ACTIVITY 1: MILKWEED & BLOOMING PLANT SURVEY

Overview

The Site Description must be completed before conducting this activity. For most plots, surveyors lay transects and subplots to record milkweed density and blooming plant frequency within a monitoring plot. Depending on the desire and skills of the observer(s), blooming plants may either be identified to species or just noted as the presence of a blooming plant. After the subplots are examined using a plant sampling frame, participants walk through the monitoring plot to record any additional blooming plant species. An alternate Census Survey is also presented for small (generally <1 acre), agricultural, or where a coarse rapid survey is preferred. For Census Surveys, skip to Step 3 on page 27. Miscellaneous monarchs encountered within the monitoring plot are also recorded. Activity 1 data will be used to quantify the availability of food plants (milkweed for reproduction and nectar plants for adult nutrition) as an indicator of habitat quality.

Attributes Measured or Assessed

- Milkweed density and species composition (**optional**)
- Blooming plants (**optional**)
    - **Option A**: Frequency, species composition, and diversity
    - **Option B**: Frequency
- Miscellaneous observations of monarchs

Supplies (* = optional)

- ☐ GPS or mobile device with locating functionality (to locate plot; not necessary if plot was marked during *Site Description*)
- ☐ Plant sampling frame (Figure 2)
- ☐ Datasheets, clipboard, writing utensil
- ☐ Compass or mobile device with compass app
- ☐ 100 m measuring tape (recommended)
- ☐ Plant identification materials*

Note about Blooming Plant Identification: There are two options for the blooming plant portion of this activity: ***Option A***, identifying blooming plants to species (preferred), and ***Option B***, where only the presence or absence of blooming plants is noted (for those who cannot identify most plants to species).

Sampling Frequency

This activity should be performed **once per month** during the season(s) in which monarchs are present, but data recorded at any interval are accepted. If a plot is monitored only once per season, we recommend monitoring during peak bloom (e.g., July in the Midwest). Typically, Activity 1 takes 1 – 4 hours to complete, depending on site conditions (e.g., plant abundance and diversity) and the sampling option chosen.

STEP 1: Lay Transects

Within a monitoring plot, the surveyor will establish 500 m of transects and collect data within 100 subplots along them (Figure 6). Transect layout methods vary based on the plot configuration, as described below. For small sites (< 0.4 ha (1 acre)) and sparse agricultural fields, skip to Step 3 for a Census Survey.

Standard rectangle, standard square, and irregular sites

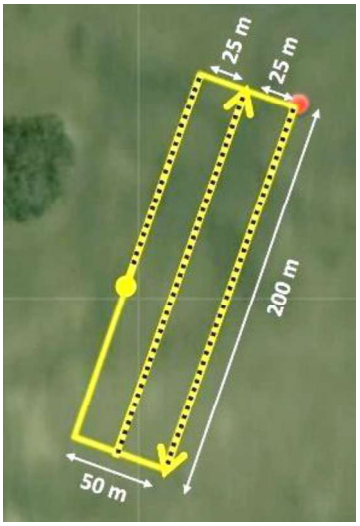


Figure 6. Example transect layout on a rectangle plot. Red dot = Point 1. Dashed lines = sampling

1.1. Navigate to Point 1 (refer to your Site Description form for coordinates).

1.2. If using a transect tape, stake the end to the ground at Point 1 (or have a partner hold it). In lieu of transect tape, you may also use a pre-measured rope or pacing.

1.3. Set a compass or mobile device application to your Start Bearing (from your Site Description form).

1.4. Walk the length of your monitoring plot in the direction of your Start Bearing (toward Point 2) while laying out the transect tape.

1.5. Starting at 0 m, monitor subplots every 5 m along the transect (see Step 2). Continue until you reach the full transect length. If your transect tape is shorter than the length of your plot, you may need to run the tape out a second time.

Figure 7. Example transect layout on a square plot. Red dot = Point 1. Dashed lines = sampling transects.

