

FIELD PROTOCOL FOR SAMPLING FOREST TENT CATERPILLAR EGG MASSES

New York State Department of Environmental Conservation- Forest Health & Protection

Naja E. Kraus- November 2005

This recommendation is based largely on the following two publications: The Development and Application of a Sequential Sampling Plan for Forest Tent Caterpillar (Connola *et al.* 1957) and Field Protocol for Sampling Forest Tent Caterpillar Egg Masses (D.C. Allen 1994)

OBJECTIVE:

The purpose of this sampling technique is to classify stands with respect to “expected defoliation.” The sampling procedure will determine if the density of forest tent caterpillar egg masses in the area sampled will lead to “noticeable defoliation” or “no noticeable defoliation” the following spring.

SEQUENTIAL SAMPLING METHOD:

Sequential sampling plans help allocate labor when determining if forest tent caterpillar egg masses exceed the noticeable defoliation threshold density for an area. A plot consists of the number of trees required to make a decision regarding expected defoliation. Areas with very low or high forest tent caterpillar populations require the least amount of sampling, as a decision will be reached after sampling only a few trees. Plot size may vary from 2-25 sugar maple trees.

SURVEY PLANNING:

First the areas of concern need to be identified. This may be based on geographical or property line boundaries, ecosystems, areas of special concern, areas that have been previously defoliated, areas with poor site quality that are more likely to be affected by defoliation or chosen on some other basis. Delineate the priority area(s) to be sampled and distribute the sample sites throughout the survey area. You may wish to distribute sample sites along an elevation gradient.

NUMBER OF SAMPLING PLOTS:

Woodlot Size	Number of Plots
< 10 acres	2 for each 5 acres
10-50 acres	1 for each 10 acres
50-100 acres	1 for each 25 acres
>100 acres	1 for each 50 acres

EQUIPMENT NEEDED:

- 1.) **Bare essentials:** Binoculars or spotting scope (45° angled zoom eyepiece recommended) with tripod, Personal Digital Assistant (i.e. IPAQ, datalogger) or paper data sheets with clipboard & pencil, forest tent caterpillar sequential sampling table, sampling protocol, GPS, site map, compass, DBH tape (if measuring tree DBH), small ruler to measure egg masses
- 2.) **Helpful extras:** folding campchair (using spotting scope) or plastic groundcloth (using binoculars). For safety: first aid kit, cell phone or radio, orange vest

CHOOSE YOUR SAMPLING TOOL/METHOD:

- 1.) **Spotting Scopes v. Binoculars.** This forest tent caterpillar egg mass sampling method has been done using both spotting scopes and binoculars and field technicians have been found to have different preferences. A spotting scope is heavier to carry and takes longer to set up (set-up time decreases with practice) than binoculars but, if available, using a good spotting scope instead of binoculars considerably improves the ability to differentiate between old and new egg masses (holes are even visible in old egg masses) and increases viewing accuracy. When purchasing either binoculars or spotting scopes it is important to consider the amount of light (aperture of 60 works well, 80 to 100 is even better) and magnification power, increasing light and magnification will make it easier to see the egg masses.
 - a) **Spotting scope-** it is recommended to get a scope with a 45° angle eyepiece as this will make your neck more comfortable. A zoom eyepiece is recommended (e.g. 20-60x). Also a sturdy tripod is important to keep your scope as stable as possible. A folding chair is a nice addition as well and will enable you to be closer to the tree when viewing egg masses than you could be if you were standing, due to the angle needed to view the tree crown.
 - b) **Binoculars-** it is recommended that you lie down when looking for egg masses to decrease neck strain and movement of binoculars. Bringing something to lie down on (piece of plastic, garbage bag, etc.) is a nice addition for this method. Binoculars are a quick and easy tool to use for this sampling method. However, it is hard to differentiate old from new egg masses with binoculars without perfect sampling weather. Note: when using binoculars, sometimes opposite buds will look like egg masses.
- 2.) **Pole Pruners.** If you can reach the upper third tree crown of an interior dominant or co-dominant sugar maple tree with your pole pruners then you can use this method. Follow the

protocol below, instead of viewing branches from the ground, cut ten, 30-inch branch tips across the top third of the crown and count the NEW egg masses on those branch tips. It is important that the branches be spread throughout the crown top and that you randomly choose the branches without looking for egg masses first.

