

# **Biological Control of Purple Loosestrife:**

A guide to Rearing *Gallerucella* spp.

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## **INTRODUCTION:**

Purple loosestrife (PL)(*Lythrum salicaria*) is a serious pest in Wisconsin because it is non-native, spreads quickly because of its enormous seed production and displaces native wetland plants, often becoming the local wetland dominant. Thus, it reduces diversity of both plants and dependent animals and degrades wetland systems. PL infests over 40,000 acres of Wisconsin wetlands.

Biological control (bio-control) is simply defined as using one living organism to control another unwanted organism. Introducing PL's host-specific European insect enemies to infested wetlands reduces the weed's vigor and competitiveness, often allowing native plants to regain dominance. If there are enough native plants present, they may even push PL out of a wetland completely, but the goal of PL bio-control in Wisconsin is to simply to reduce the numbers of the plant, not to eradicate it. Eradication is not only an unlikely biological outcome, but even if it could occur it would also eliminate host-specific control organisms. Thus, any reintroduction of the plant would simply recreate the current dilemma. Once bio-control of PL is established in Wisconsin, there will likely always be small numbers of both the plant and its control insects here. Similarly, bio-control may not eliminate PL in any particular wetland, but hopefully will at least reduce it to an acceptable level.

We now have four kinds of control insects in Wisconsin, but 2 *Gallerucella* beetles are the most successful so far since they are easily reared and released and work quickly. These 2 species of beetles are leaf and stem feeders, reducing both growth and reproduction of PL. The over-wintered adults feed, lay eggs and die. Once the larvae hatch, they feed, then move down into the soil to pupate into new adults. Larvae cause the most damage to the plant, especially through killing the stem tips that normally produce flowers, thus reducing seed production. Purple loosestrife is essentially the only plant they eat, their host specificity having been tested exhaustively before the United States Department of Agriculture gave approval to release them as biological control agents here. They did show a very limited tolerance for two native *Decodon* and *Lythrum* species, but monitoring has shown no field problems. The risk to these native plants seems far greater from over-topping and shading out by PL than from the beetles. This guide is designed to provide detailed instructions on rearing, releasing and monitoring *Gallerucella* beetles.

### **1. IDENTIFYING PURPLE LOOSESTRIFE:**

Purple loosestrife stems end with a spike of many close, individual flowers. Each flower has five to six pink-purple petals (see Figure 1). Other key characteristics include a 4-6 sided stem that can be 2-9 feet tall and woody with several stems arising from a perennial crown root. Leaves are usually opposite or whorled lower on the stem, becoming alternate at the top. They have a prominent leaf venation with pinnate veins ending in a common vein extending along the entire leaf margin (see Figure 2). Do not be confused by purple loosestrife look-a-likes (Table 1).

**Table 1. Purple Loosestrife Look-a-Likes (and potential replacements)**

<ol style="list-style-type: none"><li>1. Blazing Star (<i>Liatris spicata</i>)</li><li>2. Blue Vervain (<i>Verbena hastata</i>)</li><li>3. Fireweed (<i>Epilobium angustifolium</i>)</li><li>4. Swamp loosestrife (<i>Decodon verticillatus</i>)</li><li>5. Winged loosestrife (<i>Lythrum alatum</i>)</li></ol>
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## 2. REMOVING PURPLE LOOSESTRIFE:

PL or its cultivars growing in gardens could contribute to the loss of native wetland vegetation by spreading seeds, so state law prohibits their cultivation. Work to see that all such purple loosestrife is dug up (entire plant, roots and all) disposed of in a landfill or burned. Composting is not advised, as seeds may not be destroyed and the stem and roots decompose slowly. Replace purple loosestrife with plants selected from environmentally friendly, preferably native, perennials. (Tables 1 and 2.)

**Table 2: More Alternate Plantings for Purple Loosestrife**

<ol style="list-style-type: none"><li>1. Blazing Star, Gay feather (<i>Liatris spp.</i>)</li><li>2. Delphinium (<i>Delphinium spp.</i>)</li><li>3. False spirea (<i>Astilbe arendsii</i>)</li><li>4. Foxglove (<i>Digitalis purpurea</i>)</li><li>5. Lupine (<i>Lupinus</i>)</li><li>6. Lobelia (<i>Lobelia cardinalis</i>)</li><li>7. Obedient plant (<i>Physostegia virginiana</i>)</li><li>8. Salvia (<i>Salvia superba</i>)</li><li>9. Iris (<i>Iris</i>)</li><li>10. Spike speedwell (<i>Veronica spicata</i>)</li></ol>
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## 3. STEPS FOR BEETLE REARING:

The following text is a step-by-step guide for growing purple loosestrife and rearing the beetles. Purple loosestrife is a noxious weed and you must obtain a letter of permission from the Wisconsin Department of Natural Resources to grow these plants. It should come with confirmation that you will get beetles. Rearing/releasing the beetles, if they are acquired in Wisconsin, requires no permit.

