An Angler's Guide

Aquatic Insects of
Central California's Rivers:

Revised and Expanded

2015

By

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Entomologist and Angler

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Preface

Having fly-fished this area for many years, I have always been interested in aquatic insects. Even in my early years, it became obvious that fly-fishing went hand in hand with a thorough knowledge of the insect diet of the fish I pursued. Very early during my fishing experiences, I became frustrated with the general lack of accurate information about aquatic insects, and as a result, I attempted to learn all I could about this fascinating group of animals.

The scientific aspects of my study began with a survey of aquatic insects as a college undergraduate. My study of these insects was also my focus in graduate school, and since then, I have continued to study and learn about aquatic insects and their habitats.

Although this work bears only a single author, it is the product of many persons. Foremost among these persons is Steve Hoff, my constant fishing companion and "colleague". We have fished together for many years, and much of what has been written about in the following pages we have experienced, experimented with, and learned about together.

I would like to thank those entomologists who have helped me identify the insects covered here: Dr. D. Burdick (C.S.U., Fresno), Dr. W. Flowers (Florida A. and M.), Dr. J Unzicker (Illinois Natural History Survey), Dr. T. Baumann (Brigham Young University), Dr. K. Stewart (University of North Texas), Dr. D. Denning, and the staff of the insect identification service (C. D. Food and Agriculture, Sacramento). Several others have made helpful suggestions or aided in other ways: Dr. K. Daane and Mr. D. Harper (Kearney Agricultural Center, Parlier), Dr. J. Smilanick, Dr. J. Johnson, and Mr. J. Clark (Agricultural Research Service, U. S. D. A., Parlier). Among my fellow anglers, appreciation is given to Mr. W. Shiroyama and Mr. W. Peregrin, both of Fresno, for the many helpful conversation and insights they have given me. Special thanks must go to the late Mr. M. Powell of Buz's Fly Shop who long ago "planted the seed". Finally I must thank Linda who has reviewed and edited this manuscript in its many forms.

I envision this work as an ongoing project, since acquisition of knowledge about biological systems is a never-ending process. Hopefully, new material can be readily added as available. Although I have attempted to make this work scientifically accurate, I alone am responsible for any mistakes, improper interpretations, or other shortcomings.

My hope is that a better understanding of the trout-insect relationship will help anglers have a more enjoyable day on the river. It is also my hope that a better understanding of these relationships will result in a greater desire to protect trout fisheries and river ecosystems.

Richard F. Gill

Part I. Introduction

Those anglers new to fly-fishing may not realize the changes that have occurred since the publication of Selective Trout by Doug Swisher and Carl Richards in 1971. The impact of this book on fly-fishing methods and thought cannot be underestimated, and much of this innovative thought revolved around the important interaction between aquatic insects and trout feeding behavior. The interest in aquatic insects and their relationship to trout feeding has continued to the present, as witnessed by the volume of books and articles on the subject.

While the level of angling literature has increased and some excellent works exist, the quality is not always of high standards. In the haste to bring articles and books into print, a number of flaws have developed: the first is the accuracy of material covered and the second is excessive simplification or generalization.

First, when one reads angling works on aquatic insects, a lack of attention to details and accuracy is apparent. Authors often make improper interpretations of what is occurring, and in some cases, they simply "make-up" their own interpretations which are not based on sound observations or study. For example, I have seen articles written about imitations based on insect structures that were quite interesting, especially since the structures described do not exist on the insect in question. Many angler-authors simply hold certain beliefs that have no basis in fact. While these improper interpretations are rather easy for a professionally-trained biologist to detect, they create many problems and false impressions for the angler.

The second problem, that of simplification and generalization, may arise because anglers lack enough information to produce or do not realize or believe it necessary to present more specific publications. In an effort to simplify things, an idealized general coverage of an insect group is given. The angler who uses this type of information finds that "the hatch" does not match what is written about the insect group in question. Also, most anglers and authors attempt to simplify insect behavioral patterns too much, describing these patterns in a generalized manner when it is much more accurate to utilize the insect species as a basic behavioral unit.

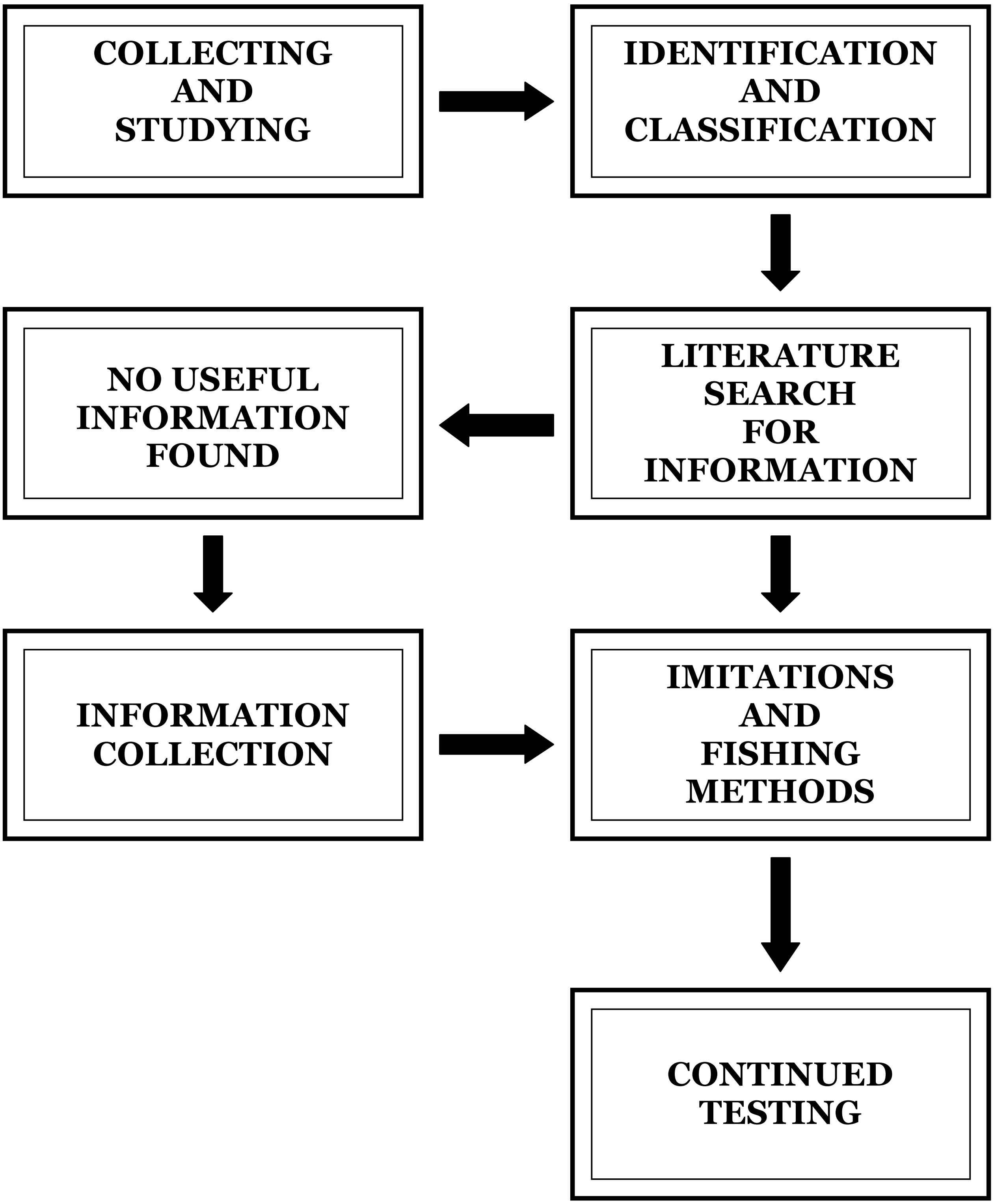
To increase the accuracy of this work, I have made careful, accurate observations and performed simple experiments on many of the topics covered. Each observation and experiment was analyzed and checked to give some kind of order and consistency to the observed phenomena. Further observations and questions resulted from my initial thoughts and observations. Continued revision of my ideas has occurred, and this "testing" will continue in the future. I have stressed behavioral patterns that have been repeatedly demonstrated to occur and imitations and fishing methods that have been repeatedly effective. This work is not made up of "one-fish theories", "one-fish imitations", or "one-fish methods". In addition, I have used the scientific literature, when possible, to back up my conclusions and observations. To avoid the problem of simplification and generalization, I have produced a work based on a localized area with specific, detailed coverage of the local insect and fish fauna given on the basis of habitat.

Fishing techniques are also covered in specific detail.

I have attempted to produce an accurate, relevant treatment of aquatic trout foods and how they affect trout fishing in a specific region. While some of this information has been covered before, I have made an effort to minimize information contained in other angling literature so that this work is not a rehash of older material. As a consequence, one may need to supplement some sections with other literature to aid in one's understanding of the information presented here.

Part II. General Topics in Angling Entomology

A. Insect Study Flow Chart



B. Studying and Collecting Aquatic Insects

The study of aquatic insects began with the early work of limnologists and fisheries biologists. Much interest in this group of insects is now due to their use as indicators of water quality. Fly-fishers have also become aware of the importance of aquatic insect study, but unfortunately a lack of knowledge about these insects still exists. For the angler, I will attempt to discuss the importance of the study of aquatic insects and how to undertake this study.

Feeding selectivity is a fly-fishing term often debated among anglers, but it still remains misunderstood. Most anglers will agree though that periods of "selective feeding" occur on trout streams. These periods coincide with the availability of large numbers of insects and offer the angler a chance to catch many fish. Fishing the "hatch" has several advantages: fish are in feeding position actively taking insects, each fish's position is known accurately, the best fishing times can be determined, and the number of fish in an area can be estimated. Fish is these situations tend to become selective, generally concentrating on a recognized food item.

Biologists call this feeding behavior "food constancy" and note that it allows efficiency in foraging. Gary Borger (Understanding Selectivity: Fly Fisherman's Tackle Bag Companion, pgs. 25-29) feels that selectivity is based on four food characteristics: size, shape, color, and motion or what I call behavior. The study of aquatic insects better allows one to cope with these periods of selective feeding and determine these four important factors.

Having explained why one should study insects, how does one collect and study them? As with any field, certain equipment is needed. Most important is a basic reference book, and the best single source is An Introduction to the Aquatic Insects of North America edited by R. W. Merritt, K. W. Cummins, and M. B. Berg (published in 2008, Kendall/Hunt Publishing Company). This book gives a general treatment of all aspects of the study of aquatic insects.

Collection of insect specimens is an absolute must. To determine size, shape, and color, one must observe the insect directly. Most aquatic insects have aquatic and terrestrial stages and must be collected in two different habitats. Aerial nets (the common butterfly net) can serve well for both types of collecting. Adult insects can be "swept" off streamside vegetation or captured directly out of the air. For larval specimens, some insects can simply be picked up by hand from the stream bed. When collecting with the use of a net, the net is held underwater, and the stream bottom upstream is disturbed. A "D" net is more useful underwater but is expensive and difficult to obtain. My favorite net is a drift net. These can be set up in the stream and left requiring no further attention. Drifting insects (larvae, emergers, and adults) are all captured and retained. Terrestrial adults can be collected by using lights of various forms such as car trouble lights or even headlights. Most of this collecting equipment can be purchased cheaply, and some can be made. Bioquip Products (http://www.bioquip.com/) is an excellent source.

Once collected, the insect should be retained and preserved. Collecting bottles present a problem since they are expensive if purchased. Substitutes such as pill or medicine bottles or baby food jars may be used. The best preservation fluid is rubbing alcohol available at any drugstore. Preserved specimens allow determination of shape, size, and proper proportion for imitations although color often fades during preservation. To determine color, it is useful to retain live insects for study. Small paper containers (i.e., ice cream cartons) or plastic containers with lids are useful for transporting live adult insects. Larval forms can be retained alive if kept cold and in water exposed to air. Either can be observed live or frozen and then examined for color. All insects collected should be labeled using heavy card stock paper. The following data should be included: location including state and county, date of collection, and the collector's name. Labels should be written with a No. 2 pencil and placed inside the collection bottle to prevent their loss.

Also useful is some sort of magnification device to observe color and detail of the specimen. A 10x hand-lens is probably most useful and can be used for streamside observation. If one can find and afford a low power (10x to 30x) dissecting scope, this is ideal. For manipulating specimens, forceps or tweezers are useful. In spite of what many angling books and articles state, identification and naming of aquatic insects is not easy, especially in California where few aquatic insects have been studied in any detail. With some work, identification of the family and genus of the insect is possible using classification keys, and this will be useful. After one can identify specimens, one can observe behavior in the field and determine how best to fish an imitation.

C. Insect Classification and Its Importance for Anglers

One of the more common misconceptions about fly-fishing is that knowledge of insects is not really necessary. The so-called "common-sense" approach also precludes the need to identify insects. While it is true that this approach allows one to catch trout, the more information one knows about insects (and other trout foods) the better fly-fisher one will be. To obtain this information, a knowledge and understanding of insect classification and identification is required. Here I will attempt to explain and clarify the benefits of insect classification and identification for the angler.

The greatest problem with insects is the great diversity of species. Insects also exhibit wide environmental and behavioral differences between species. These factors create a great need to organize this biological diversity in to a logical, ordered system, and insect classification is the system for naming and grouping insects in a logical and orderly way. Classification allows one to identify insects, facilitating their study and the exchange of information about them. This system is quite useful and convenient, summarizing the known information available about various insect groups.

The basic unit in any biological system is the species – a separate morphological group isolated from all other groups. The scientific name for any species consists of two words: the first indicates the genus and the second indicates the species. The scientific name is always unique to a single species of organism – in this case, an insect. These unique names are necessary to identify the insect specifically rather than by an ambiguous common name, and they allow a filing or classification system to be established. All information about a species is associated with its unique name. The arrangement of species into a system of classification allows storage and retrieval of information about any particular species, and information can include both environmental and behavioral characteristics. Environmental information useful to the angler includes an insect's distribution and habitat preference. Behavioral information may include an insect's general habits, how and where an insect emerges, where and how mating flights occur, and how the nymphs behave.

The biological classification system is a hierarchy with species on the lowest level. Species are grouped into larger groups known as genera (plural of genus). Genera are then grouped into larger families and families are grouped into orders. The next highest level of classification is that of class, one of which is the class insecta (the true insects). These classification groups are based on evolutionary and genetic similarities and differences, and therefore the classification of organisms may change as more information is learned about them. Classification is important for the angler because common ancestry and genetics generally indicates insect groups have common habits and common behaviors. Also, classification presents conclusions in a condensed form about relationships among species and tends to maximize the predictive powers of the system. Because the system is hierarchical (groups within groups), its predictive powers are useful, and many generalizations can be made even if one lacks needed information (i.e., species name or information associated with the species).

Perhaps all of this can best be explained by an example of the two approaches to fly-fishing – one that stresses knowledge of insects and their classification and one that feels this is not necessary. Imagine that there are a number of small insects emerging about dusk, and fish are feeding on them. The "common-sense" anglers look at the insect and pick a fly close to it and probably catch some fish. They also say one doesn't need to know about insects; one just observes and uses common sense. The next time these anglers see this insect, they go through the same process. Now let's look at how the knowledge of insect classification and insect names can help anglers who use this information. They would probably fish the same way as the first type except they take a specimen or two of the insect in question. The insect can then be identified (although this can be difficult), and its scientific name determined. This name is the key to all the information in the filing system called classification. With this name, one can go to either the angling literature about insects or scientific works and look up the species in question. Let's say our angler has identified the insect as *Tricorythodes explicatus*. This angler then finds all the associated information and finds that the major period of emergence and mating is in the morning and not at dusk when the insect was first observed.

