WRCF POSTER

ADULT AND LARVA OF MOTHS OF PENNSYLVANIA

Moths and Butterflies Which is Which?

DIFFERENCES BETWEEN MOTHS AND BUTTERFLIES

The previous WRCF poster on Butterflies and Skippers described basic structural differences of butterflies, skippers, and moths. Behaviorally, most butterflies are diurnal (day active) while most moths are nocturnal and or crepuscular, some totally night active or, as many, crepuscular (active in the twilight of dusk). Low temperature and excessively high humidity usually minimizes dawn flights.

Those moths that are nocturnal are obviously less conspicuous and observable to humans. Yet their varied coloration and patterns reflect many adaptations exhibited by a variety of life forms. This begs a question - Why are many moths so brightly colored or conspicuous when they are flying at night when it is dark? Even though the darkness of night protects them from being visible to predators most moth predators are day active and prey on moths while they are at rest. Camouflaged species such as underwing moths are less visible if they are resting on tree bark with their wings held prostrate. But when startled they will raise their forewings to reveal on the hind wing bright patterns of yellow and black, orange and black or red and black bands that communicate warning coloration. Eyespots may effectively defer predation of numerous species such as *Antheraea polyphemus***,** the owl - face mimic or likewise, *Automeris io*, the Io Moth, whereas the two large eyes on the lower wing of many sphinx moths present a menacing head with large eyes. The presence of smaller eyespots near the corners of many giant silkworm moths such as *Callasomia* and *Hyalophora* species may function to increase the "near miss" of an insectivorous bird attempting to strike at a vulnerable "eye". Such distraction may give a moth life for another day, hopefully enough time to find a mate and reproduce with its ephemeral adult life of but a few days.

Mimicry patterns such as aggregation behavior of early instar caterpillars to look not like a single caterpillar but more like a bird dropping or other inanimate object on a leaf provide Certain caterpillars remarkably resemble bird droppings and are ignored by the birds. "Hummingbird moths" those clearwing sphinx species, very fast flying and often seen hovering, are

usually mistaken for the elusive hummingbird by naive observers as the moths dart among the Phlox, the irises, and trumpet vine.

MOTH LIFE CYCLES

Moth life cycles vary tremendously. Whether a moth is single brooded (one life cycle per year), double brooded, or multiple brooded is determined by genetics and photoperiod control. The amount of ultraviolet light accumulated during the larval development (a reflection of day length of that specific latitude) clocks the emergence process. For instance, the Luna moth, *Actias luna*, emerges in southern Pennsylvania in mid – April, goes through the life cycle coinciding with the availability of host tree leaves in early spring.

Once the cocoon is spun the diapause (dormancy period) is very short under a long day length regime. The pupa goes through about a ten to fourteen day chemical transformation to the adult and the moth emerges in plenty of time to successfully complete a second generation metamorphosis before the inducement of shorter day length stimulates the next pupa to go into the lengthy over wintering diapause. The arrestment of internal development brought on by short day length and lower temperatures allows the biochemically inactive mass of protein in the pupa to remain viable until the next spring. Moving north in latitude provides a shift and shortening of day length which eventually restricts metamorphosis to one yearly brood. Many other species, due to size, complexity of cocoon spinning such as *Hyalophora cecropia* , the Cecropia Moth, are totally single brooded throughout Pennsylvania. Species with genetic adaptations such as over - wintering as larvae or adults circumvent the restricting limitation of day length and gain advantage to be coincidental with host plant availability of very early spring emerging vegetation.

MOLTING

All arthropods molt (shed) their exoskeleton (skin) when growing. When moths pass through the four stages of development (metamorphosis) during their life cycle, their cuticle (skin) changes to provide different colors for mimicry, camouflage, or warning coloration, different structures for protection and sensory feedback. Clubbed tubercles on *H. cecropia* larva, long curved “spears” on the Hickory Horned Devil larva of the Royal Walnut Moth *Citheronia regalis*, or the anal (posterior) spine on Sphingidae larva of Sphinx moths change with successive instar (larval) molts. Many caterpillars with tubercles, spines, or sharp setae may respond to a predator by thrashing their bodies about vigorously. Hand - Maid moths, especially the Drexel's Datana, *Datana drexelii*, a gregarious larval species are often seen on oaks and apples clinging to the underside of

leaves by their mid – prolegs. By actively moving the anterior and posterior segments the caterpillars create frightening or startling mimicry in unison.