### A. FIELD COLLECTION OF ROOT CROWNS:

Root crowns of purple loosestrife are collected from wetlands and grown in pots to provide the food source for the beetle adults and larvae. Collection equipment needed is listed in Table 3.

**Table 3: Equipment for Collecting Purple Loosestrife Crowns**

<ol style="list-style-type: none"><li>1. Long handle round point shovel or fork</li><li>2. Extra heavy duty garbage bags or plastic tubs</li><li>3. Pruning shears</li><li>4. Personal gear (i.e. hip or chest waders, gloves and protective eye wear)</li></ol>
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**ROOT CROWN HARVESTING:** Purple loosestrife root crowns need to be harvested in early spring. Crowns should be collected as soon as wetlands have thawed, late March to April, and before loosestrife buds and greenery begin to appear. *Remember:* shoot growth from purple loosestrife crowns is dependent upon weather conditions. Therefore, it is important to collect and pot root crowns **as soon as possible** in the spring because it takes between 3-6 weeks before plants are large enough to begin rearing beetles. Moving plants to an upland setting makes them grow faster. *Suggestion:* for those rearing in northern Wisconsin, you may want to travel south to collect root crowns in order to find a wetland that has thawed early enough. *Less desirable option:* if you have access to a cold room facility, you may also collect root crowns in the fall and store them over the

winter: Dig root crowns after the first hard frost, after flowers have senesced. Root crowns should be moist, kept in garbage bags, and stored in the cold room (approximately 40°F). *Remember:* to successfully store root crowns over the winter, make sure they are moist and receive no light source.

**ROOT CROWN DIGGING:** Choose a wetland that has easy access for hauling root crowns back to your vehicle because they are heavy! Use the shovel to cut or a fork to loosen around the outer base of a multi-stemmed loosestrife plant before pulling up the crown. Plants in standing water are usually the easiest to dig. Large crowns can be cut or pulled apart. A plant with 6 to 8 stems is probably large enough for beetle rearing; however, choose the largest rootstocks that will fit into your pots to avoid premature plant death from larval feeding. Clip the old stems and leave them in the wetland. Haul root crowns in garbage bags/tubs out of the wetland. *Remember:* wetlands are muddy and wet; wear appropriate boots and clothes, including protective eye wear!

## **B. CULTURING AND MAINTAINING HOST PLANTS:**

Again, to produce plants that are of sufficient size for beetle rearing, root crowns should be the largest possible and, when trimmed, will just fit into a 3 to 5-gallon pot.

**POTTING YOUR LOOSESTRIFE PLANTS:** The equipment needed is listed in Table 4. Transplant 12 to 15 plants for each 100-beetle starter kit. Extra plants can be used for overwintering beetles, feeding larvae or adult beetles if larvae completely consume any of your main plants (remember: get large rootstocks to avoid this) and catching stray beetles. In your pool, mix a potting soil that contains lots of peat moss, such as a "Farfard" mix, with water to a workable consistency. Fill each pot halfway with the moistened potting soil, sprinkle in the correct amount of fertilizer and mix it with the top inch of soil. Spray-wash each rootstock to remove most of the mud, especially from the top of the crown to get rid of eggs or adults of plant or insect predators, and remove any non-loosestrife roots clinging to it. To fit a large rootstock into a pot, clip the ends of the longest roots, if necessary. Place rootstocks in and pack the remainder of the pots with soil to within 2 inches of the top, being careful to push soil into all air pockets around the plants' roots.

Place a net sleeve over each pot before **any** sprouting to keep other plant or insect predators out. Duct tape one bag end to the pot. Close the top with a draw cord or fold over and 'tie' with a wire.

