Forest Tent Caterpillar
Egg Mass Sampling Design

Naja Kraus
NYSDEC
Division of Lands & Forests
Forest Health & Protection
To determine management options one needs to quantify forest tent caterpillar densities and potential effects for the following year.
Egg Mass Sampling in NY State

• Field Protocol for Sampling FTC Egg Masses
  – Based on:
    • Field protocol for sampling forest tent caterpillar egg masses - Recommendation by Douglas C. Allen 1994
    • The development and application of a sequential sampling plan for forest tent caterpillar - Connola et al. 1957

• Objective: to classify stands with respect to “expected defoliation.”
  – Noticeable defoliation v. no noticeable defoliation
Sequential sampling method

- A sequential sampling plan helps to allocate labor
- Areas with very low or high populations require the least amount of sampling.
- Plot size may vary from 2 – 25 sugar maple trees
Choose Survey Area

• Need to identify area of concern
  – Geographical boundaries
  – Ownership
  – Ecosystem
  – Areas of special concern
  – Personal choice
## Number of Sampling Plots

<table>
<thead>
<tr>
<th>Woodlot Size</th>
<th># of Plots</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10 acres</td>
<td>2 for each 5 acres</td>
</tr>
<tr>
<td>10-50 acres</td>
<td>1 for each 10 acres</td>
</tr>
<tr>
<td>50-100 acres</td>
<td>1 for each 25 acres</td>
</tr>
<tr>
<td>&gt; 100 acres</td>
<td>1 for each 50 acres</td>
</tr>
</tbody>
</table>
Choosing Sample Points

• GIS
  – Place points randomly (100 feet from road) within 50 acre grid over identified survey area polygon

• Site Map
  – Highlight areas on map within which you wish to survey
Prerequisites

- Distinguish new from old egg masses
- Delineate a 30-inch branch tip from the ground on varying height trees
- Practice, Practice, Practice
NEW egg mass: dark brown & shiny

OLD egg mass: lighter, almost whitish & dull
Sampling Procedures

• Time of year
  – Egg masses present September to mid-April
  – Easier to see egg masses without tree leaves
  – Easier to tell old from new egg masses earlier in the season

• Ideal weather conditions
  – Good light
  – No wind
  – Dry conditions
Navigating to the First Plot

• Use GPS to navigate to coordinates

  OR

• Walk 130 ft (40 m, 2 chains) perpendicular from the nearest road or trail in the area you wish to sample.

  OR

• Walk to an area you want to sample
### SAMPLE Forest Tent Caterpillar Sequential Sampling Data Form

**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

<table>
<thead>
<tr>
<th>Sugar Maple Tree #</th>
<th>Tree DBH</th>
<th>Number of NEW egg masses per 30-inch upper crown branch tips</th>
<th>Total # of egg masses per tree x 1,2 or 4</th>
<th>Cumulative # of NEW egg masses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Branch 1</td>
<td>Branch 2</td>
<td>Branch 3</td>
</tr>
<tr>
<td>1</td>
<td></td>
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<td>2</td>
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<td>3</td>
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</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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

**Comments:**
• Pick tree # 1 (an overstory sugar maple)
  – Tree closest to plot center (or choose randomly)

• Use binoculars or spotting scope to count the number of NEW egg masses on ten, 30-inch branch tips
  – Branch tips observed should cover the entire upper crown
  – Sample with back to the sun
  – Stand at the highest point
Data Sheet

SAMPLE Forest Tent Caterpillar Sequential Sampling Data Form SAMPLE

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

Plot #: ___ 1 ___ County: ___________ WARREN _____________________ Town: ____________________________________________

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

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

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<tr>
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<th>Total # of egg masses per tree x 1,2 or 4</th>
<th>Cumulative # of NEW egg masses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>Branch 1: - Branch 2: 1 Branch 3: - Branch 4: 1 Branch 5: - Branch 6: - Branch 7: 1 Branch 8: - Branch 9: 4 x 2 = 8 Branch 10: 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Branch 1: - Branch 2: - Branch 3: - Branch 4: - Branch 5: - Branch 6: - Branch 7: - Branch 8: - Branch 9: - Branch 10: -</td>
<td></td>
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<tr>
<td></td>
<td>3</td>
<td>Branch 1: - Branch 2: - Branch 3: - Branch 4: - Branch 5: - Branch 6: - Branch 7: - Branch 8: - Branch 9: - Branch 10: -</td>
<td></td>
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<tr>
<td></td>
<td>25</td>
<td>Branch 1: - Branch 2: - Branch 3: - Branch 4: - Branch 5: - Branch 6: - Branch 7: - Branch 8: - Branch 9: - Branch 10: -</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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:
Sampling Protocol (2)

• Walk 100 feet in direction noted in the random direction table and pick the closest dominant or co-dominant sugar maple tree (tree # 2)

• Red v. Sugar maple
  – do NOT survey on red maple
Choosing a Random Direction

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

Semi-random Cardinal Path

Too much science?
Random Direction Table

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.

