

FOREST HEALTH TECHNOLOGY ENTERPRISE TEAM
BUTTERFLIES AND MOTHS OF PACIFIC NORTHWEST FORESTS AND WOODLANDS: RARE, ENDANGERED, AND MANAGEMENT-SENSITIVE SPECIES MILLER AND HAMMOND

BUTTERFLIES AND MOTHS OF PACIFIC NORTHWEST FORESTS AND WOODLANDS:

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FOREST HEALTH TECHNOLOGY ENTERPRISE TEAM

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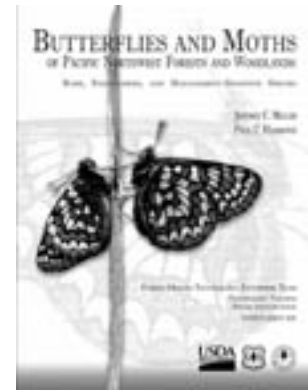
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Cover design Chuck Benedict. Photo, Taylor's Checkerspot, *Euphydryas editha taylori*. Photo by Dana Ross. See page 38.

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BUTTERFLIES AND MOTHS OF PACIFIC
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RARE, ENDANGERED, AND MANAGEMENT-
SENSITIVE SPECIES

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*This book is dedicated to Robert Micheal Pyle and David McCorkle, pioneers
and leaders in conservation, and experts in Pacific Northwest butterflies.*

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ABOUT THIS BOOK

We present a compilation of 122 taxa of butterflies and moths that are of special interest in the Pacific Northwest, regarding forest management and conservation. Our list is not a nomination slate for survey and monitor species; rather, it is an assemblage of species that should be considered as premier taxa for assessment of their current status and as candidates for long-term measures of populations for interests directed toward managing forests for biodiversity, and for comparing management/conservation policies.

The list of butterflies and moths is dominated by species and subspecies that are uncommon or rare, but we have included species that are widely distributed and associated with particular plant communities of special interest in the Pacific Northwest, including oak woodlands, alpine meadows, sand dunes, and wetlands. We present at least one photo of an adult for each taxon. More often than not we provide additional images of both sexes, and sometimes compare the dorsal wing surface to the ventral wing surface to serve as an aid in identification. Also, for each species we offer a short statement about identification, ecology, sensitivity issues, and population assessment. For a few of the species we present an image of the caterpillar. Unfortunately, many of the uncommon and rare species in the Pacific Northwest have not been photographed. In fact, the caterpillar and its foodplant are not known for some of the species.

It is our hope that this book will stimulate studies into the ecology of these species and provide a stimulus for conservation efforts to keep them from qualifying for inclusion on the Federal Endangered Species List.

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CHAPTER 1: INTRODUCTION

RARITY, OR THE THREAT OF RARITY, is a condition that contributes to designating which species society deems worthy of special consideration for protection. Regarding the issue of protection, laws have been written defining the protocol for proclaiming species as threatened or endangered and for the conservation of their populations. Ideally, those species considered to be in immediate peril of extinction are placed either on the Federal Endangered Species List, or on a list designating species status on a state-by-state (State Lists) basis. However, numerous species are not protected by an official listing even though they are known to be uncommon or rare and may exist in a habitat that is limited in its occurrence or disappearing for some reason. In this book, we illustrate and discuss the biology of butterfly and moth species living in the forests and woodlands of the Pacific Northwest of North America. The species we discuss are uncommon, rare, threatened, endangered, endemic, agents for the biological control of an exotic invasive weed, live in habitats at risk of decline, or some combination of these traits.

The abundance of individuals within a population will fluctuate through time, but some species consistently exhibit very low numbers. Such species are typically defined as uncommon to rare. In the case of our observations on the butterflies and moths in the Pacific Northwest, a rare species could be defined roughly as one for which fewer than 50 individuals will be noted in a geographically extensive and temporally intensive census of the population in any given year. The number “50” is very subjective and by no means represents a hard and fast rule. For instance, we have made observations on some species based on only one, two, or three individuals encountered over a period of fifteen years. We also encounter species by the hundreds in one year and don’t see another individual of that species for two or three years, sometimes longer. Nonetheless, the concept of rarity is generally accepted to describe a species that is seldom observed, if at all, and only then after special effort is expended at the right time and the right place.

Miller et al. (2003) discussed various aspects of rarity in Lepidoptera and the main points are repeated here. Species of butterflies and moths may be rare for a variety of reasons, including: 1) the food plant for the caterpillars is also rare; 2) the species exhibits a narrow range in its optimal climatic conditions, such as temperature and moisture conditions, that limit the availability of suitable habitat; 3) natural enemies; 4) some other species is a superior interspecific competitor and utilizes a similar and limited critical resource, such as the same food plant; and 5) the population is at the edge of the species range and therefore is inconsistent in sustaining a colony through time. These five factors contribute to the occurrence of rarity based on environmental phenomena. However, a sixth factor, one that is not biological but logistical, may contribute to the perception that a species is rare. The sixth factor is founded on insufficient sampling protocols for population assessment.

One of the most contentious aspects of rarity is the quality of data that describe a species as rare when it really is (factors 1-5), versus the quality of data that suggest a species is rare when it really is not (factor 6). Obviously, only the first five factors should be used to describe a species as rare. But how might insufficient sampling data occur, let alone become accepted, in the determination of rarity? The science of ecology is a dynamic process fueled by ever improving information. With new studies come new data. Thus, it is more likely that a poorly studied species will be described as rare, when it is not, than a well studied species. The relevance of this statement is well illustrated by a comparison of butterflies and moths.

In general, the life history, distribution, and abundance of most butterflies are well documented. Thus, information suggesting rarity is regarded as reasonably sound. Numerous butterfly species have been placed on formally composed lists of special concern based on extensive observations across a broad geographic range. Recent publications by Warren (2005), Pyle (2002), Neill (2001), and Guppy and Shepard (2001) provide information on the butterfly species of the Pacific Northwest that document life history, distribution, and abundance. Also, maps, such as those produced by Hinchliff (1994, 1996), show the geographical distribution of species and subspecies and reveal endemism for a variety of taxa across the region.

In the case of moths, many species are poorly studied and data on life history, distribution, and abundance are incomplete. Incomplete data explains, in part, why there is not a single moth species in the Pacific Northwest on the Federal Endangered Species List or any State List. There is no doubt that certain species of moths, which outnumber the known species of butterflies ten to one, are indeed rare and qualify to be considered as such. To date, the data simply do not exist to formally proclaim that a moth species is rare to the point of being considered threatened or endangered.

The process of obtaining data that reveal trends in abundance, and consequently an accurate designation of rarity to a given species, involves acquiring standardized and repeated measures of population size on a seasonal basis across the geographic range of the species over many years. Projects with the objective to produce long-term repeated measures of moth abundance are essentially lacking. Our recent projects on macromoth biodiversity are an effort to rectify the problem of limited data. We have conducted full-season, multi-trap, multi-year projects at four locations in Oregon (Miller and Hammond 2003). Our macromoth studies are conducted by selecting a site for a seasonal study and deploying a UV light trap from April or May to October, for one to two nights, every two weeks. At three locations we have samples representing every month of the year.

Our observations and comments regarding moths of special interest are primarily founded on our limited studies and secondarily on the limited information provided by museum specimens and the literature. From a review of our studies, museum specimens, and the literature we have compiled sufficient information to suggest that, based on their relative abundance and geographical range, certain moth species in the Pacific Northwest are of special interest. That is, they are uncommon, rare, threatened, endangered, endemic, biological control agents against an exotic invasive weed, or live in habitats at risk of decline. For example, we have concluded that *Acrionicta cyanescens* (a noctuid) is rare. In such cases, our conclusion was based on a combination of data from our own samples, the representation of specimens of that species in insect museums, and information in taxonomic monographs. Our judgment of rarity was considered in the following context: 1) we have recorded more than 100 individuals for a majority of the species we have

sampled; 2) only a few species are represented by more than 1,000 individuals; and 3) many species have been documented from less than 50 individuals, and in some cases only one to nine individuals. It is the group of species for which fewer than 50 individuals have been recorded that we consider uncommon to rare. In addition to rarity, many factors, such as endemism, habitat loss or degradation, climate change, and plant diseases, contribute to a species being of special interest. These factors are discussed in detail in Chapter 5: Species Accounts.

Endemism is based on the distribution of a species being limited to relatively well-defined populations within a restricted geographical area. In this sense endemism is analogous to rarity in that the occurrence of individuals within the population is confined to a particular environment that is rare in its own right. However, the number of individuals in an endemic species may be relatively high, suggesting that endemic species are not necessarily rare species. Certainly, when an endemic species is rare that species is likely threatened or endangered, particularly if the range of endemism is restricted to a localized habitat of just a few square kilometers.

The conservation of species in general, and Lepidoptera in particular, involves making decisions about management-sensitive species that are likely to disappear across forest landscapes because of either too much or too little disturbance. Very often, habitat loss or degradation is caused by timber harvest, agricultural or urban development, or other similar disturbance-based alterations of the habitat. Seemingly ironic is the observation that fire suppression actually prevents a vital disturbance. Under controlled conditions, the disturbance caused by fire is beneficial to the biota. Conversely, catastrophic fires are detrimental to the biota. Prolonged periods of time without fire will result in tree encroachment into meadows and other types of clearings and promote a more dense growth of the understory vegetation. In turn, the understory shrubs and trees outcompete species of sun-loving grasses and herbs. Many species of butterflies and moths depend on open habitats occupied by grasses and herbs, and many of these butterflies and moths are already uncommon.

An additional concern with uncommon and endemic species is a changing climate. If climatic conditions change to such a degree that the habitat suitable for a species also changes, then the species will likely be at a higher risk of extinction. For instance, butterflies and moths that are limited to alpine habitats, in particular high elevation meadows, are adapted to cool temperature conditions. A warming of the general environment will alter the habitat to an unsuitable condition, and because no other suitable habitat is being created by the changing climate the species is at high risk of extinction, and certainly will experience a shift in distribution. Plant diseases present a very real danger to certain butterflies and moths. One of the special habitats we discuss is the oak woodland. Presently, concern over the presence and expansion of a fungus-borne disease, sudden oak death, includes the loss of species that depend on oaks for their existence. Numerous butterflies and moths are oak woodland associates. Some are facultative in this relationship but others are obligate oak feeders or feeders on oak woodland plant community associates. If the occurrence of sudden oak death results in a reduction in oak tree density, or a constriction in the geographic range of oak woodland plant communities, a severe negative impact will occur on populations of invertebrate and vertebrate species involved in a variety of plant-herbivore-carnivore trophic relationships.

THE PACIFIC NORTHWEST

For our purposes, the Pacific Northwest consists of California north of San Francisco; all of Oregon, Washington, and Idaho; southern British Columbia; and western Montana (Fig. 1-1). In the context of the flora and fauna of western North America, the Pacific Northwest contains, or is contiguous with, four major biogeographic regions: California, the Great Basin, the Rocky Mountains, and the Canadian Provinces. The Pacific Northwest region contains numerous mountain ranges, high desert, the Columbia River Basin, part of the Snake River drainage, the Puget Trough, the Willamette Valley, and the northern Pacific Coast.

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



Figure 1-1. Map of the Pacific Northwest.

The woodlands and forests of the Pacific Northwest possess many types of habitats based on tree species, geographical location, and climatic conditions. We have placed these woodland and forest types into eight well-defined categories plus a ninth general category: 1) subalpine forests and alpine meadows; 2) wet forests; 3) western mixed hardwood-conifer forests; 4) dry forests; 5) dry woodlands; 6) riparian corridors; 7) forest-prairie mosaics; 8) sagebrush-bunchgrass prairies; and 9) special habitats.

Subalpine Forests and Alpine Meadows (Fig. 1-2,3) occur at high elevations, above 1,500m, and as isolated montane islands in the Great Basin and beyond into the southwestern states. The growing season



Figure 1-2. Subalpine Forest. Siskiyou Mountains, Siskiyou National Forest, Josephine County, Oregon.



Figure 1-3. Alpine Meadow. Steens Mountains, Harney County, Oregon.

is short and snow may be on the ground from September to July. Dominant tree species are Engelmann spruce, subalpine fir, lodgepole pine, and quaking aspen. The alpine meadows contain many species of herbs and grasses.

Wet forests (Fig. 1-4) are defined by annual precipitation typically in excess of 1,000mm of rain, in some places in excess of 3,000mm of rain, and are the main forest type west of the crest of the Cascade Mountains in Oregon and Washington. This type of forest is dominated by conifers, particularly Douglas-fir, western hemlock, redwoods, and Sitka spruce. The major hardwood trees are red alder and big-leaf maple. Numerous species of herbs and hardwood shrubs occur in the understory of wet forests.



Figure 1-4. Wet Forest. Redwood National Park, Del Norte County, California.

Western mixed hardwood-conifer forests (Fig. 1-5) occur at lower elevations, from sea level to generally below 500m, west of the Cascade and Sierra Nevada Mountains. The dominant conifer species are Douglas-fir, various pines, and incense cedar mixed with hardwood species such as golden chinquapin, tan oak, big-leaf maple, and myrtle. Numerous species of herbs and hardwood shrubs occur in the understory of western mixed hardwood-conifer forests.

Dry forests (Fig. 1-6) are defined by low to moderate annual precipitation, typically less than 700mm of rain, in some places as little as 500mm of rain, and are the main forest type east of the crest of the Cascade and Sierra Nevada Mountains. This forest type is dominated by ponderosa pine. The associated hardwood trees are quaking aspen at high elevations, above 1,200m, and cherry and serviceberry at lower elevation sites. Numerous species of herbs, grasses, and hardwood shrubs occur in the understory of dry forests.



Figure 1-5. Western Mixed Hardwood-Conifer Forest. Siskiyou Mountains, Six Rivers National Forest, Del Norte County, California.



Figure 1-6. Dry Forest. Ochoco Mountains, Ochoco National Forest, Crook County, Oregon.

Dry woodlands are characterized by oak woodlands west of the Cascade and Sierra Nevada Mountains (Fig. 1-7) and juniper woodlands to the east of these mountains (Fig. 1-8). Numerous species of herbs, grasses, and hardwood shrubs occur in the understory of these open dry woodlands.

Riparian corridors (Fig. 1-9) occur along rivers, creeks, and gullies. The dominant hardwood trees are poplar, willow, alder, cherry, and elderberry. Douglas-fir and western hemlock are the dominant conifers west of the Cascade and Sierra Nevada Mountains, and Ponderosa pine is dominant east of these mountains. Numerous species of herbs and hardwood shrubs occur within riparian corridors.

Forest-prairie mosaics (Fig. 1-10) occur in the transition zone between conifer forests and meadows and are made up of a variety of conifers, quaking aspen, herbs, and grasses.

The sagebrush-bunchgrass prairies (Fig. 1-11) occur east of the Cascade and Sierra Nevada Mountains. Precipitation is generally low with less than 30mm of rain per year. In many regions these prairies mix with dry forests, dry woodlands, and riparian corridors. The dominant vegetation is big sage along with many species of herbs and grasses.

Special habitats deserve mentioning, and include bogs (Fig. 1-12), coastal grasslands (Fig. 1-13), and sand dunes. These habitats represent environments that sustain many species of locally adapted plants that in turn are the food plant for butterflies and moths that are uncommon and of special interest.



Figure 1-7. Western Dry Woodland. Antelope Creek, near Medford, Jackson County, Oregon.



Figure 1-8. Eastern Dry Woodland. Pequop Mountains, Elko County, Nevada.



Figure 1-9. Riparian Corridor. H.J. Andrews Experimental Forest, Willamette National Forest, Lane County, Oregon.



Figure 1-10. Forest Prairie Mosaic. South Hills, Sawtooth National Forest, Cassia County, Idaho.



Figure 1-11. Sagebrush-Bunchgrass Prairie. Montpelier, Bear Lake County, Idaho.



Figure 1-12. Bog, Tiger Meadows, Colville National Forest, Pend Oreille County, Washington.



Figure 1-13. Coastal Grassland, Rock Creek, Siuslaw National Forest, Lane County, Oregon.

THE LEPIDOPTERA

Butterflies and moths are species of insects within the Order Lepidoptera. The butterflies in the woodlands and forests of the Pacific Northwest are represented by over 200 species in seven families: Hesperidae, Lycaenidae, Nymphalidae, Papilionidae, Pieridae, Riodinidae, and Satyridae. Many of the butterfly species in the Pacific Northwest occur throughout western North America and have been well reviewed by Warren (2005), Pyle (2002), Neill (2001) and Guppy and Shepard (2001). Also, a wealth of literature on butterflies is available in scientific journals. The moths in the woodlands and forests of the Pacific Northwest are best considered in two categories: micromoths and macromoths. The micromoths are the least studied and are likely represented by more than 1,000 species in well over 20 commonly encountered families. The macromoths are slightly better studied than the micromoths, but not as well studied as the butterflies, and are represented in the Pacific Northwest by approximately 1,200 species in twelve families: Arctiidae, Diopitidae, Drepanidae, Epiplemididae, Geometridae, Lasiocampidae, Lymantriidae, Noctuidae, Notodontidae, Saturniidae, Sphingidae, and Thyatiridae (see Miller 1995; Miller and Hammond 2000, 2003).

The simplest method for differentiating a moth from a butterfly is to look at the antennae (Fig 1-14). Butterflies possess threadlike antennae except at the tip where there is a knob (Fig. 1-14a,b), or in the case of skippers, the ends of the antennae are slightly swollen and the tip of each antenna is hooked (Fig 1-14c). The antennae in macromoths and micromoths are variably threadlike (filiform) (Fig 1-14d) to feathered (pectinate) (Fig 1-14e) along most of their length but the tip of each antenna is tapered, more or less to a slender point. The difference between macromoths and micromoths is not based solely on size, as the names suggest; rather they are distinguished by the details of the female reproductive tract and wing venation. These details are discussed and illustrated in most texts on general entomology (Triplehorn and Johnson 2005) and in books about Lepidoptera (Covell 2005). The literature related to the identification of moths exists principally in technical scientific journals, if at all. The details of taxonomy and identification of macromoths is facilitated by publications, such as *A Field Guide to the Moths of Eastern North America*, by Covell (2005), and the series *Moths of North America*, published by the Wedge Foundation. No comprehensive guide to the macromoths of the Pacific Northwest exists, but a general overview of more than 300 species can be found in Miller and Hammond (2000, 2003).

The taxonomy of butterflies, but not moths, is replete with descriptions of subspecies. Therefore, a discussion about sensitive species in the context of butterflies is bound to involve the distinctions among subspecies within the nominate species. In many cases, whenever a species of butterfly is considered uncommon, rare, threatened, endangered, or otherwise at risk, the focus is on a certain subset of distinct populations that are geographically separated and morphologically distinct from one another and, therefore, officially recognized as a subspecies. This means that a given species of butterfly may be abundant and widespread, but a subspecies within that species may be rare or endemic in an at-risk habitat, and therefore placed on the Federal Endangered Species List. In fact, this is the case with the Oregon Silverspot, *Speyeria zerene hippolyta*, and Fender's Blue, *Icaricia icarioides fenderi*, which are federally listed as endangered butterfly species in the Pacific Northwest. In each case the nominate species is common, widespread, and consists of multiple subspecies, only one of which is officially considered to be in peril.

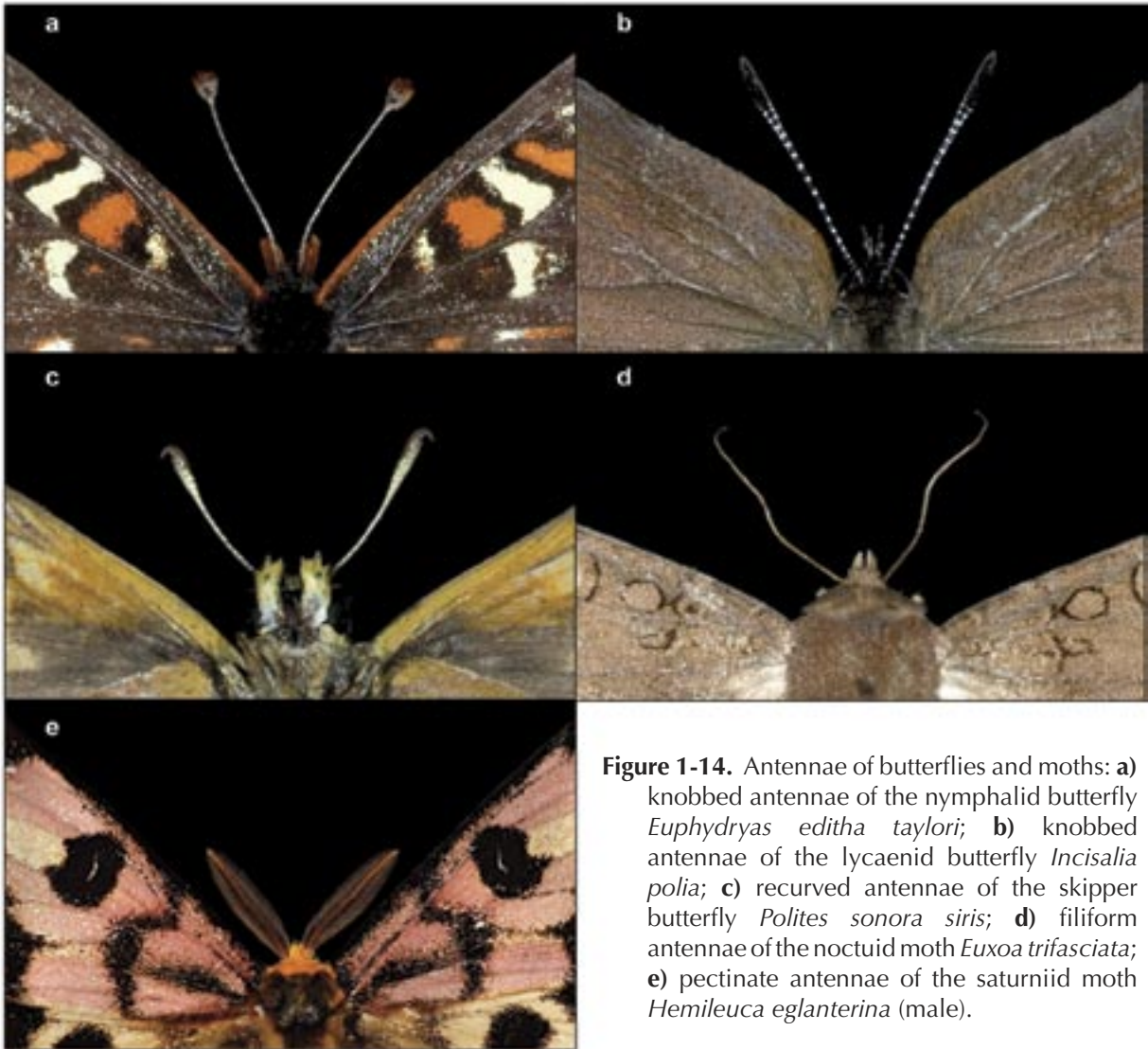


Figure 1-14. Antennae of butterflies and moths: **a)** knobbed antennae of the nymphalid butterfly *Euphydryas editha taylori*; **b)** knobbed antennae of the lycaenid butterfly *Incisalia polia*; **c)** recurved antennae of the skipper butterfly *Polites sonora siris*; **d)** filiform antennae of the noctuid moth *Euxoa trifasciata*; **e)** pectinate antennae of the saturniid moth *Hemileuca eglanterina* (male).

The typical life cycle of a butterfly or moth follows a sequence involving four life stages: adult, egg, caterpillar, and pupa. A more detailed essay on the life cycle of Lepidoptera is presented in Miller and Hammond (2003).

Adult. A butterfly or moth is the sexually mature adult life stage and serves three main functions in the life cycle: mating, dispersal, and oviposition (females). Among the species in the Pacific Northwest, all butterflies, and most moths, feed on nectar or a liquid sugar source that serves as fuel for flight. Curiously, some species of macromoths do not have functional mouthparts and cannot feed. Non-feeding adults are relatively short-lived.

Egg. Females may lay eggs singly or in clusters, depending on the species. Most species attach their eggs to the vegetation that will serve as the food plant for the caterpillar. However, some moths will scatter their eggs on the soil near suitable caterpillar food plants. Egg production may

range from a low number of less than 100 per female to a high number exceeding 1,000 per female.

Caterpillar. Only the larval stage of Lepidoptera is called a caterpillar. The caterpillar is the mobile immature stage of moths and butterflies. Caterpillars can be found in fruits, roots and stems as borers or miners; in foliage as miners; on the surface of foliage as skeletonizers or chewers; in galls; or in the nests of other insects, such as ants and bees, where they may be predaceous on immatures of their host. Caterpillars initially develop inside an egg and then emerge by chewing a hole through the eggshell that they sometimes eat in its entirety. The caterpillar increases in size each time it molts (sheds its skin). Between molts the individual caterpillar is termed an instar. Typically, a caterpillar passes through five instars as it eats and grows. In certain species a caterpillar that will become an adult female may develop through an additional instar and thus grow bigger than the male. Even into the last instar it is usually difficult to distinguish between the sexes. Identification of caterpillars is difficult (see Miller 1995) and may be facilitated by knowledge of the species of food plant (see Miller and Hammond 2003).

Caterpillar growth rates are strongly influenced by temperature and nutritional quality of food plants. Growth rates are slow at cold temperatures and, up to a certain point, faster at warm temperatures. The rates of caterpillar development depend on the nutritional quality of its food, as determined by the protein (nitrogen), water, and allelochemical content. Most plants contain between 1% and 7% nitrogen by weight and caterpillar growth rates will be faster at the higher end of that spectrum. Also, growth is enhanced when water content of the food is at the higher end of the normal range. Allelochemicals are plant-derived chemicals that may stimulate or deter feeding by caterpillars. Some allelochemicals are terpenes, alkaloids, phenolics, and various proteins. In some instances, these chemicals may poison the caterpillar. In other instances, the caterpillar may be unharmed by the poisons, but might store them internally, making them toxic to potential predators. Many of the poisonous caterpillars are aposematic, that is, they are brightly colored, the colors acting as a warning signal to fend off predators. Images of aposematic tropical caterpillars can be seen in Miller et al. (2006, 2007). The caterpillar life stage of many of the common species found in forests and woodlands of the Pacific Northwest are presented in Miller (1995) and Miller and Hammond (2003). Also, the caterpillars of many species found in forests and woodlands of the eastern United States are presented in Wagner et al. (1995, 1997, 2001) and Wagner (2005).

Pupa. Metamorphosis, the process of changing from a caterpillar into an adult, occurs within the pupa. In butterflies the pupa is called a chrysalis. In moths the pupa may be covered in silk, which is called a cocoon, or the pupa may be naked but perhaps encased in rolled foliage or in the soil. When a caterpillar has attained a critical size it will change its behavior, stop feeding, and begin searching for or creating a site to pupate. The pupal stage may last for 2 to 3 weeks or for more than 1 year. Typically, overwintering pupae are in diapause, a state of development when the emergence of the adult is in an arrested state, or in a state of very slow development. In species that diapause the adult will not emerge from the pupa at the appropriate time unless the pupa is first exposed to a period of cold temperatures.

Natural Enemies. Lepidoptera have many natural enemies. Predators of many types devour Lepidoptera, often in great quantities. Some of the most commonly encountered predators are rodents, reptiles, bats, birds, spiders, nematodes, beetles, true bugs, and parasitoids. Also, many pathogens, such as viruses, bacteria, protozoa, microsporidia, and fungi, cause fatal diseases in

Lepidoptera. Lepidoptera are equipped with defense mechanisms against such natural enemies. Physical and physiological protective features include, specialized cells in the “blood” that encapsulate foreign bodies, sharp spines, stinging hairs, toxins, camouflage, and flashy bright colors or eyespots that startle intruders.

CONSERVATION

Conservation of ecosystems, unique habitats, and biodiversity usually focuses on vascular plants and the larger and more prominent species of vertebrate animals. Yet insects and other arthropods comprise about 95% of all animal life in terrestrial environments. Thus, as representatives of about one-quarter of all insect life, butterflies and moths serve as a flagship taxon in representing animal biodiversity. Moreover, insects in general, and Lepidoptera in particular, are highly sensitive to environmental change, both climate change and habitat modification, and can serve as indicator organisms for the assessment of health, diversity, and sustainability of the environment (see New et al. 1995). Consequently, the waning and waxing of populations of the endangered or sensitive species of Lepidoptera covered in this book serve as signals that the environment has been positively or negatively impacted in some way.

How might insect herbivores, such as butterflies and moths, signal a shift in the environment? Each species is a member of a local biota that sends a message about the condition of local habitats. As certain species become less and less abundant, and others become more abundant, the message is that the habitat is changing. The change may be part of a natural cycle or it may be due to various kinds of human-induced environmental insults. The change may be slow and subtle or rapid and dramatically obvious. In either case, the purpose of conservation activities is to protect species in decline.

How do we know if a species is in decline? Long-term quantitative measurements, otherwise known as the study of population dynamics, provide a chronological record of population abundance. In a group such as the Lepidoptera, it is difficult to know which species to monitor on a long-term basis; therefore, it is difficult to determine which species are uncommon or rare. It has been our approach to monitor assemblages of species associated with a particular habitat or land management objective. In this manner we have been able to identify uncommon and rare species, especially among the moths. The presence of species either in decline or on the increase becomes apparent once a few years of data have been accumulated at one location, or, better yet, across multiple locations.

The ultimate negative fate of a species in decline is in evidence when individuals have become so rare that sampling methods used to monitor the population no longer detect the presence of a population. Typically, the lack of any observed individual of a given species in a given habitat, for a number of consecutive years, will incite a proclamation of extinction. Such a proclamation may or may not be true, as has been the case a couple of times in the Pacific Northwest. For example, the Fender’s Blue, not seen in the Willamette Valley for a period of more than 45 years, was considered extinct. Then Paul Hammond discovered a population, and then another. Today the Fender’s Blue is on the Federal Endangered Species List and a subject of much conservation activity (see Chapter 4: Special Case Histories and Chapter 5: Species Profiles).

The conservation of the Fender's Blue, and many other species that reside in meadow habitat, points out a paradox in the approach to conservation of a rare species. On the one hand, the species may be sensitive to disturbance and require late successional habitat of one kind or another, such as old-growth forest. On the other hand, many species require open habitat, or what might be called an early seral plant community. Obviously, the need to manage the habitat involves knowing when to prevent disturbances and when to use disturbance as a tool. When applied appropriately, mowing, thinning of trees, and fire are valuable tools in the conservation of species that occupy early seral habitats. When applied inappropriately, fire, mowing, and tree removal can be disastrous.

As a final note to this chapter, we have selected an issue concerning the criteria that are used, in part, to guide certain conservation efforts, specifically programs regarding the conservation of biological diversity. One objective of conservation practices is to protect habitats known to harbor a very high number of species. These types of habitats are classified as biological diversity hotspots and should be protected based on the fact that they possess an inordinate number of species. A second objective of conservation practices is the protection of designated species that are rare, endangered, or in peril due to habitat loss. Often the habitat type that is in peril is limited in its presence across the landscape and it is unique in various ways, such as a small bog or a previously vast, but now fragmented, oak woodland. There is a potential problem buried in these two conservation objectives. The problem lies in the premise that biological diversity hotspots, by the nature of possessing numerous species, will in fact inherently include uncommon and rare species. This premise leads to the possibility of a false conclusion that protection of biological diversity hotspots will inherently protect threatened or endangered species. This statement is not true, because threatened and endangered species are not necessarily a component of the species assemblage in biological diversity hotspots. Therefore, threatened and endangered species will not necessarily be protected if conservation of biological hotspots is the main criterion. In fact, threatened and endangered species are often found in habitats that are not particularly rich in other species. However, do not conclude from our argument that biological hotspots should not be conserved: they should, but for reasons other than a belief that they will include those rare species that are of special concern.

The challenge for conservation of uncommon and rare species, species of special interest, or biodiversity hotspots, includes determining the scientific merit of the research that produced the data and the need to address a multitude of persistent environmental pressures. The pressures of greatest force are the demands arising from an unending crisis of invasive exotic weeds, and a human population that relies on ever-increasing resource extraction and urban and agricultural development. We address these issues, and others, in Chapter 2: Ecological Issues and Forest Management.

CHAPTER 2: ECOLOGICAL ISSUES AND FOREST MANAGEMENT

The 122 species (or subspecies) of butterflies and moths detailed in this book are featured for various reasons: the species are either uncommon or rare, or they live in a habitat that is in peril. Each species represents a case of special relevance to forest management in the Pacific Northwest. We have assigned each species to one or two of seven categories of rarity or special interest: 1) endangered or threatened; 2) local or endemic; 3) geographically widespread but rare; 4) oak woodland; 5) climate sensitive; 6) intentionally introduced as a biological control agent for weed management, and; 7) sensitive to practices related to timber and land management.

ENDANGERED OR THREATENED SPECIES

As of 2006 we recognize eight species (or subspecies) of Lepidoptera in the Pacific Northwest that require immediate attention. These eight species are well known to occur at very low abundance or they have demonstrated a long-term trend of declining population numbers. All of these species are butterflies. At present, two of these taxa are represented by a subspecies that is formally listed under the U.S. Endangered Species Act: 1) a lycaenid, the Fender's Blue, *Icaricia icarioides fenderi*, and; 2) a nymphalid, the Oregon Silverspot, *Speyeria zerene hippolyta*. In addition to the species on the Federal List, we have included species, such as *Polites mardon*, that are listed as candidate species on State Lists. Also, we have included species such as *Euphydryas editha taylori*, and *Incisalia polia maritima* that are very close to being listed as threatened or endangered.

Many of the taxa covered in this book reveal present day patterns in distribution that appear to be remnants of the species range that historically (centuries to millennia) was more widely distributed. The current diminished ranges contracted naturally to very small populations within isolated refugia along the West Coast prior to European settlement of North America. Subsequent to the natural contraction of these species ranges, adverse human-related effects on the quality and quantity of remaining suitable habitat resulted in fragmentation of the populations, thus placing them on the brink of extinction. Four issues are responsible for the fragmentation and decline among these populations: 1) loss of habitat to urban and agricultural development; 2) logging of mature forests; 3) the controlled management of natural disturbances such as wildfires, and; 4) the introduction of tall-growing exotic grasses and brush that compete with and displace native vegetation, including the food plants required by the larvae of many butterfly species. A fifth issue, rapid climate change, is currently under study but annual census data for dozens of species over a period of multiple decades will be required before significant conclusions regarding population trends can be drawn.

LOCAL AND ENDEMIC SPECIES

We recognize about sixty species of Lepidoptera that are either very local in their distribution or narrowly endemic in the Pacific Northwest. We consider 14 of these species as particularly sensitive to being threatened due to their location and their habitat requirements. Local species usually have very narrow habitat requirements and are essentially limited to special habitats that are rare and localized within broader landscapes. For example, wet bogs are habitat for several habitat-restricted butterfly species, such as *Colias gigantea*, *Boloria bellona*, *Boloria selene*, and *Speyeria hollandi*. Colonies of these butterflies are potentially vulnerable to extirpation if the local habitat is destroyed, i.e., the bogs are drained. Other species may be restricted to certain habitats above timberline, including alpine meadows and talus slopes, that often support very local populations of plants and animals. Examples include the butterflies *Lycaena phlaeas*, *Boloria tritonia*, *Colias nastes*, and *Oeneis melissa*. Riparian habitats along forest stream corridors provide an environment that supports species with very local populations, such as the moth, *Eosphropteryx thyatyroides*, and the butterflies *Speyeria cybele* and *Pieris marginalis*.

Endemic species have very limited geographic distributions, showing a range restricted to local or regional areas. In the Pacific Northwest, regions of endemism occur along the coastal zone and in the Coast Range Mountains, Siskiyou Mountains, Cascade Mountains, Blue Mountains, Wallowa Mountains, and the Willamette Valley. While endemic species may be locally abundant, their limited geographic range and the limited availability of suitable habitat make them vulnerable to future adverse impacts, such as a changing climate, extensive fires, and habitat altering management practices. Such species include the butterflies *Erebia vidleri*, *Oeneis nevadensis*, *Chlosyne hoffmani*, and the moth *Cochisea sonomensis*.

WIDESPREAD BUT RARE SPECIES

We list about 12 species of rare Lepidoptera that are widely distributed in western North America. Examples include the moths *Hydria undulata*, *Snowia montaneria*, *Acronicta cyanescens*, and *Panthea gigantea*. However, in spite of their broad geographic scope they are almost always rare throughout their range. The reasons for their rarity are poorly understood. Because rare species are so widely distributed but infrequently encountered, quantitative assessment surveys and monitoring projects are very difficult and tenuous to perform. The caterpillars may be especially vulnerable to predation, which keeps adult numbers at a low level, or the caterpillars may be poor competitors against other species. In either event, such species are relatively unknown; therefore, typically they are not included in the environmental assessment of impacts relative to management practices. We discuss species in this category to place emphasis on the point that certain moths are widespread but rare.

OAK WOODLAND SPECIES

We have identified about 32 species of Lepidoptera that are intimately associated with oak woodlands in Northern California, Oregon, Washington, and British Columbia, from the west side of the Sierra Nevada and Cascade Mountains to the Pacific Ocean. The relationship is intimate

because the caterpillars of most of these species are specialists that feed only on the foliage of oaks or other Fagaceae. However, a few of the species feed on trees and shrubs, such as madrone, various manzanitas, *Ceanothus*, pines, or cedars, that are part of the broader plant community in oak woodlands.

Three geographic regions of North America have been identified as present-day oak woodland refugia, all that remains from an ancient biota that originated millions of years ago. These include: 1) the southern Appalachians and southeast coast; 2) the Southwest, from central Arizona south through Mexico and montane highlands of Central America, and; 3) the West Coast west of the Sierra Nevada and Cascades (Whittaker 1961). The Klamath-Siskiyou region of northwest California and southwest Oregon is at the center of this West Coast refugium, and current-day oak woodlands or mixed conifer-hardwood forests represent much of this relictual biota (Whittaker 1961).

Our list of special interest Lepidoptera contains 25 species of butterflies and moths that are associated with oak woodlands. These species are specialist feeders on various Fagaceae and are dependent on the persistence of oak woodlands along the West Coast. The woodlands comprise both valley woodlands at low elevations and mixed conifer-hardwood forests at higher elevations in the Cascade Mountains, southern Coast Range, and Siskiyou Mountains.

The assemblage of oak species at low elevations in the Pacific Northwest exhibits a strong latitudinal gradient. The oak woodlands that extend from southern British Columbia through western Washington and into the Willamette Valley of western Oregon consist only of one species, Oregon white oak. From southwestern Oregon into northern California the oak woodland communities include both Oregon white oak and California black oak. In the foothills of central California important lowland oak species include blue oak, valley oak, and interior live oak. Over this entire range of oak woodlands many species of moths, and a few species of butterflies, possess caterpillars that feed on oak foliage, such as *Acrionicta marmorata*, three species of *Catocala* (*C. abolibah*, *C. ilia*, *C. verrilliana*), *Mesogona subcuprea*, *Perigonica tertia*, and *Erynnis propertius*. Vesely and Tucker (2004) have discussed helpful management programs for maintaining low elevation oak woodlands.

Oak woodlands at middle elevations of the inner mountain ranges and the interior side of the Coast Range of southern Oregon and California usually consist of mixed hardwood-conifer forests that include golden chinquapin, canyon live oak, and tan oak. These woodlands support a rich fauna of butterflies and moths, including *Adelpha californica*, *Habrodais grunus*, *Catocala ophelia*, *Perigonica angulata*, *Perigonica pectinata*, and *Phryganidea californica*. All of these species are dependent upon forest management practices that maintain mixed hardwood-conifer forests. The use of herbicides to kill so-called weedy hardwood species, such as chinquapin, canyon live oak, and tan oak, in young plantations and stands of early stage forest regeneration, tends to produce monoculture stands of conifers that eliminate the oak woodland community from the forest landscape, greatly decreasing the biological diversity of the forest as a consequence. In turn, this greatly affects higher levels of the food-chain, such as birds, bats, and small mammals that may prey on Lepidoptera (Hammond and Miller 1998).

In addition to management concerns regarding the maintenance of oak woodlands along the West Coast, a major biological threat has recently appeared with the introduction of the exotic pathogenic fungus *Phytophthora ramorum*, the causal agent of the disease sudden oak death. In

the worst-case scenario, this pathogen could eliminate most coastal oak woodlands, virtually exterminating all species of specialist oak-feeding butterflies and moths. Similarly, several species of vertebrates such as the acorn woodpecker, *Melanerpes formicivorus*, whose niche includes an intimate relationship with oaks, also would be at-risk of extinction.

CLIMATE-SENSITIVE SPECIES

Warming climatic conditions have the potential to cause major impacts on many species of butterflies and moths. In terms of distribution and abundance, some species will be impacted positively, some negatively. Species adapted to warmer and drier conditions have the potential to greatly expand in distribution and abundance as previously cool (much of the Pacific Northwest) environments become warmer. While some species that are adapted to cool or moister conditions may move northward, others will be adversely affected by a warming climate because no new suitable habitat is available for colonization.

We have identified 16 species of butterflies and moths that may be negatively affected by a warming climate because they are currently restricted to cool alpine or subalpine habitats. Although they may survive farther north in Canada, as climatic conditions shift and become warmer, such species eventually may disappear from the southern portion of their distributions in the United States. For instance, if a warmer climate occurs in the future then endemic and local bog species, such as *Colias gigantea*, *Colias interior*, and *Speyeria hollandi*, may not survive south of Canada. Along the Oregon coast, we have observed the endangered Oregon Silverspot butterfly being adversely impacted by warming climatic conditions (Hammond 2005). The full impact of climate change is difficult to assess or predict at the present time.

WEED BIOLOGICAL CONTROL AGENTS

The use of insects in the biological (nonchemical) control of weeds has met with varied success in the Pacific Northwest (Coombs et al. 2004). Nonetheless this practice is vital to the overall success of programs aimed at suppressing exotic invasive weeds. We list three species of Lepidoptera of special interest in the biological control of weeds in forested habitats in the Pacific Northwest.

Three species of Eurasian moths are of special interest because they have been intentionally introduced into the Pacific Northwest as biological control agents to suppress populations of three noxious Eurasian weed species: 1) a sphingid, *Hyles euphorbiae*, introduced to suppress leafy spurge on western rangelands and forests east of the Cascades; 2) an arctiid, the cinnabar moth, *Tyria jacobaeae*, introduced to suppress tansy ragwort west of the Cascade and Sierra Nevada Mountains; and 3) a geometrid, *Aplocera plagiata*, introduced to suppress the Eurasian St. John's wort east and west of the Cascade Mountains and in northern California. The very nature of a successful biological control project will result in the biological control agent becoming rare as the food plant becomes less and less common. Obviously, the use of herbicides and insecticides at sites where these species have become established would be very counter productive (detrimental) to their residency and would negatively impact their ability to spread to other patches of their weedy food plant. Thus, if the goal of a particular forest district is to protect and promote the biological

suppression of weeds by these moths, then herbicides and insecticides should not be used in habitats where these noxious weed species and the biological control species occur together.