1.6. Turn 90 degrees right (or left, depending on your plot's configuration) and walk 25 m if in a rectangle or square plot.* **This is not a transect; do not place subplots along this 25 m**.
**The transect spacing for irregular plots varies based on size; see Table 6.*

At the new location, turn 90 degrees right (or left) again. This is the "back-bearing," or opposite of your Start Bearing. Following this "back-bearing," roll out the transect tape as done in step 1.4, until you reach the other side of the plot (or until your tape is fully extended).

Table 6. Transect spacing for irregular plots

Site Area (acres)	Transect Spacing (meters)
1 – 1.5	7
1.5 – 2	10
2 – 2.5	15
2.5 – 3	20
> 3	25

1.7. Monitor subplots along the transect again as done in step 1.5 (see Step 2). Continue until you reach the full transect length.

1.8. Turn 90 degrees left (or right) and walk 25 m if in a rectangle or square plot.* **This is not a transect; do not place subplots along this 25 m.**

1.9. At the new location, turn 90 degrees left (or right) again. This will be the same as your Start Bearing.

1.10. Continue laying transects in this way until 500 m in length is achieved (and 100 subplots are sampled).

Solar Sites

For **Solar (outside panels)**, follow the transect placement directions above that correspond to the plot shape. For **Solar (within panels)**, follow the instructions below. Transects should start under the solar panel and cross diagonally to the adjacent panel to survey habitat both under and between the panels.

A.1. Record "Solar (within panels)" on the Site Description form. Navigate to Point 1, which should be located under the center of a solar panel.

A.2. If using a transect tape, stake the end to the ground under the solar panel.

A.3. In a 50 x 200 m rectangular plot, walk diagonally for 50 m. Adjust the angle of the transect as needed so that it ends under the adjacent solar panel (Figure 8).

A.4. Monitor subplots along the transect (see Step 2).

A.5. Roll in the transect tape and walk to another row of solar panels. Regularly space the transects within the plot (e.g., survey between every second or third row of panels). Record the distance between transects on the Site Description datasheet (in meters).

A.6. Follow Steps 3 – 6 until 10 transects (500 m) have been surveyed. For a 100 m square plot, survey 5 100-m transects. For irregularly shaped plots, place evenly spaced transects until 500 m have been surveyed.

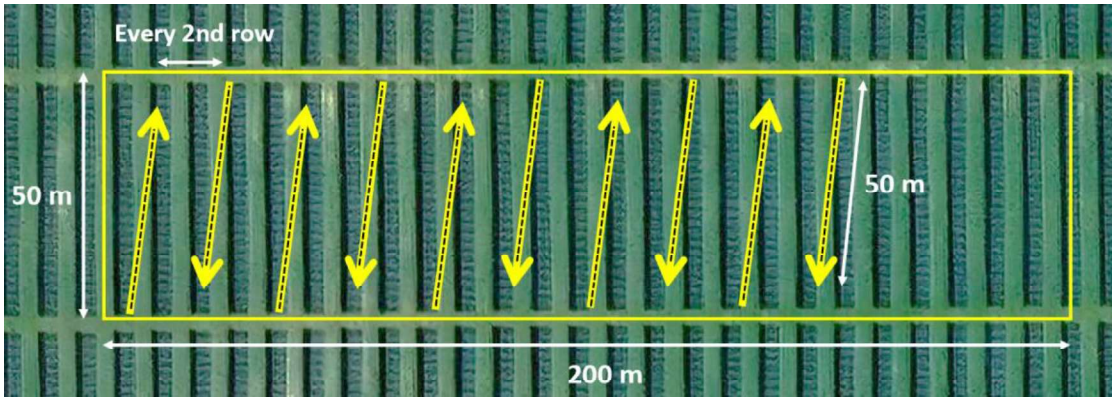


Figure 8. Transect layout on solar sites (within panels). For rectangular plots, ten 50-m transects are laid diagonally between panels. The angle of transect and distance between transects will depend on the spacing of the panels.

