FINAL REPORT: Macroinvertebrate Inventory of the Caspar Creek Watershed

Kenneth W. Cummins[1] and David Malkauskas[2]

1. California Cooperative Fisheries Research Unit, Humboldt State University
2. Department of Entomology, Michigan State University

Introduction

A macroinvertebrate assessment was conducted on the Caspar Creek Experimental Watershed in northwestern California using a functional feeding group (FFG) classification. The approach, developed over 30 years ago (Cummins 1973), has been tested, modified, and employed in many studies (e.g. Cummins and Klug 1979, Cummins and Wilzbach 1985), Merritt and Cummins 2006). The approach categorizes macroinvertebrates based on their morphological and behavioral mechanisms by which they acquire one or more of six general food types: coarse particulate organic matter (CPOM), fine particulate organic matter (FPOM), periphytic, non-filamentous algae and associated bio-film, invertebrate prey organisms, and filamentous algae (Table 1). The morpho-behavioral adaptations of stream macroinvertebrates for acquiring food are easily observed in the field on live specimens. An example is the large eyes, bright color patterns, and active movement that characterize the three predaceous stonefly families (setipalpian Plecoptera). The abundance (especially expressed as biomass) of any FFG is an indicator of the relative availability of its food resource category. The method has the advantage that the survey crew leaves the field with the data as well as with preserved samples that can be analyzed in taxonomic data, and measured for biomass conversion calculations in the lab, if (and this is almost always the problem) funds are available for the very time-consuming process of microscope analysis. The point is, that a great deal of information about the status of a stream ecosystem can be obtained in the field using the FFG approach, but it does not for close the ability to analyze the samples in the lab.

The field numbers can be converted to biomass using length-mass regressions, or to calculate any of the commonly used indices of stream condition (e.g. % Ephemeroptera, Plecoptera, and Trichoptera in a sample). Ecological tables in Merritt et al. (2008) provide information of the functional feeding group categorization of essentially every genus of North American aquatic insect. Information in Pennak (1989) can be used to assign non-insect invertebrates to functional groups.

Methods

The FFG field approach was used to rapidly characterize the North and South Branch tributaries and the Mainstem of Caspar Creek with regard to a number of ecosystem attributes of each. Field collections, together with laboratory analysis, were used to compile a taxonomic list of stream invertebrates for Caspar Creek. The samples taken in May and October of 2008 were compared to those taken by Bottorff and Knight (1996) from 1986 through 1994 to determine if taxonomic changes had occurred (Appendix 1). Timed 30 second samples were taken with a D-frame dip net (250µm mesh) in three habitats: riffle (coarse sediments), pools and backwaters (fine sediments), and plant litter accumulations (drop and trap zones). Three samples were taken pseudo- randomly (i.e. haphazardly) in each habitat type at locations along a 50 meter reach of stream at five locations. The sites were: upper and lower North Fork, lower South Fork, and upper and lower Mainstem (Fig. 1). The samples were sorted fresh at stream side primarily with the unaided eye but with some small specimens checked using a 5X hand lens. The

invertebrates were sorted into functional groups (Table 1) and the numbers in each discernable taxon recorded.
A small portion of a sample was examined at a time in a white enamel tray. After sorting a tallying the invertebrates, the sample was placed in a Whirlpac™ bag, labeled, and preserve with 75% ethanol for return to the lab. Large mineral substrates and pieces of wood were thoroughly washed and discarded. The fine sediments were placed in a bucket agitated and repeatedly decanted onto a 250µm mesh sieve until no more light materials were visible in the wash. The litter samples were examined piece by piece, small portions at a time. The average processing time for a field sample was 1 to 2 hours. In the laboratory, each sample was examined under a dissecting microscope and specimens were identified (using Merritt et al. 2008 and Pennak 1989) and measured to the nearest mm. The number of specimens of a given taxon in each mm size category was used to convert the numbers to dry biomass using the INVERTCALC program (Cummins, Merritt and Kolouch, Humboldt State University). Each taxon is coded, allowing the data on that taxon to be tabulated by functional group.