**TABLE 4: Equipment for Potting Twelve to Fifteen Purple Loosestrife Rootstocks**

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| <ol style="list-style-type: none"><li>1. Twelve to fifteen 3-5 gallon pots (10 to 14 inches in diameter)</li><li>2. About 2/3 of a 3.8 cubic foot bale of potting soil (e.g., Farfard mix)</li><li>3. 1 pound of Fertilizer (extended time release, e.g., Osmocote 18-6-12)</li><li>4. 6-foot plastic wading pool (or 2 5-foot pools or even many dish tubs)</li><li>5. At least 11 net sleeves* (other plants remain sleeveless)</li></ol> |
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\* 11 net sleeves are sufficient if you do not plan to over-winter beetles on potted plants (if so, do more.) 11 sleeves require 66 feet of no-see-um proof mosquito netting or similar material. Our fabric is light gray (making insects easy to see) and 54 inches wide. Cut 2 yards of fabric, fold the short side in half and sew up the long side, making a long, skinny sleeve 26 by 72 inches flat. Tapering one end to fit your size pots will make bags tape to the pots easier. (Bags will be shorter if you sew in 1.5 inch drawcord hem(s). Cord and cord locks are needed for this. Drawcords can make the bag ends easier to open/close, but are not necessary.) Wire ties or cords are used to suspend bags.

### C. REARING POOL SET-UP:

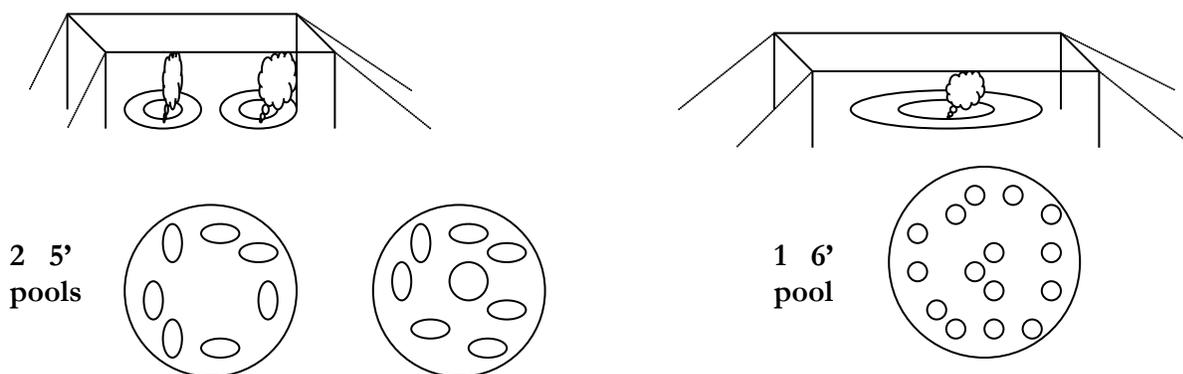
Set up your wet pool(s) right after transplanting to maximize plant growth. Drill a dozen holes about halfway up the pool's sides to ensure the max water level is 2 inches below soil height. Place the pool(s) in full sunlight, but minimal wind. Arrange beetle pots around the outside of the pool(s) for maximum sunlight. Ten pots should fit around a 6-foot pool, but if the plants are bushy 2 5-foot pools might be better. Extra plants can go into the pool center (Figure 3.) At least one of the extra plants is sleeveless to “catch” escaped beetles. The others may have bags to keep predators off.

**ASSEMBLING A SLEEVE SUPPORT SYSTEM:** The net sleeves must be supported to allow plants to grow and maintain a safe environment for the beetles. Some kind of “clothesline” or simple trellis is all you need. A clothesline with existing supports is easiest. An easy trellis is made from four conduit posts sunk into the ground with conduit cross-bars bolted on; guy lines to the ground offer stability in wind. Attach bag draw-cords or wire ties to your support system (Table 5 and Figure 6.) Be sure that the sleeves do not come off the pots, especially on windy days. Check often. If drawcords were used to attach sleeves to pots, add security by duct taping them as well.

**Table 5: Support Structure Pieces**

<ol style="list-style-type: none"><li>1. 4, 10 foot conduit “posts”</li><li>2. 2 conduit cross bars and bolts</li></ol>
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**Figure 6: View of Pools and Structure**



**GROWTH OF PURPLE LOOSESTRIFE:** Plants need about 3-6 weeks to grow enough for beetle introduction. Crowns sprout about 2 weeks after potting, then grow quickly. *Suggestion:* when stems are 12 to 15 inches tall, carefully pinch off the **tip** of each stem with a tweezers by spreading the small leaves and removing the growing point. This stimulates the growth of lateral foliage and more stem tips, which the young larvae will eat. Introduce beetles when stems are 2 or more feet tall. *Remember:* Placing beetles on plants that are too small, have too few stems, or are too old can result in reduced beetle production and even premature death of the plant and require early beetle release.

