

Ghosts in the Garden Night-flying Moths



Janet Knodel

Professor and Extension Entomologist



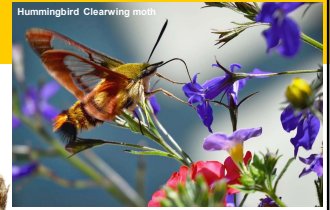
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Moths as Pollinators

- Night flying
- Better at pollinating than previously thought
- Hairy underbellies
- Food source
 - Bats, frogs, small owls
 - songbirds, flying squirrels,
 - grizzly bears



Cloves cutworm
H. Royals, USDA APHIS PPD
ITP, Bugwood.org



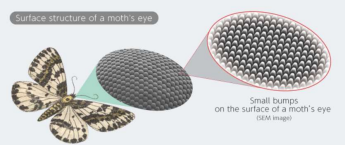
Eight spotted forester
(G. Fauske, NDSU)

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Moth Eyes

- 2 compound eyes on either side of their head
 - Each containing thousands of individual lenses (called ommatidia)
 - Anti-reflective film
- Detect movements
- See colors
- Some detect ultraviolet light

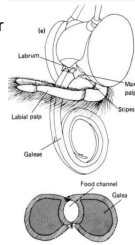


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<https://naturallycuriouswithmanyholland.wordpress.com/2013/07/01/moth-eyes-and-biomimicry/>

Moth Mouthparts

- Siphoning for probing into a flower and sucking out nectar
- A long, slender proboscis
- At rest, this tubular structure remains coiled beneath the head
- Mouthparts absent (vestigial)



(Image credit: AGD Beukhof)
<https://www.gardeningknowhow.com/garden-how-to/beneficial/common-moth-species>

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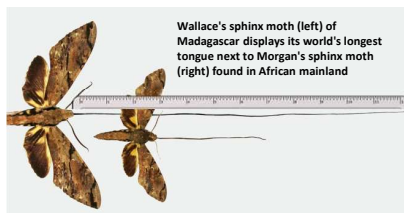
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Longest Moth Tongue

- Wallace's sphinx moth a new species in 2021!



Madagascar star orchid with its extremely long nectar tube. (Source: New York Botanical Garden)



Wallace's sphinx moth (left) of Madagascar displays its world's longest tongue next to Morgan's sphinx moth (right) found in African mainland

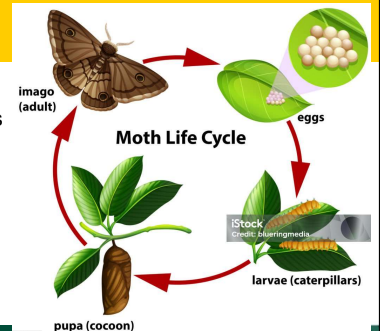
Minet et al. 2021

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Moth Life Cycle

- Complete Metamorphosis
- Egg to larval stages to pupa to adult
- Each life stage looks different
- Pupal stage (cocoon)



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Order Lepidoptera: Moths versus Butterflies

Moths

- ≈160,000 known moth species worldwide
- ≈12,000 known moth species in North America
- Night flying, some day flying



Butterflies

- ≈20,000 known butterfly species worldwide
- ≈825 known butterfly species in North America
- Day flying



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Moths versus Butterflies

Moths

- Straight filaments or feathery or branched



Luna moth



Yellow-collared scape moth
S. Ellis, bugwood.org
2013-10-07

Butterflies

- Knobbed antennae



Painted lady butterfly (P. Beauzay, NDSU)

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Moths versus Butterflies

Moths

- Robust and fuzzy bodied



Virginia Ctenucha
(J. Fauske, NDSU)



Common looper moth
(David Cappaert, Bugwood.org)

Butterflies

- Smooth larvae, slender



Clouded sulfur (J. Fauske)



Aphrodite fritillary (J. Fauske)