MANAGEMENT-SENSITIVE SPECIES

Some management sensitive species and their policy-based issues, such as weed control, and the need to retain unique habitats, such as oak woodlands and bogs, have been discussed above. However, the topic of forest management and its impacts on sensitive species deserves special consideration, because the overriding issues are region-dependent within the Pacific Northwest. Specifically, the Cascade Mountain Range divides the Pacific Northwest into two regions: the wetter, dense forests dominated by Douglas-fir to the west and the drier, less dense forests dominated by Ponderosa pine to the east. The Siskiyou Mountain area is west of the Cascade Mountains and is drier than the more northern west-side forests, but we consider the Siskiyou Mountain area to be part of the western forest region. The interplay between the socio-political “environment” and actual environmental conditions is different in each region.

WEST-SIDE FORESTS

The most publicized issue surrounding the management of west-side forests concerns the importance, protection, and use of old-growth conifer forests. The principle species in west-side old-growth forests is Douglas-fir. To a lesser degree, old-growth stands of Sitka spruce and western red cedar also are at issue. Curiously, very few species of butterflies and moths are restricted to old-growth conifer forests along the West Coast. Of the 122 species covered in this book, we list only three species as primarily associated with mature to old-growth conifer forests: a macromoth, *Autographa speciosa*; a micromoth, *Dasyphyga alternosquamella*; and a butterfly, *Mitoura johnsoni*. The latter two species feed on dwarf mistletoe, a parasitic plant living on the mature trees. Many other Lepidoptera species also occur in old-growth forests, but are not old-growth dependent and may be common in thinned, second-growth forests that are starting to display some of the characteristics of old-growth forests, such as canopy openings and strong development of understory vegetation.

The caterpillars of most butterflies and moths feed on angiosperms, relatively few species feed on gymnosperms. In a study conducted at the HJ Andrews Experimental Forest, on the west slope of the Cascade Mountains in Oregon, we found: 57% of the species in light-trap samples fed on one species of hardwood or another, particularly species of Fagaceae, Salicaceae, Ericaceae, and Rhamnaceae; 31% of the species fed on herbs and grasses; and only 9% fed on conifers in the forest canopy (Hammond and Miller 1998, Miller and Hammond 2003). Thus, unthinned conifer forests, with fewer species of flowering plants, offer some of the most unsuitable habitat for most forest butterflies and moths (Muir et al. 2002). Conversely, well-spaced trees in thinned second-growth and old-growth forests provide a habitat with suitable conditions of temperature, moisture, and light for a higher diversity of species in the understory vegetation and consequently a higher diversity of animals.

In sharp contrast to the few species that are dependent on late seral stage forest stands, there exists a relatively large number of butterfly and moth species that require open meadow-like habitats. Early seral stage habitats are often maintained by disturbances, such as fire, road construction, thinning of trees, and the clearcutting of trees. We have identified about 30 species of rare or uncommon butterflies and moths that require open areas in the forest where the environment favors either the food plants of the caterpillar or the nectar plants of the adults. Prior to the period of European settlement of North America, large wildfires produced much of this open habitat.

After many decades of wildfire suppression in the Pacific Northwest, it is the practice of timber harvesting, particularly the clearcutting of trees, that has created a majority of the early successional plant communities. Ironically, without a certain degree of natural and human-induced disturbance many of the open habitat species would become very uncommon or rare, or even disappear from the forest landscapes in this region. However, in the context of disturbance, forest management practices that use herbicides to kill weedy species of hardwoods, herbs, and grasses in clear-cuts are quite destructive to the butterflies and moths that favor early seral stage habitats. Furthermore, the removal of non-timber plant species results in a monoculture stand of conifers that greatly diminishes the biological diversity across the forest landscape. Examples of Lepidoptera that feed on early seral plants or plants that are fire-adapted include: *Euxoa vetusta* feeding on herbs such as lupines; *Apamea plutonia* feeding on grasses; *Mesogona rubra* and *Saturnia mendocino* feeding on manzanitas, such as *Arctostaphylos columbiana*; *Papilio eurymedon* feeding on snowbrush, and; *Adelpha californica* and *Habrodais grunus* feeding on golden chinquapin and canyon live oak. Along the summit of the Cascades, two rare sphinx moths, *Hyles gallii* and *Proserpinus flavofasciata*, feed on fireweed.

We have also identified several species of butterflies and moths that feed on cedar trees, such as incense cedar and western red cedar. These species include *Mitoura grynea*, *Abagrotis mirabilis*, *Abagrotis rubicundis*, and *Lithophane gausapata*. If cedar trees are not replaced following timber harvest, these insects will disappear from the forest landscape.

EAST-SIDE FORESTS AND RANGELANDS

From the east slope of the Cascade Mountains and the Sierra Nevada Mountains, eastward through the Great Basin, Intermountain, and Rocky Mountain regions, climatic conditions tend to be much drier and exhibit a more extreme range in temperatures than those in the relatively moist and mild climate found west of the Cascade Mountains. The drier climate promotes different ecological issues and management concerns, principally fire related, for the more continental biota of these regions. The west-side Siskiyou forests are relatively dry and are subject to fire.

It is thought that, prior to European settlement, wildfires had been a major disturbance factor in shaping the ecological communities of the Great Basin, the drier montane habitats east of the Cascade Mountains and the Siskiyou Mountains. In these communities, most Lepidoptera, particularly those butterflies and moths whose caterpillars feed on herbs and grasses, and their larval food plants appear to be adapted to a regular regime of fire disturbance. As in west-side forests, the suppression of wildfires has resulted in major

changes to plant communities by increasing the succession and abundance of woody vegetation. At lower elevations, the arid steppe communities have shown an increase in the abundance of woody species, such as sagebrush and western juniper, at the expense of the herb-grass community (Miller 2005). At higher elevations, more-open forests, meadows, and open prairies have become overgrown with very dense conifer forests.

Historically, regular ground fires maintained open Ponderosa pine forests with about 25-35 large old trees per acre. This provided plenty of light and open space in the forest understory to support a rich diversity of herbs, grasses, and low shrubs. In a study in the Blue Mountains of eastern Oregon, Grimble et al. (1992) found that 45% of the Lepidoptera species sampled in light traps fed on hardwood shrubs, such as bitterbrush, currents, and huckleberry, 42% fed on herbs and grasses, and only 10% fed on conifers. Even more dramatic was the proportional abundance of individual moths feeding on each plant group. Overall, 55% of all moths were feeding on herbs and grasses, 39% were feeding on hardwood shrubs, and only 5% were feeding on conifers. In turn, these Lepidoptera serve as food for higher trophic levels of the foodweb, such as arthropod predators, birds, and small mammals. As in west-side forests, a significant portion of the foodweb dynamics in east-side forests is dependent not on the conifer trees, but on the flowering plants growing in the plant communities that make up the forest understory. However, following European settlement, the control of fire has resulted in an increase in the density of conifer trees in the forests, often with tree densities exceeding 500 trees per acre. Trees at high densities shade the herb, grass, and shrub understory, resulting in lower species diversity among both plants and animals, and creating a high risk for catastrophic fire.

In 2000, the U.S. Forest Service addressed the issue of catastrophic fire prevention by developing a Fuels Reduction Program under the National Fire Plan, the primary objective of which is to reduce the danger of catastrophic wildfires, particularly at the urban-forest interface. Subsequently, in 2003 the Healthy Forests Initiative [HFI] was proposed. The HFI is designed to open dense over-grown forests by cutting most of the young trees in either commercial or pre-commercial thinning projects while leaving a lower density of large trees. Thinned forests are then managed with prescribed controlled burning of the understory.

The fire management programs that are being promoted under the HFI are extremely important for restoring the flowering communities of shrubs, herbs, and grasses to the understory of over-grown conifer stands. In turn, these communities not only support Lepidoptera communities of some 400 species of butterflies and moths, they enhance the predator communities that are vital for controlling conifer-feeding pest species. Moreover, we have found that small clear-cuts in dense conifer forests in northeastern Oregon, eastern Washington, northern Idaho, and northwest Montana are extremely valuable for restoring open, sunny habitat used by many species of butterflies and moths, including *Lycaeides idas*, *Colias occidentalis*, *Colias interior*, *Speyeria atlantis*, *Cucullia florea*, *Cucullia postera*, and *Hyles gallii*.

A related fire management issue concerns the forest-prairie landscape mosaic in montane areas throughout the Great Basin and intermountain regions. Historically, fire often restricted conifer forests to moist ravines and north-facing slopes, while open prairie

grassland occupied the dryer ridge tops and south-facing slopes. Such heterogeneity in the landscape supports an unusually large biological diversity, a fine-scaled mixture of forest and prairie habitats. However, since the end of the European settlement period the prevention and control of wildfires has resulted in dense conifer forests that have expanded over ridge tops and onto south-facing slopes, eliminating the grassland community. During drought years, dense tree stands on such dry sites become severely stressed, making them vulnerable to insect attacks and catastrophic wildfires. Open meadows and grasslands within the broader forest landscape are vital to the survival of several hundred species of butterflies and moths that depend on herbs, grasses and flowers for food and nectar.

Domestic livestock grazing is another issue pertinent to east-side forests and the management of the understory vegetation constituting the herb-grass-lepidopteran communities. In our experience, short-term, light to moderate livestock grazing, particularly during late summer, fall, or winter, typically does not negatively impact these communities. However, heavy or long-term grazing conducted throughout the spring and early summer tends to result in a negative impact on these communities. Native herbs, grasses, and the butterflies and moths that depend on these plants, are greatly reduced or in some cases eliminated by such grazing. Habitats with a high degree of absence in the native plants are prone to invasion by exotic Eurasian weed species, such as cheat grass and knapweed. Thus, over-grazed forests and rangelands tend to have very few butterflies and moths other than those that feed on weeds, conifers, and juniper. Similarly, due to the loss of insect predators over-grazed forests will be more vulnerable to outbreaks of conifer-feeding caterpillars (Hammond and Miller 1998).

INSECT PEST CONTROL

The resulting formation of dense monoculture conifer forests, combined with the loss of lepidopteran predators, provides suitable conditions for population outbreaks of conifer-defoliating caterpillars, such as the western spruce budworm, *Choristoneura occidentalis*, and the Douglas-fir tussock moth, *Orgyia pseudotsugata* (Brookes et al. 1987, Campbell 1993). During a 40-year period in the mid-20th century, the typical response to insect-pest outbreaks was the large-scale aerial application of insecticides, on a regular basis, over vast contiguous areas. Beginning in the 1950's, DDT and other chemical insecticides were applied, followed in the 1980s and 1990s by applications of the biological insecticide *Bacillus thuringiensis kurstaki* (BTK). Overall, these spray programs have had a negative impact on many nontarget Lepidoptera species, particularly those species that are highly sedentary and live in very local colonies. Following applications of BTK, Miller (1990, 1992, 1999) documented the decline in population numbers for nonpestiferous, nontarget Lepidoptera, and further noted that, whereas populations of common species may recover over a three-year period, rare species may not recover at all within the treated area. Local and endemic species, such as *Speyeria cybele*, *Speyeria hollandi*, and *Colias gigantea*, that are restricted to special habitats, such as bogs and riparian corridors, are easily extirpated during insecticide spray programs (PCH pers. obs.).

One of the best examples of a nontarget species at-risk from pest control practices is the western sulphur butterfly, *Colias occidentalis*. Caterpillars of this species feed on peas and other legumes growing in open, sunny forests and meadows at higher elevations

in the mountains. Historical records suggest that this butterfly was once common and widely distributed in the Blue and Wallowa Mountains of northeastern Oregon and southeastern Washington during 1940-1960 (Hinchliff 1994, 1996). The dense overgrowth of the conifer forests, combined with multiple insecticide spray programs, has almost completely exterminated this species within these mountains. Today, the last few colonies of *C. occidentalis* are mostly concentrated at the lower elevation perimeter of the forest within the ecotone between forest and sagebrush rangeland. We have identified at least 32 species of nontarget butterflies and moths that are similarly impacted.

Insect pest management is rife with problems regarding efficacy of control, nontarget species impacts, and biological diversity issues. Problems such as these are at the center of any risk/benefit analysis. The debate over which type(s) of pest control practices to implement, and with what ecological consequences, may also consider a plan of no action. If certain pest control programs are not conducted massive tree mortality could occur due to caterpillar defoliation and bark beetle attack. The resultant decadent forests could then provide dense stands of fuel for catastrophic wildfires. On the other hand, certain insect-pest management practices may result in undesirable consequences with regard to uncommon and rare species. Our philosophy is that no single remedy fits all situations, but monitoring protocols (Chapter 3) are vital to obtaining baseline data. We offer information and comments on population numbers as well as on issues regarding sensitivity to environmental conditions and management for each species in Chapter 5: Species Accounts. Plus, we give a more detailed description of eight species in Chapter 4: Special Case Histories.

CHAPTER 3: MONITORING BUTTERFLIES, MOTHS, AND CATERPILLARS

Population assessment involves measuring the abundance of individuals within a population at a specific time; it is crucial to understanding both the time-specific status of the population as well as the long-term trend(s) in the population's dynamics. Stable, declining, or increasing numbers can suggest whether or not a population is healthy. If some type of conservation program has been implemented, the data can be used to determine if the practices were beneficial or harmful. That said, population assessments of any species, let alone rare species, are difficult to do and care must be taken to ensure individuals are not harmed during the sampling procedure. Thus, the use of sampling techniques that involve the removal of species should be used only under certain circumstances, such as when the species being monitored are not endangered or endemic.

We have divided our discussion on monitoring into three sections: 1) butterflies, 2) moths, and 3) caterpillars. Methods of population assessment for caterpillars and adults for each species are discussed in detail in Chapter 5: Species Profiles. Each section is presented in the context that the monitoring program will occur across multiple years involving either a single species or many species being assessed simultaneously. The basic approach is to sample butterflies by counting individuals along defined transects; to sample moths using light traps; and to sample caterpillars by conducting a visual search of the vegetation, collecting them in a sweep net, or beating the vegetation with a stick and collecting them on a sheet. The protocols that we present are not intended to outline a comprehensive plan for conducting an inventory of all of the species of Lepidoptera in a given area.

The objective of a monitoring program is to measure the abundance of individuals or species at a particular location, or sets of locations, through time. The protocol must be standardized so that a measure of individual abundance at one site is comparable to another measure at the same site, and other sites, and comparable through time at all sites. The timing of the monitoring program depends on the species of interest and when the life stage being monitored is present.

BUTTERFLIES

Butterflies are diurnal, which dictates that monitoring and population assessment based on adults must be conducted during the day. A suitable approach to quantitative assessment of population numbers is to establish a spatially replicated, and temporally repeatable, sampling protocol that provides a chance for observation of all individuals in the sample zone and avoids the removal of individuals from the habitat. The sampling procedure should be nondestructive, that is, the quantitative measurements of individual abundance should not result in the death of the individuals

being sampled. Furthermore, the sampling technique must minimize both overestimation of the population density due to double counting, and underestimation of the population density due to overlooking individuals that are present. Numerous techniques have been employed to measure butterfly populations, including: 1) remaining in one spot for a defined period of time, counting individuals within a certain distance, and then moving to another spot; 2) using mark-recapture methods; 3) establishing line transects within which the census of the population is measured by walking at a slow pace while spotting and identifying specimens.

Each of these techniques has logistical difficulties and exhibits some degree of sample bias. For example, remaining in one spot and counting butterflies within a defined perimeter is practical, but will tend to underestimate a given population because some butterflies perched on the vegetation will elude observation. Furthermore, this method must be repeated at numerous sitting stations and requires many replicated samples. Mark-recapture studies are very time consuming and labor intensive, and can cause some level of mortality, particularly if individuals are small and delicate. Such mortality is a significant concern when dealing with endangered species, plus it complicates and reduces the accuracy of any population estimate. Also, mark-recapture studies may result in biased measurements if the rate of immigration and emigration in the area being studied is not at equilibrium.

Our preferred protocol for quantitative assessment of butterfly populations involves the establishment of line transects specifically designed for a given site and a particular species. This technique is based on nondestructive visual sampling, in which an observer walks through a spatially defined zone of habitat and counts perched and in-flight individuals. Line transect monitoring has been performed for many years in Britain following the protocol of Pollard and Yates (1993). However, in western North America, variations on this method are often necessary to accommodate various habitats, including open prairies, rocky cliffs above timberline, and tall dense forests. The size, visibility, and behavior of the butterfly being monitored, and the objective behind the monitoring, also may necessitate slight modifications in the protocol. For instance, if the objective is to complete a total population census of an endangered species at a single location, the studies will be very time intensive at one location. If the objective is to conduct a more generalized sampling for ecological studies, develop management policies, or to compare individual abundance among many plots, the studies will be less time-intensive at any one location, but will require a more intensive effort to standardize sampling protocols at multiple sites.

The design of a suitable line transect must incorporate certain spatial and temporal criteria. First and foremost, a line transect must traverse the habitat of interest. Randomly located transects might be suitable for projects dealing with the broader concerns about community and ecosystem ecology, but for population studies, particularly those dealing with rare species, it is essential to include patches of habitat where the population is known to exist. A strict compliance to a completely randomized field sampling design will be nonproductive, because much of the habitat of interest will be missed. Therefore, the most suitable standardized protocol employs a series of straight or curved lines, perhaps in a zigzag pattern, through the habitat (patches of food plant) area of interest.

For endangered species, such transects usually extend across designated habitat in previously defined management or conservation areas. Counts of individuals along transects that were deliberately placed in suitable habitat have been used successfully for assessment of the Oregon Silverspot butterfly in open coastal grasslands from northern California to southern Washington

(Hammond 1999). Because the Oregon Silverspot butterfly is a relatively large butterfly, inferring that it can be observed from a considerable distance, each line transect runs between 20 to 35m wide. In relatively smaller or narrow habitat areas it is sufficient to establish a single transect line through the center of the habitat. To obtain a total population census in relatively large or wide areas a series of regularly spaced parallel transect lines will be necessary. It follows that the transect width is usually reduced for monitoring small butterflies, because they are more difficult to see from longer distances and more difficult to identify “on the wing”. For example, Paul Hammond has monitored population trends in Fender’s Blue butterfly populations in western Oregon by establishing transects that are between 15 to 25m wide, depending on the vegetation height within the habitat. Low vegetation allows wider transects while high vegetation requires a narrower transect. For very small or hard-to-observe species, such as the Mardon Skipper, a suitable transect might be only 7 to 10m wide.

Sampling protocols require a large degree of flexibility and need to be adjusted according to the size and biology of the butterfly being monitored, the spatial topography of the habitat area, and the height of vegetation within the habitat. No single approach will be appropriate for every species or every habitat situation, but for any given species the protocol must be standardized for comparing results. For example, straight transect lines are used when a species is widely distributed throughout a defined habitat management area. However, as is the case with the Fender’s Blue butterfly, some species may be more localized to small patches within a larger management area. The Fender’s Blue butterfly is usually aggregated within localized patches of the lupine food plant. In habitat areas where the lupine is more uniformly distributed, straight transect lines can be employed. However, where the lupine is restricted to patches, the transect line must zigzag throughout the habitat area so that each local patch of lupine is included in the sampling effort. If the butterfly of interest is a forest species, the line transects should be placed either within patches of vegetation representing a certain plant community, or across ecotones.

Typically, the line transect census is conducted under warm, sunny conditions between 10:00am and noon. Observations can be conducted in the afternoon, providing the temperature is below 28 to 31°C; most butterflies seek shaded vegetation when afternoon temperatures exceed this range. Generally, monitoring should not be done when ambient temperatures exceed the low 30s. Likewise, monitoring should not be done under cool, cloudy, or excessively windy conditions. Obviously, if the species of butterfly being studied exhibits an atypical circadian pattern and flies early in the morning or at dusk, then the sampling must occur at that time.

The field observer should walk the transect at a slow pace, typically about 33 meters in 5 minutes, so that butterflies resting on vegetation have time to fly up and be counted. The observer should have a notebook or voice recorder, with which to rapidly record the counts for each butterfly species of interest. If butterflies are particularly abundant, with dozens of individuals swarming throughout the line transect, it is helpful to delineate a subset of blocked areas using landmarks such as shrubs, rocks, or flowers and then move sequentially from block to block, counting individuals within each block. The counts may be recorded as the number of individuals of species “X” observed per minute within a unit of habitat of “Y” square meters. The observer also may want to record the behavior—flying, nectaring, egg laying, etc—of each butterfly.

The development of a monitoring protocol for establishing trends in the population dynamics of rare and endangered species inherently involves a multiple-year investment of time and money. However, the same sampling designs are appropriate for assessing butterfly populations within a

given period of time among study plots based on ecological parameters or various management practices. For example, counts of individual butterflies and butterfly species can be compared between plots that were subjected to prescribed controlled fire, tree and brush thinning, or other management practices. We discuss a variety of population assessment techniques and conservation practices in Chapter 5: Species Profiles.

MOTHS

Moths are predominantly nocturnal creatures with only a few species flying during the day. Therefore, monitoring and population assessments of adults typically are conducted during the night. Day-flying moths can be sampled using the same techniques as those for butterflies, preferably the line transect method. Because all but a few species of moths are winged (and in those cases of winglessness it is only the female), and quite vagile, the most suitable approach to quantitative assessment of abundance is to establish a repeatable sampling protocol that is active from sundown to sunrise. The most widely used and accepted technique involves either an ultra-violet (UV) light or a mercury vapor light positioned near a sheet or in association with a bucket trap (Fig. 3-1). Each of these techniques poses certain logistical difficulties.



Figure 3-1. Bucket light trap with UV bulb for sampling moths.

Each of these techniques poses certain logistical difficulties.

The decision to conduct a sampling program by using a light with a sheet versus a bucket trap is based on the specific objectives of the project. If destructive sampling (killing specimens) is unacceptable, or only one or a few species are of interest, then the sheet technique might be best. However, if destructive sampling is acceptable, or a very large number of species require observation and measurement, and none are endangered, then the bucket trap technique may be more suitable. This is because the bucket trap technique typically involves the use of a killing agent, such as ethyl acetate, cyanide, or a commercially available plastic strip impregnated with a volatile pesticide. The killing agent is placed in the bucket and all the moths that are attracted to the light and trapped are killed. The sheet technique provides an open surface on which individual moths will perch and are easy to observe, with or without removal.

Obviously, the issue of destructive sampling is a critical concern when studying rare species and may in fact be the most important factor in determining which moth sampling technique is most suitable. Other concerns would be the

logistics of the set-up required by each technique and the scope of the sampling design. The logistics relevant to the set-up of the sampling station would include such variables as the type of light and its power source, the sheet or bucket, the number and location of sample sites operated on a given night, and the number of persons involved with the sampling effort. Each of these variables has a profound impact on the project's budget.

Two basic sources of power are possible, either a 110-volt AC power supply, or a 12-volt DC battery. A 10- or 22-watt UV light bulb can be used with either source. However, a mercury-vapor light requires a relatively high amount of electrical power and should be used only if 110-volt AC power is available either from a domestic source (wall current) or a gasoline-powered generator. Dependence on a domestic source of power will limit the location of a sampling site to the length of the extension cord(s), which should not exceed 200 to 300 meters. Gasoline powered generators will allow sampling sites in remote locations, far from domestic power sources, but generators are expensive, which means multiple units will increase the research budget dramatically. Also, generators are heavy, making them difficult to transport and position in roadless areas, and most models of generators must be refueled during the night if an all night sampling effort is to be conducted. By comparison, a UV light source powered by a 12-volt DC battery is very portable, relatively inexpensive, and depending on battery power output, which in turn is directly related to weight and cost, can run a full night (or more) on a single charge. Our experiences in the Pacific Northwest have shown only subtle differences in the number of species and number of individuals attracted to either type of light source. From reviewing the literature and observing colleagues in the field, it seems no two sheets are alike. We have noted the use of little sheets, big sheets, sheets placed horizontally on the ground, and sheets hung vertically from a rope. Also, the configuration of the sheets varies from a single sheet to multiple sheets arranged in an array that is linear, in an arc, triangular, or square-shaped. The fabric of the sheets may be either cotton or a synthetic blend, and typically they are either light tan or white. In all cases the sheet is anchored at the corners to prevent it from flapping in the wind and dislodging the moths. The light is placed anywhere from 1 to 24cm from the sheet, near the center for sheets on the ground and just above center for sheets hung on a line. Care should be taken to prevent contact between the sheet and a mercury vapor light. Such contact can cause a cotton sheet to catch fire and a synthetic blend sheet to melt and fuse to the bulb. Also, a hot mercury-vapor light can explode if struck by rain. A 22-watt UV light bulb does not get nearly as hot as a mercury-vapor light, so it will not damage the sheet, pose a risk of fire, or explode if struck by rain.

Typically, a bucket trap is used in association with a killing agent. If killing the specimens is required, and sampling is conducted by handpicking moths from a sheet, then each moth can be placed in a separate container, put into a cooler, and frozen, thus avoiding the use of any toxic materials. However, if rapid knockdown is required, as in a bucket trap sample, then a toxic killing agent is most likely needed. Presently, many projects include DNA sequencing studies for facilitating identification and other studies of taxonomic-evolutionary interest. If DNA sequencing is a goal of the project then the killing agent should be immediate freezing, ethanol, cyanide, or a commercially available plastic strip impregnated with a volatile pesticide. Ethyl acetate is not a suitable killing agent for moths that will be used in DNA sequencing activities.

When conducting studies of nocturnal moths, the sampling methods and the areas sampled differ significantly from those used in studies of butterflies and day-flying moths. Using a light and a sheet or bucket trap to collect moths is a site-specific and stationary activity. In other words,

multiple stations are required to sample a certain area of habitat. The stations may be positioned along a line transect, similar to that of a walking line transect used to study butterflies; however, whereas the distance between stations used for capturing butterflies is measured in meters, it is often measured in kilometers for moths. If time and site-specific data are required for habitat comparisons, then the samples should be taken from all stations on the same night, rather than from a certain portion of the habitat on one night and from another portion on a separate night. Thus, it may be necessary to equip six to twelve sampling stations on a given night. Weather conditions that differ dramatically from night to night may result in undesirable variance in the measurements of both species presence and abundance.

Measures of moth abundance using a light are strongly influenced by phases of the moon. The week of a full moon is particularly disruptive and should be avoided. Data collected during three days prior to the full moon and three days following the full moon will significantly underestimate species richness and abundance (JCM, pers. obs.). A final note: Certain species of moths do not respond to light at all, so they will not be observed in the light-trap samples. Some of these species may be assessed using baited traps (fermented juices), otherwise they will need to be assessed in their larval stage using sampling techniques for quantifying caterpillars.

Our preferred protocol for quantitative assessment of moth populations is the use of 22-watt UV lights in conjunction with a bucket trap. Typically, we will deploy 12 such traps on a given night to represent comparable habitats on a specific sample date. The traps are placed along a transect, 20 to 200 kilometers long, and specific to the objectives of the given project. A large amount of time during the day is spent setting up the traps. We use 12-volt DC batteries specifically manufactured for wheelchairs. They weigh 22lbs each, which is relatively “light” considering their capacity to deliver electrical power for only one night. They can be recharged numerous times before wearing down. We place a pesticide-impregnated plastic strip inside the bucket chamber to kill the moths (we are not studying endangered species). We retrieve the moths daily, so for each location we obtain data that is expressed as the number of species and the number of individuals per trap-night. We might repeat this process at the same locations on a second consecutive night, or we might deploy the traps along a second transect. Ultimately, the timing for returning to a sample site is determined by the objectives of the project and the level of funding. However, if the dynamics of patterns in population trends are important we will attempt to sample on a weekly or every-other-week basis. It is critical to store moth samples in a freezer to protect the specimens from mold and decomposition. The project should include an expert taxonomist and a select set of specimens should be placed into a voucher collection and deposited into a reputable museum that permits access to the specimens.

CATERPILLARS

Some adults present problems when sampling for population assessment. For example, they might be wingless or not respond to light. In such cases, or if measuring individual numbers of the larval life stage rather than the adult life stage is a project goal, then a sampling protocol must be designed to collect caterpillars. Typically, caterpillars reside in a microhabitat very different from that of adults, and they are not very mobile, so the sampling technique should focus on the food plant. There are caveats to this. The food plant of certain caterpillars is unknown and the

food plants for other caterpillars (generalist feeders) are highly varied. In any case, when assessing the abundance of a given species of caterpillar, the food plant, not the moth, will determine the choice of sampling method. Measures for caterpillars will differ among plants, so the first step in designing a caterpillar sampling protocol is to establish the plant species of interest. In other words, the sampling program will be plant specific.

Once the plant species is selected the sampling technique needs to be determined. Sampling may be conducted by one of many methods: casual (untimed) visual search; 2) timed visual search; 3) placing a burlap band around a tree trunk; 4) sweeping a net through “leafy” vegetation; 5) clipping and bagging foliage; 6) casual (untimed) beating of vegetation over a sheet; and 7) timed beating of vegetation over a sheet. In all cases a casual visual search of the targeted food plant species and other plant species in the area is helpful for discovering caterpillar/food plant relationship. However, casual visual observations are qualitative, not quantitative, and therefore not comparable across time or geography.

For the purposes of obtaining quantitative data that are comparable across taxa, time, and geography, the only methods suitable for obtaining data are clipping and bagging foliage, sweeping with a net, timed visual searches, and timed beating of foliage over a sheet. The bag and clip sampling method is not discussed here because the protocol is very time consuming and inefficient for specimen recovery, and it destroys the plants. Many species of rare butterflies and moths are associated with rare food plants, suggesting conservation of the food plant is critical to their survival. Thus, a destructive sampling technique would be unacceptable. Although biased toward counting larger and brightly colored specimens, the timed visual search is a very fast, highly efficient, and represents a non-destructive sampling method for assessing abundance. Furthermore, (timed or untimed) visual searching is particularly valuable for observing specimens located on the trunk or massive branches of the food plant. The timed beating sheet method is a fast, highly efficient protocol for specimen recovery from foliage, although tenacious caterpillars are not dislodged. The beating sheet method (Fig. 3-2) will not destroy the plant, providing care is taken not to beat the food plants too forcefully. The sweep-net method is best used to sample those species that are associated with herbaceous vegetation. When used properly, the sweep net method does not destroy the plant and provides an efficient means for detecting species that are easily dislodged from foliage.



Figure 3-2. Collecting caterpillars on a sheet while beating foliage with a stick.

Whether employing a timed visual search or a timed beating sheet sample it is critical to standardize the protocol as to the length of time and how frequently sampling occurs. For example, if a timed visual search is used and caterpillars are *not* removed, then the same transect line should be surveyed in the next sampling period. However, if the caterpillars are removed (typically the case with a beating sheet), then the same transect line should be avoided in subsequent sampling periods. A goal of two to three minutes of active beating sheet activity is a minimum level of sampling effort, per sample date, per location. Likewise, a goal of 15 to 30 minutes of active visual search is a minimum amount of time to spend sampling, per date, per location. Depending on proximity of sample locations and the design (single site, transect, plots), samples should be conducted at a given and constant interval, ranging from daily to once every 7 days.

The identification of some caterpillars may be difficult, either because a number of species may have similar looking caterpillars, or because the caterpillar of the species has never been seen and reared to associate the adult life stage. A concerted effort to rear caterpillars on the foliage of the plant species from which they were collected will provide very useful information on the ecology of the local Lepidoptera fauna, including food plant records and records of parasitoid relationships.

CHAPTER 4: SPECIAL CASE HISTORIES

This chapter features eight species we have determined to be of special interest due to their extreme rarity or endemism, sensitivity to forest management practices, immediate need for initiating/continuing monitoring, and conservation efforts. In this context, our interest in conserving these species is high, meriting discussion beyond that provided in Chapter 5: Species Profiles. We are not the first to propose these species as special interest cases. In fact, the ecology, distribution, and abundance of these species are well documented, certainly more extensively than for most of the other 114 taxa that we review.

SPEYERIA ZERENE BREMNERII - VALLEY SILVERSPOT - NYMPHALIDAE

The nominate species is widely distributed in western North America and occurs in many types of habitats from high elevations in the mountains to low elevation prairies and sagebrush rangelands. *Speyeria zerene* consists of numerous subspecies. Certain subspecies of *S. zerene* appear as isolated relicts that survive in disjunct areas west of the Cascade and Sierra Nevada Mountains, from southern British Columbia to the central California coast around San Francisco. One subspecies, *S. z. bremnerii*, is entirely restricted to the Pacific Northwest west of the Cascade Mountains (Fig. 5-100a,b,c,d). Records indicate that the Valley Silverspot previously occurred from the north end of Vancouver Island, British Columbia, south through the San Juan Islands and western Washington, to the Willamette Valley in western Oregon and possibly the Umpqua Valley in Douglas County, Oregon.

Four distinct ecotypes of *S. z. bremnerii* existed in the Pacific Northwest under different habitat conditions. A forest ecotype was once widely distributed at middle to low elevations in British Columbia and western Washington, and caterpillars probably fed on various forest violets, such as *Viola glabella*. Today, the forest ecotype is still present at the north end of Vancouver Island, and probably at some sites in the San Juan Islands and in western Washington. However, it appears to have disappeared from much of its former range in western Washington due to intensive commercial tree farming. The southern-most populations of this forest ecotype of the Valley Silverspot are now found around Boistfort Peak in Lewis County, Washington.

A unique mountain ecotype of *S. z. bremnerii* is found in the Olympic Mountains at high elevations in subalpine and alpine meadows near timberline. Caterpillars probably feed on *Viola adunca* and perhaps the Olympic endemic *V. fletti*. This montane ecotype probably is not threatened by human developments because it occurs within the Olympic National Park and the Olympic National Forest, but eventually may be adversely impacted by warming climatic conditions.

A low elevation ecotype of *S. z. bremnerii* is found on the native bunchgrass prairies of western Washington near Olympia. Caterpillars feed on *Viola adunca*. This particular type of native prairie habitat is severely endangered today. Most has been lost to human development, or has been overgrown with an exotic woody shrub, Scotch broom, and tall exotic grasses. Thus, only a few populations of the butterfly now survive, mostly in conservation wildlife areas and within the Fort Lewis Military Reservation.

A fourth ecotype was once found on the native bunchgrass prairies of western Oregon, extending south through the Willamette Valley and possibly reaching the Umpqua Valley in Douglas County, Oregon. This ecotype was much larger and paler in color than the more northern ecotypes found in Washington and British Columbia. These butterfly populations are now extinct. The last known specimen was found in 1973 near Corvallis, Benton County, Oregon. The extinction of the western Oregon population of the Valley Silverspot may be attributed to the loss of 99% of the native upland prairie in western Oregon resulting from human developments, such as agriculture, and to the bunchgrass prairie having been overgrown by tall exotic grasses, woody brush, and trees. Today, nearly all land in the Willamette and Umpqua Valleys is urbanized, in agricultural production, in managed forests, or infested with exotic grasses. Presently, the caterpillar's food plant, *Viola nuttallii*, is endangered in western Oregon.

SPEYERIA ZERENE HIPPOLYTA - OREGON SILVERSPOT - NYMPHALIDAE

Speyeria zerene hippolyta (Fig. 4-1a; 5-101a,b,c) is a subspecies that is closely related to *S. z. bremnerii*, and exhibits a widely disjunct distribution along the West Coast. The Oregon Silverspot has been on the Federal Endangered Species List since 1980. The habitat (Fig. 4-1b) consists of native coastal grasslands at the edge of the ocean or montane grasslands on high mountains near the ocean (McCorkle and Hammond 1988). Prior to European settlement, the distribution of the Oregon Silverspot was more or less continuous along the coast, extending from about Westport, Grays Harbor County, Washington, south nearly to Florence, Lane County, Oregon. A disjunct population occurred further south from around Crescent City, Del Norte County, California, north to Brookings, Curry County, Oregon (USFW 2001). Two closely related populations are found further south along the California coast in similar native coastal grasslands: *S. z. behrensii* in Mendocino County, and *S. z. myrtleae* in Sonoma and Marin Counties. Both of these subspecies are on the Federal Endangered Species List.

Speyeria zerene hippolyta is close to extinction. Among the three largest populations still extant in 2002 only one was thriving in 2006. Currently, the largest population occurs in subalpine meadows on top of Mt. Hebo within the Siuslaw National Forest, Tillamook County, Oregon. Another population on the decline, and barely viable, occurs in coastal meadows near the ocean in Lane County, also within the Siuslaw National Forest. A third population, also in decline, occurs in Del Norte County north of Crescent City near Point St. George and Lake Earl, California.

The decline of *S. z. hippolyta* has occurred along with the disappearance of the native coastal grassland habitat, which is comprised of native bunchgrasses such as red fescue, and low-growing forbs such as wild strawberry. The food plant of the Oregon Silverspot caterpillar is *Viola adunca*. Prior to European settlement, the coastal grasslands were maintained by periodic fires which were set by Native Americans to keep the coastal habitat open for hunting and fishing. Following



Figure 4-1. *Speyeria zerene hippolyta*: **a)** adult; **b)** grassland habitat; **c)** effect of mowing as a method for habitat management (left side is mowed); **d)** controlled fire as a method for habitat management.

European settlement, the control of wild fires allowed much of the original grassland to shift into woody brushland, with salal as an abundant species, and Sitka spruce forest. Urban development along the coast eliminated much of the suitable habitat. The last remaining habitat suitable for *S. z. hippolyta* is now being invaded by tall-growing exotic grasses and bracken fern, both of which crowd out the low-growing native prairie vegetation, including the violets. Also, the caterpillars of *S. z. hippolyta* appear unable to survive in tall vegetation, perhaps because of increased predation by spiders, carabid beetles, shrews, or mice, or interference with the solar basking behavior exhibited by caterpillars during the spring.

Since the mid 1980s, the U.S. Forest Service has attempted to conserve the last two populations of *S. z. hippolyta* within the Siuslaw National Forest by intensively managing the remaining coastal grassland. Management techniques have included mowing and cutting invading woody brush and young trees, and mowing the grasslands each year to control the tall-growing exotic grasses while preserving the low-growing native vegetation, including the violets. The effect of mowing is illustrated in Fig 4-1c, with mowed habitat on the left and unmowed habitat on the right side of the image. Early experiments with fire proved helpful in controlling woody vegetation (Fig. 4-1d). However, in the absence of mowing fire proved to be counter-productive, because it always stimulated the growth of exotic grasses, bracken fern, and tall weedy herbaceous vegetation.

The timing and frequency of mowing for successful control of exotic grass depends on the location. In the coastal grasslands, mowing is required two or three times during the spring in May and June, and sometimes in early July. On Mt. Hebo, bracken fern is best controlled by a single mowing conducted every other year. This type of vegetation management is quite intensive, done with mechanical mowers on level terrain and with hand-held “weed-eaters” on steep or rocky terrain. The management practices on Mt. Hebo have been highly successful, typically increasing the abundance of violets 300 to 400%. During the period between 1990 and 2000, the response in butterfly populations also showed an increase in abundance. In 1984, and prior to management for control of brush and bracken fern, the Mt. Hebo population was estimated at about 2,500 adults. By 2002 this population had nearly doubled to an estimated 4,500 adults (PCH, pers. obs.). Butterfly numbers dropped severely at all sites, including Mt. Hebo, from 2003 to 2005, because of drought and higher than normal temperatures. The population declines between 2003 and 2005 suggest that *S. z. hippolyta* may be adversely affected if warming climatic conditions continue to occur (Hammond 2005).

EUPHYDRYAS EDITHA TAYLORI - TAYLOR'S CHECKERSPOT - NYMPHALIDAE

The nominate species of the Taylor's Checkerspot, *Euphydryas editha*, is widely distributed in western North America, occurring in many habitats from high elevations in the mountains to low elevation deserts. This butterfly is very sedentary and lives in local colonies. As a result, the species is highly polytypic with many named subspecies. Perhaps the most primitive subspecies is *E. e. taylori* (Fig. 4-2; 5-94a,b,c). It is entirely restricted to native upland prairies at low elevations west of the Cascade



Figure 4-2. *Euphydryas editha taylori* adults.

Mountains, historically extending from Vancouver Island, south through the San Juan Islands and Puget Trough of western Washington, and in Oregon from the Willamette Valley south to the Umpqua Valley.

Today, populations of *E. e. taylori* are on the brink of extinction. Historical records indicate it has already disappeared throughout much of its previous range. The butterfly must be regarded as severely endangered but it is not currently on the Federal Endangered Species List. British Columbia has only one known colony on Hornby Island (Guppy and Shepard 2001). A few colonies still survive in the San Juan Islands and Puget prairies of western Washington, and as of 2006, a few colonies were still extant in Benton County, Oregon.

Caterpillars feed on plantains, such as *Plantago lanceolata*, which grow in very short vegetation, only a few inches high, during February and March. The low vegetation appears to be a critical habitat requirement for this butterfly, as the caterpillars appear to require solar basking near the soil surface in late winter and spring. Most of the upland native prairie, with naturally low vegetation, has either been lost to agriculture and other human developments, or has been overgrown with tall exotic grasses and woody brush or trees. For example, a large colony once found near Corvallis, Oregon, within the McDonald Research Forest of Oregon State University, was exterminated around 1990 after an invasive exotic weed, false brome grass, overgrew the habitat, forming a dense monoculture of tall grass and dead thatch.

Mowing and burning are useful management techniques to control invasive exotic grass and brush in these prairie habitats, but must be done at appropriate times of the year to minimize destructive impacts on the butterflies. Also, experimental studies are being conducted with herbicides to control invasive exotic grasses. The timing and application of herbicides must be carefully controlled to minimize negative impacts on native prairie vegetation. The utility of these methods of vegetation management are discussed in more detail in the special case history concerning the Oregon Silverspot.

POLITES MARDON - MARDON SKIPPER - HESPERIIDAE

The Mardon Skipper (Fig. 4-3; 5-21a,b,c) is one of a small number of species of Lepidoptera in the Pacific Northwest that we and others consider to be highly vulnerable to extinction in the near future. This species is listed as a State Endangered Species in Washington (Pyle 2002). The entire range of *P. mardon* includes only four localized but widely disjunct populations. These four populations appear to be relicts and are all



Figure 4-3. *Polites mardon* adults.

that remains from what was once a much more widely distributed species in western North America. Today, two populations of *P. mardon* survive at high elevations along the summit of the Cascade Mountains in southern Washington and southern Oregon, and two populations survive west of the Cascades. Historic habitat records suggest that large populations of *P. mardon* may have occurred on the upland bunchgrass prairies of the Willamette Valley in western Oregon, as well. However, almost all of the bunchgrass prairie habitat has been lost to agriculture and other human developments, or the bunchgrass has been overgrown with tall exotic Eurasian grasses such as tall oatgrass. Consequently, populations of *P. mardon* in the Willamette Valley of western Oregon probably became extinct between 1930 and 1950.

The extant population in the Cascade Mountains of southern Washington occupies subalpine meadows near Mt. Adams in Yakima and Klickitat Counties within the Gifford Pinchot National Forest. This native bunchgrass habitat is potentially vulnerable to overgrazing by domestic livestock and encroachment by woody shrubs and trees. Insecticide spraying for forest insect pests also may be a threat to this population. Ironically, although fire certainly maintained this meadow habitat prior to European settlement, the remaining butterfly colonies are so localized and limited that wildfires now must be regarded as serious threats that could result in the extermination of local colonies.

The southern Oregon Cascade population of *P. mardon* is vulnerable to the same threats as the Washington population. It occurs in open, montane meadows with bunchgrasses along the summit of the Cascade Mountains in Jackson, Klamath, and Siskiyou Counties of Oregon and in adjacent northern California. Most colonies are located within the Cascade-Siskiyou National Monument and within the adjacent Rogue River and Winema National Forests.

