

# Aquatic Ecosystems and Invertebrates of the Grand Staircase-Escalante National Monument

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Annual Report of Activities for 2001



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cover photo: Clockwise from left; Willis Creek slot canyon, Upper Calf Creek, Dance Hall Rock Tinajas, *Thermonectus marmoratus* [Coleoptera: Dytiscidae], an uncommon and beautiful predaceous diving beetle, BugLab mascot

**Foreword**

The work described in this report was conducted by the National Aquatic Monitoring Center, Utah State University, Logan, Utah. The following people participated in the field collection of the samples, the identification of the invertebrates, and the writing of this report. I thank them for all their help and good spirit.

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## Introduction

The Grand Staircase-Escalante National Monument was established on 18 September 1996 and comprises more than 760,000 hectares of geological and ecological diversity in southern Utah. In 1998 we began to survey and monitor the Monument's aquatic habitats with the goals of collecting basic faunistic and ecological data and long-term biomonitoring data. Sampling should continue through at least 2004. Our sampling strategy has been twofold:

- 1) qualitatively sample as many locations as possible; and
- 2) repeatedly sample across seasons and years a subset of perennial habitats collecting both quantitative and qualitative samples.

The purpose of this report is to describe where, when, and how we have sampled through December 2001. Similar reports were prepared for samples collected in 1999 and 2000. These reports can be obtained from our web site:

<http://www.usu.edu/buglab/gsenm.htm> or from the Grand Staircase-Escalante National Monument, 180 West 300 North, Kanab, Utah 84741, 435-644-4300.

## Study area

Elevations within and adjacent to the National Monument range from 1100 to 3000 m. At Escalante, Utah, elevation 1616 m, annual air temperatures vary widely from <10 to 100 F (−30 to 37 C). The mean annual precipitation is about 12 inches (30 mm). Winters are cold and windy and summers are characterized by hot days and cool nights. Moisture falls

predominantly as snow between January and May (Figure 1). Early summer is usually dry, whereas intense localized thunderstorms are common in late summer.

Streamflow patterns are atypical for the Rocky Mountains

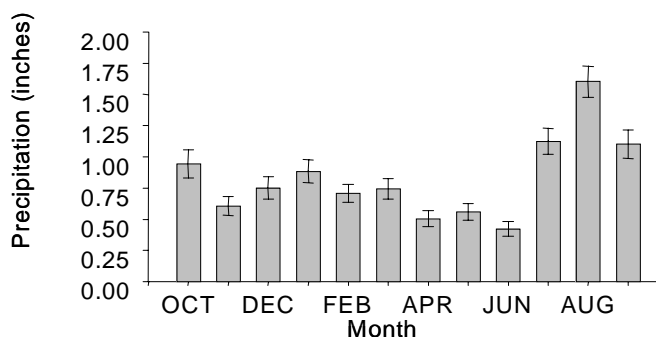


Figure 1. Long-term means  $\pm$  SE in monthly precipitation at Escalante, Utah.

with peaks occurring in response to both spring snowmelt and late summer monsoonal rain events. Monsoonal stormflows can be 50 times greater than mean annual flows and 2-10 times greater than spring peak flows (Figure 2). Water temperatures range from near zero to >33 C (Figure 2). Stream substrates vary widely and are often either bedrock or sand.