MOTH OVER - WINTERING

Some moths such as the Tussock moths over winter as eggs, notably *Lymantria dispar,* the Gypsy Moth, whose light brown egg mass containing 150 to 1000 eggs are visible on trees starting in July. The "varnished-coated" egg ring of the Eastern Tent caterpillar *Malacosma americanum* is attached to small branches of the Wild Cherry tree. Many moth species such as the Tiger Moths, an example, the Isabella Moth *Pyrrhartia isabella,* can over winter as a larva. Better known as the Woolly Bear caterpillar, this larva changes with successive larval instar molts to display less black and more red as it ages. Differences in color reflect age differences among larva later in the season and are not an indicator of the severity of the winter to come. This moth larva can be confused with another Tiger Moth, the Great Leopard Moth, *Ecpantheria scribonia,* which is totally black. So don't plan your next winter activities based on a misidentified larva!

Most moths over-winter as pupa. The large and noticeable silken cocoons of the giant silkworm moths attached to stems and leaves provide additional protection to the thin – walled pupae. As compared to chrysalides of butterflies, moth pupae are thinner and need some mechanical protection.

Silkworms innately spin a silk containment around themselves. This process (see cocoon spinning) provides insulation and mechanical protection.

Caterpillars of the Subfamily Citheroniinae are not silk spinners but instead are subterranean pupaters. The larva burrow in the soft soil for as much as eighteen inches to provide protection from heat, dryness, cold and the perils of digging insectivorous mammals. Sphinx moth larvae pupate either in soil or as some, forming loose cocoons in leaf litter. Larvae of many species of tussock and tiger moths use their body hair to construct the cocoon where tussock and tiger moths mix body hair with silk to form the cocoon.

One of the most unusual mechanisms evolved for over-wintering is evident in the Bagworm Moth, *Thyridopteryx ephemeraeformi* , that builds its bag by attaching bits of host plant leaf tissue to the silk cocoon surrounding its body. As the caterpillar moves about the host plant leaves to feed it enlarges the bag throughout the summer. At maturity the larva pupates within the bag after securely attaching the bag to the plant stem. The female moth is wingless and legless and therefore after mating must lay her eggs within the bag. This mechanism, similar to the laying of all eggs in mass on one plant as do tent

caterpillars, fall webworms, and gypsy moths creates the large number of caterpillars on one host plant which may denude that plant. Repeated subsequent seasonal leaf cropping may result in severe damage or death of the plant.

MOTH HABITATS

Moths occupy a much wider range of habitats and parameters of environmental conditions than do butterflies. Many Noctuidae moths can be seen flying on winter days when ambient temperatures hover in the high 30 degree Fahrenheit range. One of these called The Herald, *Scoliopteryx libatrix* spends the winter in caves! Some moths fly on extremely hot and humid nights when only a constant rain forces them to seek shelter.

Moth larvae eat a wide variety of host plant material including trees, shrubs, annual and perennial flowering plants, plant roots and stems, flower petals, mushrooms, lichens, mosses and even aquatic vegetation. Larvae of the pretty *Synclita obliteralis* moth dine on duckweed, pondweed, waterlillies, and other aquatic plants. Some other Subfamily Nymphulinae moths also make a case out of plant parts similar to the case making of the caddisflies.

Various species of the Family Noctuidae Pinion moths are predacious cannibals when reared in mass cultures in captivity. This may reflect an innate behavior of evolutionary need for dispersal in early instars as compared to behavior of other gregarious species.

