Scanning Electron Microscopy
Project Portfolio
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ESF
State University of New York
College of Environmental Science and Forestry
Specimens of Study

• Goldenrod
• Goldenrod Gall Fly - *Eurosta solidignis*
• Lichen
• Wooly Bear Caterpillar - *Pyrrharctia isabella*
• Utility Knife Blades
Goldenrod Gall Fly
*Eurosta solidignis*

Goldenrod Gall Fly injects its egg into the stem of Goldenrod, a native plant from the aster family. The developing larvae causes a gall to form protecting it through the winter.

http://www.naturenorth.com/winter/gallfly/images/image_02.jpg

http://www.hiltonpond.org/
ThisWeek051001.html

http://www.abundantnature.com/
2011/01/freeze-tolerance.html
Goldenrod Gall Fly
*Eurosta solidignis*

Lichen

A compound colony of algae and cyanobacteria.

Lichen growing on Birch Bark was collected to feed Wooly Bear Caterpillar.

http://www.bennett-smith.com/bark.htm
Woolly Bear Caterpillar

*Pyrrharctia isabella*

The larvae of the Isabella Tiger Moth (*Pyrrharctia isabella*) is commonly known as the Banded Woolly Bear Caterpillar
SPECIMEN PREPARATION
Wooly Bear Caterpillar and Goldenrod Gall Fly Larvae

• Specimens wire fixed in a 2 % glutaraldehyde in 0.1 M cacodylate buffer at pH 7.4 for 1.5 hours at room temperature.

• Dehydration was completed using ethanol water solutions at concentrations of 30 %, 50 %, 70 %, 95 %, and 100 %

• Final drying was accomplished using a critical point dryer with CO₂

• Finally, the samples were coated with Au/Pd
Lichen

- Lichen taken from Tree Bark dried in desiccator for 2 weeks.
- Carbon Coated
Spider Web

• Found around window of wood shop.
• Collected using Masking Tape
• Au/Pd Coated
Part 1

A portfolio of micrographs demonstrating the following techniques:

• Critical Point Drying or TMS drying
• Depth of Field
• Backscatter
• Low voltage image of uncoated sample
• High Magnification (>50,000)
• Stereo Pair
• Cryofracture
• Aesthetic (Optional)
Critical point drying

Fig. 1 Wooly Bear Caterpillar epidermis at a cross section taken a the A7 mid-abdominal segment. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 9, Working Distance 35 mm, Magnification of 85
Critical point drying

Fig. 2 Anterior end of Goldenrod Gall Fly Larvae Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 9, Working Distance 35 mm, Magnification of 43
**Depth of Field**

Fig. 3. Wooly Bear Caterpillar hair. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 9, Working Distance 35 mm, Magnification of 160
Backscatter

Fig. 4 SEM image of rust on a steel utility knife blade. Accelerating Voltage 20.0 kV, Aperture 2, Spot Size 12, Working Distance 15 mm, Magnification of 800
**Backscatter**

Fig. 5 Back Scatter image of rust on a steel utility knife blade. Same sample as Fig.4. Accelerating Voltage 20.0 kV, Aperture 2, Spot Size 12, Working Distance 15 mm, Magnification of 800
Backscatter

Fig. 6 SEM image of carbon coated Lichen. Accelerating Voltage 20.0 kV, Aperture 2, Spot Size 16, Working Distance 19 mm, Magnification of 400
Backscatter

Fig. 7 Back Scatter image of image of carbon coated Lichen. Same sample as Fig.6. Accelerating Voltage 20.0 kV, Aperture 2, Spot Size 16, Working Distance 15 mm, Magnification of 400
Low voltage of uncoated sample

Fig. 8. Low voltage image of posterior end of an uncoated Goldenrod Gall Flay Larvae. Accelerating Voltage 0.6 kV, Aperture 2, Spot Size 12, Working Distance 20 mm, Magnification of 60
Low voltage of uncoated sample

Fig. 9. Low voltage image of an uncoated cryofractured Goldenrod Gall. Accelerating Voltage 1.2 kV, Aperture 2, Spot Size 12, Working Distance 10 mm, Magnification of 100.
High Magnification

Fig.10. High magnification image of an Au/Pd coated sample of ceramic paper. Accelerating Voltage 20.0 kV, Aperture 1, Spot Size 10, Working Distance 10 mm, Magnification of 50000.
High Magnification

Fig.11. High magnification image of an uncoated sample of rust on a steel utility knife blade. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 6, Working Distance 10 mm, Magnification of 85000.
**Stereo Pair**

Fig. 12. Wooly Bear Caterpillar hair. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 6, Working Distance 35 mm, Magnification of 220
Stereo Pair

Fig. 13. Wooly Bear Caterpillar skin fold. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 6, Working Distance 35 mm, Magnification of 1500
Cryofracture

Fig. 14. SEM image of an Au/Pd coated cryofractured dry Red Oak Leaf. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 10, Working Distance 30 mm, Magnification of 1400.
Aesthetic: “Land on the edge of a knife”

Fig. 15. Low voltage image of an uncoated dull edge of a utility knife. Accelerating Voltage 12.0 kV, Aperture 1, Spot Size 12, Working Distance 30 mm, Magnification of 650
Part 2
Biological Sample

Biological Samples were chosen for two reasons:

• To develop techniques for microscopic study of common detrivores to support departments research.

• Personal curiosity to answer the questions:
  – How wooly is a Wooly Bear Caterpillar?
  – What gets caught in a spider web?
How wooly is a Wooly Bear Caterpillar?