With this knowledge of the insect's life cycle, the angler is better prepared to fish at a more appropriate time. This angler will probably catch more fish and have a better time in the process. The "common-sense" angler is totally unaware of what has been missed. By stressing the knowledge of the insect, our other angler will be prepared the next time he sees this insect. Also, since one looks more closely at the insect's details, a better imitation can be produced. More importantly, an angler can correctly and accurately make further interpretations and observations on the insect in question. One can now learn more and continually add knowledge. This approach gives one a better appreciation of insects and their role in fish behavior.

Because of the way the classification system is set up, an angler can make predictions and obtain information even if all the needed information is not available. If only the family name is known or the species identified has little information associated with it, one can still make a prediction about what to expect based on the classification system. One simply looks at the closely related groups (the group's common ancestors), and since they are related to the insect of interest, behavioral traits and environmental characteristics should be similar.

To summarize, classification is a unique, universal filing system that allows one to store and retrieve information. It is also explanatory and predictive. In short, it is an aid to the angler who understands it and what it can do for him. I constantly use this system and cannot begin to count the times it has helped me while fly-fishing.

D. Identification of Aquatic Insects

Having covered the general techniques of collecting and studying aquatic insects and how insect classification is important to anglers, I would like to explain how one can identify aquatic insects. In this section, I will present the techniques and information I use to identify insects.

The first problem is to determine which insects are useful to the angler. There are several ways to do this: observe fish actively feeding on insects; look at the stomach contents of fish; or try to determine the importance by an insect's abundance, size, or behavior. The first two methods are the only reliable ones. Once it has been shown that an insect is important, additional specimens must be collected or reared. From these specimens, one can determine the insect's species name. This name allows one to look up look up all the information associated with the species. Identification of the species also allows one to make one's own observations and gather one's own information.

How does one identify the insect that one has collected? Most commonly, insects are identified by the use of keys. Keys can be pictorial, tabular, or dichotomous. Dichotomous keys are the most common and give one the choice of two separate couplets of character sets, one of which should match one's insect. Most of these keys also have illustrations which aid in identification of the proper choice. One follows the couplets and obtains a name which relates to one's insect. Most keys only allow identification to the family level, but to be useful one must identify insects to the genus and species. Any angler can determine an insect's family with some practice. Genus and species may also be determined if keys are available; if keys are not available, it is possible the insect may never have been well-studied, especially of the species level.

Often generic level identification can be made simply by knowing which characters the genus has. Many entomologists can readily identify by sight the genus of many aquatic insects, and better anglers also often have this recognition skill. This level of identification can be useful in some genera that have only a few species, all of which exhibit similar biology. But more often than not, the generic level of identification is of little value, especially in large diverse insect genera. Because of the great number of species and their diverse biology, the most useful level of identification for anglers is the species. This is the most difficult level of identification, although one can at times find species level keys.

Entomologists often can identify by sight species of insects which they are familiar with, but even they have difficulty with some groups. Most only work with a certain group and become familiar with these species. Other species must be keyed out or identified using entomological literature (descriptions and illustrations). Commonly, only a few entomologists can identify specific insect groups so one must often send specimens to them for identification.

The only way to accurately study insects is to identify them to the species level, yet this is a difficult process even for an entomologist. Most anglers simply give up and blindly fish the water. The problem for the angler is that many groups have a number of species which are similar morphologically yet are very different in their behavior and biology. Our local Baetid mayflies are an excellent example of this phenomenon. Anglers who desire to learn about insects should attempt to separate and identify insects as well as they can. The more one practices, the better one will become at identification. When one closely examines insects, one can begin to recognize important groups and note differences in their biology. One can then plan fishing trips around insect and fish activity becoming a much better angler in the process.

E. Literature Search and Data Collection for Aquatic Insects

Once one has determined that an insect is important, collected enough specimens, and identified it, several other steps are important in undertaking a study of an aquatic insect. By using an insect's scientific name, one can find all the fishing information associated with that species. The angling books and scientific literature listed in the bibliography section are the most useful for the angler. One simply looks up the species and determines what is known about the insect in question. If information is available, this presents little problem, but one often finds that one must collect one's own information and data. This is frequently necessary as little is known about many aquatic insects. Here I will explain which information and data are important, how to gather it, and how to organize this information to produce useful imitations and fishing methods.

Data collected includes the behavior and life history of an insect as well as larval habitat, emergence periods, and emergence time. When one collects this type of information about insects, the most important observations and data relate to fish feeding behavior. One must be aware of the great variability in any behavior and make repeated observations. Other things such as size can be simply measured using a ruler. The problem is that one needs to know the range of size variation. Even something as apparently simple as size is quite variable and can be rather difficult to determine. Size is influenced by the maturity of the insect, its sex, food availability, and the season. One can also determine the proper proportion (from the insect) for one's imitation. If a specimen is live, one can approximate its color. I use dubbing blends for color comparison. Color is also quite variable, being influenced by an insect's sex, habitat, the time of year, and the time passed since molting. The best insects to examine are those in the proper habitat and at the proper state of development.

This information must be gathered and maintained in an organized manner. I collect insects on stream to use for further study and also gather as much other information as I can. At the end of a trip, all information is recorded in a notebook, and after several observations over a period of time, I transfer all information to 3 x 5 cards. Once I have a significant amount of information on the cards, I transfer the information to the computer. At this point, I can determine anything that needs further study, and this allows me to know exactly what is needed to finalize the study. To gather all this information and finish a section on a single insect requires at least two to three years and may require up to five to ten years.

Once all the information is available, anyone can produce a reliable imitation and know how to use it in imitation of the insect's behavior. Even though these observations and techniques have been "tested" for a number of years, new things can and do occur so one must continue to study even these insects. The above approach to fly-fishing is much more successful than simply placing one's faith in a "magic" fly, method, or hot-spot.

F. Metamorphosis and Insect Life Cycles

Metamorphosis is a series of changes in the form of an insect. These changes occur during the growth and development of the insect as it transforms from egg to adult. Two types of metamorphosis occur: incomplete or hemimetabolous and complete or holometabolous. Incomplete metamorphosis stages consist of the egg, larva, and adult while complete metamorphosis stages consist of egg, larva, pupa, and adult.

Incomplete metamorphosis is found in more primitive insect groups such as mayflies, dragonflies, and stoneflies. The young of these insects look similar to the adults and simply increase in size at each successive molt. Wings develop as external buds on the thorax, and wing expansion occurs after the adult emerges from the last larval instar. This type of metamorphosis does not allow the great divergence in body form and function that complete metamorphosis does.

Insects with complete metamorphosis occur in more advanced groups such as caddisflies and black flies. The insect stages in groups with this type of metamorphosis are quite different in form and function. The early larvae are worm-like, and this stage is primarily for feeding. Wings develop as internal buds and are everted (pushed out) when in the pupal stage. The pupal stage is primarily for the development and expansion of wings and their associated muscles, with the adult emerging from the fully developed pupa. This type of metamorphosis, with its great divergence in body form and function, allows insects to more fully exploit the available habitats.

An insect life cycle is the events occurring during development from egg to adult and back to the egg again (adult lays eggs). This process occurs over a period of time and represents the total number of stages as well as the different life history characteristics. Descriptions of life cycles often begin with the egg and end with the egg-laying female.

Insect eggs differ in structure depending on the insect group. Most are oval or elongated and can be covered with a fluid substance. The egg has a shell which protects the embryo or developing insect and allows the embryo to change form and structure inside the egg. Insects hatch out of the egg by using an egg-burster which breaks the shell. In females, new eggs may mature in early insect stages, such as the larva, so that as soon as possible after the adult emerges, she can lay eggs. Eggs are often the most resistant stage and often endure the most extreme environmental conditions. The insect can circumvent drought, extreme temperatures, or food shortages by passing these times in egg diapause (delayed development).

The larvae or nymphs of aquatic insect are immature stages different in form from the adults. The term nymph is being phased out as its meaning is not as clear as it once was. Larvae undergo morphological development and growth. This stage is primarily a feeding stage, so much of larval structure and behavior reflect this. Growth is generally a process which results in an increase in size. In insects, the exoskeleton (external skeleton) prevents continual growth, so it must be shed periodically. This shedding process is called molting, and an instar is the stage between molts. The number of instars is variable depending on the insect species and the availability of food. Since insects in these immature stages must feed, instar feeding behavior often relates to its feeding habits. Insects generally move to obtain their food, and this is true for predators as well as herbivores. Movement also can relate to pre-emergent or emergence behavior as insects often move into certain positions in the stream to emerge.

In hemimetabolous insects, emergence is the escape of the adult from the last larval instar. This process can vary as some adult insects emerge underwater, at the water's surface, or in a terrestrial habitat. The larval exuvia is always associated with this process and allows determination of emergence. After emergence, the adult or imago matures, except in mayflies in which the sub adult or subimago emerges and then molts to become an adult.

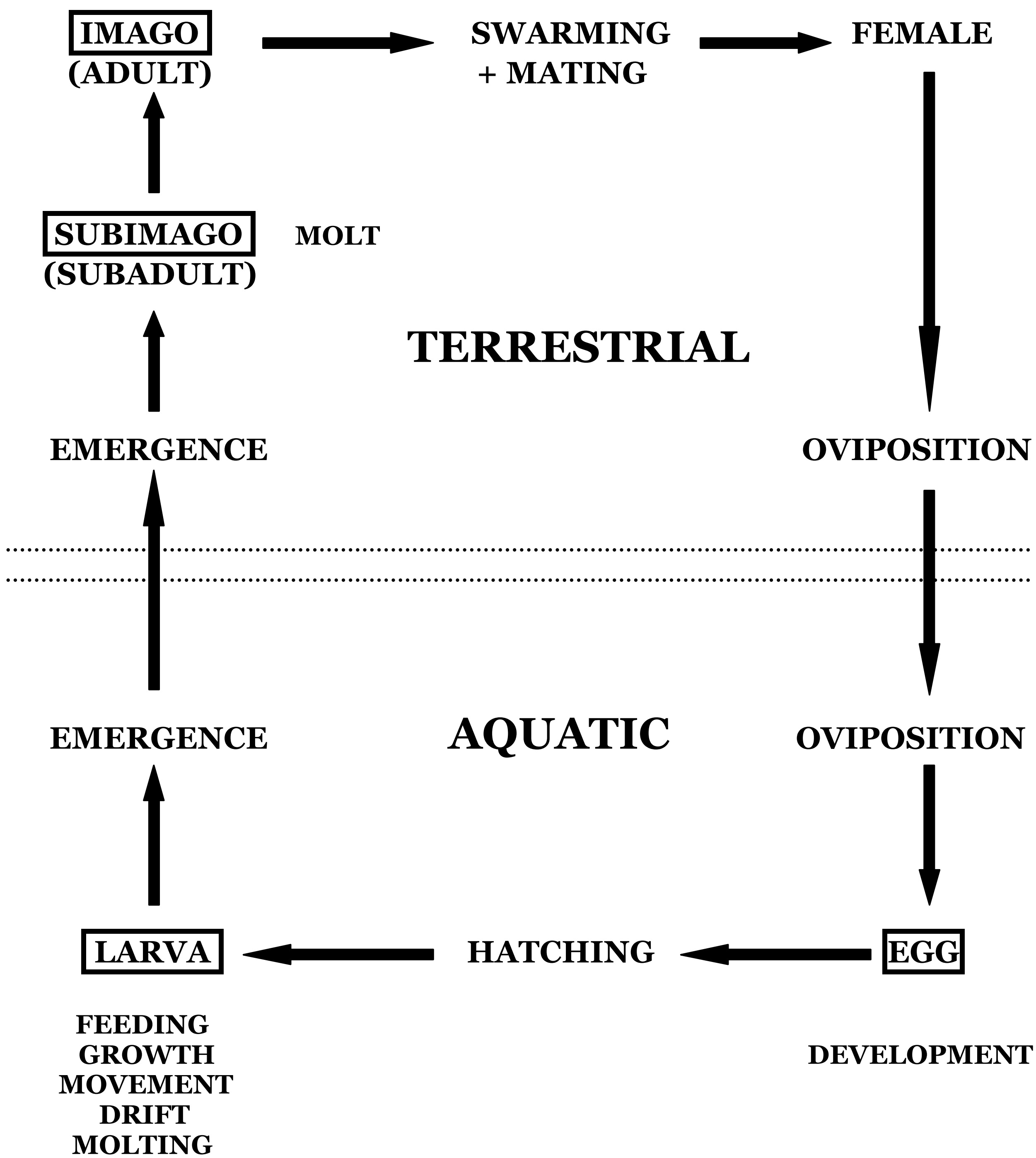
In holometabolous insects, the last larval instar forms the pupa, an intermediate form between the larva and the adult. Development of wings and their associated muscles occur at this time. Pupae can be motile or encased in a cocoon or covering. Some pupae actually swim and move about, especially during emergence. Adults may emerge underwater, at the water's surface, or in a terrestrial habitat. The pupal exuvia is cast off during emergence, and the adult emerges.

The adult is a fully-grown, sexually mature insect which disperses into new habitats. Its most obvious features are the presence of wings and the ability to fly. Flight plays an important part in daily activities such as movement, feeding, and mating. In some insects, such as stoneflies, the entire mating process occurs on substrates such as vegetation or rocks. In other groups, males form swarms into which females fly and mate. The female then returns to a resting site and when ready, returns to the water to oviposit (lay eggs). Oviposition may occur above the water, in aquatic vegetation, on the water's surface, or underwater. Females often swim to the stream-bottom to lay eggs on the substrate. This completes the life cycle as the eggs hatch.