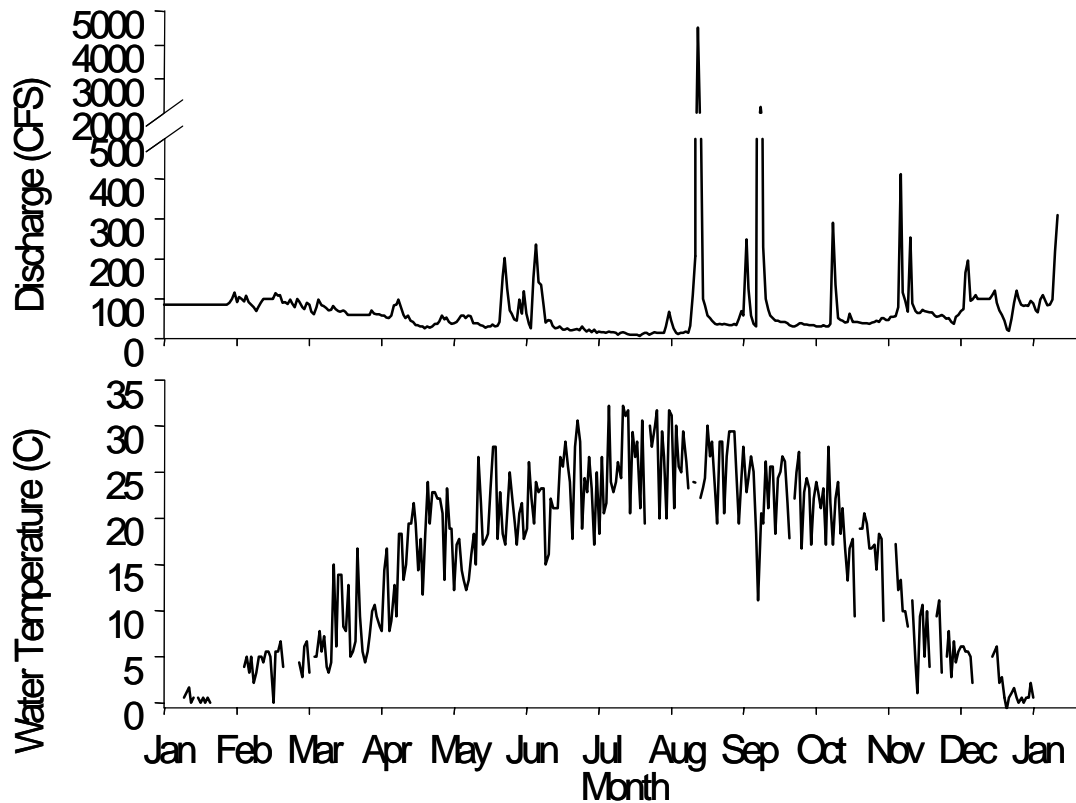


Figure 2. Discharge and water temperature for the Escalante River near its mouth in 1951.

### Aquatic habitats

This desert landscape contains many unique ephemeral and perennial aquatic habitats, including streams, alcove pools, natural and man-made ponds, springs, tinajas (rock pools), and hanging gardens. Alcove pools were defined as perennial and ephemeral pools located beneath bedrock pour-offs. Hanging gardens are assemblages of aquatic and semi-aquatic plants and animals occurring at small seeps on canyon walls. Springs were separated into rheocrenes (flowing water springs), limnocrenes (non-flowing water springs), and seeps (small water sources occurring on

the canyon floor). Tinajas are perennial and ephemeral water filled depressions in and outside of defined bedrock drainages. Please see our 2000 Annual Report for a more complete description and pictures of these habitats.

### **Long-term repeat sampling sites**

The following sites were identified as locations where long-term seasonal collections will be made. Samples collected on rivers near tributary streams would be taken upstream of the tributary stream. This list will likely be amended as we become more familiar with the Monument and additional management concerns arise.

- |                                       |  |
|---------------------------------------|--|
| 1. Escalante River near Escalante     | 13. Boulder Creek at mouth                   |
| 2. Escalante River near Mamie Creek   | 14. Deer Creek at Burr Trail Bridge          |
| 3. Escalante River near Sand Creek    | 15. The Gulch at Burr Trail Bridge           |
| 4. Escalante River near Calf Creek    | 16. The Gulch at mouth                       |
| 5. Escalante River near Boulder Creek | 17. Pine Creek at Lower Box Canyon trailhead |
| 6. Escalante River near the Gulch     | 18. Paria River at Highway 12 Bridge         |
| 7. Escalante River near Harris Wash   | 19. Harris Wash near trailhead               |
| 8. Escalante River near Coyote Gulch  | 20. Harris Wash at mouth                     |
| 9. Mamie Creek at mouth               | 21. Coyote Gulch near Hamblin Arch           |
| 10. Sand Creek at mouth               | 22. Coyote Gulch at mouth                    |
| 11. Calf Creek at mouth               |  |
| 12. Boulder Creek at Hwy. 12 Bridge   |  |

### **Methods**

#### *Streamflow*

Streamflow data is currently collected continuously by the U.S. Geological Survey in the Escalante Rive, Pine Creek, and Deer Creek drainages. The gage on the Escalante River, USGS Station 09337500, Escalante River near Escalante, Utah has been operated since 1911. The gage on Pine Creek, USGS Station 09337000, Pine Creek near Escalante, Utah has been operated since 1951. The gage on Deer Creek, USGS Station 09338900, Deer Creek near Boulder, Utah was only recently installed in

September 2001. There is also considerable historical hydrologic data available for other drainages in the Monument, e.g., Henrieville Creek and the Paria River, that are no longer continuously monitored.

