Introduction

Insects are notably abundant in a wide variety of habitats. In particular, the moths and butterflies (Lepidoptera) are some of the most obvious insect species in a variety of environments. The adult moth or butterfly is likely the most familiar life stage to the casual observer. Moths and butterflies are easily seen on the wing during the day while visiting flowers or at night while hovering about lights. However, for every adult there once existed a caterpillar that fed on one or another species of foodplant. The caterpillars are the actively feeding immature stages of moths and butterflies and are less obvious at first glance. But they can be abundant on certain plants at certain times of the year, most notably in the spring. In addition, caterpillars are diverse in the number of species present, their appearance, behavior, and developmental requirements.

Identifying field-collected Lepidoptera to the species level is essential to performing natural history observations and conducting detailed ecological studies on associating caterpillars to their adults, foodplant relationships, parasitoids, and using caterpillars as indicator species to assess environmental impacts. Diagnostic keys are not available for identifying species of caterpillars and their adults, in the Pacific Northwest. In fact few scientific papers and books can be found that illustrate caterpillars of this region. Prior to Miller (1995), Stevens et al. (1984) was one of the few sources available for illustrations of caterpillars in the Pacific Northwest. Pyle (2002) provides some photographs of caterpillars of Pacific Northwest butterflies. However, many books are available that illustrate the adult butterfly, Pyle (2002) being the most recent. Photographs of moths in Pacific Northwest forests and woodlands were published by Miller and Hammond (2000). Certain books provide excellent photographs of common caterpillar species of regions outside of the Pacific Northwest, including the Canadian Provinces (Ives and Wong 1988), the Appalachians (McCabe 1991), and eastern deciduous forests (Wagner et al. 1995, Wagner et al. 2001). Some of the species illustrated in these books also occur in the Pacific Northwest; however, Oregon alone contains over 2,000 species of Lepidoptera, and a majority of these species do not occur east of the Rocky Mountains.

This booklet is a field guide to assist in the identification of caterpillars and their adult stage, and emphasizes the fauna of the Pacific Northwest. In this work we have revised and expanded the coverage of caterpillars of Pacific Northwest forests and woodlands (Miller 1995) and adults of Pacific Northwest forests and woodlands (Miller and Hammond 2000). We have selected 239 species for diagnostic narratives and photographs of caterpillars and their adults. We have limited the photographic presentation to select taxa of butterflies and macromoths, but have not included the micromoths. The species included here are either common to the forests and woodlands of the Pacific Northwest, or they exhibit a special life history trait, such as endemism or extreme rarity. The geographical range extends beyond the Pacific Northwest States and includes regions west of the Rocky Mountains, from northern California to southern British Columbia. We present a brief section on the natural history of Lepidoptera and describe variations in morphology, color, and pattern that are used to identify caterpillars. Also, we provide details on how to collect and rear caterpillars, and how to photograph and preserve specimens. As well, there is a section on nomenclature and a narrative of the families most commonly found in the Pacific Northwest.

THE PACIFIC NORTHWEST

The Pacific Northwest includes California north of San Francisco, all of Oregon, and Washington, southern British Columbia, the northwest corner of Nevada, most of Idaho, and western Montana. In the context of the flora and fauna of North America, the Pacific Northwest contains portions

Figure 1. The Pacific Northwest.

of, or is contiguous with, four major biogeographic regions: California, the Great Basin, the Rocky Mountains, and the Canadian Provinces. The Pacific Northwest includes numerous mountain ranges, high desert, the Columbia River Basin, part of the Snake River, the Puget and Willamette Valleys, and the northern Pacific coast.

