FIELD PROTOCOL FOR SAMPLING GYPSY MOTH EGG MASSES

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

Naja E. Kraus- October 2005

This recommendation is based largely on the following two USDA Forest Service publications: Sequential Sampling Plans for Estimating Gypsy Moth Egg Mass Density (Fleischer et al. 1992) and Gypsy Moth Egg Mass Sampling for Decision Making: a Users' Guide (Liebhold et al. 1994).

OBJECTIVE:

The purpose of this sampling technique is to determine if gypsy moth densities in the area sampled fall above or below a chosen management threshold.

SEQUENTIAL SAMPLING METHOD:

Sequential sampling plans help allocate labor when determining if gypsy moth densities exceed a chosen management threshold density for an area. Areas with very low or high populations require the least amount of sampling, as a decision may be reached after sampling only 4 plots. Site sample may vary from 4-9 plots for continually forested habitats and vary from 6 or 7 to 15, 22 or 25 plots for urban/suburban habitats depending on management threshold.

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.

CHOOSE MANAGEMENT THRESHOLD:

- ➢ 250 egg masses per acre   to prevent   Noticeable Caterpillars
- ➢ 500 egg masses per acre   to prevent   Noticeable Defoliation
- ➢ 1000 egg masses per acre   to prevent   Likely Tree Mortality

EQUIPMENT NEEDED:

1.) **Bare essentials:** Binoculars or spotting scope (45º angled zoom eyepiece recommended) with tripod, Personal Digital Assistant (i.e. IPAQ, datalogger) or paper data sheets with clipboard & pencil, gypsy moth sequential sampling table(s), sampling protocol, compass, GPS, site map, 18.6 ft. (5.7 m) tape/string, 5 bright color stake flags, small ruler to measure egg masses

2.) Helpful extras: calculator, tally counters, for comfort: plastic groundcloth (using binoculars) or campchair (using spotting scope); for safety: first aid kit, cell phone or radio, orange vest

DISTINGUISH NEW FROM OLD EGG MASSES:

You will need to determine new from old egg masses. Please assess age of egg masses carefully.

New Egg Masses	Old Egg Masses
Firm to touch (feel hard and full)	Soft to touch (feel soft & spongy)
Usually darker beige, buff colored	Usually dull or bleached coloration
Opaque to dark-colored eggs	Clearer eggs (no larvae inside)
No holes or small parasitoid exit holes present	Exit holes present
Eggs will "pop" when squeezed between fingernails	Eggs will not "pop" when squeezed between fingernail
	Masses may appear torn

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.** It is easier to see, and differentiate between, old and new egg masses when there is good light and under dry conditions. You may wish to confine sampling to clear, bright and non-rainy or snowy 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.

4.) **Set up your plot.** Mark plot center with a stake flag. To help visualize a circular plot, measure 18.6 feet (5.7 meters) from plot center in four directions, perpendicular to each other, setting a flagged stake (tall, bright color flags are easiest to see) at each point. The area of this plot equals 1/40 acre (0.01 hectare).
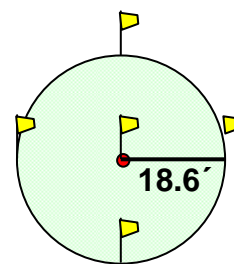
Plot layout

5.) **Enter information on data sheet.** Enter basic information such as observer name(s), date, site # or name, county, town, forest type, UTM coordinates, elevation. Make sure to note which management threshold was used and if the habitat was continually forested or urban/suburban (≥ 1 house per 10 acres). Carefully note the count of egg masses observed 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. 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.

6.) **Measure the length of 5 new egg masses.** Randomly select 5 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, (below 20 mm, indicating decreasing population), average (20-30 mm), or large (above 30 mm, indicating increasing population).

7.) **Count all egg masses (tally old and new separately) in the understory/ground.** Count all egg masses on the ground (i.e. fallen logs, branches, rocks and woody vegetation) and below 6 feet on trees. Egg masses may be found under peeling bark and in tree cavities as well.

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Tally the old and new egg masses separately. Avoid double counting, you may find it helpful to count one quadrant at a time.

8.) **Count all egg masses (tally should combine old and new) above 6 feet.** Count all egg masses (old & new combined) on trees within the plot up to 50. Avoid double counting. After you have counted 50 egg masses you may begin to estimate numbers in groups of 25. Egg masses may be on trunks or under branches. Use binoculars or spotting scope as necessary (binoculars are usually sufficient). Make sure to view trees from multiple vantage points. Count only egg masses on portions of trees that fall within the plot circle.

