

Fender's Blue Butterfly Monitoring Handbook



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Cover Photo: A Fender’s Blue butterfly male on a Kincaid’s Lupine flowering stalk with a Silvery Blue butterfly and three cryptic Silvery Blue butterfly larvae.

BACKGROUND

SUMMARY

The Fender's Blue butterfly (FBB)(*Icaricia icarioides fenderi*) is a federally endangered taxa endemic to the Willamette Valley of western Oregon. Within in its range FBB is found primarily in upland prairies where its lupine host plants are present. The two primary host plant species include Spurred Lupine (*Lupinus arbustus*) and Kincaid's Lupine (*Lupinus oregonus*), itself a federally threatened species. Monitoring of the butterfly is critical to understanding population trends, responses to management, establishing baselines for Safe Harbor Agreements and mitigation, and measuring recovery. However, monitoring is complicated by a short window of time in which surveys can be completed, a paucity of suitable survey weather conditions, and the presence of a nearly identical sympatric butterfly species the Silvery Blue butterfly (SBB)(*Glaucopsyche lygdamus*).

RANGE

The FBB is found exclusively in the Willamette Valley of western Oregon. FBB populations have been documented in Lane, Linn, Benton, Polk, Yamhill, and Washington counties. The populations are widely scattered and most are generally found west of Interstate 5.

HABITAT

FBB is considered an upland prairie specialist. However, it can be found in a variety of prairie habitats types of varying degrees of quality as long as the appropriate lupine host plant species are present. Upland prairie habitats within the FBB are typified by the presence of the following graminoid species: California oatgrass (*Danthonia californica*), Roemer's Fescue (*Festuca idahoensis roemeri*), blue wild rye (*Elymus glaucus*), tall oatgrass (*Arrhenatherum elatius*), and tall fescue (*Festuca arundinacea*) with the latter two being exotic invasives. Additionally, a majority of sites contain scattered or are bordered by Oregon White Oaks (*Quercus garryana*). FBB habitat can contain a variety of floral resources that provide nectar for adult butterflies and these include both native and exotic plant species (Appendix I).

PHENOLOGY

FBB adults fly from early May to late June at most locations (Fig. 1). Males

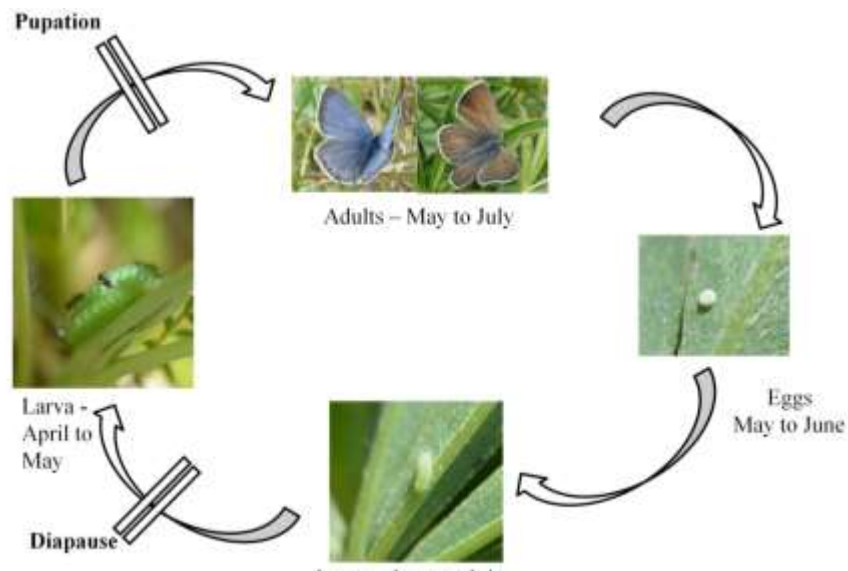


Figure 1. The life cycle and phenology of the FBB butterfly.

are usually the first to emerge followed by the first females one week later. During extremely dry and warm springs some males can be found as early April and in extreme cool wet springs adult females can be found as late as early July. Eggs are laid from May through June and hatch two weeks after oviposition. Pre-diapause larva feed on the underside of lupine leaves until the lupine senesce in late June and July. FBB diapause and overwinter as larva until lupines sprout in the spring at which time the post-diapause larva can typically be found feeding on the newly emerging leaves at the base of the plant. Post-diapause larvae grow rapidly through April and into May after which they descend into the leaf litter to pupate after which adults begin emerging again in May and June.

IDENTIFICATION

EGGS

FBB generally lays single eggs on the underside of its lupine hostplant leaves. Eggs can be found from mid-May through June at most sites. The eggs are small, 2 mm in diameter, puck shaped, and white when unhatched (Fig. 2). After FBB larva hatch from eggs the outer shell remains leaving a small white donut shaped shell behind (Fig. 2). FBB will occasionally lay eggs on the upper surface of leaves, especially in dense lupine plants, or on other parts of the lupine or on plants adjacent to lupine.



Figure 2. An unhatched (left) and hatched (right) FBB butterfly egg on the underside of a lupine leaf.

SBB generally lay their eggs on the lupine racemes or on the flowers themselves (Fig .3). Otherwise SBB eggs bear remarkable resemblance to FBB eggs in size, color, and shape. Like FBB eggs SBB egg shells will remain on the plant after hatching. For most sites the majority of SBB eggs will have hatched by the time FBB eggs are being laid but this depends on the degree of overlap of SBB and FBB phenology, which can vary by site and season.