Rights-of-Way and Agricultural Edge Sites

B.1. Navigate to Point 1 (from your Site Description form).

B.2. If using a transect tape, stake the end to the ground at the **plot's edge** (or have a partner hold it). In lieu of transect tape, you may use a pre-measured rope or pacing. For rights-of-way, this is directly adjacent to the pavement edge. For agricultural sites, this is where the crop field meets the plot.

B.3. Walk diagonally across the width of the plot for 50 m. Adjust the angle of the transect as needed so that it ends at the opposite side (Figure 9).

B.4. Monitor subplots along the transect (see Step 2).

B.5. Roll in the transect tape and walk directly across the monitoring plot back to the same side where the first transect began.

B.6. Follow Steps 2 – 5 until 10 transects are surveyed.

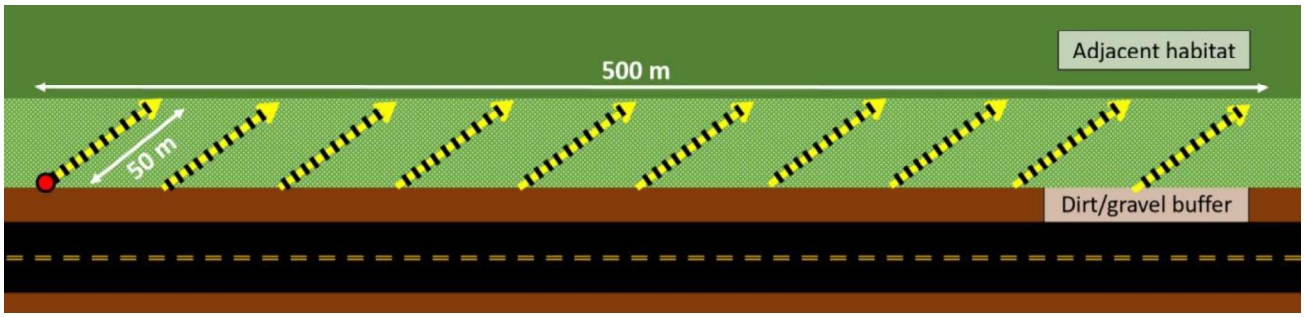


Figure 9. Transect layout in rights-of-way and agricultural field edges. Ten 50-m transects are laid diagonally across the width of the survey plot. The angle of transect will depend on the width of the plot.

Note: If the right-of-way (ROW) is 30-40 m wide, add 10 m after the end point of each transect so that the plot extends further along the ROW. For ROWs 40-50 m wide, add 20 m at the end point of each transect (Figure 10). This allows for consistency in the total area monitored among different site types.