### *Water temperatures*

Continuous recording thermographs (Hobo temps, Onset Inc.) were first deployed in January 2000. They recorded water temperatures every 2-4 hours and they are retrieved and redeployed about every 6 months. Data from these thermographs is available from the following locations for the following time periods:

1. Escalante River near the town of Escalante, January 2000 to September 2001.
2. Escalante River at the Highway 12 Bridge, May 2000 to September 2001.
3. Calf Creek near the source and at the mouth near Highway 12, May 2000 to September 2001.
4. Boulder Creek at the Highway 12 Bridge, January 2000 to September 2001.
5. Deer Creek at the Burr Trail Bridge, January 2000 to September 2001.
6. The Gulch at the Burr Trail Bridge, May 2000 to September 2001.
7. Pine Creek near the Upper and Lower Box Canyon trail heads, January 2000 to September 2001.
8. Tinajas near Highway 12 in the vicinity of the panoramic overlook and near Boulder Creek, May 2000 to September 2001.

Several thermographs were lost to high flow events and vandalism during their deployment, so data is not available for the period of record for all locations.

### *Aquatic invertebrate sampling locations and physical habitat*

The latitude and longitude of each site was determined using hand held global positioning units. Elevation was determined using an altimeter or a 7.5 min topographic map. Water and air temperatures were determined at the time of sampling using thermometers. The conductivity of the water was determined using an Oakton TDS Testr 40 hand held meter and the pH was determined using an Oakton pH Testr 2. Over-stream shade was estimated using a spherical densiometer. Substrate particle

size distributions were estimated by pebble counts (Wolman 1954). Over-stream shade was estimated using a spherical densiometer.

### *Aquatic invertebrates*

*Qualitative samples*—The objective of qualitative invertebrate collections was to collect as many different kinds of invertebrates living at a site as possible. Qualitative collections of invertebrates were done at all sites. Samples were collected with a kicknet (457 x 229 mm) with a 500 micron mesh net and by hand picking invertebrates from woody debris and large boulders. All major habitat types (e.g., riffles, pools, back waters, macrophyte beds) were sampled and all samples were composited to form a single sample from each site. In addition, tinajas were sampled with a zooplankton net (130 mm diameter, 80 micron mesh). Generally, 10 zooplankton tows were made across each tinaja at a variety of sampling depths and composited into a single sample.

*Quantitative samples*—The objective of quantitative invertebrate sampling was to collect the more common invertebrates at a site and estimate their relative abundances. Quantitative samples were collected using a rectangular kicknet (457 x 229 mm) with a 500 micron mesh net. Samples were collected by disturbing the area immediately upstream of the front of the net with our hands and scrubbing individual substrate particles within the sampling area allowing the invertebrates and detritus to wash downstream into the net. The area of each sample was approximately 0.18 m<sup>2</sup> (0.45 m wide x 0.4 m deep). Four samples were collected in 4 different riffles and composited to make a sample of approximately 0.7 m<sup>2</sup> (4 kicknets x 0.18 m<sup>2</sup>) for each location.

*Laboratory methods*—The general procedures followed for processing invertebrate samples were similar to those recommended by the United States Geological Survey (Cuffney et al. 1993) and are described in greater detail and rationalized in Vinson and Hawkins (1996). Qualitative samples were processed in their entirety, i.e., all the organisms were removed and identified. Quantitative samples were sub-sampled if the sample appeared to contain more than 500 organisms. Sub-samples were obtained by



pouring the sample into an appropriate diameter 250 micron sieve, floating this material by placing the sieve within an enamel pan partially filled with water and leveling the material within the sieve. The sieve was then removed from the water pan and the material within the sieve was divided into equal parts. One side of the sieve was then randomly chosen to be processed and the other side was set aside. The sieve was then placed back in the enamel pan and the material in the sieve again leveled and split in half. This process was repeated until approximately 500 organisms remained in one-half of the sieve. This material was then placed into a petri dish and all organisms were removed under a dissecting microscope at 10-30 power. Additional sub-samples were taken until at least 500 organisms were removed. All organisms within a sub-sample were removed. During the sorting process the organisms were separated into Orders. When the sorting of the sub-samples was completed, the entire sample was spread throughout a large white enamel pan and searched for 10 minutes to remove any taxa that might not have been picked up during the initial sample sorting process. The objective of this "big/rare" search was to provide a more complete taxa list by finding rarer taxa that may have been excluded during the sub-sampling process. These rarer bugs were placed into a separate vial and tracked separately from the bugs removed during the sub-sampling process. All the organisms removed during the sorting process were then identified. Once the data had been entered into a computer and checked, the unsorted portion of the sample was discarded. The identified portion of the sample was placed in 70% ethanol, given a catalog number, and was retained.

