indicates a good population.

A night light approach involves the use of a portable fluorescent light and a white linen sheet. The sheet is draped from a support structure (fence, wooden tripod, low tree branch, etc.) in the center of the field, adjacent to a florescent light suspended about 2 feet off the ground. Moths attracted to the light will land on the sheet, making them easy to identify. The night light is most effective about 1.5 hours after sunset on dark nights (not moonlit) in early to mid-August. Most of the adults attracted to the light will be males, so this is not a recommended technique for collection of the moth. Detection of several *A. zoegana* adults, however, is an indication that the moth is established at the site.

## Time of the Year to Collect

Collections are made in the afternoon on warm, calm days in late July through mid-August.

## Number of Insects Needed for a Release

A release should involve a minimum of 100 moths. Collection of the moth is best done with the aid of a modified hand vacuum (please contact Jim Story for a description of the collection equipment).

## Site Selection for New Release

Release sites should be dry areas with moderately tall knapweed in lower elevation sites. To ensure security of release sites, cooperation from the landowner is important, so that the release area may be protected and monitored for future collections with the landowner's permission.

## Equipment Needed to Collect and/or Monitor

1. Sweep net.
2. Modified vacuum cleaner.

**photo reference points should be taken at the same time, location and direction each year to determine success or failure of the insects. Materials needed include a camera, extra film,and notebook.*

# Spotted/Diffuse Knapweed

*Larinus minutus* adult

## Insect Species and Descriptions

*Larinus minutus* (seed head weevil) - adults are about 1/4 inch long, black, and have a large snout.

## What to Look for to Determine the Presence of the Insects

Presence of this weevil is determined by examining knapweed seed heads in the off-season (October through May), after the weevils have exited the seed head. Prior occurrence of the weevil is indicated by a distinct exit hole in the side of the seed head. Population estimates can be made by using the same procedures described for *U. affinis*, but counting exit holes rather than galls.

Weevil exit hole

Photo by: R.D. Richard, USDA-APHIS

## Time of the Year to Collect

Collecting adults is done with a sweep net at about the time when the knapweed is bolting. Collected adults should be kept cool.

## Number of Insects Needed for a Release

The minimum number of adults needed for a release is 100.

## Site Selection for New Release

The site selection for the release of this insect is probably not critical, but there needs to be sufficient population of spotted or diffuse knapweed to support the insect population. This insect seems to do best in hot, dry locations. To ensure security of release sites cooperation from the landowner is important, so others can collect from the site.

## Equipment Needed to Collect

1. Sweep net.
2. Coolers with frozen Blue Ice or similar material.

**photo reference points should be taken at the same time, location and direction each year to determine success or failure of the insects. Materials needed include a camera, extra film,and notebook.*

# Dalmatian Toadflax

## Insect Species and Descriptions

*Calophasia lunula* adult

Photo by: R.D. Richard, USDA-APHIS

*Calophasia lunula* - the adults are nondescript gray moths that are about 1/2 - 3/4 inch long.

## What to Look for to Determine the Presence of the Insects

The time of the year to look for this insect is in the middle of the day in mid-June through the end of July. The visual signs will be defoliation on the terminal shoots and also look for the absence of leaves or stems that have been stripped of leaves.

## Time of the Year to Collect

Early to late July and in some years maybe through the middle of August.

## Number of Insects Needed for a Release

The number of insects needed for a release is a minimum of 100 larvae.

Dalmatian toadflax

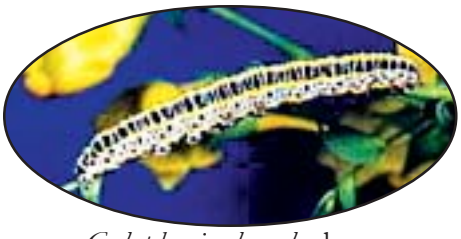
## Site Selection for New Release

Site selection as far as terrain is concerned is not critical, the plant density just needs to be high. Locate releases away from ant hills or nests. To ensure security of release sites, cooperation from the landowner is important, so that the release area may be protected and monitored for future collections with the landowner's permission.

## Equipment Needed to Collect

1. Coolers with frozen Blue Ice or similar material.
2. Unwaxed cardboard containers, at least 1 quart or larger fresh cut toadflax material for the larvae to feed on whilde in transport.
3. Since these insects are collected as larvae and are fairly large, they are collected by hand (fingers).

**photo reference points should be taken at the same time, location and direction each year to determine success or failure of the insects. Materials needed include a camera, extra film,and notebook.*



*Calophasia lunula* larva

Photo by: R.D. Richard, USDA-APHIS

# Yellow Toadflax

## Insect Species and Descriptions

*Brachypterolus pulicarius* - this insect is more widely established on yellow toadflax than dalmatian toadflax. The adults are small, black oval beetles less than 1/10$^{th}$ of an inch long.