Monarch caterpillar
Ansel Oommen, Bugwood.org

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Moths versus Butterflies

Moths

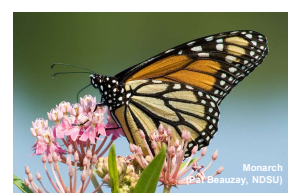
- Spread out wings at rest



Luna moth
(B. MacDonald, Sault College, bugwood)
551853

Butterflies

- Rest with wings held upright



Monarch
(Pat Beauzay, NDSU)

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Moths versus Butterflies

Moths

- Dull colors – brown, black, olive green, dark markings on wings, but exceptions



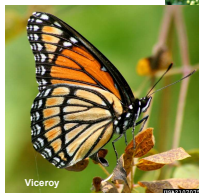
Primrose moth
(J. Yuschick, bugwood)



Variegated cutworm
(J. Fauske, NDSU)

Butterflies

- Colorful and bright

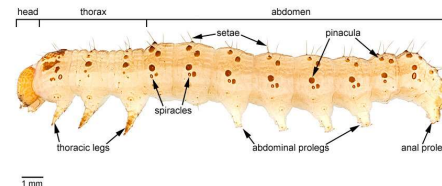


Viceroy
(David Cappaert, Bugwood.org)



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How to Identify a Larva or Caterpillar of Lepidoptera (Moth and Butterflies)



Source: LepIntercept - An identification resource for intercepted Lepidoptera larvae by Todd M. Gilligan and Steven C. Passoa

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Larvae – Crochets

Crochet arrangement on abdominal prolegs;
 A: *Helicoverpa armigera* (Noctuidae); B: *Mamestra brassicae* (Noctuidae); C: *Capitarsia* sp. (Noctuidae);
 D: *Trichoplusia ni* (Noctuidae); E: *Diaphania nitidalis* (Crambidae); F: *Diatraea lineolata* (Crambidae);
 G: *Crocidosema plebejana* (Tortricidae); H: *Thaumetotibia leucotreta* (Tortricidae);
 I: *Pectinophora gossypiella* (Gelechiidae)



Source: LepIntercept - An identification resource for intercepted Lepidoptera larvae by Todd M. Gilligan and Steven C. Passoa

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Larvae – How to Identify a Moth Caterpillar

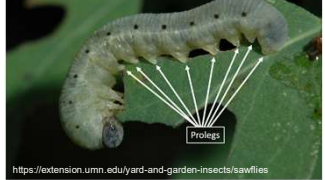
Lepidoptera: Moth larva (caterpillar)



Hermit sphinx moth (Courtesy of J. Fauske, NDSU)

2-5 pairs of prolegs on the abdomen, crochets on prolegs. Smooth, hairy or spiny, and vary in size

Hymenoptera: Sawfly larva



<https://extension.umn.edu/yard-and-garden-insects/sawflies>

Six or more pairs of prolegs, smaller prolegs, no crochets on prolegs, smooth, about 1 inch long when mature

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How to Identify a Moth Caterpillar (larva)

Lepidoptera: Moth larva (caterpillar)



Hermit sphinx moth (Courtesy of J. Fauske, NDSU)

Head capsule, 2-5 pairs of prolegs on the abdomen, thoracic legs behind head, smooth, hairy or spiny, and vary in size

Coleoptera: Grubs or wireworms



White grub (J. Knodel, NDSU)



Wireworm larva (P. Beauzay, NDSU)

Lack prolegs or have very few, 3 pairs of thoracic legs, body shape diverse

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How to Identify a Moth Caterpillar (larva)

Lepidoptera: Moth larva (caterpillar)



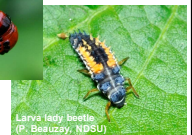
Hermit sphinx moth (Courtesy of J. Fauske, NDSU)

Head capsule, 2-5 pairs of prolegs on the abdomen, thoracic legs behind head, smooth, hairy or spiny, and vary in size

Coleoptera: Larva or wireworms



Larva CPB (J. Knodel, NDSU)



Larva lady beetle (P. Beauzay, NDSU)

Lack prolegs or have very few, 3 thoracic legs, body shape diverse

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EXTENSION

How to Identify a Moth Caterpillar (larva)