## Results

### Streamflow

The mean annual flow in the Escalante River at USGS gage near Escalante, Utah (USGS gage 09337500) was  $13.9 \text{ ft}^3 \text{ sec}^{-1}$  during 2001 which was slightly more than the long-term average of  $12.7 \text{ ft}^3 \text{ sec}^{-1}$ . Mean daily streamflow was lower in the early spring and considerably higher in early summer than the long-term median (Figure 3). There were also several large monsoonal storm events that occurred between July and October (see inset Figure 3). This included a very large monsoonal event that occurred in the Boulder area that sent extremely large flows down the Deer, Boulder, and Calf Creek drainages.

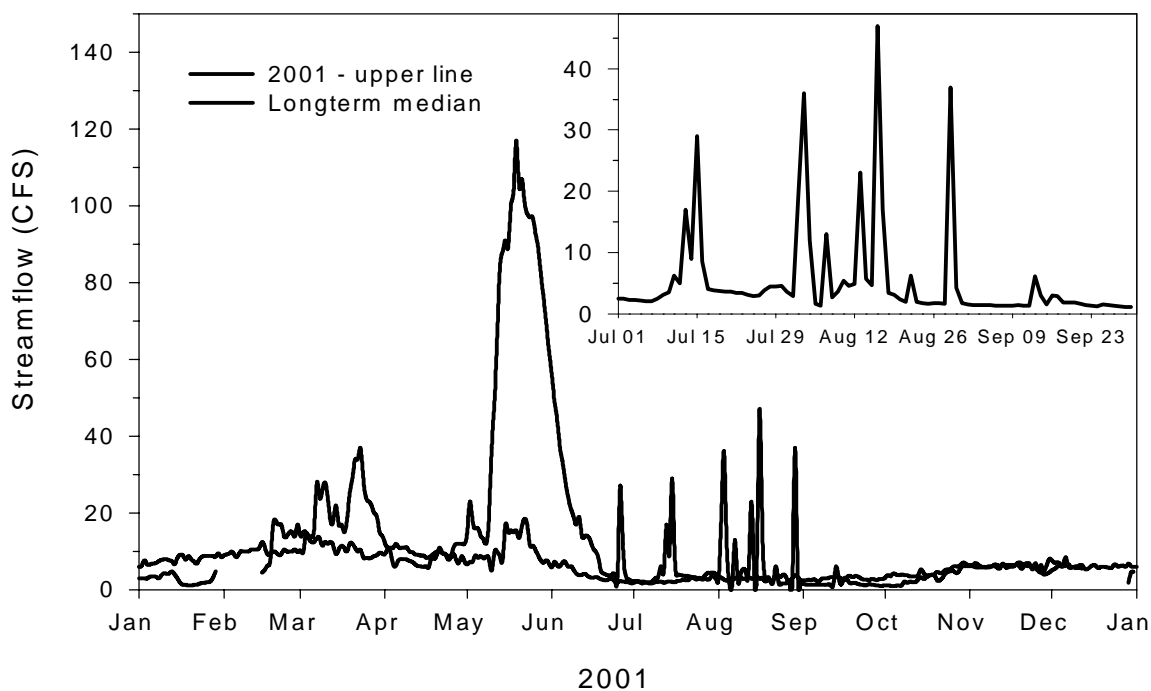


Figure 3. Mean daily flow for 2001 and the period of record for the Escalante River Escalante, Utah. Inset graph is for July to October 2001.

### Water temperatures

Minimum water temperatures occurred in the winter and were near 0 C for most locations (Table 1, Figures 4, 5, and 6). Maximum water temperatures occurred in the summer and varied from about 14 C near the headwaters of Calf Creek to 30 C in the

Escalante River. With the exception of the head of Calf Creek, all sites exhibited considerable diel variation in water temperature. Maximum diel variations were only about 5 C in Calf Creek headwaters and near 20 C in the Escalante River and Boulder Creek. Water temperatures in tinajas were highly variable both throughout the year and during summer days.

Table 1. Maximum, minimum, mean and range of water temperatures for the period of record at several locations within the Grand Staircase-Escalante National Monument.