Figure 3. A SBB egg on a lupine raceme.

LARVA

FBB larva can be located on their hostplants during two separate periods of the year. Pre-diapause, first or second instar, larva can be found on the undersides of lupine from mid-May until early July. Pre-diapause are small, typically 3 to 7 mm in length, are green in color, and covered in small whitish setae or hairs (Fig. 4).

Post-diapause FBB can be found from late March through early May depending on the site. However, April is considered the best month to detect post-diapause larva in the field. Post-diapause FBB larva are best located near the base of growing lupine where the new leaves are emerging from the soil. They range from 5 mm to 17 mm in length and are typically slug-shaped. FBB post-diapause larvae vary considerably in color. Most individuals vary from vibrant green to dull green although it is not uncommon to see a few individuals with reddish or purplish hues. All post-diapause FBB are characterized by a white dorsal stripe and larger individuals late in the season are typically tended by ants.



Figure 4. FBB pre-diapause larva (upper left). Post-diapause FBB larva with reddish hue (upper right), more typical dull green (lower left), and being tended by ants (lower right).

SBB larvae are similar in appearance to FBB larva. However, the two species can be readily differentiated by their location on the host plant. In general FBB larvae are found primarily near the base of the plant or on the underside of the lupine leaves whereas SBB larvae are found primarily on the flowering stalk. However, there are occasional exceptions especially in cool wet years where post-diapause FBB can be found more frequently feeding high on the plant on the flowering stalk (Fig. 5).



Figure 5. A FBB larva feeding on lupine flowers.

Additionally, due to phenological difference between FBB and SBB the two species can also be differentiated by size (Table I). For example, SBB diapause or overwinter as pupa. Any appropriately shaped and colored larva greater than 5 mm found during April or early May on appropriate lupine are likely be post-diapause FBB. Additionally, SBB develop rapidly during the spring. Whereas FBB rarely surpass the 2nd instar before going into diapause and as a result FBB larva are several times smaller than SBB larva in the late spring and early summer. SBB can be differentiated from FBB by their more ornamented color, which can vary from gray-green to vibrant green and brown or even purple shades, and dorsal striping (Fig. 6). Additionally, SBB larvae in late spring or early summer are almost always tended by ants whereas pre-diapause FBB larvae are not.



Figure 6. Three SBB larvae demonstrating the wide variation in coloration and their tendency to be tended by ants.

ADULTS

At first glance adult FBB and SBB seem difficult to differentiate. However, with experience the two can be readily separated in the net or through the use of close-focus binoculars. There are few dorsal characteristics that can be used to separate male FBB from male SBB (Fig. 7). Both male FBB and SBB have an iridescent blue dorsal color. However, in fresh individuals male FBB tend to have a wider black margin or edging on the wings than SBB. As males fade with age this distinguishing mark become less reliable. Differentiating FBB and SBB females using dorsal color is more reliable. Nearly all female FBB have a coppery sheen and color to the upper surface of the wings, not unlike that of an older penny, and

will almost always lack any blue coloration (Fig. 7). Female SBB are generally gray to dark brown in color and frequently have some blue flecking. Female SBB will fade to a light brown with age (in one to two weeks) similar to that of female FBB. However, a female SBB will never possess the coppery luster that a female FBB does.

Differentiating FBB and SBB is best accomplished using identification markers on the ventral or underside of the wings

(Fig. 8). Ventral patterns do not differ significantly between sexes and can be used to separate species no matter the sex. The most widely noted difference between the two species is the presence of a submarginal spot-band on both the ventral forewing and hindwing of FBB whereas this second band of spotting is always absent in SBB. However, the submarginal spot-band on FBB is not always readily apparent and can be especially difficult to detect in pale or faded individuals (Fig. 9). Fortunately, several other underwing characters can be used to differentiate the two species. For example, the cell-end bar on the ventral side of the forewing is always substantially wider in FBB than in SBB. In general the cell-end bar is about ½ as wide as it is long in FBB whereas in SBB it is typically $\leq \frac{1}{4}$ as wide as it is long. In addition, the spots in the postmedian and submarginal bands of FBB tend to be irregular in shape whereas they are typically more round in SBB. Lastly, the spots in the postmedian band on the underside of the hindwing of SBB are not aligned whereas those in FBB form near perfect arcs.



Figure 7. A comparison FBB and SBB male and female dorsal coloration.

Table I. A comparison of FBB and SBB life stages and phenology. Grey areas indicate presence of a life stage during the indicated time frame.

| | January | February | March | April | May | June | July | August | September | October | November | December |
|------------|----------|----------|-------|-------|-----|------|------|--------|-----------|----------|----------|----------|
| <i>FBB</i> | | | | | | | | | | | | |
| Egg | | | | | | | | | | | | |
| Larva | DIAPAUSE | | | | | | | | | DIAPAUSE | | |
| Pupa | | | | | | | | | | | | |
| Adult | | | | | | | | | | | | |
| <i>SBB</i> | | | | | | | | | | | | |
| Egg | | | | | | | | | | | | |
| Larva | | | | | | | | | | | | |
| Pupa | DIAPAUSE | | | | | | | | | DIAPAUSE | | |
| Adult | | | | | | | | | | | | |