INTRODUCED (EXOTIC) MOTHS

Everyone is familiar with Pennsylvania's number one exotic pest moth. You are correct; it is the Gypsy Moth *Portethria dispar* , introduced into Massachusetts in 1869 by a French scientist in an attempt to use it for silk production. In his time many scientists did not understand the complexities of the balancing mechanisms of biological control of populations among organisms evolving side by side in nature The introduction of an exotic such as the Gypsy Moth into North America provided the species an environment that did not avail the balancing control of a variety of predators, parasites and diseases that would tend to hold down a population explosion. So it happened and in twenty years the Gypsy Moth advanced southward and by 1932 reached Pennsylvania's border. It has invaded the entire state and has contributed to the loss of millions of board feet of prime oak timber and millions of dollars of other forest products. The requirements of integrated forest pest management (IFPM) is based on sound ecological principles and utilizes suitable techniques to reduce and maintain pest populations at levels below those that cause significant injury. EPA approved chemical sprays, biological controls such as

flies, beetles, parasitic wasps, bactericidal agents and nucleopolyhedrosis virus (NPV) all have effected the Gypsy Moth. Control options for homeowners include selection of landscape plants not favored by this moth larva. We must also be concerned with transporting caterpillars and/or pupae via our vehicles and Christmas trees.

Another exotic species is the Ailanthus or Cynthia Moth, *Callosamia cynthia,* also imported into the United States from China for the silk industry in the mid 1800's. This moth is ecologically of little consequence ecologically but the host plant brought along for food - *Ailanthus altissima*, the "Tree- of- Heaven" in a major invasive noxious weed tree along Pennsylvania roadways and everywhere else its seeds and suckers can find disturbed soil. Another introduced silk industry associated weed tree from China is the White Mulberry, *Morus alba***,** food for the *Bombyx mori* moth, the main silk producing moth. Don't try to find this moth at your night - lights though, because genetic inbreeding by humans over thousands of years has reduced this moth to a non-flier.

Noxious invasive plants contribute a significant environmental impact causing a potential for loss of habitat for threatened and endangered plant species. Great care should be taken to not plant and use such species for moth rearing.

FOREST PESTS

Pennsylvania has its share of moth larvae causing considerable economic loss in the forest industry. Such species as the maple spanworm, elm spanworm, and occasionally the Walnut Caterpillar *Dantana integerrima* cause defoliation of commercially important tree species. Others such as the Eastern Tent Caterpillar *Malacosma americanum,* a web maker forming a web in the crotch of wild cherry trees in the spring and the Fall Webworm, *Hyphantria cunea ,* forming a wispy web over the branches of nut trees, locusts and other deciduous trees in the fall are often misidentified as each other. Most forest pest species have one common attribute that creates the pest factor; they all lay all their eggs on a single host plant. This contributes to the gregarious behavior causing denuding of the plant.

POISONOUS MOTH SPECIES

Surprisingly, if one feels a stinging sensation on the tender parts of one's hand or arm and looks for Stinging Nettle, *Urtica dioca*, one finds that he or she has reached among a group of Saddleback Caterpillars. One or more caterpillars have just stung again. These beautiful moth larvae have specialized bristles called urticating hairs. Various species of the Slug Caterpillar Moths, Family Limacodidae, have medial prolegs replaced with suckers which makes them appear to glide as they move across leaves. Very colorful or unique looking slug caterpillars which all sting include the Hag Moth,

Phobetron pithecium, the Spiny Oak Slug, *Euclea delphinii,* and two others, the Buck Moth, *Hemileuca maia,* and the Io Moth, *Automeris io.* Other moth larvae having lesser irritating hairs include the Gypsy Moth and various Tiger Moths, notably the Woolly Bear Caterpillar.

COCOON SPINNING

One of the most interesting observations in nature is to watch a fifth instar larva of the Cecropia Moth, *Hyalophora cecropia,* construct its cocoon. Through a stereotyped fixed action pattern of movements this five- inch caterpillar spins out a mile of silk and transforms into a one -inch long pupa within the cocoon. This event requires a complex series of movement patterns and responses to both internal and external stimuli in order for the larva to create a cocoon with two distinct envelopes and a separating middle layer.