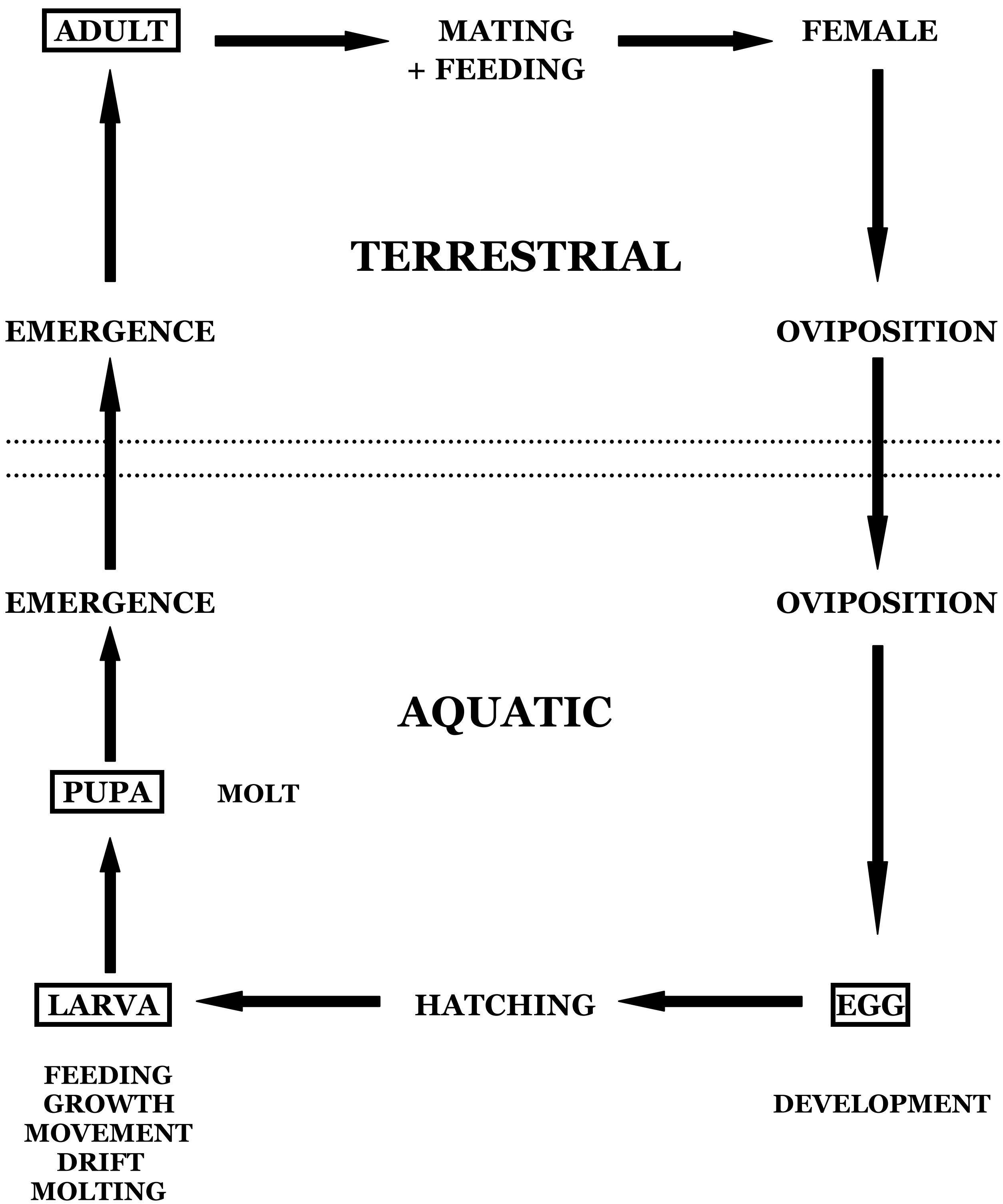
The following diagrams show generalized life cycle patterns. They are intended only as an aid to understanding aquatic insect life cycles and behavior. In the sections on specific insects, I have covered life cycle patterns in specific detail as this type of coverage is much more useful to the angler.

G. Life Cycles of Aquatic Insects

Generalized Ephemeroptera Life Cycle – Incomplete Metamorphosis



**Generalized Trichoptera Life Cycle –
Complete Metamorphosis**



H. The Effects of Water Temperature on Fish and Aquatic Insects

Seasonal and daily changes occur in the temperature regimes of both lakes and streams. Of all the environmental factors, temperature often exhibits the greatest influence on the lives of aquatic organisms. Temperature influences growth, development, and size as well as behavior and survival of all types of organisms. Since anglers are primarily interested in fishes and insects, I will confine my discussion to these two groups. The following information on fishes comes from a chapter by J. M. Elliot (*Some Aspects of Thermal Stress on Freshwater Teleosts*) in Stress and Fish (ed. A. D. Pickering, published in 1981) and the information on insects is from an article by J. Ward and J. Stanford in *Annual Review of Entomology* (Entomological Society of America, published in 1982).

Fishes and insects have little internal regulation of body temperature and tend to control their temperature by behavioral means. Each species has certain thermal limits and may be killed by freezing or excessive heat. If their thermal limits are approached, an organism can modify its behavior to cope with these changes.

Fishes are generally much less tolerant of temperature extremes than are insects, and for this reason, much has been written about temperature requirements of trout and salmon. Each species of fish has an optimum temperature range above or below which stress occurs. Although the processes determining these values are complex, the optimum range for brown and rainbow trout is from 4° to 20°C (39° to 68°F). These values are affected by a number of factors so they cannot be accepted as absolute values.

What happens to fish that are subjected to temperatures outside these values? Fish undergo what is called stress (a significant disturbance of normal functions) and alter their normal behavior patterns. The lowest stressful temperatures for both brown and rainbow trout are slightly above freezing at 0° (32°F). Feeding may also cease at these lower temperatures. A fast decrease in temperature may also suppress feeding even if the temperature values remain within the optimum range. The major difference in temperature tolerance for browns and rainbows is in the egg stage, which for rainbows is much higher.

The stressful temperatures during long term exposure for mature stages of both species begin at about 20°C (68°F). These temperatures influence behavior, feeding, competitive interactions, and ultimately survival. Also, normal feeding rates, growth, and survival may be affected at temperatures above 19°C (66°F). The recorded harmful temperatures recorded for these species is from 20° to 30°C (68° to 86°F).

My experience indicates that the lowest temperatures at which brown and rainbow trout feed is around 3°C (37°F). I have measured this value several different times in several different locations. The highest value recorded was 23°C (74°F) which occurred on the lower Kings River. This observation occurred after the temperature increased from 16°C (61°F) to the value recorded above in only 5 days. Most of my temperature measurements on the lower Kings River seem to indicate that feeding ceases at around 19°C (66°F). My actual temperature measurements indicate that those from 5° to 20°C

(41° to 68°F) are best for the angler.

The fact that temperature plays a major role in the life of insects is obvious to most anglers. Since insects have much wider temperature tolerances than fishes, it is of little value to the angler to examine extremes of temperature. Here I will concentrate on the effects of temperature on the behavior and ecology of aquatic insects. It effects their distribution, life cycles, feeding, and behavior.

The initial habitat of many aquatic insect groups was in cool head water streams, and movement into lower reaches involved adaptation to different temperature regimes. Insect species living at suboptimal conditions tend to be smaller, less abundant, and have lower reproductive capacities. Altitudinal gradients in the diversity, distribution, and abundance of insects are thought to be caused by temperature differences. At higher elevations, lower temperatures cause later emergence of insects. Often structural characters, such as wing length, change with increasing elevation, and this is thought to be related to temperature also. Temperature can also act to isolate insects in certain habitats. For example, cool mountain waters of springs act as refuges for cold-adapted fauna, and warm-adapted forms can be isolated in thermal waters.

More important to the angler are life cycle responses. Temperature changes can induce dormancy or diapause in aquatic insects, and the diapause condition allows insects to avoid temperature extremes. Growth rates are greatly influenced by temperature, with insects generally growing faster at higher temperatures until the upper threshold is reached. Exceptions to this trend occur, especially among stoneflies. The number of generations per year may also be a response to different temperature regimes. A species may have one, two, or three generations per year depending on the temperature of their habitat.

Emergence of insects is greatly influenced by temperature. Both the length and timing of emergence are affected. Under warmer conditions, insects generally emerge earlier, promoted by conditions such as warmer years, lower elevation, shallow water, and warm areas below dams. Migration of mature larvae to warmer shoreline areas also occurs. While the emergence time can be altered by changes in temperature, the sequence in which species emerge remains unchanged. Water temperature is thought to be responsible for the smaller size of many insects that emerge in summer. Temperature may also be responsible for alteration of insect behavior with this being most common among adult insects. Most often, mating and swarming behavior is affected. High water temperatures may increase the number of insects that drift in the water column. Highly variable temperature regimes also allow greater diversity of insects, as both warm and cold-adapted forms may occur in the same habitat.

For the angler, it is important to remember the effects of temperature on both fish and the insects they feed on. To find suitable fishing habitats, one may need to have an understanding of these effects, and those who do may be able to detect long term changes in the temperature regimes in which these organisms live.

I. Insect Drift

Drift or the downstream movement of aquatic organisms in currents is a recently discovered phenomenon. Anglers are now becoming aware of this process, and some have made attempts to incorporate this knowledge into improved fishing methods.

My initial interest in drift came from two observations made many years ago. First, the insect composition in trout stomachs from low elevation rivers always had a high percentage (95%) of larval *Hydropsyche californica* (Kings River Caddis). Emerging pupae and adults, which form the basis for much of our local fishing, comprised only a small percentage of the food actually ingested. I thought that if only five percent of the diet actually provided for good fishing, what would happen if I found out how ninety-five percent of the diet was taken? Unfortunately the fishing wasn't as good as I thought, but I learned many things about trout and insect behavior. The second factor prompting my initial interest in drift involved the presence of live mature *H. californica* larvae in the mouth and throat of trout caught during pupal or adult caddis emergence.

These two observations led me to examine insect drift in angling literature. This yielded few insights and indicated anglers either were not interested in drift or that the process was not well understood. I turned then to scientific literature and found this to be more useful. For those anglers that believe knowledge of insects improves one's fishing ability and enjoyment, I will explain drift and its importance to anglers. This section is based on the paper "Invertebrate Drift – A Review" in *Hydrobiologia* (166: 77-93, 1988) by J. E. Brittain and T. H Eikeland.

Drift can include pupal and adult emergence patterns, but this is not the major component which I want to examine. Drift can be divided into two major types: catastrophic (which results from flood, chemicals, drought, or extremes of temperature) and behavioral (which results from the activity or behavior of the insects). This second type is most important to anglers.

Drift is studied by placing nets in currents to collect organisms in the water column. Several nets are needed to give even a rough estimate of the composition and numbers of drifting organisms, even in smaller streams. This may be of interest to anglers since the variation in the species and number of organisms in different parts of a stream may lead to the so-called "selectivity" one sees in some trout. This certainly is an important question for anglers.

Mayflies, black flies, chironomid midges, stoneflies, and caddisflies are the most common insects found in drift samples. Any stage of an organism – egg, larva, pupa, or adult – may be found in drift. Adults and pupae can be found in drift since this can be a pathway for their emergence. Adults may also be found in drift because they are laying eggs or are spent in the surface film. The most common stages in drift are larvae and nymphs.

Drift can be quite variable, changing with the season, the time of day and from day to day in the same week. Patterns of drift occur during a twenty-four hour period. The most common pattern is an increase in numbers of organisms drifting during the night, especially after dusk and before sunrise. Mayflies, stoneflies, and black flies drift mostly during the night. Caddisflies also drift mostly at night, but some limnephilid caddisflies drift in the daytime. Chironomids as a group drift at all times of the day and night.

The number of organisms drifting varies from stream to stream and even varies within a single stream. Up to 100 insects per cubic meter can be found drifting in the water. The mayfly *Baetis* often exhibits the highest drift rates. The distance an organism drifts is dependent on the insect species, its body size, its life cycle stage, the light intensity, current velocity, substrate, and depth. Distances may be up to several hundred yards, but generally the distances are a few yards.

For the angler, the important factor is that drifting insects serve as a food resource for trout. Several studies have been done that deal with foraging by trout and salmon on drifting organisms. Much of this work shows that great variability occurs in the diet of individual trout. This should not be surprising if one believes that trout have a home territory and, as shown here, that drift composition in a stream varies. Together these two factors may relate to a trout's selectivity and certainly lead to active feeding periods. Knowledge of both of these patterns can lead to better fishing for the angler.

Part III. Aquatic Trout Foods and Their Habitats

A. Are Sierran Streams Different?

Having fished and observed our local streams since the mid-1950's, I find myself asking the question are Sierran streams really different from those found in other areas? If so, does this effect our fishing methods and our fisheries? Several observations have led me to ask these questions. First is the fact that it is difficult to apply some of the fly-fishing methods that evolved from streams in the East and Rocky Mountains to our local streams. I have attempted to use all the techniques applied to bottom-nymphing from these areas and found them largely unsuccessful. The second observation is how differently our brown trout act from those that Dr. Bachman studied in Spruce Creek, Pennsylvania. Most of the difference relates to the stability of his study site. A final observation is that our local streams respond rather poorly to any of the special management schemes that are proposed for them. Are these observations related, and if so, is there an explanation? What are some of the potential factors that could explain these differences?

When we examine the structure and function of stream ecosystems, we find these characteristics are influenced by both biological (biotic) and physical (abiotic) factors. Biotic factors include interactions between organisms such as competition and predation. Physical factors include those such as temperature, current, flooding, and drought. The structure and function of our streams seem largely determined by physical factors.

The reason for the importance of these physical factors is related to the mountain landscape where our streams and rivers are found. This steep, youthful topography influences how streams function and their internal structure. Our streams have a steep gradient and are rather unstable and unpredictable. The headwaters arise in high rocky basins among high elevation, ice-scoured peaks. These headwater streams lead to Sierran rivers which carve deep canyons surrounded by steep ridges. These steep mountain rivers have stronger currents and run straighter than most other rivers. These factors cause our turbulent, fast-flowing rivers to have certain characteristics. First, more small particles such as soil and debris will be carried downstream. Large boulders and bedrock sections are stable, but the smaller particles tend to be lost or moved around. Overall, the streambed tends to be rather unstable and habitats unpredictable. The stream channel tends to be made up of short, steep riffles and very deep pools. In addition, there is poor debris retention so little woody material is present. Also, fast rates of erosion and poor soil development along stream banks allow little growth of riparian vegetation. As a result, little leaf litter input into the stream occurs. Organic particulate matter, an important part of stream structure, is also poorly developed. Large aquatic plants and algal development is poor. Overall, our streams lack a great deal of large scale structure common to streams found in other regions.

Precipitation is rather variable with most occurring in the winter as snow. Snowfall melts in spring forming turbulent, fast-flowing rivers which add to the instability and unpredictability of the physical environment. This is followed by hot, dry summers. Water temperature regimes are variable, ranging from nearly freezing in winter to very warm in the summer.

This type of physically stressed, unstable, and unpredictable habitat influences both the types and numbers of aquatic organisms that can tolerate it. Invertebrate species tend to be colonizing forms which survive well in these demanding habitats. Invertebrates which depend on woody debris, leaf litter, aquatic plants, or algae tend to be underrepresented so invertebrate diversity is low. Fish communities rely on some of these factors also and utilize invertebrates as food, so they tend to be poorly developed also.

The question of how our streams may differ seems to have been largely overlooked. The fact that both the structure and function of Sierran streams differ should influence anglers to develop different techniques and strategies developed specifically for our streams. Perhaps more importantly, stream management strategies should also take these factors into account. It would appear unlikely that in our streams, management plans that stress biological factors, such as competition or predation, are going to be useful. It is more likely that physical factors such as temperature, current, and weather related factors are more important.

B. Aquatic Insect Habitats

On the western side of the Sierra Nevada, numerous rivers exist, many of which are similar in a number of environmental factors. Some of these factors are stream gradient, flow, temperature, water chemistry, cover and substrate type. Since the distribution of both fishes and insects is greatly influenced by these factors, it is not surprising that certain aquatic habitats have a similar insect fauna. What I have attempted to do is determine which insects are important to anglers and which regions in these habitats have similar “hatches”. Our local rivers and streams can be grouped based on their altitude and size. In each of the following regions, the insects are the same and can be fished with the same imitations and techniques.

C. Central California’s Low Elevation Rivers

The first region I want to cover is the low elevation rivers of the Central Valley and adjacent foothill regions. Historically, these large Central Valley and foothill rivers held a warm-water fauna, and trout fishing was seasonal at best. Formerly, these areas formed extensive overflow and marsh habitats. The construction of various dams (i.e., Friant, Pine Flat) altered these overflow areas and caused the development of a permanent cold-water release from the bottom regions of the reservoirs created. At present, land surrounding these habitats is largely agricultural and much of it irrigated. In the foothill regions, cattle grazing occurs. Elevation of these rivers runs from 150 to 600 feet, and above these elevations, a different group of insects is found. Water temperatures generally range from about 18°C (65°F) in the summer to about 10°C (50°F) in the winter. Substrates are generally large rounded rocks, although some aquatic vegetation occurs in slower reaches. The climate is mild except for the hot summers. The highest monthly mean maximum temperature is 38°C (101°F) while the lowest monthly mean minimum temperature is 2°C (36°F). The rivers covered here consist of the lower Kings, San Joaquin, Merced, Tuolumne, and Stanislaus. Rivers to the north of these appear to be similar since many of the same insects occur in the Sacramento River drainage. Rivers to the south also appear similar but require further study.