The vegetation in the Pacific Northwest is diverse and includes a flora adapted to an array of habitats including coastal, desert, and alpine environments. The prevalent forest trees include the conifers Douglas-fir, ponderosa pine, lodgepole pine, and redwoods. Other conifers include spruce, hemlock, larch, true fir, cedar and numerous species of pine. The prevalent woodland trees include oak, alder, poplar, ash, aspen, maple, and juniper. The understory vegetation in these forests and woodlands is also very rich in species. Included among some of the more prevalent species of flowering trees and shrubs are the genera: *Acer*, *Alnus*, *Amelanchier*, *Arbutus*, *Arctostaphylos*, *Artemisia*, *Baccharis*, *Ceanothus*, *Celtis*, *Cercocarpus*, *Chrysolepis*, *Cornus*, *Corylus*, *Crataegus*, *Fraxinus*, *Gaultheria*, *Holodiscus*, *Juniperus*, *Lithocarpus*, *Myrica*, *Oemleria*, *Pachistima*, *Philadelphus*, *Physocarpus*, *Populus*, *Prunus*, *Purshia*, *Quercus*, *Rhamnus*, *Rhododendron*, *Ribes*, *Rubus*, *Salix*, *Sambucus*, *Sorbus*, *Spiraea*, *Symphoricarpos*, *Umbellularia*, and *Vaccinium*.

The forests and woodlands of the Pacific Northwest possess many types of habitats based on tree species, geographical location, and climatic conditions. We have placed these habitats into five categories: subalpine forest, rain-wet-moist forest, dry forest, dry woodland, and riparian forest and woodland.

Subalpine forest Occurs at high elevation (above 1,500 meters) in the Cascade Mountains, Rocky Mountains, Sierra Nevada Mountains, and on isolated montane islands in the Great Basin and the southwest states. Dominant tree species are Engelmann spruce, subalpine fir, lodgepole pine, and quaking aspen.

Rain-wet-moist forest Dominated by conifers, particularly Douglas-fir, western hemlock, redwoods, and Sitka spruce. The major hardwood trees are red alder and big-leaf maple. Forest types transition subtly from one to the other based on precipitation. Rainforests may receive in excess of 254 centimeters (100 inches) of rain per year, wet forests receive between 152 and 254 centimeters (60 to 100 inches), and moist forests receive between 89 and 152 centimeters (35 to 60 inches).

Dry forest Dominated by ponderosa pine. The associated hardwood trees are quaking aspen at high elevations and cherry and serviceberry at lower elevations.

Dry woodland Characterized by oak woodlands west of the Cascade and Sierra Nevada Mountains, and juniper woodlands to the east of the Cascade Mountains. Dry woodlands in the Southwest and Great Basin are characterized by piñon pine.

Riparian forest and riparian woodland Occurs in dry regions along rivers, creeks, and gullies. The dominant trees are poplars, willow, alder, cherry, and elderberry.

THE LEPIDOPTERA

The Order Lepidoptera is divided into three groups: butterflies and skippers, macromoths, and micromoths. Each group consists of numerous families. The family as a taxonomic unit is a grouping of genera which are taxonomic units of related species. The differences between groups of Lepidoptera include obvious morphological features, technical anatomical characteristics, and some behavioral ecological traits.

A majority of the described and documented Lepidoptera in the Pacific Northwest are macromoths. Over 1,200 species of macromoths have been recorded to date. Between 180 and 200 species of butterflies and skippers, and 700 to 900 species of micromoths are listed as well. However, the scientific effort that goes into understanding the Lepidoptera fauna is not evenly distributed among the species. Much is known about the presence and identity of butterfly and skipper species in the Pacific Northwest; less is known about the presence and identity of macromoths. Even less is known about the micromoths. The macromoth fauna of the Northwest has never been the subject of a comprehensive study, and many species remain to be discovered and described. As more studies are conducted we expect the butterfly species count will remain nearly the same, but the macromoth species count could increase another 25 percent, to around 1,500 species. The micromoth species count is likely to equal or exceed the number of macromoths.

The butterflies and skippers are known as the Rhopalocera. There are seven families: Hesperiidae, Lycaenidae, Nymphalidae, Papilionidae, Pieridae, Riodinidae, and Satyridae. The butterflies and skippers are distinguished by swollen areas at or near the end of the antennae. Butterflies have a swollen area at the tip of the antennae. Skippers have a swollen area near the end, but the enlargement is slightly expanded and tapers into a hooked tip. Nearly all adult butterflies and skippers are diurnal, meaning they are active during the day. Associated with their diurnal behavior, butterflies and skippers tend to bask in sunlight which is a behavior involved in thermoregulation.