*Brachypterolus pulicarius* adults

Photo by: R.D. Richard, USDA-APHIS

## What to Look for to Determine the Presence of the Insect

Any site where a few hundred adult beetles can be collected within a few minutes. The time of the year to look for this insect is in the middle of the day in mid-May through the end of June.

## Time of Year to Collect

Early June through July.

## Number of Insects Needed for a Release

The number of insects needed for a release is a minimum of 100 adults. A sweep net may leave some adults encased in the flowers, so some adults may be missed. An aspirator may be a better method of collection.

Photo from: Western Society of Weed Science

Flowering yellow toadflax

## Site Selection for New Release

Site selection as far as terrain is concerned is not critical, the plant density just needs to be high. To ensure security of release sites, cooperation from the landowner is important, so that the release area may be protected and monitored for future collections with the landowner's permission.

## Equipment Needed to Collect

1. Sweep net.
2. Unwaxed paper containers.
3. Coolers with frozen Blue Ice or similar material.

**photo reference points should be taken at the same time, location and direction each year to determine success or failure of the insects. Materials needed include a camera, extra film,and notebook.*

# Leafy Spurge

## Insect Species and Description

In general most *Aphthona species* are about 1/8 inch long with enlarged hind legs adapted for jumping.
*Aphthona nigriscutis* and *Aphthona cyparissiae* - generally are a brown color.
*Aphthona flava* - bright coppery appearance when fresh.
*Aphthona lacertosa* and *Aphthona czwalinae* - generally are black in color.

*A. czwalinae* adult

*A. cyparissiae* adult

*A. nigriscutis* adult

Photo by: R.D. Richard, USDA-APHIS

*A. flava* adult

*A. lacertosa* adult

## What to Look for to Determine the Presence of the Insects

Early indications of establishment, include short unflowering spurge, or dead spurge stems on the edge or perimeter of the release. To determine if the insects are present, sweep the spurge at or near the point of release for adults on sunny calm days between 10:30 AM and 4:00 PM. If you are able to easily collect 500-1000 insects in 10 minutes of sweeping you have a high enough population to start collecting and redistribute on a limited basis.

## Time of the Year to Collect *Aphthona Species*

Normally the best time to collect *Aphthona species* would be, depending upon the weather and site, would be the last two weeks of June through the first two weeks of July.

Flowering leafy spurge

## Number of Insects Needed for a Release

The normal number of insects that make up a release is 1000, however, the minimum number would be 250 insects. The release of more insects may result in an increased level of establishment and control at the site in a shorter period of time. It is very important to mark the area the insects were released, this should be some type of permanent marker (such as driving a metal stake in the ground, a corner fence post or spray painting a large rock) then release the insects at the base of the marker. Do not forget to take photographs of the area, and keep a written log of the type of insects released and the time, date, and even weather conditions.

## Site Selection for New Release

*A. nigriscutis* appears to prefer sunny, dry sandy loam sites with open sunny areas with more spread out spurge. This species has done poorly in tall, thick, high density spurge sites.

*A. flava* prefers sunny, south facing slopes in cooler climates with annual precipitation of less than 18-20 inches. Unfortunately, this species has had a major impact on leafy spurge at only a handful of sites in Montana.

*A. cyparissiae* appear to prefer sandy loam soil sites, with warm open sunny areas. Unfortunately, this species has had a major impact on leafy spurge at only a handful of sites in Montana.

*A. lacertosa* appears to be able to establish over a wider range of site conditions than *A. nigriscutis*, as it appears to be able to impact low as well as high spurge density sites, it also seems to like shaded areas. This suggests that it may be appropriate for release in dry as well as moist leafy spurge sites.

*A. czwalinae* appears to prefer relatively moist, high density spurge sites. Unfortunately, this species has only established at a few sites in Montana, and its impact on spurge is unclear.

The initial release site should not be close to ant hills. To ensure security of release sites, cooperation from the landowner is important, so that the release area may be protected and monitored for future collections with the landowner's permission.

## Equipment Needed to Collect *Aphthona species*

1. Sweep net.
2. Coolers with frozen Blue Ice or similar material.
3. Unwaxed paper containers.
4. Newspaper (to separate the cold packs from the insects).
5. Masking tape.

** photo reference points should be taken at the same time, location and direction each year to determine success or failure of the insects. Materials needed include a camera, extra film,and notebook.*

# Leafy Spurge

## Insect Species and Descriptions

*Oberea erythrocephala* adult

*Oberea erythrocephala* - the adult is a slender grayish-black, red-headed beetle, approximately 1/4 to 1/2 inch long plus the antennae.