D. Insects of Low Elevation Rivers

Diptera – True Flies

Chironomidae – Midge
Simulidae – Black Fly
    Simulium spp.
Tipulidae – Crane Fly

Ephemeroptera – Mayflies

Baetidae – Blue Winged Olive
    Acentrella insignificans
    Anafroptilum sp.
    Baetis spp.
    Fallceon quilleri
    Paracloeodes minutus
Ephemerellidae – Small Western Green Drake
    Drunella coloradensis
Leptohyphidae – Tiny White Winged Black
    Tricorythodes explicatus

Lepidoptera – Moths

Pyralidae – Aquatic Moth
    Petrophila confusalis

Plecoptera – Stoneflies

Perlidae – Golden Stonefly
    Claassenia sabulosa

Tricoptera – Caddisflies

Glossosomatidae – Turtle Case Caddis
    Glossosoma oregonense
Hydropsychidae – Kings River Caddis
    Hydropsyche californica
Hydroptilidae – Microcaddis
    Hydroptila spp.
    Oxyethira spp.

E. Insects of Low Elevation Rivers Hatch Chart (Listed in Order of Importance)

Insect	Emergence Period	Important Stage	Size	Important Time
Kings River Caddis *Hydropsyche californica*	all year with fall and spring peaks	larva pupa adult	13-17 mm 10-12 mm 10-12 mm	all day dusk dusk to midnight
Blue Winged Olive *Acentrella insignificans* *Anafroptilum sp.* *Baetis spp.* *Fallceon quilleri* *Paracloeodes minutus*	all year with winter peak	larva subimago imago	4-9 mm 3-8 mm 3-8 mm	midday to dusk
Tiny White Winged Black *Tricorythodes explicatus*	all year with fall and spring peaks	larva subimago imago	4-6 mm 3-5 mm 3-5 mm	day and night morning peak
Aquatic Moth *Petrophila confusalis*	late spring to late fall	adult	7-8 mm	dusk to midnight
Small Western Green Drake *Drunella coloradensis*	winter to late spring	emerger subimago	13-15 mm 13-15 mm	afternoon to dusk
Microcaddis *Hydroptila spp.* *Oxyethira spp.*	all year with winter peak	pupa adult	2-3 mm 2-3 mm	midday to dusk
Black Fly *Simulium spp.*	all year with winter peak	adult	2-3 mm	midday to dusk
Turtle Cased Caddis *Glossosoma oregonense*	spring and fall	larva pupa	6-8 mm 5-7 mm	afternoon to dusk
Midge Chironomidae	all year with winter peak	pupa adult	3-5 mm 3-5 mm	morning to dusk
Crane Fly Tipulidae	spring	adult	30-40 mm	midday to dusk
Golden Stonefly *Claassenia sabulosa*	spring and fall	larva adult	22-30 mm 20-28 mm	dusk to midnight

Kings River Caddis

SPECIES: *Hyropsyche californica*
FAMILY: Hydropsychidae
COMMON NAME: Kings River Caddis
EMERGENCE PERIOD: All year.
LARVAL HABITAT: Runs and riffles on rocky substrate.
LARVAL CHARACTERS: Length to 17 mm, thorax brown with 3 dark bands, abdomen green to brown with branched gills, 2 tufts of long hairs at tail end.
PUPAL CHARACTERS: Length 10 to 12 mm, head and thorax brown to gray, abdomen tan to yellow.
ADULT CHARACTERS: Length 10 to 12 mm, wings dark brown to gray with light spots, abdomen tan to yellow, antennae same length as body, wing base area (mesoscutum) without hairy warts.

The importance of this insect to fly-fishers in the Central Valley and adjacent foothill regions has long been known. Wayne "Buz" Buszek originated the Kings River Caddis pattern almost certainly to imitate the caddisfly *Hydropsyche californica*. "Hatches" of this insect occur on the Kings, Kaweah, San Joaquin, Merced, and Stanislaus Rivers. It is also found in the Sacramento River drainage and the Owens River in the eastern Sierra Nevada. In our local waters, it can be especially common with the adults emerging most of the year. All stages – larvae, pupae, and adults – are available to fish. The best way to fish this "hatch" is to look at each stage and match the stage's appearance and behavior. It is also important to note the insect's influence on the feeding patterns of the fish.

Larvae live in fast riffles or runs and are the stage most commonly eaten by trout. Larvae are available to fish all year, even in winter. Most are green to brown on the posterior two-thirds and dark brown on the anterior third, so larval imitations should be tied in a similar manner. Since larvae cannot swim well and drift freely in all but the slowest currents, larval patterns should be fished dead-drift in riffles and runs. Current tongues in pools are also good places to use larval imitations.

When ready to pupate, larvae move down under rocks and form a case. After about two weeks, the pupae cut their way out of the case and swim up to the water's surface where the adult emerges. Emergence generally occurs at dusk, but in the winter, small numbers of adults emerge at midday. The pupae's abdomen is tan, and the anterior fourth, which includes the head and thorax, is dark brown. Gary LaFontaine's Deep Sparkle Pupa imitations are good as are my simplified pupal imitations. Current tongues at the head of a pool, drop-offs, and fast runs are the best places to fish pupal imitations. To imitate the moving pupae, I use the method described by James Leisenring. One casts above a fish, allowing the fly to sink and drift down in front of the fish. Then the angler simply stops the line, and the water causes the fly to swing up in front of the fish. Anglers often use dry flies when fish are making splashy rises, but most of those fish are taking pupae.

Although adults are taken less frequently than the other stages, they can be important. After adults split the pupal exuvia (skin) at the water's surface, they move toward streamside vegetation. Some fly away, but others walk along the water's surface and are fed upon by trout. These adults create a wake as they walk on the water, and one's imitation should mimic this behavior. After the cast is made, the imitation should be stripped in or a hand-twist retrieve used. At other times, a twitched fly will take fish.

Dry fly imitations are generally of two types: feather wing forms and deer hair forms. The feather wing forms are best used in calm flat water while the deer hair forms are better in faster flows. The best method for fishing dry flies is to cast into faster water and move one's imitation into the slower currents. Long searching casts can be made over calm water such as pools.

Mature females lay their eggs on the substrate in riffles or runs. After dark, the females swim or crawl down rocks and lay their eggs in areas of fast current. Imitations of swimming females are best fished by casting into currents and either allowing the fly to swing in the current or by using a short strip retrieve. Spent imitations can also be used in calm water where dead-drift floats best mimic the dead females found there.

To effectively imitate the insect, the angler must observe the insect, noting the correct stage, behavior, and location in the stream. The resultant behavior of the fish should also be noted. This streamside observation is the most important aspect of fishing this insect successfully.

Blue Winged Olive

SPECIES: *Acentrella insignificans, Anafroptilum sp., Baetis spp., Fallceon quilleri, Paracloeodes minutus*
FAMILY: Baetidae
COMMON NAME: Blue Winged Olive
EMERGENCE PERIOD: All year with a winter peak.
LARVAL HABITAT: Riffles and runs on rocky substrate.
LARVAL CHARACTERS: Length 4 to 9 mm, streamlined form, antennae 3 times the length of head.
ADULT CHARACTERS: Length 3 to 8 mm, wings with single or double marginal intercalaries, males with turbinate eyes.

The importance to anglers of Blue Winged Olives was first noted by the English with the most complete information given by J. Harris in An Angler's Entomology. Several American writers have also covered the Blue Winged Olives. This coverage started with V. Marinaro in A Modern Dry Fly Code and continued with E. Schwiebert's Matching The Hatch, D. Swisher and C. Richard's Selective Trout, F. Arbona's Mayflies, The Angler And The Trout, and M. Knopp and R. Cormier's Mayflies.

The mayfly family Baetidae is important to local anglers, and although small, these insects are abundant and emerge throughout the year. In our lowland rivers, at least five species have been collected: *Acentrella insignificans, Anafroptilum sp. Baetis spp.,* *Fallceon quilleri,* and *Paracloeodes minutus*. At least ten other species of Blue Winged Olives, excluding *Callibaetis*, are also recorded from our general area. This difficult complex of insects represents what anglers call the blue wing olive "hatch".

As one might expect, much confusion exists as to what a blue winged olive is. Color, size, behavior, and emergence times vary within and between species. When one cannot identify the different species, anything more than a general treatment is impossible. In the many years I have fished this "hatch", much professional entomological work has clarified the classification and relationships among baetid mayflies. Many species are now much easier to identify, and many generic groups have been changed. Hopefully, this will allow a more accurate treatment of this important group of mayflies than has been possible in the past. At this time, this group of mayflies still needs to be separated and identified.

The nymphs have a streamlined form, being almost bullet-shaped. Coloration is generally from light to dark green with a brown thorax, and their size ranges from 4 mm to 9 mm. Most nymphs occupy shallow flowing water in riffles, mostly on the tops of stones and rocks. Since they occur in flowing water, they often are found drifting in the water column. Most commonly, these drifting nymphs can be found along edges between current tongues in the slower water at the head of a pool. These are excellent places to dead drift or very slowly swing a sinking nymph across the current if there is no surface activity. But one must be careful in doing this since these are also major areas of emergence and trout feeding activity during the "hatch". When fishing Blue Winged Olives on some of our local rivers which contain few fish, it is often best to wait until many insects are emerging and the trout are actively feeding before casting. One can then make a reasonable plan for how to approach and cast to single trout and minimize disturbance to other fish.

The duns or subadults emerge in the riffles, at current edges, and at the ends of current tongues where the water slows down. They quickly split the nymphal exuvia, pulling themselves free at the water's surface. In these riffles and edges, floating nymphs can be used as well as various emerger and cripple patterns. A dead drift or totally drag-free float works best with all these patterns. Often these patterns work well when fish have become selective, being "conditioned" to standard dry fly patterns.

Emergence time varies with the season, occurring at dusk and late afternoon in the warmer months and at midday in the late fall and early winter. During winter, the most important time for Blue Winged Olives locally, emergence can come in "waves" where the numbers of duns peak, decline, and peak again. This may be due to the fact that males and females emerge at different times and that several different species of small mayflies are found in our local waters.

Dry flies that imitate the dun are also excellent patterns that can be used anywhere fish are feeding. The duns have light gray wings with a gray to gray-green body. As with most insects, color varies within a single population. They are generally 4.5 mm to 8 mm in length with most males being 5 mm and most females 5 mm to 7 mm. Later in the year, the duns may be even smaller.

The effect of air temperature on the duns after emergence has an impact on where the fish feed on them. During warm, sunny winter days, which are more common recently, the duns can fly away more quickly, so it is better to fish in or close to the riffles and current tongues. These fish are easier to catch since both the approach and drag-free floats are easier to make here. Most standard casting techniques, both upstream and downstream, will work, but imitations need to float drag free.

During cold, wet weather, the insects often sit on the water for long periods. They cannot fly well until their flight muscles warm up. One can still find some fish working close to the tongues, yet many will feed in the slow water in the downstream pools. These fish are often very tough to catch. In this flat water, one's approach must be slow and careful. It is critical not to send a wake forward as one wades. The fish also tend to move around a lot, not setting up any feeding rhythm or feeding location. Generally, the only insects one finds here are duns, which the fish get a good look at. The duns sit quietly with their wings held straight up, the slight currents slowly moving them around. Often a slight breeze can gently blow them upstream or across the current. All these factors create a difficult situation for the angler, so an imitation must be very close to the natural insect in both size and behavior. I prefer no hackle duns, lightly hackled thorax duns, or half hackle duns. One's cast should generally be totally drag-free, and various downstream slack line casts should generally be used. Often a downstream pile cast is most effective. A George Harvey leader with a five-foot or longer tippet of 5x to 8x is often needed to prevent drag. This is especially true after the fish have been conditioned, having been caught or fished over several times. When the tiny, delicate duns are wind blown across the surface, their behavior is almost impossible to duplicate. During these times, the weight of the fly, its construction, and the influence of the leader make proper presentation extremely difficult.

After emergence, duns fly to streamside vegetation or other structures where they molt into fully mature adults or spinners. Mating flights mostly occur in the afternoon, but generally only a few individuals are involved. After mating, females generally crawl down a partly submerged object and lay their eggs while other females can be found floating in the surface film. The spinners on the water are almost all females. These spinners are generally light tan to brown and range in size from 6 mm to 7 mm in length. During the afternoon, a spinner imitation can be effectively fished dead drift in riffles or flat water areas. Again, one needs to be very careful, as when fishing duns on flat water. The fish's rise forms are more subtle that those for the duns. Often, only a flush floating spent spinner imitation will be effective at this time.

During the afternoon periods, a sinking Blue Winged Olive spinner or knocked-down dun imitation can be effective although somewhat difficult to fish. On occasion, fish will also respond to dead or stillborn duns that are present in the surface film. These stages are often in eddies or backwater areas. They may occur at any time, but are most common after the large daily emergence has terminated, and the fish are still feeding on the surface. A knocked-down dun is often effective for these fish.

While spent spinners may be fished later in the day, other families of mayflies can be active in the winter, and they are often found emerging in the riffles. Most are in the families Heptageniidae and Ephemerellidae, and both need further study. In the Heptageniidae, the sub-adults are much larger and more active so the trout respond more aggressively and in a different location. The fish are much easier to locate and catch during this emergence. The ephemerellid is much smaller and approach the baetids in size, yet the color is a light tan. They generally emerge late in the afternoon, and the fish often respond to them.

Any or all of the above insect species in any of their different stages may be present, and the fish's feeding behavior can change over the course of the day. It pays to observe carefully, especially during the afternoon, to determine what the fish are actually feeding on. At the present time, Blue Winged Olives are probably the second most important insect in our low elevation rivers. While often more difficult to fish than other insects, they provide exacting fishing situations, and in the late fall to winter, they are the most important insects present. They also provide the opportunity to hone one's skill with small flies and improve one's casting in difficult situations.

Tiny White Winged Black

SPECIES: *Tricorythodes explicatus*
FAMILY: Leptohyphidae
COMMON NAMES: Tiny White Winged Black, Trico
EMERGENCE PERIOD: All year with peaks in spring and fall.
LARVAL HABITAT: Slower water with silt and debris, and on aquatic vegetation.
LARVAL CHARACTERS: Length 4 to 6 mm, body mottled brown to tan, triangular second gill on abdomen that covers the other gills.
ADULT CHARACTERS: Length 3 to 5 mm, wings clear with thorax black, abdomen cream or black in male and olive or cream in female.

This tiny mayfly is often ignored by anglers, no doubt due to its small size. Although more commonly associated with spring creeks, "hatches" occur in our local rivers though not in the numbers they did in the 1970's. As one might expect, fishing these tiny imitations requires special techniques: light lines from two to five weights, Harvey leaders with tippets from 5x to 8x, short accurate slack line casts, and a slow careful approach.