- 3.) **Felled Tree.** If felling a tree is an option for you than you can use this method. Follow the protocol below but instead of viewing the branches from the ground, fell a dominant or co-dominant sugar maple tree and count the number of NEW egg masses on ten randomly chosen 30-inch branch tips spread across the top third of the tree crown. It is important that you choose the branches without looking for egg masses first.

PREREQUISITES:

- 1.) **Distinguish new from old egg masses.** Please assess age of egg masses carefully.

New Egg Masses	Old Egg Masses
Dark brown	Lighter in color, whitish
Shiny	Dull
No holes or small parasitoid exit holes present	Exit holes often present

- 2.) **Delineate a 30-inch branch tip from the ground on varying height trees.** This includes all of the smaller side twigs within those 30 inches.
- 3.) **Practice.** Before counting egg masses in a tree you should practice on the ground. Cut a few 30-inch branch tips containing egg masses (old and new if possible) and place them $\pm$ 70 ft away from you; choose a distance comparable to the height of the trees that will be sampled. Stand with your back to the sun and view the twigs with your equipment (spotting scope or binoculars). Practice differentiating between old and new egg masses and get a feel for what a 30-inch branch tip looks like from varying distances away.

SAMPLING PROCEDURES:

- 1.) **Time of year.** Egg masses are present from September to mid-April and sampling can occur throughout this time. However, it is easier to count the egg masses when there are no leaves on the trees and it easier to tell old from new egg masses when they have not weathered the entire winter.
- 2.) **Weather.** As it is easier to see egg masses when there is good light, no wind and under dry conditions you may wish to confine sampling to clear, bright, calm and non-rainy/snow days.

- 3.) Navigate to the survey plot.** The plot should lie within a forested area (with susceptible host species) and be more than 100 feet (30 meters) from the forest edge.
- a) Method 1: Go to the area you wish to sample and randomly pick a plot center.
 - b) Method 2: To decrease bias when choosing the first plot walk 130 feet (40 meters, 2 chains) perpendicular from the nearest road or trail in the area you wish to sample. If the area you wish to sample is farther than 130 feet from the trail or road, choose a longer distance before you start walking. Plot center is where you reach 130 feet (or the longer distance chosen); follow a compass bearing from the road/trail to decrease bias in choosing plot center.
 - c) Method 3: If random coordinates were generated in advance for sampling, using GIS or another computer program, then those coordinates should be used to find your first plot center location (plot center is where the GPS first falls within 50 feet of the entered coordinates).
 - d) For additional plots walk 100 ft (30 m, 1½ chains) in the direction given in the random direction table. The random direction table will move you around the area in a semi-random cardinal path and help decrease surveyor bias in choosing additional plots. If the direction takes you out of the desired forest type (i.e. into a conifer stand, cliff edge, or road) then use the next direction instead.
 - e) If there is insufficient sugar maple in the plot area then you can move the plot to a nearby area (i.e. 500 feet away) with more sugar maple. If no sugar maple is found or the forest has a small sugar maple component then that plot should not be surveyed.
- 4.) Enter information on data sheet.** Enter basic information such as observer name(s), date, site # or name, county, town, forest type, UTM coordinates and elevation. Make sure to note which sample method (spotting scope, binocular, pole pruner or felled tree) was used. Carefully note the count of egg masses observed per branch in the appropriate part of the table and answer the questions at the bottom of the data sheet. Include any site comments you might have. You may want to include weather data (i.e. sky color, amount of light and wind present) as this may affect the quality of the data collected. If you are not using a GPS or map then you should write a good description of the plot area or draw a map with place names and comments so that the plot can be located on a map and the UTM coordinates determined at a later time.