West of the Cascades, a population of *P. mardon* is found on the low elevation bunchgrass prairies of western Washington near Olympia. Some of the largest surviving colonies are found on the Fort Lewis Military Reservation. Most of the original bunchgrass prairie in western Washington has been lost to human developments, and what remains is severely threatened by spreading infestations of Scotch broom, an invasive exotic weed.

The fourth surviving population is found in the Siskiyou and coastal mountains of northwestern California in Del Norte County. The habitat consists of open meadows on serpentine ridge tops near the ocean. Additional colonies are likely present immediately to the north in Oregon within the Siskiyou National Forest, Curry County, where open meadows on serpentine soil are found at high elevations. As with the Yakima population, the Del Norte population is threatened by encroachment of woody shrubs and trees into their meadow habitat. Again, fire is a potential threat to this population.

ICARICIA ICARIOIDES FENDERI - FENDER'S BLUE - LYCAENIDAE

The nominate species, *Icaricia icarioides*, of the Fender's Blue is widely distributed throughout western North America and occurs in many habitats ranging from high elevation mountains to lowland deserts. However, some of the more primitive subspecies of *I. icarioides* occur as isolated, relict populations that survive at low elevations west of the Cascade Mountains in western Oregon and the Sierra Nevada Mountains in California, and also in central Arizona. One such subspecies is the Fender's Blue (Fig. 5-31a,b,c,d), *I. i. fenderi*, which is restricted to native upland prairies

in the Willamette Valley of western Oregon, from Yamhill County south through Lane County. The Fender's Blue butterfly was listed as endangered in 2000 under the U.S. Endangered Species Act.

Populations of *I. i. fenderi* have nearly disappeared in western Oregon due to the loss of 99% of the native upland prairie since the period of initial European settlement. Most of the native habitat has been lost to agriculture and other human developments or has been overgrown with tall exotic grasses, woody brush, and trees. Only about ten localized populations of *I. i. fenderi* survive in Oregon today, all occurring in Yamhill, Polk, Benton, and Lane Counties. The habitat consists of dry upland bunchgrass prairies dominated by *Festuca roemerii*. The primary larval food plant is *Lupinus sulphureus kincaidii*, but *L. arbustus* also is important, particularly on dry sites. The remaining prairie habitat is severely threatened by exotic Eurasian grasses, especially tall oatgrass and false brome grass. Woody brush, including the exotic Scotch broom, and an assortment of native trees also threaten the prairie habitat.

Mowing and burning have been employed as useful conservation management practices to suppress invasive exotic grass and brush in these prairie habitats. However, the timing of these practices is critical for minimizing negative impacts on the lupine food plants and the butterflies. Experimental studies are being conducted with herbicides to control invasive exotic grasses. As with mowing and burning, timing and application techniques of the herbicide treatments must be carefully controlled to minimize negative impacts on native prairie vegetation (Schultz et al. 2003).

INCISALIA POLIA MARITIMA - MARITIME ELFIN - LYCAENIDAE

The nominate species, *Incisalia polia*, of the Maritime Elfin is common and widely distributed across northern regions of North America, extending southward through the Rocky Mountains from Montana, across northeastern Oregon and northern Idaho, and into Colorado. As one of the two subspecies in the Pacific Northwest, *I. p. maritima* (Fig. 5-32a,b,c,d,e) is restricted to the coast and found in sand dune habitats near the Pacific Ocean in Oregon and northern California. This subspecies was distributed more extensively along the Oregon coast prior to European settlement, but is now nearly extinct. As of 2007, only two colonies remain in Oregon, one near Waldport in Lincoln County, and one near the mouth of the Pistol River in Curry County. The largest surviving population is found in the sand dunes around Lake Earl in Del Norte County, California. This population appears to be at-risk of extinction due to habitat deterioration in recent years (PCH pers. obs.). It is possible that additional colonies may yet be discovered in the sand dunes around Coos Bay, Coos County, but to date none have been found in spite of considerable exploration.

The most critical component of the habitat needed to maintain the Maritime Elfin involves the stabilization of the sand dunes. The sand dunes are mostly open with light stands of American dune grass and scattered lodgepole pine trees, all located just inland from the beach. Prior to European settlement native American dune grass was the species primarily responsible for dune stabilization. It provides open space for the establishment of forbs such as lupines, goldenrod, strawberry, and mats of kinnikinnick. Kinnikinnick not only serves an important role as part of the vegetative ground cover helping to stabilize the dunes, but it is also the food plant for the caterpillar. The decline of *I. p. maritima* is thought to be a result of changes to vegetative

succession on stabilized sand dunes following European settlement, and may be due to the introduction of disruptive exotic Eurasian plant species.

Today, very dense stands of exotic European beach grass stabilize sand dunes along the West Coast, providing little open space for the establishment of native forbs and kinnikinnick. In addition, exotic woody shrubs such as Scotch broom and gorse have formed a dense cover over sand dunes in many areas. Open stands of lodgepole pine are usually compatible with the maritime elfin and kinnikinnick, but dense, closed-canopy stands of lodgepole pine exclude and eliminate the butterfly and the food plant of its caterpillar.

MITOURA JOHNSONI - JOHNSON'S HAIRSTREAK - LYCAENIDAE

Among the dwarf mistletoe-feeding species of *Mitoura*, *M. johnsoni* (Fig. 5-36a,b,c,d,e) is almost entirely restricted to cool, moist, old-growth conifer forests of the Pacific Northwest west of the Cascade Mountains and in the Sierra Nevada Mountains in California. However, there is a disjunct population of Johnson's Hairstreak in the Hell's Canyon region of northeast Oregon and adjacent Idaho. This butterfly is considered endangered in British Columbia and Washington, and of concern in Oregon (Pyle 2002). The species is distributed from the Coast Range and Sierra Nevada Mountains of central California to southern British Columbia. The habitat and distribution is almost identical to that of the northern spotted owl, *Strix occidentalis*, except that the butterfly does not occur south of central California.

At lower elevations on the west slope of the Cascade Mountains and in the Coast Range, *M. johnsoni* feeds on *Arceuthobium tsugense* growing on large mature western hemlock in old-growth forests. Butterflies fly in the forest canopy most of the time, but may nectar on flowers in open areas along roadsides. At higher elevations in the Cascade Mountains, this species feeds on *A. abietinum* growing on true firs in subalpine forests. Southward, *M. johnsoni* is particularly associated with an *Arceuthobium* growing on Brewer spruce at high elevations in the Siskiyou Mountains of southwestern Oregon and northwestern California.

The closely related *Mitoura spinetorum* is widely distributed throughout western North America, and utilizes various *Arceuthobium* mistletoe species growing on various pines in warmer, drier forests of southwest Oregon, California, and east of the Cascades through the Rocky Mountains. Some evidence suggests that, beginning over the past 20 years, *M. spinetorum* may be ecologically replacing *M. johnsoni* in forest clearcuts and young regenerating conifer stands west of the Cascade Mountains in Oregon, just as the eastern barred owl, *Strix varia*, may be replacing the spotted owl in similar habitats (D. McCorkle pers. comm.). Warming climatic conditions also may play a role in such replacement.

Management practices that would benefit this species need to promote the maintenance of mature and old-growth conifer forests at middle to low elevations on the west slope of the Cascade Mountains and Coast Range. Elsewhere, suitable conservation management practices would be to increase the length of time in the harvest rotation of mature true fir forests along the summit of the Cascade Mountains, and replant Brewer spruce at high elevations in the Siskiyou Mountains following timber harvests and wild fires.

PLEBEJUS SAEPIOLUS INSULANUS - COASTAL GREENISH BLUE - LYCAENIDAE

The nominate species of the Coastal Greenish Blue (a common name for the subspecies being used here for the first time), *Plebejus saepiolus*, is common and widely distributed across northern and montane regions of North America. A taxonomic review of the status of subspecies is in order. Colonies of this butterfly south of Washington have been named *P. s. littoralis*, but individuals in these colonies do not appear to be different from individuals in the northern populations that we classify as *P. s. insulanus* (PCH pers. obs.). Thus, we are treating the name “*littoralis*” as a synonym of “*insulanus*”. The nominate species, *P. saepiolus*, is divided into many diverse subspecies that show local and endemic distributions. For example, *P. s. insulanus* (Fig. 5-38a,b,c,d,e) occurs only along the Pacific Coast in the Pacific Northwest. This subspecies was originally described from Vancouver Island, British Columbia, but that population is now believed to be extinct (Pyle 2002). Historically, populations occurred on higher elevation headlands overlooking the ocean southward to northern California near Crescent City. Nearly all of these populations are now extinct. The most extensive extant populations are found in subalpine meadows in the Olympic Mountains, Washington, and in wet meadows of open sand dunes at Lake Earl in Del Norte County, California. No extant populations are known along the coast of Washington and northern Oregon. A few small colonies may still exist within the coastal headlands in southern Oregon.

Prior to the time of European settlement, coastal meadow habitats suitable for *P. s. insulanus* were maintained by periodic ground fires set by Native Americans to keep the coastal lands open for fishing and hunting activities. In recent times, most of this meadow habitat has been lost to human development, or in the absence of fire, to succession of salal, a woody native shrub, and Sitka spruce forest. The small amount of meadow habitat that remains has been invaded by many tall, rank-growing exotic Eurasian grasses, such as bent grass, heath grass, spring vernal grass, velvet grass, orchard grass, and European beach grass. These exotic grasses have crowded out the native meadow vegetation originally dominated by red fescue bunchgrass, wild strawberry, western buttercup, *Viola adunca*, and springbank clover. This caterpillar is a food plant specialist and feeds on only springbank clover.

The Siuslaw National Forest has begun an extensive mowing management program in coastal meadows of Lane County, Oregon, to control the exotic grasses and woody brush. Although this program is principally designed to conserve the endangered Oregon Silverspot, there is hope that it also will benefit other coastal meadow species, such as the Coastal Greenish Blue.

CHAPTER 5: SPECIES PROFILES

The photographs of butterflies and moths are organized according to a family-based scheme, following Hodges et al. (1983), which places species next to one another based on how closely related they are, rather than on obvious features, such as colors and patterns. Many of the species that belong in closely related groups tend to exhibit some similarity in certain features that may be useful in the sense of a field guide where identifications are attempted without the aid of magnification or a detailed knowledge of morphology.

For each of the 122 taxa presented with at least one photograph of the adult, we provide a narrative that includes: 1) the common name, some of which we have assigned here for the first time, and a statement about taxonomic relatives; 2) the wingspan of a typical adult with a description of diagnostic morphological traits, mostly wing patterns (Fig. 5-1); 3) a description of the larva either from our own work or from that in the published literature or from images available on the Internet (Fig. 5-2); 4) comments on the ecology of the species, including habitat, range of occurrence, caterpillar food plants, and phenology; and 5) a statement regarding the sensitivity issues affecting the species, comments pertinent to mitigation of population decline, and techniques for sampling either larvae or adults for the purpose of monitoring populations.

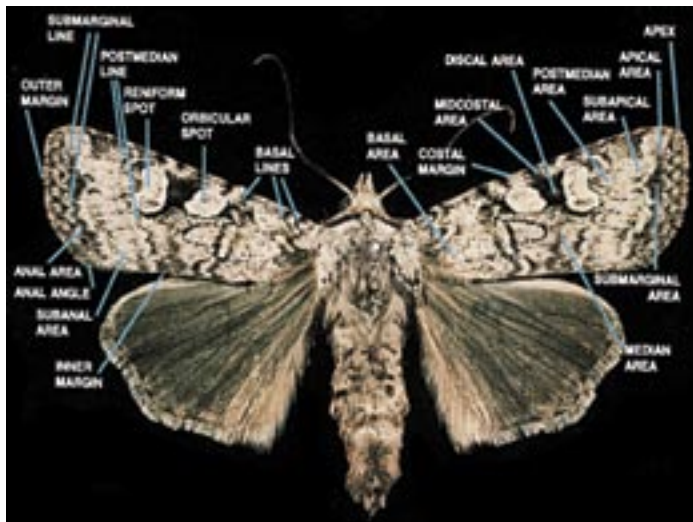


Figure 5-1. Adult morphology

For each of the 122 taxa presented with at least one photograph of the adult, we provide a narrative that includes: 1) the common name, some of which we have assigned here for the first time, and a statement about taxonomic relatives; 2) the wingspan of a typical adult with a description of diagnostic morphological traits, mostly wing patterns (Fig. 5-1); 3) a description of the larva either from our own work or from that in the published literature or from images available on the Internet (Fig. 5-2); 4) comments on the ecology of the species, including habitat, range of occurrence, caterpillar food plants, and phenology; and 5) a statement regarding the sensitivity issues affecting the species, comments pertinent to mitigation of population decline, and techniques for sampling either larvae or adults for the purpose of monitoring populations.

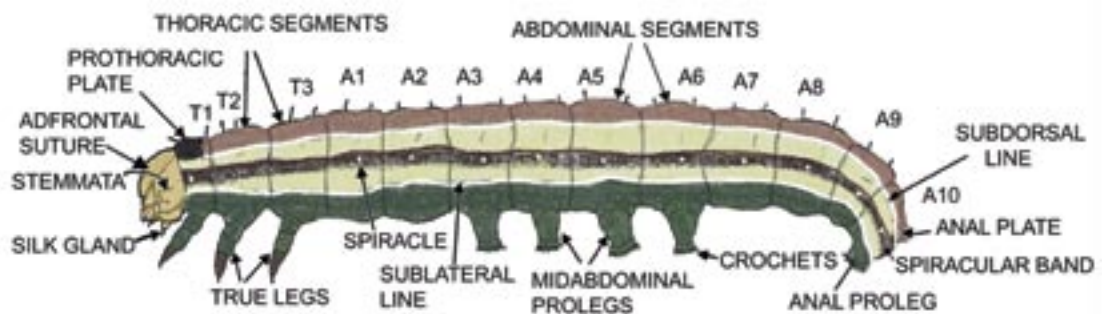


Figure 5-2. Caterpillar morphology.

GNOPHAELA LATIPENNIS - HOUND'S TONGUE WOOLLY BEAR - ARCTIIDAE

Two species of *Gnophaela* occur in the Pacific Northwest.

ADULT (PLATE 1, FIG. 5-1A,B)

Wingspan 5.4 cm.

The dorsal surface of the forewings is black with a narrow, white, subapical patch; and either small, white, medial spots or a larger patch that does not extend to the wing base. Similarly, the dorsal surface of the hindwings is black with a small, white, medial patch that is broken by a central black band. The ventral surface of the fore- and hindwings is similar to the dorsal surface.

CATERPILLAR (FIG. 5-1C)

Yellow with dorsal, lateral, and ventral black patches. Clusters of white hairs originate from black bases with blue spots. The head is red-brown.

ECOLOGY

Larvae and adults are commonly found in open conifer forests from central California to western and central Oregon. Caterpillars feed on foliage of hound's tongue during late spring and early summer. Moths are diurnal and fly from mid- to late summer. Adults are fairly sedentary and live in local colonies in close association with the larval food plant that occurs in moist mountain meadows, open forests, and riparian zones.

SENSITIVITY ISSUE AND POLICY ASSESSMENT

The Hound's Tongue Woollybear is sensitive to land management practices. Because the caterpillar food plant requires an open overstory, it is necessary to remove dense brush and trees. An open overstory may be created and maintained with infrequent, controlled ground fires and prescribed forest thinning of understory vegetation.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults can be assessed by visually searching habitat containing the larval food plants (and the general vicinity) for a predetermined amount of time. Studies on relative measures of abundance of larvae and adults in a Ponderosa pine forest in the Metolius Basin, Oregon, indicated that as many as 16 caterpillars and ten adults could be seen during 30-minute searches.

GNOPHAELA VERMICULATA - BLUEBELL WOOLLY BEAR - ARCTIIDAE

Two species of *Gnophaela* occur in the Pacific Northwest.

ADULT (PLATE 1, FIG. 5-2)

Wingspan 5.4 cm.

The dorsal surface of the forewings is black with a broad, white, subapical patch and a broad, white patch extending from the median area nearly to the wing base that is outlined with black veins. Similarly, the dorsal surface of the hindwings is mostly black with a broad, white medial area outlined with black veins. The ventral surface of the fore- and hindwings is similar to the dorsal surface.

CATERPILLAR

Yellow with dorsal, lateral, and ventral black patches. Clusters of white hairs originate from black bases with blue spots. The head is dark red-brown.

ECOLOGY

Larvae and adults are commonly found and widely distributed at mid elevations in the various mountain ranges of western North America. Caterpillars feed on foliage and flowers of bluebells. Moths fly during the day in midsummer. Adults are weak fliers and fairly sedentary, living in local colonies in close association with the food plant which occurs in moist mountain meadows, open forests, and riparian zones.

SENSITIVITY ISSUE AND POLICY ASSESSMENT

The Bluebell Woolly bear is sensitive to land management practices. The caterpillar food plant requires an open overstory. An open overstory may be created and maintained with infrequent, controlled ground fires. Also, the thinning of forest trees would be beneficial to this species, whereas, thick understory shrubs and invasive weeds would be detrimental.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults can be assessed by visually searching habitat containing the larval food plants (and the general vicinity) for a predetermined amount of time.

PLATARCTIA PARTHENOS - SAINT LAWRENCE TIGER MOTH - ARCTIIDAE

One species of *Platarctia* occurs in the Pacific Northwest.

ADULT (PLATE 1, FIG. 5-3)

Wingspan 6.5 cm.

The dorsal surface of the forewings ranges from a dark black-brown to red-brown with scattered, small, white spots in the basal, medial, and submarginal areas. The dorsal surface of the hindwings is orange with medial, anal, and submarginal black bands. The ventral surface of the fore- and hindwings is similar to the dorsal surface but paler. The thorax and abdomen are black with red lateral bands.

CATERPILLAR

We have yet to collect this caterpillar in the Pacific Northwest. Wagner (2005) shows an image of a caterpillar of the St. Lawrence tiger moth with a dense coat of moderately long black hairs and interspersed white hairs; lateral white spots; brown spiracles.

ECOLOGY

This species is widely distributed in moist forests across Canada, extending south through the Rocky Mountains, and in the Pacific Northwest where it occurs in British Columbia, northern Washington and Idaho, northwestern Montana, and northeastern Oregon. In general, this moth is rare but in certain years may be common, locally. Caterpillars feed on foliage of alders, birches, and willows in northeastern North America (Covell 1984). We do not have larval food plant records for the Pacific Northwest. Adults are nocturnal and fly during June and July.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The St. Lawrence Tiger Moth is sensitive to land management practices. Although the species is widespread across the northern tier of North America, and in the upper Pacific Northwest, it is generally rare to very uncommon within its range, with only an occasional and ephemeral occurrence, where it is of localized common abundance. The species utilizes food plants most common in riparian habitats; therefore, it likely would benefit from riparian restoration and conservation projects.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. Quantitative measures of larval and adult abundance are difficult to obtain due to the rarity of individuals. Larvae may be best sampled using a beating sheet; clipped-branch samples likely will not recover any individuals unless the sampling site happens to coincide with an unusual event of a local population increase. Adults are attracted to UV or mercury-vapor lights at night and may be documented using a bucket light-trap or sheet collecting. We have observed 60 individuals, 33 of which occurred on just two sample nights at one specific trap location in the Blue Mountains (Grimble et al. 1992).

PLATYPREPIA VIRGINALIS - RANCHMAN'S TIGER MOTH - ARCTIIDAE

One species of *Platyprepia* occurs in the Pacific Northwest.

ADULT (PLATE 1, FIG. 5-4A; PLATE 2, FIG. 5-4B)

Wingspan 6.2 cm.

The dorsal surface of the forewings is black; basal, medial, and submarginal areas with many large, round pale yellow to cream-colored spots. The dorsal surface of the hindwings is also black but the maculation patterns are dimorphic, either with small orange submarginal spots or with broad, orange discal, medial, and submarginal bands. The ventral surface of the fore- and hindwings is similar to the dorsal surface. The thorax is black with dorsal-anterior patches of yellow. The abdomen is variable, either black with an orange tip, or black with orange bands.

CATERPILLAR (PLATE 2, FIG. 5-4C)

Black with orange hairs at the anterior and posterior ends. The middle portion of the body has long white hairs.

ECOLOGY

Larvae and adults can be very common locally and occur in colonies in association with wet meadows in coniferous forests, deciduous (ash, hawthorn, oak) woodlands, and open riparian zones, throughout western North America. Caterpillars can be very abundant, feeding on various herbs, such as plantain, during fall and through the winter months. Larval development is completed by June. Adults are diurnal and present during early summer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Ranchman's Tiger Moth is sensitive to land management practices. As an inhabitant of wetlands habitat within forests, woodlands, and along riparian zones, this species is particularly sensitive to urban and agricultural development, adult mosquito control, and conservation efforts to restore wetlands.

Information regarding the geographic range of the species is excellent. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults can be assessed by visually searching meadow areas along a predetermined transect for a predetermined amount of time. Under conditions when the species is uncommon, population density is so low not a single caterpillar or adult will be seen over a distance of hundreds of meters during a 30-minute effort. However, during times of high abundance many hundreds of caterpillars and adults can be counted with the same effort.

TYRIA JACOBÆAE - CINNABAR MOTH - ARCTIIDAE

One species of *Tyria* occurs in the Pacific Northwest.

ADULT (PLATE 2, FIG. 5-5A)

Wingspan 3.7 cm.

The dorsal surface of the forewings is dark gray-black with a red costal stripe and two red submarginal spots. The dorsal surface of the hindwings is nearly all red with a thin gray margin. The ventral surface of the fore- and hindwings is similar to the dorsal surface. The thorax and abdomen are black.

CATERPILLAR (PLATE 2, FIG. 5-5B)

A number of alternating orange and black rings along the entire length of the body display a very unique and diagnostic pattern and color combination. Also, the lack of hairs on the thorax and abdomen are atypical among the arctiids found in the Pacific Northwest.

ECOLOGY

This species is not native to the Pacific Northwest. It was intentionally introduced into northern California in 1959, and subsequently introduced into Oregon and Washington, and has established and spread on its own. This species is found in open habitats west of the Cascade Mountains in Oregon and west of the Sierra Nevada Mountains in northern California, specifically in meadows and clearcuts where tansy ragwort and some other *Senecio* occur. Caterpillars feed almost exclusively, and gregariously, on leaves and flowers of the exotic invasive weed tansy ragwort. Caterpillars can be very common during July and August. The aposematic caterpillars are poisonous to insectivorous vertebrates due to the sequestration of pyrrolizidine alkaloids from the food plant. Adults are diurnal and fly in May and June.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Cinnabar Moth is a beneficial insect serving as a weed biological control agent useful in the management of tansy ragwort. The species was intentionally introduced into the Pacific Northwest and any disruption of its population dynamics creates a potential conflict in management issues. For instance, the use of pesticides, including the bacterium *Bacillus thuringiensis kurstaki*, for control of forest pests, such as the gypsy moth and the spruce budworm, kill caterpillars and reduce populations of *T. jacobæae* (James et al. 1993). If pesticides are used and result in the loss or decline of a cinnabar moth population, then treated areas can be repopulated with individuals collected from nearby areas.

Information regarding the geographic range of the species is excellent. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults can be assessed by visually searching habitat containing the larval food plants. In western Oregon an observation of 8 to 16 caterpillars per plant is common, but caterpillars will not occur on every plant in the vicinity (Coombs et al. 2004). Although adults are diurnal and will come to UV or mercury-vapor light traps, this is not a satisfactory method for population estimates. Adults are best measured by conducting a set of counts

along predetermined time-length transects, as prescribed for butterflies. Typically, in an area where the species is well established the adult count can exceed dozens of individuals in 15 minutes over 100 meters. Because adults can be sedentary during the day, it is best to use a stick to sweep over the vegetation while conducting the transect measurements.

PHRYGANIDIA CALIFORNICA - CALIFORNIA OAKWORM - DIOPTIDAE

One species of *Phryganidia* occurs in the Pacific Northwest.

ADULT (PLATE 2, FIG. 5-6A)

Wingspan 3.5 cm.

The dorsal surface of the forewings is tan or light brown with a faint, yellow median patch. Similarly, the dorsal surface of the hindwings is tan or light brown but with no distinguishing yellow median patch. The colors and patterns on the ventral surface of the fore- and hindwings are identical to those on the dorsal surface.

CATERPILLAR (PLATE 2, FIG. 5-6B)

Two middorsal white bands bordered in purple; yellow subdorsal and spiracular bands separated by a gray-purple band bordered in black; transverse black stripe on T-1, A-1, and A-8; A-5 with a middorsal black spot. The head is tan with a faint tint of orange.

ECOLOGY

This species is predominately found in dry woodlands in southwestern Oregon and California. The northern extent of the species appears to be the southern area of the Willamette Valley. Caterpillars are common and during fall, winter, and spring may be an occasional pest on Oregon white oak, live oak, and chinquapin. Adults are nocturnal and fly in midsummer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The California Oakworm is associated with oak woodlands. This species represents an interesting contrast regarding issues of sensitive species. On the one hand, it can be classified as a sensitive species because of its association with the oak woodland community. On the other hand, it may be considered an occasional pest as well, particularly in urban and suburban developments where the caterpillars will feed on landscaped foliage. Nonetheless, through the restricted feeding habits of the larvae, the species is intimately associated with oak woodlands and mixed conifer-hardwood forests containing live oaks and chinquapin. These woodlands and forests environments may be maintained by infrequent, controlled understory fires or by prescribed forest thinning that retains select hardwood species, i.e., the fagaceous hardwood species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae on various species of Fagaceae may be assessed from timed samples using a beating sheet. Samples from numerous sites in southwestern Oregon have yielded up to 15 caterpillars per 100 seconds of sampling effort. Adults may be sampled using UV or mercury-vapor light traps, but the lights appear to be only weakly attractive to the moths. Our projects, which have not coincided with an epizootic of this species, typically document only 1 to 5 moths per trap-night with one or two moths occurring in the most typical observation.

DREPANA BILINEATA - TWO-LINED HOOKTIP - DREPANIDAE

Two species of *Drepana* occur in the Pacific Northwest.

ADULT (PLATE 3, FIG. 5-7)

Wingspan 3.5 cm.

The dorsal surface of the forewings is strongly falcate at the apex with a scalloped outer margin. The basic ground color of the forewings ranges from yellow to brown. The center area of the forewings is marked with two narrow, dark brown medial lines. The dorsal surface of the hindwings is a pale cream color and immaculate. The ventral surface of the fore- and hindwings is pale yellow. The central area of the hindwings is marked with a narrow, brown, transverse line.

CATERPILLAR

We have yet to collect this caterpillar in the Pacific Northwest. The following description is based on an image presented by Wagner (2005). Dorsum with small patches of dark brown contrasting with a general body color of light brown and tan, warts equally prominent from T1-A7, anal segment extended into a single point. The head is mottled brown-tan and lacks transverse bands as in *Drepana arcuata* (Miller and Hammond 2003).

ECOLOGY

This species is widely distributed in moist forests in both northeastern North America and the Pacific Northwest. However, in the Pacific Northwest individuals are very uncommon to rarely seen. Caterpillars feed on alders and birches in the Northeast (Covell 1984). We suspect that alders could be a food plant used in the Pacific Northwest, but we cannot verify this suspicion until we acquire records on field-collected individuals from the region. The species is bivoltine in the Pacific Northwest with the nocturnal adults flying during May and June, and again in July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Two-Lined Hooktip is rare in Pacific Northwest forests and woodlands. Although a geographically widespread species, it is very uncommon to rare in field samples throughout its range in the Pacific Northwest. Species that are present in extremely low numbers are at risk of local extinction if a large-scale alteration of its habitat occurs. In this case the alteration would likely be from a major fire. The fact that the species is widespread suggests that various populations would still persist across its range and that recolonization could eventually occur if the habitat returned to its prior, moist-forest state.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. Larvae are likely to be found using a beating sheet, but because the food plant for the populations of this species in the Pacific Northwest is unknown, we cannot recommend which plant species should be used for sampling other than to suggest that alders are the “best bet”. We have sampled alders very extensively, but throughout all of our projects we have yet to collect a caterpillar of this species (see Miller and Hammond 2003 for a list of caterpillars

reared from *Alnus* in western Oregon). Field studies looking for caterpillar food plants are needed. Until the food plant is discovered we do not recommend limiting the sampling effort to timed sessions. Another approach would be to collect a live female and attempt to obtain eggs for rearing caterpillars placed under sleeves on various trees, including alders. Adults should be the focus of population assessment. Adults may be sampled using UV or mercury-vapor light traps. Our experience suggests the response will be that only on very rare occasions will an adult be observed and that an intensive sampling effort will be required to quantify population levels. For example, we observed only ten adults (and never more than one individual on any given trap-night) in a Lepidoptera inventory project over a four-year span, from 1994-1997, involving hundreds of trap-nights and hundreds of locations, north to south from Corvallis to Roseburg, Oregon, and west to east from the eastern slopes of the coastal mountain range to the western slopes of the Cascade Mountains.

APLOCERA PLAGIATA - ST. JOHN'S-WORT LOOPER - GEOMETRIDAE

One species of *Aplocera* occurs in the Pacific Northwest.

ADULT (PLATE 3, FIG. 5-8)

Wingspan 3.8 cm.

The dorsal surface of the forewings is pale gray with two dark median bands, two faint basal bands or lines, a submarginal band, and a marginal band. The dorsal surface of the hindwings is immaculate, pale gray in the basal area, and a darker gray in the marginal area. The ventral surface of the fore- and hindwings is a fairly uniform gray and lacks markings.

CATERPILLAR

A gray-brown dorsum transitions into a cream-white longitudinal band laterally that has a distinct edge along its lower margin; sublateral and ventral area brown to light brown. An image of this caterpillar may be seen in Coombs et al. (2004).

ECOLOGY

This species was intentionally introduced into Montana from northern Europe in 1989 (Coombs et al 2004). It has established and spread with additional intentional releases. We found this species to be common and widely distributed in the Blue Mountains of eastern Oregon in 1990. Since then it was intentionally released into the Cascade Mountains of western Oregon (E. Coombs pers. comm.). Caterpillars overwinter and feed on the foliage of European St. John's-wort, a noxious exotic weed that is widely established in open disturbed habitats, such as roadsides, throughout much of western North America. It often becomes a serious problem in natural prairies and meadows. Adults are nocturnal, the first generation flying in May-June and a second generation flying in August-September.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The St. John's-Wort Looper is a beneficial insect used for biological control of a noxious weed. Any disruption of its population dynamics creates a potential conflict in management issues. For instance, the use of pesticides, including the bacterium *Bacillus thuringiensis kurstaki*, for control of forest pests, such as the gypsy moth and the spruce budworm, will likely kill caterpillars. If pesticides are used and result in the loss or decline of the species from a given area, then the treated area can be repopulated with individuals collected from nearby areas.

Information regarding the geographic range of the species is poor. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by collecting stems of food plants and counting the number of caterpillars per plant. Adults are nocturnal and come to UV or mercury-vapor light traps. In studies at the HJ Andrews Experimental Forest we collected two individuals in 2004 and 30 individuals in 2005. The highest number of individuals collected in a given trap-night was three.

APODREPANULATRIX LITARIA - GRAY-BANDED LILAC LOOPER - GEOMETRIDAE

One species of *Apodrepanulatrix* occurs in the Pacific Northwest.

ADULT (PLATE 3, FIG. 5-9A)

Wingspan 3.5 cm.

The dorsal surface of the fore- and hindwings is dark gray or brown with an overlay of a mottled pattern either in light gray or yellow. The wings are marked with three dark, wavy medial lines and a row of black postmedian spots. The ventral surface of the fore- and hindwings is mottled in pale brown and marked with black discal and black postmedian spots.

CATERPILLAR (PLATE 2, FIG. 5-9B)

Green with a wide, mid-dorsal white band.

ECOLOGY

This species is uncommon to rare but widely distributed in both dry and moist coniferous forests throughout much of western North America where *Ceanothus* is present. Caterpillars are uncommon to rare and are specialist feeders on species of *Ceanothus* during the spring. Adults are nocturnal and fly from late summer to fall. The guild of caterpillars that feed exclusively on species of *Ceanothus* consists, in part, of nine closely related species: *A. litaria*, *Eudrepanulatrix rectifascia*, and seven species of *Drepanulatrix*. With the exception of *A. litaria*, caterpillars and adults of all of the species are commonly encountered.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Gray-Banded Lilac Looper is rare in Pacific Northwest forests and woodlands. Although a geographically widespread species, it is very uncommon to rare in field samples throughout its range in the Pacific Northwest. The low abundance (rarity) of *A. litaria* is not understood, but perhaps a contributing factor is intraguild competition among the species of the *Ceanothus*-feeding Lepidoptera. Species that are present in extremely low numbers are at risk of local extinction if a large-scale alteration of its habitat occurs. In this case the alteration would likely be from a major fire. The fact that the species is widespread suggests that various populations would still persist across its range and that recolonization could eventually occur if the habitat returned to a prior state that included the presence of *Ceanothus*. It is very likely population levels of *A. litaria* would change in conjunction with the seral stage of a disturbed habitat and the dynamic change in population numbers of the other *Ceanothus* specialist feeders.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of *Ceanothus* using a beating sheet. Surveys from western Oregon have yielded only four caterpillars, all from *Ceanothus velutinus* in southwestern Oregon. Adults may be sampled using UV or mercury-vapor light traps. Overall, we have observed approximately 100 individuals with a typical high number in a collection totaling only 1 to 3 moths per trap-night.

COCHISEA SINUARIA - WAVY-LINED COCHISEA - GEOMETRIDAE

Two species of *Cochisea* occur in the Pacific Northwest.

ADULT (PLATE 10, FIG. 5-10A)

Wingspan 5.0 cm.

The dorsal surface of the fore- and hindwings is white with fine black dots. Also, both wings are marked with a thin, wavy black postmedian line and black discal spots. A thin black basal line is present on the dorsal surface of the forewings. The ventral surface of the fore- and hindwings is similar to the dorsal surface. Males have strongly pectinate (feathery) antennae while females have antennae that are filiform (thin and hair-like).

CATERPILLAR (PLATE 3, FIG. 5-10B)

Yellow with an undertone of green; T-1 with a pair of minute bumps. The head is red-brown with two dorsal cone-like projections.

ECOLOGY

This species is distributed from west of the Cascade Mountains in Douglas, Josephine, and Jackson Counties, Oregon, south through California, and then disjunctly from central Arizona to northern Mexico. This species favors low-elevation habitats consisting of dry, open forests with manzanita, its larval food plant. This species may be locally common where manzanita is abundant. Adults are nocturnal and fly in the fall.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Wavy-lined Cochisea is locally distributed and generally uncommon in the Pacific Northwest. Because this species is dependent on mature manzanita shrubs as a food plant, frequent fires or brush clearing may be harmful to this species; however, infrequent fires may be beneficial in rejuvenating old, senescent manzanita.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of manzanita using a beating sheet. During our studies in southwestern Oregon we have collected and reared three caterpillars. Adults may be sampled using UV or mercury-vapor light traps. We have observed 75 individuals, with the high number for a single trap-night collection totaling 20 moths; typically 1 to 4 moths are collected per trap-night.

COCHISEA SONOMENSIS - SONOMA COCHISEA - GEOMETRIDAE

Two species of *Cochisea* occur in the Pacific Northwest.

ADULT (PLATE 4, FIG. 5-11A,B)

Wingspan 4.3 cm.

The dorsal surface of the forewings is dark gray with a broad, wavy black postmedian line and a shorter black basal line. The dorsal surface of the hindwings is light gray with a black postmedian line and a small black discal spot. The ventral surface of the fore- and hindwings is similar to the dorsal surface but paler in color. Males have strongly pectinate (feathery) antennae while females have antennae that are filiform (thin and hair-like).

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This geometrid is distributed from west of the Cascades and Sierra Nevada mountains from southwestern Oregon through central California. In Oregon, this moth is known only from Douglas, Josephine, and Jackson Counties where it may be locally frequent in low elevation forests with Ponderosa pine. Caterpillars feed on pine foliage. Adults are nocturnal and fly during the fall.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Sonoma Cochisea is locally distributed and generally uncommon in the Pacific Northwest. Populations of this moth will benefit from infrequent, controlled ground fires and forest thinning to create an open pine forest.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of pines using a beating sheet. We have sampled pines very extensively, but throughout all of our projects we have yet to collect a single caterpillar of this species (see Miller and Hammond 2003 for a list of caterpillars reared from *Pinus* in western Oregon). Adults should be the focus of population assessment. Adults may be sampled using UV or mercury-vapor light traps. Overall, we have observed 98 individuals with 38 moths as the record high number in a single trap-night; typically only 1 to 3 moths occur per trap-night.

DIGRAMMIA RESPERSATA - OAK ANGLE - GEOMETRIDAE

Ten species of *Digrammia* occur in the Pacific Northwest. This species was previously placed in *Semiothisa*.

ADULT (PLATE 4, FIG. 5-12)

Wingspan 2.8 cm.

The dorsal surface of the fore- and hindwings is gray and speckled with fine black dots. Each forewing has three thin, black lines in the median area, while each hindwing has two faint lines. The ventral surface of the fore- and hindwings is similar to the dorsal wings, but paler.

CATERPILLAR

We have reared this caterpillar from *Quercus garryana* but do not have a photograph or a description.

ECOLOGY

The preferred habitat for this species is oak woodlands and mixed conifer-hardwood forests in the foothills of the Cascades, Coast Range, and Siskiyou Mountains of western Oregon, extending southward through California. Caterpillars are common and feed on the foliage of deciduous oaks west of the Cascade Range. Adults are nocturnal and are common in spring, generally from late April to June.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Oak Angle is associated with oak woodlands. The oak woodland habitats in the Willamette Valley and other low elevation zones west of the Cascades are critical to this species. Agricultural, rural, and urban developments are relatively intense in these zones. The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow the encroachment and prevent displacement of the oak trees, should be encouraged. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of oaks using a beating sheet. Our studies have resulted in the collection and rearing of two caterpillars from Oregon white oak in the Willamette Valley. Adults may be sampled using UV or mercury-vapor light traps. We have observed a few hundred individuals, with a typical collection of 1 to 5 moths per trap-night.

HYDRIA UNDULATA - SCALLOP SHELL - GEOMETRIDAE

One species of *Hydria* occurs in the Pacific Northwest. Some authors have presented *H. undulata* under the name of *Rheumaptera undulata*.

ADULT (PLATE 4, FIG. 5-13)

Wingspan 3.2 cm.

The dorsal surface of the fore- and hindwings is brown, covered with many thin white or wavy yellow lines. A small black discal spot is present on both the fore- and hindwings. The ventral surface of the fore- and hindwings is similar to the dorsal surface, but paler.

CATERPILLAR

We have not reared this caterpillar in the Pacific Northwest. Wagner (2001) shows a photograph of the caterpillar (listed as *Rheumaptera undulata*) and described it as varying from pale beige, green, tan, or yellow, to deep red-brown; a broad, brownish, supraspiracular stripe; thin addorsal and subdorsal stripes break into a series of whitish spots; a pale stripe above and below black-ringed spiracles.

ECOLOGY

This species is widely distributed in montane forests of the Pacific Northwest, and also in northeastern North America and across Eurasia. In spite of this distribution, adult moths are usually uncommon to rare. Caterpillars feed on many hardwood shrubs, such as *Rhododendron*, *Salix*, and *Spiraea*, in cool, moist forests (Covell 1984). Adults are nocturnal and fly from May to August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Scallop Shell is widespread but rare in Pacific Northwest forests and woodlands. We have no specific prescription for conservation of this species other than to suggest maintaining angiosperm diversity within forested stands.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of food plants. We have sampled the food plant species very extensively, but throughout all of our projects we have yet to collect a caterpillar of this species (see Miller and Hammond 2003 for a list of caterpillars reared from *Rhododendron*, *Salix*, and *Spiraea* in western Oregon). Given the rarity of this species the quantification of larvae is unlikely. Adults may be sampled using UV or mercury-vapor light traps. Overall, we have observed 45 individuals with the record high number in a collection totaling only six moths per trap-night, typically only 1 to 2 moths are collected on any given trap-night.

HYDRIOMENA EDENATA - LARGE HYDRIOMENA - GEOMETRIDAE

At least 12 species of *Hydriomena* occur in the Pacific Northwest.

ADULT (PLATE 4, FIG. 5-14)

Wingspan 3.8 cm.

The dorsal surface of the forewings is light brown to gray and marked with a white or dusky median band, black subapical streaks, a black band along the inner margin, and a small, white wing base. The dorsal surface of the hindwings is pale gray with faint median and postmedian lines. The ventral surface of the fore- and hindwings is pale gray with black median lines.

CATERPILLAR

We successfully reared a few caterpillars of this species to an adult, but no photos were taken and no larval descriptions were written for those individuals. Because the caterpillars of this genus are difficult to identify, we require an adult voucher to assign a name to a larval photograph or description. Thus, the larvae remain undescribed in the Pacific Northwest.

ECOLOGY

This species occurs in open oak woodlands and mixed conifer-hardwood forests in the foothills of the Cascades, Coast Range, and Siskiyou Mountains of western Oregon, southward through California. This moth may be locally common where its oak food plant is abundant. West of the Cascade Mountains, caterpillars feed on foliage of deciduous oaks. Adults are nocturnal and fly in late winter and early spring, typically from February through April.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Large *Hydriomena* is dependent on the maintenance of oak woodland habitats at low elevations west of the Cascades. The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow encroachment into the woodland and prevent displacement of the oak trees, should be encouraged. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of oaks using a beating sheet. Our studies have resulted in the collection and rearing of only one caterpillar. Adults may be sampled using UV or mercury-vapor light traps. We have observed 46 individuals with the record high number of five moths collected on a single trap-night. Typically only one moth is collected on any given trap-night.

HYDRIOMENA NUBILOFASCIATA - BANDED *HYDRIOMENA* - GEOMETRIDAE

At least 12 species of *Hydriomena* occur in the Pacific Northwest.

ADULT (PLATE 4, FIG. 5-15A; PLATE 5, FIG. 5-15B)

Wingspan 3.0 cm.

The dorsal surface of the forewings is gray or brown with wavy, pale green or white median bands and a small pale area at the wing base. In addition, a dark, gray postmedian band and pale submarginal band that are straight along the outer margin of the forewing distinguish this species from other *Hydriomena* species. The dorsal surface of the hindwings is pale gray with faint median and postmedian lines. The ventral surface of the fore- and hindwings is similar to the dorsal surface of the wings, but paler in color.

CATERPILLAR

We have successfully reared a few caterpillars of this species to adults, but no photos were taken and no larval descriptions were written for those individuals. Because the caterpillars of this genus are difficult to identify, we require an adult voucher to assign a name to a larval photograph or description. Thus, the larvae remain undescribed in the Pacific Northwest.

ECOLOGY

This moth inhabits oak woodlands and mixed conifer-hardwood forests in the foothills of the Cascades, Coast Range, and Siskiyou Mountains of western Oregon, southward through California. Caterpillars feed on the foliage of deciduous oaks west of the Cascade Range, and can be common. Adults are nocturnal and fly in late winter and early spring, mostly from February through April.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Banded *Hydriomena* is associated with oak woodlands. This moth is dependent on the maintenance of oak woodland habitats at low elevations west of the Cascades. The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow their encroachment into the oak woodlands and prevent displacement of the oak trees, should be encouraged. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of oaks using a beating sheet. Our studies have resulted in the collection of only a few caterpillars and they are difficult to rear into adults. Adults may be sampled using UV or mercury-vapor light traps. We have observed 135 individuals with a typical collection of 1 to 3 moths per trap-night.