Station	Location	Observations	Water temperatures (C)			
			Max	Min	Mean	Range
ES-121	Boulder Creek near Hwy. 12 Bridge	609	26.52	-1.17	8.37	23.18
ES-113	Calf Creek near mouth	207	26.00	4.00	15.24	16.00
ES-038	Calf Creek near source	62	15.20	8.60	13.74	4.70
ES-004	Deer Creek at Burr Creek Bridge	544	22.40	0.20	9.68	12.50
ES-001	Escalante near Escalante, Utah	499	31.10	-1.00	8.81	18.60
ES-120	Escalante River near Hwy. 12 Bridge	469	29.10	-0.60	12.42	11.90
ES-096	Pine Creek at upper trailhead	349	20.90	-0.60	7.84	11.50
ES-099	Pine Creek at lower trailhead	518	22.10	-0.60	6.24	11.50
ES-006	The Gulch at Burr Creek Bridge	463	29.40	-0.30	11.03	15.80
ES-127	Tinaja near Boulder Creek	126	23.20	0.20	17.89	14.60
ES-128	Tinaja near Boulder Creek	126	38.30	0.20	19.39	28.30
ES-133	Tinaja near Hwy. 12 overlook (up drainage)	285	37.40	4.10	16.83	21.10
ES-002	Tinaja near Hwy. 12 overlook (down drainage)	151	27.50	4.10	17.72	12.70

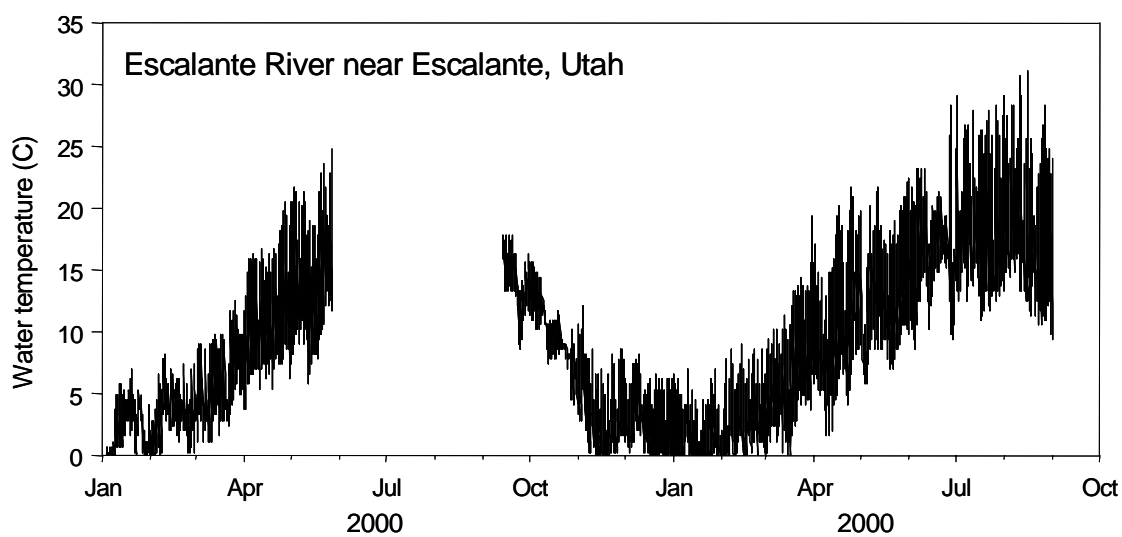


Figure 4. Instantaneous water temperatures for the Escalante River by the upper trailhead near Escalante, Utah.