- 5.) **Choose your sample tree.** Choose the closest dominant or co-dominant sugar maple tree to your plot center and measure the diameter at breast height (DBH). Edge trees (roadside, hedgerow or otherwise open grown maples) may contain less egg masses than interior populations, so only interior trees should be sampled. Note: This survey method is done when there are no leaves on the trees and you need to ensure that you are sampling a sugar maple (pointy buds) and not a red maple (round, red buds) as eggs are not oviposited on red maple.
- 6.) **Find a good sample viewpoint.** Sampling with your back to the sun helps to reflect sunlight off of new egg masses and makes it easier to tell them apart from old egg masses. If you can view the tree crown from a higher point of ground it will be easier to view the egg masses as you are now closer and have a better angle. Using a camp chair with a spotting scope will enable you to sit closer to the tree than you could if you were standing up due to the scope angle and this is helpful as well.
- 7.) **Count NEW egg masses on ten 30-inch branch tips.** Using binoculars or spotting scope count the NEW egg masses visible on ten, 30-inch branch tips. Pick branch tips so that they are spaced evenly throughout the entire upper third of the crown. For example, you may want to start on the left side of the crown and move to the right, up and over the crown (Branch #1 on the left, Branch #5 in the middle, Branch #10 on the right). A 30-inch branch tip is the last 30 inches of a branch and includes all of the smaller side twigs within those 30 inches. These branch tips should be chosen without first looking for egg masses, having a count of 0 is OK!
- 8.) **Sum the NEW egg masses per tree and adjust the sum by the methods multiplier.** This is based on an adjustment recommended by Connola *et al.* to account for egg masses missed when viewed from the ground. Sum the egg masses viewed on the 10 branch tips and multiply by the following amount to get the total number of egg masses per tree.
- Binocular: multiply by 4
 - Spotting scope: multiply by 2
 - Pole pruners: multiply by 1
 - Felled tree: multiply by 1
- 9.) **Gather equipment, check to make sure datasheet is completely filled out, move on to the next tree and repeat sample procedure.** Walk 100 feet (30 meters, 1½ chains) in the direction noted on the random direction table (see Procedure #3d). If you choose not to use the random direction table, then you will need to randomly pick the direction to walk.

10.) Consult Sequential Sampling Table after sampling 2 trees. After sampling 2 sugar maple trees, compare the cumulative total of all new egg masses observed to the sequential sampling table to determine if the stand falls above or below the noticeable defoliation threshold. Stop sampling if a result is determined. If “Continue Sampling” is indicated, sample additional trees and compare the cumulative total of all new egg masses to the sequential sampling table after each additional tree until a result is determined and the chart indicates that you should stop sampling.

- a) In the unlikely event that you sample 25 trees and the defoliation level is still unknown, then stop sampling and make your decision based on your best guess. You should consider defoliation from previous years, outbreak length, adjacent areas, and egg mass size when making your prediction.

11.) Measure the length of 5 new egg masses. Throughout the areas you are sampling, randomly select 5 reachable egg masses (i.e. they can be the first 5 you observe) and measure the length (longest section) in millimeters. Enter the measurements on the bottom of the data sheet and check the box indicating if the average length is small (≤ 7 mm ($\frac{1}{4}$ inch) indicating decreasing population) or “normal” (> 7 mm ($\frac{1}{4}$ inch)). You may not always be able to find reachable egg masses as they tend to mostly be laid on understory twigs only during outbreaks.

ADDITIONAL INFORMATION:

- This sampling plan is set up with specified confidence levels. The chances are 1 in 10 that a “not noticeable” area will be called “noticeable” and 1 in 20 that a “noticeable” area will be called “not noticeable.”
- You may wish to sample an additional tree or two if the trees you sample have dramatically different egg mass numbers.
- You may want to flag or mark sampled trees in order to compare actual caterpillars/defoliation/tree mortality the following year with your egg mass survey prediction.
- If you choose not to have a random method of choosing the trees or plots to sample then you may wish to start at the highest point in your sample area and work down as this makes it easier to see the treetops and some people theorize that sampling along an elevation gradient helps in predicting stand-level populations.
- If you determine that other forest tent caterpillar preferred host trees such as trembling aspen, black cherry or oaks are more prevalent in your area than sugar maple then you can use that

tree species as your sample tree. Be aware that different trees will present varying degrees of difficulty in viewing egg masses and that when eastern tent caterpillar population levels are high, eastern tent caterpillar egg masses (which look very similar to forest tent caterpillar egg masses) may also be present on black cherry, aspen and oaks.