SNOWIA MONTANERIA - MONTANE SNOWIA - GEOMETRIDAE

One species of *Snowia* occurs in the Pacific Northwest.

ADULT (PLATE 5, FIG. 5-16)

Wingspan 3.8 cm.

The dorsal surface of the forewings is light pink-orange with a black basal streak, a recurved, black median line, and a straight, black postmedian line that is abruptly recurved at the subapex. The dorsal surface of the hindwings is white with a faint, black, discal spot and thin postmedian line. The ventral surface of the fore- and hindwings is similar to the dorsal surface, but pale, with a strongly developed black discal spot and black postmedian spot on the ventral surface of the hindwing.

CATERPILLAR

Undescribed, and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species is widely distributed in drier Ponderosa pine forests throughout the montane regions of the western United States. However, it is always a rare species. The reasons for this rarity are unknown. Perhaps *S. montaneria* may be particularly vulnerable to predators or pathogens. The caterpillar and its food plant are unknown, but caterpillars of species in a related genus, *Caripeta*, feed on conifers (Pinaceae). Adults are nocturnal and fly in July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Montane Snowia is rare. Without knowledge of the caterpillar food plant, any prescription for the conservation of this species must rely on information about the habitat where the adults are known to occur. Given the species occurs in pine forests the protection of mature pines would be prudent.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. Studies to discover the caterpillar food plant are needed. Adults should be the focus of population assessment. Adults may be sampled using UV or mercury-vapor light traps. Overall, we have observed only two individuals.

STENOPORPIA EXCELSARIA - SCARCE GRAY - GEOMETRIDAE

Four species of *Stenoporpia* occur in the Pacific Northwest.

ADULT (PLATE 5, FIG. 5-17)

Wingspan 4.0 cm.

The dorsal surface of the fore- and hindwings is white with heavy, gray overscaling. Each forewing has a black basal line and three black median lines. The hindwings also have three black median lines and a relatively faint submarginal line or spots. The ventral surface of the fore- and hindwings is white with faint lines and no spots.

CATERPILLAR

Duncan (2006) provides photographs and describes the larva as follows: “Body light grey to pinkish grey; pair of oblique dashes near the posterior margin of each abdominal segment. The head is slightly bi-lobed, grey to rusty brown with a herringbone pattern on each lobe.”

ECOLOGY

This species occurs in open pine and fir forests and is widely distributed throughout western North America, from British Columbia to Durango, Mexico. In spite of this wide distribution, it is usually rare in most areas, although it may be relatively more common in the southern Rocky Mountains and Southwest. Caterpillars feed on the foliage of pines and Douglas fir. Adults are nocturnal and fly in late spring, generally from late May through June.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Scarce Gray is rare in the northern range of the Pacific Northwest. Also, Duncan (2006) describes this species as uncommon in British Columbia. This species resides in Douglas-fir forests and would likely be sensitive to large-scale timber harvesting.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of conifers using a beating sheet. We have sampled pines and Douglas-fir very extensively, but throughout all of our projects we have yet to collect a caterpillar of this species (see Miller and Hammond 2003 for a list of caterpillars reared from *Pinus* and *Pseudotsuga* in western Oregon). Adults may be sampled using UV or mercury-vapor light traps. We have observed only four individuals.

ERYNNIS PROPERTIUS - PROPERTIUS DUSKYWING - HESPERIIDAE

Five species of *Erynnis* occur in the Pacific Northwest. This species is of special concern in British Columbia (Pyle 2002).

ADULT (PLATE 5, FIG. 5-18A,B)

Wingspan 4.2 cm.

The dorsal surface of the forewings is dark black-brown with extensive, pale gray scales and a row of small, white postmedian spots. The dorsal surface of the hindwings is similar to the forewings, but lacks the gray overscaling. The ventral surface of the fore- and hindwings is similar to the dorsal surface, but without the pale gray scales.

CATERPILLAR (PLATE 5, FIG. 5-18C)

Pale green with white speckles and a faint yellow, subdorsal longitudinal line. The head is brown with tan patches.

ECOLOGY

This species occurs from southern California to British Columbia in dry, open forests with chinquapin at high elevations, and oak woodlands at low elevations. Caterpillars are common, and feed during late spring on both evergreen and deciduous oaks, tan oak, and chinquapin. Adults are diurnal and fly in spring, primarily from late March to early July, depending on elevation.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Propertius Duskywing is dependent on the maintenance of woodland habitats where species of Fagaceae are prevalent. The species is widely distributed and common on the west side of the Cascade and Sierra Nevada Mountains, but more sparsely distributed in Washington (Hinchliff 1996). The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow the encroachment and prevent displacement of the oak trees, should be encouraged. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is excellent. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships where the Propertius Dusky Wing has been recorded. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of Fagaceae using a beating sheet. Studies in Oregon have resulted in the collection of numerous caterpillars, typically zero to three individuals per 100 sec of sampling effort. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants are present. Multiple individuals will likely be noted during such a sampling event. Pyle (2002) comments that he has seen dozens of adults nectaring on lilac.

HESPERIA COLUMBIA - COLUMBIAN SKIPPER - HESPERIIDAE

Six species of *Hesperia* occur in the Pacific Northwest.

ADULT (PLATE 6, FIG. 5-19A,B,C)

Wingspan 3.0 cm.

The dorsal surface of the forewings is orange with a broad, black, submarginal border and a diagonal, central, black, median band. In the male, this median band includes a straight patch of pheromone scales or stigma. The dorsal surface of the hindwings is also orange with broad, black borders. The ventral surface of the forewings is similar to the dorsal surface, but paler; however, the ventral surface of the hindwings is greenish orange with a brighter, orange, anal margin, with a narrow median band of white spots, and a white discal spot.

CATERPILLAR

Pyle (2002) describes the larva as tan with a dark face showing a light-colored “M” pattern.

ECOLOGY

This species occurs in dry meadows with bunchgrasses, in open oak woodlands, and mixed hardwood-conifer forests at low to middle elevations in California and southwest Oregon. Caterpillars feed on native bunchgrasses, such as *Koeleria macrantha* and *Danthonia californica* (Warren 2005). Adults are diurnal and fly in two broods at lower elevations. The first brood flies in May and June, and the second from mid-September into October.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Columbian Skipper is associated with oak woodlands. This species will benefit from the conservation of the remaining patches of oak habitat, including removal of conifer trees to slow their encroachment and prevent displacement of the oak trees. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species. The northernmost range in the distribution of this species occurs in southern Oregon. Populations of this butterfly will benefit from infrequent, controlled ground fires, which prevent heavy brush and tree encroachment into open meadow and oak woodland habitat. Loss of habitat in Oregon will severely limit the biogeographic scope of this species.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only ten southern townships where the Columbian skipper has been recorded (Hinchliff 1994). Information regarding the status of numbers of individuals within populations is poor. Larval and adult densities may be assessed either by sampling various species of grasses with a sweep net, or by conducting a visual search.

OCHLODES AGRICOLA AGRICOLA - RURAL SKIPPER - HESPERIIDAE

Three species of *Ochlodes* occur in the Pacific Northwest. The species *agricola* has one subspecies in the Pacific Northwest.

ADULT (PLATE 6, FIG. 5-20 A,B,C)

Wingspan 2.7 cm.

The dorsal surface of the forewings is orange with a broad, black, submarginal border and a broad, diagonal, black median band across the center of the wing. In the male, this median band includes a straight patch of pheromone scales or stigma. The dorsal surface of the hindwings is also orange with a black, submarginal border. The ventral surface of the forewings is mostly orange with weak or gray markings. The ventral surface of the hindwings is also orange with no distinct markings.

CATERPILLAR

We have yet to rear this caterpillar in the Pacific Northwest. On-line image of the nominate species show a larva that is a mottled tweed brown, tan, and greenish with a dark middorsal line. The head is light brown.

ECOLOGY

This subspecies occurs in moist, open woodlands at middle elevations in the mountains of California and southwest Oregon. Populations of this butterfly are very local. In Oregon, the subspecies is most frequently seen in the Siskiyou Mountains of Josephine County (Warren 2005), but occurs in southern Douglas County. Caterpillar food plants are not documented but they likely feed on grasses. Adults are diurnal and fly in early summer, mostly during June and July.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Rural Skipper is very limited in its geographic range and is land-management sensitive. Populations of this butterfly will benefit from infrequent, controlled ground fires and forest thinning to create an open woodland habitat. The northernmost range in the distribution of this species occurs in southwest Oregon. Any loss of habitat in Oregon will limit the biogeographic scope of this species.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only four southern townships where the Rural Skipper has been recorded (Hinchliff 1994). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae might be assessed by sampling species of grasses with a sweep net or by conducting a visual search. Studies are needed to determine the caterpillar food plants. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants are present.

POLITES MARDON - MARDON SKIPPER - HESPERIIDAE

Six species of *Polites* occur in the Pacific Northwest. This species is endangered in Washington, imperiled in Oregon, and a candidate for federal listing (Pyle 2002). We discuss this species in more detail as a special case in Chapter 4.

ADULT (PLATE 7, FIG. 5-21A,B,C)

Wingspan 2.8 cm.

The dorsal surface of the forewings is orange with a broad, black submarginal border and a diagonal, black median band in the center of the wing. In the male, this median band has a short, zigzag shaped stigma or patch of pheromone scales. The dorsal surface of the hindwings is mostly black-brown with an orange median patch. The ventral surface of the forewings is similar to the dorsal surface, but paler. The ventral surface of the hindwings is highly variable, orange to pale brown, with a central median band that may be yellow to light orange and narrow to wide.

CATERPILLAR

Pyle (2002) describes the larva as brown-flecked gray with dorsal lines and a black head.

ECOLOGY

This species occurs from southern Washington to northern California and lives in native meadows and prairies with bunchgrasses. As of 2006, it survives in only four widely disjunct populations: 1) on the Tenino Prairies of western Washington near Olympia, 2) along the summit of the Cascades in southern Washington near Mt. Adams, 3) along the summit of the Cascades in southern Oregon and northern California in Jackson, Klamath, and Siskiyou Counties, and 4) in the Siskiyou and coastal mountains of Del Norte County, California. Caterpillars feed on native bunchgrasses, such as *Danthonia californica*, *Festuca idahoensis*, and *F. roemerii*. Adults are diurnal and fly from May to July, depending on elevation (Warren 2005).

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Mardon Skipper is a rare species, listed in Washington as endangered, in Oregon as imperiled, and a candidate for federal listing as endangered (Pyle 2002). Meadow overgrowth by exotic grasses, overgrazing by domestic livestock, or encroachment into the meadow habitat by woody brush or trees will be harmful to this species.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only five southern Oregon townships, each in very close proximity to one another, where the Mardon skipper has been recorded (Hinchliff 1994). Similarly, the atlas of Washington butterflies shows only two clusters of sites where the Mardon Skipper has been recorded in 11 townships (Hinchliff 1996). Prior information regarding the status of numbers of individuals within populations was poor but is currently under study (D. Ross pers. comm.). Caterpillars are rarely found; however, abundance of larvae may be assessed by sampling species of grasses with a sweep net or by conducting a visual search. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants are present.

POLITES MYSTIC - LONG DASH SKIPPER - HESPERIIDAE

Six species of *Polites* occur in the Pacific Northwest.

ADULT (PLATE 22, FIG. 5-22A,B,C)

Wingspan 3.0 cm.

The dorsal surface of the forewings is orange with a broad, black submarginal border and a diagonal, black median band in the center of the wing. In the male, this median band has a broad, black stigma or patch of pheromone scales. The dorsal surface of the hindwings is mostly black with an orange median band. The ventral surface of the forewings is similar to the dorsal surface, but very pale. The ventral surface of the hindwings is light to medium orange with a faint, yellow median band and basal spot.

CATERPILLAR

Guppy and Shepard (2001) describe the caterpillar as brownish green with white hairs, a darker middorsal line, lateral dark spots, and the first thoracic segment is white with a light brown sclerotization across the dorsum.

ECOLOGY

This species is distributed in the northeastern portion of the Pacific Northwest, from southeast British Columbia and northeast Washington through northern Idaho and northwest Montana. Colonies of this butterfly are usually very local. Caterpillars feed on various grasses growing in open, boggy meadows and wet prairies. Adults are diurnal and fly in late spring and early summer from May to August, depending on elevation (Pyle 2002).

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Long Dash Skipper is sensitive to forest management. Overgrazing by domestic livestock or encroachment into the meadow habitat by woody brush or trees will be harmful to this species. The westernmost range in the distribution of this species occurs in eastern Washington and Oregon; loss of habitat in this region will severely limit the biogeographic scope of this species.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only two northeastern townships where the Long Dash Skipper has been recorded (Hinchliff 1994). The atlas of Washington butterflies shows 17 northeastern townships where the Long Dash Skipper has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of grasses with a sweep net or by conducting a visual search. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants are present.

POLITES PECKIUS - PECK'S SKIPPER - HESPERIIDAE

Six species of *Polites* occur in the Pacific Northwest.

ADULT (PLATE 8, FIG. 5-23A,B,C)

Wingspan 2.6 cm.

The dorsal surface of the forewings is orange with a broad, black submarginal border and a diagonal, black median band in the center of the wing. In the male, this median band has a thin, curved stigma or patch of pheromone scales with a central, brown patch adjacent to the stigma. The dorsal surface of the hindwings is mostly black with a central, orange median patch. The ventral surface of the forewings is similar to the dorsal surface, but paler. However, the ventral surface of the hindwings is brown with very broad, yellow median and basal bands.

CATERPILLAR

Dethier (1940) describes the larva as maroon, mottled with light brown, and covered with fine dark hairs. Pyle (2002) adds that the caterpillar has a light marked face on a black head.

ECOLOGY

This species occurs in open, boggy meadows and wet prairies in montane areas of the northeastern portion of the Pacific Northwest, from southeastern British Columbia to western Montana and northeast Oregon. Colonies of this butterfly usually are very local. Caterpillars feed on various grasses, such as *Poa* (Pyle 2002). Adults are diurnal and fly in June and July.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Peck's Skipper is sensitive to forest management. Overgrazing by domestic livestock or encroachment into the meadow habitat by woody brush or trees would be harmful to this species. Northeastern Oregon is the southernmost range in the distribution of this species. Therefore, loss of habitat in Oregon will severely limit the biogeographic scope of this species.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only six northeastern townships where the Peck's Skipper has been recorded (Hinchliff 1994). The atlas of Washington butterflies shows 14 northeastern townships where the Peck's Skipper has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of grasses with a sweep net or by conducting a visual search. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants are present.

POLITES SONORA - SONORAN SKIPPER - HESPERIIDAE

Six species of *Polites* occur in the Pacific Northwest. The *sonora* species has three subspecies in the Pacific Northwest. We illustrate *P. sonora siris*.

ADULT (PLATE 8, FIG. 5-24A,B,C)

Wingspan 2.8 cm.

The dorsal surface of the forewings is orange with a broad, brown submarginal border and a diagonal, brown median band in the center of the wing. In the male, this median band has a broad black stigma or patch of pheromone scales. The dorsal surface of the hindwings is mostly orange-brown with a narrow, orange median band. The ventral surface of the forewings is similar to the dorsal surface, but paler. The ventral surface of the hindwings is light to dark yellow-brown with a narrow, yellow median band and basal spot.

CATERPILLAR

Pyle (2002) describes the larva as grayish green with a black head.

ECOLOGY

This species is closely related to *Polites mystic*, a species with a more northern distribution, and replaces that species in wet, boggy meadow and prairie habitats southward in Washington, Oregon, Idaho, Utah, Nevada, and California. Colonies of this butterfly usually are very local. Caterpillars feed on various grasses, such as *Poa* (Warren 2005). Adults are diurnal and fly from May to August, depending on elevation.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Sonoran Skipper is sensitive to forest management. Overgrazing by domestic livestock or encroachment into the meadow habitat by woody brush or trees would be harmful to this species.

Information regarding the geographic range of the species is excellent. The Sonoran skipper should be relatively common in samples conducted in Oregon. However, the butterfly is less common in Washington, occurring in only 16 western and central townships (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of grasses with a sweep net or by conducting a visual search. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants are present.

PLATE 1, FIGURES 5-1A – 5-4A

Figure 5-1a. *Gnophaela latipennis*: female, dorsal.Figure 5-1b. *Gnophaela latipennis*: male, dorsal.Figure 5-1c. *Gnophaela latipennis*: caterpillar.Figure 5-2. *Gnophaela vermiculata*: dorsal.Figure 5-3. *Platarctia parthenos*: dorsal.Figure 5-4a. *Platyrepia virginalis*: dorsal, dark form.

PLATE 2, FIGURES 5-4B – 5-6B



Figure 5-4b. *Platyprepia virginalis*: dorsal, light form.



Figure 5-4c. *Platyprepia virginalis*: caterpillar.



Figure 5-5a. *Tyria jacobaeae*: dorsal.



Figure 5-5b. *Tyria jacobaeae*: caterpillar.



Figure 5-6a. *Phryganidea californica*: dorsal.



Figure 5-6b. *Phryganidea californica* caterpillar.

PLATE 3, FIGURES 5-7 – 5-10B



Figure 5-7. *Drepana bilineata*: dorsal.



Figure 5-8. *Aplocera plagiata*: dorsal.



Figure 5-9a. *Apodrepanulatrix litaria*: dorsal.



Figure 5-9b. *Apodrepanulatrix litaria*: caterpillar.



Figure 5-10a. *Cochisea sinuaria*: dorsal.



Figure 5-10b. *Cochisea sinuaria*: caterpillar.

PLATE 4, FIGURES 5-11A – 5-15A



Figure 5-11a. *Cochisea sonomensis*: female, dorsal.



Figure 5-11b. *Cochisea sonomensis*: male, dorsal.



Figure 5-12. *Digrammia respersata*: dorsal.



Figure 5-13. *Hydria undulata*: dorsal.



Figure 5-14. *Hydriomena edenata*: dorsal.



Figure 5-15a. *Hydriomena nubilofasciata*: dorsal, dark form.

PLATE 5, FIGURES 5-15B – 5-18C



Figure 5-15b. *Hydriomena nubilofasciata*: dorsal, light form.



Figure 5-16. *Snowia montaneria*: dorsal.



Figure 5-17. *Stenoporpia excelsaria*: dorsal.



Figure 5-18a. *Erynnis propertius*: female, dorsal.



Figure 5-18b. *Erynnis propertius*: male, dorsal.



Figure 5-18c. *Erynnis propertius*: caterpillar.

PLATE 6, FIGURES 5-19A – 5-20C



Figure 5-19a. *Hesperia columbia*: female, dorsal.



Figure 5-19b. *Hesperia columbia*: female, ventral.



Figure 5-19c. *Hesperia columbia*: male, dorsal.



Figure 5-20a. *Ochlodes agricola agricola*: female, dorsal.



Figure 5-20b. *Ochlodes agricola agricola*: male, dorsal.



Figure 5-20c. *Ochlodes agricola agricola*: male, ventral.

PLATE 7, FIGURES 5-21A – 5-22C



Figure 5-21a. *Polites mardon*: female, dorsal.



Figure 5-21b. *Polites mardon*: female, ventral.



Figure 5-21c. *Polites mardon*: male, dorsal.



Figure 5-22a. *Polites mystic*: female, dorsal.



Figure 5-22b. *Polites mystic*: male, dorsal.



Figure 5-22c. *Polites mystic*: male, ventral.

PLATE 8, FIGURES 5-23A – 5-24C



Figure 5-23a. *Polites peckius*: female, dorsal.



Figure 5-23b. *Polites peckius*: female, ventral.



Figure 5-23c. *Polites peckius*: male, dorsal.



Figure 5-24a. *Polites sonora siris*: female, dorsal.



Figure 5-24b. *Polites sonora siris*: female, ventral.



Figure 5-24c. *Polites sonora siris*: male, dorsal.

PYRGUS CENTAUREAE LOKI - ALPINE CHECKERED SKIPPER - HESPERIIDAE

Three species of *Pyrgus* occur in the Pacific Northwest. The species *centaureae* has one subspecies in the Pacific Northwest.

ADULT (PLATE 9, FIG. 5-25A,B)

Wingspan 2.8 cm.

The dorsal surface of the forewings is black with white discal spots and a row of white median spots. The dorsal surface of the hindwings is black with a white median band and white submarginal spots. The ventral surface of the fore- and hindwings is similar in pattern to the dorsal surface, but with a paler gray or brown ground color.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species occurs in open meadows at high elevations in the mountains at or above timberline in the subalpine and alpine zones. The species is primarily distributed at high elevations in the northern Rocky Mountains of Montana, Alberta, and British Columbia, but extends southward into the Cascade Mountains of northern Washington. Caterpillars likely feed on cinquefoils (Pyle 2002). Adults are diurnal and fly from early July to early August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Alpine Checkered Skipper is very limited in its geographic range in the United States and may be sensitive to warming climatic conditions that could eventually eliminate its alpine habitats in Washington. Infrequent fire and inhibition of conifer encroachment into meadows will help to preserve suitable habitat. The westernmost range in the distribution of this species occurs in northern Washington. Therefore, loss of habitat in Washington will limit the biogeographic scope of this species.

Information regarding the geographic range of the species is excellent. The atlas of Washington butterflies shows only five northcentral townships where the Alpine Checkered Skipper has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling meadows, perhaps focusing on habitats with species of *Potentilla*, with a sweep net or by conducting a visual search. Adults may be sampled by conducting a timed visual search along transects through habitat where adult nectar plants are present.

THORYBES MEXICANUS - NEVADA CLOUDY WING SKIPPER - HESPERIIDAE*THORYBES DIVERSUS* - WESTERN CLOUDY WING SKIPPER - HESPERIIDAE

Three species of *Thorybes* occur in the Pacific Northwest.

ADULT (PLATE 9, FIG. 5-26)

Wingspan 3.0 cm.

Thorybes mexicanus: Dorsal surface of the forewings is dark black-brown with a small white discal spot and a row of small, white postmedian spots. The dorsal surface of the hindwings is black-brown with no markings. The ventral surface of the forewings is similar to the dorsal surface, but paler. The ventral surface of the hindwings is a lighter brown with mottled streaks and darker median bands.

Thorybes diversus: Dorsal surface of the forewings has very small, reduced white spots and lacks the mottled streaks on the ventral surface of the hindwings.

CATERPILLAR

Thorybes mexicanus: Unknown, but likely very similar to *T. diversus*.

Thorybes diversus: Olive colored with a yellowish pile, first thoracic segment rust colored, dark dorsal stripes and lighter stripes laterally; head black.

ECOLOGY

While *T. mexicanus* and *T. diversus* are sympatric in the Sierra Nevada of California, in Oregon *T. mexicanus* is restricted to boggy meadows and wet prairies at high elevations along the east side of the Cascade Range. In comparison, *T. diversus* is restricted to boggy seeps and *Darlingtonia* bogs in the Siskiyou Mountains of southwest Oregon. Caterpillars feed on legumes, particularly clovers. Adults are diurnal and fly from May to August, depending on elevation (Warren 2005).

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Both species occur in very local colonies and are management sensitive. Overgrazing by domestic livestock or encroachment into meadow and bog habitats by woody brush and trees would be harmful to these species. The northernmost range in the distribution of both species occurs in Oregon. Therefore, loss of habitat in Oregon will severely limit the biogeographic scope of these species.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only five southwestern townships where the Western Cloudy Wing Skipper has been recorded and 16 Cascadia townships where the Nevada Cloudy Wing Skipper has been recorded (Hinchliff 1994). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of legumes with a sweep net or by conducting a visual search. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where adult nectar plants are present.

AGRIADES GLANDON PODARCE - SIERRA NEVADA BLUE - LYCAENIDAE*AGRIADES GLANDON MEGALO* - ARCTIC BLUE - LYCAENIDAE

One species of *Agriades* occurs in the Pacific Northwest. The species *glandon* has two subspecies in the Pacific Northwest. Various authorities differ on their interpretation of the specific/subspecific status of these taxa (Guppy and Shepard 2001, Pyle 2002, Warren 2005).

ADULT

Agriades glandon podarce (PLATE 9, FIG. 5-27A,B; PLATE 10, FIG. 5-27C,D)

Agriades glandon megalo (PLATE 10, FIG. 5-28A,B,C,D)

Wingspan 2.6 cm.

In both subspecies the dorsal surface of the forewings is silvery blue with a small black discal spot and a narrow to wide black border. The dorsal surface of the hindwings is similar to the forewings, but may have a row of black submarginal spots. The ventral surface of the fore- and hindwings is light to dark gray with black discal spots and rows of black median, postmedian, and submarginal spots that are strongly outlined in white.

CATERPILLAR

Pyle (2002) describes the larva as deep purple and ornamented with hourglass markings and bands of yellow bars.

ECOLOGY

The northern subspecies, *A. g. megalo*, is widely distributed at high elevations in alpine and subalpine meadows of the northern Rocky Mountains in Montana, Alberta, and British Columbia, extending southward through the Olympic Mountains and Cascade Mountains of Washington. Caterpillars feed on saxifrages. Adults are diurnal and fly in July and August. The southern subspecies, *A. g. podarce*, is distributed in similar habitats of the California Sierra Nevada, extending northward through the Siskiyou and southern Cascade mountains of Oregon to Douglas County. Caterpillars feed on shooting stars in wet, boggy meadows. Adults are diurnal and fly in midsummer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Sierra Nevada Blue and Arctic Blue subspecies are very localized in their distribution and are climate sensitive. Because they live in very local colonies, these butterflies may be extirpated easily by destructive impacts, such as overgrazing by domestic livestock or encroachment into meadows by woody brush or trees. Warming climatic conditions eventually may eliminate the alpine habitat from much of its southern distribution in the United States.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only seven townships where the Sierra Nevada Blue has been recorded (Hinchliff 1994). The atlas of Washington butterflies shows 30 townships where the Arctic Blue has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of *podarce* and *megalo*

larvae may be assessed by sampling species of *Saxifraga* and *Dodecatheon*, respectively, with a sweep net or by conducting a visual search. Adults may be sampled by conducting a timed visual search along transects through meadows where food plants for the caterpillar and the nectar sources for the adults are present.

ATLIDES HALESUS ESTESI - GREAT PURPLE HAIRSTREAK - LYCAENIDAE

One species of *Atlides* occurs in the Pacific Northwest. The species *halesus* has one subspecies in the Pacific Northwest.

ADULT (PLATE 11, FIG. 5-29A,B,C,D)

Wingspan 3.6 cm.

The dorsal surface of the forewings in males is iridescent blue or blue-green with a small, black discal stigma and a narrow, black submarginal band; females are blue and black. Also, the dorsal surface of the hindwings in males is basally blue and black along the outer margin, with small, iridescent-green spots at the anal margin and one or two thin, wispy tails on each hindwing. The ventral surface of the wings is black with small, red basal spots and iridescent-green anal spots on the hindwings. An iridescent-blue-green band at the wing base of the ventral forewings is present in the male, absent in the female. The venter of the abdomen is bright orange in both male and female.

CATERPILLAR (PLATE 11, FIG. 5-29E)

Green to blue-green with short, fine, white hairs; sometimes a white, diamond-shaped blaze middorsally on T-2.

ECOLOGY

This species belongs to a Neotropical group of hairstreak butterflies, and is mostly restricted to the southern United States. However, its range does extend to the north along the West Coast. It is mostly restricted to oak woodlands in California and western Oregon but records from Klamath and Lake Counties, Oregon, suggest that it also may use mistletoes growing on junipers east of the Cascades. Freezing winter temperatures probably limit its occurrence east of the Cascades. Caterpillars feed on mistletoes (*Phoradendron*) growing on trees, such as oaks. Adults are diurnal and fly in two broods from April to October, but particularly in July and August (Pyle 2002).

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Great Purple Hairstreak is dependent on the maintenance of oak woodland habitats on the west side of the Cascades. The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow their encroachment into the woodland habitat and prevent displacement of the oak trees, should be encouraged. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species. The northernmost range in the distribution of this species occurs in the Willamette Valley in western Oregon. Therefore, loss of habitat in Oregon will severely limit the biogeographic scope of this species.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows 14 townships where the Great Purple Hairstreak has been recorded (Hinchliff 1994). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of trees harboring broad-leaved mistletoe. Adults may be sampled by conducting a timed visual search along transects through oak woodlands.

HABRODAIS GRUNUS - CHINQUAPIN HAIRSTREAK - LYCAENIDAE

One species of *Habrodais* occurs in the Pacific Northwest. The species *grunus* has two subspecies in the Pacific Northwest. *Habrodais grunus herri* is a candidate for state listing in Washington (Pyle 2002).

ADULT (PLATE 11, FIG. 5-30A; PLATE 12B,C)

Wingspan 3.1 cm.

The dorsal surface of the fore- and hindwings is yellow-orange in the Cascade subspecies, *herri*, and brown in the Sierra-Siskiyou subspecies, *lorquini*. Both subspecies exhibit broad, black submarginal bands, and a short, hair-like tail on the hindwing. The ventral surface of the fore- and hindwings is light orange with thin, brown discal spots and a row of median spots. In addition, the ventral hindwings have a row of thin, crescent-shaped submarginal spots.

CATERPILLAR (PLATE 12, FIG. 5-30D)

Yellow-green with a pale-yellow subdorsal line.

ECOLOGY

This species is found in oak woodlands from Arizona and southern California north throughout western Oregon to southern Washington. This species is common and widespread at the higher elevations in the Siskiyou Mountains of southwest Oregon and northwest California, but more localized in the Cascade Mountains and north into southern Washington (Pyle 2002). Caterpillars are common and feed during the spring on evergreen Fagaceae, such as chinquapin, canyon live oak, and tan oak. Adults are diurnal and fly from mid to late summer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

In the Cascade Mountains, the species is completely dependent on the maintenance of golden chinquapin, the principal food plant of larvae. Prescribed forest thinning and small clearcuts that include the preservation of chinquapin will be beneficial to this species. In addition, maintenance of canyon live oak and tan oak in the Siskiyou Mountains is essential for the survival of this butterfly. This species may ultimately be threatened with extinction due to the recently introduced sudden oak death fungus that attacks and kills the host trees of *H. grunus*. The northernmost range in the distribution of this species occurs in south-central Washington. Loss of habitat in Washington and north central Oregon will severely limit the biogeographic scope of this species.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows numerous townships where each subspecies of the Chinquapin Hairstreak has been recorded (Hinchliff 1994). However, the atlas of Washington butterflies shows just one township where the Chinquapin Hairstreak has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of Fagaceae. Our studies have resulted in the collection of up to five caterpillars per 100 sec of sampling effort. Adults may be sampled by conducting a timed visual search along transects through oak woodlands (Bowden 2003).

ICARICIA ICARIOIDES FENDERI - FENDER'S BLUE - LYCAENIDAE

Four species of *Icaricia* occur in the Pacific Northwest. The species *icarioides* has four subspecies in the Pacific Northwest. This subspecies is listed as an endangered species under the U.S. Endangered Species Act. We have provided an extended account of this species as a special case history in Chapter 4.

ADULT (PLATE 12, FIG. 5-31A,B,C)

Wingspan 3.0 cm.

The dorsal surface of the fore- and hindwings in the male is silvery blue with thin, black margins. The dorsal surface of the fore- and hindwings in the female is dark, reddish brown. The ground color of the ventral surface of the fore- and hindwings is light to dark gray in the male and brown in the female. Also, the ventral surface of the fore- and hindwings is marked with crescent-shaped, black discal spots, a row of round, black median spots, and a row of elongate, black submarginal spots.

CATERPILLAR (PLATE 13, FIG. 5-31D)

Light green, immaculate.

ECOLOGY

This subspecies of *I. icarioides* is confined entirely to native upland prairies in the Willamette Valley of western Oregon, from Yamhill County south to Lane County. Caterpillars feed on native prairie species of lupine during April and early May. Adults are diurnal and fly from May into early June.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Fender's Blue is rare and listed as endangered. Only about 12 local populations of this butterfly still exist and all of them are threatened by invasive exotic grasses and woody vegetation, such as the exotic Scotch broom. Mowing and burning management treatments are beneficial to this species, when conducted at the appropriate time of the year.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only 11 townships where the Fender's Blue has been recorded (Hinchliff 1994). Information regarding the status of numbers of individuals within populations is good. Because of this butterfly's endangered status, larval and adult abundance should be assessed by conducting timed visual searches along transects in meadows where larval food plants and the adult nectar plants are present.

INCISALIA POLIA MARITIMA - MARITIME ELFIN - LYCAENIDAE

Four species of *Incisalia* occur in the Pacific Northwest. The species *polia* has two subspecies in the Pacific Northwest. This subspecies is considered imperiled in Oregon (Pyle 2002). An extended account of this species is provided in Chapter 4.

ADULT (PLATE 13, FIG. 5-32A,B,C,D)

Wingspan 2.3 cm.

The dorsal surface of the fore- and hindwings is dark brown with no markings. The male has a stigma or patch of pheromone scales in the discal area of each forewing that is absent in the female. The hindwing in both sexes has a scalloped margin. The ventral surface of the forewings is dark brown with a thin median line and small postmedian spots. The ventral surface of the hindwings is dark brown-black basal to the median line and violaceous gray in the postmedian and submarginal areas.

CATERPILLAR (PLATE 13, FIG. 5-32E)

Pyle (2002) describes the larva as green with lighter stripes and dashes.

ECOLOGY

This species is widely distributed across northern regions of North America, but the subspecies *I. p. maritima* is very narrowly restricted to sand dune habitats along the Oregon coast south to Del Norte County in northwest California. Caterpillars feed on kinnikinnick in open areas near the ocean. Adults are diurnal and fly in early spring, mostly from late March through May.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Maritime Elfin is rare. Only a few colonies exist and several are threatened with extinction. These are found in Lincoln and Curry Counties, Oregon, and in sand dunes near Lake Earl in Del Norte County. This species requires an open habitat, and is threatened by woody brush and tree encroachment from dense stands of lodgepole pine or exotic Scotch broom and gorse brush.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only two townships where the Maritime Elfin has been recorded (Hinchliff 1994). Information regarding the status of numbers of individuals within populations is poor. Because of the rarity of this butterfly larval and adult abundance should be assessed by conducting timed visual searches along transects in sand dune habitat where kinnikinnick and nectar plants for the adults are present.

LYCAEIDES IDAS - NORTHERN BLUE - LYCAENIDAE

Two species of *Lycaeides* occur in the Pacific Northwest. There has been some taxonomic confusion concerning this species. Guppy and Shepard (2001) treated the West Coast populations as a separate species, *L. anna*, based on food plant differences. However, these differences relate to northern and northeastern populations in North America, which probably constitute a distinct species, *L. aster*, that feed on various members of the heath family (Ericaceae). In the Pacific Northwest, the heath-feeding populations are not known to occur south of central British Columbia. We consider the West Coast *L. anna* populations to be a subspecies of *L. idas*.

ADULT (PLATE 14, FIG. 5-33A,B,C,D)

Wingspan 3.0 cm.

The dorsal surface of the fore- and hindwings in the male is violaceous blue with no markings. The dorsal surface of the fore- and hindwings in the female is dark red-brown, and a row of orange, crescent-shaped submarginal spots are variably present or absent. The ventral surface of the fore- and hindwings is white with crescent-shaped, black discal spots, a row of round, black median spots, and a row of crescent-shaped, orange and black submarginal spots. Development of an orange hue is weak in Cascade Mountain populations and strong in Rocky Mountain and Intermountain populations.

CATERPILLAR

We have not collected this caterpillar in the Pacific Northwest. Guppy and Shepard (2001) show a photograph of the caterpillar and describe it as green with a thin white lateral line.

ECOLOGY

This species is widely distributed across northern regions of Eurasia and higher elevation montane regions of western North America. It occurs in open forests and meadows at higher elevations in the mountains. Caterpillars feed on various legumes, including lupines and milkvetches. Adults are diurnal and fly in June and July.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Northern Blue is sensitive to forest management and needs some disturbance to maintain the open habitat in high montane environments. Populations of this butterfly will benefit from infrequent, controlled ground fires and prescribed forest thinning to prevent brush and tree encroachment into meadow habitat.

Information regarding the geographic range of the species is excellent. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships where the Northern Blue has been recorded. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of lupine and milkvetch with a sweep net or by conducting a visual search. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants for the adults are present.

LYCAENA PHLAEAS ARCTODON - BEARTOOTH COPPER - LYCAENIDAE

Eleven species of *Lycaena* occur in the Pacific Northwest. The species *phlaeas* has one subspecies in the Pacific Northwest.

ADULT (PLATE 14, FIG. 5-34A,B; PLATE 15, FIG.5-34C,D)

Wingspan 3.0 cm.

The dorsal surface of the forewings is orange with a narrow, gray-brown submarginal border, two black discal spots, and a row of round, black median spots. The dorsal surface of the hindwings is gray-brown with an orange submarginal band. The forewings of males have a brown tinge to the orange ground color, while females are bright orange. The ventral surface of the forewings is similar to the dorsal surface, but paler. The ventral surface of the hindwings is light gray with small black discal spots, a row of black median spots, and red-orange submarginal spots.

CATERPILLAR

Pyle (2002) describes the larva as variably yellow, green, and rose-colored. An image of a caterpillar of the nominate species from the Yukon territory is shown in Guppy and Shepard (2001).

ECOLOGY

This species is widely distributed in Alaska and across northern Canada occurring in arctic-alpine habitats consisting of open rocky slopes above timberline. Numerous isolated and disjunct populations, some of which have attained subspecific status, occur as relicts in the alpine zone of high mountains in western North America. Most of these butterflies are found in the central Rocky Mountains of northwest Wyoming, southern Montana, and adjacent Idaho, but isolated populations also occur in the high Wallowa Mountains of northeast Oregon and in the high Sierra Nevada of California. Caterpillars feed on *Oxyria digyna* (Polygonaceae). Adults are diurnal and fly in midsummer, typically in July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Beartooth Copper is rare, endemic, and due to its endemism in alpine habitats, it is considered climate sensitive. A warming climate may eliminate this species, or at least many of the subspecies, from much of its southern distribution in the United States.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only two townships where the Beartooth Copper has been recorded (Hinchliff 1994). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults should be assessed by conducting a timed visual search along transects through alpine meadow habitat where *Oxyria* and nectar plants for the adults are present.

MITOURA GRYNEA - CEDAR HAIRSTREAK - LYCAENIDAE

Three species of *Mitoura* occur in the Pacific Northwest. The species *grynea* has three subspecies in the Pacific Northwest. *Mitoura grynea chalcosiva* (previously known as *barryi*) is a candidate for state listing in Washington (Pyle 2002).

ADULT (PLATE 15, FIG. 5-35A,B,C,D)

Wingspan 2.7 cm.

The dorsal surface of the fore- and hindwings in the male is gray with an orange flush in the submarginal areas, and with a stigma or patch of pheromone scales in the discal cell of the forewings. The dorsal surface of the fore- and hindwings in the female is mostly orange with narrow, black costal and submarginal borders. The ventral surface of the forewings is mostly orange with a narrow, white postmedian line. The ventral surface of the hindwings is purple-brown with a narrow, white median line, small, black postmedian spots, and orange submarginal spots. The hindwings (in both sexes) have a short, wispy tail.

CATERPILLAR (PLATE 16, FIG. 5-35E)

Green with chevron or circular subdorsal patches of white; lateral white streaks.

ECOLOGY

This species is found in conifer forests and juniper woodlands and is widely distributed in western North America. Caterpillars are common. There are three subspecies in the Pacific Northwest: *chalcosiva* feeds on western juniper in the desert rangelands east of the Cascades; *M. g. nelsoni* feeds on incense cedar in the warmer, drier forests of southwest Oregon and California; *rosneri* feeds on western red cedar in the cooler, moister forests of northwest Oregon, western Washington, and southwest British Columbia. Adults are diurnal and fly from spring to midsummer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The issues of sensitivity of populations to management practices occur at the subspecies level. The desert juniper-feeding subspecies is not of concern south of Washington. However, the other two subspecies are management sensitive because they depend on cedar trees as food plants. Duncan (2006) describes the Cedar Hairstreak as uncommon in British Columbia. Following timber harvest, replacing mixed conifer stands containing cedars with monoculture stands of Douglas fir would tend to eliminate this species from the forest. However, following clearcutting, if cedars are planted with other conifers, the resulting mixed conifer forest will sustain this species.

Information regarding the geographic range of the species is excellent. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships spread across both states where the species has been recorded. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of cedars and juniper using a beating sheet. We have collected three caterpillars in our studies. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants are present.

MITOURA JOHNSONI - JOHNSON'S HAIRSTREAK - LYCAENIDAE

Three species of *Mitoura* occur in the Pacific Northwest. Guppy and Shepard (2001) place this species as *Loranthomitoura johnsoni*. This species is considered endangered in British Columbia, a candidate for listing in Washington, and of concern in Oregon (Pyle 2002). We discuss the conservation of this species in more detail in Chapter 4.

ADULT (PLATE 16, FIG. 5-36A,B,C,D)

Wingspan 3.0 cm.

The dorsal surface of the fore- and hindwings is gray-brown to red-brown with no markings except for a stigma or patch of pheromone scales in the male that is absent in the female. The ventral surface of the fore- and hindwings is red-brown with a narrow, white median line. Also, the ventral surface of each hindwing has three black postmedian spots and a blue subanal patch. The hindwings (in both sexes) have short wispy tails.

CATERPILLAR (PLATE 16, FIG. 5-36E)

Green with white markings highlighted in yellow-gold shading. Dorsum with transverse-oblique, ridge-like warts marked with white and yellow-gold, subdorsal area green, spiracular line is white with irregular edges expanded cephalad of the spiracle and continuous or nearly so.

ECOLOGY

The species is characteristic of mature to old-growth conifer forests. The distribution is largely restricted to the Pacific Northwest, extending from the Sierra Nevada and Cascade Mountains, including the Coast Range and Siskiyou Mountains, north to British Columbia. A disjunct population is isolated in the Hell's Canyon region of northeast Oregon and adjacent Idaho. Caterpillars feed on dwarf mistletoes that grow on various conifers (Pinaceae). Adults are diurnal and fly in the forest canopy during June and July.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Johnson's Hairstreak is dependent on the maintenance of mature to old-growth coniferous forests in the Pacific Northwest.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows 23 townships in western and eastern Oregon where this butterfly has been recorded (Hinchliff 1994). The atlas of Washington butterflies shows 16 townships, all in western Washington, where Johnson's Hairstreak has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by using a beating sheet to sample species of conifers that are infested with dwarf mistletoe. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants for the adults are present.

PLATE 9, FIGURES 5-25A – 5-27B

Figure 5-25a. *Pyrgus centaurae loki*: male, dorsal.Figure 5-25b. *Pyrgus centaurae loki*: male, ventral.Figure 5-26a. *Thorybes mexicanus*: female, dorsal.Figure 5-26b. *Thorybes mexicanus*: female, ventral.Figure 5-27a. *Agriades glandon podarce*: female, dorsal.Figure 5-27b. *Agriades glandon podarce*: female, ventral.

PLATE 10, FIGURES 5-27C – 5-28D



Figure 5-27c. *Agriades glandon podarce*: male, dorsal.



Figure 5-27d. *Agriades glandon podarce*: male, ventral.



Figure 5-28a. *Agriades glandon megalos*: female, dorsal.



Figure 5-28b. *Agriades glandon megalos*: female, ventral.



Figure 5-28c. *Agriades glandon megalos*: male, dorsal.