Emergence in our region occurs during two periods of the day – from late afternoon until after dark and from early morning to about noon. The afternoon emergence is made up of males, and no spinner fall occurs at this time. Fishing the male emergence period is simpler than during the morning period. Various dun imitations are the easiest to fish and should normally be used first. Generally a dead drift presentation is best, but some slight movement can be used if the duns are moving about. I only use nymphs if the dun is generally refused by rising trout. Nymphs can be effective during emergence and at times are favored by fish. As many as five nymphs to a single dun can be taken; when this happens, fish can be seen "rising" much more often than the number of duns present. Nymphs seem to generally move to the surface film to emerge in our local rivers. Floating nymphs are the most practical nymph imitation at this time. A Sawyer Pheasant Tail is also effective when fishing dead drift. One can use the greased leader technique to help detect takes.

During the morning female emergence period, the situation is much more complex. Although nymphs can be used early during this emergence, dun imitations may become favored by the fish. They often sit on the water for a time before flying away. The duns are not the typical mayfly as they move about, often flip-flopping or flexing their wings. Some fly along barely above the water's surface. While dead drift imitations are generally the most productive, slight movement of the dun can, at times, be successful. The duns sit on the water with their wings at a 45 degree angle, and one's imitation should reflect this. Tiny no hackle dry flies are best used at this time, but hackled patterns may work better if the duns are moving on the surface.

The most exciting and difficult fishing is during the morning spinner fall. Adult insects become concentrated in feeding lanes, and the fish respond with vigorous feeding. At times, the trout simply hold their heads above the water and feed without submerging. Spinner imitations with both wings spent and fished dead drift seem to work best, yet at times some females have upright wings. Fish can be approached quite close, and many short, accurate slack line casts are needed to place the fly in the fish's feeding lane. Often, one needs to change casting position to either upstream or downstream for the best results and limit the number of current lanes one casts across. Later during and after emergence, a sunken spinner or wet fly may prove an effective imitation. Some of the many adults from the previous day are taken during "non-hatch" periods, and a spent spinner is effective at this time.

The preceding discussion is typical of how many fly fishers approach the trico "hatch". But often, the fishing is difficult, and anglers are not as successful as they would like, myself included. Having fished this "hatch" since the 1970's and having made many detailed observations over the years, I would like to share some additional thoughts about fishing tricos. Most of the difficulties are during the morning period.

The first issue is the great diversity of stages and forms that may be available at this time. The fish see a transition from female nymphs, female emergers, upright female duns, and male and female spinners. Also present in small numbers are stillborn female duns and stillborn duns and spinners from the previous days. The males and females also differ in size and color. Fish may become selective to a stage or form of a stage during these periods. One may need to separate all these forms out, something especially difficult when there are so many insects on the water.

The second issue, and probably the most important, is the "imprint" of the fly on the water and micro drag caused by the leader. All anglers have put down fish because the fly was dragging on the water's surface or didn't look right to the fish. Long, fine tippets can help, as do the newer lightweight small hooks. At times, hackled patterns or sunken wet flies work when other patterns fail. This issue is especially important on flat, slow water.

Often, fish become conditioned in response to angling pressure, especially on popular catch-and-release waters. Being caught seems to greatly alter a fish's response to our flies and angling techniques. If one is prepared and observant, fishing these minute imitations can be rewarding and quite a contrast to easier forms of fly fishing.

Aquatic Moths

SPECIES: *Petrophila confusalis*
FAMILY: Pyralidae
EMERGENCE PERIOD: Late spring to late fall.
LARVAL HABITAT: In riffles and runs on rock substrate.
LARVAL CHARACTERS: Length 9 to 10 mm, head flattened, thorax and abdomen with numerous filamentous gills, body tan to brown.
PUPAL CHARACTERS: Length 7 to 8 mm, caddis-like but in flat silken cocoons with holes.
ADULT CHARACTERS: Length 7 to 8 mm, well-developed beak, wings with scales and metallic marks.

The aquatic moth *Petrophila confusalis* is not commonly observed by anglers, and few anglers fish the "hatch". This occurs because of the moth's nocturnal behavior and small size. This species is found in many of the lower reaches of San Joaquin Valley rivers. Angling literature has largely ignored this group, although Gary LaFontaine in <u>Caddisflies</u> mentions them briefly, and Patrick McCafferty in *Fly Fisherman Magazine* (May, 1983) covers aquatic moths in more detail. McCafferty's description of moth behavior differs greatly from the behavior noted in this section, and fishing techniques should be altered accordingly.

Aquatic moths are similar to the more familiar butterflies but have aquatic larval and pupal stages followed by a terrestrial adult stage. In *P. confusalis*, the female walks down rocks into the water where she deposits eggs. Gilled larvae hatch and make flattened silk tent-like structures. The larvae feed on algae protected under these tents. After a period of time, each larva spins a silk pupal cocoon. Before pupation, each larva cuts an escape hole allowing the adult to emerge. After pupation is complete, the emerging adult moves to the water's surface.

For the angler, the importance of the larval stage is unknown. Trout eat the larvae but may "graze" them off rocks on the stream bottom. Little is known about the pupal stage, but it may be important at certain times.

My fishing experience has shown that the adult stage is most important. Adults emerge rather late in the day, from dusk to about midnight. Normally, emergence occurs 25 minutes after *Hydropsyche californica* (Kings River Caddis). Adults move through the water column and pop up to the water's surface. Trout respond to their presence immediately by feeding on the quickly moving adults. This insect emerges differently than others since the wings are not fully expanded and appear as short stubs held back over the abdomen. Adults cannot fly but walk quickly across the water's surface. They then crawl up on exposed rocks and one's waders and fully expand their wings. The presence of these adults is the best clue to moth emergence.

To fish the adult imitations, make a long cast, and then strip the line very quickly. Flies used should be similar to caddis imitations, such as the Elk Hair Caddis. Initially, fish take caddisflies in faster water, then later move into slower currents to feed on adult moths. By noting this change in position, one can determine that moths are emerging. While not often imitated, this interesting insect allows some exciting night fishing and the chance for large trout on a dry fly.

Small Western Green Drake

SPECIES: *Drunella coloradensis*
FAMILY: Ephemerellidae
COMMON NAME: Small Western Green Drake
EMERGENCE PERIOD: December to August with April to June peak.
LARVAL HABITAT: Rocky runs and riffles.
LARVAL CHARACTERS: Length 13 to 15 mm, dark brown to black, underbody maroon, leading edge of femora with spines.
ADULT CHARACTERS: Length 13 to 15 mm, wings slate gray, body robust, wings with detached marginal intercalaries.

Drunella coloradensis is an insect that trout are highly selective to with other insects being ignored when it is emerging. Even though the emergence is often sparse, large trout feed on this insect. I first became aware of this “hatch” while fishing Quarry Run on the lower Kings River in 1972. Since that time, I have fished and observed this insect many times. Although primarily a late winter and spring emerger, in 1986 the emergence period lasted until August.

Larvae are large, robust, and flattened, with the body dark brown to black and the underside maroon. Larvae are clumsy and if swept away make feeble swimming movements. Trout feed heavily on larvae during the spring but take emergers and adults when they are present. Nymph imitations are effective when fished dead-drift in runs and riffles.

Emergence occurs from late afternoon to about dark. Adults are quite clumsy, often tipping and tilting or falling over on their sides. Other adults are able to bring their wings together and sit upright. Emergers with short to long wings, flush-floating adults, and upright adults are all present at the same time. This variability of emerging forms can present problems since certain fish key in on a single insect stage.

The most effective fly patterns have been an emerger and a paradrake dry fly. Both are taken by fish but at times can be refused. Emerger patterns are best fished in riffles or runs either dead-drift or using Leisenring’s lift. Dry flies can be used in riffles and runs or on flats to where the adults drift. Spinners are dark brown with dark venation in the wings. This stage is rarely important to the angler since it is never very common or concentrated.

In the spring, "masking hatches" involving this insect and the Kings River Caddis occur. Most fish prefer this mayfly to the faster moving caddisflies. The rise forms, emergence points, and emergence times are similar, which further adds to the difficulty of taking fish. Most often, I use mayfly imitations first and later switch to caddis imitations.

Microcaddis

SPECIES: *Hydroptila arctia, Hydroptila rono, Oxyethira dualis, Oxyethira pallida*
FAMILY: Hydroptilidae
COMMON NAME: Microcaddis
EMERGENCE PERIOD: All year.
LARVAL HABITAT: Substrates with algae.
LARVAL CHARACTERISTICS: Length 1 to 4 mm, thorax with 3 dark bands, end of abdomen without long hairs, abdomen light tan.
PUPAL CHARACTERS: Length to 3 mm, head and wings dark, abdomen tan, mandibles without inner teeth.
ADULT CHARACTERS: Length to 3 mm, wings with a long fringe of hairs.

This group of insects may be the smallest that trout commonly feed on. Adults emerge most of the year but are most important during the winter when few other insects are present.

Larvae are free-living except during the last instar, at which time they produce a small, purse-like case. The early instar larvae commonly drift in the water column and are fed on by fish. Larval imitations are rarely important to the angler due to their small size and the difficulty in fishing them properly.

Pupal stages emerge from their cases and move onto the water's surface where trout feed on them. Emergence occurs at dusk in the warmer months and at midday in winter. Small imitations can be fished in the water column or on the surface film. One should determine which level the fish are feeding at and present one's fly at that level. Although the insects move slowly to the surface, I find that dead-drift presentations work best. Pupae have a dark head and wings with a lighter abdomen, and imitations should reflect this.

Adults emerge from the pupal exuvia at the water's surface. There they generally walk on the water toward shoreline where they crawl up on rocks. Adults are also taken by trout, and imitations are most effective when fished dead drift. Since the insects are so small, it is difficult to move an imitation slow enough to mimic the insects' behavior.

These insects are so small that fishing them requires short, delicate casts and long, fine leaders. Even with these refinements, the fishing is difficult and often accounts for those seemingly impossible "hatches" one encounters.

Black Fly

GENUS: *Simulium spp.*
FAMILY: Simuliidae
COMMON NAME: Black Fly
EMERGENCE PERIOD: All year with a winter peak.
LARVAL HABITAT: Fast, shallow currents, attached to rocks and substrate.
LARVAL CHARACTERS: Length to 9 mm, head with fan-like brushes, abdomen enlarged.
PUPAL CHARACTERS: Length to 3 mm, in shoe-like cocoons attached to substrate.
ADULT CHARACTERS: Length to 3 mm, robust humpbacked flies with short legs, body black to gray.

Although often associated with disease transmission or their severe bite, black flies can provide the angler with an excellent "hatch" over which to fish. Emergence can often be intense and concentrated, with fish actively feeding on the emerging adults. These "hatches" are often concentrated below dams, spillways, or narrow chutes in rivers or streams. Their small size and the large numbers of adults on the water make for some difficult fishing.

This group of insects is rarely treated in angling literature, except in Europe. The best angling treatments are by J. R. Harris in An Angling Entomology and by W. P. McCafferty in Aquatic Entomology. P. H. Adler in *Natural History* (Vol. 97, N0. 6, June 1988) wrote a more technical article that describes in detail the biology of this group with excellent color photographs that show the various life stages.

For the angler, the larvae and pupae present an interesting problem. Both are eaten by trout, but they generally stay in a fixed spot in very fast, shallow water. The larvae also use a safety line in case they are swept away. This suggests that trout simply graze them off the surface of the substrate, although some larvae are taken when they drift. The presence of black flies can be determined by looking for the larvae with their swollen abdomens and the shoe-like pupae in fast, shallow water.

After pupation is complete, the adult splits the pupal case, and the adult insect crawls out. The adult is covered by a bubble of air that buoys it to the water's surface (see P. H. Adler, *Natural History*, pg. 38). Since the adult has emerged and remains dry, it can quickly fly away. This behavior occurs most commonly on warm clear days. Generally, one fishes the ascending adult as one would a caddis pupa using Leisenring's Lift to imitate this behavior.

If the weather is cold and wet, many adults move along the water's surface, not being able to fly directly away. An intermediate behavior occurs in which adults skim along the water's surface. This behavior is difficult to imitate using such a small fly. Often, the fish key on these adults and one must skate a Griffith's Gnat on a long leader to take certain fish. This situation can often be very frustrating for the angler.

During the winter, many adults float dead drift or spent on the surface. These are best imitated with a Griffith's Gnat using slack line downstream casts. Knocked Down Duns with a very short tail and tailless floating nymphs also work during this period. To add to the problems, Blue Winged Olives are often present at the same time.

Although I have fished our local waters for many years, I only discovered this "hatch" in 1990. Even for the experienced angler, it pays to keep an open mind, maintain the ability to take in new information, and to observe each angling situation carefully. Each angler needs to think about what is observed and interpret it correctly to be successful.

Turtle Cased Caddis

SPECIES: *Glossosoma oregonense*
FAMILY: Glossosomatidae
COMMON NAME: Turtle Cased Caddis
EMERGENCE PERIOD: Spring and fall.
LARVAL HABITAT: On rocks in runs and riffles.
LARVAL CHARACTERS: Length 6 to 8 mm, thorax with one dark band, abdomen tan, turtle-shaped case.
PUPAL CHARACTERS: Length 7 mm, head and thorax dark brown, abdomen tan, wings dark brown.
ADULT CHARACTERS: Length 7 mm, abdomen tan, wings brown, wing base area with "V" shaped warts.

Locally, there are several minor insect "hatches" on low elevation rivers that can provide excellent fishing. *Glossosoma oregonense* emerges sporadically in the spring and fall in our local rivers. Larvae are small and have tan bodies with dark anterior regions. These larvae produce the typical "turtle cases" found on rocks in fast riffles. Larvae may leave their cases and drift freely in the current, often being fed on by trout. They can be imitated by a Hare's Ear Nymph fished dead-drift.

The pupa is the most important stage, and it emerges from afternoon to about dusk. Its behavior is quite different from most other aquatic insects. The pupa swims up to the water's surface and pops up on top, paddling with its legs until it reaches shore. There it casts off its exuvia, and the adult expands its wings and flies away. Trout key in on these paddling pupae which have dark wings and heads with tan abdomens. I have no satisfactory imitation but use a LaFontaine Deep Pupa and dress it to float. It is best to cast to a rising fish and slowly strip the fly in. At times, a few adults can be found "walking" along the water's surface. Adults are small and have dark brown wings with tan bodies. They can be imitated by a standard caddis dry fly slowly stripped in short pulses.

Midge

FAMILY: Chironomidae
COMMON NAME: Midge
EMERGENCE PERIOD: All year.

LARVAL HABITAT: All aquatic habitats.
LARVAL CHARACTERS: Length to 10 mm, head well-developed, prolegs on prothorax and end of abdomen.
PUPAL CHARACTERS: Length to 5 mm, thorax enlarged, 2 wing pads.
ADULT CHARACTERS: Length to 5 mm, 2 wings without scales, males with plumose antennae.

The Chironomidae or true midges are an important group of aquatic insects to anglers. Their importance is due to the great number of species and their high densities. Since so many species exist and so little is known about their biology, any treatment of Chironomids must be of a general nature.

Our low elevation rivers have several midges; the most important are black, olive, and gray to tan varieties. The black and olive forms are associated with slow waters, while the gray to tan form is found in faster moving areas. Both have similar behavior and can be treated as a single group.

The larvae of these midges are fed on by trout, but fishing tiny larval imitations on the bottom of a river is difficult at best. Many midge larvae live freely, swimming in the water column above the streambed, yet anglers have rarely thought about fishing this habitat with midge imitations.

