Dry Creek Project

A Study of Aquatic Invertebrates in Putah Creek's Intermittent Tributaries

FINAL REPORT

Funded by:
Yocha-De-He Community Fund

Administered by:
Putah Creek Council

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Acknowledgements

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Putah Creek Council and its former Executive Director Dawn Calciano were instrumental in administering the project and gaining unlimited access to the Dry Creek watershed on Bobcat Ranch, now owned by Audubon. Thanks to Libby Earthman, current Putah Creek Council Executive Director, for her endless support, patience, and editing.

The Putah Creek Volunteer Biomonitoring Team's participation in the project was crucial as their emotional support, field efforts, and overall enthusiasm for Putah Creek was contagious. Many volunteers gave up their Saturday mornings to the work on the project - their support is greatly appreciated.

As always, Rich Marovich - Putah Creek Streamkeeper - extended his hand for whatever we needed to complete the project. His breadth of "people skills" is phenomenal and has helped secure unprecedented access to Putah Creek.

Thanks to Audubon Landowner Stewardship Project and Marion Hamilton for allowing access to the Dry and Enos creek watersheds on Bobcat Ranch.

Pat Randolph (PhD, UCD), our under-spoken expert on mayflies, gave many days to help with collecting, insect processing, and endless discussions about survey protocols. I thank him for his dedication and expertise.

Ken W. Davis
Principal Investigator

Cover Images: Background (Dry Creek - Bobcat Ranch). Mayfly: *Centroptilum* sub-imago (male) collected in Thompson Creek and hatched in WS&PS lab.

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Putah Creek Council Team processing soil in Dry Creek. The team was searching for Dobsonfly pupae. Image taken 1/6/08.

Thompson Creek showing diminishing flow. Thompson Creek supports a healthy population of invertebrates including one mayfly that remains to be officially identified.

California newt (larval stage) are common in some intermittent waterways.

August 20, 2009

To: Libby Earthman
Executive Director
Putah Creek Council

Subject: Intermittent Creek Invertebrate Study

Executive Summary

Intermittent waterways flow from three to eight months per year and as of 2006 are no longer protected under the Clean Water Act. They support, in some cases, very diverse and dense populations of benthic aquatic invertebrates that form the basis of the food chain for fish, birds, and amphibians. Throughout this study, I documented that invertebrates, such as large mayflies and stoneflies, are present in Putah Creek's intermittent tributaries. Invertebrate nymphs probably enter Putah Creek during spring storm events or "drift" downstream during normal stream flow. The overall restoration of Putah Creek requires the "protection," and enhancement of intermittent waterways such as Dry and Miller creeks. It is also crucial to continue the improvement of benthic habitat in Putah Creek with weir development, gravel injections, cobble enhancement, sediment reduction, and scarification. Those improvements will maintain a home in Putah Creek for recruited invertebrates that form the prey base for fish and riparian wildlife.

Background - Intermittent Waterways

Intermittent waterways on the West Coast are generally freestone-streams that flow from early spring to mid-summer depending upon rainfall. They are different from ephemeral waterways that flow temporarily during rainstorms and perennial streams that flow year around. Intermittent streams frequently support high density and diverse communities of aquatic insects. In fact, intermittent waterways might be the ideal baseline data set in clean-water modelling.

Unfortunately, a Supreme Court decision in 2006 removed,or at least complicated, Clean Water Act protections for intermittent waterways. The legal ruling ignores that the dry stream beds shown on the left can support populations of invertebrates during the 4-6 months that they are wet. It is likely that invertebrates evolved to survive in intermittent conditions and support fish species that use intermittent waterways for spawning. The intermittent waterway invertebrates are important for recruitment and replenishment of invertebrate populations that form the prey base for many fish including trout, steelhead, and salmon.

Cold Creek - Wet Phase

Cold Creek - Dry Phase

Enos Creek. The main tributary of Dry Creek. Wet phase on 2/8/08.

Enos Creek. The main tributary of Dry Creek. Dry phase on 10/16/2006.