Figure 5-28d. *Agriades glandon megalos*: male, ventral.

PLATE 11, FIGURES 5-29A – 5-30A



Figure 5-29a. *Atlides halesus*: female, dorsal.



Figure 5-29b. *Atlides halesus*: female, ventral.



Figure 5-29c. *Atlides halesus*: male, dorsal.



Figure 5-29d. *Atlides halesus*: male, ventral.



Figure 5-29e. *Atlides halesus*: caterpillar.



Figure 5-30a. *Habrodais grunus*: dorsal, dark form.

PLATE 12, FIGURES 5-30B – 5-31C



Figure 5-30b. *Habrodais grunus*: ventral, dark form.



Figure 5-30c. *Habrodais grunus*: dorsal, light form.



Figure 5-30d. *Habrodais grunus*: caterpillar.



Figure 5-31a. *Icaricia icarioides fenderi*: female, dorsal.



Figure 5-31b. *Icaricia icarioides fenderi*: male, dorsal.



Figure 5-31c. *Icaricia icarioides fenderi*: male, ventral.

PLATE 13, FIGURES 5-31D – 5-32E



Figure 5-31d. *Icaricia icarioides fenderi*: caterpillar.



Figure 5-32a. *Incisalia polia*: female, dorsal.



Figure 5-32b. *Incisalia polia*: female, ventral.



Figure 5-32c. *Incisalia polia*: male, dorsal.



Figure 5-32d. *Incisalia polia*: male, ventral.



Figure 5-32e. *Incisalia polia*: caterpillar.

PLATE 14, FIGURES 5-33A – 5-34B



Figure 5-33a. *Lycaeides idas atrapraetextus*: female, dorsal.



Figure 5-33b. *Lycaeides idas atrapraetextus*: female, ventral.



Figure 5-33c. *Lycaeides idas atrapraetextus*: male, dorsal.



Figure 5-33d. *Lycaeides idas atrapraetextus*: male, ventral.



Figure 5-34a. *Lycaena phalaeas hypophalaeas*: female, dorsal.



Figure 5-34b. *Lycaena phalaeas hypophalaeas*: female, ventral.

PLATE 15, FIGURES 5-34C – 5-35D



Figure 5-34c. *Lycaena phalaeas hypophalaes*: male, dorsal.



Figure 5-34d. *Lycaena phalaeas hypophalaes*: male, ventral.



Figure 5-35a. *Mitoura grynea plicataria*: female, dorsal.



Figure 5-35b. *Mitoura grynea plicataria*: female, ventral.



Figure 5-35c. *Mitoura grynea plicataria*: male, dorsal.



Figure 5-35d. *Mitoura grynea plicataria*: male, ventral.

PLATE 16, FIGURES 5-35E – 5-36E



Figure 5-35e. *Mitoura grynea*: caterpillar.



Figure 5-36a. *Mitoura johnsoni*: female, dorsal.



Figure 5-36b. *Mitoura johnsoni*: female, ventral.



Figure 5-36c. *Mitoura johnsoni*: male, dorsal.



Figure 5-36d. *Mitoura johnsoni*: male, ventral.



Figure 5-36e. *Mitoura johnsoni*: caterpillar.

PHILOTIELLA LEONA - LEONA'S BLUE - LYCAENIDAE

One species of *Philotiella* occurs in the Pacific Northwest. This species was discovered by Harold Rice in 1995 and described by Hammond and McCorkle (2000).

ADULT (PLATE 17, FIG. 5-37A,B,C,D)

Wingspan 2.1 cm.

The dorsal surface of the fore- and hindwings in the male is dark blue in the basal and median areas and black in the submarginal and marginal areas. The dorsal surface of the fore- and hindwings in the female is completely black. The ventral surface of the fore- and hindwings is white with large, round, black discal and median spots on the forewings and smaller, black, discal and median spots on the hindwings.

CATERPILLAR (PLATE 17, FIG. 5-37E)

Intermixed colors of red, green, and off-white; irregular, red-purple middorsal stripe bordered by an irregular, off-white band; subdorsally and laterally green and tan shading surrounding small, oblique, white dashes.

ECOLOGY

This butterfly occurs in open, dry meadows in lodgepole pine forests within the volcanic ash and pumice zone east of Crater Lake. At present, it is only known from a very small geographic area in the Sand Creek area east of Crater Lake. If this is the entire range of the species, it may be severely endangered. The larval food plant is widely distributed along the east slope of the Sierra Nevada Mountains, but the butterfly has yet to be found in California. Additional populations of this butterfly may yet be discovered with additional exploration in the volcanic ash and pumice habitat in northeast California, from Mt. Lassen and Mt. Shasta north to the Medicine Lake volcano system. Caterpillars feed on a species of small, annual buckwheat growing in loose ash and pumice soil on the east slope of the Cascades in Oregon. Adults are diurnal and fly during June and July.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Leona's Blue is endemic. Populations of this butterfly will benefit from thinning and the preservation of its limited meadow habitat in lodgepole pine forest.

Information regarding the geographic range of the species is poor. Information regarding the status of numbers of individuals within populations is poor. Because this species is only known from a single location in Oregon the assessment of larval and adult abundance should be conducted via a timed visual search along transects through areas where annual buckwheat and adult nectar plants are present.

PLEBEJUS SAEPIOLUS INSULANUS - COASTAL GREENISH BLUE - LYCAENIDAE

One species of *Plebejus* occurs in the Pacific Northwest. Guppy and Shepard (2001) address this species as *Plebeius saepiolus* (exchanging the “j” for an “i”). The species *saepiolus* has three subspecies in the Pacific Northwest. This subspecies is extinct in British Columbia (Pyle 2002). We discuss this subspecies in more detail in Chapter 4.

ADULT (PLATE 17, FIG. 5-38A; PLATE 18, FIG. 5-38B,C,D)

Wingspan 2.7 cm.

The dorsal surface of the forewings in the male is silvery blue with a small black discal spot and a narrow black border. The dorsal surface of the hindwings is similar to the forewings but lacks the discal spot. The dorsal surface of the fore- and hindwings of the female is dark brown, sometimes with blue basal coloration on the forewings and small, orange submarginal spots on the hindwings. The ventral surface of the fore- and hindwings is light gray in the male and dark gray in the female. In addition to the black discal spots, rows of small, black median and submarginal spots are present, with the median spots outlined in white.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

The historical distribution extended from Vancouver Island, British Columbia, south through the Olympic Mountains of Washington, and along the Oregon coast to Del Norte County, California, near Crescent City. Current knowledge of distribution of this butterfly indicates that it is severely restricted to a few populations. Caterpillars feed on springbank clover in coastal grasslands or subalpine meadows. Adults are diurnal and fly from May to July, depending on elevation.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Coastal Greenish Blue is on the brink of extinction due to a loss of suitable coastal meadow habitat.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only five townships where historically this subspecies has been recorded (Hinchliff 1994). However, as of 2006, only two populations are known to remain, one in southern Oregon and the other in Del Norte County, California. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling springbank clover with a sweep net or by conducting a visual search. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants are present.

SATYRIUM AURETORUM AURETORUM - GOLD-HUNTER'S HAIRSTREAK - LYCAENIDAE

Eight species of *Satyrium* occur in the Pacific Northwest. The species *auretorum* has one subspecies in the Pacific Northwest.

ADULT (PLATE 18, FIG. 5-39A,B; PLATE 19, FIG. 39C,D)

Wingspan 2.8 cm.

The dorsal surface of the fore- and hindwings in the male is gray-brown with a stigma or patch of pheromone scales in the discal cell of the forewing. The female lacks the stigma, and has an orange flush in the distal parts of the wings. The ventral surface of the fore- and hindwings is gray with narrow, faint discal spots and rows of small, faint median and submarginal spots. A small orange and black subanal spot is present on the hindwings. The hindwings possess a short tail.

CATERPILLAR

Pyle (2002) describes the larva as green with white speckles and lateral yellow stripes.

ECOLOGY

This species is largely restricted to oak woodlands in California but it does extend northward into the southern Cascades of Klamath and Jackson Counties, Oregon. It may be most common on the Cascade-Siskiyou National Monument (Warren 2005). Caterpillars feed on oaks. Adults are diurnal and fly from late May to early July, depending on elevation.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Gold-Hunter's Hairstreak is dependent on the maintenance of oaks in forest habitats, particularly on *Quercus garryana* in the southern Cascade Mountains. The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow their encroachment into oak woodlands and prevent displacement of the oak trees, should be encouraged. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species. Because the northernmost range in the distribution of this species occurs in southern Oregon, any loss of suitable habitat will severely limit the biogeographic scope of this species.

Information regarding the geographic range of the species is good. The atlas of Oregon butterflies shows only two townships where the Gold-hunter's Hairstreak has been recorded (Hinchliff 1994). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of oaks using a beating sheet. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants are present.

ABAGROTIS MIRABILIS - BLACK CEDAR DART - NOCTUIDAE

At least 23 species of *Abagrotis* occur in the Pacific Northwest.

ADULT (PLATE 19, FIG. 5-40)

Wingspan 3.8 cm.

The dorsal surface of the forewings is black with a round, white reniform spot. The dorsal surface of the hindwings is dark gray and without markings. The ventral surface of the fore- and hindwings is dark gray and without markings. The sides of the thorax are black, the center of the thorax is orange. The abdomen is gray.

CATERPILLAR

Duncan (2006) provides photographs and describes the larva as follows: “This species has two distinct color pattern forms. The head of both forms is light yellowish brown with dark netting and a dark band over the vertex of each lobe. The body of the more common brown form has broken white middorsal, subdorsal and spiracular stripes, and paired brown, wedge-shaped subdorsal markings. The less common grey form has a similar pattern.”

ECOLOGY

This species is widely distributed throughout western North America where junipers and cedars are present (Lafontaine 1998), but is usually rare in most areas. In the Pacific Northwest, *A. mirabilis* is most common in the Siskiyou Mountains of northern California and southwest Oregon, where it probably uses incense-cedar as a caterpillar food plant. Adults are nocturnal and fly in midsummer, usually from late June through August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Black Cedar Dart is widespread but rare. Duncan (2006) describes this species as uncommon in British Columbia. Replanting western red cedar and incense cedar as part of forest restoration projects in clearcuts and after wild fires would be beneficial to this moth.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of cedars. Studies are needed to verify the caterpillar food plant in our region. Adults may be sampled using UV or mercury-vapor light traps. We have observed 57 individuals from sites east and west of the Cascade Mountains, but typically observe only one moth per trap night.

ABAGROTIS RUBICUNDIS - RED CEDAR DART - NOCTUIDAE

At least 23 species of *Abagrotis* occur in the Pacific Northwest.

ADULT (PLATE 19, FIG. 5-41)

Wingspan 3.6 cm.

The dorsal surface of the forewings is brick red with a round, yellow reniform spot. The dorsal surface of the hindwings is dark gray and without markings. The ventral surface of the fore- and hindwings is also dark gray and without markings.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

The distribution of this moth species extends from the south end of the Sierra Nevada Mountains in California, north through the Siskiyou Mountains and southern Cascades to Lane County, Oregon. The caterpillar food plant is unknown, but the species belongs to a group of *Abagrotis* that feeds on Cupressaceae (Lafontaine 1998). Adults are nocturnal and fly from June through August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Red Cedar Dart is a rare species. The distribution of this moth is coincident with that of incense-cedar; *A. rubicundis* is thought to be a food plant specialist on this tree. Thus, if this suspicion is correct, replanting cedars in clearcuts and after wildfires as part of forest restoration projects would be beneficial to this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. Studies to determine food plant relationships are needed and would be best conducted by visual search or beating sheet samples of potential food plant species, namely cedars. Adults may be sampled using UV or mercury-vapor light traps. We have observed only two individuals, one each in two samples. One moth was observed in the Cascade Mountains and the other in the Siskiyou Mountains.

ACRONICTA CYANESCENS - BLUE-GRAY DAGGER MOTH - NOCTUIDAE

At least 17 species of *Acronicta* occur in the Pacific Northwest.

ADULT (PLATE 19, FIG. 5-42A)

Wingspan 5.0 cm.

The dorsal surface of the forewings is gray with black basal and subanal streaks. The dorsal surface of the hindwings is white in the male and gray in the female. The ventral surface of the fore- and hindwings is paler than the dorsal surface and has a black reniform spot and a faint, black median line.

CATERPILLAR (PLATE 19, FIG. 5-42B)

Extremely long and dense white hairs obscure the green body.

ECOLOGY

This species is widely distributed in dry forests throughout much of western North America. However, it appears to be rare in nearly all regions. Caterpillars are rare and feed on snowbrush during late spring. Adults are nocturnal and fly in midsummer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Blue-Gray Dagger Moth is rare. Disturbances, such as ground fires and forest thinning, may stimulate growth of snowbrush and benefit this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using visual search or a beating sheet to sample species of snowbrush. We have collected just one caterpillar, that observation occurring in the Metolius Basin, Oregon. Adults may be sampled using UV or mercury-vapor light traps. Overall, we have observed 20 individuals from 18 of 19 trap-nights yielding just one moth.

ACRONICTA MARMORATA - MARBLED OAK DAGGER MOTH - NOCTUIDAE

At least 17 species of *Acronicta* occur in the Pacific Northwest.

ADULT (PLATE 20, FIG. 5-43A)

Wingspan 4.3 cm.

The dorsal surface of the forewings is mottled with black, gray, and white; lacking basal and subanal dashes. The dorsal surface of the hindwings is white with black streaks along the outer veins. The ventral surface of the fore- and hindwings is paler than the dorsal surface and possess faint, black reniform spots and thin, black median lines.

CATERPILLAR (PLATE 20, FIG. 5-43B)

Yellow and brown; dark brown middorsal line. The head is dark brown.

ECOLOGY

The species is widely distributed in oak woodlands at low elevations along the Pacific Coast, from western Oregon south through California. Although very common, on the west side of the Cascade and Sierra Nevada Mountains this species is completely dependent on the maintenance of oak woodland habitats at low elevations. Caterpillars are very common on deciduous oaks, such as *Quercus garryana*. Adults are nocturnal and fly from spring to early summer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Marbled Oak Dagger Moth is associated with oak woodlands. This species will benefit from the conservation of the remaining patches of oak habitat, including removal of conifer trees to slow their encroachment into the oak woodland and prevent displacement of the oak trees. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is good. The abundance of larvae may be assessed using a beating sheet to sample species of oaks. In our studies we have collected one to two caterpillars per 100 sec of sampling effort. Adults may be sampled using UV or mercury-vapor light traps. Overall, we have observed more than 550 individuals, typically with high sampling range of 4 to 8 moths per trap-night.

APAMEA PLUTONIA - *PLUTONIA APAMEA* - NOCTUIDAE

At least 31 species of *Apamea* occur in the Pacific Northwest.

ADULT (PLATE 20, FIG. 5-44)

Wingspan 3.8 cm.

The dorsal surface of the forewings is dark, brown-black to black with a small, thin, white, crescent-shaped reniform spot. The dorsal surface of the hindwings is light to dark gray with no markings. The ventral surface of the forewings is dark gray to black. The ventral surface of the hindwings is pale gray basally and dark gray to black distally with a small, black discal spot and a faint, black median band. The thorax is dark brown to black. The abdomen is light gray and male valves are covered with prominent yellow-orange hairs.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species is always uncommon to rare. It has a disjunct distribution in boreal forests of northeastern North America and in coastal rainforests west of the Cascades in the Pacific Northwest. Caterpillars feed on grasses. Adults are nocturnal and fly in mid-summer, typically from June to August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The *Plutonia Apamea* is rare. Although the species is restricted to cool, moist forests, it may depend on disturbances within the forest to promote growth of the grasses used by the larvae. Disturbed areas along roadsides and small clearcuts within the forest may help sustain populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search or using a sweep net to sample grasses. Adults may be sampled using UV or mercury-vapor light traps. Overall, we have observed four individuals from three sites in the western foothills bordering the Willamette Valley.

APAMEA REMISSA - IGNORANT *APAMEA* - NOCTUIDAE

At least 31 species of *Apamea* occur in the Pacific Northwest.

ADULT (PLATE 20, FIG. 5-45A,B)

Wingspan 3.3 cm.

The dorsal surface of the forewings is polymorphic, either black with fine white lines and marks, or white and pale gray with a black median area and large, pale discal spots. The ventral surface of the fore- and hindwings is dark gray in the black form and pale gray in the white form. The ventral surface of each hindwing has a small, black discal spot and a narrow, black median line.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species is always uncommon to rare. It is widely distributed in boreal forests across Canada, extending southward in cool, moist forests of the northern Rocky Mountains and Pacific Northwest. Caterpillars feed on grasses. Adults are nocturnal and fly in mid-summer, generally from June to August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Ignorant *Apamea* is rare. This species may depend on disturbances within the forest to promote growth of the grasses used by the larvae. Disturbed areas along roadsides and small clearcuts within the forest may help sustain populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search or using a sweep net to sample grasses. Adults may be sampled using UV or mercury-vapor light traps. We have observed three individuals from two sites, the HJ Andrews Experimental Forest in the Cascade Mountains, and another site in the Blue Mountains.

AUTOGRAPHHA SPECIOSA - SPECIOSA SEMI-LOOPER - NOCTUIDAE

At least ten species of *Autographa* occur in the Pacific Northwest.

ADULT (PLATE 20, FIG. 5-46)

Wingspan 3.5 cm.

The dorsal surface of the forewings exhibits contrasting shades of brown to black and pale gray, with straight, thin basal and median lines, and a prominent, white, comma-shaped stigma. The dorsal surface of the hindwings is pale gray basally and dark gray distally. The ventral surface of the fore- and hindwings is dark gray with obscure markings.

CATERPILLAR

Undescribed, and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species of moth has a very restricted distribution along the West Coast, extending from the central Sierra Nevada Mountains in California north through western Oregon, with a disjunct population on Vancouver Island, British Columbia. It occurs in a variety of habitats, but only in extremely pristine habitats. In Oregon, we have found *A. speciosa* in two distinctly different types of habitat. Along the summit of the Cascades, this species is found in undisturbed subalpine meadows at high elevations. The species is entirely restricted to undisturbed old-growth conifer forests at low elevations in the Coast Range. The caterpillar food plant is unknown. However, based on the food plants of closely related species it probably feeds on herbs, such as legumes. Adults are nocturnal and fly during July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Speciosa Semi-Looper is rare and sensitive to forest management (Miller et al. 2003). Management issues include protecting subalpine meadows in the Cascade Mountains from spring-summer livestock grazing, or being overgrown with woody brush and trees. In the Coast Range, the species appears to be dependent on the maintenance of old-growth conifer forests.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae cannot be assessed until the food plant is discovered. Adults may be sampled using UV or mercury-vapor light traps. We have observed 28 individuals from the Cascade Mountains and the Coast Range. A typical sample yields one moth per trap-night.

CATOCALA AHOLIBAH - AHOLIBAH UNDERWING - NOCTUIDAE

Twelve species of *Catocala* occur in the Pacific Northwest.

ADULT (PLATE 21, FIG. 5-47A,B)

Wingspan 7.7 cm.

The dorsal surface of the forewings is mottled black, gray, and red-brown with jagged black lines. The dorsal surface of the hindwings is rosy-red with a black median band narrowly constricted in the center and with broad black submarginal borders. The ventral surfaces of the fore- and hindwings exhibit alternating red, white, and black bands.

CATERPILLAR (PLATE 21, FIG. 5-47C)

Gray-tan with a subtle, rosy-pink hue and covered with minute, black speckles; small tubercles middorsum on A-5 and A-8; ventral row of short whisker-like hairs; true legs pink-red. Head is cream-colored with reticulated lines.

ECOLOGY

This species is widely distributed in western North America and is most likely to occur where oak woodlands are present along the West Coast, the Southwest, and in the southern Rocky Mountains. It is generally uncommon to rare, but may be common locally in low-elevation oak woodlands in southwest Oregon. Caterpillars feed on deciduous oaks, such as Oregon white oak, during the spring. Adults are nocturnal and fly during late summer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Aholibah Underwing is associated with oak woodlands at low elevations. This species will benefit from the conservation of the remaining patches of oak habitat, including the removal of conifer trees to slow their encroachment into the oak woodlands and prevent displacement of the oak trees. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of oaks. Our studies have resulted in the collection of 1 to 2 caterpillars per 100 sec of sampling effort. Adults may be sampled using UV or mercury-vapor light traps. We have observed 92 individuals, with 88 of the moths coming from samples in the Siskiyou Mountains.

CATOCALA ILIA ZOE - ZOE UNDERWING - NOCTUIDAE

Twelve species of *Catocala* occur in the Pacific Northwest. The species *ilia* has one subspecies in the Pacific Northwest.

ADULT (PLATE 21, FIG. 5-48A,B)

Wingspan 7.5 cm.

The dorsal surface of the forewings is mottled black, gray, and white with jagged, black lines. The dorsal surface of the hindwings is orange with a black median band and submarginal border showing wavy undulations. The ventral surface of the fore- and hindwings has alternating orange, yellow, and black bands.

CATERPILLAR (PLATE 21, FIG. 5-48C)

Cryptic coloration and pattern match the lichens on oak branches, mottled with green and black (also see Wagner 2005).

ECOLOGY

The subspecies found in the Pacific Northwest is endemic to low-elevation oak woodlands along the West Coast, west of the Sierra Nevada and Cascade Mountains, extending from California north through western Oregon. Caterpillars are uncommon and feed on Oregon white oak during late spring. Adults are common, nocturnal, and fly in late summer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Zoe Underwing is associated with oak woodlands at low elevations on the west side of the Cascades and Sierra Nevada. The conservation of the remaining patches of oak habitat in these areas, including removal of conifer trees to slow their encroachment into the oak woodlands and prevent displacement of the oak trees, should be encouraged. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of oaks. Adults may be sampled using UV or mercury-vapor light traps. We have observed 29 individuals from three sites, all in southern Oregon. Typically, only one moth is observed per trap-night.

CATOCALA OPHELIA - OPHELIA UNDERWING - NOCTUIDAE

Twelve species of *Catocala* occur in the Pacific Northwest.

ADULT (PLATE 22, FIG. 5-49A,B)

Wingspan 5.2 cm.

The dorsal surface of the forewings is dark gray and mottled with white, combined with a mix of red-brown and black, jagged lines. The dorsal surface of the hindwings is red with a black median band and submarginal border. The ventral surface of the fore- and hindwings has alternating red and black bands.

CATERPILLAR

We have reared only one caterpillar of this species but did not obtain a photograph or a description.

ECOLOGY

This species may be locally common where the food plant is abundant, but it is completely dependent on the maintenance of canyon live oak shrubs and trees in the Sierra Nevada, Siskiyou, and southern Cascade Mountains. This species may be a food plant specialist on canyon live oak, because its distribution is coincident with the distribution of canyon live oak through California and southwest Oregon north to Douglas County. Adults are diurnal and fly in mid to late summer, primarily from mid-July to September.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The *Ophelia Underwing* is associated with oak woodlands. The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow their encroachment into oak woodlands and prevent displacement of the oak trees, should be encouraged. The larval food plant is often eliminated as a “weed species” during forest management. However, forest thinning and clearcutting that preserve canyon live oak are beneficial to *C. ophelia*. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample oak species. In our studies, we have collected one caterpillar per 1000 sec of sampling effort. Adults may be sampled using UV or mercury-vapor light traps. We have observed seven individuals from two sites, six moths from one site in the Siskiyou Mountains and one moth from the Cascade Mountains.

CATOCALA VERRILLIANA - VERRILLIANA UNDERWING - NOCTUIDAE

Twelve species of *Catocala* occur in the Pacific Northwest.

ADULT (PLATE 22, FIG. 5-50A,B)

Wingspan 5.0 cm.

The dorsal surface of the forewings is pale gray with a white median area and jagged black lines. The dorsal surface of the hindwings is orange-red with a black median band constricted in the center and a broad black submarginal border. The ventral surface of the forewings has alternating orange and black bands, while the ventral surface of the hindwings has alternating red and black bands.

CATERPILLAR (PLATE 22, FIG. 5-50C)

Uniformly gray/white with a pale pink hue; middorsum of A-5 and A-8 with tubercles; ventral row of short, whisker-like hairs. Head color same as body color, but with reticulated lines.

ECOLOGY

This species is common and widely distributed in low-elevation oak woodlands along the West Coast from California north to Washington. It appears to favor habitats with deciduous oaks, such as Oregon white oak. Caterpillars are common and feed on Oregon white oak during spring. Adults are nocturnal and fly in late summer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Verrilliana Underwing is associated with oak woodlands at low elevations on the west side of the Cascades and Sierra Nevada. The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow their encroachment into oak woodlands and prevent displacement of the oak trees, should be encouraged. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of oaks. Our studies have resulted in the collection of one to two caterpillars per 100 sec of sampling effort. Adults may be sampled using UV or mercury-vapor light traps. We have observed 27 individuals from the Cascade Mountains, the Coast Range, and the Siskiyou Mountains. A typical observation is one moth per trap-night.

CUCULLIA FLOREA - FLOREA *CUCULLIA* - NOCTUIDAE

At least 12 species of *Cucullia* occur in the Pacific Northwest.

ADULT (PLATE 22, FIG. 5-51)

Wingspan 5.2 cm.

The forewings are very long and slender. The dorsal surface of the forewings is pale gray with gray streaks, faint discal spots, and a curved, black subanal streak. The dorsal surface of the hindwings is pale gray with a dark gray submarginal border. The ventral surface of the forewings is dark gray. The ventral surface of the hindwings is pale gray with a dark gray submarginal border.

CATERPILLAR

Details of the larval description are rephrased from Poole (1995) and also pertain to *Cucullia postera*. The dorsal margin of each subdorsal band is very dark and thin and sets off a distinctive dorsal region. The two thin lines between the subdorsal band and the spiracular region are almost absent. The subspiracular line is distinctly dark and margined ventrally by a wide, reticulate, brown band, resulting in a well-defined yellow-green to green band between the spiracle and the subspiracular line, followed by a brown band.

ECOLOGY

This species is widely distributed across northern regions of North America, extending southward through the Rocky Mountains and in the Cascade and Sierra Nevada Mountains. It is usually uncommon to rare species, occurring at high elevations in the mountains in habitats consisting of open meadows and forests, particularly subalpine forests and meadows. Caterpillars feed on the flower heads of herbaceous composites, such as *Solidago*, *Aster*, and *Erigeron* species. Adults are nocturnal and fly in early to mid-summer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Florea *Cucullia* is rare and sensitive to forest management. This species requires some disturbance to maintain an open meadow habitat against heavy brush and tree encroachment. Populations of this moth will benefit from infrequent, controlled ground fires, prescribed forest thinning, and clearcuts.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search or by using a sweep net to sample herbaceous plant species in meadows. Adults may be sampled using UV or mercury-vapor light traps. We have observed five individuals, each from a separate trap site, in one region in the central Cascade Mountains, in and near the HJ Andrews Experimental Forest.

CUCULLIA POSTERA - POSTERA *CUCULLIA* - NOCTUIDAE

At least 12 species of *Cucullia* occur in the Pacific Northwest.

ADULT (PLATE 23, FIG. 5-52)

Wingspan 5.2 cm.

The forewings are very long and slender. The dorsal surface of the forewings is pale gray with a red-brown costal margin, faint discal spots, and a curved, black subanal streak. The dorsal surface of the hindwings is pale gray with a dark gray submarginal border. The ventral surface of the forewings is dark gray. The ventral surface of the hindwings is pale gray with a dark gray submarginal border.

CATERPILLAR

Details of the larval description are rephrased from Poole (1995) and also pertain to *Cucullia florea*. The dorsal margin of each subdorsal band is very dark and thin and sets off a distinctive dorsal region. The two thin lines between the subdorsal band and the spiracular region are almost absent. The subspiracular line is distinctly dark and margined ventrally by a wide, reticulate, brown band, resulting in a well-defined yellow-green to green band between the spiracle and the subspiracular line, followed by a brown band.

ECOLOGY

This species is widely distributed across northern regions of North America, extending southward through the Rocky Mountains and in the Cascade Mountains. It is usually an uncommon to rare species, occurring at high elevations in the mountains in habitats consisting of open meadows and forests, particularly subalpine forests and meadows. Caterpillars feed on the flower heads of herbaceous composites such as *Solidago*, *Aster*, and *Erigeron* species. Adults are nocturnal, and fly in early to mid-summer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Postera *Cucullia* is rare and management sensitive. This species requires some disturbance to maintain the open habitat against heavy brush and tree encroachment into the meadow habitat. Populations of this moth will benefit from infrequent, controlled ground fires, prescribed forest thinning, and clearcutting.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search or by using a sweep net to sample herbaceous plant species in meadows. Adults may be sampled using UV or mercury-vapor light traps. We have observed three individuals, two in the Blue Mountains and one at the Santiam Pass in the Cascade Mountains, Oregon.

EGIRA FEBRUALIS - MOTTLED OAK WOODLING - NOCTUIDAE

At least ten species of *Egira* occur in the Pacific Northwest.

ADULT (PLATE 23, FIG. 5-53A)

Wingspan 3.7 cm.

The dorsal surface of the forewings is white and heavily mottled with black. The dorsal surface of the hindwings is white with a small, black discal spot, a narrow, black median line, and small, black marginal spots. The ventral surface of the fore- and hindwings is similar to the dorsal surface, but paler.

CATERPILLAR (PLATE 23, FIG. 5-53B)

White with blue-gray shading; subdorsal yellow streaks; black spots; black spiracles. Head mottled tan and black with a dorsal, black, triangular patch.

ECOLOGY

This species lives in dry oak woodlands at low elevations in California and western Oregon. Caterpillars are uncommon and feed on deciduous oaks, such as Oregon white oak, during late spring. Adults are nocturnal and fly in early spring.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Mottled Oak Woodling is associated with oak woodlands. This species is dependent on the maintenance of oak woodlands at low elevations on the west side of the Cascade and Sierra Nevada Mountains. The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow their encroachment into the oak woodlands and prevent displacement of the oak trees, should be encouraged. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of oaks. Adults may be sampled using UV or mercury-vapor light traps. We have observed 120 individuals, all during February and March.

EOSPHOROPTERYX THYATYROIDES - PINK-PATCHED LOOPER - NOCTUIDAE

One species of *Eosphoropteryx* occurs in the Pacific Northwest.

ADULT (PLATE 23, FIG. 5-54)

Wingspan 3.7 cm.

The dorsal surface of the forewings is pale gray with pink shadings and a pink basal area, a thin, black, subapical streak, and a small, white, comma-shaped stigma. The dorsal surface of the hindwings is gray. The ventral surface of the fore- and hindwings is pale gray without markings.

CATERPILLAR

We have not collected this caterpillar in the Pacific Northwest.

ECOLOGY

This is an uncommon to rare species found in cool, moist forests of northeastern North America, with a disjunct population in the Pacific Northwest (Miller et al. 2003). It requires shady, moist, undisturbed riparian habitats along forest streams. The caterpillar feeds on the foliage of herbaceous Ranunculaceae, such as meadow-rue and columbine. Adults are nocturnal and fly in late summer, mostly from July to September.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Pink-Patched Looper is rare and sensitive to forest management. The maintenance and restoration of riparian habitats will be beneficial to this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search or by using a sweep net to sample herbaceous species of plants in meadows. Adults may be sampled using UV or mercury-vapor light traps. We have observed five individuals, one moth from each of five trap sites in the Blue Mountains, Cascade Mountains, and the Coast Range.

EUXOA AURIPENNIS - LAVENDAR DART - NOCTUIDAE

At least 100 species of *Euxoa* occur in the Pacific Northwest.

ADULT (PLATE 23, FIG. 5-55)

Wingspan 3.5 cm.

The dorsal surface of the forewings is dark, purplish-black with a black basal dash, combined with pale, lavender postmedian and basal bands, and large, pale, lavender discal spots. The dorsal surface of the hindwings is gray. The ventral surface of the fore- and hindwings is pale gray with faint median lines.

CATERPILLAR

Undescribed and we have yet to collect this species in the Pacific Northwest.

ECOLOGY

This species is usually a rare species, although it is widely distributed in the drier regions of western North America. Its preferred habitats are open, dry forests of Ponderosa pine and juniper woodlands. Caterpillars of *Euxoa* species are soil-surface cutworms that feed on various herbs, particularly legumes, such as lupines. The food plant of *E. auripennis* caterpillars is unknown. Adults are nocturnal and fly during August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Lavendar Dart is sensitive to forest management and needs some disturbance to maintain the open habitat against heavy brush and tree encroachment. Populations of this moth will benefit from infrequent, controlled ground fires and prescribed forest thinning.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search, sifting soil, perhaps deploying pitfall traps, or using a sweep net to sample herbaceous species. Adults may be sampled using UV or mercury-vapor light traps. We have observed 165 individuals, a majority occurring in the Blue Mountains with a typical sample yielding 1 to 4 moths per trap-night.

EUXOA BIFORMATA - TWO-COLORED DART - NOCTUIDAE

At least 100 species of *Euxoa* occur in the Pacific Northwest.

ADULT (PLATE 23, FIG. 5-56A; PLATE 24, FIG. 5-56B)

Wingspan 4.2 cm.

The dorsal surface of the forewings is black-brown, sometimes with a reddish tinge, with discal spots thinly outlined in white. The dorsal surface of the hindwings is white in the male and white with a gray border in the female. The ventral surface of the forewings is dark gray and the ventral surface of the hindwings is mostly white.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species can be frequent in open, dry Ponderosa pine forests in the Pacific Northwest. It is generally distributed in montane areas from the east slope of the Cascade Mountains to the Rocky Mountains. Caterpillars of *Euxoa* species are soil-surface cutworms that feed on various herbs, particularly legumes, such as lupines. The food plant of *E. biformata* caterpillars is unknown. Adults are nocturnal and fly in August and September.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Two-Colored Dart is sensitive to forest management. This species requires some disturbance to maintain the open habitat against heavy brush and tree encroachment. Populations of this moth will benefit from infrequent, controlled ground fires and prescribed forest thinning.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search, sifting soil, perhaps deploying pitfall traps, or using a sweep net to sample herbaceous species of plants. Adults may be sampled using UV or mercury-vapor light traps. We have observed over 575 individuals, mostly from east of the crest of the Cascade Mountains. Typically, we observe 1 to 8 moths in a single sample, but we have collected as many as 96 moths in one trap-night.

EUXOA EXTRANEA - SUBALPINE DART - NOCTUIDAE

At least 100 species of *Euxoa* occur in the Pacific Northwest.

ADULT (PLATE 24, FIG. 5-57)

Wingspan 4.5 cm.

The dorsal surface of the forewings is gray with large discal spots outlined in black, and a central, black median band. There is also a wavy, black, basal line and small submarginal spots. The dorsal surface of the hindwings is dark gray. The ventral surface of the fore- and hindwings is pale gray with small, black discal spots and narrow, black median lines.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species is endemic to high elevations in the Cascade and Sierra Nevada Mountains. Its preferred habitats are high, open, subalpine forests and meadows. It is abundant in the early successional communities of the volcanic blast zone on Mt. St. Helens in Washington. Caterpillars of *Euxoa* species are soil-surface cutworms that feed on various herbs, particularly legumes, such as lupines. The food plant of *E. extranea* caterpillars is unknown. Adults are nocturnal and fly in July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Subalpine Dart is rare, and climate and management sensitive. This species requires some disturbance to maintain an open habitat against heavy brush and tree encroachment. Populations of this moth will benefit from infrequent, controlled ground fires and prescribed forest thinning. This species is sensitive to climate change, and warming climatic conditions will likely be deleterious to this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search, sifting soil, perhaps deploying pitfall traps, or using a sweep net to sample herbaceous species of plants. Adults may be sampled using UV or mercury-vapor light traps. We have observed 11 individuals, all from three trap sites along the Santiam Pass in the Cascade Mountains, Oregon.

EUXOA LEWISI - LEWIS' DART - NOCTUIDAE

At least 100 species of *Euxoa* occur in the Pacific Northwest.

ADULT (PLATE 24, FIG. 5-58)

Wingspan 3.8 cm.

The dorsal surface of the forewings is light to dark red-brown with a small, black patch separating the discal spots. The dorsal surface of the hindwings is light to dark gray. The ventral surface of the fore- and hindwings is pale gray-brown with faint discal spots and median lines.

CATERPILLAR

Undescribed, and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species is restricted to high elevations in the Cascade and Sierra Nevada Mountains, and throughout the Rocky Mountains. Its preferred habitats are high, open subalpine forests and meadows. Caterpillars of *Euxoa* species are soil-surface cutworms that feed on various herbs, particularly legumes, such as lupines. The food plant of *E. lewisi* caterpillars is unknown. Adults are nocturnal and fly in July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Lewis' Dart is rare and climate and management sensitive. This species requires some disturbance to maintain an open habitat against heavy brush and tree encroachment. Populations of this moth will benefit from infrequent, controlled ground fires and prescribed forest thinning. In addition, this species is sensitive to climate change and warming climatic conditions are likely to be deleterious to this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search, sifting soil, perhaps deploying pitfall traps, or using a sweep net to sample herbaceous species of plants. Adults may be sampled using UV or mercury-vapor light traps. We have observed only one individual occurring along the Santiam Pass in the Cascade Mountains, Oregon.

EUXOA MURDOCKI - MURDOCK'S DART - NOCTUIDAE

At least 100 species of *Euxoa* occur in the Pacific Northwest.

ADULT (PLATE 24, FIG. 5-59)

Wingspan 3.5 cm.

The dorsal surface of the forewings is red-brown with a central gray median band outlined with black, and with large discal spots. The dorsal surface of the hindwing is gray. The ventral surface of the forewings is pale gray with a black flush. The ventral surface of the hindwings is white with a small, black discal spot and thin, black median line.

CATERPILLAR

Undescribed, and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

Although it is widely distributed in the drier regions of western North America, this species is usually rather rare. Its preferred habitats are open, dry forests of Ponderosa pine and juniper woodlands. Caterpillars of *Euxoa* species are soil-surface cutworms that feed on various herbs, particularly legumes, such as lupines. The food plant of *E. murdocki* caterpillars is unknown. Adults are nocturnal and fly in late August and September.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Murdock's Dart is sensitive to forest management. This species requires some disturbance to maintain the open habitat against heavy brush and tree encroachment. Populations of this moth will benefit from infrequent, controlled ground fires and prescribed forest thinning.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search, sifting soil, perhaps deploying pitfall traps, or using a sweep net to sample herbaceous species of plants. Adults may be sampled using UV or mercury-vapor light traps. We have observed 27 individuals from two trap sites, 25 of the moths came from one site 12 km east of Sisters, Oregon.

EUXOA TRIFASCIATA - BANDED DART - NOCTUIDAE

At least 100 species of *Euxoa* occur in the Pacific Northwest.

ADULT (PLATE 60, FIG. 5-60)

Wingspan 4.3 cm.

The dorsal surface of the forewings is medium red-brown with large discal spots outlined in black, combined with thin, black basal and median lines. The dorsal surface of the hindwings is brown. The ventral fore- and hindwings are brown with thin, faint discal spots and median lines.

CATERPILLAR

Undescribed, and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species is restricted to high elevations in the Cascade and Sierra Nevada mountains. Its preferred habitats are open subalpine forests and meadows. Caterpillars of *Euxoa* species are soil-surface cutworms that feed on various herbs, particularly legumes, such as lupines. The food plant of *E. trifasciata* caterpillars is unknown. Adults are nocturnal and fly in July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Banded Dart is rare, and climate and management sensitive. This species requires some disturbance to maintain the open habitat against heavy brush and tree encroachment. Populations of this moth will benefit from infrequent, controlled ground fires and prescribed forest thinning. In addition, this species is probably climate sensitive, warming climatic conditions will probably be deleterious to this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search, sifting soil, perhaps deploying pitfall traps, or using a sweep net to sample herbaceous species of plants. Adults may be sampled using UV or mercury-vapor light traps. We have observed five individuals from four trap sites along and near the Santiam Pass in the central Cascade Mountains, Oregon.

PLATE 17, FIGURES 5-37A – 5-38A



Figure 5-37a. *Philotiella leona*: female, dorsal.



Figure 5-37b. *Philotiella leona*: female, ventral.



Figure 5-37c. *Philotiella leona*: male, dorsal.



Figure 5-37d. *Philotiella leona*: male, ventral.



Figure 5-37e. *Philotiella leona*: caterpillar.



Figure 5-38a. *Plebejus saepiolus insulanus*: female, dorsal, brown form.

PLATE 18, FIGURES 5-38B – 5-39B



Figure 5-38b. *Plebejus saepiolus insulanus*: female, dorsal, blue form.



Figure 5-38c. *Plebejus saepiolus insulanus*: female, ventral.



Figure 5-38d. *Plebejus saepiolus insulanus*: male, dorsal.



Figure 5-38e. *Plebejus saepiolus insulanus*: male, ventral.



Figure 5-39a. *Satyrium auretorum auretorum*: female, dorsal.



Figure 5-39b. *Satyrium auretorum auretorum*: female, ventral.

PLATE 19, FIGURES 5-39C – 5-42B



Figure 5-39c. *Satyrium auretorum auretorum*: male, dorsal.



Figure 5-39d. *Satyrium auretorum auretorum*: male, ventral.



Figure 5-40. *Abagrotis mirabilis*: dorsal.



Figure 5-41. *Abagrotis rubicundis*: dorsal.



Figure 5-42a. *Acronicta cyanescens*: dorsal.



Figure 5-42b. *Acronicta cyanescens*: caterpillar.

PLATE 20, FIGURES 5-43A – 5-46



Figure 5-43a. *Acronicta marmorata*: dorsal.



Figure 5-43b. *Acronicta marmorata*: caterpillar.



Figure 5-44. *Apamea plutonia*: dorsal.



Figure 5-45a. *Apamea remissa*: dorsal, dark form.



Figure 5-45b. *Apamea remissa*: dorsal, light form.



Figure 5-46. *Autographa speciosa*: dorsal.

PLATE 21, FIGURES 5-47A – 5-48C



Figure 5-47a. *Catocala aholibah*: dorsal.



Figure 5-47b. *Catocala aholibah*: ventral.



Figure 5-47c. *Catocala aholibah*: caterpillar.



Figure 5-48a. *Catocala ilia zoe*: dorsal.



Figure 5-48b. *Catocala ilia zoe*: ventral.

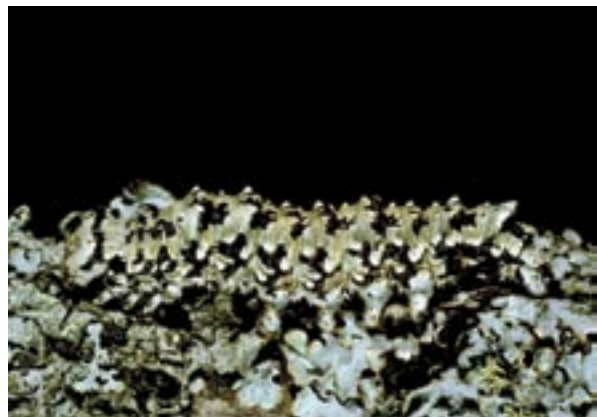


Figure 5-48c. *Catocala ilia zoe*: caterpillar.

PLATE 22, FIGURES 5-49A – 5-51



Figure 5-49a. *Catocala ophelia*: dorsal.



Figure 5-49b. *Catocala ophelia*: ventral.



Figure 5-50a. *Catocala verrilliana*: dorsal.



Figure 5-50b. *Catocala verrilliana*: ventral.