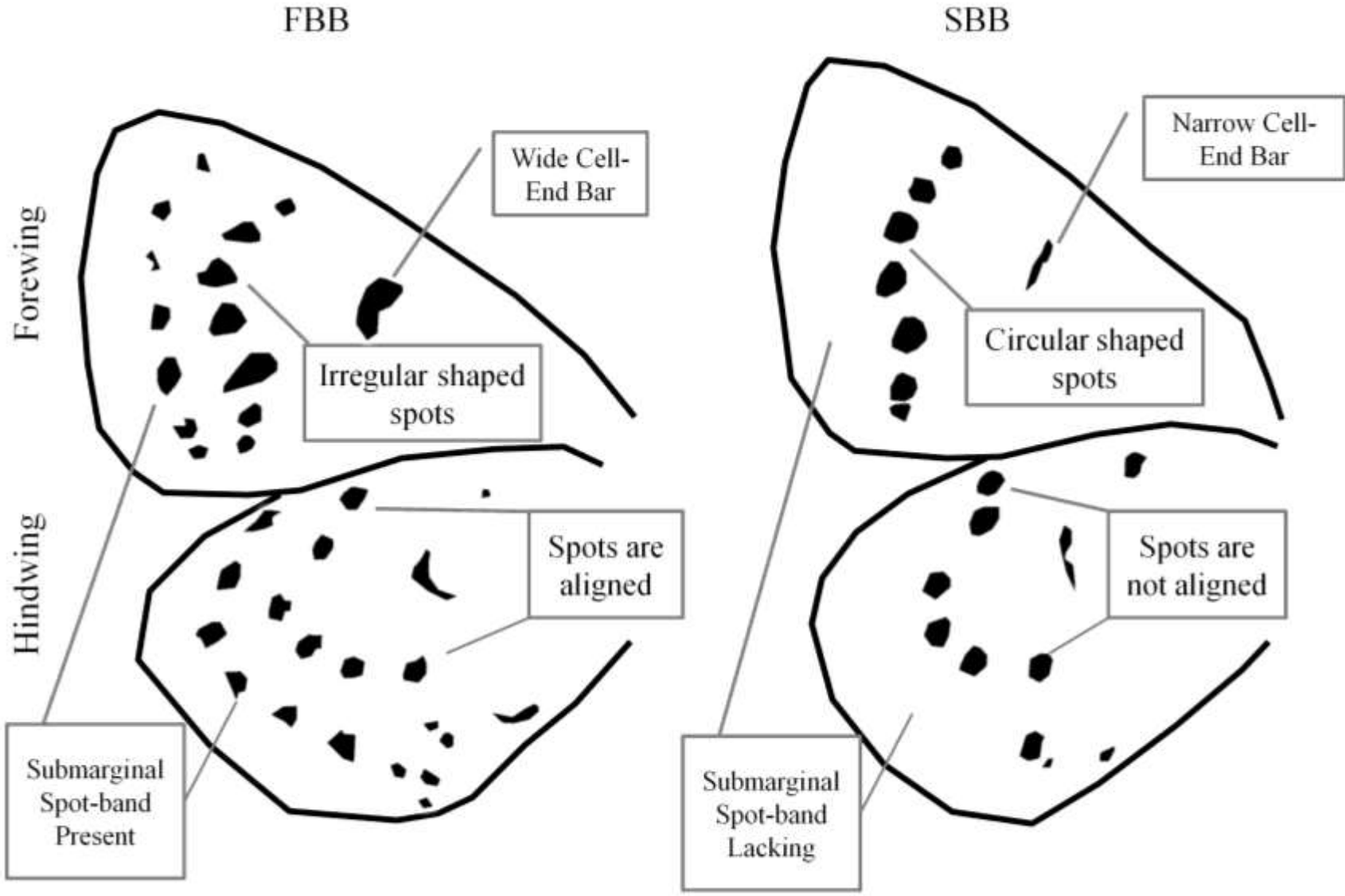


Figure 8. A comparison of the dorsal patterns differences and key identification marks separating FBB from SBB.

