Gypsy Moth Egg Mass Sampling Design

Naja Kraus
NYS DEC
Division of Lands & Forests
Forest Health & Protection

To determine management options one needs to quantify gypsy moth densities and potential effects for the following year

Choose Survey Area

- Need to identify area of concern
  - Geographical boundaries
  - Ownership
  - Ecosystem
  - Areas of special concern
  - Personal choice

Management Thresholds

- USDA Forest Service (Liebhold et al 1994)
  - 500-750 egg masses/acre to prevent noticeable defoliation (>30% defoliation)
  - 700-900 egg masses/acre to prevent growth loss (>40% defoliation)
  - 1000-1400 egg masses/acre to prevent mortality (> 60% defoliation)

Management Threshold (egg masses/acre)
250 egg masses/acre "Noticeable Caterpillars"
500 egg masses/acre "Noticeable Defoliation"
1000 egg masses/acre "Likely Mortality"

Egg Mass Sampling in NY State

- Based on USDA Forest Service Publication
  - Sequential sampling plans for estimating gypsy moth egg mass density (Fleischer et. al. 1992)
- Objective: to determine if gypsy moth population numbers in sampled stands fall above or below chosen management threshold

Sequential sampling method

- A sequential sampling plan helps to allocate labor
- Very low and very high populations require the least sampling
- Site sample may vary from 4 – 9 plots
- Different tables for forested and urban/ suburban habitats