Lepidoptera: Moth larva (caterpillar)



Hermit sphinx moth (J. Fauske, NDSU)

Head capsule, 2-5 pairs of prolegs on the abdomen, thoracic legs behind head, smooth, hairy or spiny, and vary in size

Diptera: Fly larva (maggot)



Blow flies (Susan Ellis, Bugwood.org)

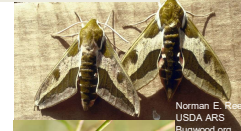
No legs and no prolegs, no head capsule, burrow into moist, decaying organic matter or dead animals

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Common Moth Families Sphingidae - Hornworms, Sphinx, or Hawk moth

Leafy spurge hawkmoth



Norman E. Brown
USDA ARS
Bugwood.org
000000000



Patrick Beauzay
NDSU



White-lined sphinx

Terry Curtis
Bugwood.org



Patrick Beauzay
NDSU

Fast-flying

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Source: <https://extension.sdstate.edu/night-blooming-flowers-and-host-plants-moths>

Common Moth Families Noctuidae – Owlets, Cutworms, Underwings

Winter cutworm or large yellow underwing



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Larry Line, Mostly Moths of
Maryland, Bugwood.org



Red-backed cutworm

Gerard Fauske
NDSU



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Maryland, Bugwood.org

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Common Moth Families – Erebidæ (Lymantriidæ) - Tussock Caterpillars

Milkweed tussock moth and caterpillars



Whitney Cranshaw, Colorado
State University, Bugwood.org

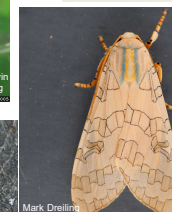


Kevin D. Arvin
Bugwood.org



Invasive Spongy moth

Pale tussock moth and caterpillar



Mark Drilling
Bugwood.org



Jon Yuschick
Bugwood.org

5539717

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Common Moth Families - Erebidæ (Arctiidæ) Tiger moths, Lichen moths

Saltmarsh caterpillar



Whitney Cranshaw, Colorado State
University, Bugwood.org



Whitney Cranshaw, Colorado State
University, Bugwood.org



Banded woollybear

Sturgis McKeever,
Georgia Southern
University, Bugwood.org



Whitney Cranshaw, Colorado State
University, Bugwood.org

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Common Moth Families Erebidæ (Arctiidæ) Banded woolly bear



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Banded woollybear

Sturgis McKeever,
Georgia Southern
University, Bugwood.org

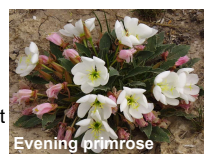


Whitney Cranshaw, Colorado State
University, Bugwood.org

Host Plants for Moths

- Typically white or pale in color
 - Datura (*Datura wrightii*)
 - Morning glory (*Convolvulus* spp.)
 - Common evening primrose (*Oenothera biennis*)
- Long tubular flowers with lots of nectar
- Landing platforms/clusters
- Open late afternoon or night
- Plant larval host plants

Datura



Evening primrose



Morning glory

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Source: <https://www.xerxes.org>

Food Sources and Host Plants for Moths

- Most nectar generalists
- Some nectar specialists
- Native plants
- Oaks, birch, willows, cherries
- Native flowers and grasses
 - Leadplant
 - Blazing star
 - Joe Pye weed
 - Milkweed

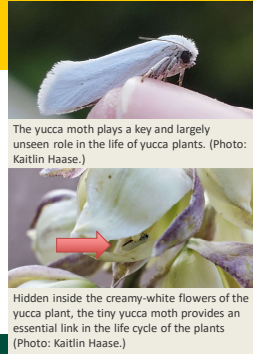


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Source: <https://extension.adstate.edu/night-blooming-flowers-and-host-plants-moths>

Host Plant – Moths Relationship

- Yucca plant – solely pollinated by yucca moths, and the moth caterpillars feed only on yucca seeds
- Yucca plant and yucca moths have coevolved to rely entirely on each other



Source: <https://www.xerces.org/blog/the-right-shill-moths-as-nocturnal-pollinators>