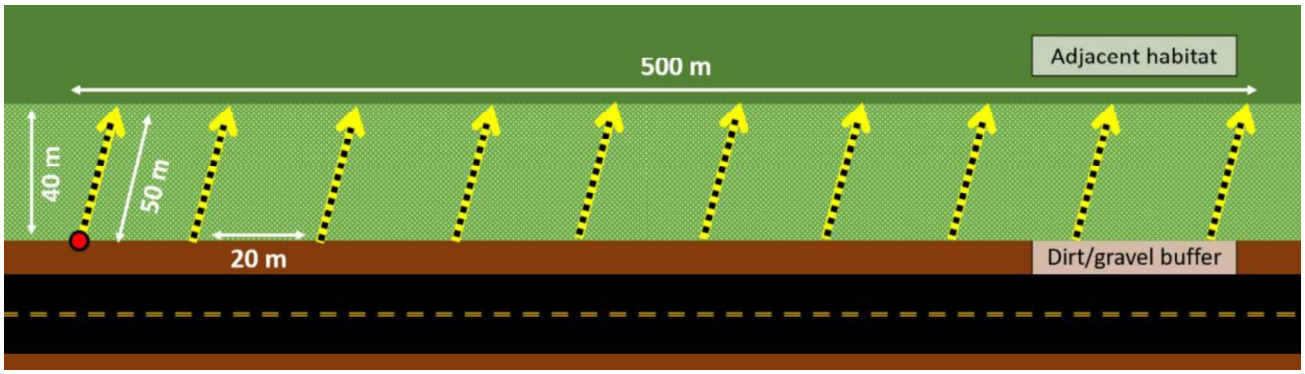


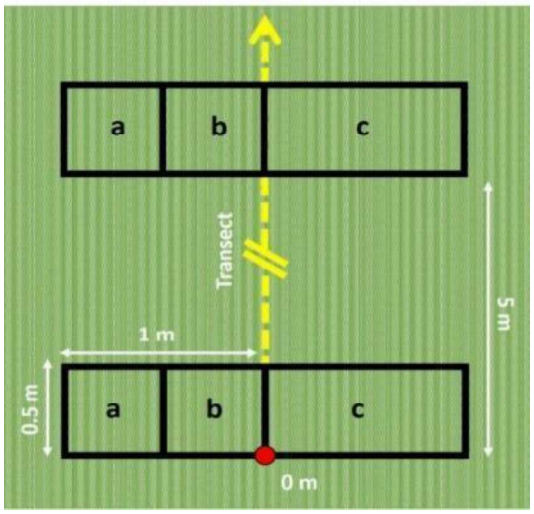
Figure 10. Transect layout in wide (40-50 m) rights-of-way and agricultural field edges. The 50-m transects are spaced apart by 20 m for consistency in the total area monitored.

STEP 2: Place Subplots and Record Data

Every 5 m along each transect,* a **subplot** is evaluated and information about **blooming plants (exclude grasses)** and **milkweed** is recorded. The subplot is constructed using a plant sampling frame and measures 2 m x 0.5 m for a total area of 1 square meter (Figures 11 and 12). This allows accurate information about the site to be recorded without surveying every single plant within the entire plot.
**In linear plots <8m wide, place subplots every 4m.*

You may choose between identifying blooming plants to species (Option A), or simply recording their presence (Level B). When identifying plants to species, you may record the common or scientific name of your choosing on your datasheet, but **you must use the common or scientific name used by USDA PLANTS Database when entering data in the IMMP Portal.** If you do not initially find the species you are searching for, try entering it in Google to see if there is another common or scientific name – many plants have multiple common names associated with a single species and some scientific names have changed through time. If selecting Option A, there are options to record plants to genus, or as unknown, so knowing every species on site is not necessary. Decide which level you are using and select the appropriate paper datasheet.

Figure 11 (Right). First two subplots on a transect starting at 0 m (red dot). The sampling frame is first placed to the left of the transect to form Sections A and B. Then it is moved to the right side to form Section C, for a total area of 1 square meter. The second subplot is placed at the 5 m mark.



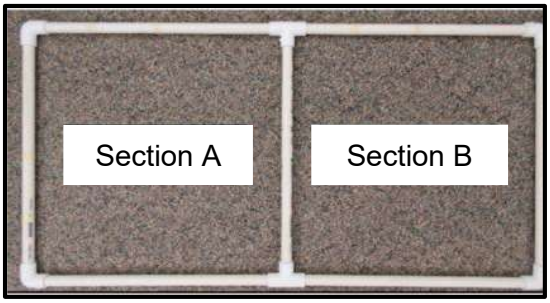


Figure 12. The plant sampling frame measures 1.0 x 0.5 m, marked or divided in the center to form two 0.5 x 0.5 m sections.

2.1. On the first transect, place the sampling frame at 0 m on the left side of the transect tape, so the bottom right corner is aligned with the zero mark (Figure 11). This forms Sections A and B. In narrow roadsides or agricultural edges (<8 m wide), placing the first subplot at the 0 meter mark may cause you to sample almost entirely pavement. Instead**,** start sampling wherever the subplot first fits within the roadside vegetation.