Also, the larva must spin the cocoon so that the two envelopes have valves aligned together so that months later the emerging moth can swiftly squeeze through the two valves. The process of cocoon spinning involves a series of maneuvers called the stretch-bend movement pattern and the swing-swing movement pattern. By stretching upward, away from gravity, the caterpillar attaches a strand of silk to a twig or leaf then moves in the opposite direction as far as it can and again attaches the silk strand to another surface. Continuing this procedure repeatedly at all angles the caterpillar eventually forms a tent - shaped structure around itself. But because its head bumps into the strands of silk when it attempts to stretch upward an area of more loosely woven silk forms an escape valve at the apex of the cocoon. After a prescribed time the caterpillar inverts itself. Now, under the influence of a new orientation to gravity it does the swing- swing movement pattern and moves left and right to form the blunt end of the cocoon. Repeated swing-swing movements and reorientation laterally at all angles completely seals off the bottom of the cocoon. The fact that it cannot reach the valve end to spot silk because it is blocked by its own body precludes it from effecting the valves. The caterpillar's activities are clocked by a timing control and by the amount of silk released through its spinnerettes. When two - thirds of the silk has been used the animal changes from doing the stretch-bend to the swing-swing on a 40-minute interval and extends the timing to a 170 -minute interval.

Dissection of an empty Cecropia cocoon will show that the outer envelope has a relatively thin wall as compared to the inner envelope. Therefore two thirds of the silk is needed to produce one thinner protective layer whereas only one third of is silk is needed to produce the much shrunken but thicker inner envelope. The inner envelope becomes thicker because the shrinking caterpillar is reeling out less silk but on a much smaller area. As the end of silk production nears the larva secretes an enzyme that partially dissolves the silk strand and they use a figure eight movement pattern to smear the silk

and fill in the spaces between the silk strands. The result is a very smooth, waterproof surface on the inside of the inner envelope that minimizes abrasion on the delicate pupa. This same enzyme is later secreted by the adult moth to dissolve the silk strands in the valves as the moth squeezes through what appears to us to be a much too small diameter hole in the valves. Inspection of the cocoon shows the middle layer of loosely meshed silk between the outer and inner envelopes. This structure is formed as a result of a shift of timing of the turnabouts from 40 minutes to 170 minutes. Once all the silk has been exhausted the larva will molt its caterpillar skin to reveal the pupa. The shed skin will slip downward to be lodged below the pupa. If the caterpillar did not respond to the force of gravity correctly the shedding of the 5th instar larva would cause the shed skin to block the exit through the valves. The caterpillar would face the blunt end and never be able to emerge.

In nature, only a freak occurrence such as wind breaking a limb to invert the cocoon during the critical spinning period could cause entombment of the moth. But many moth rearers have inadvertently moved cocoons during the cocoon spinning, causing the caterpillar to reverse the orientation of the valves and therefore never be able to exit the cocoon.

MOTH CLASSIFICATION

Taxonomic classification is based on structural characteristics. Of nearly 100,000 known species of insects in America north of Mexico, the Order Lepidoptera includes over 11,230 species. Only about 765 of these are butterflies, the rest are moths. The most easily recognized and readily collected are the larger, showier moths from three families. The sphinx or hawk moths (Family Sphingiidae), the giant silkworm moths (Family Saturniidae), and the underwings (Family Noctudiidae). Tiger moths (Family Arctiidae), geometer moths (Family Geometriidae), and the prominent moths (Family Notodontiidae) comprise the majority of moths that are readily identifiable by amateur collectors. The remaining moths are collectively referred to a "microlepidoptera" which are small, confusingly similar and very difficult to identify and therefore not readily added to a collection.

Their importance, though, as economic pests to human societies and their biological valuable in the scheme of the energy foodweb cannot be ignored. Countless larva and moths of all types contribute a major portion of the diet of many birds, mammals, and other insects.

Moths differ from butterflies structurally as well. Moths have "feathery" antennae while butterflies have stalked antennae with a club on the end. The feathery antenna

allows the male moth to sense the sex pheromone given off by the female whereas the butterflies are attracted by sight and respond with a nuptial flight that behaviorally bonds the pair for mating. All lepidopterans are scaled insects. Scales provide aerodynamic lift advantage on the large surface area of the body and wings. Scales also provide an escape mechanism for moths and butterflies. When caught by a predator scales are easily shed, allowing the loss of grip by bird beaks, insect claws, and mammal feet. So the moth or butterfly may get to fly another day.