Once the data had been summarized, a number of ratios of functional groups are used as surrogates for selected stream ecosystem attributes (Table 2). The ratios were calculated for the three habitats for each of the 5 sites for the fall samples (Table 3). Because the major analysis utilized dimensionless ratios, the resulting values are fairly independent of sample size. Particular emphasis was placed on the characteristics of the riparian vegetation cover at each sample site, i.e. percent shading and relative proportion of evergreens to deciduous trees.

Results

Using the proposed threshold values for the functional group surrogate ratio for the autotrophic/heterotrophic (P/R) index (i.e. > 0.75 = autotrophic, Merritt *et al*. 1996, 2002, 2008). This ecosystem attribute(P?R) is directly measured as the ratio of gross primary production to total community respiration. The Caspar Creek water shed is heterotrophic (Table 3). This is as expected because the stream is heavily shaded throughout the drainage and nearly canopy closed along the North and South Forks and the Upper Mainstem. The riparian is dominated by second growth conifers and the colonizing hardwood red alder. The South Fork is bordered by relatively more red alder, but the entire drainage has a mix of evergreens and deciduous hardwoods. The expected shredder index (Table 2), which reflects the abundance of coarse organic litter (CPOM) relative to fine organic litter (FPOM), was well above 0.50 at all sites in October. As expected, the values were highest in the litter samples, but since coarse litter can be trapped or deposited in any of the habitats, shedders were wildly distributed. Therefore, taken together, the macroinvertebrate surrogate ratios for P/R and CPOM/FPOM (Table 3) characterize Caspar Creek as an heterotrophic ecosystem with a litter supply that supports a strong linkage between the riparian vegetation and shredder macroinvertebrates. If the presence – absence taxonomic data from Botteroff and Knight (B and K, 1996) are compared to that for the present study (PS) in 2008 (Appendix Table) for the functional group surrogate P/R ratio, both indicate Caspar Creek is heterotrophic (i.e. < 0.75). The ratios are essentially the same: B and K = 0.33 and PS = 0.35. Similarly, the surrogate for

CPOM/FPOM indicates a normal linkage between shredders and riparian litter for an heterotrophic system (i.e. > 0.50; B and K = 0.59, PS = 0.69). This is in agreement with the sample data from the present study (Table 3) in which the surrogate ratios ranged from 0.78 to 30.40 for the five sites. The ratio of suspended FPOM to benthic FPOM as indicated by the functional group surrogate (Table 3) is below or at the threshold value of 0.25 (B and K = 0.15, PS = 0.26). This lack of suspended FPOM in the system is likely a partial explanation for the poor representation by filtering collectors in Caspar Creek (Table 3, Appendix Table). Not only the quantity of FPOM in transport but also its quality as a food resource could be limiting the filtering collectors. The availability of stable substrates, i.e. coarse sediments in riffles, large wood, and rooted aquatic vascular plants, as measured by the functional group surrogate, indicates they are scarce (threshold = 0.5, Table 2; Appendix Table, B and K = 0.45, PS = 0.53). This is reflected in the relative scarcity of large wood, poorly represented riffles, and the scarcity of rooted plants in Caspar Creek. The scarcity of stable substrates is likely also a factor in the low abundance of filtering collectors in Caspar Creek (Table 3, appendix Table), because they require such locations to set up their filtering stations. The ratio of behavioral drifting macroinvertebrates to accidental drifters is an indicator of the reliable dawn and dusk food supply for macroinvertebrates in the water column to serve as prey of drift-feeding salmonids. In Caspar Creek in October, less than half of the macroinvertebrate fauna was represented by behavior drifting taxa (Table 3, 21 to 37%) indicating possible less than optimal food supply for drift-feeding salmonids.