Adults tend to be brightly colored, at least in one of the sexes. Depending on the species, the male or female is the more colorful, and the color serves to attract a mate. For instance, in many of the blue Lycaenidae the male is an iridescent blue/purple and the female is mostly brown. The bright and obvious colors and patterns on the wings might be associated with aposematism, a mechanism which serves to warn predators that the individual is poisonous. While at rest, but not while basking in the sun, the wings of butterflies are typically held pressed together above the body. The underside of a butterfly wing is often marked in colors and patterns that allow the individual to blend into the substrate upon which it is resting, a morphological and behavioral condition known as crypsis. Skippers differ slightly from butterflies in their resting posture. Typically they hold their wings at an oblique angle, or laterally, while at rest.

Adult butterflies and skippers are readily seen at flowers where they are sucking up nectar to obtain the energy required for flight. Caterpillars of butterflies and skippers do not exhibit any general traits that separate them from the caterpillars of macromoths.

Macromoths and micromoths differ from the Rhopalocera in the morphology of the antennae, flight activity patterns, and coloration. The tip of the antennae in macromoths and micromoths is not knobbed or swollen with a hook, although some Sphingidae may exhibit slightly swollen antennae that taper to a point which is curved. Most species of moths fly at night, their nocturnal flight behavior is one of the reasons moths are readily seen at lights. Unlike the Rhopalocera, moths at rest do not press their wings together vertically above their bodies. Rather, they hold their wings flat over their abdomens in a near horizontal position. The top surface of the wings is typically colored and patterned to blend into the environment. Thus, bright colors are the exception rather than the rule in moths. However, in a few species of moths the upper surface of the hindwing is brightly colored; a sudden exposing of the hindwing, which is typically covered by the forewing when at rest, may serve to startle a predator.

Adults of many moth species do not feed. Typically, those that do feed seek the carbohydrate- and energy-rich nectar of flowers.

Contrary to what the names suggest, overall size is not what distinguishes the macromoths from micromoths. Rather, the distinction is in the details of the wing venation and the female reproductive tract. These details are discussed and illustrated in most texts on general entomology (Borror et al. 1989) and in books about Lepidoptera (Covell 1984).

The macromoths in the woodlands and forests of the Pacific Northwest are comprised of 1,200 species in twelve families: Arctiidae, Dioptidae, Drepanidae, Epiplemidae, Geometridae, Lasiocampidae, Lymantriidae, Noctuidae, Notodontidae, Saturniidae, Sphingidae, and Thyatiridae. The micromoths in the woodlands and forests of the Pacific Northwest are represented by at least 500 species in over 20 families, the four most common being the Tortricidae, Pyralidae, Gelechiidae, and Pterophoridae.

COMMON FAMILIES OF LEPIDOPTERA IN FORESTS AND WOODLANDS OF THE PACIFIC NORTHWEST

In general, about 21 families of Lepidoptera are common in the Pacific Northwest, and are briefly described, below. Due to the dynamics of name changes, recognized species status, and the nature of incomplete records, species numbers are estimates.

Butterflies

Hesperiidae Skippers; 40 species. Caterpillars are external leaf feeders but can be found within tied leaves on broadleaf plants and grasses. The most obvious diagnostic trait for identification of caterpillars is that the first segment of the thorax is constricted. A full grown caterpillar may reach 50 millimeters in length. Adults are day-flying.

Lycaenidae Hairstreaks, elfins, blues and coppers; 60 species. Caterpillars are external leaf feeders, and occur primarily on broadleaf plants. The body is covered with many short hairs, giving a velvet-like appearance. The head is usually concealed from above by the prothorax. The dorsal aspect of the body is humped, a feature best seen in lateral view. A full grown caterpillar may reach 30 millimeters in length. Adults are day-flying.

Nymphalidae Brush-footed butterflies, fritillaries, commas, admirals, crescents, checkerspots, and tortoiseshells; 50 species. Caterpillars are external leaf feeders, and occur primarily on broadleaf plants. Many species have middorsal spines on A7 but not on A9. The head of nymphalid caterpillars may possess non-stinging spines. A full grown caterpillar may reach 75 millimeters in length. Adults are day-flying.