Putah Creek - Dry Creek Confluence

Invertebrate recruitment is important to the restoration of Putah Creek after the invasion of New Zealand Mudsnails (NZMS), the unnatural relocation of the main streambed near the City of Winters, and sedimentation caused by continued upstream sediment loading. The mudsnail invasion, streambed relocation, and sediment deposition altered the Putah Creek aquatic invertebrate community. New Zealand mudsnails were discovered at Fishing Access No 5 in October 2003. The tiny mollusks - native to New Zealand - were likely carried to Putah Creek in the boots of anglers. Prior to 1997 a large bed of Giant Reed (*Arundo donax*) forced the low-flow channel of Putah Creek, near the confluence with Dry Creek, about 500 feet to the south. The move prevented the natural recruitment of gravel, cobble, and invertebrates from Dry Creek, a north-bank tributary, into the main stem of Putah Creek (Report 2040c-Davis). Upstream sediment loading has been documented in several locations including Pleasant's Creek, Thompson Creek, and along the main stem of Putah Creek. Sediment fills the interstitial spaces causing the cobble to appear as if it is cemented in place. Severe cementation (60-90%) exists in many areas of Lower Putah Creek including the Design Channel, a segment of the creek which was realigned and restored. Interstitial cementation destroys invertebrate habitat and prevents normal movement of water through the gravel.

In 2005, the Design Channel was initiated primarily due to heavy erosion undermining Putah Creek Road, a walnut orchard, and other property. In the fall of 2005, streambed engineers located the original streambed, realigned the watered channel with Dry Creek, and dewatered the old channel. The project increased the effective riffle habitat in the new Design Channel by 60%.

The old channel and many other areas in Putah Creek had been monitored for NZMS and native invertebrates since the discovery of mudsnails in October 2003. The data generated from the NZMS surveys in Putah Creek are the only relevant information we have concerning the aquatic invertebrate community in Putah Creek.

New Invertebrates in Design Channel

In early 2006 routine invertebrate surveys in the Design Channel discovered five mayfly species (Ephemeroptera) that were not previously documented to live in Putah Creek. In the summer of 2006, an additional mayfly species and two species of large stoneflies were collected in the Design Channel. Due to the importance of the aquatic invertebrate community to the aquatic and riparian food web, it was important to determine the source of the eight species newly discovered in the Design Channel. Studies undertaken in intermittent waterways in the Putah Creek drainage above Lake Berryessa revealed that they support large numbers of invertebrates but the distance

Centroptilum asperatum (male sub-imago) collected in Thompson Creek.

and the presence of Lake Berryessa are problematic. Dry Creek, or another intermittent creek below Monticello Dam, appeared to be the logical source of the invertebrates and should be investigated.

Due to the natural interest of Native Americans in natural resource preservation, I appealed to the Putah Creek Council to apply to the Rumsey Community Fund for monetary support to study the invertebrate population in Dry Creek. Unfortunately, since receiving the grant, there has not been enough water in Dry Creek to support (and study) an invertebrate population. To remedy the situation, I utilized Thompson Creek (also Yolo County) which flows into Putah Creek just below Monticello Dam. While Thompson Creek is smaller than the Dry / Enos creek complex, it still has a significant impact on Putah Creek.

Intermittent Creek Study Objectives

1. Determine the invertebrate species in Putah Creek tributaries - including the historical watershed.
2. Determine if Putah Creek is recruiting invertebrates from intermittent tributaries.
3. Determine what can be done to "protect" and/or enhance intermittent tributaries.
4. Educate the watershed managers, governmental agencies and the lay public about the importance of intermittent tributaries to the fish and riparian wildlife in receiving waters such as Putah Creek.