Midge pupae, on the other hand, are very important to anglers. Stomach contents of trout generally contain mostly emerging pupae. Mature pupae move to the water's surface where they emerge. During this time, fish feed freely on the moving pupae, and imitations fished from two feet below the surface up to the surface film are effective. One can grease the leader with floatant to control the depth of the fly. Pupae may also concentrate their emergence in certain areas of the stream. Imitations can be fished either dead-drift or, at times, with a slow hand-twist retrieve. My favorite imitations are those of Ed Koch; these "simfectives" are tied rather fat and can be weighted.

Adult midges emerge on the water's surface and generally fly quickly away. Some linger a while longer, especially when the weather is cold. Adult imitations, although not as important as pupae, can be fished in typical dry-fly fashion. Locally, midges do not form mating clusters so these patterns are not needed.

Crane Fly

FAMILY: Tipulidae
COMMON NAME: Crane Fly
EMERGENCE PERIOD: Spring
HABITAT: Mostly terrestrial.
ADULT CHARACTERS: Length to 4 cm, single pair of delicate wings, long delicate legs, tan to orange.

This "hatch" is not an emergence but an insect behavior pattern that occurs often enough to be of interest to anglers. Tipulidae, or crane flies, often emerge from their terrestrial habitats in large numbers. These primitive flies cannot maintain their flight position in even a slight wind, so they are often blown across the water's surface. Trout respond with aggressive, splashy rises. This response is often difficult to understand since no insects are emerging from the water's surface. This insect is best fished using a spider-type fly stripped quickly across the water, and this method can be used for any insect that has a similar behavior.

Golden Stonefly

SPECIES: *Claassenia sabulosa*
FAMILY: Perlidae
COMMON NAME: Golden Stonefly
EMERGENCE PERIOD: Spring to late fall.
LARVAL HABITAT: In riffles and runs among rocky substrates.
LARVAL CHARACTERS: Length 22 to 30 mm, filamentous gills on sides of thorax.
ADULT CHARACTERS: Length 20 to 28 mm, 4 wings of same size, remnants of gills on thorax.

Golden stoneflies are well-known and often imitated by anglers. At times, they can be the most important stonefly in our trout streams, and their larvae are found in the faster runs and riffles of lower, mid, and high elevation rivers on the western slope of the Sierra Nevada Mountains.

Although a rather large insect, the larvae hide in the spaces among rocky stream bottoms. Larvae move freely, stalking their prey which consists of other insects. If swept away, they drift with the current, so free-drifting flies work best. Current tongues flowing into pools and drop-offs are excellent places to use nymphs. Nymph imitations can be used all year and produce well during spring runoff. Fast sinking lines and heavy rods can be useful.

Larvae of these insects have extensive brown markings on the head, thorax, and legs, while the abdomen is golden-brown with dark rings. Nymphal imitations should reflect this coloration. I use two types of imitations: suggestive and those that closely imitate the insect. Suggestive flies are only used in heavy flows and around snags where their loss can be expected.

When ready to emerge, the larvae move into certain stream regions and crawl out onto the stream bank. Once on the bank, adults emerge from the nymphal exuvia and can be spotted on rocks and vegetation indicating good places to use nymphal imitations. Emergence generally occurs at dusk or shortly thereafter. Adults have four dark wings, a golden-yellow abdomen, and a dark thorax. Adults stay in streamside vegetation until they mate. Females then return to the water to lay eggs, which occurs after dark in our area. Females often run along the water's surface or flutter about quickly, and one should imitate these movements when fishing dry flies.

Although they never produce extensive "hatches", golden stoneflies allow the angler excellent year-round fishing. An occasional large fish can also be taken during these "hatch" periods.

NOTE: This insect is now rare in low elevation rivers; it is more common in mid and high elevation rivers. The golden stonefly group, as a whole, needs further study.

F. Central California's Mid Elevation Rivers

The next region covered consists of the mid elevation foothill rivers of the western Sierra Nevada. These rivers, in the past as well as the present, are primarily rainbow trout fisheries. The native fish fauna has been altered though by the introduction of several non-native fishes. These rivers occupy deep canyons surrounded by the Foothill Belt. This area is subject to both recreational uses and cattle grazing.

Elevation ranges from about 900 to 2000 feet with these ranges being higher in the southerly rivers. Water temperatures are generally more extreme than those of the lower reaches, ranging from about 2°C (35°F) in winter to over 28°C (82°F) in summer. Water temperatures are greatly influenced by air temperatures, snow melt runoff, and water levels. Substrates are generally large rounded rocks, but extensive boulders and bedrock sections occur. Gravel and sand are also common in certain areas.

The climate is mild except for the hot summers, and the highest monthly mean maximum temperature is 35°C (95°F) while the lowest monthly mean minimum temperature is 3°C (38°F). These rivers present some difficulties since as a group the insect fauna is much more diverse than at lower elevations. Some insects are common to all rivers, while several are important in only a limited area. Some rivers also have important insects that are found in the lower elevation sections and will be covered here again.

Of the rivers covered, most have not been examined in great detail. Since further study is needed, I will discuss insects that may prove to be of significance on these rivers. Some of these insects may prove to be unimportant, while some species may be locally important only in certain rivers.

G. Insects of Mid Elevation Rivers

Ephemeroptera – Mayflies

Baetidae – Blue Winged Olive
Anafroptilum sp.
Baetis sp.
Heptageniidae – Light Cahill
Epeorus sp.
Heptageniidae – American March Brown
Rhithrogena morrisoni
Leptophlebiidae – Blue Quill
Paraleptophlebia sp.

Plecoptera – Stoneflies

Perlidae – Golden Stonefly
Calineuria californica
Claassenia sabulosa
Doroneuria baumanni
Hesperoperla hoguei
Hesperoperla pacifica
Perlodidae – Early Golden Stonefly
Skwala americana
Pteronarcyidae – Salmonfly
Pteronarcys californica

Tricoptera – Caddisflies

Brachycentridae – American Grannom
Brachycentrus occidentalis

H. Insects of Mid Elevation Rivers Hatch Chart
(Listed in Order of Importance)

Insect	Emergence Period	Important Stage	Size	Important Time
American March Brown *Rhithrogena morrisoni*	winter to spring	subimago	10 mm	noon to dusk
American Grannom *Brachycentrus occidentalis*	May and June	pupa adult	8 mm 10 mm	midday
Blue Winged Olive *Anafroptilum sp.* *Baetis sp.*	all year with fall and spring peaks	subimago	5-7 mm	midday
Light Cahill *Epeorus* sp.	summer to fall	subimago adult	10-13 mm 10-13 mm	dusk
Blue Quill *Paraleptophlebia sp.*	October to November	subimago imago	10-12 mm 10-12 mm	afternoon to dark
Early Golden Stonefly *Skwala americana*	February to April	adult	20 mm	midday to dusk
Golden Stonefly *Calineuria californica* *Claassenia sabulosa* *Doroneuria baumanni* *Hesperoperla hoguei* *Hesperoperla pacifica*	spring to fall	larva adult	30 mm 20-28 mm	afternoon to dusk
Salmonfly *Pteronarcys californica*	March and April	larva adult	43 mm 38-43 mm	afternoon to dark

American March Brown

SPECIES: *Rhithrogena morrisoni*
FAMILY: Heptageniidae
COMMON NAME: American March Brown
EMERGENCE PERIOD: Late winter to spring.
LARVAL HABITAT: Fast, rocky riffles and runs.
LARVAL CHARACTERS: Length 12 mm, gills on first and seventh abdominal segments overlap.
ADULT CHARACTERS: Length 10 mm, legs with dark streak, wing veins anastomosed.

Rhithrogena morrisoni is a widespread species occurring in the western United States. This insect is one of the most important "hatches" on the upper Kings River. Since they emerge in the late winter through early spring, they provide a welcome break from the smaller insects so common during the winter season. At times, these emerging insects concentrate in mid reaches of pools and provide excellent fishing.

Larvae are rather large insects which occur in fast flowing water. There they cling to large round rocks and are aided in this behavior by overlapping gills, which form a ventral disc. Larvae vary in size and color throughout the stage and when ready to emerge, rise up to the water's surface. Little is known about the importance of this stage to anglers.

The subimagos, or duns, have a brown to tan body with dark mottled wings. Most duns emerge in the mid reaches of pools along foam lines, but some can be found in back eddies and in slower water. Emergence occurs from 12:30 to 6:00 pm during February to April. Most often, emergence occurs between 2:30 and 3:30, but a split "hatch" at about 2:00 pm and then again at 5:00 pm may occur. Duns stay on the water's surface for long periods of time, often with their wings folded down into the water. They may move a great deal, hopping, jumping, or skipping about. At times, they fly up and then drop down on the water. Strong winds can also force the duns to lower their wings onto the water. Fish respond with vigorous rises, often porpoising to catch the moving adults. Fish generally take duns in swirling foam lines or current tongues making drag free floats difficult. Long casts are often the rule in these areas. A reach or slack line cast is useful, but most important is a Harvey style leader which helps prevent drag. The most effective patterns are paradrakes and in rough, fast water, fully hackled hairwing forms. At times, a down wing deer hair dry fly or a sunken wet fly can be productive, especially in situations where drag free floats are difficult.

The imago, or spinner, has a brown body with large clear wings. They often swarm from 10 to 200 feet above the water at the same time as emergence. Fish rarely respond to these adults because they only drop to the water for short periods of time. In other regions, the main spinner flights occur in the evening so the possibility that they are important should be examined in our area.

On certain local rivers, this insect provides excellent fishing since most fish will be up and actively feeding. Even larger fish can be taken on dry flies at this time. This “hatch” offers a change from the small fly and long leader fishing so common during our winter season.

American Grannom

SPECIES: *Brachycentrus occidentalis*
FAMILY: Brachycentridae
COMMON NAME: American Grannom
EMERGENCE PERIOD: May to June during runoff.
LARVAL HABITAT: Aggregated on top of rocks in pool tails.
LARVAL CHARACTERS: Length to 10 mm, larvae lack abdominal humps, rear legs with short spiny hairs.
PUPAL CHARACTERS: Length to 8 mm, color dark gray to brown.
ADULT CHARACTERS: Length to 8 mm, wings dark gray, body gray to brown.

Brachycentrus occidentalis produces excellent springtime fishing approximately a month after the mayfly *Rhithrogena morrisoni* (American March Brown) Many fish, some of them rather large, can often be found rising to the midday emergence of these insects. When emergence occurs, even in high spring flows, trout readily feed on them. This “hatch” is one of the most important mid elevation, early season insects.

The larvae are very common in the runs and tail outs of our mid elevation rivers. They sit in their cases, crowded together, where they feed by filtering the current and grazing off rock surfaces. Larvae are light green on the posterior three-fourths and dark brown to black on the anterior one-fourth. The presence of these larvae allows one to monitor larval growth and determine the onset of pupation. Once the larval cases are sealed on the end, pupation has begun, and emergence will follow in a week or two. Great numbers of the larvae can be found drifting in the water column, generally when the flow is decreasing. One can use larval imitations at this time.

Pupation occurs in the larval habitat, and when complete, pupae cut their way out of the case. They move toward the water’s surface where they emerge at midday. Pupae are fed on by trout and can be important for anglers. The wing color is dark gray with a gray to brown body. Adults emerge in mid stream, so these are the best places to use pupal imitations. Imitations are cast above the lies of fish and allowed to drift in the current toward the fish.

My experience indicates that the adult stage is the most important for anglers. Numerous fish are often present and actively feeding when this insect is available. Adult insects remain on the water’s surface for a long period of time and are readily eaten by fish. Adults are small and have dark gray wings with a dark gray-brown body. Fish tend to take adult insects in slower currents, so imitations are best used in these locations. This species generally emerges for only a short period in the spring so one must be present at the proper time or the emergence period will be missed.

While this “hatch” does not approach that found during the famous Mother’s Day “hatch” in the Yellowstone area, it is important in our region. This insect often emerges before the high elevation streams are fishable, so it provides excellent angling during a difficult period for the angler.

Blue Winged Olive

SPECIES: *Anafroptilum sp.*, *Baetis sp.*
FAMILY: Baetidae
COMMON NAME: Blue Winged Olive
EMERGENCE PERIOD: All year except January.
LARVAL HABITAT: On tops of rocks in currents.
LARVAL CHARACTERS: Length to 7 mm, streamlined forms with antennae 3 times as long as head.
ADULT CHARACTERS: Length 5 to 7 mm, wings with single or double marginal intercalaries.

This family of mayflies is important to the angler who frequents both the early and late fishing season on our mid elevation rivers. Commonly referred to as blue winged olives, these insects are among the first to emerge from fall to late winter. Unlike their presence in our low elevation rivers, they do not provide very good fishing opportunities during the coldest winter months, although trout can feed on these insects in rather cold temperatures. This group of mayflies has not been identified with any certainty as of yet but are similar to the baetids on the lower Kings River. At times, a masking "hatch" with the light cahill can occur, but the more numerous baetids are generally not preferred by the trout. This situation is not as confusing as on our lower rivers, and the best fishing approach is still to directly examine the specimens that are emerging and match them as closely as possible.

In our mid elevation rivers, the prime fishing months are February to March, and September to December. At these times, water temperatures can be extremely important. In late winter, the temperatures are less critical since the temperatures are increasing toward a more suitable range. The most critical time is in late fall when a sudden temperature drop often stops trout from feeding, even though the baetids continue to emerge.

Streamlined baetid larvae are most common on top of rocks where they are exposed to fast currents. Their coloration is light green, and they are up to 7 mm long. Larvae are active and can dart about rather quickly. The best method to fish larval imitations is dead drift in current tongues at the head of a pool.

Duns emerge as the larvae move to the water's surface. The duns, especially during cold weather, can ride the current for a long period and attract feeding fish. Emergence can occur all day but is most common during midday. The dun has light gray wings and a gray-green body, although color does vary. When fishing, delicate slack line casts are best, allowing long drag free floats that mimic the insect's behavior. Downstream and across current reach casts are the most effective presentations. Imitations can be much larger than the insect as the fish here are not selective or difficult.

After emergence, the dun flies to the streamside, and the spinner, or adult insect, casts off its exuvia. The adults then form mating flights, mate, and lay eggs. At times, spinner imitations can be effective in flat water areas such as pool tail outs. Spinners generally have clear wings with a rusty-tan body.

As with baetids in low elevation rivers, this information is of general nature, and careful observation is needed. Also, “hatches” and spinner falls are not as intense as in the low elevation rivers but provide fair fishing for the observant off-season angler.

Light Cahill

SPECIES: *Epeorus sp.*
FAMILY: Heptageniidae
COMMON NAME: Light Cahill
EMERGENCE PERIOD: Early summer to fall.
LARVAL HABITAT: On tops of rocks in shallow, fast currents.
LARVAL CHARACTERS: Length to 13 mm, flattened with long tail filaments and lateral gills.
ADULT CHARACTERS: Length to 10 mm, body clear white to yellow.

This species is an important one for anglers fishing our mid elevation rivers, in addition it occurs in our high elevation rivers. We have keyed this species out to *Epeorus albertae* but at least four other species are common to the area. Excellent “hatches” occur from early summer through the fall. Often because of extreme water temperatures, the best fishing is in the fall after these waters cool off. The best time to fish is at dusk when the duns emerge and the adults are most active.

Larvae are rather large, flattened insects, and the coloration is generally tan to light green. Larvae live in shallow, rapidly moving water, generally clinging to large round rocks. Their gills, which form a disc, aid in allowing them to live in extreme water currents. Larvae are rather poor swimmers and can make only feeble swimming movements. Little is known of their importance to the angler.