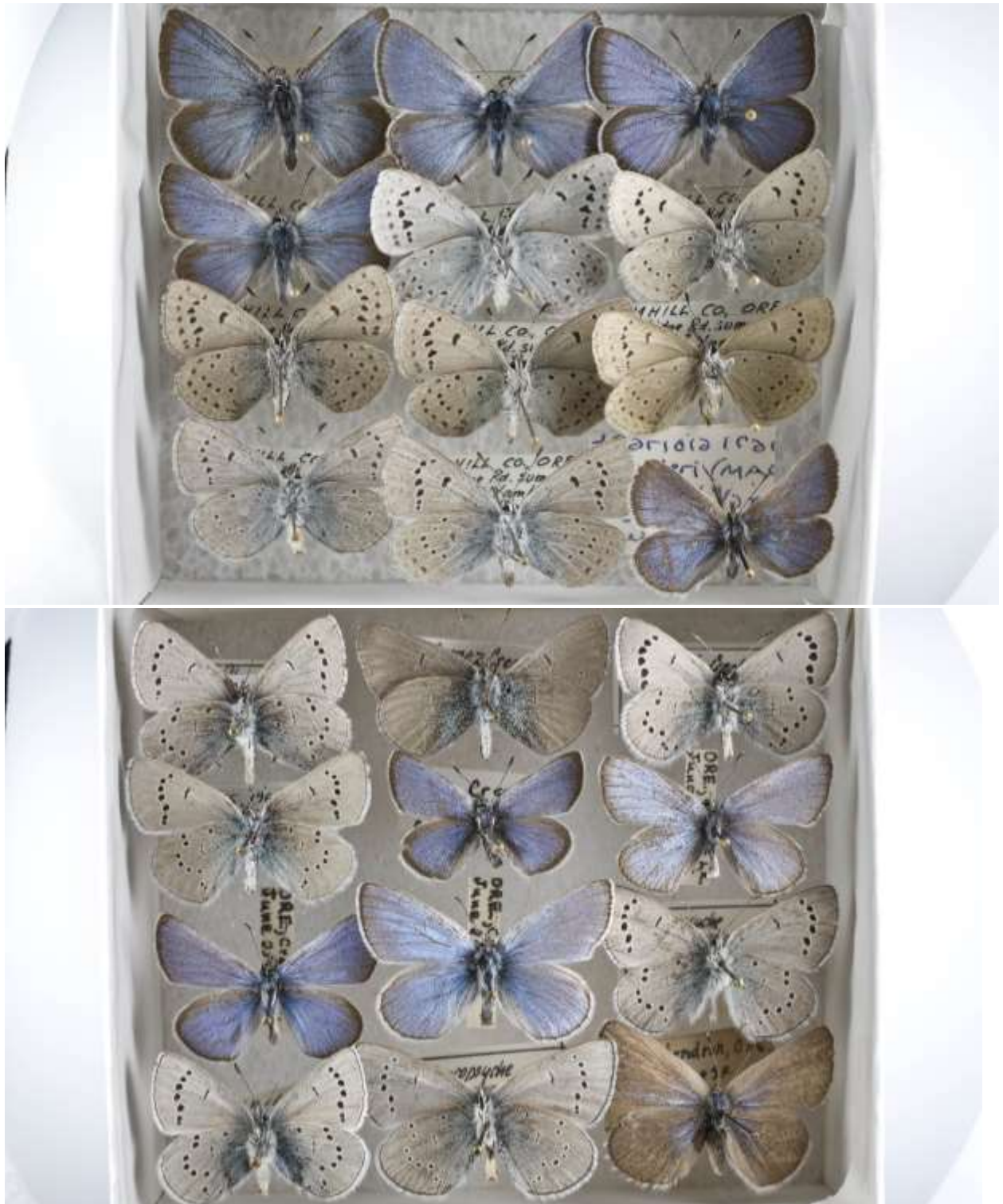


Figure 9. FBB (top) and SBB (bottom) pinned specimens. Note that some FBB have very pale or lack the submarginal spot-band.

MONITORING

TECHNIQUES

Monitoring of FBB takes on three forms of varied intensity. The least intensive form of monitoring is presence/absence monitoring, followed by the modified peak count method, and finally the most intensive monitoring, distance sampling. Factors determining which technique should be used include: season, site size, site protection, the potential FBB population size, and the goals of the monitoring project. Use the questions in Table II to determine which method of monitoring is recommended for your site. If you are uncertain consult with USFWS.

Table II. Use this table and the questions below to determine which level of monitoring is appropriate.

| | Yes | No |
|--|-----|----|
| Is the site larger than 1 ha? | | |
| Is the site likely to support more than 200 FBB? | | |
| Do you want to measure FBB response to management or restoration? | | |
| If you answered yes to <u>any</u> of the above questions you should implement Distance sampling. If you answered no to all the questions above proceed below. | | |
| Is the site under protection (e.g. conservation easement, federal lands)? | | |
| Is the site likely to support more than 50 FBB? | | |
| Is the site within 1 km of another FBB population?* | | |
| If you answered yes to <u>all</u> of the above questions use a modified peak count. If you answered no to one or more of the above confirm presence/absence on an annual basis if possible. * Contact USFWS if uncertain. | | |

PRESENCE/ABSENCE

Presence/absence is the least intensive method of monitoring with broadest temporal window for completion. The objective of presence/absence is to confirm occupancy and monitor persistence of FBB populations. FBB populations, especially small populations, are subject to periodic extinctions and recolonization events. Presence/absence can be established from early April through the end of June using immature and adult life stages. However, it is recommended that monitoring of adult life stages be used when possible. For most sites adults are flying from mid-May through mid-June. Observers may wish to visit multiple times across the season to confirm presence/absence. However, once presence is confirmed additional visits during that year are not necessary. Presence/absence of adults is best achieved by slowly walking the site and visiting key resource areas including: lupine patches, areas rich in nectar, and any exposed wet mud where males may congregate. During presence/absence surveys a rough count of the total adult FBB should be noted.