CALCULATIONS & ADDITIONAL COUNT PROCEDURES (SEE NOTES):

a. **Determine the % of new egg masses (EM) in the understory/ground count.** Use the total counts of all old and new egg masses observed.

$$\% \text{ new EM} = \text{new ground EM} / (\text{new ground EM} + \text{old ground EM}).$$

Note: If there are no egg masses observed in the understory/ground within the plot, you will need to go outside the plot to find egg masses to determine this percentage. Do not incorporate the count of these outside egg masses into the plot egg mass total count, use only for calculation.

b. **Determine the number of new egg masses above 6 feet ("Crown").** Multiply the total number of egg masses found above six feet by the % new egg masses on the ground/understory.

$$\# \text{ new crown EM} = \text{all crown EM} * \% \text{ new EM}$$

Note: If no egg masses are found below 6 feet within or outside the plot you will need to determine the number of new egg masses above six feet without being able to multiply by the % of new egg masses determined from the ground/understory. In this case you will have to very carefully visually determine if an egg mass above 6 feet is new or old. Count only new egg masses in this case.

c. **Determine the total number of new egg masses found within the plot.** Sum the total number of new egg masses found in the ground/understory count and the total number of new egg masses above 6 feet.

$$\text{Total} \# \text{ new egg masses} = \# \text{ new ground EM} + \# \text{ new crown EM}$$

9.) **Gather equipment, check to make sure datasheet is completely filled out and move on to the next plot.** Walk 100 feet (30 meters, 1½ chains) in the direction noted on the random direction table (see Procedure # 2d) to determine the next plot center. 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 4 plots (for continually forested habitats).** After sampling 4 plots, compare the cumulative total of all new egg masses observed to the chosen management threshold portion of the sequential sampling table to determine if the stand falls above or below the chosen management threshold. Stop sampling if a result is determined. If "Continue Sampling" is indicated, sample additional plots and compare the cumulative total of all new egg masses to the sequential sampling table after each additional plot until a result is determined and the chart indicates that you should stop sampling. Note: If surveying in an urban/suburban habitat refer to the urban/suburban sequential sampling table after a minimum of 6 or 7 plots.

ADDITIONAL INFORMATION

▪ You may want to flag or mark plot center in order to compare actual caterpillars, defoliation, or tree mortality the following year with amounts predicted from your egg mass survey.

▪ Caution: some people have allergic respiratory and skin reactions to gypsy moth parts.

A NOTE OF CAUTION:

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 your survey determines that your sampled area falls above your chosen threshold does not mean that outcome ("noticeable" caterpillars, defoliation, or tree mortality next year) will definitely occur. Your prediction should be tempered by a subjective value judgment based on such factors as level of defoliation in previous years, number of years of previous defoliation (heavy defoliation rarely occurs more than two years in a row at a given site), extent of defoliation in adjacent areas, and size of egg masses. Also, whether or not a high egg mass count results in "noticeable" caterpillars, defoliation, or tree mortality depends on egg and larval survival. Weather, parasites and other factors may cause significant egg and larval mortality before noticeable outcomes occurs.

SUBMIT YOUR DATA:

Once you have completed sampling for gypsy moth egg masses please email or mail your results to NYSDEC Forest Health and Protection so that your data can contribute to our understanding of gypsy moth 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:

> Gypsy moth sequential sampling DATA FORM
> Gypsy moth sequential sampling DATA FORM for CONTINUALLY FORESTED SITES
> SEQUENTIAL SAMPLING TABLE for sampling gypsy moth egg mass populations at three management thresholds in CONTINUOUSLY FORESTED EASTERN HARDWOODS
> RANDOM DIRECTION TABLE
> SEQUENTIAL SAMPLING TABLE for sampling gypsy moth egg mass populations at three management thresholds in URBAN/SUBURBAN HABITATS
> Gypsy moth sequential sampling SAMPLE DATA FORM

Gypsy Moth Sequential Sampling Data Form

Observer Name(s): _____ Date: _____

Site #: _____ County: _____ Town: _____

Forest Type: _____ GPS coordinates*: _____ , _____ Elev: _____
(&/or 3 dominant tree species)   * NYSDEC uses UTM NAD 83