Figure 5-50c. *Catocala verrilliana*: caterpillar.



Figure 5-51. *Cucullia florea*: dorsal.

PLATE 23, FIGURES 5-52 – 5-56A



Figure 5-52. *Cucullia postera*: dorsal.



Figure 5-53a. *Egira februalis*: dorsal.



Figure 5-53b. *Egira februalis*: caterpillar.



Figure 5-54. *Eosphoropteryx thyatyroides*: dorsal.



Figure 5-55. *Euxoa auripennis*: dorsal.



Figure 5-56a. *Euxoa biformata*: female, dorsal.

PLATE 24, FIGURES 5-56B – 5-60



Figure 5-56b. *Euxoa biformata*: male, dorsal.



Figure 5-57. *Euxoa extranea*: dorsal.



Figure 5-58. *Euxoa lewisi*: dorsal.



Figure 5-59. *Euxoa murdocki*: dorsal.



Figure 5-60. *Euxoa trifasciata*: dorsal.

EUXOA VETUSTA - VETUSTA DART - NOCTUIDAE

At least 100 species of *Euxoa* occur in the Pacific Northwest.

ADULT (PLATE 25, FIG. 5-61A,B)

Wingspan 4.0 cm.

The dorsal surface of the forewings is white to pale gray with large discal spots outlined with black, and with a black patch between the discal spots; black basal and median lines are often prominent. The dorsal surface of the hindwings is dark gray. The ventral surface of the forewings is black. The ventral surface of the hindwings is gray mottled with black specks and with a small, black discal spot. Males have pectinate (feathery) antennae while females have filiform (thin, hair-like) antennae. Head and thorax are gray with a black collar between them.

CATERPILLAR

Undescribed, and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species is usually rather rare, and is narrowly endemic to coastal rainforests of the Pacific Northwest, west of the Cascade Range. Its preferred habitats are open disturbed areas within the forest, such as roadsides and small clearcuts. Caterpillars of *Euxoa* species are soil-surface cutworms that feed on various herbs, particularly legumes, such as lupines. The food plant of *E. vetusta* caterpillars is unknown. Adults are nocturnal and fly in July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Vetusta Dart is sensitive to forest management. This species requires some disturbance to produce small open areas in the forest that can support early successional vegetation, such as lupines.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search, sifting soil, perhaps deploying pitfall traps, or using a sweep net to sample herbaceous species of plants. Adults may be sampled using UV or mercury-vapor light traps. We have observed 56 individuals with a single moth representing the typical collection per trap-night.

Feralia februalis - GREEN OAK SALLOW - NOCTUIDAE

Three species of *Feralia* occur in the Pacific Northwest.

ADULT (PLATE 25, FIG. 5-62A)

Wingspan 3.7 cm.

The dorsal surface of the forewings is green with large, jagged discal spots outlined in black, and with thin, black basal and median lines. The dorsal surface of the hindwings is white with small, black marginal spots. The ventral surface of the fore- and hindwings is mostly white. The ventral surface of each hindwing has a thin, black median line. Males have pectinate (feathery) antennae and females have filiform (thin, hair-like) antennae. The thorax is green and the abdomen is orange with thin black bands.

CATERPILLAR (PLATE 25, FIG. 5-62B)

Green with white markings, white spiracular line edged dorsally with a shadow of red-pink; true legs red. According to Poole (1995), the following two characters separate this species from other *Feralia*: a conspicuous conical hump on A-8, and the pedicel of the antenna is yellow. Additional details may be found in Crumb (1956).

ECOLOGY

This species is narrowly endemic to California north to Washington, and is usually uncommon to rare. Its preferred habitat is oak woodlands at low elevations west of the Sierra Nevada and Cascade Mountains. Caterpillars feed on deciduous oaks, such as Oregon white oak. Adults are nocturnal and fly in late winter to early spring, usually from February to April.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Green Oak Sallow is associated with oak woodlands. This moth is dependent on the maintenance of oak woodlands at low elevations along the West Coast. The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow their encroachment into the oak woodlands and prevent displacement of the oak trees, should be encouraged. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of oaks. Adults may be sampled using UV or mercury-vapor light traps. We have observed nine individuals from two sites, all in February and March.

FISHIA YOSEMITAE - YOSEMITE SALLOW - NOCTUIDAE

Four species of *Fishia* occur in the Pacific Northwest.

ADULT (PLATE 25, FIG. 5-63A,B)

Wingspan 4.0cm.

The dorsal surface of the forewings is pale gray with obscure discal spots, a black basal streak, and jagged, thin, black basal and median lines. The dorsal surface of the hindwings is white in the male and gray in the female. The ventral surface of the fore- and hindwings is pale gray in the male and dark gray in the female, with small, faint discal spots and a thin median line.

CATERPILLAR

Undescribed, and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

Although it is widely distributed in the drier regions of western North America, this is a rare species. Its preferred habitats are open, dry forests of Ponderosa pine and juniper woodlands. The food plant for *F. yosemitae* caterpillars is unknown. Adults are nocturnal and fly during the fall in late September and October.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Yosemite Sallow is sensitive to forest management. This species requires some disturbance to maintain an open habitat against heavy tree encroachment. Populations of this moth will benefit from infrequent, controlled ground fires and prescribed forest thinning.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. Studies are needed to discover the caterpillar food plant. Adults may be sampled using UV or mercury-vapor light traps. Overall, we have observed 21 individuals, all occurring in September and October.

HADENA VARIOLATA - VARIABLE CAPSULE MOTH - NOCTUIDAE

Four species of *Hadena* occur in the Pacific Northwest. This species was previously listed under the genus *Miselia*.

ADULT (PLATE 26, FIG. 5-64)

Wingspan 3.2 cm.

The dorsal surface of the forewings is dark gray to gray-black with discal spots, basal line, median line, and submarginal line outlined with white. The round, white orbicular spot has a prominent, black pupil. The dorsal surface of the hindwings is dark gray or gray-black. The ventral surface of the fore- and hindwings is gray with faint, black discal spots and thin median lines.

CATERPILLAR

We have not collected this caterpillar in the Pacific Northwest.

ECOLOGY

This species is widely distributed in montane regions of western North America, but it is usually uncommon to rare. Such rarity is partly due to the patchiness of the habitat, typically an environment with *Silene* species, which grow in open, rocky areas along ridge tops or in open, dry meadows. This habitat is usually quite fragmented in most forested mountain regions. Caterpillars feed on *Silene*. Adults are nocturnal and fly from June to August, depending on elevation.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Variable Capsule Moth is rare. This moth is dependent on rocky outcroppings and the conservation of such patches, including the prevention of encroachment and management of exotic weeds, should be encouraged.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search or by a sweep net to sample species of *Silene*. Adults may be sampled using UV or mercury-vapor light traps. We have observed seven individuals all occurring in just three trap sites in the HJ Andrews Experimental Forest.

LITHOPHANE BAILEYI - BAILEY'S PINION - NOCTUIDAE

At least 19 species of *Lithophane* occur in the Pacific Northwest.

ADULT (PLATE 26, FIG. 5-65)

Wingspan 4.0 cm.

The dorsal surface of the forewings ranges from white to dark gray, with a black basal dash, large discal spots outlined in black, and thin black basal and median lines. The dorsal surface of the hindwings is dark black-brown. The ventral surface of the fore- and hindwings is mostly black. The ventral surface of the hindwings has a black discal spot and median band.

CATERPILLAR

Undescribed, although we have collected this caterpillar from red blueberry in the Pacific Northwest.

ECOLOGY

This species has widely disjunct populations in the northeastern region of North America, and the coastal rainforests of the Pacific Northwest. The species appears to be most closely associated with hardwood trees growing in riparian corridors along forest streams. In the northeastern parts of its range the caterpillars feed on various hardwoods, such as birch, cherry, and willow (Covell 1984). In the Pacific Northwest we have reared caterpillars only from red blueberry. Adults are nocturnal, and fly in late fall, winter, and early spring.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Bailey's Pinion is uncommon and sensitive to forest management. The maintenance of hardwood forest in riparian zones will be beneficial to this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of *Vaccinium*. Our studies have resulted in the collection of one caterpillar per 100 sec of sampling effort on one occasion. Adults may be sampled using UV or mercury-vapor light traps. We have observed nine individuals from various sites in the Cascade Mountains and the Coast Range.

LITHOPHANE CONTENTA - WESTERN OAK PINION - NOCTUIDAE

At least 19 species of *Lithophane* occur in the Pacific Northwest.

ADULT (PLATE 26, FIG. 5-66A)

Wingspan 4.3 cm.

The dorsal surface of the forewings is streaky gray with obscure discal spots. The dorsal surface of the hindwings is pale gray. The ventral surface of the fore- and hindwings is pale gray. The ventral surface of each hindwing has a small, faint, black discal spot and thin median line.

CATERPILLAR (PLATE 26, FIG. 5-66B)

Dark green with white, mottled spots; spiracular band white to yellow, with an uneven bottom edge, and pink patches around the spiracles in later instars. The head is green with the labrum and area around the stemmata white.

ECOLOGY

This species is fairly common in oak woodlands at low elevations in California and western Oregon, but is narrowly endemic to the West Coast region west of the Sierra Nevada and Cascade Mountains. Caterpillars are common and feed on deciduous oaks, such as Oregon white oak, during the spring. Adults are nocturnal and fly in the fall and early spring.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Western Oak Pinion is associated with oak woodlands. This moth is dependent on the maintenance of oak woodlands at low elevations. The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow their encroachment into oak woodlands and prevent displacement of the oak trees should be encouraged. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of oaks. Our studies have resulted in the collection of up to two caterpillars per 100 sec of sampling effort. Adults may be sampled using UV or mercury-vapor light traps. We have observed 24 individuals.

LITHOPHANE GAUSAPATA - CEDAR PINION - NOCTUIDAE

At least 19 species of *Lithophane* occur in the Pacific Northwest.

ADULT (PLATE 26, FIG. 5-67)

Wingspan 4.0 cm.

The dorsal surface of the forewings is variable gray or reddish with obscure markings. The dorsal surface of the hindwings is red-brown to red-gray. The ventral surface of the fore- and hindwings is also red-brown to red-gray, but with indistinct markings.

CATERPILLAR

We have collected this caterpillar from incense cedar in the Pacific Northwest, but do not have a photograph or a description.

ECOLOGY

This is a relatively rare species with its distribution coincident with that of incense cedar in the mountains of California and western Oregon, and it is suspected to be a food plant specialist on this tree. Caterpillars feed on incense cedar. Adults are nocturnal and fly in fall and early spring.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Cedar Pinion is rare and sensitive to forest management. Replacing mixed conifer forests containing cedars with monoculture stands of Douglas fir would tend to eliminate *L. gausapata* from the forest. However, replanting incense cedar in clearcuts following timber harvest or wild fires will be beneficial to this species.

Information regarding the geographic range of the species is poor. Information regarding the status of numbers of individuals within populations is poor. In our studies, we have collected one caterpillar per 100 sec of sampling effort. Adults may be sampled using UV or mercury-vapor light traps. We have observed just one individual at a site in the Warm Springs Indian Reservation east of the crest of the Cascade Mountains.

LITHOPHANE THAXTERI - THAXTER'S PINION - NOCTUIDAE

At least 19 species of *Lithophane* occur in the Pacific Northwest.

ADULT (PLATE 26, FIG. 5-68A)

Wingspan 4.2 cm.

The dorsal surface of the forewings is gray with black basal and median dashes, jagged black basal and submarginal lines, and large, pink discal spots. The dorsal surface of the hindwings is dark pink-gray to black-brown. The ventral surface of the forewings is dark, black-gray with a red hue. The ventral surface of the hindwings is light gray with a red hue and a small, black discal spot.

CATERPILLAR (PLATE 27, FIG. 5-68B)

Green with a thin, subdorsal, yellow longitudinal line; light, yellow-white speckles. The head is green.

ECOLOGY

This species is widely distributed in wet forests and bogs across northern regions of North America, extending south into the northern Rocky Mountains and the Pacific Northwest. In the Pacific Northwest it is mostly limited to bogs at high elevations in the mountains, such as in the subalpine zone along the summit of the Cascades. Caterpillars are uncommon and feed on *Spiraea* during the spring. Adults are nocturnal and fly in the fall and early spring.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Thaxter's Pinion is rare and sensitive to forest management. Duncan (2006) describes this species as uncommon in British Columbia. This species is dependent on the maintenance of open, undisturbed bogs containing stands of *Spiraea*. Infrequent fires may be beneficial in maintaining open bogs against tree encroachment.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search or by using a beating sheet to sample species of *Spiraea*. In our studies, we have collected one caterpillar per 100 sec of sampling effort. Adults may be sampled using UV or mercury-vapor light traps. We have observed four individuals, two from the Warm Springs Indian Reservation east of the crest of the Cascade Mountains and two from the Blue Mountains.

LITOCALA SEXSIGNATA - SIX-SPOTTED LITOCALA - NOCTUIDAE

One species of *Litocala* occurs in the Pacific Northwest.

ADULT (PLATE 27, FIG. 5-69A)

Wingspan 3.3 cm.

The dorsal surface of the forewings is gray-black with white medial and subapical spots. The dorsal surface of the hindwings is black with three white spots. The ventral surface of the forewings is black with white medial and subapical bands. The ventral surface of the hindwings is also black with three white spots.

CATERPILLAR (PLATE 27, FIG. 5-69B)

Brown with subdorsal, scalloped dashes; a fluffy fringe of hairs along the sublateral area.

ECOLOGY

This species is widely distributed in oak woodlands from the southwestern states and California north to Washington. Its preferred habitats are dry, open forests at high elevation with chinquapin, or open oak woodlands at low elevations. Caterpillars are common and feed on oak and chinquapin during the spring. Adults are diurnal and fly in the spring.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Six-Spotted *Litocala* is associated with oak woodlands. This moth is dependent on the maintenance of open, oak woodland habitats. Forest thinning and clearcutting that preserve the chinquapin or oaks are of benefit to this species. The recent introduction of the sudden oak death disease along the West Coast ultimately may pose a serious threat to this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of oaks. Our studies have resulted in the collection of 1 to 2 caterpillars per 100 sec of sampling effort. The moth is diurnal and does not respond to light traps; therefore, sampling must be conducted by visual search or by using an aerial/sweep net to collect adults.

MELANCHRA ASSIMILIS - BLACK ARCHES - NOCTUIDAE

Four species of *Melanchra* occur in the Pacific Northwest.

ADULT (PLATE 27, FIG. 5-70)

Wingspan 3.7 cm.

The dorsal surface of the forewings is black with obscure markings and a prominent, white subanal spot. The dorsal surface of the hindwings is dark black-brown. The ventral surface of the forewings is black. The ventral surface of the hindwings is pale gray with a black submarginal border.

CATERPILLAR

We have not collected caterpillars of this species in the Pacific Northwest but Wagner (2005) illustrates two phenotypes and describes the larva from the eastern United States as follows: "...green or brown and boldly striped with yellow. Broad yellow subdorsal stripe edged with white and black; spiracular stripe with reduced black edging below. Spiracles white with black outer ring."

ECOLOGY

This species is widely distributed across northern regions of North America in moist forests and boggy habitats. It is usually uncommon to rare. In the Pacific Northwest, it is completely confined to coastal rainforests west of the Cascades in British Columbia, western Washington, and western Oregon. Caterpillars are general feeders on many herbs and hardwood shrubs or trees (Covell 1984). Adults are nocturnal and fly in July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Black Arches is rare and management sensitive. This species requires disturbed areas within the forest, such as roadsides and small clearcuts, that are suitable for the growth of the herb and shrub food plants.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of herbs, shrubs, and trees. Adults may be sampled using UV or mercury-vapor light traps. We have observed a combined total of six individuals from the Cascade Mountains and the Coast Range.

MESOGONA RUBRA - RED MANZANITA SALLOW - NOCTUIDAE

Three species of *Mesogona* occur in the Pacific Northwest.

ADULT (PLATE 27, FIG. 5-71A,B)

Wingspan 4.5 cm.

The dorsal surface of the forewings has obscure markings and is variable in color: It is usually bright red or brick red, but may be dark red-brown, pink-gray, or pale pink. The dorsal surface of the hindwings is red without markings. The ventral surface of the fore- and hindwings is light red with faint, thin median lines.

CATERPILLAR (PLATE 28, FIG. 5-71C)

Pale creamy white to tan; faintly mottled in gray, silver, black, pink and dark brown; with a thin, white spiracular line and dark brown prothoracic shield. The head is brown.

ECOLOGY

This species has a very limited distribution along the West Coast from central California north to southern Washington. It is very local, occurring in open, dry habitats with manzanita, where it can be common if manzanita is abundant. Caterpillars feed on certain species of manzanita, such as *Arctostaphylos columbiana* and *A. cinerea*. Adults are nocturnal and fly in September.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Red Manzanita Sallow is sensitive to forest management. The caterpillar of this species is dependent on mature manzanita as a food plant. Frequent fires or brush clearing may be harmful to this species, but infrequent, controlled fires may be beneficial in rejuvenating old, senescent manzanita. Also, this species benefits from the presence of disturbed areas along roadsides and open forest clearcuts where manzanita becomes established as an early successional shrub.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of *Arctostaphylos*. In our studies, we have collected 1 to 2 caterpillars per 100 sec of sampling effort. Adults may be sampled using UV or mercury-vapor light traps. We have observed 54 individuals from numerous sites.

MESOGONA SUBCUPREA - WESTERN OAK SALLOW - NOCTUIDAE

Three species of *Mesogona* occur in the Pacific Northwest.

ADULT (PLATE 28, FIG. 5-72)

Wingspan 4.5 cm.

The dorsal surface of the forewings is yellow, orange, or gray-brown with large discal spots narrowly outlined with black, and with thin basal, median, and postmedian lines. The dorsal surface of the hindwings is reddish copper to red. The ventral surface of the fore- and hindwings is light yellow to red with small discal spots and thin median lines.

CATERPILLAR

Undescribed and we have yet to collect caterpillars in the Pacific Northwest.

ECOLOGY

This species is widely distributed in dry oak woodlands at low elevations along the West Coast, from southern California north to southern Washington. However, it is usually uncommon to rare and sporadically present/absent in most areas. It is relatively common only at low elevations in the Siskiyou Mountains of southwest Oregon. Caterpillars feed on both evergreen and deciduous oaks. Adults are nocturnal and fly in August and September.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Western Oak Sallow is associated with oak woodlands. This moth is dependent on the maintenance of oak woodland habitats at low elevations, mostly on the west side of the Cascades and Sierra Nevada. Also, it occurs in Oregon white oak woodlands on the east side of the Cascades near the Columbia Gorge in Oregon and Washington. The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow their encroachment into the oak woodlands and prevent displacement of the oak trees, should be encouraged. The threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of oaks. Adults may be sampled using UV or mercury-vapor light traps. We have observed 51 individuals, most of which were seen as only one moth per trap-night.

OLIGIA VIOLACEA - VIOLET BROCADE MOTH - NOCTUIDAE

Seven species of *Oligia* occur in the Pacific Northwest.

ADULT (PLATE 28, FIG. 5-73)

Wingspan 3.5 cm.

The dorsal surface of the forewings is red-brown or purple-brown with a lavender postmedian area, large, yellow discal spots, and a yellow apical patch. The dorsal surface of the hindwings is white and without markings. The ventral surface of the fore- and hindwings is white and there is a purple subapical patch on the forewing.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species is widely distributed in western North America, but is usually rare in most regions. Its preferred habitats are dry, open forests and woodlands at low elevations, including oak woodlands in California and western Oregon, and open Ponderosa pine forests or juniper woodlands east of the Cascades and in the Rocky Mountains. The caterpillar food plant is unknown. Adults are nocturnal and fly from June to August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Violet Brocade Moth is rare and associated with oak woodlands. The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow their encroachment into the oak woodlands and prevent displacement of the oak trees, should be encouraged. Populations of this moth will benefit from infrequent, controlled ground fires and prescribed forest thinning to maintain open forests.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. Studies are needed on the caterpillar's food plant. Adults may be sampled using UV or mercury-vapor light traps. We have observed 22 individuals with a typical high number of only 1 to 2 moths collected per trap-night.

ONCOCNEMIS CHALYBDIS - CHALYBDIS MOTH - NOCTUIDAE

At least 44 species of *Oncocnemis* occur in the Pacific Northwest. We previously believed *O. chalybdis* to be the closely related species *O. piffardi* of northeastern North America. (The abdomen for the moth shown here is missing because it was used for dissection of genitalia to provide confirmation of the species identity.)

ADULT (PLATE 28, FIG. 5-74A)

Wingspan 3.4 cm.

The dorsal surface of the fore- and hindwings is pale gray and each forewing has a black median band and irregular, black submarginal band. The dorsal surface of the hindwings is white with broad, black submarginal borders.

CATERPILLAR (PLATE 28, FIG. 5-74B)

Golden brown with faint, off-white, wavy longitudinal lines; middorsum of T-1 with white streak bordered by dark brown; A-8 and A-9 swollen dorsally.

ECOLOGY

This species is endemic and rare in moist montane forests and bogs of the Pacific Northwest, usually at high elevations within the transition and subalpine zones of the Cascades. The species may be dependent on the maintenance of open bogs containing stands of *Spiraea*. This species is rare throughout its range and tightly restricted to its limited habitat. Caterpillars are uncommon and feed on *Spiraea* during late spring. Adults are nocturnal and fly in late summer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Chalybdis Moth is rare and sensitive to forest management. Infrequent fires may be beneficial in maintaining open bogs against heavy tree invasion.

Information regarding the geographic range of the species is poor. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of *Spiraea*. We have collected six caterpillars, all observed at the same time at one site at Green Ridge just east of the Metolius Basin in the Cascade Mountains, Oregon. We assume adults may be sampled using UV or mercury-vapor light traps; this species is so rare we have never observed an adult in light trap samples.

PANTHEA GIGANTEA - GIANT PANTHEA - NOCTUIDAE

Three species of *Panthea* occur in the Pacific Northwest.

ADULT (PLATE 28, FIG. 5-75A; PLATE 29, FIG. 5-75B)

Wingspan 5.2 cm in the female and 6.0 cm in the male.

The dorsal surface of the forewings is dark gray-black with fine, white speckling; markings include two straight, black median lines, a curved, black median line, a jagged, black postmedian line, and a thin, black reniform spot at the end of the discal cell. The dorsal surface of the hindwing is white with gray basal, median, and postmedian lines or bands. The ventral surface of the fore- and hindwings is similar to the dorsal surface, but paler.

CATERPILLAR

Duncan (2006) provides photographs and describes the larva as follows: “Body, rusty brown; faint white to light brown middorsal stripe. Prominent wide black band over the second thoracic segment. Striking black-bordered red band on dorsum of each thoracic segment. Body covered with brown hairs (white on thoracic segment 2) radiating from orange tubercles; two long brown pencil tufts project vertically from each of the first eight abdominal segments and the first thoracic segment.”

ECOLOGY

This species appears to be widely distributed in montane regions of western North America. The habitat consists of open, dry Ponderosa pine forests. The species is always rare and sporadic in its occurrence. Caterpillars feed on conifers, particularly pines. Adults are nocturnal and fly from April to September, probably exhibiting two generations.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Giant Panthea is widely distributed but rare. Duncan (2006) describes this species as uncommon in British Columbia. The reasons for its rarity are not known. Our only recommendation for the conservation of this poorly studied species is to avoid large-scale cutting of pine forests.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of pines. Adults may be sampled using UV or mercury-vapor light traps. We have observed six individuals from two trap sites in the same general area in the Siskiyou Mountains.

PERIGONICA ANGULATA - ANGULATE OAK QUAKER - NOCTUIDAE

Three species of *Perigonica* occur in the Pacific Northwest.

ADULT (PLATE 29, FIG. 5-76A)

Wingspan 3.6 cm.

The forewings are strongly falcate. The dorsal surface of the forewings is pale yellow to red with faint markings. The dorsal surface of the hindwings is white with a small, black discal spot. The ventral surface of the fore- and hindwings is pale tan with small, black discal spots and thin black median lines. Both males and females have filiform antennae.

CATERPILLAR (PLATE 29, FIG. 5-76B)

Body color may be a mixture of shades from green to yellow; faint off-white to yellow longitudinal lines, barely apparent at the subdorsal and lateral position; a few small, black spots mark the primary setae.

ECOLOGY

This species is found in dry oak woodlands and mixed forests along the West Coast in California and western Oregon. Caterpillars are common and feed on various evergreen Fagaceae, such as canyon live oak, tan oak, and chinquapin during late spring. Adults are nocturnal and fly in the spring, mostly from April to early June, depending on elevation.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Angulate Oak Quaker is associated with oak woodlands. This moth is dependent on the maintenance of golden chinquapin shrubs and trees in the Cascade Mountains, which are often eliminated as “weed species” during forest management. However, forest thinning and clearcutting that preserve the chinquapin are beneficial to this species. In addition, maintenance of canyon live oak and tan oak in the Siskiyou Mountains is essential for the survival of this moth. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of oaks. Our studies have resulted in the collection of 2 to 3 caterpillars per 100 sec of sampling effort. Adults may be sampled using UV or mercury-vapor light traps. We have observed over 1,000 individuals with a high number of 41 in a single sample.

PERIGONICA PECTINATA - PECTINATE OAK QUAKER - NOCTUIDAE

Three species of *Perigonica* occur in the Pacific Northwest.

ADULT (PLATE 29, FIG. 5-77A,B,C)

Wingspan 3.5 cm.

The forewings are slightly falcate. The dorsal surface of the forewings is highly variable in color from yellow and pink to orange, gray, or brown. The reniform spot is variably pale to black and the median line consists of very small black dots. The dorsal surface of the hindwings is black or dark gray-brown. The ventral surface of the fore- and hindwings is pale tan with small black discal spots and thin, black, median lines. Males have strongly pectinate (feathery) antennae while females have filiform (thin, hair-like) antennae.

CATERPILLAR (PLATE 30, FIG. 5-77D)

Green with faint, white, longitudinal lines and black pinaculae.

ECOLOGY

This species is found in dry oak woodlands and mixed forests along the West Coast in California and western Oregon. Caterpillars are common and feed on various evergreen Fagaceae, such as canyon live oak, tan oak, and chinquapin, during late spring. Adults are nocturnal and fly in spring, from April to early June, depending on elevation.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Pectinate Oak Quaker is associated with oak woodlands. This moth is dependent on the maintenance of golden chinquapin shrubs and trees in the Cascade Mountains, which are often eliminated as “weed species” during forest management. However, forest thinning and clearcutting that preserve the chinquapin are beneficial to this species. Maintenance of canyon live oak and tan oak in the Siskiyou Mountains is essential for the survival of this moth. The threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of oaks. Our studies have resulted in the collection of 2 to 3 caterpillars per 100 sec of sampling effort. Adults may be sampled using UV or mercury-vapor light traps. We have observed 550 individuals, with 27 moths being the highest number collected on a single trap-night.

PERIGONICA TERTIA - TERTIA OAK QUAKER - NOCTUIDAE

Three species of *Perigonica* occur in the Pacific Northwest.

ADULT (PLATE 30, FIG. 5-78A,B)

Wingspan 4.0 cm.

The apex of the forewings is strongly falcate with the dorsal surface variably pale yellow, brown, or red. The discal spots are often a darker brown, and there is often heavy speckling with small black dots over most of the forewings. The dorsal surface of the hindwings is white with a small, black discal spot and a pale-brown submarginal border. The ventral surface of the fore- and hindwings is pale tan with small, black, discal spots and thin, black, median lines. Males have strongly pectinate (feathery) antennae while females have filiform (thin, hair-like) antennae.

CATERPILLAR

Undescribed although we have collected this caterpillar from Oregon white oak.

ECOLOGY

This species is abundant in deciduous oak woodlands along the West Coast in California and western Oregon, extending northward sporadically in western Washington. Caterpillars feed on deciduous oaks, such as Oregon white oak, and tan oak. Adults are nocturnal, and fly at low elevations in early spring, usually March and April.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Tertia Oak Quaker is associated with oak woodlands. This moth is dependent on the maintenance of oak woodlands at low elevations on the west side of the Cascade and Sierra Nevada Mountains. The conservation of the remaining patches of oak habitat, including removal of conifer trees to slow their encroachment into the oak woodlands and prevent displacement of the oak trees, should be encouraged. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of oaks. Our studies have resulted in the collection of 1 caterpillar per 100 sec of sampling effort. Adults may be sampled using UV or mercury-vapor light traps. We have observed 112 individuals; all but three moths were from one site near Corvallis in the western foothills of the Willamette Valley.

PROTOGYGIA MILLERI - MILLER'S DART - NOCTUIDAE

Seven species of *Protophygia* occur in the Pacific Northwest.

ADULT (PLATE 30, FIG. 5-79)

Wingspan 3.8 cm.

The dorsal surface of the forewings is dark gray with large, pale discal spots, a jagged, black basal line, and a narrow, black median line. The reniform spot is strongly curved or comma-shaped. The dorsal surface of the hindwings is gray. The ventral surface of the forewings is black or dark gray with a faint, black median line. The ventral surface of the hindwings is paler gray with a black discal spot and thin, black median line.

CATERPILLAR

Lafontaine (2004) provides a technical description of laboratory reared caterpillars as follows: "The larva is generally white with slightly darker brownish-gray shading dorsally and subdorsally so that a thin white middorsal line and a similar subdorsal line below the D-2 setae are evident. The setae have a black basal ring around the socket surrounded by a gray pinaculum. The head is pale yellow brown with large dark brown freckles dorsally and posteriorly and with darker brown shading over most of the frons. The prothoracic shield is pale gray brown, slightly darker toward the midline and with numerous dark freckles. Larvae in the field may be darker and more boldly patterned than larvae reared on artificial diet."

ECOLOGY

This species is usually rare, sporadic, and endemic to dry, open forests along the east slope of California's Sierra Nevada and Oregon's Cascade Mountains (Lafontaine 2004). It usually occurs at high elevations in the Sierra Nevada, but occurs at lower elevations in Oregon where it may be frequent in open juniper woodlands along the east side of the Cascade Mountains. Other habitats include open, dry forests of lodgepole pine and Ponderosa pine, extending upward into spruce-fir forests along the summit of the Cascade Mountains. The caterpillar food plant is unknown, but related species feed on herbs. Adults are nocturnal and fly from May to July, depending on elevation.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Miller's *Protophygia* is rare and probably sensitive to forest management. This species requires some disturbance to maintain the open habitat against heavy brush and tree encroachment. Populations of this moth will benefit from infrequent, controlled ground fires and prescribed forest thinning.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. Studies to discover the caterpillar food plant are needed. Adults may be sampled using UV or mercury-vapor light traps. We have observed 29 individuals from just west and east of the crest of the Cascade Mountains along the Santiam Pass, Oregon.

PSEUDOCOPIVALERIA SONOMA - SONOMA SALLOW - NOCTUIDAE

One species of *Pseudocopivaleria* occurs in the Pacific Northwest.

ADULT (PLATE 30, FIG. 5-80A,B)

Wingspan 3.8 cm.

The dorsal surface of the forewings has a dark gray-black median area with pale-gray basal and postmedian areas, and large, pale-gray discal spots. A thin, black basal line and a strongly recurved, black median line delineate the darker median area. The dorsal surface of the hindwings is white in the male and dark gray-black in the female. The ventral surface of the forewings is dark gray-black, and the ventral surface of the hindwings is white in the male and pale gray in the female, with a small, black discal spot and thin, black median line.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species is rare, although it is widely distributed in low elevation oak woodlands from southern California north to Portland, Oregon, and it is sporadic in its presence/absence within this distribution. We have never encountered this species during our extensive oak woodland studies in western Oregon. The caterpillar food plant is unknown, but related species feed on oaks. Adults are nocturnal and fly in early spring, typically during March and April.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Sonoma Sallow is rare and associated with oak woodlands. Survival of the species is dependent on the maintenance of oak woodlands at low elevations on the west side of the Cascade and Sierra Nevada Mountains. The conservation of the remaining patches of oak habitat should be encouraged, including removal of conifer trees to slow encroachment and prevent displacement of the oak trees. Also, the threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is poor. Information regarding the status of numbers of individuals within populations is poor. Studies to discover the food plants are needed. Adults may be sampled using UV or mercury-vapor light traps. We have never recovered any moths of this species.

PSEUDOHERMONASSA FLAVOTINCTA - YELLOW-TINTED DART - NOCTUIDAE

One species of *Pseudohermionassa* occurs in the Pacific Northwest.

ADULT (PLATE 31, FIG. 5-81A,B)

Wingspan 3.5 cm.

The dorsal surface of the forewings is pale brown with thin, dark streaks along the veins of the outer margin, a dark brown discal cell with contrasting pale yellow discal spots, and curved, pale median and postmedian lines. The dorsal surface of the hindwings is light to dark gray. The ventral surface of the forewings is black. The ventral surface of the hindwings is pale yellow.

CATERPILLAR

Lafontaine (1998) describes this species as follows: "...a prominent black line along each side of the middorsal line; and having the spines on hypopharynx both short and sparse." Additional details can be found in Crumb (1956).

ECOLOGY

This species is endemic to rainforests along the West Coast from southern Alaska south through the coastal mountains of Oregon. It is usually rare and sporadic in its occurrence and typically occupies open, disturbed areas, such as roadsides and small clearcuts, within the forest. Caterpillars feed on grasses (Lafontaine 1998). Adults are nocturnal, and fly in July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Yellow-Tinted Dart is rare and sensitive to forest management. This species requires some disturbance to produce small open areas in the forest that can support early successional vegetation, such as grasses.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by visual search or by using a sweep net to sample species of grasses. Adults may be sampled using UV or mercury-vapor light traps. We have observed three individuals, all from a single site on the eastern slope of the Coast Range.

PYRRHIA EXPRIMENS - PURPLE-LINED SALLOW - NOCTUIDAE

One species of *Pyrrhia* occurs in the Pacific Northwest.

ADULT (PLATE 31, FIG. 5-82)

Wingspan 4.0 cm.

The dorsal surface of the forewings is pink to red-orange with a sharply recurved, black median line and a straight, black postmedian line. The dorsal surface of the hindwings is pale yellow with a large, black discal spot and a broad, black submarginal border. The ventral surface of the forewings is yellow with a large, black discal spot and a broad, black postmedian band. The ventral surface of the hindwings is yellow with a small, black discal spot and a reddish submarginal border.

CATERPILLAR

We have not collected caterpillars of this species in the Pacific Northwest, but Wagner (2005) illustrates four phenotypes and describes the larva from the eastern United States as follows: "... variable coloration, ranging from almost white, yellow, green to black with striping variously expressed; integument shiny with prominent, raised setal bases that are usually blackened. Spiracular stripe best developed, ranging from a narrow creamy line to a broad, orange to yellow belt that includes the subventral setae. Subdorsal stripe present, although vaguely expressed in many forms. Two sets of faint addorsal stripes"

ECOLOGY

This species is widely distributed in moist forests throughout much of North America, but is always uncommon to rare. In the Pacific Northwest, *P. exprimens* is found mostly in coastal rainforests west of the Cascade Mountains, but it also is known from the Blue Mountains of northeast Oregon. Caterpillars feed on various herbs and low shrubs (Covell 1984). Adults are nocturnal and fly from May to October, possibly exhibiting two generations (Wagner 2005).

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Purple-Lined Sallow is rare. The reasons for its rarity are not known. It could be a poor competitor with other herbivores, or the caterpillars may be unusually vulnerable to predators.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of herbs. Adults may be sampled using UV or mercury-vapor light traps. We have observed seven individuals from six sites yielding only one moth per trap-night.

SYNGRAPHA VIRIDISIGMA - GREEN-MARKED SEMI-LOOPER - NOCTUIDAE

Nine species of *Syngrapha* occur in the Pacific Northwest.

ADULT (PLATE 31, FIG. 5-83)

Wingspan 4.2 cm.

The dorsal surface of the forewings is pale gray with fine, black mottling, and thin, black basal and postmedian lines. The anal margin is falcate. The dorsal surface of the hindwings is pale gray with a dark, gray-brown to gray-black submarginal band. The ventral surface of the fore- and hindwings is pale gray.

CATERPILLAR

Duncan (2006) provides photographs and describes the larva as follows: “Body, yellowish green; white addorsal, subdorsal and spiracular stripes; spiracular stripe is much broader than the addorsal and subdorsal stripes.” Additional details on larval morphology are described in Crumb (1956), Eichlin and Cunningham (1978), and Lafontaine and Poole (1991).

ECOLOGY

This species is widely distributed in boreal conifer forests across Canada, extending from Newfoundland to Alaska, and southward through the Rocky Mountains and Pacific Northwest. Its preferred habitat is higher elevation mixed spruce and fir forests and coastal rainforests. In spite of the wide distribution and abundance of food plants, this species is always uncommon to rare and sporadic in its occurrence (Miller et al. 2003). In the Pacific Northwest, the species is found in all mountain regions including the Siskiyou Mountains in the southwestern part of the region. Caterpillars feed on conifers (Pinaceae), particularly spruce and fir (Lafontaine and Poole 1991). Adults are nocturnal and fly from late July through August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Green-Marked Semi-Looper is rare in the southern range of the Pacific Northwest and likely sensitive to forest management. Duncan (2006) describes this species as common in British Columbia. We have no specific prescription for conservation except to suggest that large-scale harvesting would likely be detrimental to populations of this moth.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of conifers. Adults may be sampled using UV or mercury-vapor light traps. We have observed 11 individuals from five sites with a typical number in a collection totaling only one moth per trap-night.

ZALE TERMINA - TERMINAL OAK ZALE - NOCTUIDAE

Five species of *Zale* occur in the Pacific Northwest.

ADULT (PLATE 31, FIG. 5-84A)

Wingspan 3.7 cm.

The dorsal surface of the forewings is dark gray with fine lines and thin, black basal and postmedian bands. The dorsal surface of the hindwings is dark gray with fine, black lines and a scalloped margin. The ventral surface of the fore- and hindwings is pale gray.

CATERPILLAR (PLATE 31, FIG. 5-84B)

Light gray with dark gray longitudinal lines; subdorsal line nearly black and scalloped; prolegs on A-3 smaller than on A-6.

ECOLOGY

This species is found in dry mixed forests and oak woodlands with evergreen Fagaceae in the Southwest and along the West Coast in California and western Oregon. It is dependent on the maintenance of golden chinquapin in the Cascade Mountains. Also, caterpillars are common and feed on canyon live oak and chinquapin in southwestern Oregon. Larvae occur in the spring; adults are nocturnal and fly during May and June.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Terminal Oak Zale is associated with oak woodlands. Historically, the food plant often has been eliminated as a “weedy species” during forest management. However, forest thinning and clearcutting that preserve the chinquapin are beneficial to this species. Maintenance of canyon live oak in the Siskiyou Mountains is essential for the survival of this moth. The threat of sudden oak death is likely to put additional pressure on populations of this species.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample golden chinkapin and canyon live oak. Generally, in our studies, we have collected 1 to 2 caterpillars per 100 sec of sampling effort. Adults may be sampled using UV or mercury-vapor light traps. Overall, we have observed 30 individuals from five sites.

NOTODONTA PACIFICA - PACIFIC PROMINENT - NOTODONTIDAE

One species of *Notodonta* occurs in the Pacific Northwest.

ADULT (PLATE 32, FIG. 5-85)

Wingspan 5.0 cm.

The dorsal surface of the forewings is light red-brown with a gray discal area, and thin, faint basal, median, and submarginal lines. There is a black hair tuft in the center of the inner margin. The dorsal surface of the hindwings is pale gray with a small, black discal spot. The ventral surface of the fore- and hindwings is pale gray with small, black discal spots.

CATERPILLAR

Undescribed, and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species is endemic to the Pacific Northwest and is one of our most rarely encountered moths. Although rare and sporadic in its occurrence, this species has been found at lower elevations along both west and east slopes of the Cascade Mountains in both Oregon and Washington. The caterpillar food plant is unknown, but related species feed on hardwoods, such as cherry. Adults are nocturnal and fly during May and June.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Pacific Prominent is rare. Conservation measures are unknown due to the lack of information on population status and biology of the immatures and adults. However, we suggest that the maintenance of angiosperm diversity in forested habitat would benefit this species.

Information regarding the geographic range of the species is poor. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of hardwoods. Studies on the caterpillar food plant are needed. Adults may be sampled using UV or mercury-vapor light traps. We have observed two individuals.

ADELPHA CALIFORNICA - CALIFORNIA SISTER - NYMPHALIDAE

One species of *Adelpha* occurs in the Pacific Northwest. The populations of this species in the Pacific Northwest had been considered a subspecies of *A. bredowii*. Warren (2005) has determined that populations previously considered as subspecies of *A. bredowii* should be considered as species: *A. bredowii* in Mexico, *A. eulalia* in the Southwest United States, and *A. californica* along the West Coast.

ADULT (PLATE 32, FIG. 5-86A,B)

Wingspan 6.5 cm in the female and 7.5 cm in the male.

The dorsal surface of the forewings is black-brown with a narrow, white median band and a large, round, orange apical patch. The dorsal surface of the hindwings is black-brown with a white median band and a small, orange anal spot. The patterns on the ventral surface of the fore- and hindwings are similar to the dorsal surface, but have blue basal color with reddish discal spots, bronze-black distal color, and a row of blue submarginal spots.

CATERPILLAR (PLATE 32, FIG. 5-86C)

Dorsum green with fine white speckles; ventrally light brown; elongate, light-brown scoli on T-2, T-3, A-2, A-4, A-7, and A-9. Head light brown with multiple small spines, including one pair of spines at the top of the head capsule.

ECOLOGY

Found in montane forests and oak woodlands along the West Coast in California and western Oregon, with a few records in western Washington. Caterpillars are common and feed on various Fagaceae, both deciduous and evergreen oaks, tan oak, and chinquapin. Adults are diurnal and fly from May to October, exhibiting at least two generations.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The California Sister is associated with oak woodlands. This species benefits from the maintenance of both golden chinquapin and canyon live oak trees and shrubs, which are often eliminated as “weed species” during forest management. However, forest thinning and clearcutting that preserve chinquapin and canyon live oak are beneficial to this species. The recently introduced “sudden oak death” fungus that attacks and kills the larval food plant poses a serious threat to this species.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows numerous townships in the western region of the state where this butterfly has been recorded (Hinchliff 1994). However, the atlas of Washington butterflies shows only five townships where the California Sister has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of oak. In our studies we have collected up to two caterpillars per 100 sec of sampling effort. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants are present.

BOLORIA BELLONA TODDI - MEADOW FRITILLARY - NYMPHALIDAE

Six species of *Boloria* occur in the Pacific Northwest. Guppy and Shepard (2001) place this species as *Clossiana bellona*. The species *bellona* has one subspecies in the Pacific Northwest. *Boloria bellona toddi* is critically imperiled in Oregon (Pyle 2002).

ADULT (PLATE 32, FIG. 5-87A,B)

Wingspan 4.2 cm.

The dorsal surface of the fore- and hindwings is medium orange with heavy, black basal suffusion, black discal and median bars, round, black postmedian spots, and round, black submarginal spots. The ventral surface of the forewings is similar to the dorsal surface. The ventral surface of the hindwings is purple with an orange median band, and faint, round postmedian and submarginal spots.

CATERPILLAR

Pyle (2002) describes the larva as olive to purplish black, with variable greenish or yellowish blotches and bars and brown spines.