2.2. Record **blooming plant** data across the sampling frame as instructed below, according to the sampling option you have selected. **Do not record grasses, ferns, or pine trees**. A blooming plant is recorded if it has at least one flower that is open and accessible to a pollinator. Recording blooming plants is optional (some users may choose to conduct milkweed sampling only). **If you searched for blooming plants within subplots, mark "Yes"** to the question "Did you conduct a blooming plant survey?" in the IMMP Data Entry Portal, even if no blooming plants were present.

a. **Option A** – Identifying blooming plants to species

i. Look in Section A of the sampling frame for blooming plants. Record each blooming species you observe that is **rooted within the sampling frame**. Record "A" next to that species under the appropriate subplot number to reflect that this species was *first observed* in Section A of this subplot.

ii. Next, look in Section B and record any blooming plant species not already observed in Section A. Record "B" next to that species, to reflect that this species was *first observed* in Section B of this subplot.

iii. Move the frame to the right of the transect line to form Section C. Look in Section C and record any blooming plant species not already observed in Sections A or B. Record "C" next to that species, to reflect that this species was *first observed* in Section C of this subplot.

Note: When encountering a species that was already observed in a previous subplot, there is **no need to write the species name again**. Instead, find the *row* where you first recorded this species and mark the Section in which you observe it in the current (new) subplot's *column*.

Tip: If using paper datasheets and no blooming plants are found within a subplot, draw a line vertically through the subplot's column to keep track of which subplots have already been surveyed. This helps you keep track of the zeros and not accidentally record data for the next subplot in the wrong column.

b. **Option B** – Recording the presence or absence of blooming plants

i. Look in Section A for blooming plants. If there is one or more present, record "A" for this subplot, to indicate that the *first* Section to contain a blooming plant was Section A. **Only record blooming plants if they are rooted within the sampling frame**. If a blooming plant was found in Section A, **do not record any more blooming plant information for this subplot**.

ii. If Section A contains no blooming plants, look in Section B and record "B" if a blooming plant is present. If a blooming plant was found in Section B, **do not record any more blooming plant information for this subplot**.

iii. If Sections A and B do not contain any blooming plants, move the frame to the right side of the transect to form Section C. Look in Section C and record "C" if there is a blooming plant in this Section, or leave it blank (or mark "X") if no blooming plants are observed in any Sections.

2.3. **Options A & B:** After recording the blooming plants in each subplot, record any **milkweed plants** (*Asclepias* species and honeyvine (*Cynanchum laeve*)) growing within the subplot. Recording milkweed stems and plants is optional (some users may choose to only conduct the blooming plant

portion of the survey). **If you searched for milkweed within subplots or along the transect, mark "Yes"** to the question "Did you conduct a milkweed survey?" in the IMMP Data Entry Portal, even if no milkweed were present.

a. On the bottom half of your datasheet (in the section labeled "MILKWEED"), record each species of milkweed observed in the entire subplot (Sections A, B and C together). Do not list them separately by Section like you did for the blooming plants.

b. For each species of milkweed observed, count the number of **plants** and **stems** separately. See callout box on next page and Appendix F for guidance on counting plants and stems. Record the plant only if it is **rooted within the sampling frame** and count the number of stems associated with that plant (Figure 13 and Appendix F).

Blooming Milkweed: If milkweed is blooming in a subplot, it will be recorded twice: once in the milkweed section and once in the blooming plant section. Blooming milkweed has two functions: it serves as a host plant for larvae and a nectar source for adults.