Papilionidae Swallowtails and parnassians; 10 species. Caterpillars are external leaf feeders. Body color in swallowtail caterpillars is a mixture of green, yellow, and black. Body color in Parnassians is black. Caterpillars of Papilionidae possess an osmeterium, which is an eversible forked pouch on the prothorax. A full grown caterpillar may reach 70 millimeters in length. Adults are day-flying.

Pieridae Whites and sulphurs; 20 species. Caterpillars are external leaf feeders, and occur primarily on broadleaf plants. The body is covered with many very short hairs, giving the appearance of velvet. A full grown caterpillar may reach 50 millimeters in length. Adults are day-flying.

Satyridae Satyrs; 12 species. Caterpillars are external leaf feeders, and occur on grasses. The body is covered with many very short hairs, giving a velvet-like appearance. A full grown caterpillar may reach 40 millimeters in length. Adults are day-flying.

Macromoths

Arctiidae Woollybear caterpillars, tiger moths; 30 species. Caterpillars are external leaf feeders and occur on conifers and broadleaf plants. Typical arctiid caterpillars have dense coats of long hairs, giving the caterpillars a woolly appearance, hence the common name. Many species are covered with densely packed, wispy hairs that are longer than the width of the body. Some species are covered by densely packed hairs that are shorter than the width of the body. A majority

of the species overwinter in the caterpillar stage. A full grown caterpillar may reach 60 millimeters in length. Caterpillars among the species of arctiids may feed on the foliage of conifers, flowering trees and shrubs, herbs, or grasses. Adult moths of most of the species are night-flying. However, some arctiids fly during the day. One of the day-flying species is the cinnabar moth, *Tyria jacobaeae*, which was intentionally introduced as a biological control agent because the caterpillar feeds on flowers and leaves of the noxious weed tansy ragwort, *Senecio jacobaea*. Adults exhibit a wide range of colors and patterns of markings. Some species have immaculate wings while others show large spots or extensive crisscrossing bands. Some of the species are considered pests, such as the fall webworm and the silver spotted tiger moth. Adult Arctiidae of North America are illustrated in Covell (1984).

Dioptidae Oak worm moths; 1 species. *Phryganidia californica* is our only species in this family and occurs in forests and woodlands containing live oaks and chinquapin, upon which the caterpillars are leaf feeders. Because caterpillars overwinter, and may feed on warmer days, they require an evergreen host, such as live oaks and chinquapin. The species is considered a pest because it can severely defoliate its hosts. Adults are not strongly attracted to light and may fly during the day or at night.

Drepanidae Hook-tip moths; 2 species. *Drepana arcuata* is common, *D. bilineata* is not. Caterpillars are external leaf feeders and occur primarily on broadleaf plants, especially alder species. Two features are characteristic in the caterpillar: the rearward projecting knob on A10, and the prolegs on A10 which project backwards and lack crochets. Full grown caterpillars may reach 30 millimeters in length. Adults are night-flying and attracted to light.

Epiplemidae Epiplemids; 1 species. *Callizzia amorata* is the only species in this family. It is most common in the wet forests in the Pacific Western States, but is widely distributed in North America. Caterpillars feed on the foliage of honeysuckle. Adults fly at night and are attracted to light.

Figure 2 Wingless female adult.

Geometridae Inchworms, loopers, and geometer moths; 400 species. This family is second only to the noctuids in number of species. Typically, inchworms possess one pair of midabdominal prolegs on segment A6. The presence of two pairs of midabdominal prolegs is less common. If two pair of prolegs do appear, they occur on segments A5 and A6 (see *Campaea perlata*). Also, the presence of four pairs of midabdominal prolegs is very uncommon. If they do appear, they occur on A3-A6 (see *Archiearis infans*). Many species have caterpillars that feed on the foliage of conifers. The most common hosts are species of Pinaceae, but a few moths prefer the Cupressaceae as their primary host. A majority of the inchworm species feed on the foliage of flowering trees and shrubs, and less frequently on herbaceous plants. Adults of most species fly at night and are readily attracted to light. Females of some species (*Phigalia plumogeraria*, *Operopthera bruceata* and *Operopthera danbyi*) are wingless (Figure 2). Generally, filiform antennae are present in both sexes. However, males in certain species have pectinate antennae (see *Protoboarmia porcelaria* or *Drepanulatrix foeminaria*). Full grown caterpillars

in small species may reach only 20 millimeters in length, while large species may reach 80 millimeters. Ferguson (1985) provides detailed illustrations and references to the green geometers, Geometrinae, of North America.