Fig. 1 Wooly Bear Caterpillar epidermis at a cross section taken a the A7 mid-abdominal segment. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 9, Working Distance 35 mm, Magnification of 85
How wooly is a Wooly Bear Caterpillar?

Fig. 16 Wooly Bear Caterpillar skin fold of leg joint taken a the A5 mid-abdominal segment. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 7, Working Distance 35 mm, Magnification of 200
How wooly is a Wooly Bear Caterpillar?

Fig. 16 Wooly Bear Caterpillar skin fold of leg joint taken a the A5 mid-abdominal segment. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 6, Working Distance 35 mm, Magnification of 1500
How wooly is a Wooly Bear Caterpillar?

Fig. 17 Wooly Bear Caterpillar Head. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 8, Working Distance 35 mm, Magnification of 35
How wooly is a Wooly Bear Caterpillar?

Fig. 18 Wooly Bear Caterpillar Antennae. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 8, Working Distance 35 mm, Magnification of 220
How wooly is a Wooly Bear Caterpillar?

Fig. 19 Wooly Bear Caterpillar broken Antennae. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 8, Working Distance 35 mm, Magnification of 400
How wooly is a Woolly Bear Caterpillar?

Fig. 20 Wooly Bear Caterpillar Labrum. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 8, Working Distance 35 mm, Magnification of 90
How wooly is a Wooly Bear Caterpillar?

Fig. 21 Wooly Bear Caterpillar Sub labrum. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 6, Working Distance 35 mm, Magnification of 500
How wooly is a Wooly Bear Caterpillar?

Fig. 22 Wooly Bear Caterpillar Sub labrum. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 6, Working Distance 35 mm, Magnification of 4500
How wooly is a Wooly Bear Caterpillar?

Fig. 23 Wooly Bear Caterpillar Sub labrum. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 6, Working Distance 35 mm, Magnification of 1200
How wooly is a Wooly Bear Caterpillar?

Fig. 24 Wooly Bear Caterpillar Sub labrum. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 6, Working Distance 35 mm, Magnification of 25000
Caught in a Web

Fig. 25 Shell found in spider web. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 9, Working Distance 15 mm, Magnification of 230
Caught in a Web

Fig. 26 Particles found in spider web. Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 9, Working Distance 10 mm, Magnification of 5500
Caught in a Web

Fig. 27 Pollen found in spider web. Accelerating Voltage 20.0 kV, Aperture 1, Spot Size 9, Working Distance 10 mm, Magnification of 20000
Caught in a Web

Fig. 27 Particle found in spider web. Accelerating Voltage 20.0 kV, Aperture 1, Spot Size 9, Working Distance 10 mm, Magnification of 3000
Goldenrod Gall Fly Larvae: “You Eat with that?”

Fig. 2 Anterior end of Goldenrod Gall Fly Larvae Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 9, Working Distance 35 mm, Magnification of 43
Goldenrod Gall Fly Larvae: “You Eat with that?”

Fig. 28 Anterior end of Goldenrod Gall Fly Larvae Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 10, Working Distance 35 mm, Magnification of 130
Goldenrod Gall Fly Larvae: “You Eat with that?”

Fig. 29 Anterior end of Goldenrod Gall Fly Larvae Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 10, Working Distance 35 mm, Magnification of 350
White Pine Cone

Fig. 29 Cryofracture of cone segment Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 12, Working Distance 35 mm, Magnification of 430
White Pine Cone: “What is this?”

Fig. 30 Cryofracture of cone segment Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 10, Working Distance 35 mm, Magnification of 1800
Non-Biological Samples were also chosen for two reasons:

• Ceramic Paper is being developed by members of my department. Microscopic analysis will help explain its properties and refine its formulation.

• Personal curiosity as to what happens when a blade loses its edge.
Ceramic Paper

Fig. 31 Uncoated sample Accelerating Voltage 5.0 kV, Aperture 2, Spot Size 12, Working Distance 30 mm, Magnification of 550
Ceramic Paper

Fig. 32 Au/Pd coated sample Accelerating Voltage 10.0 kV, Aperture 2, Spot Size 12, Working Distance 30 mm, Magnification of 550
Ceramic Paper

Fig. 33 Au/Pd coated sample Accelerating Voltage 10.0 kV, Aperture 2, Spot Size 12, Working Distance 30 mm, Magnification of 1000
Fig. 34 Au/Pd coated sample Accelerating Voltage 10.0 kV, Aperture 2, Spot Size 12, Working Distance 30 mm, Magnification of 4000

Ceramic Paper
Ceramic Paper

Fig. 35 Carbon coated sample Accelerating Voltage 20.0 kV, Aperture 1, Spot Size 10, Working Distance 34 mm, Magnification of 4000
The Beauty of being Dull

Fig. 35 Uncoated Utility Knife Blade Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 8, Working Distance 18 mm, Magnification of 350
The Beauty of being Dull

Fig. 37 Uncoated Utility Knife Blade Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 12, Working Distance 35 mm, Magnification of 180
The Beauty of being Sharp

Fig. 38 Uncoated New Utility Knife Blade Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 12, Working Distance 35 mm, Magnification of 150
The Beauty of being Sharp

Fig. 39 Uncoated New Utility Knife Blade Accelerating Voltage 5.0 kV, Aperture 1, Spot Size 12, Working Distance 35 mm, Magnification of 3700
Special Thanks

To

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