## D. BEETLE REARING:

The beetle rearing procedure is designed to be simple, with minimal work. Here's how to obtain beetles and what you will see as you rear them.

**BEETLE SUPPLY:** You will usually get your first beetle “starter kit” or two from WDNR for a donation of WDNR's cost or from another person or organization that started this way and now has extras. If you place your first propagated beetles in well-chosen PL patches (see site selection), you may be able to field collect your own propagation stock in spring within 1-3 years. Setting up such local field nursery sites (insectaries) is critical for long term rearing because you soon control your own propagation stock supply. Field collected stock is also usually very prolific and produces hardy insects. Over-wintering beetles in a refrigerator is also possible. (Ask for instructions, if interested.)

**INTRODUCING THE BEETLES:** When your loosestrife plants are about two feet tall, put ten beetles on each of ten sleeved plants, but first check your plants for spiders, ladybugs or other predators, especially if your plants were not netted immediately after transplanting. Open the top of each rearing sleeve and just drop them in. Make sure none fly back out, then tightly cinch the top closed and re-suspend the sleeve. Do not use tweezers to handle the insects; a bug aspirator is the best device for catching and moving beetles (see Additional Materials sheet).

**BEETLE LIFE CYCLE:** The four life stages are egg, larva, pupa, and adult. The descriptions, color photos (you will get with the beetles) and Figure 4 will aid you in identifying these stages as well as help in field monitoring. Figure 5 shows the approximate amount of time and overlap of life stages. *Note:* temperature and weather conditions will be important factors in the amount of activity you see in beetles and the number of days each life stage takes to develop.

**Eggs** – Adults aggregate near the top of the plant where feeding damage of small holes is most obvious on the newly expanded leaves on each stem (week 0). Adults begin feeding soon after they have been released into the sleeves and will live for up to 40 days. Tiny egg masses will be evident on leaves and stems throughout the plant 7-10 days after adults have begun feeding. The egg mass (clutch) size will average 6.6 eggs per mass. Females lay an average of 10.5 eggs per day for 30 days or more. Eggs are round and white with dark frass (beetle excrement) laid on their tops. *Note:* **humidity** is important for egg hatching, make sure pools remain half full with water so the humidity remains high. *Note:* once plants have grown another 1-2 feet adults are hard to see, but their feeding damage is easy to spot. If it seems like no beetles are present (indicated by a lack of leaf damage) after the first week, look around the sleeve, in the lower parts of the plant and along the soil for live adults. If there are no adults present, then check the screen sleeve for holes or other possible means of escape. If no escape was possible, check for insect predators that may have eaten your beetles, resulting in loss of the beetles. Check your sleeveless plant for escapees and return them once any means of escape has been fixed.

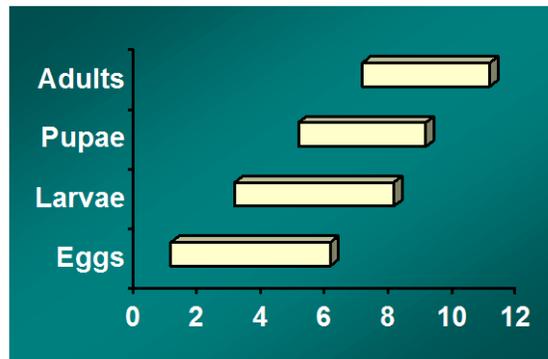
**Larvae** – Eggs hatch 2-3 weeks after they are laid. Although newly hatched larvae are very hard to see, the larval damage is quite evident because they crawl into buds and areas of new growth and destroy this tissue. We call this damage “tip-feeding.” Tip feeding is easy to spot and is often accompanied by frass (black insect excrement) which indicates larval presence. Larvae are yellow with a dark head capsule and molt five times, each time increasing in size. Over 80% of the larval growth occurs in the 4<sup>th</sup> and 5<sup>th</sup> larval instars. Their feeding damage is described as “window” feeding because the leaf issue is left brown, thin, and translucent. It is unlike adult feeding damage,

which is described as “skeletonized,” where complete holes are made in the leaves, but leaf veins are left intact.

**Pupae** – Larvae complete development after 2-3 weeks of feeding. Large, yellow 5<sup>th</sup> instar larvae (ca. ¼”) wander down the stems of the plant and bury themselves in the soil. When the stems and leaves have relatively few larvae remaining on them and there is little or no green tissue left, then most larvae have formed pupae which are found in the top ½ in. of soil. *Note:* the highest mortality occurs between the 5<sup>th</sup> instar larva and the pupal stage. We believe excessive water and saturated soil at this critical stage is detrimental to survival. Once 5<sup>th</sup> instar larvae are seen, pools should be no more than half-full of water. Never water the pots themselves, just the pools to sub-irrigate the pots. This allows the top few inches of soil to dry providing a more favorable habitat for pupation.