Lasiocampidae Tent caterpillars and lappet moths; 6 species. Caterpillars are external leaf feeders, and occur primarily on broadleaf plants. Biordinal crochets of lasiocampids are unique among the common hairy caterpillars of the Pacific Northwest.

Caterpillars of lasiocampids may be found feeding on the foliage of conifers or flowering trees and shrubs. Adults are night-flying. The lappet moth body is notably hairy. Colors and markings on the forewings and hindwings of lappet moths do not create strongly contrasting or intricate patterns. Adults fly at night and are readily attracted to light. Lappet moths do not have functional mouthparts and therefore do not feed. A full grown caterpillar may reach 100 millimeters in length. Franclemont (1973) includes illustrations of North American lappet moths.

Lymantriidae Tussock moths; 8 species. Caterpillars are external leaf feeders, and occur on conifers and broadleaf plants. Typically, caterpillars exhibit tufts of dense hairs on middorsal segments A1 through A4, and a brightly colored (red or orange) gland on middorsal segments A6 and A7. An introduced species, *Leucoma salicis*, lacks the tufts of dense hairs and thus does not fit the description of a "typical" Pacific Northwest lymantriid caterpillar.

Caterpillars in most of the species feed on the foliage of conifers or flowering trees and shrubs. Many species are considered pests, the most notable being the gypsy moth**,** *Lymantria dispar*, and the Douglas-fir tussock moth, *Orgyia pseudotsugata*. The gypsy moth has created problems, but has not established permanent residence in the Pacific Northwest. A gypsy moth infestation can prompt an eradication project involving pesticides, which in turn may lead to unintended ecological impacts on other Lepidoptera species (Miller 1990a,b). *Orgyia pseudotsugata* is a native pest of conifer forests. Adults of most species fly at night and are readily attracted to light. However, the males of some species, such as *Orgyia antiqua* and *Orgyia pseudotsugata,* are day flyers. The females of many of the lymantriids are wingless/ flightless. A full grown caterpillar may reach between 60 and 70 millimeters in length. Ferguson (1978) provides illustrations and references to the tussock moths of North America.

Noctuidae Cutworms, armyworms, semi-loopers, and underwings; 850 species, more than any other family of Lepidoptera in the Pacific Northwest. Habits and habitats vary among species. Some species occur in the soil, others bore in stems, and many are external leaf feeders. Host plants include conifers, broadleaf trees and shrubs, herbs, and grasses. Caterpillars may be hairy, nearly naked, brightly colored or cryptic. All noctuids, except the Plusiinae, have four pairs of midabdominal prolegs. The Plusiinae have only two pairs of midabdominal prolegs, occurring on segments A5 and A6. Most of the caterpillars of noctuid species feed on the foliage of flowering trees, shrubs, or herbs. Numerous species are considered pests of agricultural crops, but none are considered chronic pests of woodlands and forests. Adults range in size from the very small *Nola minna*, with a wingspan of 2.3 centimeters, to the relatively large *Catocala ilia*, with a wingspan of 7.9 centimeters.

Noctuid moths exhibit a broad array of colors and markings, but generally the forewings, hindwings and bodies exhibit varying hues of white, silver, gray, tan, brown, and black. Most noctuid species fly at night and are readily attracted to light. Certain species, such as *Oncocnemis dunbari*, rarely show up at lights at night, yet collections of caterpillars from the foliage of ocean spray, *Holodiscus discolor,* suggest the species is very abundant. Full grown caterpillars of the smaller species reach between 15 and 20 millimeters, while large species may be 70 millimeters in length. Eichlin and Cunningham (1978), Lafontaine (1987), Lafontaine and Poole (1991), Poole (1995), and Lafontaine (1998) provide illustrations and references to the noctuids of North America.