Besides adults, eggs offer a viable alternative to presence/absence monitoring and can be useful if poor survey weather conditions prohibit adult surveys. The underside of lupine leaves can be checked during June for the presence of FBB eggs. Lupine leaves can be rapidly assessed by gently bending the stems so the underside of the leaf is facing you and rolled between your fingers so that the entire underside of a leaf can be assessed. SBB will occasionally lay eggs on the underside of leaves. When monitoring the presence/absence of FBB eggs you should check between 250-1000 leaves across the site. Focus your efforts on small isolated plants as they tend to hold larger numbers of eggs. If one to nine eggs are found the site is considered “probable” for presence. If more than 10 eggs are found the site is considered “confirmed” for presence. The most difficult life stage to use in establishing presence/absence is the larval stages due to their low detectability. However, it does allow for monitoring during April prior to the flight season. Post-diapause larvae are most easily found in April by searching carefully at the base of the plants where new shoots are emerging. Choose plants that show damage from larval feeding to increase your odds of locating a larva. Post-diapause larvae are frequently tended by ants and a lupine with ants crawling on it are a good sign that a FBB larva might be present. Pre-diapause larvae may be encountered during June when searching for eggs.

Table III. Levels of confirmation of presence/absence of FBB.

| Absent | Probable | Confirmed |
|---|--|---|
| - No adult or immature life stages of FBB present | - 1 to 9 eggs of suitable size and color found on the underside of lupine leaves | - Adult or larval FBB present - 10 or more eggs of suitable size and color found on the underside of lupine leaves |

MODIFIED PEAK COUNT

The objective of the modified peak count is to provide an approximate estimate of FBB population size with a minimal amount of time invested in surveying. The accuracy of the estimate is principally determined by the observer’s ability to survey during the peak flight period of male FBB. Male FBB populations tend to peak within 1 to 3 weeks after the first adult ecloses or emerges from the pupa. In order to ensure that the site is surveyed during the peak male flight multiple visits during early to late May are necessary. Early visits to sites should serve to inform the surveyor of the relative size of the FBB population (e.g. are there many or very few adults flying early in the flight season), the distribution of resources (e.g. lupine, nectar, mud) at the site that should be surveyed during the peak count, and the temporal proximity to peak male flight. For most sites in most years peak flight will occur between the 18th to 31st of May. In cooler years or at later sites peak may occur in early June. **Good indications of peak flight include: 30-40% of the FBB individuals observed are female and a sudden spike in the number of fresh (brightly colored and no wing wear) males flying.** Nearby sites (< 2 km away) with similar slopes and aspects can be used as sentinel sites to determine peak at outlying sites.

For most sites surveyors should plan to visit a site at least once between the 10th and 17th of May to get a sense of the relative flight phenology. An additional two visits will likely to be necessary between May 18th and the 31st (or early June for some sites) to complete the peak survey count or confirm the peak flight period has passed. Surveys should take place between 10 AM – 4 PM on days with less than 50% cloud cover, greater than 60 F air temperature, and wind less than 12 mph. In some years surveyors may be forced to survey during sub-optimal weather. During each visit surveyors should thoroughly survey all

resources where adult male FBBs are likely to congregate including: lupine patches, nectar patches, and exposed wet mud where males gather to collect salts (Fig. 10). Areas of prairie with no FBB resources do not need to be surveyed. During each survey the total number of adult blue butterflies should be recorded. Either during the survey or after the survey is complete a subset consisting of at least 10 male blues (if < 100 male blues counted) or 10% of the total male blues counted should be captured or viewed through binoculars and identified to the species level and that data should be recorded. Surveyor should record the start and end time of surveys, weather condition, site data, total number of males blues counted, and the FBB/SBB ratios on a data sheet during each survey (Appendix II).

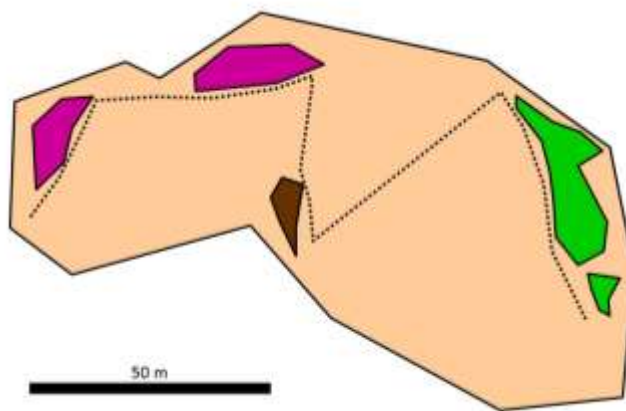


Figure 10. When surveying for presence/absence or completing a peak count all resources of a site should be visited including: nectar (pink), mud puddles (brown), and lupine (green). All other areas can be ignored.

DISTANCE SAMPLING

Distance sampling is the most intensive method of monitoring FBB. It is a transect based survey technique that can account for undetected butterflies, observer differences, variability in detectability due to abiotic and biotic factors (e.g. weather, vegetation) and generates confidence intervals around population estimates. Distance sampling is widely employed in monitoring animals especially those occurring in open landscape such as prairie. It is currently used in monitoring the endangered Karner Blue Butterfly (*Lycaeides melissa samuelis*) in the Great Lakes region.

There are three major assumptions that need to be met when completing Distance sampling surveys. Meeting these assumptions is critical to accurately estimating FBB populations and are explained in more detail below.

- 1.) Butterflies on the transect line are detected with certainty.
- 2.) Distance measures are accurate.
- 3.) Distance measures are to the location where the butterfly was first detected.

Survey Design

The first step in Distance sampling FBB is establishing survey transects. An assumption of Distance sampling is that the butterflies locations are independent of the survey transects. This assumption is met by choosing a random start point and systematically placing transects across the site. Transects should be placed 5-20 m apart and each transect should be given a unique alphanumeric identifier. Use larger spacing to more efficiently survey large sites and use smaller spacing at smaller sites, sites known or expected to support low densities of butterflies, or where lupine patches are small and infrequent.