**Adults** – Adults emerge 2-3 weeks after larvae have entered the soil to pupate. They will be light in color (no dark coloration on either their front or back side) and tend to aggregate at the top of the sleeve. Each pot that began initially with 10 adults should produce at least 1,000 and as many as 2,000 beetles. As soon as you start seeing the **first** new adults emerge, promptly take the pots to the field for release. *Note:* if a prompt release is not possible (i.e. impermissible weather, weekend, limited time and/or workers) then it is critical to maintain a fresh supply of foliage for the emerging adults until they can be released. Newly emerging adults will not survive if larvae completely defoliated your plant, and especially if the days are hot. To feed adults, use freshly clipped loosestrife stems collected from extra plants or at the nearby wetland (these can be collected ahead of time and stored in a garbage bag in a refrigerator for several days). Re-cut the stems (about 12 inches long) with a sharp blade at a 45° angle while submerged in water. Insert the stems into a jar (or other container) filled with water. A full bouquet (10-12 stems) will keep the beetles from crawling down the jar, and provide enough food for 1-2 days depending on the number of adults. Put this bouquet into the screen sleeve by carefully propping it up against dead stems. *Remember:* the beetles will be emerging from the soil, so avoid placing the jar directly on the soil surface. You can over winter 300-500 beetles in outdoor pots for propagation next year as stated above. Simply transfer them to the unused, sleeved plant. In fall, dig the pot into the ground and cover with screen.

**Figure 7: Development Time Periods for the Four Life Stages of Galerucella spp.**



#### **4. RELEASING BEETLES INTO THE WETLAND:**

Once the **first** new adults have emerged, take the pots to the wetland. Newly emerged beetles are rather delicate and handling them at this stage is not recommended. Newly emerged adults cannot fly until 24-36 hours after emergence.

**CHOOSING RELEASE SITES:** All immediate release areas should have at least one hundred healthy, mature loosestrife plants. Also they should have landowner assurance of site security, receive no insecticide spraying (such as for mosquito control), and have little spring flooding and no summer flooding. Half or more of your initial beetle production should go to an insectary site that is less than 1 acre, with good footing and access for easy monitoring and recollection. Refer to other published information or contact WDNR personnel for further advice on selecting the best site(s).

**RELEASING:** When transporting the potted plants and sleeves to the site, keep in mind the conditions in which you will be traveling (i.e. distance to site, vehicle's climate conditions, etc.). To make sure beetles arrive in the best condition, avoid jarring, high temperatures, and especially avoid tipping pots over. *Note:* prolonged exposure (over an hour) to intense sunlight and dry heat is detrimental to the beetles. The simplest way to release adults is to take the entire pot with the sleeve into the field. Place pots in clusters of 2-4 pots adjacent to purple loosestrife plants. Remove the sleeves and shake out any adults onto nearby foliage. Bend nearby loosestrife plant stems into potted plant stems to allow beetles to walk onto fresh foliage. Leave the pots at the site for the remaining beetles to emerge on their own and mark the site with a PVC pole or flags (see Table 8).

If beetle release is late and hundreds of beetles are congregating in the bag tops, a different release procedure is recommended. Loosen the sleeve from the pot, lift the pot and spread one side of the sleeve open, inserting several field stems into it as you lower it to the ground. Snug the bottom of the sleeve around the pot and new stems as well as possible. This gives the new adults additional "field" food, getting them used to the site, before they are actually released when the sleeves are completely removed two to three days later.

**Table 8: Equipment for Releasing**

<ol style="list-style-type: none"><li>1. 7 ft. PVC (3/4 in.) pole spray painted orange at the top or</li><li>2. Colored flags</li></ol>
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#### **5. MONITORING IN THE FIELD:**

Released adults feed on leaves for a few weeks, but disappear around mid-August to over winter in the leaf litter near host plants or in surrounding uplands. They are difficult to find once released.

**FALL, YEAR OF RELEASE AND LATER:** Wait at least 4 weeks after the release before recovering your pots or leave them until the next spring. You may see evidence of adult feeding. *Reminder:* Do not expect to see much beetle activity the first year. They seldom lay eggs and often disappear into the leaf litter early. **Take a photograph of the site when it is in full bloom.** Mark photo point with a stake. Return annually to the same point, at the height of flowering, to take photos that can easily show any changes in vegetation (especially decreases in PL or its flowering!)