EGGS OF MOTHS

Eggs come in many sizes and shapes. The Cecropia and Polyphemus Moths have the largest eggs, slightly smaller than a BB. The smallest would not be much larger than the head of a sewing pin. Most eggs are spherical, but some are oblong and many are dimpled. Size is unimportant as compared to where and how the eggs are laid. For their invisibility to predators determines their survival. Most moth eggs are carefully laid on the underside of leaves of the host plant. The eggs have a gluey surface and stick tightly to the leaf. Each species has its own behavior in this regard. The "bad" moths lay a mass of possibly a few hundred to one thousand eggs on just one plant. All the caterpillars hatched then attempt to eat all the leaves they can. If it is a small tree it can be denuded and die. Ecologically, the "good" moths lay only about one half dozen eggs on a given tree. Therefore moth larva of the Cecropia, Luna, or Polyphemus can live on the trees in your yard most of the summer and you would not even notice they are there. If you ever catch a female moth and find that she starts laying eggs while you have her in captivity attempt to identify her species and find out its host plant. Place her in a paper sandwich bag and let her lay all her eggs, then cut the bag in pieces and staple them egg side down to the underside of the leaves. That way they will receive enough light to properly hatch out, eat their eggshell (their first meal), and then crawl onto the leaves.

LARVAE OF MOTHS

The larvae of certain moths are among the most strikingly beautiful organisms. The shear massiveness and color variation of the Royal Walnut Moth, the Polyphemus Moth, and the Imperial Moth larvae (shown on the poster face side) are spectacularly beautiful. Most people are amazed that these beauties exist here in Pennsylvania. The Royal Walnut Moth larva is the largest caterpillar in North America, sometimes nearly six inches long in an optimum growth season. The Polyphemus Moth larva keeps its characteristic green color throughout its larval instars while the larva of the Imperial Moth often shows various colors of rust red, orange - red, green (as shown) and then a very dark brown or black in the last instar. Many changes of the presence of the number of tubercles, setae, and hairs occur as the larva advance through the instars. One of the obvious problems for

novice amateur students of moths and butterflies is the lack of identification guides for the early instars. Current references such as those listed in the Additional Reading and Reference section only show the last instar in their life cycle sequences.

PUPAE OF MOTHS

The pupa of a moth is usually not as noticeable as other stages of the life cycle. A pupa such as that of the Cecropia moth (see illustration), is securely hidden in the cocoon. Others such as the Sphinx moths do not spin silk elaborate cocoons but pupate underground or form loose cocoons in leaves and grasses. Tiger moths generally create their cocoons out of hair from their bodies.

ADULT MOTHS

Adult moths have their beauties in nature also. The Io moth with its large eyespots on the lower wing is interesting in that its female (shown on the face side of this poster) has a more camouflaged forewing than the male (not shown) which has a more uniform yellow coloration. This difference between the coloration of female and male is called sexual dimorphism. This is not evident in the Luna Moth though; their greatest difference is evident in the size of their antennae. Most male silk moths show significantly larger antenna as with the face photograph of the Polyphemus Moth (shown). The Royal Walnut Moth (shown) is a brilliant orange - red with yellow spots but hides much of its beauty as it rests with its forewings laid down over its hindwings. The large yellow Imperial Moth (shown) is trickier to sex due to slight differences in the amount of yellow burnished by splotches of brown. The Hummingbird Clearwing Moth has large unscaled (clear) areas of the wings that help make the wings appear to blur as the beat rapidly. Finally, that subtle combination of yellow and red of the Rosy Maple Moth, scarcely an inch long that rivals the beauty of the much larger moths. Few organisms in Pennsylvania can match the radiant beauty of many of our moths and their larva.