The subimagos, or duns, have a yellow to cream body with light gray wings. They emerge from current tongues in pools below large, fast riffles. Emergence is generally at dusk, and trout rise quickly to take the duns. Yet late in the fall, at midday, masking “hatches” with baetids occur. Most fish seem to take the larger insects. Light cahill dry flies work well in fast, rough water although cream parachutes also work. In the fall, flows are generally lower and slower than in the springtime, so drag free floats are easier to make.

The imago, or spinner, has a clear white to yellow body with clear wings. Females are slightly longer than males, and both can be found swarming over riffles from late afternoon to dusk. They sit on the water, like duns, and a CDC Compara-dun is often useful. Fish may respond to these adults in tail outs and slow backwater areas where the insects concentrate in fair numbers. Often, it is difficult to determine which stage is being taken, although either a dun or spinner imitation works well. Upright spinners tend to be most common at the head of a pool or run while spent spinners tend to be common at the tail outs.

This insect can provide the angler with good summer to fall angling on our local rivers. One must pay close attention to water temperatures as they can slow fishing. When conditions are right, this "hatch" provides relatively easy fall fishing for the observant angler.

Blue Quill

SPECIES: *Paraleptophlebia sp.*
FAMILY: Leptophlebiidae
COMMON NAME: Blue Quill
EMERGENCE PERIOD: October to November.
LARVAL HABITAT: In riffles and runs often moving into slower water.
LARVAL CHARACTERS: Length to 12 mm, tuning fork gills, often with tusks, body brown.
ADULT CHARACTERS: Length to 10 mm, wings and body dark gray, 3 tails.

This group of insects has been under study for many years, but became numerous during the warm, low water years of 2013 and 2014. The nymphs have large tusks which allow for easy identification. Little is known about the nymph or its importance on these rivers. They are thought to move into slower water sections near shore prior to emergence. This movement could prove to be important.

The subadult, or dun, has been the most important stage, often emerging in slower current seams. They also emerge in the main current tongues and channels, at least during low water years. Emergence begins in the afternoon and can continue for several hours. The number of insects is never great, but they are commonly fed on by fish. The body and wings are dark gray.

The adult is also important and can be found later in the afternoon and at dusk. The wings are clear, and the body dark brown. They are fed on in slow, slack water sections of large pools.

This insect has been observed for many years, generally being uncommon and not very important. However, during low water years, they become numerous and produce excellent fishing opportunities for larger fish. At this time, it is not known what will occur in future years, but it is an insect to be aware of.

Early Golden Stonefly

SPECIES: *Skwala americana*
FAMILY: Perlodidae
COMMOM NAME: Early Golden Stonefly
EMERGENCE PERIOD: February to April.

LARVAL HABITAT: Under rocks in riffles and runs.
LARVAL CHARACTERS: Length to 22 mm, thoracic gills absent, color brown and yellow.
ADULT CHARACTERS: Length to 20 mm, thoracic gill remnants absent, body dark brown on top and tan to yellow underneath.

Our mid elevation rivers have several insects which produce a number of sporadic “hatches”. Of these, the early-season stonefly, *Skwala americana*, can provide excellent angling. Locally, the insects are called early golden stoneflies, but they are not related to the typical golden stoneflies in the family Perlidae.

Larvae are large and brown mixed with yellow. The immature stages are predators and move about in rocky runs and riffles. Trout feed on the larvae early in the year, so imitations can be useful at this time. True golden stoneflies are also present, and a single imitation can work for both groups of insects. The most important aspect of the larval life cycle is their movement prior to and during emergence. Larvae move into certain regions near the shore and crawl out onto streamside vegetation where the adults emerge. Anglers should be observant since fish may feed on these larvae. This movement also allows the angler to time the emergence period and to predict egg-laying flights.

Some adults emerge on streamside vegetation and are rather large with dark brown coloration on top and tan to yellow underneath. The wings are slightly longer than the body and clear with dark veins.

Most important to anglers are the midday flights in which adults move along the water’s surface. This is apparently an egg-laying strategy used by the females. During these times, a large golden stonefly imitation can be very effective. Imitations are simply cast into current tongues or runs and allowed to move slowly across the water.

Although they emerge at the same time as the salmon fly, *Pteronarcys californica*, these insects are more commonly fed on by trout. This apparently results from their greater availability during the midday flight, so anglers need to be aware of this species.

NOTE: Other species of this family may be of importance and require further study.

Golden Stonefly

SPECIES: *Calineuria californica, Claassenia sabulosa, Doroneuria baumanni, Hesperoperla hoguei, Hesperoperla pacifica*
FAMILY: Perlidae
COMMON NAME: Golden Stonefly
EMERGENCE PERIOD: Spring to late fall.
LARVAL HABITAT: In riffles and runs among rocky substrates.
LARVAL CHARACTERS: Length to 30 mm, filamentous gills on sides of thorax.
ADULT CHARACTERS: Length 20 to 28 mm, 4 wings of same size, remnants of gills on thorax.

Several species exist in our local mid elevation rivers, and at times, they are the most important stonefly in these streams. Their larvae are found in the faster runs and riffles of lower, mid, and high elevation rivers on the western slope of the Sierra Nevada Mountains.

Although being rather large insects, the larvae of these species hide in the spaces among rocky stream bottoms. Larvae move freely, stalking their prey, which consists of other insects. If swept away, they drift with the current, so free-drifting flies work best. Current tongues flowing into pools and drop-offs are excellent places to use nymphs. These larvae have two to three year life cycles, so nymph imitations can be used all year and produce well during spring runoff.

Larvae of these insects have extensive brown and yellow markings on the head, thorax, and legs, while the abdomen is golden brown with dark rings. Nymphal imitations should reflect this coloration.

When ready to emerge, the larvae move into certain stream regions close to the shore and crawl out onto the stream bank. Once on the bank, adults emerge from the nymphal exuvia and can be spotted on rocks and vegetation, indicating good places to use nymphal imitations. Emergence generally occurs late in the day. Adults have four dark wings, a golden yellow abdomen, and a dark thorax. Adults stay in streamside vegetation until they mate. Females then return to the water to lay eggs, often running along or fluttering about quickly on the water's surface. One should imitate these movements when fishing dry flies. Although they never produce extensive "hatches", mid elevation golden stoneflies allow the angler excellent year-round fishing and an occasional large fish.

NOTE: The golden stonefly group, as a whole, needs further study. The exact habitats and species present are still being examined.

Salmonfly

SPECIES: *Pteronarcys californica*
FAMILY: Pteronarcyidae
COMMON NAME: Salmonfly
EMERGENCE PERIOD: Late March to early April.
LARVAL CHARACTERS: Length to 43 mm, thorax and first 2 abdominal segments with gills, body dark brown.
ADULT CHARACTERS: Length to 43 mm, forewings with 2 rows of anal cross veins, body brown on top and orange to brown underneath.

Salmonflies, *Pteronarcys californica*, are found on all mid elevation rivers in our region, but the rivers here lack the extensive "hatches" found in many other western rivers. Since the insects are so large, they are commonly observed by anglers and cause them to wonder about their importance. Here, I will attempt to cover what is known about this species in Central California.

Their larvae are among the largest insects found in aquatic habitats, and their imitations can be useful for the trout angler. They are dark brown in color with gills on the thorax and abdomen. Larvae feed by shredding leaves and other organic matter. They live for several years before they mature, making them available to trout year round. Several size classes are present at any one time, and nymphal imitations can be used at any time. Larvae make feeble movements, so dead-drift presentations are most useful. The best places to use nymphs are in very fast runs and chutes where they enter pools. Larvae also migrate towards shore where they emerge, and anglers must be aware of this movement as trout can intercept these larvae. In our region, the migration and emergence usually occurs in late March to early April.

Adults emerge after the larvae have crawled up on the shoreline vegetation or substrate. Here, the adult emerges from the nymphal exuvia and expands its wings. Adult stages can, at times, be important if one finds many adults along shoreline vegetation. Adults may fall into the water and be taken by fish, although this is rather uncommon locally. During midday, females return to lay their eggs, but for the angler, this is generally unimportant as they often drop their eggs from the air. This behavior needs to be examined in more detail.

In Central California, this insect is not very important, but may provide occasional fishing opportunities. My observations are that in the 1970's this "hatch" provided better fishing than it does today. I have unconfirmed reports of it still being important on the Merced River. The reason for this decline is unknown, but it is still useful to be aware of this insect's potential importance.

I. Central California's High Elevation Rivers

The next region covered consists of the montane rivers of the western Sierra Nevada. In the past, these rivers were primarily rainbow trout fisheries, yet the native fish fauna has been altered by the introduction of several non-native trout species, brown trout being the most common. These rivers occupy deep canyons surrounded by mixed conifer forests. This area is subject to recreational uses, and much of it is in wilderness or national park lands.

Elevation ranges from about 3000 to 7000 feet with these ranges being higher in the southerly rivers. Water temperatures are more conducive to trout than those of the lower reaches, and these temperatures range from about 2°C (35°F) in winter to about 20°C (68°F) in summer. The upper warm temperatures are rarely maintained for more than a few hours at a time. Water temperatures are greatly influenced by air temperatures, snow melt runoff, and water levels. Substrates are generally large, rounded rocks and gravel, but extensive boulders and bedrock sections occur. The climate is mild except for the hot summers. The highest monthly mean maximum temperature is 24°C (76°F) while the lowest monthly mean minimum temperature is -9°C (16°F).

These rivers are a continuation of the mid elevation rivers covered in the last section. The insect fauna is much less diverse than at lower elevations. Only a few insects are of any importance to the fly fisher. Some insects found here may also be found in the lower elevation sections. Of the rivers covered, the Kings River, the Merced River, the Tule, and the Kaweah have been examined in detail. Further study is needed in all areas.

J. Insects of High Elevation Rivers

Ephemeroptera – Mayflies

Heptageniidae – March Brown
    Rhithrogena sp.
Heptageniidae – Light Cahill
    Epeorus sp.
Baetidae – Blue Winged Olive
    Baetis sp.

Plecoptera – Stoneflies

Perlidae – Golden Stonefly
    Calineuria californica
    Claassenia sabulosa
    Doroneuria baumanni
    Hesperoperla hoguei
    Hesperoperla pacifica
Perlodidae – Yellow Sally
    Isoperla sp.

K. Insects of High Elevation Rivers Hatch Chart (Listed in Order of Importance)

Insect	**Emergence Period**	**Important Stage**	**Size**	**Important Time**
March Brown *Rhithrogena sp.*	late spring to summer	adult	13 mm	late afternoon
Light Cahill *Epeorus sp.*	summer to late fall	adult	10 mm	late afternoon
Blue Winged Olive *Baetis sp.*	all year except January	subadult	7 mm	midday
Yellow Sally *Isoperla sp.*	Spring to Summer	adult	10 mm	dusk
Golden Stonefly *Calineuria californica* *Claassenia sabulosa* *Doroneuria baumanni* *Hesperoperla hoguei* *Hesperoperla pacifica*	spring to late fall	larva adult	30 mm 20-28 mm	late afternoon to dusk

March Brown

SPECIES: *Rhithrogena sp.*
FAMILY: Heptageniidae
COMMON NAME: March Brown
EMERGENCE PERIOD: Late spring to summer.
LARVAL HABITAT: Fast, rocky riffles and runs.
LARVAL CHARACTERS: Length 14 mm, gills of first and seventh abdominal segments overlap.
ADULT CHARACTERS: Length 13 mm, leg with dark streak, wing veins anastomosed.

Rhithrogena sp. is a widespread species occurring in many of the high elevation rivers and streams in this area and is the most important insect there. At this time, it is not known if it is the same species that occurs in the mid elevation rivers. In addition, several other species occur in these areas, but it appears that only a single one is common. This species emerges in the spring to early summer and provides excellent fishing, often bringing larger fish to the surface to feed.

Larvae are large insects which occur in fast flowing water. There they cling to large, round rocks and are aided in this behavior by overlapping gills, which form a ventral disc. Larvae vary in size and color even at maturity, and when ready to emerge, they rise up to the water's surface. Little is known about the importance of this stage to anglers as this stage is never very common.

The subimagos, or duns, are rarely seen, and unlike those of the mid elevation rivers, little is known about their importance. They may emerge in small numbers throughout the day, or they may emerge after dark. Even though they are not observed emerging, a paradrake, or in rough, fast water, a fully hackled hairwing dry fly is effective when fished in a searching manner.

The imago, or spinner, has a brown body with large, clear wings. They often swarm from 2 to 200 feet above the water in the late afternoon to about dusk. Fish often respond to these large adults even though they only drop to the water for short periods. At times, any large dry fly cast toward these fish brings an instant response, yet other fish only take a dry fly skated across the surface.

On certain local rivers, this insect provides excellent fishing since most fish will be up and actively feeding. Even larger fish can be taken on dry flies at this time.

Light Cahill

SPECIES: *Epeorus sp.*
FAMILY: Heptageniidae
COMMON NAME: Light Cahill
EMERGENCE PERIOD: Early summer to late fall.
LARVAL HABITAT: On top of rocks in shallow fast currents.

LARVAL CHARACTERS: Length to 12 mm, flattened with long tail filaments and lateral gills.
ADULT CHARACTERS: Length to 10 mm, body clear white to yellow.

This species is an important group for anglers fishing our high elevation rivers, in addition it occurs in our mid elevation rivers. We have keyed this species out to *Epeorus albertae* but at least four other species are commonly collected in our area. Excellent "hatches" occur from early summer through fall. Often because of extreme water temperatures, the best fishing is in the fall after these waters cool off. The best time to fish is at dusk when the duns emerge and the adults are most active.

Larvae are rather large, flattened insects, and the coloration is generally tan to light green. Larvae live in shallow, rapidly moving water, generally clinging to large, round rocks. Although they live in extreme water currents, larvae are rather poor swimmers and can make only feeble swimming movements. Little is known of their importance to the angler.

The subimagos, or duns, of this complex have a yellow to cream or orange to cream body with light gray wings. They emerge from current tongues in pools below large, fast riffles. Emergence is generally at dusk, and trout rise quickly to take the duns. Light cahill dry flies work well in fast, rough water although cream parachutes also work.

The imagoes, or spinners, of this complex have clear white to yellow bodies with clear wings. Females are slightly longer than the males, and both can be found swarming over riffles from late afternoon to dusk. They sit on the water, like duns, and a CDC Compara-dun is often useful. Fish may respond to these adults in tail outs and slow backwater areas where insects concentrate in good numbers. Often it is difficult to determine which stage is being taken, although either a dun or spinner imitation works well. Upright spinners tend to be most common at the head of a pool or run while spent spinners tend to be common at the tail outs.

This insect can provide the angler with good summer to fall angling on our local rivers. One must be careful to pay close attention to water temperatures as they can cause the fishing to slow. When conditions are right, this "hatch" provides relatively easy fall fishing for the observant angler.

Blue Winged Olive

SPECIES: *Baetis sp.*
FAMILY: Baetidae
COMMON NAME: Blue Winged Olive
EMERGENCE PERIOD: All year except January.
LARVAL HABITAT: On tops of rocks in currents.
LARVAL CHARACTERS: Length to 7 mm, streamlined forms with antennae 3 times as long as head.

ADULT CHARACTERS: Length 5 to 7 mm, wings with single or double marginal intercalaries.

This family of mayflies is important to the angler who frequents both the early and late fishing season on our high elevation rivers. Commonly referred to as blue winged olives, these insects are among the first to emerge in late winter and the last to emerge in late fall. Unlike their presence in our low elevation rivers, they do not provide very good fishing opportunities during the coldest winter months. However, trout can feed on these insects in rather cold temperatures in the fall. This species of mayfly has not been identified with any certainty as of yet but is similar to the baetids on our mid and low elevation rivers. The best approach is still to directly examine the specimens that are emerging and match them as closely as possible.