ECOLOGY

This species is widely distributed across northern and montane regions of North America, but colonies are very local and endemic in the Pacific Northwest. Its preferred habitat is open, boggy, wet meadows. In the Pacific Northwest, this species is most common in northeastern Washington. A few historical colonies were known in the Blue Mountains of southeast Washington and northeast Oregon, but these have mostly disappeared. Only one colony may still survive in Oregon at Lehman Springs in the Umatilla National Forest. Caterpillars feed on violets. Adults fly in two generations from May to June, and in late July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Meadow Fritillary is endemic and considered critically imperiled in Oregon. This butterfly is dependent on the maintenance of the open, wet meadow habitat. Drainage of water from the bogs, overgrazing by domestic livestock, and overgrowth of the meadows by woody brush, such as willows and hawthorns, are harmful to this species. The Oregon record, and the three records in southeastern Washington, represent the westernmost range for this species; loss of habitat will severely affect the overall range of the species.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only one township, in Umatilla County, where this species has been recorded (Hinchliff 1994). The atlas of Washington butterflies shows 15 townships where the Meadow Fritillary has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

PLATE 25, FIGURES 5-61A – 5-63B



Figure 5-61a. *Euxoa vetusta*: female, dorsal.



Figure 5-61b. *Euxoa vetusta*: male, dorsal.



Figure 5-62a. *Ferialia februalis*: dorsal.



Figure 5-62b. *Ferialia februalis*: caterpillar.



Figure 5-63a. *Fishia yosemitae*: female, dorsal.



Figure 5-63b. *Fishia yosemitae*: male, dorsal.

PLATE 26, FIGURES 5-64 – 5-68A



Figure 5-64. *Hadena variolata*: dorsal.



Figure 5-65. *Lithophane baileyi*: dorsal.



Figure 5-66a. *Lithophane contenta*: dorsal.



Figure 5-66b. *Lithophane contenta*: caterpillar.



Figure 5-67. *Lithophane gausapata*: dorsal.



Figure 5-68a. *Lithophane thaxteri*: dorsal.

PLATE 27, FIGURES 5-68B – 5-71B



Figure 5-68b. *Lithophane thaxteri*: caterpillar.



Figure 5-69a. *Litocala sexsignata*: dorsal.



Figure 5-69b. *Litocala sexsignata*: caterpillar.



Figure 5-70. *Melanchra assimilis*: dorsal.



Figure 5-71a. *Mesogona rubra*: dorsal, dark form.



Figure 5-71b. *Mesogona rubra*: dorsal, light form.

PLATE 28, FIGURES 5-71C – 5-75A



Figure 5-71c. *Mesogona rubra*: caterpillar.



Figure 5-72. *Mesogona subcuprea*: dorsal.



Figure 5-73. *Oligia violacea*: dorsal.



Figure 5-74a. *Oncocnemis chalybdis*: dorsal.



Figure 5-74b. *Oncocnemis chalybdis*: caterpillar.



Figure 5-75a. *Panthea gigantea*: female, dorsal.

PLATE 29, FIGURES 5-75B – 5-77C



Figure 5-75b. *Panthea gigantea*: male, dorsal.



Figure 5-76a. *Perigonica angulata*: dorsal.



Figure 5-76b. *Perigonica angulata*: caterpillar.



Figure 5-77a. *Perigonica pectinata*: dorsal, dark form.



Figure 5-77b. *Perigonica pectinata*: dorsal, medium form.



Figure 5-77c. *Perigonica pectinata*: dorsal, light form.

PLATE 30, FIGURES 5-77D – 5-80B



Figure 5-77d. *Perigonica pectinata*: caterpillar.



Figure 5-78a. *Perigonica tertia*: dorsal, dark form.



Figure 5-78b. *Perigonica tertia*: dorsal, light form.



Figure 5-79. *Protogygia milleri*: dorsal.



Figure 5-80a. *Pseudocopivaleria sonoma*: female, dorsal.



Figure 5-80b. *Pseudocopivaleria sonoma*: male, dorsal.

PLATE 31, FIGURES 5-81A – 5-84B



Figure 5-81a. *Pseudohermonassa flavotincta*: dorsal, dark form.



Figure 5-81b. *Pseudohermonassa flavotincta*: dorsal, light form.



Figure 5-82. *Pyrrhia exprimens*: dorsal.



Figure 5-83. *Syngnatha viridisigma*: dorsal.



Figure 5-84a. *Zale termina*: dorsal.



Figure 5-84b. *Zale termina*: caterpillar.

PLATE 32, FIGURES 5-85 – 5-87B



Figure 5-85. *Notodonta pacifica*: dorsal.



Figure 5-86a. *Adelpha californica*: male, dorsal.



Figure 5-86b. *Adelpha californica*: male, ventral.



Figure 5-86c. *Adelpha californica*: caterpillar.



Figure 5-87a. *Boloria bellona*: male, dorsal.



Figure 5-87b. *Boloria bellona*: male, ventral.

BOLORIA FREIJA FREIJA - FREIJA FRITILLARY - NYMPHALIDAE

Six species of *Boloria* occur in the Pacific Northwest. Guppy and Shepard (2001) place this species as *Clossiana freija*. The species *freija* has one subspecies in the Pacific Northwest.

ADULT (PLATE 33, FIG. 5-88A,B)

Wingspan 3.6 cm.

The dorsal surface of the fore- and hindwings is light orange with heavy, black basal suffusion, black discal and median bars, round, black postmedian spots, and crescent-shaped, black submarginal spots. The ventral surface of the forewings is similar to the dorsal surface, but paler. The ventral surface of the hindwings is dark red-brown with a jagged, sharply dentate median band outlined with black, and two silver-white median spots, small, round postmedian spots, and crescent-shaped submarginal spots.

CATERPILLAR

Pyle (2002) describes the larva as dark brown with black spines. Images presented on the internet show the nominate species in Europe to be brownish grey.

ECOLOGY

This is an arctic-alpine species that is widely distributed across northern regions of Canada and Alaska. It extends southward in alpine habitats through the Rocky Mountains and British Columbia to the north Cascade Mountains in Washington. Caterpillars feed on *Vaccinium caespitosum* (Pyle 2002). Adults are diurnal and fly in May and June.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Freija Fritillary is sensitive to climate change. Warming climatic conditions eventually may eliminate the alpine habitat from much of its southern distribution in the United States. The Washington records represent the southernmost range for this species; loss of habitat will severely affect the overall range of the species.

Information regarding the geographic range of the species is excellent. The atlas of Washington butterflies shows only four townships along the eastern slope of the north central Cascade Mountains where the Freija Fritillary has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

BOLORIA SELENE ATROCOSTALIS - SILVER-BORDERED FRITILLARY - NYMPHALIDAE

Six species of *Boloria* occur in the Pacific Northwest. Guppy and Shepard (2001) place this species as *Clossiana selene*. The species *selene* has one subspecies in the Pacific Northwest. This subspecies is considered imperiled in Oregon and is a candidate for listing in Washington (Pyle 2002).

ADULT (PLATE 33, FIG. 5-89A,B)

Wingspan 3.8 cm.

The dorsal surface of the fore- and hindwings is light orange with black discal and median bars, round, black postmedian spots, and crescent-shaped, black submarginal spots. The ventral surface of the forewings is similar to the dorsal surface, but paler. The ventral surface of the hindwings is red-brown with a median band consisting of yellow and silver spots outlined with brown, small, round, black postmedian spots, and crescent-shaped, silver submarginal spots.

CATERPILLAR (PLATE 33, FIG. 5-89C)

Pyle (2002) describes the larva as blackish with yellowish spines and black filaments near the head. An image of the caterpillar is shown in Guppy and Shepard (2001).

ECOLOGY

This species is widely distributed across northern and montane regions of North America, but colonies are very local and endemic in the Pacific Northwest. The habitat consists of open, boggy, wet meadows. While it is common and widespread in northeastern Washington and northern Idaho, colonies are extremely local and isolated southward, and are particularly vulnerable to local extinctions. Only two primary colonies are found in Oregon, one at Big Summit Prairie on the Ochoco National Forest and one in the Strawberry Mountains on the Malheur National Forest. Caterpillars feed on violets, such as the marsh violet and bog violet. Adults fly in May to July, with a second generation flying from August into September.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Silver-Bordered Fritillary is locally distributed and dependent on the maintenance of the open and wet meadow habitat. Drainage of water from the bogs, overgrazing by domestic livestock, and overgrowth of the meadows by woody brush, such as willows and hawthorns, are harmful to this species.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only five townships where the Silver-Bordered Fritillary has been recorded, four of the records represent contiguous locations in Crook County (Hinchliff 1994). The atlas of Washington butterflies shows 19 townships in the eastern region of the state where this butterfly has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

BOLORIA TRITONIA ASTARTE - ASTARTE FRITILLARY - NYMPHALIDAE

Six species of *Boloria* occur in the Pacific Northwest. Guppy and Shepard (2001) place this species as *Clossiana tritonia*. The species *tritonia* has one subspecies in the Pacific Northwest. Pyle (2002) raised the status of the subspecies *B. t. astarte* to the species level, creating *Boloria astarte*.

ADULT (PLATE 33, FIG. 5-90A; PLATE 34, FIG. 5-90B)

Wingspan 4.5 cm.

The dorsal surface of the fore- and hindwings is light orange with black discal and median bars, round postmedian spots, and round submarginal spots. The hues and patterns on the ventral surface of the forewings are similar to the dorsal surface. The ventral surface of the hindwings is red-brown with a jagged, white median band outlined with black, and small round, black postmedian and submarginal spots.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This is an arctic-alpine species distributed in Siberia and Alaska, extending south through the Rocky Mountains of Alberta and Montana, and through British Columbia to the North Cascades of Washington. It is limited to barren rocky habitats above timberline. Caterpillars feed on *Saxifraga bronchialis* (Guppy and Shepard 2001). Adults are diurnal and fly in July and August. There is a single generation every two years (even numbered years).

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Astarte Fritillary is sensitive to climate change. A warming climate eventually would eliminate the alpine habitat. The western and southernmost range of this species is represented by the north central Washington population and the population in northwestern Montana. Loss of these populations would severely decrease the range of the species.

Information regarding the geographic range of the species is excellent. The atlas of Washington butterflies shows only eight townships where this butterfly has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

CHLOSYNE HOFFMANNI - HOFFMAN'S CHECKERSPOT - NYMPHALIDAE

Five species of *Chlosyne* occur in the Pacific Northwest. Guppy and Shepard (2001) place this species as *Charidryas hoffmanni*. The species *hoffmanni* has two subspecies in the Pacific Northwest.

ADULT (PLATE 34, FIG. 5-91A,B)

Wingspan 4.3 cm.

The dorsal surface of the fore- and hindwings is red-orange with black basal spots, a black median band, a contrasting yellow median band, and narrow, black postmedian and submarginal lines. The ventral surface of the forewings is similar to the dorsal surface. The ventral surface of the hindwings is red with cream-white discal spots, a median band, and submarginal spots all strongly outlined in black.

CATERPILLAR

Newcomer (1967) describes the larva as follows: "Third instar dark gray above, lighter below; a narrow, darker dorsal stripe and a wider dark dorsolateral stripe. Dorsolateral tubercles black, lateral light yellow. Fourth instar: Head width 1.5 mm, color as in preceding instar. Body length 10-15 mm, color as in preceding instar. Fifth instar: Head width 2.0 mm, black, cleft, with setae as before. Body length 16-19 mm, as much as 25 mm when fully fed; color black above with numerous whitish dots; tubercles and spines located as before, those above lateral line black, circled with white. A cream-colored scalloped line just above the spiracles; color below that and on venter brownish, tubercles here brown. Thoracic legs black."

ECOLOGY

This species is restricted to the Cascade and Sierra Nevada Mountains, extending from southern British Columbia south through California. Its preferred habitat consists of open, subalpine forests and meadows at high elevations. Caterpillars feed on asters (Pyle 2002). Adults are diurnal and fly from June to August, depending on elevation.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Hoffman's Checkerspot is sensitive to forest management. The creation of suitable habitat requires some disturbance to prevent heavy brush and tree encroachment into meadow habitat. Populations of this butterfly will benefit from infrequent, controlled ground fires and prescribed forest thinning to create an open habitat.

Information regarding the geographic range of the species is excellent. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships where this butterfly has been recorded. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

EUPHYDRYAS CHALCEDONA - CHALCEDONA CHECKERSPOT - NYMPHALIDAE

Four species of *Euphydryas* occur in the Pacific Northwest. The species *chalcedona* has seven subspecies in the Pacific Northwest.

ADULT (PLATE 34, FIG. 5-92A,B)

Wingspan 4.4 cm.

The dorsal surface of the fore- and hindwings is white with broad, black basal and discal spots, a black median band, and black submarginal border. The center of the discal spots is variably red to black. The wing margin has red marginal spots. The ventral surface of the forewings is red with discal spots thinly outlined with black, and small white postmedian spots. The ventral surface of the hindwings is red with white discal spots, a median band, and submarginal spots all strongly outlined in black.

CATERPILLAR (PLATE 34, FIG. 5-92C)

Mottled with black and white markings; three longitudinal rows of short, black spines on an orange base. Head black.

ECOLOGY

This species is found in open forests, riparian habitats and mountain meadows in the Pacific western states and northern Rocky Mountains. This butterfly tends to exist in very local colonies. Caterpillars are common and feed on penstemon and snowberry in spring. Adults are diurnal and fly from early to midsummer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Chalcedona Checkerspot is sensitive to forest management. The creation of suitable habitat requires some disturbance to prevent heavy brush and tree encroachment into meadow habitat. Small clearcuts within the forest also are favorable to *E. chalcedona*. However, because the species lives in very local, sedentary colonies, it may be exterminated easily by insecticide spray programs for forest pest insects, such as the western spruce budworm and Douglas fir tussock moth. Many colonies of this species, along the east slope of the Cascades in Washington and in the Blue and Willowa Mountains of northeast Oregon and southeast Washington, appear to have been extirpated as a result of spray programs (D. McCorkle and P. Hammond pers. obs.).

Information regarding the geographic range of the species is excellent. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships where this species and its subspecies have been recorded. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

EUPHYDRYAS EDITHA COMPLEX - EDITH'S CHECKERSPOT - NYMPHALIDAE

Four species of *Euphydryas* occur in the Pacific Northwest. The species *editha* has seven subspecies in the Pacific Northwest, including *E. e. taylori*, which we present as a separate account. The images shown to illustrate this species complex are *E. editha colonia*.

ADULT (PLATE 35, FIG. 5-93A,B)

Wingspan 4.0 cm.

The dorsal surface of the fore- and hindwings is red with basal and discal spots outlined with black, and with a white median band and discal area. The ventral surface of the forewings is red with discal spots thinly outlined with black, and small white postmedian spots. The ventral surface of the hindwings is red with white discal spots, a median band, and submarginal spots all strongly outlined in black.

CATERPILLAR

Pyle (2002) describes the larva as black, spotted or striped with orange. (See our image and description of *E. e. taylori*).

ECOLOGY

The habitat consists of open forests and meadows or prairies. It is extremely sedentary and lives in very local colonies. Caterpillars feed on plantains, paintbrushes, and *Collinsia*. Adults are diurnal and fly from April to August, depending on elevation.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Edith's Checkerspot is sensitive to forest management. The creation of suitable habitat requires some disturbance to prevent heavy brush and tree encroachment into meadow habitat. Populations of this butterfly will benefit from infrequent, controlled ground fires and prescribed forest thinning or clearcutting to create an open habitat. Maintenance of natural meadows and prairies is particularly important for *E. editha*. It is highly vulnerable to extermination during insecticide spray programs for insect pests in either forest or rangeland ecosystems.

Information regarding the geographic range of the species is excellent. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships where this species and its subspecies have been recorded. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

EUPHYDRYAS EDITHA TAYLORI - TAYLOR'S CHECKERSPOT - NYMPHALIDAE

Four species of *Euphydryas* occur in the Pacific Northwest. The species *editha* has seven subspecies in the Pacific Northwest, including *E. e. taylori*. We also present this species in Chapter 4 as a special species account. This subspecies is listed as a species of concern in Washington (Vaughan and Black 2002).

ADULT (PLATE 35, FIG. 5-94A,B)

Wingspan 4.3 cm.

The dorsal surface of the fore- and hindwings is white with black basal and discal spots, a red median band outlined with black, and thin, black submarginal lines. The center of the discal spots is red. The wing margin has red marginal spots. The ventral surface of the forewings is similar to the dorsal surface. The ventral surface of the hindwings is red with white discal spots, a median band, and submarginal spots all strongly outlined in black.

CATERPILLAR (PLATE 35, FIG. 5-94C)

Black mottled with grey-white and a series of eight orange middorsal, spots.

ECOLOGY

This butterfly is highly sedentary and localized. Its preferred habitat is native, upland bunchgrass prairies west of the Cascades. The historical distribution once extended from Vancouver Island, British Columbia, south through the Puget Trough of Washington and Willamette Valley of Oregon, south probably to the Umpqua Valley of Douglas County, Oregon. Only one colony is known to survive in British Columbia on Hornsby Island, a few populations survive in Washington in the San Juan Islands and on the Tenino Prairies near Olympia, and a few colonies survive in Benton County, Oregon. Caterpillars feed on plantains (Pyle 2002). Adults are diurnal and fly in April and May.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Taylor's Checkerspot is endangered although it is not officially listed as such. It is nearly extinct due to the loss of the native prairie habitat to human developments and exotic vegetation, such as exotic grasses and Scotch broom. Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only four townships where historically Taylor's Checkerspot has been recorded (Hinchliff 1994). The atlas of Washington butterflies shows 11 townships where this butterfly has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is currently under study (D. Ross pers. comm.). The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

EUPHYDRYAS GILLETTII - GILLETT'S CHECKERSPOT - NYMPHALIDAE

Four species of *Euphydryas* occur in the Pacific Northwest. There are no named subspecies of *gillettii*.

ADULT (PLATE 35, FIG. 5-95A; PLATE 36, FIG. 5-95B)

Wingspan 4.0 cm.

The dorsal surface of the fore- and hindwings is white with red basal and discal spots outlined with black, a black median band, and a broad, red postmedian band. The ventral surface of the forewings is similar to the dorsal surface. The ventral surface of the hindwings is red with white discal spots, a median band, and submarginal spots that are strongly outlined in black.

CATERPILLAR

Pyle (2002) describes the larva as dark brown with black spines, dorsal yellow stripe, and lateral white stripes.

ECOLOGY

This species is distributed in the northern Rocky Mountains, occurring from northwest Wyoming to southern Alberta and west to the Imnaha Mountains of northwest Oregon. Its preferred habitat is restricted to open, sunny, subalpine meadows at high elevations in the mountains. It is extremely sedentary, and lives in very local colonies. Caterpillars feed on twinberry. Adults are diurnal and fly in June and July.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Gillett's Checkerspot is sensitive to forest management. The creation of suitable habitat requires some disturbance to prevent heavy brush and tree encroachment into meadow habitat. Maintenance of natural meadows is particularly important for *E. gillettii* (Warren 2005). Populations of this butterfly will benefit from infrequent, controlled ground fires, prescribed forest thinning, and clearcutting, to maintain the open meadow habitat. As a result of the local, sedentary population structure, it is also highly vulnerable to extermination during insecticide spray programs for forest insect pests, such as the western spruce budworm.

Information regarding the geographic range of the species is excellent. The western boundary of this species range is represented by two populations in western Idaho and one population in the Imnaha Mountains of northeast Oregon (Pyle 2002). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

SPEYERIA ATLANTIS DODGEI - DODGE'S FRITILLARY - NYMPHALIDAE

Eleven species of *Speyeria* occur in the Pacific Northwest. The species *atlantis* has four subspecies in the Pacific Northwest.

ADULT (PLATE 36, FIG. 5-96A,B)

Wingspan 5.5 cm.

The dorsal surface of the fore- and hindwings is orange with heavy, black basal suffusion, black discal bars, black median bars, round, black postmedian spots, and black, crescent-shaped submarginal spots. The ventral surface of the forewings is similar to the dorsal surface. The ventral surface of the hindwings is brick red to bright red with large round, white discal and median spots, a narrow, yellow submarginal band, and white, triangular submarginal spots.

CATERPILLAR (PLATE 36, FIG. 5-96C)

Black with few or no markings; middorsum mostly black; subdorsal and lateral scoli tan to orange. The head is black.

ECOLOGY

While *S. atlantis* (inclusive of all the subspecies) is widely distributed in montane regions of North America, the particular subspecies we feature, *S. a. dodgei*, is endemic to the Pacific Northwest, extending from central Idaho through eastern and central Oregon, and in the Cascade Mountains from southern Washington to northern California. Its preferred habitat is dry, open, subalpine meadows at high elevations in the mountains. Caterpillars are common and feed on violets, particularly *V. nuttallii*. Adults are diurnal and fly in midsummer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Dodge's Fritillary is sensitive to forest management. The creation of suitable habitat requires some disturbance to prevent heavy brush and tree encroachment into meadow habitat. Populations of this butterfly will benefit from infrequent, controlled ground fires and tree and brush clearing to maintain meadow habitat.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows numerous townships where this butterfly has been recorded (Hinchliff 1994). The atlas of Washington butterflies shows 21 townships where Dodge's Fritillary has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

SPEYERIA CYBELE - GREAT SPANGLED FRITILLARY - NYMPHALIDAE

Eleven species of *Speyeria* occur in the Pacific Northwest. The species *cybele* has two subspecies in the Pacific Northwest.

ADULT (PLATE 36, FIG. 5-97A,B; PLATE 37, FIG. 5-97C,D)

Wingspan 7.5 cm.

The dorsal surface of the fore- and hindwings in the male is medium to dark orange with heavy, black basal suffusion, black discal bars, black median bars, round, black postmedian spots, and black, crescent-shaped submarginal spots. The female is similar in pattern, but has a yellow dorsal ground color combined with extremely heavy black basal suffusion. The ventral surface of the forewings is similar to the dorsal surface, but paler and without the basal suffusion. The ventral surface of the hindwing is red-brown with small, silver discal and median spots, a wide, yellow submarginal band, and small, silver, triangular submarginal spots.

CATERPILLAR (PLATE 37, FIG. 5-97E)

Black with tan middorsal, subdorsal, and lateral scoli. The head is black.

ECOLOGY

This species is widely distributed at lower elevations in the mountains of western North America. The habitat is wet forests and riparian zones along creeks and boggy seeps. This butterfly is quite sedentary and lives in very local colonies. Caterpillars are common and feed on violets, particularly *Viola glabella*, *V. palustris*, and *V. adunca*, during spring. Adults are diurnal and fly in midsummer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Great Spangled Fritillary is sensitive to forest management. This butterfly requires maintenance of riparian habitats along streams. It is also highly sensitive to insecticide spraying for forest pest insects, such as western spruce budworm and Douglas fir tussock moth. Because of the local, sedentary nature of *S. cybele* colonies, this species is easily exterminated by insecticide spray programs. For example, in 1987 extensive populations in the Canyon Creek drainage on the south slope of the Strawberry Mountains on the Malheur National Forest in Oregon were almost completely extirpated during a BTK spray program for spruce budworms (D. McCorkle and P. Hammond, pers. obs.).

Information regarding the geographic range of the species is excellent. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships where this species and its subspecies have been recorded. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

SPEYERIA HOLLANDI - HOLLAND'S FRITILLARY - NYMPHALIDAE

Eleven species of *Speyeria* occur in the Pacific Northwest. The species *hollandi* has one subspecies in the Pacific Northwest. This species was previously known as a subspecies, *S. atlantis hollandi*.

ADULT (PLATE 37, FIG. 5-98A,B)

Wingspan 6.0 cm.

The dorsal surface of the fore- and hindwings is medium orange with heavy, black basal suffusion, black discal bars, thin, black median bars, round, black postmedian spots, black, crescent-shaped submarginal spots, and black wing margins. The ventral surface of the forewings is similar to the dorsal surface, but paler and without the basal suffusion. The ventral surface of the hindwings is dark brown or black-brown with small, silver discal spots, sharp, pointed, silver median spots, a narrow, yellow submarginal band, and sharp, triangular, silver submarginal spots.

CATERPILLAR

Black with faint off-white streaks; a dual longitudinal line along the middorsum; subdorsal and lateral scoli gray to tan. The head is black.

ECOLOGY

This species was previously confused with the closely related *S. atlantis*. While *S. atlantis* is widely distributed in montane regions of North America, and is particularly common in drier upland forests, *S. hollandi* is more narrowly distributed and limited in habitat. It occurs across central Canada from western Manitoba to the Rocky Mountains of Alberta, extending north to northern British Columbia and south through western Montana. Its preferred habitat is very narrowly restricted to cold, boggy forests, particularly spruce bogs. The species is very sedentary and lives in very local colonies that tend to remain within the confines of the habitat. Caterpillars feed on violets, particularly *V. canadensis*. Adults are diurnal and fly in midsummer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Holland's Fritillary is sensitive to forest management due to its populations being local and sedentary. Draining water from bogs is detrimental to this species. It is also highly vulnerable to insecticide spray programs for insect pests, such as the western spruce budworm; local colonies are easily extirpated through such programs.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

SPEYERIA MORMONIA - MORMON FRITILLARY - NYMPHALIDAE

Eleven species of *Speyeria* occur in the Pacific Northwest. The species *mormonia* has four subspecies in the Pacific Northwest. The subspecies *S. m. erinna* is considered threatened in British Columbia (Pyle 2002).

ADULT (PLATE 37, FIG. 5-99A; PLATE 38, FIG. 5-99B)

Wingspan 4.8 cm.

The dorsal surface of the fore- and hindwings is light orange with black discal bars, thin, black median bars, round, black postmedian spots, and crescent-shaped, black submarginal spots. The ventral surface of the forewings is similar to the dorsal surface. The ventral surface of the hindwings is variably red-brown, green, or yellow, with silver discal and median spots, a narrow to wide yellow submarginal band, and silver, crescent-shaped submarginal spots. In the Rocky Mountain populations, the ventral spots are variably silver or yellow with no silver.

CATERPILLAR (FIG. 5-99C)

Brown with pale-yellow mid-dorsal stripes and very short, tan scoli.

ECOLOGY

This species is widely distributed in the montane regions of western North America. Its preferred habitat is wet, open, subalpine meadows and bogs at high elevations. Caterpillars are common and feed on various violets, particularly *V. adunca*, *V. palustris*, and *V. nephrophylla*. Adults are diurnal and fly in midsummer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Mormon Fritillary is sensitive to forest management. The creation of suitable habitat requires some disturbance to prevent heavy brush and tree encroachment into the meadows. Populations of this butterfly will benefit from infrequent, controlled ground fires and tree and brush clearing to maintain meadow habitat; draining water from the bogs or overgrazing by domestic livestock may be detrimental to this species.

Information regarding the geographic range of the species is excellent. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships where this species and its subspecies have been recorded. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

SPEYERIA ZERENE BREMNERII - VALLEY SILVERSPOT - NYMPHALIDAE

Eleven species of *Speyeria* occur in the Pacific Northwest. The species *zerene* has six subspecies in the Pacific Northwest. This subspecies is a species of concern in British Columbia (Pyle 2002), and a Federal species of concern and considered a candidate for listing in Washington. We discuss more details regarding the ecology and conservation of the Valley Silverspot in Chapter 4.

ADULT (PLATE 38, FIG. 5-100A,B,C,D)

Wingspan 6.0 cm.

The dorsal surface of the fore- and hindwings is orange with heavy, black basal suffusion, black discal bars, broad, black median bars, round, black postmedian spots, and crescent-shaped, black submarginal spots. The ventral surface of the forewings is similar to the dorsal surface, but without the basal suffusion. The ventral surface of the hindwings is red-brown with large, round, silver discal and median spots, a narrow, yellow submarginal band, and crescent shaped, silver submarginal spots.

CATERPILLAR

Light black to dark gray with faint off-white mottling; gray-black dorsal and subdorsal scoli; lateral scoli on A-1 through A-8 cream-white. The head is black.

ECOLOGY

This butterfly is extinct in Oregon and greatly reduced in Washington and British Columbia. However, the historical distribution extended from the north end of Vancouver Island, British Columbia south through the San Juan Islands and western Washington, the Willamette Valley of western Oregon, and possibly the Umpqua Valley of Douglas County, Oregon. Caterpillars feed on various violets, depending on regional population characteristics (ecotype). There are at least four distinct ecotypes of *S. z. bremnerii*: 1) the extinct Oregon ecotype, which was larger in size and paler than any of the other ecotypes; it occupied native bunchgrass prairies in the Willamette Valley, and used *Viola nuttallii* as a caterpillar food plant; 2) a prairie ecotype very similar to the Oregon ecotype, occurs on the Tenino Prairies of western Washington and uses *V. adunca* as a caterpillar food plant; 3) a forest ecotype was once widely distributed, but now is much more restricted in its distribution, in western Washington and on Vancouver Island, and probably uses *V. glabella* as a caterpillar food plant; and 4) an alpine or subalpine ecotype in the Olympic Mountains which probably uses *V. adunca* or other species of high elevation violets as food plants. Adults are diurnal and fly from late June through August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Valley Silverspot is sensitive to forest and prairie management. The creation of suitable habitat requires some disturbance to prevent heavy brush and tree encroachment into prairie and meadow habitat. This butterfly has disappeared from much of its former range due to the loss of native prairies west of the Cascade Mountains resulting from human developments, such as agriculture and urban growth, and encroachment of invasive exotic weedy grasses and Scotch broom.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows only eight townships where this subspecies of *S. zerene* has been recorded (Hinchliff 1994). The atlas of Washington butterflies shows twenty townships where this subspecies has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

SPEYERIA ZERENE HIPPOLYTA - OREGON SILVERSPOT - NYMPHALIDAE

Seven species of *Speyeria* occur in the Pacific Northwest. The species *zerene* has six subspecies in the Pacific Northwest. This subspecies is on the Federal List of Endangered Species. (We present an expanded species account for this butterfly in Chapter 4.)

ADULT (PLATE 39, FIG. 5-101A,B)

Wingspan 5.0 cm.

The dorsal surface of the fore- and hindwings is orange with very heavy, black basal suffusion, black discal bars, broad, black median bars, round, black postmedian spots, and crescent-shaped, black submarginal spots. The ventral surface of the forewings is similar to the dorsal surface, but without the basal suffusion. The ventral surface of the hindwings is dark red-brown with silver discal and median spots, a narrow, yellow submarginal band, and silver, crescent-shaped submarginal spots.

CATERPILLAR (PLATE 39, FIG. 5-101C)

Dark gray with faint off-white mottling; gray-black dorsal and subdorsal scoli; lateral scoli on A-1 through A-8 cream-white. The head is black.

ECOLOGY

This butterfly is nearly extinct. Its preferred habitat is coastal meadows at the edge of the Pacific Ocean, and montane grasslands near the ocean. The historical distribution once extended from Westport, Washington, south to Lane County, Oregon, with a disjunct population near Crescent City in Del Norte County, California. Only three large surviving populations were known at the time of this writing: 1) one population occurs in subalpine meadows on top of Mt. Hebo in Tillamook County, Oregon; 2) a coastal population in Lane County, Oregon; and 3) a population north of Crescent City in Del Norte County, California. Caterpillars feed on violets, primarily on *Viola adunca*. Adults are diurnal and fly from late July through September.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Oregon Silverspot is sensitive to forest management, specifically the creation or maintenance of meadow habitat. The creation of suitable habitat requires some disturbance to prevent heavy brush and tree encroachment into meadows. Most of the original coastal meadow habitat has been lost to human developments, succession to woody brush and forest, or to tall and dense exotic grasses that crowd out the violets and native meadow vegetation. The two Oregon populations located on the Siuslaw National Forest and are managed by the U.S. Forest Service have declined substantially in recent years due to adverse weather conditions, possibly resulting from warming climatic conditions. An expanded discussion of mitigation practices is presented in Chapter 4.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows fourteen townships where this butterfly has occurred (Hinchliff 1994); however, only two of these populations remain. The atlas of Washington butterflies shows three townships where this butterfly has occurred (Hinchliff 1996); however, none

of these populations remain. Information regarding the status of numbers of individuals within populations is under study by one of us (PCH). The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

PAPILIO EURYMEDON - PALE TIGER SWALLOWTAIL - PAPILIONIDAE

Six species of *Papilio* occur in the Pacific Northwest.

ADULT (PLATE 39, FIG. 5-102A,B,

Wingspan 8.5 cm.

The dorsal surface of the forewings is white with four black bars, a broad, black marginal border, and small, white submarginal spots. The dorsal surface of the hindwings is white with a black median stripe, a broad, black marginal border, white-orange, narrow submarginal spots, blue postmedian patches, and a red-orange anal spot. The ventral surface of the fore- and hindwings is similar to that of the dorsal surface. The margin of the hindwings is scalloped and expands into a long tail.

CATERPILLAR (PLATE 39, FIG. 5-102C)

Dorsum yellow-green transitioning to a light blue hue laterally and sublaterally; thorax enlarged, T-3 with a broken transverse band of yellow (four patches), the outermost yellow patch is marked with a black line and circle encompassing a blue spot. The intersegmental region between A-1 and A-2 with a broad, transverse, black band counter-shaded with a yellow band along the anterior edge. A-2 to A-7 dark blue spots below the spiracles; A-1 with light blue spots dorsally and subdorsally; A-4 with a dark blue subdorsal spot; A-5 to A-7 with dark blue spots dorsally and subdorsally.

ECOLOGY

This species is common and widely distributed in montane regions of western North America. Its favored habitats are open areas in forests, roadsides, meadows, and clearcuts. Caterpillars feed primarily on species of *Ceanothus*, such as *C. velutinus* and *C. sanguineus*, but may occur on *Rhamnus*, *Alnus*, and various Rosaceae. Adults are diurnal and fly from May to August depending on elevation.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Pale Tiger Swallowtail is sensitive to forest management. The creation of suitable habitat requires some disturbance, such as infrequent fires, prescribed forest thinning and clearcutting for tree harvests, to create canopy-free gaps in forests, or to prevent tree encroachment by conifers into natural meadows or open areas. This butterfly is dependent on the maintenance of *Ceanothus* shrubs, which are often eliminated as weedy species during clearcutting.

Information regarding the geographic range of the species is excellent. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships where this species has been recorded. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of caterpillar food plants using a beating sheet. In our studies, we have collected up to two caterpillars per 100 sec of sampling effort. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants for the adults are present.

PARNASSIUS CLODIUS - CLODIUS PARNASSIAN - PAPILIONIDAE

Two species of *Parnassius* occur in the Pacific Northwest. The subspecies *P. c. shepardi* is a state candidate in Washington and the subspecies *P. c. altaurus* is of special concern in British Columbia (Pyle 2002). We have chosen to discuss the species as a whole, not by subspecies.

ADULT (PLATE 40, FIG. 5-103A,B,C,D,E)

Wingspan 6.5 centimeters.

The dorsal surface of the forewings is white with black discal bars, a black median band, and a black marginal border with white submarginal spots. The dorsal surface of the hindwings is white with black basal suffusion, two round, red median spots outlined with black, and variable black submarginal spots. The female differs from the male in having a red anal spot on the hindwing. The ventral surface of the fore- and hindwings is similar to the dorsal surface except there are red basal spots on the hindwings.

CATERPILLAR (PLATE 40, FIG. 5-103F)

Black, a single row of yellow subdorsal spots on A-1 through A-8.

ECOLOGY

Caterpillars are not commonly seen, but adults can be very common and are widely distributed in coastal rainforests, riparian forests, and subalpine meadows in western North America. Caterpillars feed on bleeding heart, *Dicentra formosa*, west of the Cascades, and *D. cucullaria*, *D. uniflora*, and *D. pauciflora* east of the Cascades (Pyle 2002) during late spring to early summer. Adults are diurnal and fly from early to midsummer.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Clodius Parnassian is sensitive to forest management. West of the Cascades it favors some disturbance in the forest, such as the open areas along roadsides and small clearcuts. East of the Cascades it tends to be very local and sedentary in moist riparian zones in the forest and subalpine meadows. It is dependent on the maintenance of riparian forest habitats, and is highly vulnerable to extermination during insecticide spray programs for forest insect pests, such as the western spruce budworm and Douglas fir tussock moth.

Information regarding the geographic range of the species is excellent. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships, mostly west of the Cascade Mountains, where this species and its subspecies have been recorded. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where bleeding hearts and nectar plants for adults are present.

PLATE 33, FIGURES 5-88A – 5-90A



Figure 5-88a. *Boloria freija freija*: female, dorsal.



Figure 5-88b. *Boloria freija freija*: female, ventral.



Figure 5-89a. *Boloria selene*: dorsal.



Figure 5-89b. *Boloria selene*: ventral.



Figure 5-89c. *Boloria selene*: caterpillar.

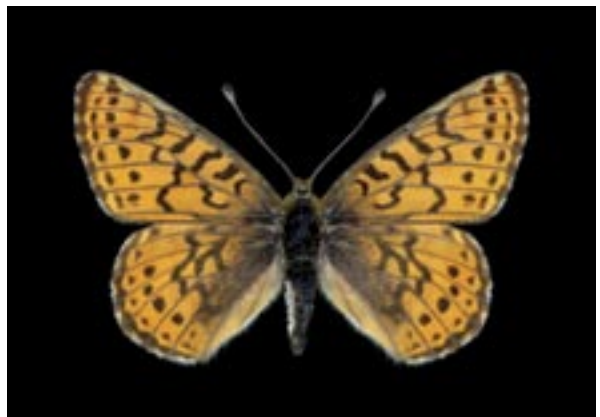


Figure 5-90a. *Boloria tritonia astarte*: female, dorsal.

PLATE 34, FIGURES 5-90B – 5-92C



Figure 5-90b. *Boloria tritonia astarte*: female, ventral.



Figure 5-91a. *Chlosyne hoffmani*: dorsal.



Figure 5-91b. *Chlosyne hoffmani*: ventral.



Figure 5-92a. *Euphydryas chalcedona*: dorsal.

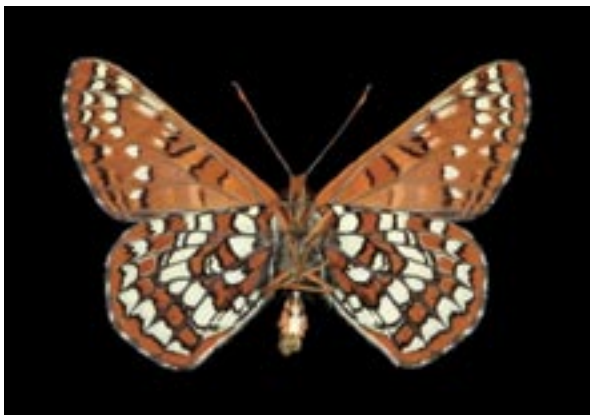


Figure 5-92b. *Euphydryas chalcedona*: ventral.



Figure 5-92c. *Euphydryas chalcedona*: caterpillar.

PLATE 35, FIGURES 5-93A – 5-95A



Figure 5-93a. *Euphydryas editha colonia*: dorsal.



Figure 5-93b. *Euphydryas editha colonia*: ventral.



Figure 5-94a. *Euphydryas editha taylori*: dorsal.



Figure 5-94b. *Euphydryas editha taylori*: ventral.



Figure 5-94c. *Euphydryas editha taylori*: caterpillar.



Figure 5-95a. *Euphydryas gillettii*: dorsal.

PLATE 36, FIGURES 5-95B – 5-97B



Figure 5-95b. *Euphydryas gillettii*: ventral.



Figure 5-96a. *Speyeria atlantis dodgei*: dorsal.

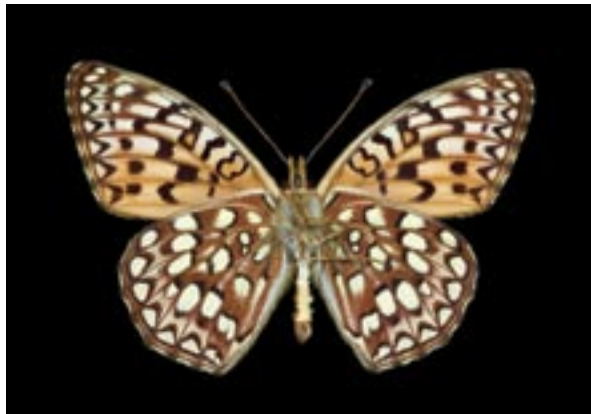


Figure 5-96b. *Speyeria atlantis dodgei*: ventral.



Figure 5-96c. *Speyeria atlantis dodgei*: caterpillar.



Figure 5-97a. *Speyeria cybele leto*: female, dorsal.

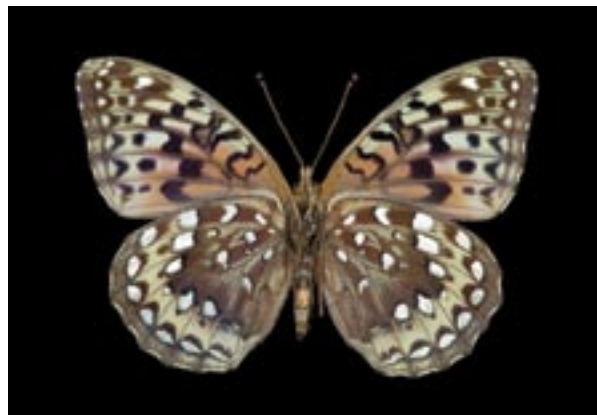


Figure 5-97b. *Speyeria cybele leto*: female, ventral.

PLATE 37, FIGURES 5-97c – 5-99a



Figure 5-97c. *Speyeria cybele leto*: male, dorsal.



Figure 5-97d. *Speyeria cybele leto*: male, ventral.



Figure 5-97e. *Speyeria cybele leto*: caterpillar.



Figure 5-98a. *Speyeria hollandi*: dorsal.

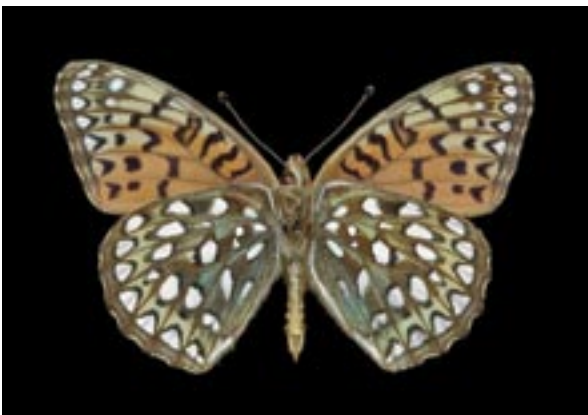


Figure 5-98b. *Speyeria hollandi*: ventral.



Figure 5-99a. *Speyeria mormonia erinna*: dorsal.

PLATE 38, FIGURES 5-99B – 5-100D

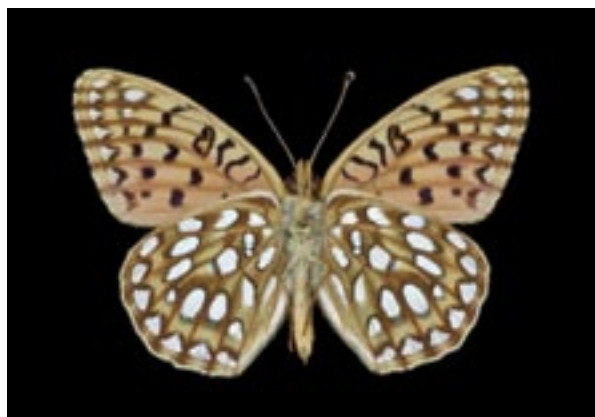


Figure 5-99b. *Speyeria mormonia erinna*: ventral.