<table>
<thead>
<tr>
<th>Date</th>
<th>Direction</th>
<th>Date</th>
<th>Direction</th>
<th>Date</th>
<th>Direction</th>
<th>Date</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NE</td>
<td>15</td>
<td>SE</td>
<td>25</td>
<td>E</td>
<td>-</td>
<td>N</td>
</tr>
<tr>
<td>2</td>
<td>SE</td>
<td>16</td>
<td>NE</td>
<td>26</td>
<td>SE</td>
<td>-</td>
<td>SW</td>
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<tr>
<td>3</td>
<td>N</td>
<td>17</td>
<td>E</td>
<td>27</td>
<td>NE</td>
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<tr>
<td>4</td>
<td>NW</td>
<td>18</td>
<td>N</td>
<td>28</td>
<td>SE</td>
<td>-</td>
<td>NW</td>
</tr>
<tr>
<td>5</td>
<td>SW</td>
<td>19</td>
<td>NW</td>
<td>29</td>
<td>NE</td>
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<td>N</td>
<td>30</td>
<td>E</td>
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<td>W</td>
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<td>7</td>
<td>S</td>
<td>21</td>
<td>W</td>
<td>31</td>
<td>N</td>
<td>-</td>
<td>SE</td>
</tr>
<tr>
<td>8</td>
<td>SE</td>
<td>22</td>
<td>S</td>
<td>-</td>
<td>N</td>
<td>-</td>
<td>S</td>
</tr>
<tr>
<td>9</td>
<td>SW</td>
<td>23</td>
<td>W</td>
<td>-</td>
<td>SW</td>
<td>-</td>
<td>E</td>
</tr>
<tr>
<td>10</td>
<td>W</td>
<td>24</td>
<td>W</td>
<td>-</td>
<td>W</td>
<td>-</td>
<td>S</td>
</tr>
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<td>11</td>
<td>S</td>
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<td>SW</td>
<td>-</td>
<td>NW</td>
<td>-</td>
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<tr>
<td>12</td>
<td>E</td>
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<td>NW</td>
<td>-</td>
<td>NE</td>
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<td>E</td>
<td>-</td>
<td>NW</td>
<td>-</td>
<td>NE</td>
<td>-</td>
<td>NE</td>
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<td>14</td>
<td>NE</td>
<td>-</td>
<td>NE</td>
<td>-</td>
<td>NE</td>
<td>-</td>
<td>NE</td>
</tr>
</tbody>
</table>

1 Random direction table based on Scott Costa’s hemlock wooly adelgid sequential sampling plan.
Sampling Protocol (3)

- Repeat the sampling procedure on tree #2
- Sum the cumulative number of NEW egg masses counted
  - Multiply by 4 (binoculars)
  - Multiply by 2 (spotting scope)
Data Sheet

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

<table>
<thead>
<tr>
<th>Sugar Maple Tree #</th>
<th>Tree DBH</th>
<th>Number of NEW egg masses per 30-inch upper crown branch tips</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Branch 1</td>
<td>Branch 2</td>
<td>Branch 3</td>
<td>Branch 4</td>
</tr>
<tr>
<td>1</td>
<td>12.6&quot;</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>15&quot;</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>25</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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”

□ small (≤ ¼ inch, 7 mm) □ “normal” (> ¼ inch, 7 mm)

Comments:
Sampling Protocol (4)

- Consult sequential sampling table to determine if you are able to predict the “expected defoliation” or if sampling additional trees is necessary.

- Continue sampling additional trees until the “expected defoliation” level can be predicted.
### Sequential sampling table for FTC egg mass populations in NY

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

<table>
<thead>
<tr>
<th># of trees (10-twig) sampled</th>
<th>Total number of NEW egg masses counted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No defoliation predicted. STOP sampling</td>
</tr>
<tr>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>2 or less</td>
</tr>
<tr>
<td>4</td>
<td>4 or less</td>
</tr>
<tr>
<td>5</td>
<td>6 or less</td>
</tr>
<tr>
<td>6</td>
<td>8 or less</td>
</tr>
<tr>
<td>7</td>
<td>11 or less</td>
</tr>
<tr>
<td>8</td>
<td>13 or less</td>
</tr>
<tr>
<td>9</td>
<td>15 or less</td>
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<tr>
<td>10</td>
<td>17 or less</td>
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<tr>
<td>11</td>
<td>20 or less</td>
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<tr>
<td>12</td>
<td>22 or less</td>
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<td>13</td>
<td>24 or less</td>
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<td>14</td>
<td>26 or less</td>
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<td>15</td>
<td>28 or less</td>
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<td>16</td>
<td>30 or less</td>
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<td>17</td>
<td>33 or less</td>
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<td>18</td>
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<tr>
<td>23</td>
<td>46 or less</td>
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<tr>
<td>24</td>
<td>48 or less</td>
</tr>
<tr>
<td>25</td>
<td>50 or less</td>
</tr>
</tbody>
</table>
**Data Sheet**