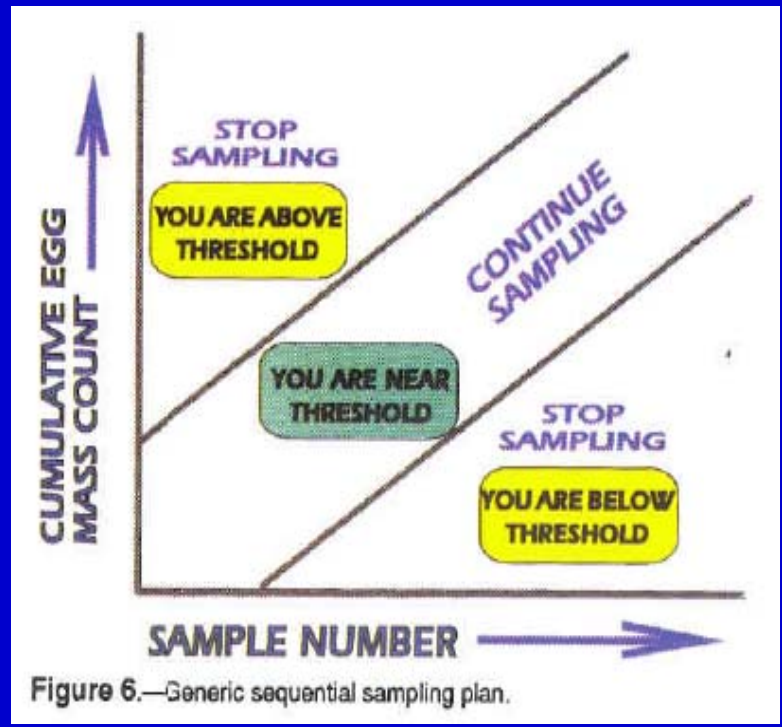


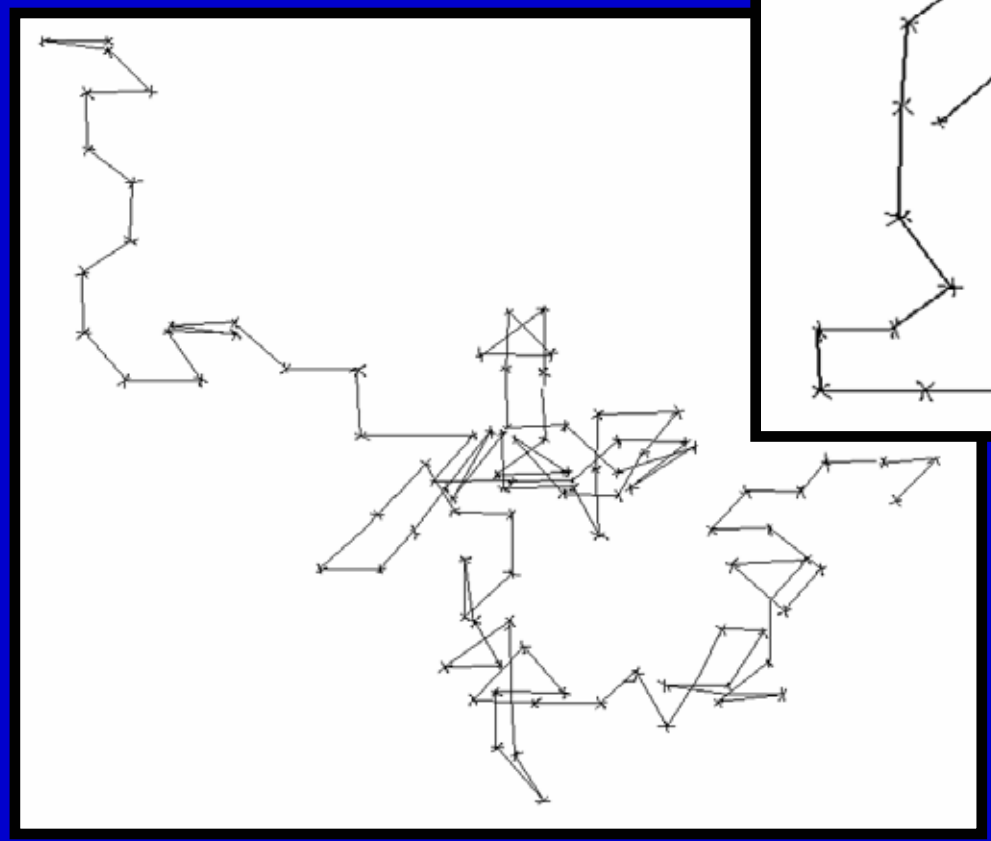
Figure 6.—Generic sequential sampling plan.

Choosing Plot Center

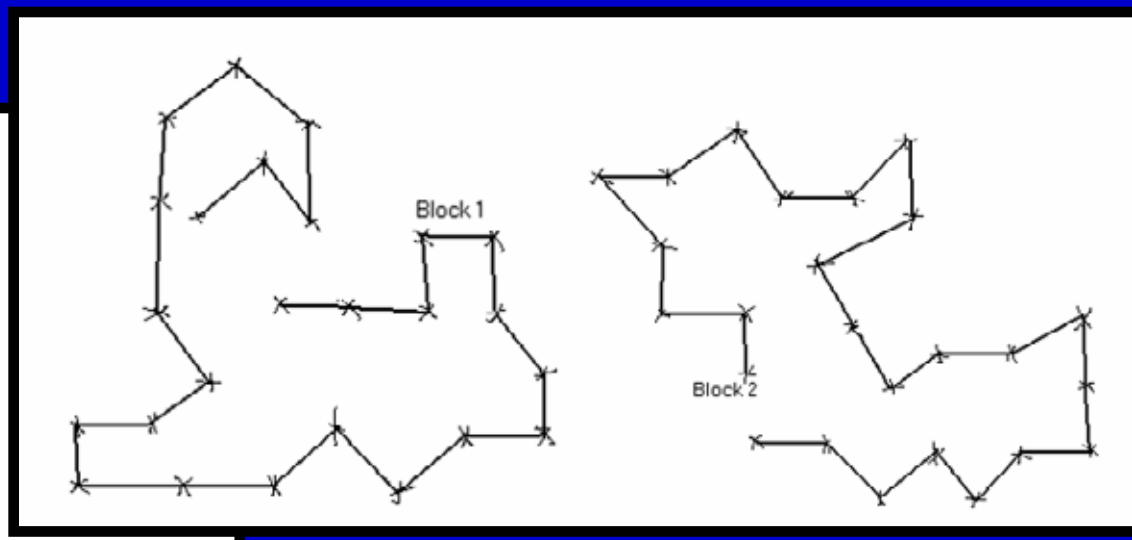
- 1st plot center
  - generated random coordinates
  - or walk 40 m (130 ft, 2 chains) perpendicular from the nearest road or trail in the area you wish to sample.
- Additional plots
  - Walk 100 ft (30 m, 1½ chains) in direction noted on random direction table.