In our high elevation rivers, the prime fishing months are October to November. At these times, water temperatures can be extremely important. The most critical time is when a sudden water temperature drop often stops the trout from feeding even though the baetids continue to emerge.

Streamlined baetid larvae are most common on top of rocks where they are exposed to fast currents. Their coloration is light green, and they are up to 7 mm long. Larvae are active and can dart about rather quickly. The best method to fish larval imitations is dead drift in current tongues at the head of a pool.

Duns emerge as the larvae move to the water's surface. The duns, especially during cold fall weather, can ride the current for a long period and attract feeding fish. Emergence is most common during midday. The dun has light gray wings and a gray-green body although color does vary. When fishing, delicate slack line casts are best, allowing long drag-free floats that mimic the insect's behavior. Downstream and across current reach casts are the most effective presentations. Imitations can be much larger than the insect as the fish here are not selective or difficult.

After emergence, the dun flies to the streamside, and the spinner, or adult insect, casts off its exuvia. The adults then form mating flights, mate, and lay eggs. It is not known if spinner imitations are effective.

As with baetids in low and mid elevation rivers, this information is of general nature, and careful observation is needed. Also, "hatches" and spinner falls are not as intense as in the low elevation rivers but provide fair fishing for the observant off-season angler.

Yellow Sally

SPECIES: *Isoperla sp.*
FAMILY: Perlodidae
COMMON NAME: Yellow Sally
EMERGENCE PERIOD: Spring to summer
LARVAL HABITAT: under rocks in riffles and runs.

LARVAL CHARACTERS: Length to 10 mm, color light brown and yellow.
ADULT CHARACTERS: Length to 10 mm, body light brown and yellow.

Locally, these insects are called yellow sallies, being related to the early golden stoneflies in the family Perlodidae. They have yet to be identified but key to *Isoperla*, a genus which has many species locally.

Larvae are small and coloration is brown mixed with yellow. The immature stages are herbivores and move about in rocky runs and riffles. Little is known about the importance of the larvae to anglers.

Adults emerge on streamside vegetation and are rather small with light brown and yellow coloration. The wings are clear with dark veins and are slightly longer than the body. Most important to the angler are the dusk flights in which adults move along the water's surface. This is apparently an egg-laying strategy used by females. During these times, a small yellow stonefly imitation can be very effective. Imitations are simply cast into current tongues or runs and allowed to move slowly across the water.

This insect has only rarely been found to be important and then only at dusk. Most often, any dry fly can be used, but at times, a more exact imitation is needed.

Golden Stonefly

SPECIES: *Calineuria californica, Claassenia sabulosa, Doroneuria baumanni, Hesperoperla hoguei, Hesperoperla pacifica*
FAMILY: Perlidae
COMMON NAME: Golden Stonefly
EMERGENCE PERIOD: Spring to late fall.
LARVAL HABITAT: In riffles and runs among rocky substrates.
LARVAL CHARACTERS: Length to 30 mm, filamentous gills on sides of thorax.
ADULT CHARACTERS: Length 20 to 28 mm, 4 wings of same size, remnants of gills on thorax.

Several species exist in our local high elevation rivers, and at times, they are the most important stonefly in these streams. Their larvae are found in the faster runs and riffles of lower, mid, and high elevation rivers on the western slope of the Sierra Nevada Mountains.

Although being rather large insects, the larvae of these species hide in the spaces among rocky stream bottoms. Larvae move freely, stalking their prey, which consists of other insects. If swept away, they drift with the current, so free-drifting flies work best. Current tongues flowing into pools and drop-offs are excellent places to use nymphs. These larvae have two to three year life cycles, so nymph imitations can be used all year and produce well during spring runoff.

Larvae of these insects have extensive brown and yellow markings on the head, thorax, and legs, while the abdomen is golden brown with dark rings. Nymphal imitations should reflect this coloration.

When ready to emerge, the larvae move into certain stream regions close to the shore and crawl out onto the stream bank. Once on the bank, adults emerge from the nymphal exuvia and can be spotted on rocks and vegetation, indicating good places to use nymphal imitations. Emergence generally occurs late in the day. Adults have four dark wings, a golden yellow abdomen, and a dark thorax. Adults stay in streamside vegetation until they mate. Females then return to the water to lay eggs, often running along or fluttering about quickly on the water's surface. One should imitate these movements when fishing dry flies. Although they never produce extensive "hatches", high elevation golden stoneflies allow the angler excellent year-round fishing and an occasional large fish.

NOTE: The golden stonefly group, as a whole, needs further study. The exact habitats and species present are still being examined.

Appendix A:
Forage Fish of Low and Mid Elevation Rivers

The following fish are included in this work because they are commonly fed upon by trout. They require different angling equipment including heavier rods, fast sinking lines, and large imitations.

List of Common Forage Fish

Catostomidae – Sacramento Suckers
Catostomus occidentalis

Cottidae – Sculpins
Cottus asper
Cottus gulosus

Cyprinidae – Hardheads, Sacramento Pikeminnows
Mylopharodon conocephalus
Ptychocheilus grandis

Hardhead, Pikeminnow, and Sucker

The hardhead, Sacramento pikeminnow, Sacramento sucker, and sculpin are commonly found in the lowland rivers of the Central Valley and adjacent foothill regions. Although often called “trash” or “rough” fish, all are native to this area, and their young are eaten by trout.

Hardheads are rather large minnows very similar to the Sacramento pikeminnow. Small hardheads have silver sides and bellies with darker upper areas. They tend to be bottom feeders taking small invertebrates and foraging on aquatic plants. Their most common habitat is large pools.

The Sacramento pikeminnow is another large native minnow which is shaped like a pike. The young are similar in coloration to hardheads and are found in pools or slower quiet water feeding mostly on aquatic insects. Pikeminnows are more common in warmer streams. Although larger pikeminnows do prey on trout, their negative effects on trout populations are generally exaggerated by anglers.

Of the forage fish, the Sacramento sucker is the easiest to recognize because of its downward projecting mouth. Small suckers are gray to golden brown with several dark spots on the sides. They are found in schools in shallow water along stream edges or in shallow riffles. Feeding generally occurs on rocks, with algae, detritus, and bottom invertebrates commonly taken.

My favorite imitations of these fish are marabou streamers and rabbit-strip

Matukas. I use wings that match the colors of the various fish mentioned. Imitations are best fished in the habitats occupied by the young of these fish, such as shallow riffles, quiet water next to riffles, open water, or the bottom of pools. These fish are more active than sculpins, and fishing techniques should mimic this behavior. Flies can be cast either upstream or downstream and allowed to drift with the current. Imitations can also be pulled in short bursts or strips while being allowed to swing in the current. Various retrieves can be used in slower water.

Although often disliked by anglers, these fishes are fed upon by trout. They not only provide food for trout but are endemic or native to the rivers and streams of the Central Valley and adjacent foothills, and as such they should not be despised by anglers.

Sculpin

Sculpins are common freshwater fish, often imitated by fly fishers. Many patterns have been produced to imitate this fish including the Muddler Minnow, Spuddler, Troth Bullhead, and the Whitlock Sculpin.

These small bottom fish can be up to 100 mm long and have a large, flattened head, elongate body, and large fan-shaped front fins. Body color is quite variable, generally dark green to brown with a white belly. They lack an air bladder which further enhances their bottom-dwelling nature. Most important in our local area are the prickly sculpin and the riffle sculpin which occupy a wide range of habitats from lakes to streams and are especially common in Central Valley rivers. They are most often found on the bottom of pools and riffles of our low and mid elevation streams.

During most of the day, sculpins hide under rocks, logs, and debris. At night, they actively forage along the streambed and movement generally consists of rapid, short, darting motions directly on the stream bottom. Their diet consists of aquatic insects and other arthropods, mollusks, and small fish. They mature after the first year and spawn from late winter to spring. Both male and female remain together in a concealed nest.

The fly fisher should mimic the sculpin’s behavior as closely as possible. Flies should be fished close to the bottom and moved erratically along. In large deep rivers, special equipment is needed to fish these large, heavy flies. Rods 9 feet long and 8 weight are needed as are fast sinking lines. I often use lines with a sink rate up to 7 to 8 inches per second and weighted conehead flies which put the flies on the bottom where they belong.

Leaders should be about 4 feet with a 10 pound tippet. The best fishing method is to allow the fly to swim, drifting and darting along the bottom with the current. This is accomplished by casting upstream or quartering downstream and allowing the fly to swing below the angler. Short strips of line should be made during the swing across stream. The best fishing periods are from late in the day to early morning. Although difficult and tiring to fish, these large flies account for the capture of some large trout.

Appendix B:
Topics for Further Study

The following subjects require further research and study:

- Baetidae
- Heptageniidae
- Perlidae - golden stoneflies
- Perlodidae -stoneflies
- other insects in tributary creeks
- other insects in mid and high elevation rivers and streams
- Tule and Kern Rivers in general
- drought and temperature effects on aquatic insects and fish

Glossary of Angling Entomology

Although I have attempted to keep the number of terms to a minimum, several dozen have crept into this work. Definitions were taken from various sources as needed.

abdomen	the posterior third division of the insect body
adult	a fully grown, sexually mature insect
antennae	paired segmental appendages on the insect's head which function as sense organs
cocoon	a covering of the pupa
detritus	disintegrated or broken-up organic matter
diapause	physiologically delayed development
drift	the downstream transport of aquatic organisms in the current
dun	angler's term for subadult or subimago in mayflies
emergence	escape of the adult insect from the cuticle of the pupa or nymph
emerger	angler's term for the adult insect in which the wings are not fully expanded
endemic	a taxonomic group restricted to a given geographical region.
exuvia	castoff skin of larvae, nymphs, or pupae
family	taxonomic grouping of similar genera
femur (femora – pl.)	the third and usually stoutest segment of the leg
filamentous	threadlike
genus (genera – pl.)	a set of similar species with a recent common ancestry
gill	a special, variously formed respiratory organ in the aquatic immature stages of many insects
hatch	angler's term for emergence

head	the anterior region of the insect body where the mouth, eyes, and antennae are located
hemimetaboly	incomplete metamorphosis
holometaboly	complete metamorphosis
imago	the adult or reproductive stage of an insect
instar	a stage between molts in nymphs and larvae
intercalaries	additional or inserted between, as in wing veins
larva	the immature form of insects that undergo complete metamorphosis (egg → larva → pupa → adult)
mandibles	the first pair of jaws in insects
moult(ing)	the periodic formation of new cuticle
nymph	an immature stage of hemimetabolous insects (egg → nymph → adult)
oviposit	to lay eggs or ova
proleg	any process or appendage that serves the purpose of a leg
plumose	feather-like
pupa	a developmental stage in all holometabolous insects; the stage between larva and adult
scale	flat outgrowth of the body wall on insects
species	groups of interbreeding natural populations
spinner	angler's term for adult mayfly
subadult	angler's dun or subimago in mayflies
thorax	the middle portion of the insect body between the head and abdomen; portion where legs and wings are located if present
venation	the complex system of veins of an insect wing
wart	dome-shaped structure with hair-like setae on the top of the head or thorax in Trichoptera

Scientific References:

Anderson, N. H. 1976. The distribution and biology of the Oregon Trichoptera. Ore. Agric. Exp. Sta. Tech. Bull. 134:1-160.

Brittain, J. E. 1982. The biology of mayflies. Ann. Rev. Ent. 27:119-147.

Corbet, P. S. 1999. Dragonflies: behavior and ecology of Odonata. Cornell Univ. Press, Ithaca, NY. 829 pp.

Edmunds, G. F., Jr., S. L. Jensen, and L. Berner. 1976. The mayflies of North and Central America. Univ. Minnesota Press, Minneapolis. 330 pp.

Edmunds, G. F., Jr., and W. P. McCafferty. 1988. The mayfly subimago. Ann. Rev. Ent. 33:509-529.

Evans, E. D. 1972. A study of the Megaloptera of the Pacific coastal region of the United States. Ph.D. diss. Oregon State University, Corvallis. 210 pp.

Gullan, P. J., and P. S. Cranston. 2014. The insects: an outline of entomology, 5th ed. Wiley/ Blackwell Publ. 595 pp.

Hynes, H. B. N. 1970. The ecology of stream insects. Ann. Rev. Ent. 15:25-42.

Jewett, S. G., Jr., 1960. The stoneflies (Plecoptera) of California. Bull. Calif. Insect Surv. 6:122-177.

Lehmkuhl, D. M. 1979. How to know the aquatic insects. Wm. C. Brown, Dubuque, IA. 168 pp.

Manolis, T. 2003. Dragonflies and damselflies of California. Univ. Calif. Press, Berkeley. 201 pp.

Menke, A. S. (ed.). 1979. The semiaquatic and aquatic Hemiptera of California (Heteroptera: Hemiptera). Bull. Calif. Insect Surv. 21:1-166.

Merritt, R. W., K. W. Cummins, and M. B. Berg (eds.). 2008. An introduction to the aquatic insects of North America, 4th ed. Kendall/Hunt Publ. Co., Dubuque, IA. 1158 pp.

Moyle, P. B. 2002. Inland fishes of California revised and expanded. Univ. Calif. Press, Berkeley. 502 pp.

Needham, J. G., M. J. Westfall, Jr., and M. J. May. 2000. Dragonflies of North America, revised edition. Scientific Publ., Gainesville, FL. 939 pp.

Oliver, D. R. 1971. Life history of the Chironomidae. Ann. Rev. Ent. 16:211-230.

Pennak, R. W. 1978. Freshwater invertebrates of the United States, 2nd ed. John Wiley and Sons, Inc., New York. 803 pp.

Pinder, L. C. V. 1986. Biology of freshwater Chironomidae. Ann. Rev. Ent. 31:1-23.

Ross, H. H. 1944. The caddisflies, or Trichoptera, of Illinois. Bull. Ill. Nat. Hist. Surv. 23:1-326.

Stehr, F. W. (ed.). 1987. Immature insects. Vol. 1. Kendall/Hunt Publ. Co., Dubuque, IA. 754 pp.

Stehr, F. W. (ed.). 1991. Immature insects. Vol. 2. Kendall/Hunt Publ. Co., Dubuque, IA. 974 pp.

Stewart, K. W., and B. P. Stark. 2002. Nymphs of North American stonefly genera (Plecoptera), 2nd ed. The Caddis Press, Columbus, OH. 510 pp.

Thorp, J. H., and A. P. Covich (eds.). 2001. Ecology and classification of North American freshwater invertebrates, 2nd ed. Academic Press, San Diego, CA. 1056 pp.

Triplehorn, C. A., and N. F. Johnson. 2005. Borror and DeLong's introduction to the study of insects, 7th ed. Thompson Books/Cole, Belmont, CA 864 pp.

Usinger, R. L. (ed.). 1956. Aquatic insects of California. Univ. Calif. Press, Berkeley. 508 pp.

Ward, J. V., B. C. Kondratieff, and R. E. Zwelling. 2002. An illustrated guide to the mountain stream insects of Colorado. Univ. Colorado Press, Boulder, CO.

Wiggins, G. B. 1996. Larvae of the North American caddisfly genera, 2nd ed. Univ. Toronto Press, Toronto. 457 pp.

Wiggins, G. B. 2004. Caddisflies: the underwater architects. Univ. Toronto Press, Toronto, Canada.