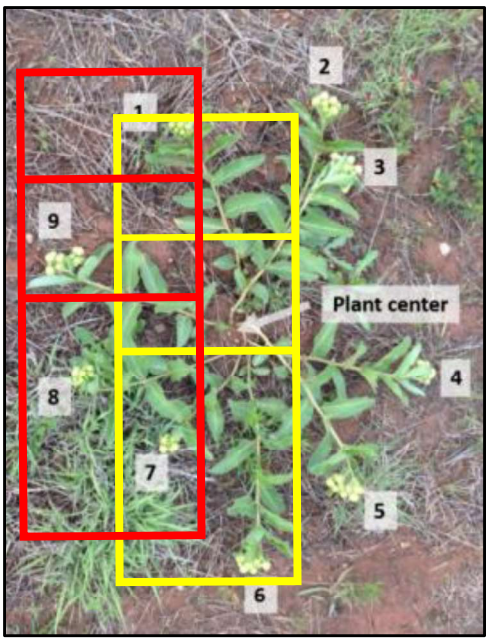
Plant Nomenclature: Some plants may have multiple common names and/or scientific names listed in field guides and on websites. The IMMP uses the USDA PLANTS Database to track them. You may record either the common or scientific name, as these are linked together in the data entry system. If you do not find the name you are looking for, **look up the scientific name USDA PLANTS Database uses for your species**. Note that sometimes these names change.

Plant Identification Tips: A native plant guide specific to your region, iNaturalist, or other plant identification apps can aid in species identification during or after monitoring. If there is a species you cannot identify in the field, it may be helpful to take a photo and then look it up later on once you are finished with your survey. If you still cannot identify the blooming species, you may instead classify it according to genus, or select "unknown" as the plant name if conducting Option A.

2.4. Pick up the sampling frame and walk forward 5 m* (to the 5 meter mark, for subplot number 2) on the transect, either by moving along the transect tape, using a pre-measured 5 m rope, using your 1 m sampling frame edge to measure 5 m, or pacing 5 m. *GPS/mobile device is not recommended for measuring distance between subplots* due to the level or accuracy needed.
**In narrow linear plots (<8m wide), place subplots 4m apart.*

2.5. Follow steps 2.1 – 2.4 until 100 subplots are sampled.

If milkweed is very sparse at your site, you have the option of recording milkweed along the **entire transect** (i.e., ***milkweed both within the subplots and between them***). This increases the chance that you will encounter milkweeds in your survey by increasing the area you are surveying for milkweed. This technique can be effective for sites where milkweed is present but not detected in the regular subplot sampling. **Note on your datasheet** (upper right-hand corner) whether you monitored milkweed along the entire transects (belt) or just within subplots. Tally the plants and stems of these between-subplot milkweeds within the section titled, "Milkweed (between subplots)."



Counting Milkweed Plants and Stems

In the IMMP, a milkweed **plant** includes all above-ground stems originating from a visually-identifiable, common central area in the ground. Several species, such as *A. tuberosa* (butterfly weed), grow multiple stems from a common central area (Figure 13, Appendix F) in the ground.

To record **stems**, count each stem originating from that central area in the soil. Some species, such as *A. syriaca* (common milkweed), may grow several "ramets" (stems) that are connected below ground. However, it is impossible to tell which ramets are connected without excavating their roots. Therefore, count each stem of *A. syriaca* and *A. verticillata* (whorled milkweed) that is separated by soil as a distinct plant.

Figure 13. A. viridis plant with multiple stems. If the frame was placed as indicated by the yellow lines (right), the plant would be recorded as: 1 plant, 9 stems, since the milkweed plant is rooted within the sampling frame. If the frame was placed as indicated by the red lines (left), the plant would NOT be recorded in the subplot. Although there are stems that are bent into the frame, the plant is rooted outside of the frame, so is not included in the milkweed count (Photos courtesy of Kristen Baum). See Appendix F for additional guidance on milkweed stem counts.

Inaccessible subplots

Some survey plots will contain **thick patches of vegetation** that cannot be traversed. If you cannot reach the subplot to lay the transect tape or place the sampling frame on the ground, **look into the thicket** to estimate blooming plants and milkweed that would fall within the subplot. If you see either, estimate their location within the subplot and record accordingly. If none are present, record zeros. Continue the transect on the other side of the thicket.

If you cannot view or safely access the area where the subplot would fall, skip this subplot and continue the transect on the other side. For example, if you absolutely cannot view the area where subplot 24 should be, move to the opposite site of the thicket and record the next accessible subplot as 24. Place additional subplots as necessary at the end of your final transect to reach 100 subplots surveyed. If subplots become accessible due to management or other reasons later in the season, survey through the cleared area as normal, and remove the added subplots from the end.