Transects should be oriented to maximize length for more efficient and complete coverage of the site (Fig. 11). For large sites with localized lupine resources it may be more cost and time efficient to delineate smaller patches that are surveyed rather than surveying an entire site (Fig. 12). With this approach you will have higher FBB population densities but a smaller occupied area. Transect start and end points should be flagged or marked in a manner that will last the field season. For transects longer than 50 m or in hilly terrain it is often useful to periodically flag along transects so that surveyors do not deviate from the transect lines.

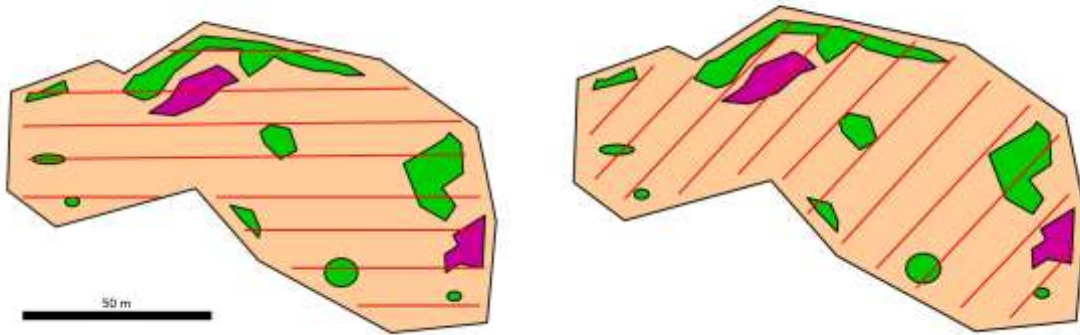


Figure 11. A comparison of efficient (left) versus inefficient (right) transect placement. When placing transects it is more efficient to orient transects to maximize length. This reduces the amount of time surveys spend not surveying walking between transects.

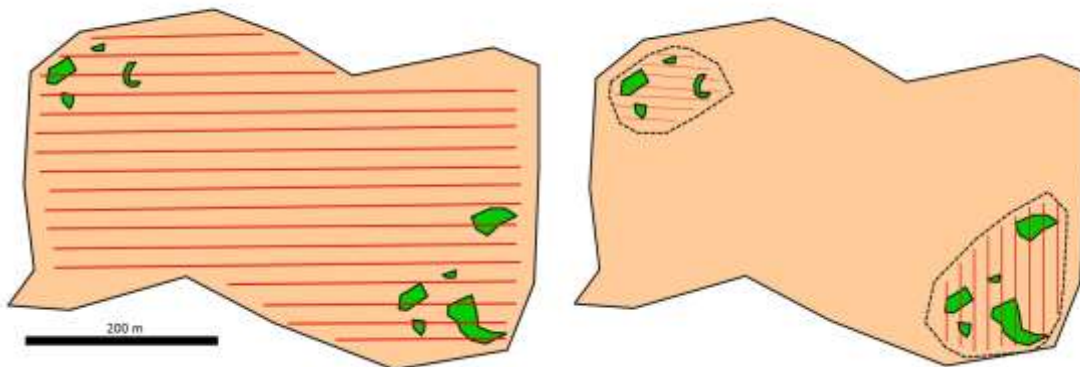


Figure 12. For large prairie patches with isolated lupine it may be more efficient to designate smaller FBB patches for surveys (right) rather than survey the entire site (left).

Completing Surveys

Each site will need to be surveyed a minimum of five times during the flight male FBB flight season from early to mid-May to mid-June. Surveyors should attempt to complete at least one survey at or near the peak flight period. Prior to each survey surveyors should record the location, date, time, temperature, wind speed, and percent cloud cover. It is recommended that surveyors record survey data using a digital recorder or record app on their smartphone and later transcribe the data onto data sheets. This allows the

observer to continuously keep their eyes on the survey transect. At the beginning of each new transect surveyors should note the transect identifier.

During each survey surveyors should walk each transect line at a steady pace. Surveyors should focus most of their attention directly in front of them in order to ensure that all male blue butterflies on or near the line are detected. When surveyors detect a blue butterfly they should note its location of first detection in front of them and whether or not it was flying or sitting at time of detection. If multiple butterflies are interacting (e.g. chasing or mating) the “cluster size” or number of individuals should be noted on the datasheet. When surveyors reach the location perpendicular to the original butterfly(ies) location along the survey transect they should measure the distance from the survey transect to the original point of detection (Fig. 13). This measurement is best accomplished using a 3 to 4 m lightweight pole made from aluminum with distance bins of 0.25 to 0.5 m in width marked out along the pole. Distance greater than the pole can be estimated. Collapsible poles of this length can be readily purchased from entomological suppliers such as Bioquip. Distance to the butterfly can be estimated to the nearest tenth of meter or butterflies can be placed into distance bins 0.25 to 0.5 m in width. Surveyors should to their best ability avoid double counting butterflies on a single transect and may need to note the locations of several butterflies at one time (Fig. 13). Surveyor should only record data while walking survey transects. When all transects have been surveyed surveyors should record the time and note any significant changes in the weather or other pertinent notes on their audio recorders. Either during the survey or after the survey is complete a subset consisting of at least 10 male blues (if < 100 male blues counted) or 10% of the total male blues counted should be captured or viewed through binoculars and identified to the species level and that data should be recorded.