Notodontidae Prominents; 20 species. With only 20 of the 136 species known to occur in the United States and Canada, the prominents are not well represented in the Pacific Northwest. Typically, caterpillars feed on the foliage of flowering trees and shrubs. On occasion *Schizura concinna* may be a pest on ornamental trees and in orchards. Prolegs of A10 may be either extremely short or extremely long relative to the midabdominal prolegs, and are often elevated above the plant. Caterpillars may reach 60 millimeters when full grown. Adults fly at night and are readily attracted to light.

Saturniidae Silk moths; 12 species. Although called "silkworms," these are not the caterpillars used in commercial silk production. Caterpillars are external leaf feeders, occurring primarily on conifers and broadleaf plants. Many species exhibit middorsal scoli on segments A8 and A9, but not A7. Caterpillars of many species have stinging hairs that inflict a sharp pain similar to that inflicted by species of stinging nettle, *Urtica*. The forewings and hindwings of silk moths are very large; wingspans in many of the species can extend between 10 - 15 centimeters. Accordingly, the wingbeat of most silk moths is much like that of most butterflies; it is relatively slow and each beat easily seen. Wing colors and markings typically occur in distinct and sometimes intricate patterns, making identification of certain species rather easy. However, many silk moths are known to have hybrid populations in areas where two closely related species can interbreed. The adults of most species fly at night and are readily attracted to light. A few species, notably *Hemileuca eglanterina* and *Saturnia mendocino*, will fly during the day. The morphology of silk moth antennae is unique; they resemble fern fronds, with two to four branches along their lengths. The branched antennae are particularly noticeable in the males. Adults possess atrophied mouthparts and do not feed. Typically, they are not long-lived. A full grown saturniid caterpillar may exceed 100 millimeters in length. Ferguson (1971, 1972) and Tuskes et al. (1996) provide illustrations and references to the silk moths of North America.

Sphingidae Hornworms, sphinx moths; 25 species. Caterpillars are external leaf feeders, occurring primarily on broadleaf plants. A notable exception being the caterpillars of *Sphinx sequoiae* which feed on junipers, *Juniperus,* and western red cedar, *Thuja plicata.* A single middorsal horn usually occurs on segment A8.

Caterpillars often rest in a prayer-like pose, with the head and true legs raised above the plant surface. Sphinx moths are very strong fliers; their wingbeat produces a sound similar to that of a hummingbird. The adults of most species fly at night and are readily attracted to light. Sphinx moths are attracted to nectar-producing flowers that have long tubular corollas. Many of these flowers are aromatic, white, and flower at night. A full grown caterpillar may exceed 100 millimeters in length. See Hodges (1971) for illustrations and references to the sphinx moths of North America.

Thyatiridae Thyatirids; 10 species. Caterpillars are external leaf feeders, and may be found in loosely tied leaves on broadleaf plants. The tail end (prolegs are reduced) is often raised above the plant surface. Line patterns on the forewings and hindwings of thyatirids often are wavy, curled, or zigzagged. Adults of thyatirids fly at night and are attracted to light. When full grown, caterpillars may be 40 millimeters long.

Micromoths

Gelechiidae Gelechiids; 200 species, but poorly documented. Habits and habitats vary among species. Caterpillars occur on conifers and broadleaf plants. They are external leaf feeders, borers and tunnelers, and leaf tiers, and are found in flowers and seeds. Caterpillars are fairly nondescript, making field identification difficult. Identification is best achieved using keys which rely on the arrangement of hairs. Most full grown caterpillars are less than 15 millimeters long. Adults are night-flying.

Plutellidae Plutellids or diamondback moths; 25 species, but poorly documented. Caterpillars occur primarily on broadleaf plants, are usually external leaf feeders, and may tie leaves loosely together. Body color varies from yellow to green. They are relatively small, rarely exceeding 15 millimeters when full grown.