A CAUTION FROM DR. ALLEN:

Any time we simplify a survey tool such as a population sampling method, we must be careful how we interpret and use the results. Just because we determine that defoliation next year is likely to be “noticeable”, does not mean that we are going to get heavy (e.g., 60% or more) defoliation. This must be a subjective value judgment based on such things as level of defoliation in previous years, number of years of previous defoliation, extent of defoliation in adjacent areas, and size of egg masses.

Also, whether or not a high egg mass count results in “noticeable” defoliation depends on egg and larval survival. Weather and parasites may cause significant mortality before defoliation occurs.

SUBMIT YOUR DATA:

Once you have completed sampling for forest tent caterpillar egg masses please email or mail your results to NYSDEC Forest Health and Protection so that your data can contribute to our understanding of forest tent caterpillar population levels throughout New York State. An outcome where no defoliation is predicted is also of interest to us. Please contact your local NYSDEC foresters or the NYSDEC Forest Health and protection staff if you have any questions about this protocol. Thank you for your interest in our state forests!

NYSDEC
Div. of Lands & Forests
Forest Health & Protection
625 Broadway
Albany, NY 12233-4253

Telephone: 518-402-9425

Fax: 518-402-9028

Email (in the subject line please write “To the Attention of Forest Health”): lands@gw.dec.state.ny.us

ATTACHED DOCUMENTS:

- Forest tent caterpillar sequential sampling DATA FORM
- SEQUENTIAL SAMPLING TABLE for sampling forest tent caterpillar egg mass populations in NY
- RANDOM DIRECTION TABLE
- Forest tent caterpillar sequential sampling SAMPLE DATA FORM

Forest Tent Caterpillar Sequential Sampling Data Form

Observer Name(s): _____ Date: _____

Plot #: _____ County: _____ Town: _____

Forest Type (&/or 3 dominant tree species): _____

GPS coordinates (NYSDEC uses UTM NAD 83): _____, _____ Elev: _____

Weather observations: Sky color: _____ Amount of light: _____ Wind: _____

Sample Method: ☐ Binocular ☐ Spotting Scope ☐ Pole Pruner ☐ Felled Tree
Adjustment #: Multiply by 4 Multiply by 2 Multiply by 1 Multiply by 1

Sugar Maple Tree #	Tree DBH	Number of NEW egg masses per 30-inch upper crown branch tips										Total # of egg masses per tree x 1,2 or 4	Cumulative # of NEW egg masses
		Branch 1	Branch 2	Branch 3	Branch 4	Branch 5	Branch 6	Branch 7	Branch 8	Branch 9	Branch 10		
1													
2													
3													
4													
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Total number of trees sampled: _____ Total number of NEW egg masses found: _____

Noticeable defoliation predicted? ☐ Yes ☐ No ☐ Undetermined

Average egg mass length (measure 5 reachable egg masses): ☐ small ☐ "normal"
(≤ ¼ inch, 7 mm) (> ¼ inch, 7 mm)

Comments: _____

Sequential sampling table for sampling forest tent caterpillar egg mass populations in New York

Sample guide showing minimum numbers of trees (10-twigs samples) that must be examined in an egg mass survey to permit site classification with respect to expected forest tent caterpillar defoliation.