Taxonomic differences in the macroinvertebrate fauna reported by Bottorff and Knight (1996) and the present study were not great indicating that Caspar Creek has not changed significantly in the ensuing 12 years. The differences observed (Appendix 1 can be attributed to a number of causes.
1) The study by Bottorff and Knight (1996) was conducted over 8 years and the longer time frame and greater number of samples increased the probability of collecting rarer taxa, for example the large megalopteran predator *Dysmicohermes*.
2) Changes in the taxonomy resulting over the 12 years, for example Bottorff and Knight (1996) used Merritt *et al.* (1996, 3rd edition) and the present study used Merritt *et al.* (2008, 4th edition). This is reflected in changes in groups such as the mayflies and caddisflies.
3) The use of artificial substrates by Bottorff and Knight (1996), namely rock baskets and leaf packs, increased the probability of attracting and concentrating riffle forms and litter-feeding taxa (shredders).
4) Sampling with a D-frame net used in the present study allowed for the collection of surface skating forms, such as Gerridae and Gyrinidae, which is unlikely when artificial substrates are used because the surface skaters are lost when the substrates are removed from the water.
5) A major part of the difference is the greater taxonomic resolution employed I the present study in the dipteran family Chironomidae. In Bottorff and Knight (1996) all representatives of the family were lumped together, while in the present study the specimens were sorted to subfamily and genera. (Appendix 2). This also accounts for some of the differences in functional group totals (Appendix Table) between the two

studies because the Chironomidae is a large group representing several functional groups. Whereas Bottorff and Knight (1996) categorized all specimens as collector-filterers.

In summary, Caspar Creek can be characterized as being in a stable period with regard to the macroinvertebrate fauna, and by extension using the functional group surrogate ratios, also in a stable period considering selective ecosystem attributes (Table 3, Appendix 1). Caspar Creek has been and still is heterotrophic with a stable linkage between shredders and the riparian vegetation that borders the stream and provides their litter food supply. Of the four taxa that occurred at all five sites, two are shedder-detritivores (*Hydatophylax* and *Lepidostoma*) and two are collector-gatherers (Paraleptophlebia and Oligochaeta). Stable substrates are marginally available and the FPOM food supply for collector-filterers is poor. This has consequences for the drift-feeding salmonids because many of the filtering collectors are behavioral drifters that would be reliably available to dawn and dusk drift-feeding fish. In general, Caspar Creek invertebrate taxa do not represent a dominance of behavioral drifters (Table 3). Future harvest plans, if they include alteration of the riparian zone could have significant impact on the macroinvertebrate communities and, by extension, the resident salmonids of Caspar Creek.

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Table 1. Macroinvertebrate functional feeding group (FFG) characteristics. CPOM = coarse particulate organic matter, FPOM = fine particulate organic matter. (Data combined and modified from Merritt *et al.* (2008).

Functional feeding group	Primary food resource	Secondary food resource for facultative taxa	Voltinism (no. generations / y)
Shredders			
Plant litter CPOM Shredders	Microbially conditioned riparian plant litter	Some facultative for FPOM	Univoltine, a few semi-voltine
Herbivore shredders	Live vascular aquatic plants	None (obligate for primary food resource)	
Scrapers	Non-filamentous periphyton algae and associated biofilm	Some facultative for FPOM	Univoltine (some bivoltine)
Filtering collectors	FPOM in suspension	A few facultative scrapers	Polyvoltine or bivoltine
Gathering collectors	Deposited FPOM	A few facultative scrapers	Polyvoltine or bivoltine
Predators			
Engulfing forms	Prey (tend to be smaller)	Some facultative for FPOM in first and second instar	Usually semivoltine (some univoltine)
Piercing forms	Prey (tend to be larger)		
Piercers (herbivores only present with filamentous algae)	Single cells of filamentous algae	None (all obligate for primary food resource)	Univoltine

Table 2. Examples of functional feeding group ratios serving as surrogates for stream ecosystem attributes. Modified from Merritt *et al.* (2008).