Thompson Creek (Yolo County) 2/18/08

Planned Study & Collection Sites

The main intermittent waterway to be surveyed for aquatic invertebrates is the Dry Creek watershed that drains a significant section of Rocky Ridge east of Lake Berryessa,. Dry Creek is actually the smaller tributary that is formed by Enos Creek and Dry Creek. Because the Dry Creek watershed has not received sufficient rainfall to complete the study after receipt of the Rumsey Community Fund Grant, I decided to use Thompson Creek to complete the initial portion of the Intermittent Waterway Invertebrate Study. Thompson Creek (Yolo County) also drains a significant portion of Rocky Ridge. Several other intermittent creeks within the historic Putah Creek drainage were used to complete the survey. Those are Miller Creek, Capell Creek (two sites), Pope Creek, Cold Creek, and Foxtail Creek.

Intermittent Creeks - Site Information

Dry Creek

Dry creek is a narrow to wide (4 - 30 feet) waterway formed by springs. It drains a significant section of Rocky Ridge (Western Yolo County) and Wild Cow Mountain. Due to the lack of rainfall during the study

Capell Creek - Wet Phase

Capell Creek - Dry Phase

Rainbow trout fry. Stranded in Cold Creek isolation pool. Fish commonly migrate into intermittent waterways to spawn.

Corydalus nymph (Dobsonfly) are common in some intermittent waterways.

period, we were unable to determine the actual amount of rain that will allow the creek to support a healthy invertebrate community. During sporadic rain events we did collect winter stoneflies and found numerous California Newts (*Taricha torosa*) in isolation ponds. Residents in the Winters area claim that in the past they caught trout in Dry Creek during significant storm periods. The benthic structure of the streambed is certainly capable of supporting a healthy invertebrate community such as the one collected in the Design Channel in the summer of 2006. The rock complex consists of car-sized boulders to pea-size gravel. I saw no evidence of emergence (stonefly shucks or caddisfly cases) in the Upper Dry Creek watershed. Surveys will be conducted in Dry Creek when the watershed receives sufficient rainfall.

Enos Creek

Enos Creek is the largest of the Dry Creek tributaries. Some areas of the watercourse are freestone and capable of supporting benthic macroinvertebrates. Large isolation pools, created after minor storm events, support California Newts.

Thompson Creek

Thompson Creek is a narrow waterway averaging from four to eight feet wide. The benthic structure is limited to several melon-sized rocks to a few smaller rocks. When flows begin to diminish, the water "pools" and then disappears to reappear again on the next downstream plateau. The water carries a fine silt which tends to coat some of the invertebrates. The invertebrate community is characterized by many hellgrammites (*Corydalus*), a stonefly species that is unusual and only occurs in intermittent waterways, and a mayfly (*Paraleptophlebia sp*) which has not been identified by the scientific community. Pat Randolph, a UC Davis entomologist who studies mayflies, is preparing a paper to describe the small *Paraleptophlebia* mayfly that has long finger-like gills on its abdomen. It is very common in Thompson Creek. See image on page 5.

Cold Creek

Cold Creek is a high-gradient waterway that has large boulders and deep pools. California Newts are common in the deeper pools. The invertebrate community is characterized by hellgrammites and stoneflies. Several species of stoneflies occur in Cold Creek, including *Kogatus*, *Baumanella*, and small winter stoneflies which are common at the confluence with Putah Creek in January.

Miller Creek

Miller Creek is a high-gradient, spring-fed creek which shows intermittent qualities as long sections are dry by early summer.

Ecdyonurus criddlei adult. One of the mayflies that is probably recruited into Putah Creek

Calineuria californica nymph collected in the Design Channel.

Drunella coloradensis adult.

Paraleptophlebia sp. collected from Thompson Creek.

Neophylax caddisfly adult. Pupae collected from Capell Creek.

While we have not dug into the streambed, it appears that water continues to flow beneath the surface. The invertebrate community is composed of a large population of stoneflies (*Calineuria californica*), large mayflies (*Siphonurus* and *Ameletus*), and several caddisflies that we have not yet identified. I just gained access to Miller Creek in 2009 and plan on continuing to survey the waterway in the coming years.