**SAMPLE**  Forest Tent Caterpillar Sequential Sampling Data Form  **SAMPLE**

Observer Name(s): ___________________________  Date: 11/15/2005

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

<table>
<thead>
<tr>
<th>Sugar Maple Tree #</th>
<th>Tree DBH</th>
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<tbody>
<tr>
<td></td>
<td>Branch 1</td>
<td>Branch 2</td>
<td>Branch 3</td>
<td>Branch 4</td>
</tr>
<tr>
<td>1 12.6”</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>2 15”</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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”

Comments:
Egg Mass Size

- Measure the length of 5 NEW egg masses
- Determine if the average length is ≤ or > than ¼ inch
- “Normal” egg masses are ½ inch long
- Egg masses ≤ ¼ inch may indicate decreasing population
**Data Sheet**

**SAMPLE Forest Tent Caterpillar Sequential Sampling Data Form**

**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

**Number of NEW egg masses per 30-inch upper crown branch tips**

<table>
<thead>
<tr>
<th>Sugar Maple Tree #</th>
<th>Tree DBH</th>
<th>Branch 1</th>
<th>Branch 2</th>
<th>Branch 3</th>
<th>Branch 4</th>
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<th>Branch 6</th>
<th>Branch 7</th>
<th>Branch 8</th>
<th>Branch 9</th>
<th>Branch 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12.6”</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>4 x 2 = 8</td>
</tr>
<tr>
<td>2</td>
<td>15”</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>6 x 2 = 12</td>
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</tr>
</tbody>
</table>

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”  
- □ (≤ ¼ inch, 7 mm)
- □ (> ¼ inch, 7 mm)

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

- This is a simplified population sampling survey tool. Be careful how you interpret and use the results.
- A determination of “noticeable” defoliation does not always mean that heavy defoliation will occur.
- Weather, parasites and other factors may cause significant egg and larval mortality.
Modifiers

- Other factors to consider
  - levels of defoliation from previous years
  - numbers of years of previous defoliation
    - Heavy defoliation rarely occurs more than 3 years at a given site
  - extent of defoliation in adjacent areas
  - length of egg masses
    - Average length of $\leq \frac{1}{4}$ inch may indicate lower defoliation than predicted
Additional Information

- Edge trees may contain less egg masses than interior populations.
- Typically can do 2-3 sites per day.
- May want to flag or mark sampled trees in order to compare actual with predicted defoliation.
- Sampling along an elevation gradient may help with predicting stand-level populations.
Choosing your Optics

• Get the best your $$$ can buy
• Increasing light and magnification- improves your ability to view egg masses
• Aperture of 60 is fine, 80 to 100 is better
Spotting Scopes

Advantages over binoculars:
- Increases viewing accuracy
- Easier to differentiate between old & new egg masses

Recommendations:
- 45° angle eyepiece
- Zoom eyepiece (e.g. 20-60x)
- Sturdy tripod
- Folding chair

Comments:
- With practice spotting scopes become easy to use
- Can be expensive to buy a scope that is good enough to work for egg mass surveys
Binoculars

**Advantages over spotting scope:**
- Quick & easy tool
- Lighter and smaller to carry
- Fast learning curve
- Less expensive

**Recommendations:**
- Lie down when viewing egg masses
- Bring something to lie down on (e.g. piece of thick plastic)

**Comments:**
- Opposite buds may look like egg masses
- Difficult to differentiate between old & new egg masses
Additional Options

• **Pole Pruners**
  – Must be able to reach the upper 1/3 of the tree crown.
  – *Cut* ten, 30” branches within the top 1/3 of tree crown
  – Count NEW egg masses on cut branches
  – Choose branches without looking for egg masses first

• **Felled Tree**
  – Fell a dominant or co-dominant Sugar Maple tree
  – Count new egg masses on ten, 30” branches spread across top 1/3 of tree crown
  – Choose branches without looking for egg masses first
Suggested Survey Equipment

- Binoculars or spotting scope & tripod
- Personal Digital Assistant (i.e. IPAQ, datalogger) or paper data sheets with clipboard & pencil
- Sequential sampling table & sampling protocol
- GPS, compass & site map
- DBH tape (if measuring tree DBH)
- Small ruler to measure egg masses
Survey Equipment - Helpful Extras

- 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 FTC 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!