Attribute	Direct measurement of ecosystem attribute	Functional feeding group surrogate	Suggested thresholds for FFG attribute ratios from previous studies
Ratio of autotrophy to heterotrophy (P/R)	Gross primary production *as a ratio of* total community respiration (i.e. oxygen consumed, including by primary producers	Scrapers + heribovre shedders *as a ratio of* plant litter shredders + total collectors	Autotrophic system ≥ 0.75
Riparian linkage to shredders	Leaf pack studies with riparian species utilizing data on percent cover of those riparian species	Plant litter shredders *as a ratio of* total collectors (CPOM consumers/FPOM consumers)	Expected linkage between riparian vegetation and shredders Fall-winter shredder populations > 0.50 Spring-summer shredder populations > 0.25
Habitat stability for macroinvertebrates	Inventory of areal coverage of stream bottom by boulders, cobbles, bedrock, and LWD	Filtering collectors + scrapers (+herbivorous shredders if present) *as a ratio of* total shredders + gathering collectors	Adequate stable substrates > 0.50
Annual flow regime	Annual and longer flow records (recurrence intervals)	Semivoltine invertebrate taxa *as a ratio of* polyvoltine invertebrate taxa	Predictable annual flow regime > 0.10
Top-down predator control of invertebrate community structure	Gut analyses of predators and determination of density and generation times of prey in guts	Predators *as a ratio of* total of all other functional feeding groups	Expected predator-prey balance = 0.10 – 0.20
Quantity and quality of FPOM in transport (organic portion of suspended load that can serve as a food resource for suspension feeders	Quantity and quality (O2 consumption or loss of mass on ignition) of FPOM in transport *as a ratio of* CPOM and FPOM in storage in and on the sediments	Filtering collectors *as a ratio of* gathering collectors	Expected quantity and quality (i.e. sufficient to support suspension feeders) of FPOM in transport > 0.25

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Appendix 1. Comparison of the taxa collected by Bottorff and Knight (1996; North Fork) and in the present study (2008; North and South Forks and Mainstem) in Caspar Creek, Jackson State Forest, CA. (X = present in samples; * = Collected in only one of the studies; Shred-detrit = shredder-detritivore; Shred-herb = shredder-herbivore; Coll-gather = collector-gatherer; Coll-filt = collector-filterer; Scrape = scraper; Pred = predator; Piercer = macrophyte piercer.

Taxa	Bottorff and Knight	Functional Groups (Merritt and Cummins 1984)	Present Study	Functional Groups (Merritt and Cummins 2008)
Collembola (springtails)	X	Coll-gather	X	Coll-gather
Entomobryidae			X	Coll-gather
Hypogasturidae			X	Coll-gather
Simithuridae			X	Coll-gather; (facultative Shred-herbivore)
Tomoceridae			X	
Ephemeroptera (mayflies)				
Siphloneuridae now Ameletidae				
Ameletus	X	Coll-gather	X	Coll-gather; (facultative Scrape)
A. cooki				
Baetidae				
Baetis	X	Coll-gather	X	Coll-gather
B. bicaudatus				
B. tricaudatus				
Diphetor hageni			X	Coll-gather ?
Fallceon quilleri			X	Coll-gather ?
Ephemerellidae				
Drunella	X	Scrape	X	Scrape (facultative pred)
D. flavilinea			X	Scrape
Ephemerella	X	Coll-gather	X	Coll-gather; (facultative Scrape)
E. dorothea infrequens				
Serratella	X	Coll-gather	X	Coll-gather
S. teresa				
S. tibialis				
Timpanoga hecuba	X	Coll-gather	X	Coll-gather
Heptageniidae				
Cinygma	X	Scrape	X	Scrape;

				(facultative Coll-gather)
Cinygmula	X	Scrape	X	Scrape; (facultative Coll-gather)
Epeorus	X	Coll-gather	X	Scrape; (facultative Coll-gather)
Ironodes	X	Scrape	X	Scrape; (facultative Coll-gather)
Nixe	X	Scrape	X	Scrape; (facultative Coll-gather)
N. kennedyi				
Rithrogena	X	Coll-gather	*	
Leptophlebiidae				
Paraleptophlebia	X	Coll-gather	X	Coll-gather; (facultative Shred-detritivore)
P. zayante				
Siphlonuridae	*		X	Coll-gather; (facultative scrape, pred)
Siphlonurus occidentalis				
Leptohyphidae (=Tricorythidae)			X	Coll-gather
Tricorythodes minutus				
Plecoptera (stoneflies)				
Chloroperlidae	X		X	Pred;
Kathoperla	X	Coll-gather	X	Coll-gather; (facultative scrape)
Bisancora			X	Pred?
Plumiperla			X	Pred?
Sweltsa			X	Pred; (facultative Coll-gather)
Capniidae	X	Shred	X	Shred-detrit
Mesocapnia				
Leuctridae	X	Shred	X	Shred-detrit
Despaxia augusta			X	Shred-detrit
Paraleuctra sara			X	Shred-detrit
Nemouridae	X	Shred	X	Shred-detrit; (facultative Coll-gather)
Malenka	X	Shred	X	Shred-detrit?
M. californica			X	
Nemoura spiniloba			X	Shred-detrit; (facultative Shred-herb?)