Figure 5-99c. *Speyeria mormonia erinna*: caterpillar.

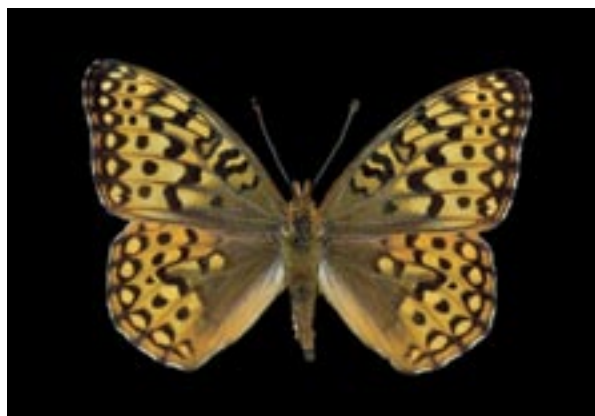


Figure 5-100a. *Speyeria zerene bremnerii*: female, dorsal.

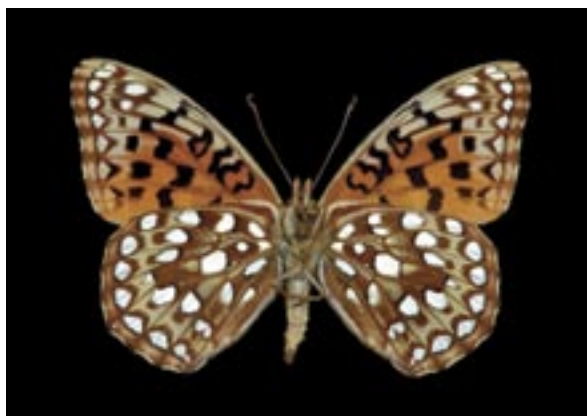


Figure 5-100b. *Speyeria zerene bremnerii*: female, ventral.

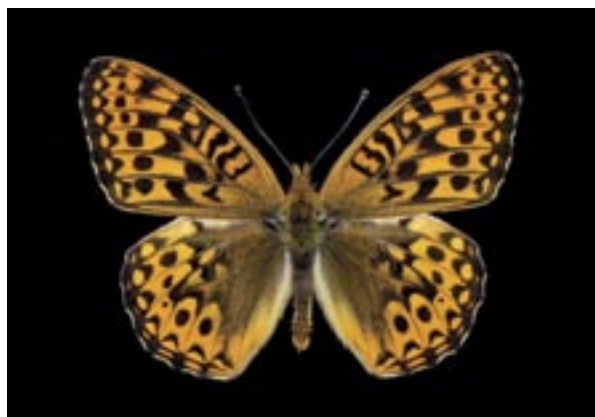


Figure 5-100c. *Speyeria zerene bremnerii*: male, dorsal.

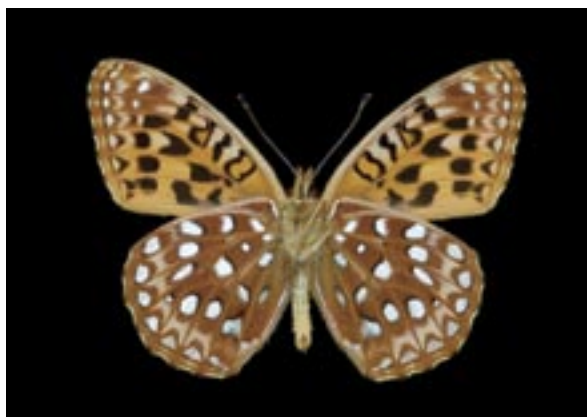


Figure 5-100d. *Speyeria zerene bremnerii*: male, ventral.

PLATE 39, FIGURES 5-101A – 5-102C



Figure 5-101a. *Speyeria zerene hippolyta*: male, dorsal.



Figure 5-101b. *Speyeria zerene hippolyta*: male, ventral.



Figure 5-101c. *Speyeria zerene hippolyta*: caterpillar.



Figure 5-102a. *Papilio eurymedon*: male, dorsal.



Figure 5-102b. *Papilio eurymedon*: male, ventral.



Figure 5-102c. *Papilio eurymedon*: caterpillar.

PLATE 40, FIGURES 5-103A – 5-103F

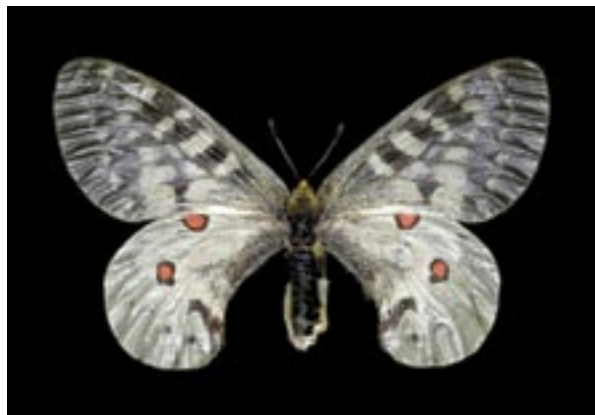


Figure 5-103a. *Parnassius clodius claudianus* female, dorsal.

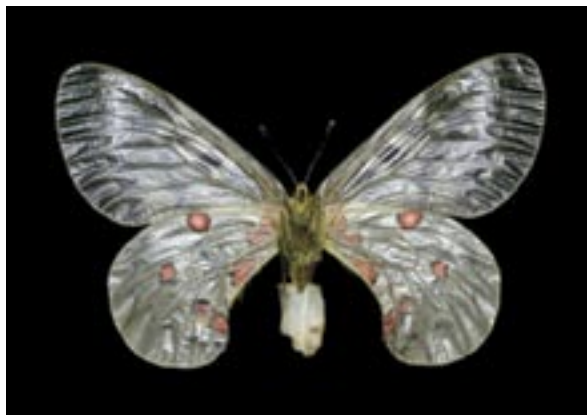


Figure 5-103b. *Parnassius clodius claudianus*: female, ventral.



Figure 5-103c. *Parnassius clodius claudianus*: female, with sphragis.



Figure 5-103d. *Parnassius clodius claudianus*: male, dorsal



Figure 5-103e. *Parnassius clodius claudianus*: male, ventral.



Figure 5-103f. *Parnassius clodius claudianus*: caterpillar.

COLIAS GIGANTEA - GIANT SULPHUR - PIERIDAE

Nine species of *Colias* occur in the Pacific Northwest.

ADULT (PLATE 41, FIG. 5-104A,B,C,D)

Wingspan 5.0 cm.

The dorsal surface of the forewings in the male is yellow with a broad black marginal border and a small black discal spot. The dorsal surface of the hindwings in the male has a narrow black marginal border and a faint yellow discal spot. The dorsal surface of the forewings of the female is variable: yellow, cream, or white, with a small, black discal spot, variably with or without a faint, black submarginal line. The female dorsal surface of the hindwings has an orange discal spot. The ventral surface of the forewings is yellow with a black discal spot. The ventral surface of the hindwings is yellow to orange with variable black, melanic scaling, and with a round, white discal spot ringed with red and often with a smaller red satellite spot.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species is widely distributed across arctic and subarctic regions of Canada and Alaska, extending southward along the Rocky Mountains to central Idaho and Wyoming. It occurs in extremely local and sedentary colonies. Within the subalpine zone of the Rocky Mountains, the butterflies do not fly far from boggy meadows and seep areas along creeks. Caterpillars feed on dwarf willows growing in subalpine bogs at high elevations in the mountains. Adults are diurnal and fly in July.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Giant Sulphur is sensitive to forest management. Draining water from the boggy meadows and tree encroachment into the open bog habitats would be detrimental to populations of this species. Prescribed forest thinning and clearing would be beneficial in maintaining suitable habitat. This species is vulnerable to local extermination during insecticide spray programs.

Information regarding the geographic range of the species is good. In the Pacific Northwest, this species is confined to the high mountains of western Montana and central Idaho. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet to sample species of willows. Adults may be sampled by conducting a timed visual search along transects through boggy meadows.

COLIAS INTERIOR - PINK-EDGED SULPHUR - PIERIDAE

Nine species of *Colias* occur in the Pacific Northwest.

ADULT (PLATE 41, FIG. 5-105A,B; PLATE 42, FIG. 5-105C,D)

Wingspan 4.5 cm.

The dorsal surface of the forewings in the male is yellow with a broad, black marginal border and a small, faint discal spot. The dorsal surface of the hindwings in the male has a narrow, black marginal border and a faint, orange discal spot. The dorsal surface of the forewings in the female is variable: yellow, cream, or white, with a small, faint discal spot. A thin, dusky, black border is present at the forewing apex. The dorsal surface of the hindwings in the female has a faint, orange discal spot. The ventral surface of the forewings is yellow with a black discal spot. The ventral surface of the hindwings is yellow to orange with weak or no black melanic scaling, and with a round, white discal spot ringed with red.

CATERPILLAR

Pyle (2002) describes the larva as dark mustard-green above, blue on the lateral surfaces, with a red longitudinal stripe.

ECOLOGY

This species is widely distributed in northern forests across Canada, extending southward in the Cascade Mountains and northern Rocky Mountains of the Pacific Northwest. It is quite sedentary and lives in local colonies tightly associated with its caterpillar food plant. Its preferred habitat is open, sunny forests at middle elevations in the northern Rocky Mountains, extending southward through eastern Oregon, central Idaho, and along the east slope of the Cascades in Oregon. Caterpillars feed on dwarf huckleberries, such as *Vaccinium caespitosum*. Adults are diurnal and fly in July.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Pink-Edged Sulphur is sensitive to forest management. The creation of suitable habitat requires some disturbance to prevent heavy brush and dense tree stands. Populations of this butterfly will benefit from infrequent, controlled ground fires and prescribed forest thinning. Small clearcuts have been observed to benefit this species. The local population structure makes this species highly vulnerable to extermination during insecticide spray programs for such insect pests as the western spruce budworm and Douglas fir tussock moth.

Information regarding the geographic range of the species is excellent. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships where this species has been recorded; nearly all records are east of the crest of the Cascade Mountains. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of huckleberries using a beating sheet. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants for adults are present.

COLIAS NASTES STRECKERI - LABRADOR SULPHUR - PIERIDAE

Nine species of *Colias* occur in the Pacific Northwest. The species *nastes* has one subspecies in the Pacific Northwest.

ADULT (PLATE 42, FIG. 5-106A,B,C,D)

Wingspan 4.4 cm.

The dorsal surface of the fore- and hindwings is pale yellow with heavy, black melanic scaling, black basal suffusion, and broken, black marginal borders. The dorsal surface of the forewings has a small, black discal spot, and the dorsal surface of the hindwings has a small, pale, yellow to orange discal spot. The ventral surface of the forewings is white with a dusky yellow apex and a small, black discal spot. The ventral surface of the hindwings is yellow with very heavy, black melanic scaling and a small, white, discal spot ringed with red.

CATERPILLAR (FIG. 5-106E)

Pyle (2002) describes the larva as moss green with lateral stripes edged in red.

ECOLOGY

This is an arctic species found on tundra across northern regions of Eurasia and North America. It also occurs above timberline in alpine habitats of the Rocky Mountains southward to Montana and the Cascade Mountains in northern Washington. Caterpillars feed on legumes, such as *Astragalus* and *Oxytropis* (Pyle 2002), but also may feed on dwarf willows in the northern Cascades of Washington and British Columbia (D. McCorkle, per. comm.). Adults are diurnal and fly in July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Labrador Sulphur is sensitive to climate change. Warming climatic conditions may eliminate this species from the southern regions of its range in the United States. The location of populations in north-central Washington and northwestern Montana represent the southern extent of the species, and any loss of habitat in these regions would severely restrict the distribution of this species.

Information regarding the geographic range of the species is excellent. The atlas of Washington butterflies shows only four townships where this species has been recorded. The townships are in a cluster along the central northern border of Okanogan County, Washington (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

COLIAS OCCIDENTALIS - WESTERN SULPHUR - PIERIDAE

Nine species of *Colias* occur in the Pacific Northwest. The diagnosis of numerous subspecies in the PNW is currently in progress.

ADULT (PLATE 43, FIG. 5-107A,B,C,D,E; PLATE 44, FIG. 5-107F,G,H,I,J)

Wingspan 5.0 cm.

The dorsal surface of the forewings in the male is yellow to orange with a broad, black marginal border and a small, black discal spot. The dorsal surface of the hindwings in the male has a narrow, black marginal border, heavy, black basal suffusion, and a faint, yellow to orange discal spot. The dorsal surface of the forewings in the female is either orange, yellow, cream, or white with a small black discal spot. A broken, black marginal border is variably present or completely absent. The dorsal surface of the hindwings in the female has an orange to yellow discal spot. The ventral surface of the forewings is yellow with a black discal spot. The ventral surface of the hindwings is variably green, yellow, or orange with heavy, black melanic scaling, and with a round, white discal spot ringed with red and often with a smaller red satellite spot.

CATERPILLAR

Pyle (2002) describes the larva as green with fine white hairs, green-ringed black dots, white and rose-colored lateral lines.

ECOLOGY

Although this species is widely distributed in western North America, the butterflies are extremely sedentary and live in local colonies in close association with its caterpillar food plant. The butterfly is most common in open Ponderosa pine forests at middle elevations with preferred habitat in open, sunny forests and meadows, ranging from juniper woodlands at lower elevations to subalpine meadows at higher elevations. Caterpillars feed on herbaceous legumes, such as peas and false lupine. Adults are diurnal and fly in May to August, depending on elevation.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Western Sulphur is sensitive to forest management. The creation of suitable habitat requires some disturbance to prevent heavy brush and tree encroachment into open forests and meadows. Populations of this butterfly will benefit from infrequent, controlled ground fires, prescribed forest thinning, and small clearcuts to create an open habitat. The local population structure of *C. occidentalis* makes it highly vulnerable to extermination during insecticide spray programs for forest insect pests, such as the western spruce budworm and Douglas fir tussock moth.

Information regarding the geographic range of the species is good. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships where this species and its subspecies have been recorded. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

COLIAS PELIDNE SKINNERI - PELIDNE SULPHUR - PIERIDAE

Nine species of *Colias* occur in the Pacific Northwest. The species *pelidne* has one subspecies in the Pacific Northwest.

ADULT (PLATE 44, FIG. 5-108A; PLATE 45, FIG. 5-108B,C,D,E,F)

Wingspan 4.3 cm.

The dorsal surface of the forewing in the male is yellow with a broad, black marginal border and a small, black discal spot. The dorsal surface of the hindwings in the male has a narrow, black marginal border, very heavy, black basal suffusion, and a small, faint, yellow discal spot. The dorsal surface of the forewings in the female is variably yellow, cream, or white with a narrow, broken black marginal border and a small, black discal spot. The dorsal surface of the hindwings in the female has a narrow, black marginal border and a small, faint, yellow to orange discal spot. The ventral surface of the forewings is yellow with very heavy, black melanic scaling. The ventral surface of the hindwings is orange with very heavy, black melanic scaling and a small, red discal spot.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species ranges from the northern Rocky Mountains of Alberta and British Columbia south through Montana and Idaho to western Wyoming and eastern Oregon. Its preferred habitat is open, subalpine or alpine meadows at or above timberline. Caterpillars feed on dwarf huckleberries, such as *Vaccinium caepitosum*. Adults are diurnal and fly in July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Pelidne Sulphur is sensitive to climate change. Warming climatic conditions may eliminate this species from the southern regions of its range in the United States.

Information regarding the geographic range of the species is good. The atlas of Oregon butterflies shows only nine townships, forming two clusters, where the Pelidne Sulphur has been recorded (Hinchliff 1994). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of huckleberries using a beating sheet. Adults may be sampled by conducting a timed visual search along transects through suitable habitat where nectar plants for adults are present.

PIERIS MARGINALIS - MARGINED WHITE - PIERIDAE

Two species of *Pieris* occur in the Pacific Northwest. The Margined White was previously known as *Pieris napi*.

ADULT (PLATE 45, FIG. 5-109A; PLATE 46, FIG. 5-109B,C,D,E,F,G; PLATE 47, FIG. 5-109H)

Wingspan 4.2 cm.

The dorsal surface of the fore- and hindwings in the male is white with black basal suffusion and weak, dark, scaling on the veins. The dorsal surface of the fore- and hindwings in the female is pale yellow with heavier black scaling along the veins and variably with two faint, black median spots on the forewing. The ventral surface of the forewings is white with a pale yellow apex. The ventral surface of the hindwings is pale yellow. Spring forms have heavy black scaling along the veins, while summer forms show reduced scaling.

CATERPILLAR

Pyle (2002) describes the larva as green, stippled in black, green dorsal stripe, and pale lateral stripes. Guppy and Shepard (2001) show an image of the caterpillar of *P. m. tremblayi*.

ECOLOGY

This species occurs in wet forests in montane regions of western North America, particularly moist riparian zones along forest streams. Caterpillars feed on crucifers (Brassicaceae), particularly species of *Dentaria* and *Rorippa*, growing in moist to wet habitats (Pyle 2002). Adults are diurnal and fly in at least two broods from March to September.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Margined White is sensitive to forest management. This butterfly is dependent on the maintenance of riparian forest habitats. East of the Cascades it is vulnerable to extermination during insecticide spray programs for forest insect pests, such as the western spruce budworm and Douglas fir tussock moth.

Information regarding the geographic range of the species is excellent. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships where this species has been recorded. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

DASYPYGA ALTERNOSQUAMELLA - DWARF MISTLETOE SNOUT MOTH - PYRALIDAE

One species of *Dasyphyga* occurs in the Pacific Northwest.

ADULT (PLATE 47, FIG. 5-110)

Wingspan 2.2 cm.

The dorsal surface of the forewings is gray in the basal half and orange in the distal half with a faint basal band and thin, black subapical streak. The dorsal surface of the hindwings is white. The ventral surface of the forewings is gray. The ventral surface of the hindwings is white.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species is widely distributed in western North America. Caterpillars feed on dwarf mistletoes growing on conifers. Adults are diurnal and fly in early summer during June and July.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Dwarf Mistletoe Snout Moth is sensitive to forest management. This species requires mature to old-growth coniferous forests that are infested with dwarf mistletoes, on which they feed. In this same context, the caterpillars serve a beneficial role because dwarf mistletoe is considered a pest plant. This role is identical to that of biological control agents employed for the regulation of weed populations (see *Tyria jacobaeae*, *Aplocera plagiata*, and *Hyles euphorbiae*).

Information regarding the geographic range of the species is poor. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling trees infested with dwarf mistletoe using a beating sheet. Adults may be sampled using UV or mercury-vapor light traps. Overall, we have observed 71 individuals, typically noting only 1 to 2 moths per trap-night.

SATURNIA MENDOCINO - MENDOCINO SILKMOTH - SATURNIIDAE

One species of *Saturnia* occurs in the Pacific Northwest. A very similar species, *S. walterorum*, occurs to the south (Tuskes et al. 1996).

ADULT (PLATE 47, FIG. 5-111A)

Wingspan 5.7 cm. in the male and 7.0 cm. in the female.

The dorsal surface of the forewings is brown with a round, black reniform spot, and a black, white, and red subapical patch. The dorsal surface of the hindwings is yellow-orange with a round, black reniform spot and a broad, black postmedian band. The ventral surface of the fore- and hindwings is similar to the dorsal surface, but paler orange.

CATERPILLAR (PLATE 47, FIG. 5-111B,C,D; PLATE 48, FIG. 5-111E,F)

The coloration of the body varies widely through the various instars. In late instars the dorsum is yellow with fine, wispy, white hairs and some patches of shorter, densely packed, orange hairs; the ventor is black anterior to the prolegs. The hairs on the caterpillar are urticating. Head is brown.

ECOLOGY

The species is endemic to the West Coast west of the Cascade and Sierra Nevada Mountains, extending from central California to northwest Oregon. It is generally uncommon within its distribution in the Pacific Northwest, but it may be locally frequent where food plants are abundant. The habitat consists of dry, open forests and brushland. Caterpillars are uncommon and readily feed on the foliage of manzanita and madrone. Adults are diurnal and fly in early spring.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Mendocino Silkmoth is rare in the Pacific Northwest. Because the caterpillar of this species is dependent on madrone and manzanita as food plants, frequent fires or brush clearing may be harmful to this species. In contrast, infrequent fires may be beneficial in rejuvenating old, senescent manzanita.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling manzanita, in particular, using a beating sheet. We have collected two caterpillars in our studies. Adults may be measured by conducting a timed visual search along transects through suitable habitat where food plants for caterpillars are present.

CERCYONIS STHENELE SILVESTRIS - GREAT BASIN WOOD NYMPH - SATYRIDAE

Three species of *Cercyonis* occur in the Pacific Northwest. The species *sthenele* has two subspecies in the Pacific Northwest.

ADULT (PLATE 48, FIG. 5-112A,B)

Wingspan 4.2 cm.

The dorsal surface of the forewings is dark brown with two black postmedian spots. The dorsal surface of the hindwings is dark brown and without markings. The ventral surface of the forewings is brown with faint mottled striations. Two large, black postmedian spots are broadly ringed with yellow and have a small, white pupil. The ventral surface of the hindwings is also brown but with faint, mottled striations and with one or two small, black postmedian spots.

CATERPILLAR

Guppy and Shepard (2001) describe the caterpillar as ... light green with a dark green dorsal stripe and whitish lateral stripes.

ECOLOGY

This subspecies of *C. sthenele* is restricted to dry woodlands west of the Sierra Nevada and Cascade Mountains in California and southwest Oregon north to Lane County. Other subspecies occur in sagebrush rangelands and juniper woodlands east of the Cascade Mountains. Its preferred habitat is oak woodlands at low elevations and open coniferous forests at middle elevations. Caterpillars feed on grasses, particularly native bunchgrasses, such as *Festuca*. Adults are diurnal and fly in July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Great Basin Wood Nymph is sensitive to forest management. The creation of suitable habitat requires some disturbance to prevent heavy brush and tree encroachment into the open forests and grassy meadows. Populations of this butterfly will benefit from infrequent, controlled ground fires and prescribed forest thinning to create an open forest habitat that conserves the native grasses.

Information regarding the geographic range of the species is excellent. The atlas of Oregon butterflies shows numerous townships where the Great Basin Wood Nymph has been recorded (Hinchliff 1994). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by sampling with a sweep net or conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

EREBIA VIDLERI - VIDLER'S ALPINE - SATYRIDAE

Two species of *Erebia* occur in the Pacific Northwest.

ADULT (PLATE 48, FIG. 5-113A,B)

Wingspan 4.0 cm.

The dorsal surface of the forewings is dark black-brown with a broad, yellow-orange postmedian band and three black postmedian spots. The dorsal surface of the hindwings is similar to the forewing but with smaller markings. The ventral surface of the forewings is similar to the dorsal surface, but paler. The ventral surface of the hindwings is brown with a broad, pale-gray to brown postmedian band.

CATERPILLAR

Undescribed and we have yet to collect this caterpillar in the Pacific Northwest.

ECOLOGY

This species is narrowly endemic to the northern portion of the Pacific Northwest, extending from central British Columbia south through the Cascades and Olympic Mountains of Washington. Its preferred habitat is moist, subalpine or alpine meadows at high elevations in the mountains. Caterpillars feed on grasses and sedges, perhaps pine grass (Pyle 2002). Adults are diurnal and fly in July and August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Vidler's Alpine is sensitive to climate change. Warming climatic conditions may eliminate this species from much of its southern distribution in the United States.

Information regarding the geographic range of the species is excellent. The atlas of Washington butterflies shows numerous townships where Vidler's Alpine has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. Caterpillar food plants are not known and need to be studied. The abundance of larvae and adults may be measured by sampling with a sweep net or conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

PLATE 41, FIGURES 5-104A – 5-105B



Figure 5-104a. *Colias gigantea*: female, dorsal.



Figure 5-104b. *Colias gigantea*: female, ventral.



Figure 5-104c. *Colias gigantea*: male, dorsal.



Figure 5-104d. *Colias gigantea*: male, ventral.



Figure 5-105a. *Colias interior interior*: female, dorsal.



Figure 5-105b. *Colias interior interior*: female, ventral.

PLATE 42, FIGURES 5-105C – 5-106D



Figure 5-105c. *Colias interior interior*: male, dorsal.



Figure 5-105d. *Colias interior interior*: male, ventral.



Figure 5-106a. *Colias nastes streckeri*: female, dorsal.



Figure 5-106b. *Colias nastes streckeri*: female, ventral.



Figure 5-106c. *Colias nastes streckeri*: male, dorsal.



Figure 5-106d. *Colias nastes streckeri*: male, ventral.

PLATE 43, FIGURES 5-106E – 5-107E



Figure 5-106e. *Colias nastes streckeri*: caterpillar.



Figure 5-107a. *Colias occidentalis*: female, dorsal, white form.



Figure 5-107b. *Colias occidentalis*: female, ventral, white form.



Figure 5-107c. *Colias occidentalis*: female, dorsal, yellow form.



Figure 5-107d. *Colias occidentalis*: female, ventral, yellow form.



Figure 5-107e. *Colias occidentalis*: male, dorsal, yellow form.

PLATE 44, FIGURES 5-107F – 5-108A



Figure 5-107f. *Colias occidentalis*: male, ventral, yellow form.



Figure 5-107g. *Colias occidentalis*: female, dorsal, orange form.



Figure 5-107h. *Colias occidentalis*: female, ventral, orange form.



Figure 5-107i. *Colias occidentalis*: male, dorsal, orange form.



Figure 5-107j. *Colias occidentalis*: male, ventral, orange form.



Figure 5-108a. *Colias pelidne skinneri*: female, dorsal, white form.

PLATE 45, FIGURES 5-108B – 5-109A



Figure 5-108b. *Colias pelidne skinneri*: female, ventral, white form.



Figure 5-108c. *Colias pelidne skinneri*: female, dorsal, yellow form.



Figure 5-108d. *Colias pelidne skinneri*: female, ventral, yellow form.



Figure 5-108e. *Colias pelidne skinneri*: male, dorsal.



Figure 5-108f. *Colias pelidne skinneri*: male, ventral.



Figure 5-109a. *Pieris marginalis*: female, dorsal, spring generation.

PLATE 46, FIGURES 5-109B – 5-109G



Figure 5-109b. *Pieris marginalis*: female, ventral, spring generation.



Figure 5-109c. *Pieris marginalis*: male, dorsal, spring generation.



Figure 5-109d. *Pieris marginalis*: male, ventral, spring generation.



Figure 5-109e. *Pieris marginalis*: female, dorsal, summer generation.



Figure 5-109f. *Pieris marginalis*: female, ventral, summer generation.



Figure 5-109g. *Pieris marginalis*: male, dorsal, summer generation.

PLATE 47, FIGURES 5-109H – 5-111D



Figure 5-109h. *Pieris marginalis*: male, ventral, summer generation.



Figure 5-110. *Dasyphyga alternosquamella*: dorsal.



Figure 5-111a. *Saturnia mendocino*: female, dorsal.



Figure 5-111b. *Saturnia mendocino*: 1st instar.



Figure 5-111c. *Saturnia mendocino*: 2nd instar.



Figure 5-111d. *Saturnia mendocino*: 3rd instar.

PLATE 48, FIGURES 5-111E – 5-113B



Figure 5-111e. *Saturnia mendocino*: 4th instar.



Figure 5-111f. *Saturnia mendocino*: 5th instar.



Figure 5-112a. *Cercyonis sthenele silvestris*: dorsal.



Figure 5-112b. *Cercyonis sthenele silvestris*: ventral.



Figure 5-113a. *Erebia vidleri*: male, dorsal.



Figure 5-113b. *Erebia vidleri*: male, ventral.

OENEIS CHRYXUS - *CHRYXUS ARCTIC* - SATYRIDAE

Three species of *Oeneis* occur in the Pacific Northwest.

ADULT (PLATE 49, FIG. 5-114A,B,C,D)

Wingspan 4.7 cm.

The dorsal surface of the forewings in the male is orange with a broad, black-brown discal area of pheromone scales, 1 to 3 black postmedian spots, and brown wing veins. Females lack the pheromone scales on the forewings. The dorsal surface of the hindwings is a mottled orange. The ventral surface of the forewings is similar to the dorsal surface, but paler yellow with some brown striate mottling. The ventral surface of the hindwings is mottled with white and brown striations and has two small, black postmedian spots.

CATERPILLAR

Guppy and Shepard (2001) describe the caterpillar as follows: "...thickest in the middle and have an arched back and two short tails. The color is various shades of buff, with longitudinal stripes. Down the middle of the back is a narrow black stripe bordered on both sides with a yellow buff line. There is a dorsolateral broad black stripe, bordered above with a brown buff stripe and below with a red buff stripe with a reddish line in the center ..., below that is a yellow line, a brown buff lateral line, a yellow line along the ventrolateral ridge, and finally a brown buff line."

ECOLOGY

This species is widely distributed across Canada and Alaska, extending southward through the Rocky Mountains, and with widely disjunct populations along the West Coast from British Columbia to the California Sierra Nevada. Its preferred habitat is open, subalpine forests and alpine meadows at high elevations in the mountains. Caterpillars feed on grasses and sedges. Adults are diurnal and fly from June to August. This species may exhibit a two-year life cycle, although annual populations are found in most areas.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The *Chryxus Arctic* is sensitive to climate change. Warming climatic conditions may eliminate this species from its southern locations in the United States.

Information regarding the geographic range of the species is excellent. The atlas of Washington butterflies shows numerous townships where the *Chryxus Arctic* has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. Caterpillar food plants are not known and need to be studied. The abundance of larvae and adults may be measured by sampling with a sweep net or conducting a timed visual search along transects through suitable habitat where food plants (once discovered) for caterpillars and nectar plants for adults are present.

OENEIS MELISSA BEANII - MELISSA ARCTIC - SATYRIDAE

Three species of *Oeneis* occur in the Pacific Northwest. The species *melissa* has one subspecies in the Pacific Northwest.

ADULT (PLATE 49, FIG. 5-115A,B)

Wingspan 4.7 cm.

The dorsal surface of the fore- and hindwings is a translucent gray-brown and without markings. The ventral surface of the forewings is dark gray-brown with some fine mottling. The ventral surface of the hindwings is black with fine, yellow or pale gray mottling or speckling.

CATERPILLAR

Guppy and Shepard (2001) describe the caterpillar as follows: "... mature larvae are shades of buff. The dorsal line is grey green, with dark spots edged with white lines between segments; below this, the ground color is grey buff with blackish longitudinal streaks, and there are two brown dorsolateral lines ..., lateral band is broad and deep black, and has a light buff line below that. The spiracular band is dark grey."

ECOLOGY

This species is widely distributed in arctic regions across Eurasia and North America, extending southward in the Rocky Mountains to New Mexico. The subspecies *O. m. beanii* is endemic to the northern portion of the Pacific Northwest, extending from central British Columbia and Alberta south to northwest Montana and the north Cascades of Washington. Its preferred habitat is rocky tundra above timberline at the highest elevations in the mountains. Caterpillars feed on grasses and sedges (Pyle 2002). Adults are diurnal and fly in July and August. This species may exhibit a two-year life cycle, although annual populations are found in most areas.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Melissa Arctic is sensitive to climate change. Warming climatic conditions may eliminate this species from much of its southern distribution in the United States.

Information regarding the geographic range of the species is excellent. The atlas of Washington butterflies shows only eight townships where the Melissa Arctic has been recorded (Hinchliff 1996). Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by sampling with a sweep net or conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

OENEIS NEVADENSIS - GREAT ARCTIC - SATYRIDAE

Three species of *Oeneis* occur in the Pacific Northwest.

ADULT (PLATE 50, FIG. 5-116A,B,C,D)

Wingspan 5.5 cm.

The dorsal surface of the forewings in the male is orange with a broad, black-brown discal area of pheromone scales, two black postmedian spots with a small, white pupil, and narrow, black-brown costal and marginal borders. Females lack the pheromone scales on the forewings. The dorsal surface of the hindwing in the male is orange with one black postmedian spot with a small, white pupil and a narrow, black marginal border. The ventral surface of the forewings is similar to the dorsal surface. The ventral surface of the hindwings is mottled with white and brown striations and has one black postmedian spot.

CATERPILLAR

Guppy and Shepard (2001) describe the caterpillar as follows: "... buff brown. The dorsal stripe is black below which is a whitish stripe shading outward to brown and streaked longitudinally with dark brown and black. The subdorsal line is black, and below it the ground color is buff with black speckles. The lateral band is deep black, the spiracular band green buff, the basal ridge yellow white... ."

ECOLOGY

This species is distributed at higher elevations in the mountains along the West Coast from southern British Columbia south through the mountains of California. Its preferred habitat is open, sunny, coniferous forests at moderate to high elevations. Caterpillars feed on grasses and sedges. Adults are diurnal and fly from June through August, depending on elevation. This species appears to have a two-year life cycle, and butterflies in many areas fly only in even numbered years. Annual populations occur at lower elevations in southwest Oregon.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Great Arctic is sensitive to forest management. The creation of suitable habitat requires some disturbance to prevent heavy brush and tree encroachment into the open forests and subalpine meadows. Populations of this butterfly will benefit from infrequent, controlled ground fires and prescribed forest thinning to create an open forest habitat suitable for native grasses.

Information regarding the geographic range of the species is excellent. Both the atlas of Oregon butterflies (Hinchliff 1994) and the atlas of Washington butterflies (Hinchliff 1996) show numerous townships where this species and its subspecies have been recorded. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be measured by sampling with a sweep net or conducting a timed visual search along transects through suitable habitat where food plants for caterpillars and nectar plants for adults are present.

ARCTONOTUS LUCIDUS - PACIFIC GREEN SPHINX - SPHINGIDAE

One species of *Arctonotus* occurs in the Pacific Northwest.

ADULT (PLATE 50, FIG. 5-117)

Wingspan 5.0 cm.

The dorsal surface of the forewings is green with purple basal and postmedian bands. The dorsal surface of the hindwings is pink with a dark red submarginal band. The ventral surface of the fore- and hindwings is pink-gray.

CATERPILLAR

Dark green-black, white transverse bands are located dorsally with a black patch medially, dorsal dark area of each segment from A-4 through A-9 with a pair of dorso-lateral white dots, a series of oblique, irregular, white lines are located laterally and angle posterior-ventral to anterior-dorsal, a pair of faint lines run from the head to the caudal button (Hodges 1971).

ECOLOGY

The species is narrowly distributed along the West Coast in California and southwest Oregon, extending east of the Cascades northward through eastern Oregon and Washington to western Idaho. Its preferred habitat is open, dry forests and rangelands, including oak woodlands west of the Cascades, and open, Ponderosa pine forests, juniper woodlands, and sagebrush rangelands east of the Cascade Mountains. Caterpillars feed on the foliage of evening primrose. Adults are reported to be both nocturnal and diurnal in flight and fly in late winter and early spring, mainly in February and March.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Pacific Green Sphinx is sensitive to forest management. The creation of suitable habitat requires some disturbance to prevent heavy brush and dense stands of trees. Populations of this moth will benefit from infrequent, controlled ground fires and prescribed forest thinning to create an open habitat.

Information regarding the geographic range of the species is good. The species is distributed throughout much of the Pacific Northwest as described above. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling species of evening primrose with a sweep net or by conducting a visual search along transects. Given reports that this moth can be nocturnal, it might be possible to sample adults using UV or mercury-vapor light traps. The species ranges over a large portion of the Pacific Northwest. However, due to their late winter to early spring flight season specimens are difficult to collect. Thus, individuals are uncommon in museum collections.

Hyles euphorbiae - LEAFY SPURGE HAWKMOTH - SPHINGIDAE

Three species of *Hyles* occur in the Pacific Northwest.

ADULT (PLATE 50, FIG. 5-118)

Wingspan 7.0 cm.

The dorsal surface of the forewings is dark brown with a central, pale yellow stripe, a brown discal spot, and a pale brown marginal border. The dorsal surface of the hindwings is pink to rose-red with black basal and marginal bands. The ventral surface of the fore- and hindwings is pale pink with a black discal spot on the forewing.

CATERPILLAR

Colors and pattern are relatively consistent. The predominant color and pattern is black with yellow stippling that is aligned in a circumsegmental (ringed) pattern on the thorax and abdomen (T-2 to A-8). An irregularly shaped but rounded patch of black surrounds a pair of yellow spots subdorsally on the thorax and abdomen (T-2 to A-8). The mid-dorsal longitudinal stripe is red.

ECOLOGY

This species is widely distributed in the drier regions of Eurasia and was intentionally introduced into Montana in 1966 from Europe as a biological control agent to suppress leafy spurge, a non-native (exotic) pest plant, in the drier rangelands of western North America. Caterpillars feed on weedy spurges. Within the scope of the greater Pacific Northwest the moth is established only in Idaho and Montana (Hansen 2004). Adults are nocturnal and diurnal and fly from April to August.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Leafy Spurge Hawkmoth is a weed biological control agent. However, this species is not considered to be highly effective at suppressing leafy spurge (Hansen 2004). If this sphingid is found in an area of interest, the use of pesticides, including BTK, should be avoided.

Information regarding the geographic range of the species is poor. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling leafy spurge with a sweep net or by conducting a visual search along transects through spurge infested areas. Adults may be sampled using UV or mercury-vapor light traps.

Hyles gallii - GALIUM SPHINX - SPHINGIDAE

Three species of *Hyles* occur in the Pacific Northwest.

ADULT (PLATE 51, FIG. 5-119)

Wingspan 6.8 cm.

The dorsal surface of the forewings is black with a central, cream-white stripe and a gray marginal border. The dorsal surface of the hindwings is pink to rose-red with black basal and marginal bands. The ventral surface of the fore- and hindwings is similar to the dorsal surface, but paler.

CATERPILLAR

Highly variable colors but the pattern is relatively consistent. The predominant colors include mostly black, yellow-tan-brown, or green. An irregularly shaped but rounded patch of black, white, or yellow occurs subdorsally on the thorax and abdomen (T-2 to A-8). Also on the thorax and abdomen (T-2 to A-8), yellow stippling is aligned in a circumsegmental (ringed) pattern.

ECOLOGY

This species is widely distributed across northern regions of both Eurasia and North America. It occurs in high montane regions of the Pacific Northwest, extending southward at high elevations through the Rocky Mountains to Colorado. Caterpillars feed on fireweed. Adults are nocturnal and diurnal and fly in at least two generations from June to September.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Galium Sphinx is rare in the Pacific Northwest and is sensitive to forest management. The creation of suitable habitat requires some disturbance, such as controlled ground fires, tree thinning, and small-scale clearcutting, to create open habitat suitable for the growth of fireweed.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed by sampling fireweed with a sweep net or by conducting a visual search along transects through patches of fireweed. Adults may be sampled using UV or mercury-vapor light traps.

PROSERPINUS CLARKIAE - CLARK'S DAY SPHINX - SPHINGIDAE

Two species of *Proserpinus* occur in the Pacific Northwest.

ADULT (PLATE 51, FIG. 5-120)

Wingspan 4.0 cm.

The dorsal surface of the forewings is pale green with a dark green median band and a small, black discal spot. The dorsal surface of the hindwings is orange with a black marginal band. The ventral surface of the fore- and hindwings is gray with a pale yellow median band.

CATERPILLAR

The mature larva is black dorsally and in the area of the spiracles, the supraspiracular area is a creamy white-gray with black spots. An irregular and wavy black spiracular band is enlarged at each spiracle encircling the spiracles and is continuous or nearly so. The last instar lacks a caudal horn.

ECOLOGY

This species is distributed in the Pacific Northwest from central California to British Columbia and east to Idaho. Its preferred habitats are dry, open, oak woodlands and native prairies west of the Cascades, and open Ponderosa pine forest east of the Cascades. Caterpillars feed on *Clarkia*. Adults are diurnal and fly in late spring and early summer, typically from May to June.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

Clark's Day Sphinx is sensitive to forest management. The creation of suitable habitat requires some disturbance to prevent heavy brush and dense stands of trees encroaching into the open habitat needed for the growth of *Clarkia*. Populations of this moth will benefit from infrequent, controlled ground fires and prescribed forest thinning to create an open habitat.

Information regarding the geographic range of the species is good. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae and adults may be assessed by sampling with a sweep net or by conducting a visual search along transects through patches of *Clarkia* and nectar flowers.

PROSERPINUS FLAVOFASCIATA - YELLOW-BANDED DAY SPHINX - SPHINGIDAE

Two species of *Proserpinus* occur in the Pacific Northwest.

ADULT (PLATE 51, FIG. 5-121)

Wingspan 4.0 cm.

This species is a bumblebee mimic. The dorsal surface of the forewings is black with a white median band. The dorsal surface of the hindwings is yellow-orange or black with black basal and marginal borders. The ventral surface of the fore- and hindwings is black with a yellow-white median band. The head and thorax are yellow, and the abdomen nearly entirely black except for a wisp of yellow hairs distally.

CATERPILLAR

Penultimate instar: pale green, a pair of pale dorso-lateral lines from the head to the caudal horn. Last instar: brown to near black, with numerous black dots; one middorsal, and a pair of subdorsal, black longitudinal black lines; the caudal horn is represented by a black button encircled first by white, then black, lines (Hodges 1971).

ECOLOGY

This species is widely distributed across the subarctic regions of Canada and Alaska, extending southward at high elevations in the Rocky Mountains and Cascade Mountains of Oregon. It is sensitive to forest management, and requires meadows at mid to high elevations. Caterpillars feed on fireweed. Adults are diurnal and fly in early spring when snow is still on the ground, usually May at high elevations in the mountains.

SENSITIVITY ISSUE AND POPULATION ASSESSMENT

The Yellow-Banded Day Sphinx is rare and sensitive to forest management. Populations of this moth will benefit from the creation of open habitat. Disturbances, such as burning and clearcutting, will promote the growth of fireweed.

Information regarding the geographic range of the species is poor due to the early flight season. Information regarding the status of numbers of individuals within populations is poor. The abundance of larvae may be assessed using a beating sheet or sweep net to sample fireweed. As day-fliers adults may be measured by conducting a timed visual search along transects through patches of fireweed and adult nectar flowers. Overall, we have observed only two moths.

PLATE 49, FIGURES 5-114A – 5-115B



Figure 5-114a. *Oeneis chryxus*: female, dorsal.



Figure 5-114b. *Oeneis chryxus*: female, ventral.



Figure 5-114c. *Oeneis chryxus*: male, dorsal.



Figure 5-114d. *Oeneis chryxus*: male, ventral.



Figure 5-115a. *Oeneis melissa beanii*: dorsal.



Figure 5-115b. *Oeneis melissa beanii*: ventral.

PLATE 50, FIGURES 5-116A – 5-118



Figure 5-116a. *Oeneis nevadensis*: female, dorsal.



Figure 5-116b. *Oeneis nevadensis*: female, ventral.



Figure 5-116c. *Oeneis nevadensis*: male, dorsal.



Figure 5-116d. *Oeneis nevadensis*: male, ventral.



Figure 5-117. *Arctonotus lucidus*: dorsal.



Figure 5-118. *Hyles euphorbiae*: dorsal.

PLATE 51, FIGURES 5-119 – 5-121



Figure 5-119. *Hyles gallii*: dorsal.



Figure 5-120. *Proserpinus clarkiae*: dorsal.



Figure 5-121. *Proserpinus flavofasciata*: dorsal.

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