Choosing a Random Direction

Developed by Scott Costa, University of VT, Entomology Research Lab



Too much science?



Semi-random Cardinal Path

Random Direction Table

Random Direction Table[1]

The first plot should be chosen by walking 130 ft (40 m, 2 chains) perpendicular from the nearest road 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] Random direction table based on Scott Costa's hemlock wooly adelgid sequential sampling plan.

Data Sheet (1)

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 feet

* DEC uses UTM NAD 83

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

Habitat: ☑ continually forested (minimum: 4 plots, maximum: 10 plots) ☐ urban/suburban (≥ 1 house per 10 acres) (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 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							
⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩
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

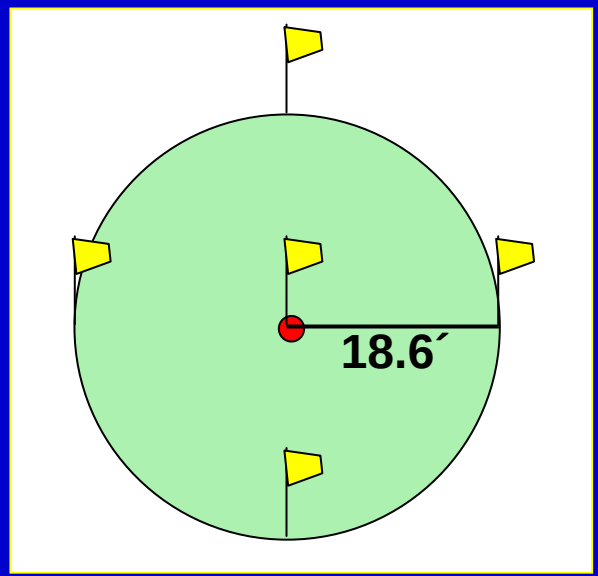
Average egg mass length (*measure 5 typical egg masses*): ☐ small (< 20 mm) ☐ average (20-30 mm) ☐ large (> 30 mm)

_____ _____ _____ _____ _____

Comments:

Plot Layout

- 18.6 ft (5.7 m) radius circular plot
- Plot area = 1/40 acre (0.01 ha)
- Set up flags at center and 4 cardinal directions



Counting Egg Masses

- All egg masses within circular plot must be counted
  - 1st count all egg masses on the ground (i.e. on fallen branches or rocks) & below six feet on trees (old & new separately)
  - 2nd count all egg masses (old & new combined) above six feet
    - Use binoculars or spotting scope
    - View trees from multiple vantage points

Data Sheet (2)

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 feet

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Habitat: ☑ continually forested (minimum: 4 plots, maximum: 10 plots) ☐ urban/suburban (≥ 1 house per 10 acres) (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 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				
2							
3							
4							
5							
⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩
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 (< 20 mm) ☐ average (20-30 mm) ☐ large (> 30 mm)

_____ _____ _____ _____ _____

Comments:

Calculations (1)

- Determine % of new egg masses in the ground count
  - Divide number of new ground egg masses by total number of ground egg masses

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 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			

Calculations (2)

- Determine number of new egg masses in the crown
  - Multiply number of all crown egg masses with % new egg masses

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 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		

Calculations (3)

- Determine total number of new egg masses
  - sum new ground egg masses & new crown egg masses

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 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	
2							

Data Sheet (3): Sample 4 plots & sum total # of new egg masses

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 feet

* DEC uses UTM NAD 83

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

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

Plot (1/40 -acre)	Actual egg mass counts			Formulas to estimate % new			
	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)**	Total # of new egg masses per plot **(F)**	Cumulative # of egg masses [sum of egg masses found at all plots]
	Old **(A)**	New **(B)**		B/(B+A)	C * D	B+E	F+F+F….
1	8	19	28	0.70	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							
⇩	⇩	⇩	⇩	⇩	⇩	⇩	⇩
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

Consult Sequential Sampling Table

- Consult sequential sampling table to determine if the stand falls above or below the chosen threshold.
- Continue sampling additional plots until a result is determined.