Soyedina	X	Shred	X	Shred-detrit?
Zapada	X	Shred	*	
Peltoperlidae	X	Shred	X	Shred-detrit
Soliperla quadrispinula	X			
Perlidae	X	Pred	X	Pred
Calineuria californica	X	Pred	X	Pred
Hesperoperla	X	Pred	X	Pred
H. pacifica				
Claasenia sabulosa			X	Pred
Perlodidae	X	Pred	X	Pred; (facultative Scrape, Pred)
Isoperla			X	Pred; (facultative Coll-gather)
Pteronarcyidae	X	Shred	*	
Pteronarcys				
Odonata (dragon- and damselflies)				
Corduligasteridae				
Corduligaster dorsalis	X	Pred	X	Pred
Gomphidae				
Octogomphus specularis	X	Pred	X	Pred
Aeshnidae	*		X	Pred
Megaloptera (dobsonflies, alderflies)				
Sialidae				
Sialis californica	X	Pred	X	Pred
Corydalidae				
Dysmicohermes	X	Pred	*	
Trichoptera (caddisflies)				
Apataniidae				
Apatania	X	Scrape	X	Scrape; (facultative Coll-gather)
Brachycentridae				
Micrasema	X	Shred	*	
Calamoceratidae				
Heterplectron califonicum	X	Shred	X	Shred-detrit (including wood)
Glossosmatidae				
Glossosoma	X	Scrape	X	Scrape
Hydropsychidae				
Hydropsyche	X	Coll-filt	X	Coll-filt
Parapsyche	X	Coll-filt	*	
Hydroptilidae				
Hydroptila	X	Piercers (macrophytes)	X	Piercers (macrophytes)

Palaeagapetus	X	Shred	*	
Goeridae				
Goeracea	X	Scrape		
Lepidostomatidae				
Lepidostoma	X	Shred	X	Shred-detrit
Limnephilidae				
Cryptochia	X	Scrape	X	Shred-detrit; (facultative Scrape)
Ecclisomyia	X	Coll-gather	X	Coll-gather; (facultative Scrape-mineral case, Shred-detrit-organic case)
Hydatophylax hesperus	X	Shred	X	Shred-detrit
Psychoglypha subborialis	X	Shred	X	Shred-detrit
Dicomoecus atripes	*		X	Scrape
Onocosmoecus unicolor	*		X	Shred-detrit
Odontoceridae				
Parthina vierra	X	Shred	X	Shred-detrit
Namamyia plutonis	X	Coll-gather	*	
Nerophilus californicus	X	Shred	*	
Philopotamidae				
Wormaldia	X	Coll-gather	X	
Phryganeidae				
Yphnia californica	X	Pred	*	
Polycentropodidae				
Polycentropus	X	Pred	X	Coll-filt; (facultative Pred, Shred-herb)
Rhyocophilidae				
Rhyacophila	X	Pred	X	Pred
Uenoidae				
Neophylax splendens	X	Scrape	X	Scrape
Farula	X	Scrape	*	
Lepidoptera (Moths)				
Crambidae	*		X	Shred-herb; (facultative Scrape)
Hemiptera (True bugs)				
Geridae	*		X	Pred
Coleoptera (Beetles)				
Dytiscidae				
Agabus pandurus	X	Pred	X	Pred
Rhantus consimilis	*		X	Pred
Ilybius	*		X	Pred