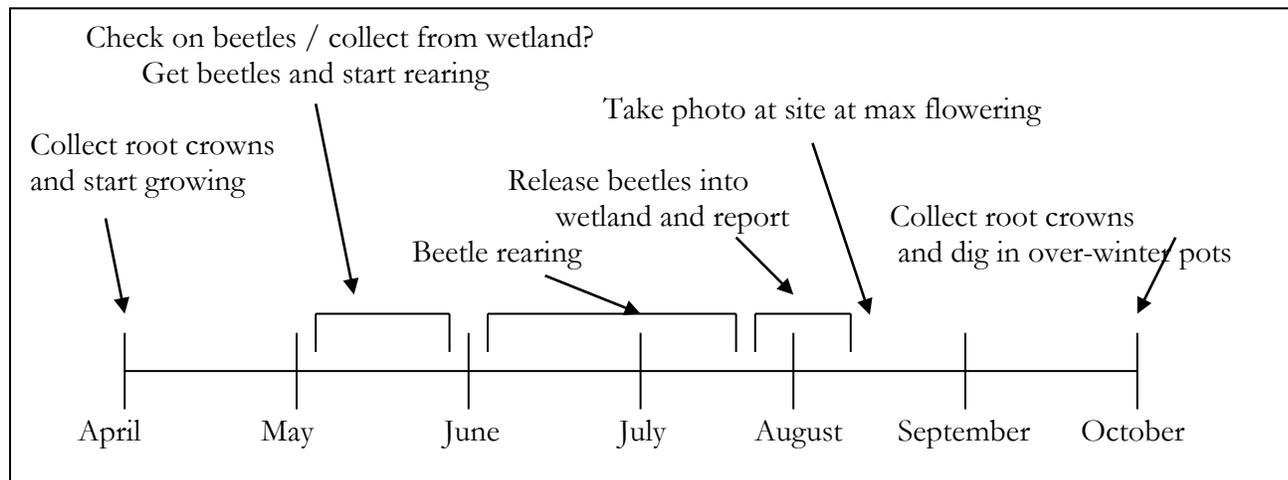
**SPRING, YEARS FOLLOWING A RELEASE:** Each year when loosestrife is 1/2 to 1 foot tall at your release site(s) you should monitor for adults or evidence of feeding (often early to mid May). This is the critical time to understand how your new beetle population is doing and if it needs more beetles to keep growing. A simple monitoring procedure, adapted from a more detailed, optional process, follows below. This is also the time to collect new propagation stock, if enough beetles are present to easily get what you need. Simply knock beetles off the plant into a collecting jar, cap and move them immediately to new potted plants. Ultimately, we hope all propagation stock can come from Wisconsin field sites. You should also consider doing summer visits to your site because this allows you to observe more egg laying, larval feeding and development as well as the most severe plant damage. More detailed monitoring instructions are available on request.

**SPRING BEETLE COUNTING PROCEDURE:** When loosestrife is 6 to 12" tall, take **notes** on beetle numbers, plant damage, etc. as you walk through your area. Next, **count** beetles using a consistent area measure, such as a hula hoop or a 1 square meter frame (e.g. made from pvc pipe). Mark at least several spots in each release area to count at the same places each year. Carefully put the frame down at each spot in turn and record the number of adult beetles you see on plants in it in one minute. If there are too many bugs to count, use abundance categories (see data sheet). If two people count, decrease count time by half (for a total one-minute count.) If eggs or larvae are seen during the adult count, do another one-minute count for each. Record results on the Spring Census Form provided (good for 6 years of counting) and send a copy to us. Note whether your beetle population is present, increasing or decreasing and add more beetles accordingly. When all beetle counts are consistently high category 2+ you ought to be able to collect for your propagation work!

**7. BEETLE MAINTENANCE:**

Below is a figure that gives you an overview of yearly activities and when they must be done in order to rear and maintain a beetle population.

**Figure 9: Yearly Beetle Rearing and Maintenance Activities (approximate)**



**8. REPORTING:**

Use a separate Bio-Control Insect Release Form for each site on which you release beetles. Mail this and any other pertinent information such as spring up-dates from beetle monitoring, to Purple Loosestrife Bio-control, WDNR, 1350 Femrite Dr., Monona, WI 53716. (Phone 608-221-6349)