Capell Creek (near Lake Berryessa - Napa County)

Capell Creek was a significant tributary to Putah Creek prior to the construction of Monticello Dam. Surveys in Capell Creek might give a good snapshot of the invertebrate community in Putah Creek prior to the construction of Monticello Dam. It is the most interesting (and puzzling) waterway surveyed in this project. Capell Creek drains a large section of Atlas Peak and the accompanying ridge. The water is highly mineralized as shown by the image on Page 4. The invertebrate community is unusual and extremely interesting. The salmonfly, typically found in fast moving waters such as the Trinity or Upper Sacramento River, is rather common in Capell Creek near Lake Berryessa. An uncommon caddisfly (*Neophylax occidentalis*) requires a low-water level (possibly dry conditions) to complete their life-cycle. The larvae seal their rock cases in early summer and remain quiescent in a pre-pupal stage for six months. Capell Creek has also proven to be an interesting destination for citizens who volunteer though a program offered by the Putah Creek Council.

Capell Creek (Highway 121 Bridge)

The second Capell Creek site is a very shallow, freestone waterway that is dry by early summer. The invertebrate community is similar to other intermittent waterways and represented by Hellgrammites, *Baumanella*, *Ameletus*, and *Siphonurus.*

Pope Creek

Pope Creek is possibly the largest of the tributaries in the Putah Creek watershed draining the Pope Valley. The creek is defined by large, shallow pools with some major riffle areas. The invertebrate community is one of the most remarkable assemblages I've seen on the West Coast. Rare and highly unusual benthic macroinvertebrates are common in some areas of Pope Creek.

Survey Protocol

There is no official protocol (such as EPA) that outlines the best survey protocol to be used in intermittent waterways. Most intermittent waterways are too shallow to collect with a "D" net which makes it difficult to compare collection data. Some investigators have used colonization plates, riffle colonization bags, or smaller aquarium nets to collect specimens. I discussed the issue at length with project taxonomist Pat Randolph (PhD. UCD). We decided to collect

Baumanella sp. nymph collected in Cold **Creek.**

Ameletus adult

Drunella coloradensis nymph.

Pteronarcys nymph collected in Capell Creek.

"everything possible" in an area of a creek with at least one square meter and do the same every 50 feet until we have at least 300 hundred specimens and have collected in all habitats which includes riffles, pools and runs. The specimens were then transported to my lab in an ice chest. In the lab they were counted, photographed, and preserved in a mixture of 70% Ethyl Alcohol (ETOH), Glycol, and distilled water.

Because the adult stages of mayflies (Ephemeroptera), caddisflies (Tricoptera) and stoneflies (Plectoptera) are necessary for species level identification some nymphs were kept alive and placed in aquaria supplied with aerators. When possible, the nymphs were raised to the emergence stage. If successfully hatched, the adults were harvested from the aquarium, photographed, then preserved in the same mixture with the nymphs.

California Tolerance Value (CTV)

The California Tolerance Value is based on the Hilsenhoff Biotic Index that measured tolerance of invertebrates to organic pollution in Wisconsin. Somewhat representative of California waters and organic pollution, the CTV uses values based on a scale of 0 (highly intolerant) to 10 (highly tolerant). The "values" are generally valid, but caution should be used as biologists frequently disagree concerning the values placed on certain genera. This is important to any discussion about intermittent waterways as the vast majority of invertebrates living in Intermittent streams are rated very low (0,1,2,or 3) because they are generally intolerant of organic pollution.