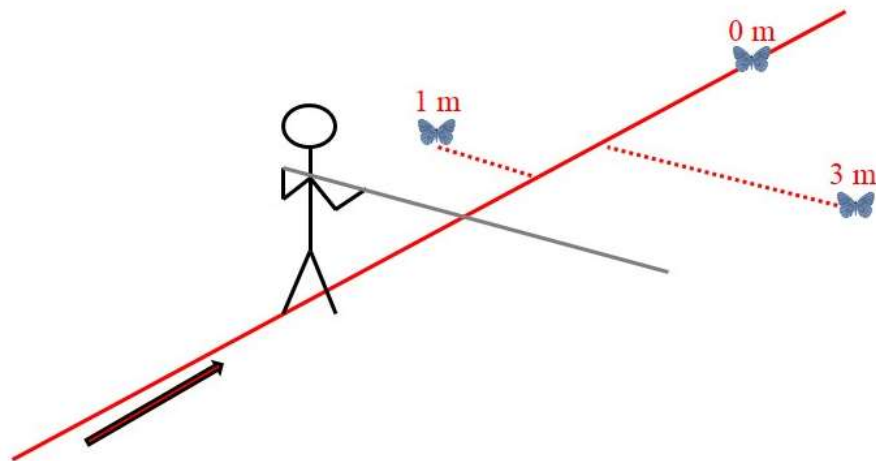


Figure 13. Surveyors should walk each transect and measure and record the perpendicular distance of each male blue butterfly from the transect line.

Data Analysis

After completing surveys data should be transcribed from audio recordings onto data sheets or directly into a database. Data analysis is completed within the program Distance (<http://www.ruwpa.st-and.ac.uk/distance/>). Data analysis should be completed by someone trained in analysis of Distance

sampling data and familiar with the life history, behavior, and sites occupied by FBB. Contact USFWS if you are unable to find someone who can complete analysis of your Distance sampling data.

Databases should be prepared in a manner to facilitate importation in to the program Distance. Data for detections is entered in rows. Each detection gets its own row of data. The columns are populated with information on the site, time, weather, distance, cluster size, and FBB/SBB ratio. If a transect is surveyed and no individuals are encountered then a row is entered with no values entered in the perpendicular distance, behavior, cluster size, or sex column (Fig. 14). Data can be entered into Excel, Google Spreadsheets, or tab/comma delimited text files.

Columnar data should be entered in the following sequence (Fig. 14).

- 1.) Site
- 2.) Patch (if applicable)
- 3.) Surveyor
- 4.) Date
- 5.) Start Time (follow military time)
- 6.) End Time (follow military time)
- 7.) Temp (F or C but be consistent)
- 8.) Wind (mph, kph, or beaufort)
- 9.) Cloud Cover
- 10.) Transect identification
- 11.) Transect length (meters only)
- 12.) Perpendicular distance to butterfly or butterfly cluster (leave blank if no detections on transect)
- 13.) Behavior (flying or sitting) (leave blank if no detections on transect)
- 14.) Cluster size (leave blank if no detections on transect)
- 15.) Sex
- 16.) % Fenders

| Site | Patch | Surveyor | Date | Start Time | End Time | Temp F | Wind | Cloud Cover | Transect | Length | Perp Dist | Behavior | Cluster | Sex | % Fenders |
|-------|--------|----------|-----------|------------|----------|--------|------|-------------|----------|--------|-----------|----------|---------|------|-----------|
| BSNWR | Area 5 | TLH | 5/18/2012 | 1353 | 1426 | 65 | 1 | 20 | 1 | 57 | 0.5 | Flying | 1 | M | 0.62 |
| BSNWR | Area 5 | TLH | 5/18/2012 | 1353 | 1426 | 65 | 1 | 20 | 2 | 85 | | | | | 0.62 |
| BSNWR | Area 5 | TLH | 5/18/2012 | 1353 | 1426 | 65 | 1 | 20 | 3 | 141 | | | | | 0.62 |
| BSNWR | Area 5 | TLH | 5/18/2012 | 1353 | 1426 | 65 | 1 | 20 | 4 | 198 | 1 | Flying | 1 | M | 0.62 |
| BSNWR | Area 5 | TLH | 5/18/2012 | 1353 | 1426 | 65 | 1 | 20 | 4 | 198 | 0 | Flying | 1 | M | 0.62 |
| BSNWR | Area 5 | TLH | 5/18/2012 | 1353 | 1426 | 65 | 1 | 20 | 4 | 198 | 0 | Flying | 2 | M | 0.62 |
| BSNWR | Area 5 | TLH | 5/18/2012 | 1353 | 1426 | 65 | 1 | 20 | 4 | 198 | 1 | Flying | 1 | M | 0.62 |
| BSNWR | Area 5 | TLH | 5/18/2012 | 1353 | 1426 | 65 | 1 | 20 | 5 | 170 | 2 | Flying | 2 | M, F | 0.62 |
| BSNWR | Area 5 | TLH | 5/18/2012 | 1353 | 1426 | 65 | 1 | 20 | 6 | 57 | 0.5 | Flying | 1 | M | 0.62 |
| BSNWR | Area 5 | TLH | 5/18/2012 | 1353 | 1426 | 65 | 1 | 20 | 6 | 57 | 0 | Sitting | 1 | M | 0.62 |
| BSNWR | Area 5 | TLH | 5/18/2012 | 1353 | 1426 | 65 | 1 | 20 | 7 | 85 | | | | | 0.62 |
| BSNWR | Area 5 | TLH | 5/18/2012 | 1353 | 1426 | 65 | 1 | 20 | 8 | 85 | | | | | 0.62 |

Figure 14. An example of FBB Distance sampling database. Note how transects with no detections are left blank.