# of trees (10-twigs) sampled	Total number of NEW egg masses counted		
	No defoliation predicted. STOP sampling	Defoliation level unknown. Continue sampling	Noticeable defoliation predicted. STOP sampling
1	-	-	-
2	0	1 – 7	8 or more
3	2 or less	3 – 9	10 or more
4	4 or less	5 – 11	12 or more
5	6 or less	7 – 14	15 or more
6	8 or less	9 – 16	17 or more
7	11 or less	12 – 18	19 or more
8	13 or less	14 – 20	21 or more
9	15 or less	16 – 22	23 or more
10	17 or less	18 – 24	25 or more
11	20 or less	21 – 27	28 or more
12	22 or less	23 – 29	30 or more
13	24 or less	25 – 31	32 or more
14	26 or less	27 – 33	34 or more
15	28 or less	29 – 35	36 or more
16	30 or less	31 – 38	39 or more
17	33 or less	34 – 40	41 or more
18	35 or less	36 – 42	43 or more
19	37 or less	38 – 44	45 or more
20	39 or less	40 – 46	47 or more
21	41 or less	42 – 48	49 or more
22	43 or less	44 – 51	52 or more
23	46 or less	47 – 53	54 or more
24	48 or less	49 – 55	56 or more
25	50 or less	51 – 57	58 or more

Random Direction Table

Sample the first dominant or co-dominant sugar maple tree closest to plot center. If random coordinates were generated for sampling then that should be your first plot center. Otherwise plot center is determined by walking 130 ft (40 m, 2 chains) perpendicular from the nearest road or trail in the area you wish to sample. For the next tree, locate today's date on the table below and walk 100 ft (30 m, 1½ chains) in the direction noted and sample the closest dominant or co-dominant sugar maple tree. Today's date is the starting point; continue down the table to choose the walking direction for each additional tree sampled. If the direction takes you out of the sugar maple stand type (i.e. into a conifer stand, cliff edge, or road) then use the next direction instead.

Date	Direction		Date	Direction		Date	Direction		Date	Direction
1	NE		15	SE		25	E		-	N
2	SE		16	NE		26	SE		-	SW
3	N		17	E		27	NE		-	W
4	NW		18	N		28	SE		-	NW
5	SW		19	NW		29	NE		-	SW
6	S		20	N		30	E		-	W
7	S		21	W		31	N		-	SE
8	SE		22	S		-	N		-	S
9	SW		23	W		-	SW		-	E
10	W		24	W		-	W		-	S
11	S		Return to 1 for additional directions			-	SW		Return to 25 for additional directions	
12	E					-	NW			
13	E					-	NW			
14	NE					-	NE			

SAMPLE Forest Tent Caterpillar Sequential Sampling Data Form SAMPLE

Observer Name(s): NAJA KRAUS Date: 11/15/2005

Plot #: 1 County: WARREN Town: THURMAN

Forest Type (&/or 3 dominant tree species): MAPLE, BEECH, BIRCH

GPS coordinates (NYSDEC uses UTM NAD 83): 18 589475 E , 4823612 N Elev: 1350 feet

Weather observations: Sky color: GREY/CLOUDY Amount of light: LOW/POOR Wind: CALM

Sample Method: ☐ Binocular ☒ Spotting Scope ☐ Pole Pruner ☐ Felled Tree
Adjustment #: Multiply by 4 Multiply by 2 Multiply by 1 Multiply by 1

Sugar Maple Tree #	Tree DBH	Number of NEW egg masses per 30-inch upper crown branch tips										Total # of egg masses per tree x 1,2 or 4	Cumulative # of NEW egg masses
		Branch 1	Branch 2	Branch 3	Branch 4	Branch 5	Branch 6	Branch 7	Branch 8	Branch 9	Branch 10		
1	12.6"	-	1	-	1	-	1	-	-	1	-	4 x 2 = 8	8
2	15"	2	-	1	-	1	-	1	-	1	-	6 x 2 = 12	20
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Total number of trees sampled: 2 Total number of NEW egg masses found: 20

Noticeable defoliation predicted? ☒ Yes ☐ No ☐ Undetermined

Average egg mass length (measure 5 reachable egg masses): ☐ small ☒ "normal"
9 mm 8 mm 11 mm 9 mm 10 mm (≤ ¼ inch, 7 mm) (> ¼ inch, 7 mm)

Comments: This stand experienced moderate defoliation in 2004, heavy defoliation in 2005