Significant Invertebrates Observed

Baumanella alameda

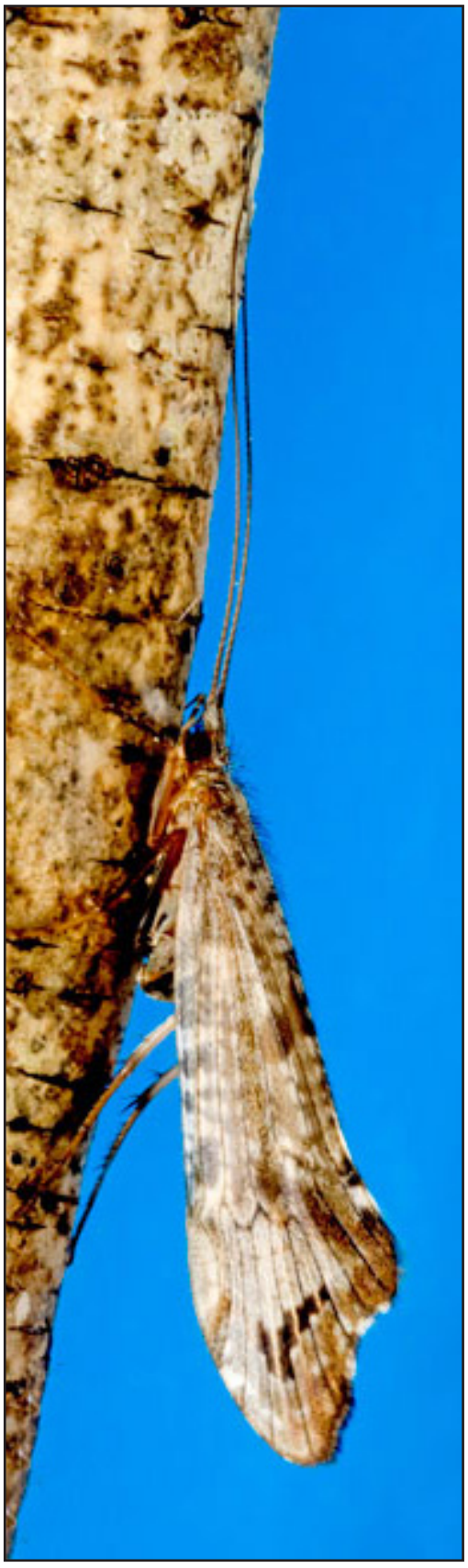
Baumanella is an uncommon stonefly that I have never collected in a perennial waterway. It appears to be intolerant of perennial water conditions and restricted to intermittent creeks. The 15mm long nymphs are highly predaceous. Cold Creek is the type locality for *Baumanella alameda.*

Kogatus nonus

Kogotus nonus and *Rickera sorpta* are difficult to identify according to some taxonomists. We believe that *Kogotus nonus* occurs in several of the study streams including Cold Creek.

Hellgrammites

Corydalus sp. are common in several of our study streams including Thompson Creek. They are predacious and will attempt to bite humans. They are frequently considered the keystone species for intermittent waterways.



Neophylax adult.

Paraleptophlebia sp.

Paraleptophlebia are considered marginally tolerant of pollution including sediment. They are frequently found in Putah Creek, probably recruited from Thompson Creek.

Ameletus sp.

Ameletus are rated "zero" on the California Tolerance Value index which indicates pollution intolerance. In early spring, Ameletus is incredibly common in several of the study streams including Miller, Ulatis and Pope creeks.

Calineuria californica

Calineuria are very large stoneflies rated "2" on the California Tolerance Value index. They are common in most of the larger intermittent waterways. Also called "Golden Stoneflies," they are common in many perennial waterways in Northern California and a preferred prey of steelhead. There is some indication that the large stoneflies such as *Calineuria* are instrumental in protecting salmonid eggs from decimation by *Saprolegnia*, a water fungus. They are reported to devour eggs infested with *Saprolegnia* before the fungus can spread to healthy eggs. During wet years, Miller Creek supports a high density of *Calineuria*.

Hesperoperla pacifica

Hesperoperla is also a large stonefly that is rated as "2" on the California Tolerance Value index. It is not as common as *Calineuria,* but is frequently collected in Miller and Pope creeks.

Neophylax sp.

Capell Creek is the only known location in the study creeks for this unusual caddisfly.

Pteronarcys sp.