Fender's Blue Butterfly Modified Peak Count Monitoring Form

Site Name: _____ Surveyor Name: _____

Date: _____ Time: _____ Temperature °F: _____

Wind Speed (Beaufort scale): _____ Cloud Cover (10% increments): _____

Use the space below, if needed, to tally butterflies. (Divide by SBB/FBB, Male and Female, if desired)

How many male blue butterflies did you encounter at the site? _____

Species subsampling results: # of Fender's _____ # of Silvery _____

Using your best judgment do you believe that this survey was completed **before** **during** or **after** the peak flight period for this site? (circle one)

Did you observe any site level impacts at the site? (Check all that apply)

- | | |
|---|--|
| <input type="checkbox"/> Mechanical treatment (mowing, tilling, etc...) | <input type="checkbox"/> Grazing (presence or evidence of livestock) |
| <input type="checkbox"/> Fire | <input type="checkbox"/> Invasion (blackberry, broom, grasses, etc...) |
| <input type="checkbox"/> Habitat loss (development, road development, etc...) | <input type="checkbox"/> Chemical application (herbicides) |
| <input type="checkbox"/> Other: _____ | <input type="checkbox"/> Habitat improvement |

Please provide a description of site level impacts (use back if you need more space):

If photos of site impacts were taken write the photo id(s) here: _____

| Beaufort | | Speed | | Specification on land |
|----------|-----------------|-------------|-------------|---|
| | | km/h | mph | |
| 0 | Calm | Less than 1 | Less than 1 | Smoke rises vertically. |
| 1 | Very Light | 1-5 | 1-3 | Direction of wind shown by smoke drift but not by wind vanes. |
| 2 | Light breeze | 6-11 | 4-7 | Wind felt on face , leaves rustle, ordinary wind vane moved by wind. |
| 3 | Gentle breeze | 12-19 | 8-12 | Leaves and small twigs in constant motion, wind extends white flag. |
| 4 | Moderate breeze | 20-29 | 13-18 | Wind raises dust and loose paper, small branches move. |
| 5 | Fresh breeze | 30-39 | 19-24 | Small trees in leaf start to sway, crested wavelets on inland waters. |
| 6 | Strong breeze | 40-50 | 25-31 | Large branches in motion, whistling in telegraph wires, umbrellas used with difficulty. |

Time Budget Data (Please record the amount of time in minutes you spent doing the following activities in order to survey this site):

Driving: _____ Walking: _____ Surveying: _____

Fender's Blue Butterfly Distance Sampling Form

Site Name: _____ Surveyor Name: _____

Date: _____ Start Time: _____ End Time: _____

Temperature °F: _____ Wind Speed (Beaufort scale): _____ Cloud Cover (10% increments): _____

Behavior Codes: F = Flying or S = Sitting Sex Codes: M = Male or F = Female

| Transect | Perp. Dist. | Behavior | Cluster Size | Sex(es) | Comments or Notes |
|----------|-------------|----------|--------------|---------|-------------------|
| | | | | | |
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Species subsampling results: # of Fender's _____ # of Silvery _____
Page: _____ of _____

Did you observe any site levels impacts at the site? (Check all that apply)

- | | |
|---|--|
| <input type="checkbox"/> Mechanical treatment (mowing, tilling, etc...) | <input type="checkbox"/> Grazing (presence or evidence of livestock) |
| <input type="checkbox"/> Fire | <input type="checkbox"/> Invasion (blackberry, broom, grasses, etc...) |
| <input type="checkbox"/> Habitat loss (development, road development, etc...) | <input type="checkbox"/> Chemical application (herbicides) |
| <input type="checkbox"/> Other: _____ | <input type="checkbox"/> Habitat improvement |

Please provide a description of site level impacts:

| Beaufort | | Speed | | Specification on land |
|----------|-----------------|-------------|-------------|---|
| | | km/h | mph | |
| 0 | Calm | Less than 1 | Less than 1 | Smoke rises vertically. |
| 1 | Very Light | 1-5 | 1-3 | Direction of wind shown by smoke drift but not by wind vanes. |
| 2 | Light breeze | 6-11 | 4-7 | Wind felt on face , leaves rustle, ordinary wind vane moved by wind. |
| 3 | Gentle breeze | 12-19 | 8-12 | Leaves and small twigs in constant motion, wind extends white flag. |
| 4 | Moderate breeze | 20-29 | 13-18 | Wind raises dust and loose paper, small branches move. |
| 5 | Fresh breeze | 30-39 | 19-24 | Small trees in leaf start to sway, crested wavelets on inland waters. |
| 6 | Strong breeze | 40-50 | 25-31 | Large branches in motion, whistling in telegraph wires, umbrellas used with difficulty. |