Pyralidae Snout moths; 200 species, but poorly documented. Caterpillars typically occur on conifers, broadleaf plants, and in nests of other insects. They are borers in plant stems and fruits. Identification is best achieved using keys that rely on the arrangement of hairs. The caterpillar is usually less than 30 millimeters long when full grown. Adults are night-flying.

Tortricidae Leaf-tiers; 300 species, but poorly documented. Caterpillars are typically external leaf feeders but often found in rolled leaves. Many species are leaf miners as early instars, and occur on conifers and broadleaf plants. Some species are distinctively marked and identifiable in the field, but identification is best achieved using keys that rely on the arrangement of hairs. A large, full grown tortricid caterpillar will measure between 20 and 25 millimeters in length. Adults are night-flying.

NOMENCLATURE

The common names of Lepidoptera often describe their appearance or where they live. Typical examples are: linden looper, alfalfa semilooper, western spruce budworm, green oak caterpillar, fall webworm, cabbage white, pine white, and chinquapin hairstreak. Whereas a species will have a unique scientific name, a caterpillar, moth, butterfly, or skipper, might have many common names, and some common names might be used for more than one species. The common names used here were found in Essig (1929), Ives and Wong (1988), Hinchliff (1994), and Wagner et al. (1995), and the list of common names that has been officially adopted by the Entomological Society of America (Stoetzel 1989). Most of the moths of western North America do not have recognized common names, whereas butterflies are well known by their common names.

The scientific name of all organisms is derived from Latin or Greek and consists of at least two parts and often a third. Also, the last name of the author who described the species is sometimes included in the presentation of the name (not in this book). The first name refers to the genus and is always capitalized. The second name, not capitalized, represents the species epithet. In combination, the genus and species epithet represent a binomen that is the full name of the species. Some species have a third name that denotes a subspecies. Subspecies status is applied to distinct populations that are geographically separated. Individuals of different subspecies within a species are capable of interbreeding and producing fertile offspring. With few exceptions, individuals of different species do not naturally interbreed or produce fertile offspring.

No two animals are allowed to have the same scientific name. A species might possess a list of invalid scientific names (synonyms) due to a history of taxonomic revisions.

BIODIVERSITY STUDIES

Understanding the biodiversity of Lepidoptera is essential to understanding many important ecological issues, such as: recognizing special, rare, or endangered species and habitats; assessing the impact of land management practices; and determining food web relationships and the interdependence of plants, Lepidoptera as herbivores and pollinators, and predators of Lepidoptera.

Two important indicators of biodiversity are species richness (number of species in a community) and abundance of individuals (population numbers). Because Lepidoptera function as defoliators, decomposers and pollinators, and are both prey and hosts to carnivores (Miller 1993), species richness and abundance of individuals should be measured and evaluated within the context of the ecosystems in which they are found. To that end, various sampling techniques can be used, including light traps and aerial net collecting for flying moths and butterflies, and clipping or beating foliage to capture caterpillars.

A list of plant and animal species is the foundation of any biodiversity study. Such a list is most meaningful when the species are evaluated within the context of their ecological functions. That is, a species list can become the foundation for an ecological database. One way to do this would be to relate the life history attributes of the species to each name, and then create functional groups according to those attributes and the number of species exhibiting them.

For example, for western Oregon we have found an average of 350 species of macromoths in a typical forested site dominated by Douglas-fir. Our record high collection of species from a single trap night was 104, but a count of 20-50 species per trap night is more typical. Similarly, a typical forested habitat will support 80 butterfly species, on any good day at the peak of the season up to 32 species may be seen.

By categorizing the listed species of macromoths according to the host plants (an attribute of ecological function) of their respective caterpillar, we can qualify the importance of plant communities on biodiversity of the macromoths (Hammond and Miller 1998, Miller et al. 2003). The macromoth species were assigned to one of three major vegetation groups: conifers, hardwood trees and shrubs, and herbs and grasses. The results showed that conifers supported only 10 to 12 percent of the species, whereas flowering trees and shrubs supported 52 to 66 percent of the species, and herbs-grasses supported 20 to 33 percent of the species.