Moth flight times in Pennsylvania vary with latitude and altitude, but generally moths fly at relatively specific times during the day. The following list of more common species indicates the average dates, peak presence time and hours of flight:

(1) Angulifera Moth , *C. angulifera ,* June 20 - August 1, Peak June 10 - June 25. Males fly from just after dark until about 11 PM. (2) Cecropia Moth, *Hyalophora cecropia,* May 25 - July 10; peak June 5 - June 15. Adults fly from 02 AM until just before daybreak. (3) Imperial Moth, *Eacles imperial,* June 15 - Aug 15, peak June 20 - July 7 Adults fly between 12 PM - 03 AM. (4) Io moth, *Automeris io*, June - July, peak June 15 - July 7, Adults fly between 10 PM - 02 AM (5) Luna Moth, *Actias luna*, April 10 - Sept 1. Peak first brood in May, peak second brood in mid-July. Hatching dates appea

to depend on elevation. In the Poconos, for example, they often don't hatch until early June whereas in southeastern Pennsylvania adults often start hatching by mid-April or even earlier. Spring brood flies from 11 PM-01AM; summer brood flies from 10 PM - 02 AM. (6) Polyphemus Moth, *Antheraea polyphemus*, June 10 - August 15, peak June 10 - June 25. Some moths are double brooded, particularly the early June hatchers. Adults fly from 10 PM - 02 AM. (7) Promethea Moth, May 20 - July 1. Pea June 1 - June 15. Males fly from 3 PM until dusk. Royal Walnut Moth, *Citheronia regalis,* June 20 - August 1, peak June 7 - 25. Adults fly between 11 PM and 02 AM.

REARING MOTHS

Many elementary science classes raise butterflies as a class activity. To do so and ther watch the adult butterfly hatch out of the chrysalis is an awesome sight. Setting them free makes a great connection with nature for kids. With a little training you can also successfully rear (raise in captivity) moths. Note: These instructions work well for butterflies also. Some tricks of the trade: 1. Be prepared. Research rearing and prepare collecting and rearing equipment ahead of time. Sometimes you find eggs just days before they hatch. 2. Identify the moth or moth eggs you will use. 3. Make sure you have the correct host plants to feed your caterpillars. 4. Determine whether you will attempt to rear the caterpillars in containers or on live vegetation. 5. Set up containers in airy area away from direct sunlight. Remember caterpillars are usually upside down on the underside of the leaves out of direct sunlight. Observe the feeding behavior of the caterpillars on the vegetation. At some point the caterpillars will molt as they grow.

Recognizing when they attach silk to a twig or leaf prior to shedding is important. The caterpillar needs to make a pad of silk on the twig and then walk forward their exact body length and sink their anal prolegs in the soft silk. They then rest until the silk dries and glues the old skin fast to the twig. The caterpillar then begins to pull and stretch and turn sideways left and right while sequentially expanding individual body segments to force the old skin off their body. As they move left and right their old skin will split at the head end. The clear plastic - like skin will fall off the eyes first and then the skin will be pushed back off the entire body by left and right wiggling movements. Once free of the old skin the caterpillar will walk away and begin to feed again. If you attempt to pick up caterpillars at this critical time and you tear the silk pad off the twig the caterpillar may not be able to get free of its old skin. The old (and now too small) skin can strangle the caterpillar as it continues to grow. If rearing caterpillars in containers you will have to give them fresh leaves once or twice a day. Try not to move caterpillars by hand but rather cut excess leaf material off the old leaves and let the caterpillars move from the old leaves onto the new fresh leaves. If rearing caterpillars on live vegetation you will need a bag constructed of "mosquito netting " available through fabric stores or military surplus

outlets. Make a bag at least as big as a pillowcase. Sew it just like one and after you shake the branch free of insects and spiders stretch it over the small branch. Place a few caterpillars on leaves in the bag and then tie the open end of the bag closed with a sturdy string. The mesh bag is necessary to keep the caterpillars from getting away and to keep parasitic and predator away from your caterpillars. Stink bugs, earwigs, spiders, the preying mantis, and especially parasitic wasps can destroy your caterpillars. Parasitic wasps lay eggs in the bodies of the caterpillars and those eggs hatch and grow. Eventually the wasp larva chew out through the skin and spin cocoons on the back of the caterpillar. This is usually the way people find various Sphinx caterpillars feeding on their tomato plants.