Sequential sampling table

for Gypsy Moth egg masses at three management thresholds in continuously forested eastern hardwoods

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

Data Sheet (5)

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 feet

* DEC uses UTM NAD 83

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

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

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	Old **(A)**	New **(B)**		B/(B+A)	C * D	B+E	F+F+F….
1	8	19	28	0.70	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
	⇩		⇩		⇩		⇩
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 (< 20 mm) ☐ average (20-30 mm) ☐ large (> 30 mm)

_____ _____ _____ _____ _____

Comments:

Sequential sampling table

for Gypsy Moth egg masses at three management thresholds in continuously forested eastern hardwoods

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	8	< 31	31 – 66	> 66
	9	< 37	37 -73	> 73
500 egg masses/acre "Noticeable Defoliation"	4	< 16	16 – 81	> 81
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	6	< 40	40 – 106	> 106
	7	< 53	53 – 118	> 118
	8	< 65	65 – 130	> 130
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	7	< 93	93 – 252	> 252
	8	< 117	117 – 276	> 276
	9	< 142	142 - 301	> 301

Data Sheet (4)

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 feet

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

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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
	⇩		⇩		⇩		⇩
25							

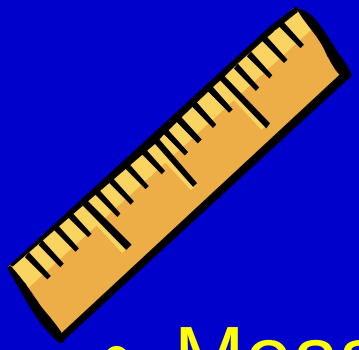
Total # of egg masses found: 209 Total # of plots sampled: 5 Average # of egg masses/acre: [(total # egg masses/total # plots)*40] 1672

Above management threshold? ☑ Yes ☐ No ☐ Undetermined

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

_____ _____ _____ _____ _____

Comments:



Egg Mass Size

- Measure the length of 5 egg masses
- Determine if the average length is
  - < 20 mm (small)
  - 20 – 30 mm (normal)
  - > 30 mm (large)
- Small egg masses may indicate decreasing population
- Large egg masses may indicate increasing population

Data Sheet (5)

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 feet

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	⇩		⇩		⇩		⇩
25							

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

Above management threshold? ☑ Yes ☐ No ☐ Undetermined

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

29 34 33 31 33

Comments: THIS SITE WAS MODERATELY DEFOLIATED IN 2004.

Qualifiers

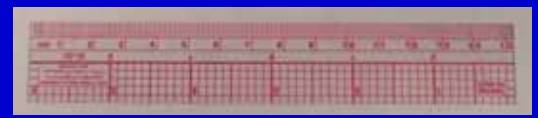
- This is not a 100% accurate method
- Weather, parasites and other factors may cause significant egg and larval mortality
- Other factors to consider
  - levels of defoliation from previous years
  - number of years of previous defoliation
  - extent of defoliation in adjacent areas
  - length of egg masses

Additional Information

- It is easier to see egg masses with good light and under dry conditions
- May want to flag or mark plot center in order to compare actual defoliation with predicted defoliation
- Some people have allergic respiratory and skin reactions to gypsy moth parts

Suggested Survey Equipment

- Binoculars or spotting scope & tripod
- Personal Digital Assistant (i.e. IPAQ, datalogger) paper data sheets with clipboard & pencil
- Sequential sampling table(s) & sampling protocol
- GPS, compass & site map
- 5.7 m (18.6 ft.) tape/string
- 5 bright color stake flags
- Small ruler to measure egg masses



Survey Equipment - Helpful Extras

- Tally counters
- Plastic groundcloth (using binoculars)
- Campchair (using spotting scope)
- For Safety:
  - First aid kit
  - Cell phone or radio
  - Orange vest
  - Hardhat

Submit your data

- Please email or mail your egg mass sampling 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.

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

Telephone: 518-402-9425
Fax: 518-402-9028
Email: lands@gw.dec.state.ny.us
In the subject line please write
"To the Attention of Forest Health"

- An outcome where no defoliation is predicted is also of interest to us.
- 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!