Management Threshold (egg masses/acre):   □ 250   □ 500   □ 1000

Habitat: □ continually forested   □ urban/suburban (≥ 1 house per 10 acres)
               (minimum: 4 plots, maximum: 10 plots)   (minimum: 6 or 7 plots, maximum: 15, 22 or 25 plots)

| Plot (1/40 -acre) | Actual egg mass counts | | | Formulas to estimate % new | | Total # of new egg masses per plot (F) | Cumulative # of egg masses [sum of new egg masses found at all plots] |
| | Egg masses on ground and lower portion of trunks | | All egg masses in Crown (C) | % new egg masses (D) | # of new crown egg masses (E) | | |
	Old (A)	New (B)		B/(B+A)	C * D	B+E	F+F+F….
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
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23							
24							
25							

Total # of egg masses found: [____]   Total # of plots sampled: [____]   Average # of egg masses/acre: [____]
[(total # egg masses/total # plots)*40]

Above management threshold?   □ Yes   □ No   □ Undetermined

Average egg mass length (*measure 5 typical egg masses*):   □ small   □ average   □ large
                                                              (< 20 mm)   (20-30 mm)   (> 30 mm)
_____   _____   _____   _____   _____

Comments:

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Gypsy Moth Sequential Sampling Data Form
for Continually Forested Sites

Observer Name(s): _____ Date: _____

Site #: _____ County: _____ Town: _____

Forest Type: _____ GPS coordinates*: _____ , _____ Elev: _____
(&/or 3 dominant tree species)   *NYSDEC uses UTM NAD 83

Management Threshold (egg masses/acre):   □ 250   □ 500   □ 1000

Plot (1/40 -acre)	Actual egg mass counts			Formulas to estimate % new		Total # of new egg masses per plot (F)	Cumulative # of egg masses [sum of new egg masses found at all plots]
	Egg masses on ground and lower portions of trunks		All egg masses in Crown (C)	% new egg masses (D)	# of new crown egg masses (E)		
	Old (A)	New (B)		B/(B+A)	C * D	B+E	F+F+F….
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Total # of egg masses found: [____]   Total # of plots sampled: [____]   Average # of egg masses/acre: [____]
[(total # egg masses/total # plots)*40]

Above management threshold?   □ Yes   □ No   □ Undetermined

Average egg mass length (*measure 5 typical egg masses*):   □ small   □ average   □ large
                                                                 (< 20 mm)   (20-30 mm)   (> 30 mm)

_____ _____ _____ _____ _____

Comments:

Sequential sampling table for sampling gypsy moth egg mass populations at three management thresholds in continuously forested eastern hardwoods[1]

Sample guide showing minimum numbers of plots (1/40 acre) that must be examined in an egg mass survey to permit site classification with respect to expected gypsy moth defoliation.

Management Threshold (egg masses/acre)	# of plots (1/40 acre) sampled	Total number of new egg masses counted		
		Below threshold STOP sampling	Continue sampling	Above threshold STOP sampling
250 egg masses/acre "Noticeable Caterpillars"	4	< 7	7 – 42	> 42
	5	< 13	13 – 48	> 48
	6	< 19	19 – 54	> 54
	7	< 25	25 – 60	> 60
	8	< 31	31 – 66	> 66
	9	< 37	37 -73	> 73
500 egg masses/acre "Noticeable Defoliation"	4	< 16	16 – 81	> 81
	5	< 28	28 – 94	> 94
	6	< 40	40 – 106	> 106
	7	< 53	53 – 118	> 118
	8	< 65	65 – 130	> 130
	9	< 77	77 – 143	> 143
1000 egg masses/acre "Likely Mortality"	4	< 19	19 – 178	> 178
	5	< 44	44 -202	> 202
	6	< 68	68 – 227	> 227
	7	< 93	93 – 252	> 252
	8	< 117	117 – 276	> 276
	9	< 142	142 - 301	> 301

Random Direction Table[2]

The first plot should be chosen by walking 130 ft (40 m, 2 chains) perpendicular from the nearest road or trail in the area you wish to sample. If random coordinates were generated for sampling then that should be your first plot location. For the next plot, locate today's date on the table below and walk 100 ft (30 m, 1½ chains) in the direction noted and place a flag there as plot center. Today's date is the starting point; continue down the table to choose the walking direction for each additional plot sampled. If the direction takes you out of the desired forest type (i.e. into a conifer stand, cliff edge, road or swamp) 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			

[1] Sequential table from Fleischer et al. 1992. Sequential sampling plans for estimating gypsy moth egg mass density. NA-TP-07-92, U.S. Department of Agriculture, Forest Service, Northeastern Area, Morgantown, WV.
[2] Random direction table based on Scott Costa's hemlock wooly adelgid sequential sampling plan.

Sequential sampling table for sampling gypsy moth egg mass populations
at three management thresholds in urban/suburban habitats[3]

Sample guide showing minimum numbers of plots (1/40 acre) that must be examined in an
egg mass survey to permit site classification with respect to expected gypsy moth defoliation.