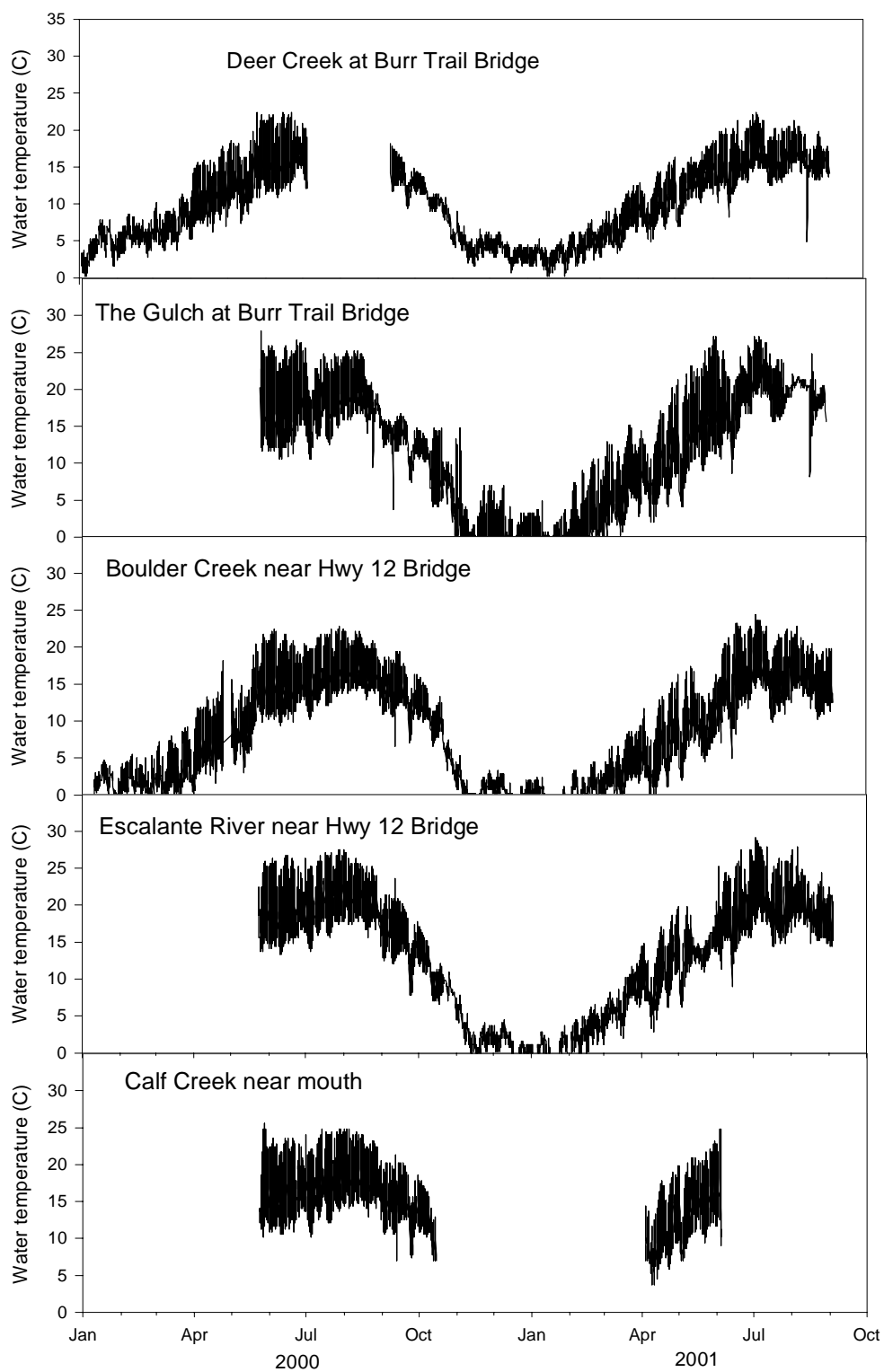


Figure 5. Instantaneous water temperatures for several drainages within the Grand Staircase - Escalante National Monument.