Oreodytes	*		X	Pred
Elmidae				
Lara avara	*		X	Shred-detrit (including wood)
Narpus concolor	X	Coll-gather	X	Coll-gather; (larvae) Scrape (adults)
Optioservus quadrimaculatu	X	Scrape	*	
O. seriatus	*		X	Coll-gather; (larvae) Scrape (adults)
Zaitzevia parvula	X	Coll-gather	*	
Hydraenidae				
Hydraena	X	Scrape	*	
Hydrophilidae	X	Pred (larvae)		
Ametor scabrosus	*		X	Pred (larvae); Coll-gather (adults)
Cymbiodyta	*		X	Pred (larvae); Coll-gather (adults)
Hydrochus variolatus	*		X	Shred-herb
Psephenidae				
Acneus	X	Scrape	X	Scrape
Eubrianax edwardsii	X	Scrape	X	Scrape
Haliplidae				
Brychius pacificus	*		X	Shred-herb; (facultative Pred) (larvae and adults)
Diptera (true flies)				
Ceratopogonidae	X	Pred		
Atrichopogon	*		X	Coll-gather; (facultative Scrape)
Forcipomyia	*		X	Coll-gather; (facultative Scrape)
Probezzia	*		X	Pred
Leptoconops??	*		X	Pred
Chironomidae	X	Coll-gather		
Tanypodinae				
Paramerina	*		X	Pred?
Chironominae				
Rheotanytarsus	*		X	Coll-filt
Tanytarsus	*		X	Coll-filt; (facultative Coll-gather, Scrape)
Constempellina	*		X	Coll-gather;

				(facultative Coll-filt)
Dixidae				
Dixa	X	Coll-gather	X	Coll-filt; (facultative Coll-gather)
Meringodixa	X	Coll-gather	*	
Culicidae	X	Coll-filt	*	
Empididae				
Chelifera	X	Pred	X	Pred
Clinocera	X	Pred	*	
Hemerodromia	X	Pred	*	
Dolichopodidae	*		X	Pred
Ephydridae	X	Coll-gather		
Pelina	*		X	Scrape
Pelecorhynchidae				
Glutops	X	Pred	X	Pred; (facultative Shred-herb)
Psychodie				
Maruina	X	Scrape	X	Scrape; (Coll-gather)
Pericoma	X	Coll-gather	*	
Psychoda	*		X	Coll-gather
Ptychopteridae				
Ptychoptera	X	Coll-gather	X	Coll-gather
Simuliidae				
Simulium	X	Coll-gather	X	
Statiomyidae	X	Coll-gather	*	
Tabanidae	X	Pred	*	
Tipulidae				
Dicranota	X	Pred	X	Pred
Hexatoma	X	Pred	X	Pred
Tipula	X	Shred	X	Shred-detrit
Antocha	X	Coll-gather	*	
Limnophila	X	Pred	*	
Limonia	X	Shred	*	
Pedicia	X	Pred	*	
Rhabdomastix	X	Shred	*	
Phoridae	*		X	Coll-gather; (facultative Pred)
Tantderidae				
Prototanyderus	*		X	Pred?
Non-Insects				
Annelida, Oligochaeta	X	Coll-gather	X	Coll-gather

Coelenterata, *Hydra*	X	Pred	X	Pred
Nematomorpha	X	Parasite	*	
Hydracarina	X	Pred	X	Pred
Nematoda	X	Pred	*	
Turbellaria				
Planaeidae	X	Pred	X	Pred
Crustacea				
Cyclopoida	X	Coll-gather	*	Coll-filt
Harpactacioda	*		X	Coll-gather
Cladocera	X	Coll-filt	*	
Isopoda				
Asellus	*		X	Shred-detrit
Ostracoda	X	Coll-gather	*	
Gastropoda				
Pisidium	*		X	Coll-filt
Total taxa	100		102	
Missing taxa	48		31	
Collector-gatherers	27		27	
Predator	27		34	
Shredder	18		--	
Shredder-detritivore	--		20	
Shredder-herbivore	--		3	
Scraper	17		15	
Collector-filterers	4		7	
Piercer (macrophytes)	1		1	
Parasite	1		0	

Appendix 2. Caspar Creek Taxon List

Aquatic Insects:

Coleoptera

Dytiscidae

Agabus pandurus
Rhantus consimilis
Oreodytes
Ilybius

Elmidae

Lara avara

Narpus concolor

Optioservus seriatus

Gyrinidae

Gyrinus

Haliplidae

Brychius pacificus

Hydrochidae

Hydrochus variolatus

Hydrophilidae

Ametor scabrosus
Cymbiodyta

Psephenidae

Eubrianax edwardsii
Acneus

Diptera

Ceratopogonidae

Atrichopogon
Forcipomyia
Leptoconops ?
Probezzia

Chironomidae

Tanypodinae

Pentaneurini

Paramerina

Chironominae

Tanytarsini

Rheotanytarsus
Tanytarsus
Constempellina

Dixidae

Dixa

Dolichopodidae

Empididae

Chelifera?
Ephydridae
Pelina
Pelicorhynchidae
Glutops
Phoridae
Diplonevra
Protanyderidae ?
Protanyderus ?
Psychodidae
Maruina
Psychoda
Ptychopteridae
Ptychoptera
Simuliidae
Simulium
Tipulidae
Dicranota
Hexatoma
Tipula
Ephemeroptera
Ameletidae
Ameletus sp.
Ameletus cooki
Baetidae
Baetis bicaudatus
Baetis tricaudatus
Diphetor hageni
Fallceon quilleri
Ephemerellidae
Drunella flavilinea
Ephemerella dorothea infrequens
Serratella teresa
Serratella tibialis
Timpanoga hecuba pacifica
Heptageniidae
Cinygma
Cinygmula
Epeorus
Ironodes
Nixe kennedyi
Leptophlebiidae
Paraleptophlebia spp.
Paralpetophlebia zayante

Siphlonuridae
Siphlonurus occidentalis
Leptohyphidae (=Tricorythidae)
Tricorythodes minutus
Hemiptera
Gerridae
Metrobates trux
Veliidae
Microvelia californiensis
Lepidoptera
Geometridae
Pyralidae
Megaloptera
Sialidae
Sialis
Odonata
Aeshnidae
Cordulegastridae
Cordulegaster dorsalis
Gomphidae
Octogomphus specularis
Plecoptera
Chloroperlidae
Bisancora pastina?
Kathroperla
Plumiperla
Sweltsa
Capniidae
Mesocapnia
Leuctridae
Despaxia augusta
Paraleuctra sara
Nemouridae
Malenka californica
Nemoura spiniloba
Soyedina
Peltoperlidae
Perlidae
Calineuria californica
Claasenia sabulosa
Hesperoperla pacifica
Perlodidae
Isoperla
Trichoptera

Apataniidae
Apatania
Calamoceratidae
Heteroplectron californicum
Glossosomatidae
Glossosoma
Hydropsychidae
Hydropsyche
Hydroptilidae
Hydroptila
Lepidostomatidae
Lepidostoma
Limnephilidae
Hydatophylax hesperus
Psychoglypha sp.
Psychoglypha subborealis
Dicosmoecus atripes
Onocosmoecus unicolor
Ecclisomyia
Cryptochia
Odontoceridae
Parthina vierra
Philopotamidae
Wormaldia
Polycentropodidae
Polycentropus
Rhyacophilidae
Rhyacophila
Uenoidae
Neophylax splendens

Other Aquatic Invertebrates:

Acari (subclass)
Anthoathecatae

Hydridae
Hydra
Basommatomorpha
Planorbidae
Collembola
Entomobryidae
Hypogastruridae
Simithuridae
Dicyrtoma
Tomoceridae

Tomocerus
Cyclopoida
Harpacticoida
Isopoda
Asellidae
Asellus
Nemata (phylum)
Oligochaeta (subclass)
Poecilostomatoida
Ergasilidae
Ergasilus
Tardigrada (phylum)
Turbellaria (class)
Veneroida
Pisidiidae
Pisidium

Terrestrial Insects:

Coleoptera
Corylophidae
Curculionidae
Staphylinidae

Diptera
Cecidomyiidae
Sciaridae
Xylophagidae?
Hymenoptera
Apidae
Formicidae
Mymaridae
Pteromalidae
Scelionidae
Thysanoptera
Thripidae

Other Taxa:

Araneae
Pseudoscorpiones