As the caterpillars grow they will drop frass (fecal material). It is important to remove it daily, especially before a rain. If the frass gets wet it can cause mold growth that can injure the leaves and caterpillars. Eventually the number of caterpillars will have to be reduced in each bag as they grow larger and eat more leaves or you will be changing bags daily. Spreading them out will also lessen the chance of incurring diseases. Bacteria, viruses, and molds can kill many caterpillars in a short time.

Once the caterpillars have gone through all the larval instars they will be ready to spin the cocoons. They need specific conditions of a three-dimensional surface area on which to spin although sometimes they will spin right on the bag surface. Once they begin to spin be careful not to disturb them. (See the section on Cocoon Spinning)
If rearing in containers it is best to quickly transfer any larva that start spinning to a bag on the host plant so they can spin their cocoons in a more natural environment.

Cocoons can be successfully stored over winter in a cool dry area in darkness and protected from predators such as mice and squirrels. Place them on an open box wrapped in tissues and place them in a hamster cage covered with window screening to keep out rodents. Squirrels relish Luna moth cocoons grown on nut trees, as they taste like nuts! Periodically mist-spray the cocoons over the winter to avoid excessive drying. Don't do this procedure before about August as some moths are double brooded and could hatch out again in your container and not be noticed.

Bring the cocoons out into sunlight about April as the host plants are pushing their leaves. The lengthening amount of sunlight and warming temperatures will parallel the adult emergence with the availability of food.

Mating moths is tricky but can be successful. A male and female moth can be placed in a small wire container made of wire screening of one-half inch grid size. That way males and female will be able to mate through the holes in the screening. Once

moths have mated don't disturb them. They may remain attached for a day or so. Once they have separated place the female in a sandwich bag closed with a clothespin. Place the bag out of direct sunlight and she will lay her eggs on the bag surface. (See the section on Eggs of Moths)

Eggs can also be gotten by tying out unmated females to attract wild males. Females can again be places in a wire cage and wild males can be attracted for mating. Females can also be "harnessed" by carefully tying a thread halter around her body on both sides of the wings and attaching her to the branch of a tree. When using this method though, you must check them very early in the morning to avoid predation by birds.

Sometimes more than one male will be attracted to a female and may remain sitting in the area. These are good sources for other parings or a specimen for the collection. It is preferred that males for collections only be sacrificed after mating has been completed. Also, it is preferred that females not be sacrificed for collections prior to known egg laying.

MOTHS: the GOOD, the BAD, and the UGLY.

What is a good moth? All moth species, whether eggs, larvae, pupae, or adults serve as food for other organisms and therefore play an integral role in the ecological scheme of balance. Many, like the Yucca Moth, serve a mutualism requirement such as in this case the larva chews through a closed flower to effect pollination. Many, just by eating leaves, cause plants to be stimulated to grow new healthier leaves; nature's way of pruning. And, of course, moths are interesting and enjoyable creatures to see and study in nature.

Moth such as the Gypsy Moth, Codling and Clothes Moths, Indian Meal Moth, Tent and Fall Webworms, Bagworms, Spanworms, Cutworms, and many others cause major economic damage worldwide. Moth also can be a minor inconvenience to people when attracted to outside lights during the summer.

That’s the good and the bad of the moths. There are no ugly moths.

Additional Reading and References

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WEBSITES AND LINKS

http://www.mothman.org is the website of John D. Laskowski, the Mothman, This site lists contact information, schedules, references, photographs of Mothman, moths and their larva, and information on rearing moths.

http://butterflywebsite.com/Articles/npwc/mothchecklist.htm is a complete listing of all US moths, by state.
http://butterflywebsite.com/atlas/index.htm is a world atlas of Butterflies and moths, an ordered database of all www sites containing moth and butterfly photographs.
http://butterflywebsite.com/society/index.htm is a worldwide list of butterfly and moth clubs and societies.
http://butterflygardeners.com is a quarterly publication containing reference articles on moths and butterflies.

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