"Unsuitable" habitat: If along the transect you encounter habitat that appears unsuitable for monarchs within a subplot, such as a thicket or water, please collect the data for that subplot regardless. Do not be tempted to move the location of the subplot in order to capture particular plants.

STEP 3: Meandering Walk Survey

After completing the subplot sampling, walk through all areas of the monitoring plot to record any additional blooming plant or milkweed species that were not observed within the subplots as Additional Plant Species. There are two options for the Meandering Walk:

> **Option A:** Record **all blooming plant species in bloom**, and all milkweed species, that were not observed in your subplots. Record to genus, family, or unknown if you cannot identify to species.
>
> **Option B:** Record **all blooming plant species *regardless of their blooming status***, and all milkweed species, that were not observed in your subplots. Record to genus, family, or unknown if you cannot identify to species.

As with subplot sampling, if a milkweed plant is observed blooming during the meander survey, record it in both the blooming plant and milkweed section. Walk systematically through the plot to ensure as much coverage as possible. You may also record additional species as you see them while monitoring subplots. Record the time you spent conducting the Meandering Walk Survey in minutes on your datasheet.

Meandering Walk Options

The Meandering Walk is an optional and **highly recommended** component of the Milkweed & Blooming Plant survey.

Recording blooming species observed within the IMMP plot, yet not present in subplots, enables participants to create a complete list of blooming species on site **and** enables researchers to compare species counts across IMMP plots.

Additionally, recording forb species that are not currently in bloom generates a more complete list of species counts and is useful for evaluating seedings or plantings, among other management actions.

Ensure your list is as complete as possible, even if species are identified only to genus, family, or unknown.

Census Surveys: Small sites (generally <0.4 ha (1 acre)), agricultural fields, and rapid assessments:
In sites that cannot efficiently accommodate transects and subplots, use a **census survey** in lieu of Steps 1 – 2 above. This is particularly useful in a site devoid of vegetation such as a fallow crop field or soccer field, or small pollinator plantings. Users may choose to record both **milkweed** and **flowering plants**, **or just one or the other**. Use the Activity 1 Census Survey paper datasheet to collect this information instead of the regular Activity 1A or 1B datasheets.

Comprehensively survey the entire area, walking a systematic pattern through the plot (weaving back and forth). If you choose to record flowering plants, list each species observed in bloom. Optionally, you may also record species that are not in bloom at the time of the survey. If you are conducting a milkweed survey, count the number of plants and stems for each species of milkweed present. Ensure an accurate milkweed stem count by covering the entire area thoroughly and avoid walking through the same area twice.

STEP 4: Miscellaneous Monarch Observations

If monarchs of any stage are observed outside pertinent monarch monitoring activities, record them as Miscellaneous Monarch Observations. For adult monarchs, also record their predominant behavior: flying through site, flying high over site (greater than 5 m high), resting (including roosting), ovipositing (laying eggs), mating, or nectaring. See Appendix E for behavior definitions and information on how to distinguish among them. If butterflies are observed nectaring or ovipositing, record the associated plant species. For egg, larva, or pupa observations, simply tally the stages observed in the plot.

ADDITIONAL OPTIONS

- **Activity 2:** If you are conducting Activity 2 (monitoring milkweed to detect eggs and larvae) during the same monitoring session, it is efficient to complete the two activities together. As you record milkweed and blooming plants in each subplot, also record data for Activity 2 on its respective datasheet. When conducting Activity 2, examine *all* milkweed along each transect for eggs and larvae (until you hit the target of 100 milkweeds), not just those within the subplots. However, on Activity 1 datasheets, record milkweed according to the Activity 1 protocol.

- **Species not in bloom:** If you would like to also track the forb species that are not in bloom at the time of your visit, record them in the designated "Species Not in Bloom" column in the Meandering Walk Survey section. This is especially helpful for those who are only able to visit once per season but wish to generate a complete species richness list for the plot.