Management Threshold (egg masses/acre)	# of plots (1/40 acre) sampled	Total number of new egg masses counted		
		Below threshold STOP sampling	Continue sampling	Above threshold STOP sampling
250 egg masses/acre "Noticeable Caterpillars"	6	< 4	4 – 71	> 71
	7	< 10	10 – 77	> 77
	8	< 16	16 – 83	> 83
	9	< 22	22 – 89	> 89
	10	< 28	28 – 95	> 95
	11	< 34	34 – 101	> 101
	12	< 40	40 – 107	> 107
	13	< 46	46 – 113	> 113
	14	< 52	52 – 119	> 119
	15	< 58	58 – 125	> 125
500 egg masses/acre "Noticeable Defoliation"	7	< 7	7 – 159	> 159
	8	<19	19 – 171	> 171
	9	< 31	31 – 182	> 182
	10	< 43	43 – 194	> 194
	11	< 54	54 – 206	> 206
	12	< 66	66 – 218	> 218
	13	< 78	78 – 229	> 229
	14	< 90	90 – 241	> 241
	15	< 101	101 – 253	> 253
	16	< 113	113 – 265	> 265
	17	< 125	125 – 277	> 277
	18	< 137	137 – 288	> 288
	19	< 149	149 – 300	> 300
	20	< 160	160 – 312	> 312
	21	< 172	172 – 324	> 324
	22	< 184	184 – 335	> 335
1000 egg masses/acre "Likely Mortality"	7	< 11	11 – 334	> 334
	8	< 35	35 – 359	> 359
	9	< 60	60 – 383	> 383
	10	< 85	85 – 408	> 408
	11	< 109	109 – 432	> 432
	12	< 134	134 – 457	> 457
	13	< 159	159 – 482	> 482
	14	< 183	183 – 506	> 506
	15	< 208	208 – 531	> 531
	16	< 232	232 – 555	> 555
	17	< 257	257 – 580	> 580
	18	< 281	281 – 604	> 604
	19	< 306	306 – 629	> 629
	20	< 330	330 – 654	> 654
	21	< 355	355 – 678	> 678
	22	< 380	380 – 703	> 703
	23	< 404	404 – 727	> 727
	24	< 429	429 – 752	> 752

[3] Sequential table from Fleischer et al. 1992. Sequential sampling plans for estimating gypsy moth egg mass density. NA-TP-07-92, U.S. Department of Agriculture, Forest Service, Northeastern Area, Morgantown, WV.

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Gypsy Moth Sequential Sampling Data Form

Observer Name(s): ___NAJA KRAUS___ Date: ___11/15/2005___

Site #: __1__ County: ___WARREN___ Town: ___THURMAN___

Forest Type: __MIXED HARDWOODS__ GPS coordinates*: __18 589475E__ , __4823612N__ Elev: __1300 ft__
(&/or 3 dominant tree species) * NYSDEC uses UTM NAD 83

Management Threshold (egg masses/acre): ☐ 250 ☐ 500 ☑ 1000

Habitat: ☑ continually forested ☐ urban/suburban (≥ 1 house per 10 acres)
(minimum: 4 plots, maximum: 10 plots) (minimum: 6 or 7 plots, maximum: 15, 22 or 25 plots)

Plot (1/40 -acre)	Actual egg mass counts			Formulas to estimate % new		Total # of new egg masses per plot (F)	Cumulative # of egg masses [sum of new egg masses found at all plots]
	Egg masses on ground and lower portion of trunks		All egg masses in Crown (C)	% new egg masses (D)	# of new crown egg masses (E)		
	Old (A)	New (B)		B/(B+A)	C * D	B+E	F+F+F….
1	8	19	28	19/(19+8) = 0.70	28 * 0.70 = 20	28 + 20 = 39	39
2	8	24	30	0.75	23	47	86
3	4	20	25	0.83	21	41	127
4	7	21	20	0.75	15	36	163
5	6	22	31	0.79	24	46	209
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25							

Total # of egg masses found: 209 Total # of plots sampled: 5 Average # of egg masses/acre: 1672
[(total # egg masses/total # plots)*40]

Above management threshold? ☑ Yes ☐ No ☐ Undetermined

Average egg mass length (*measure 5 typical egg masses*): ☐ small ☐ average ☑ large
__29__ __34__ __33__ __31__ __33__ (< 20 mm) (20-30 mm)

Comments: THIS STAND WAS MODERATELY DEFOLIATED IN 2004

2005