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Night-blooming Flowers for Moths

Common Name	Scientific Name	Sun	Height	Bloom	Characteristics
Angel's trumpet	<i>Burmannia</i> sp.	Sun	5-10'	Fragrant yellow or white flowers	Subtropical annual
Devil's trumpet, Moonflower	<i>Datura innoxia</i>	Sun	2-5'	Large white, fragrant, trumpet shaped flowers	Annual
Evening scented stock	<i>Mathiola longipetala</i>	Sun, part shade	12-15"	Summer flowering, Creamy yellow, pink, or white	Annual
Flowering tobacco	<i>Nicotiana glauca</i>	Sun	2-7'	Fragrant white flowers	Annual
Moonflower	<i>Ipomoea alba</i>	Sun	Vine to 20'	White, saucer shaped fragrant flowers	Annual

Source: <https://extension.sdstate.edu/night-blooming-flowers-and-host-plants-moths>

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Night-blooming Flowers for Moths

Tuberose	<i>Agave amica</i>	Sun	2-3' stalks	Tubular white, fragrant flowers	Annual
Four o'clocks	<i>Mirabilis jalapa</i>	Sun, part shade	6-12"	Tubular orange, white, pink, or yellow flowers	Annual
Night phlox	<i>Zoluzianeskya cupensis</i>	Sun	6-12"	Lacy white flowers with burgundy petals with honey fragrance	Annual
Four o'clocks	<i>Tiarella</i> sp.	Part shade, shade	6-12"	Groundcover with pink flowers	Perennial
Evening primrose	<i>Oenothera biennis</i>	Sun, part shade	1-5'	White, pink, or yellow flowers	Biennial
Yucca	<i>Yucca glauca</i>	Sun	3-4'	White, yellow flowers	Perennial

Source: <https://extension.sdstate.edu/night-blooming-flowers-and-host-plants-moths>

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Food Sources and Host Plants

- Most nectar generalists
- Some nectar specialists
- Native keystone plants
- Oaks, birch, willows, cherries
- Native flowers and grasses

Common Name	Scientific Name	Sun	Moisture	Height	Bloom	Color	Form	Moth Visitors/Hosts
Oak	<i>Quercus</i> sp.	Sun	Dry, medium	50-80'	NA	NA	Tree	Imperial, Polyphemus, Banded tussock
River birch	<i>Betula nigra</i>	Sun, part shade	Medium to wet	40-70'	NA	NA	Tree	Luna, Imperial
Wild grape	<i>Vitis riparia</i>	Sun, part shade	Dry, medium	Up to 20' long	May-Jun	White, green	Vine	Eight spotted forester
Leadplant	<i>Amorpha canescens</i>	Sun, part shade	Dry	1-3'	Jun-Jul	Purple	Shrub	Leadplant flower, Megalopa underwing
Northern bush honeysuckle	<i>Diervilla lonicera</i>	Sun, part shade	Dry, medium	1-3'	Jun-Aug	Yellow	Shrub	Laurel sphinx, Strawberry clearwing
Serviceberry	<i>Amelanchier</i> sp.	Sun, shade	Medium	10-25'	May-Jun	White	Shrub	Small-eyed sphinx, Interrupted dagger

Source: <https://extension.sdstate.edu/night-blooming-flowers-and-host-plants-moths>

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Food Sources and Host Plants

Aster	<i>Symphoricarpos</i> sp.	Sun, part shade	Dry, medium	2-5'	Aug-Oct	Purple-blue	Perennial forb	Wavy-lined emerald
Blazing star	<i>Liatris</i> sp.	Sun	Dry, medium	3-5'	Aug-Sep	Purple	Perennial forb	Glorious flower 3-lined flower, Wavy-lined emerald
Goldenrod	<i>Solidago</i> sp.	Sun	Dry, medium	3-5'	Aug-Oct	Yellow	Perennial forb	Wavy-lined emerald
Joe Pye weed	<i>Euthyrium purpureum</i>	Sun, part shade	Medium, wet	3-7'	Jul-Sep	Pink, purple	Perennial forb	Clymene 3-lined flower, Ruby tiger, Great tiger
Rose milkweed	<i>Asclepias incarnata</i>	Sun	Medium, wet	3-5'	Jun-Aug	Pink	Perennial forb	Hawk moth, Dogbane tiger, milkweed tussock
Yucca	<i>Yucca glauca</i>	Sun	Dry	3-4'	Jun-Aug	White	Perennial forb	Yucca moth