Pteronarcys are also called "Salmonflies." These large members of the stonefly family are typically found in large perennial waterways such as the Upper Sacramento and the Trinity rivers. In my experience, they are unusual, even rare, in intermittent streams. This species is commonly collected in Capell Creek. Additional collections are being made of this species in Capell creek to determine if it is the same species as elsewhere in California.

Drunella coloradensis

Also know as the "Western Drake," this large mayfly is very common in Pope and Miller creeks. When found in other areas of the West Coast and the Rockies, it is typically found in limited numbers. It

Siphlonurus adult. Large mayfly that is common in some intermittent waterways. Adult hatched in WS&PS lab.

is rated as a "zero" on the California Tolerance Value index. This species contributes to the biological conundrum found in Capell Creek as the conditions - highly mineralized, warm, with intermittent water flows - do not represent what this animal typically prefers.

Discussion

Intermittent tributaries represent an crucial resource to many perennial waterways as they provide cobble to the main water course and are an important source of invertebrates. Despite the fact that water flows are temporal, sometimes only a few months, fish have been documented to use intermittent waterways for spawning. That includes trout and steelhead.

Without doubt, intermittent waterways serve as a source of invertebrate recruitment into Putah Creek. The diversity of invertebrates and the relative value of each tributary remains to be determined as each tributary appears to have separate value. For example, Cold Creek has a limited invertebrate population with a major stonefly hatch in early spring at the confluence with Putah Creek and provides spawning habitat for rainbow trout near the Highway 128 bridge. On the other side of Putah Creek, Thompson Creek does not appear to support spawning and has a remarkably different invertebrate community.

Of all the waterways studied, Miller Creek possibly represents the most important tributary for the "direct restoration" of the historic invertebrate population in Putah Creek. Direct restoration would be the recruitment of invertebrate nymphs from Miller Creek during spring storm events directly into Putah Creek. With sufficient rainfall, invertebrate recruitment from Miller Creek possibly happens every year.

The complete restoration of Putah Creek must involve the identification of ways to protect and/or improve intermittent tributaries and the restoration of the benthic structure in Putah Creek. Protecting and enhancing intermittent waterways can include bank stabilization, restoring riparian vegetation, controlling cattle grazing during the wet phase, and preventing urban runoff from entering the dry waterway. Benthic restoration in Putah Creek includes injecting spawning-size gravel, enhancing the density of invertebrate-preferred cobble, reducing the sediment loads that eliminate interstitial spaces in the streambed and scarifying the existing creekbed.

Recommendations

1. Continue educating the public, watershed managers, and governmental regulators about the importance of intermittent waterways to the overall health of perennial streams and their biota.

2. Survey Dry Creek for invertebrates during the next period of sufficient rainfall.

3. Continue survey work in the major intermittent waterways that potentially provide invertebrate

recruitment into Putah Creek

4. Measure the invertebrate recruitment from Miller Creek which requires healthy working relationships with the landowners.

5. Continue to document and identify the invertebrate species collected from the Putah Creek's intermittent tributaries.

6. Continue the restoration work on Putah Creek to create benthic habitat, such as weir construction, that supports invertebrate recruitment from tributaries.

7. Continue restoration work that reduces the sediment load into Putah Creek. Sediment eventually eliminates the interstitial spaces between cobble which is essential for invertebrate survival.

8. Continue gravel injections into Putah Creek at appropriate sites and investigate gravel scarification protocols.

9. Consider moving gravel and cobble from Dry Creek to sites such as the Pickerel Weir below the Putah Diversion Dam.

Submitted 8/18/09

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Attachments

Davis, Ken W., 2/26/06. *Report 1685 - 22A. Putah Creek (Dry Creek Confluence) Invertebrate Population.* Report to Rich Marovich. One page.

Davis, Ken W. 10/16/06. *Report 2040c - Putah Creek - Design Channel.* Report to Rich Marovich. Five pages.

Davis, Ken W. 1/11/08. *Report 2610 - Gravel Recruitment from Dry Creek.* Report to Rich Marovich. One page.