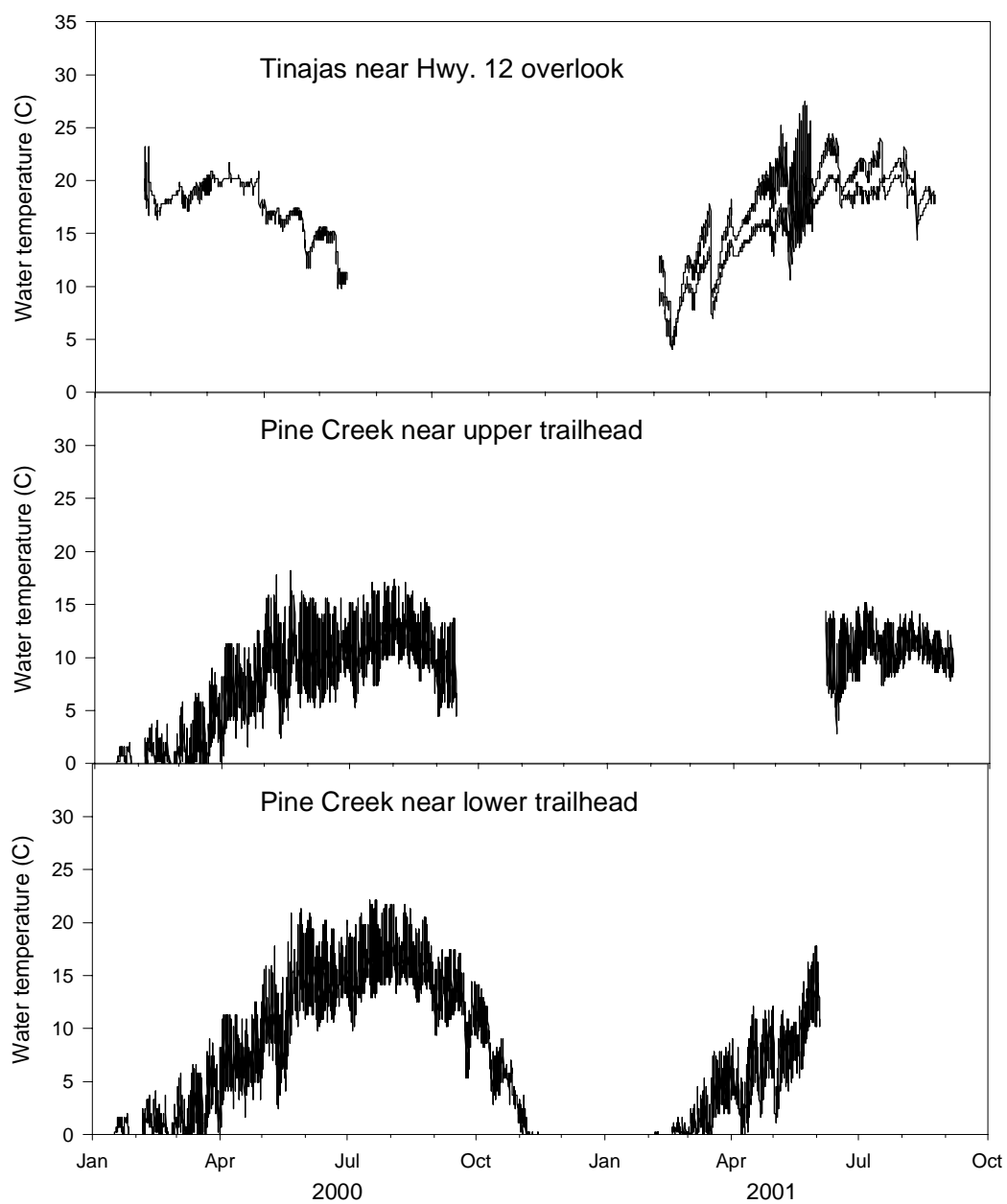


Figure 6. Instantaneous water temperatures for 2 tinajas near Hwy 12 and for 2 locations within Pine Creek within the Grand Staircase- Escalante National Monument.

### *Aquatic invertebrate sampling locations*

To date we have sampled 180 locations within and adjacent to the Grand Staircase-Escalante National Monument (Figure 7). The majority of these sites have been streams (106), but we also sampled alcove pools (7), hanging gardens (1), ponds, lakes, wetlands, and reservoirs (13), tinajas (41), and limnocrene and rheocrene springs (12). The general location and specific geographic coordinates for each sampling location are presented in Appendix 2.

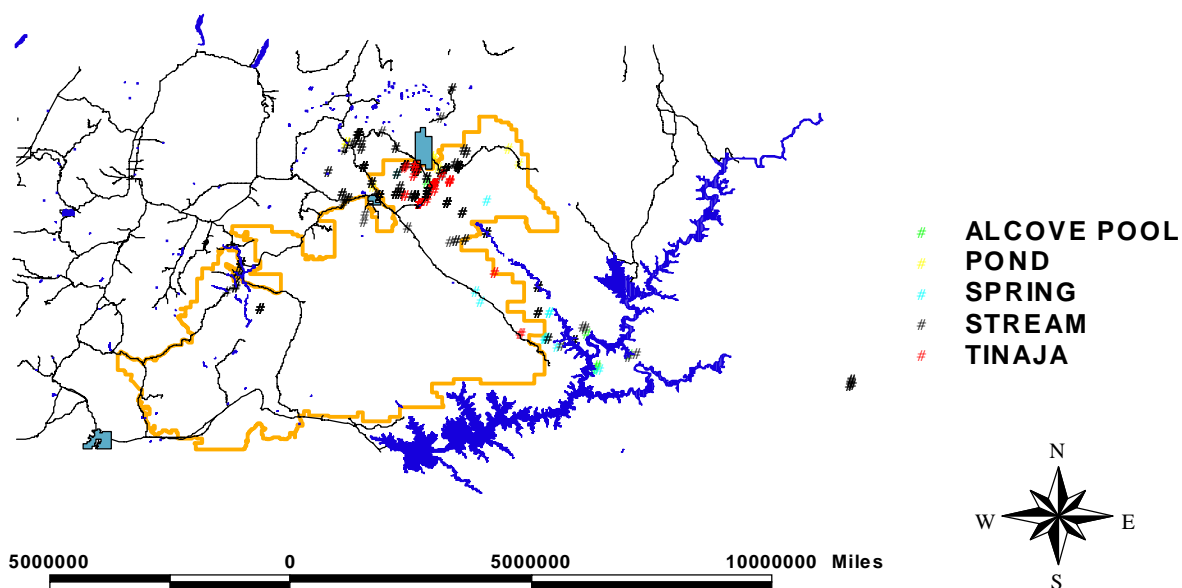


Figure 7. Aquatic invertebrate sampling locations.