Source: <https://extension.sdstate.edu/night-blooming-flowers-and-host-plants-moths>

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Moon Gardens

- White or silvery foliage
 - White hydrangeas, moonflowers, white cosmos, white lilies, white phlox
- Night-blooming plants with strong scents (fragrant flowers)
 - Jasmine, night-scented stock
- Soft lighting - moon's light
- Peaceful ambiance
 - Water features or wind chimes



Watching Moths in your Gardens

- Light trap
 - Take photographs instead of “killing and collecting” moths
- Flashlight with red lens
- National Moth Week



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<https://www.xerces.org/blog/moths-are-cool-too>

ALL MOTHS in Trouble! Help save!

- Turn Out the Lights! **Light pollution**
 - Decline in moths and fireflies
 - Disruptive to bird migrations
- Outdoor lights (rising sun) attract night-flying moths
 - Confuses moth and fly in circles around artificial light
 - LED lights increase the mortality of insects
 - Use warm colors, dim low-voltage lighting
 - Motion-activated lights



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ALL MOTHS in Trouble! Help save!

- Electric bug zappers
 - Useless for controlling mosquitoes and other insect pests
 - Total catch per summer – 13,789 moths and only 31 biting insects
 - 1990 study – 4 million bug zappers in use in the U.S.
 - Killing 71 billion harmless and beneficial insects
 - Electrocuted insects are blasted and release a fine mist containing insect parts and, bacteria and viruses up to 7 feet from the device.
 - Detrimental to your health
- Pesticides, Habitat loss, invasive species



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Protect Moths

- Brush piles
- Leaf litter
- Limited pesticide use

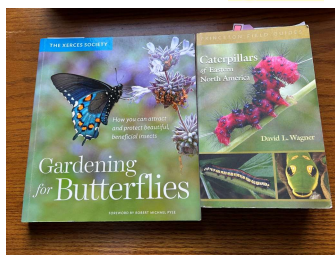


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Moth Resources

- Xerces website – “Moths”
 - <https://www.xerces.org/>
- SDSU Extension
 - “Night-Blooming Flower and Host Plants for Moths”
- U.S. Forest Service
 - “Moth Pollination”
- McCormac, J., & Gottfried, C. (2023). *Gardening for Moths: A Regional Guide*. Ohio University Press.



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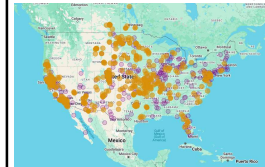
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Moth Resources

Butterflies and Moths of North America

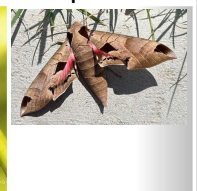
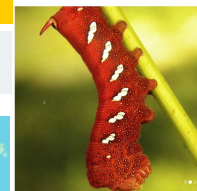


<https://www.butterfliesandmoths.org>



Achemon sphinx
Eumegastis achemon (Drury, 1773)

Achemon sphinx moth



Family: Tortricidae
Subfamily: Tortricinae
Identification: Larva of large, light yellow-green. Forewing has a squiggle dark spot at the center of the brown margin. Hindwing has a brownish black line separating the brown and white areas.
Life Cycle: Larva of large, light yellow-green. Forewing has a squiggle dark spot at the center of the brown margin. Hindwing has a brownish black line separating the brown and white areas.
Host Plants: Larva feeds on a variety of plants, including alfalfa, clover, and alfalfa.
Geography: Larva feeds on a variety of plants, including alfalfa, clover, and alfalfa.
Management: Larva feeds on a variety of plants, including alfalfa, clover, and alfalfa.

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