## What to Look for to Determine the Presence of Insects

Plants that are late blooming, short, and have a stunted appearance may contain beetle larvae. Also, large and older roots will be missing or deteriorating and plants dry up earlier in summer than healthy plants. Plants occasionally turn red showing signs of pathogens. Wayne Pearson, Stillwater County Weed District Supervisor, has said they do cause a lot of damage to the spurge roots, the areas these insects are working will show up from quite a distance away.

## Time of the Year to Collect

The adult is the best stage to collect and redistribute. This is best done late morning to early afternoon in late June to mid-July.

## Number of Insects Needed for a Release

The average number of insects needed for a release is 100-200 insects. Wayne Pearson believes this insect is best transported in the spurge duff, that was collected in the sweep net.

## Site Selection for New Release

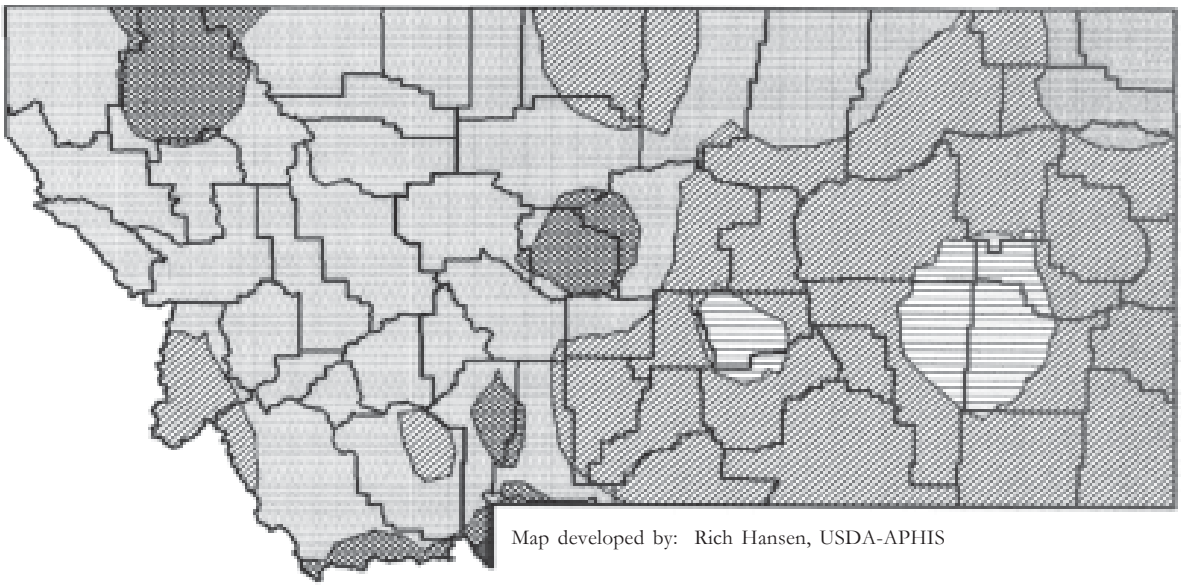
It was originally thought this species preferred shaded areas with trees. This has not been the case, they seem to move on their own to dry sunny sites. According to Wayne Pearson, he does not believe the release sites to be critical as they seem to move on their own. He has found this insect to move primarily to dry sunny sites, such as gravel bars or along railroad rights-of-way. To ensure security of release sites, cooperation from the landowner is important, so that the release area may be protected and monitored for future collections with the landowner's permission.

## Equipment Needed to Collect

1. Sweep net.
2. Unwaxed paper container.
3. Coolers with frozen Blue Ice or similar material.

** photo reference points should be taken at the same time, location and direction each year to determine success or failure of the insects. Materials needed include a camera, extra film,and notebook.*

# Average Date of Estimated Peak
# *Aphthona species* Adult Abundance



Map developed by: Rich Hansen, USDA-APHIS

06/26 - 07/02
07/03 - 07/09
07/10 - 07/16
07/17 - 07/23
07/24 - 07/30

| Station | County | *A.czwalinae/ A. lacertosa* | *A. nigriscutis* | *A. cyparissiae* | *A. flava* |
|---|---|---|---|---|---|
| Bozeman | Gallatin | July 09 | July 14 | July 27 | July 27 |
| Ekalaka | Carter | June 29 | July 04 | July 15 | July 16 |
| Glasgow | Valley | June 29 | July 03 | July 15 | July 15 |
| Havre | Hill | June 29 | July 03 | July 15 | July 16 |
| Huntley | Yellowstone | June 24 | June 28 | July 10 | July 11 |
| Missoula | Missoula | June 30 | July 05 | July 17 | July 18 |
| Moccasin | Judith Basin | July 09 | July 14 | July 27 | July 27 |
| Savage | Richland | June 26 | July 01 | July 12 | July 13 |
| Valier | Pondera | July 06 | July 11 | July 24 | July 24 |

# NOTES: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