### *Aquatic invertebrates*

An impressive number of aquatic invertebrates have been collected from the many unique habitats present in the Monument. To date we have collected and processed 498 samples from 180 locations. We have identified 60,553 individual invertebrates from 29 orders, 101 families, and 185 different genera (Table 2). Diversity was highest among insects. We have found 37 Coleoptera, 34 Diptera (excluding Chironomidae), 16 Ephemeroptera, 11 Hemiptera, 18 Odonata, 15 Plecoptera, and 31 genera of Trichoptera (Table 2). Non-insects were less diverse, but we have also not yet

identified many of these taxa to genus, so the results are more preliminary.

Nonetheless, we found 12 genera of Crustacea and 7 genera of Mollusca. Species accumulation curves suggest that we are a long ways from finding all of the different aquatic invertebrate taxa in the Monument (Figure 8). With each new location that we sample we find new taxa, and there is little indication that this relationship is flattening out.

**Table 2.** Summary of aquatic macroinvertebrate collections made through December 2001 by major habitat type. OTU = operational taxonomic unit and represents a mix of taxonomic levels, because not all individuals can be identified to a consistent taxonomic level.

Measure	All locations	Alcove pools	Hanging gardens	Wetlands, Ponds, Lakes Reservoirs	Springs, Seeps	Rivers, Streams	Tinajas
Number of samples	498	13	1	17	13	348	110
Total OTU taxa richness	320	70	13	84	63	285	107
Total invertebrate genera	185	39	8	50	37	167	57
Total insect genera	164	34	8	38	34	153	48
Coleoptera genera	37	14	4	14	10	31	18
Diptera (non-midge) genera	34	7	2	7	10	31	10
Ephemeroptera genera	16	2	1	2	2	16	2
Hemiptera genera	11	4	1	3	4	8	7
Megaloptera genera	2	0	0	0	0	2	0
Odonata genera	18	6	0	8	2	16	6
Plecoptera genera	15	0	0	0	0	17	0
Trichoptera genera	31	1	0	4	5	31	5
Crustacea genera	12	3	0	5	1	5	6
Mollusca genera	7	2	0	6	1	7	1

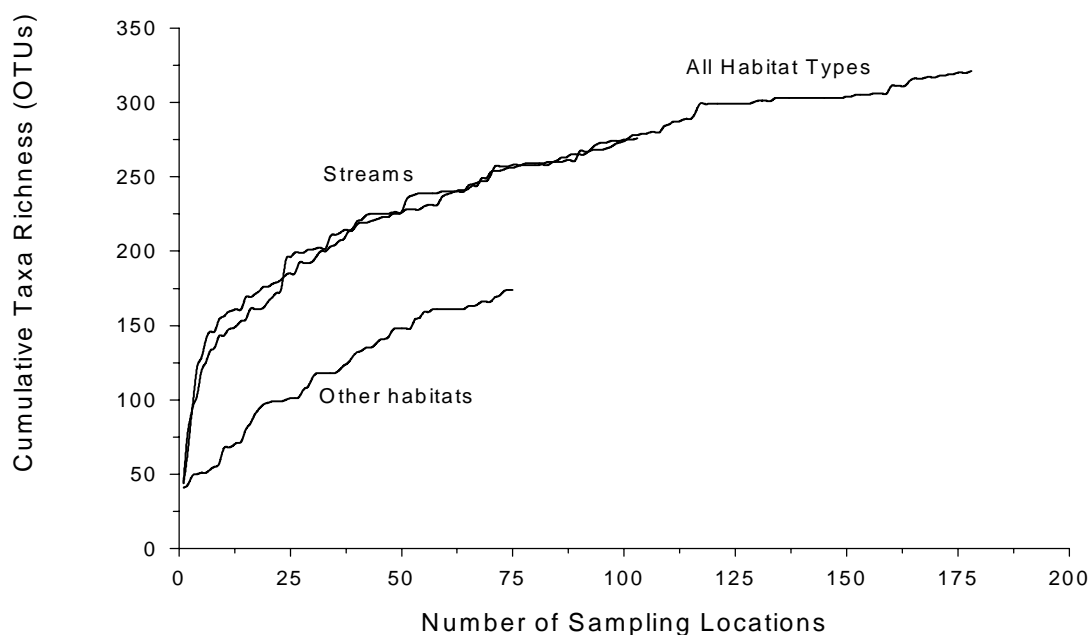


Figure 8. Taxa accumulation curves for all sampling locations, flowing waters (streams) and other habitats (e.g., tinajas, ponds, wetlands, alcove pools).

### Effects of a large late summer thunderstorm on aquatic invertebrate assemblages

On about 14 September 2001 a large thunderstorm occurred in the vicinity of the upper parts of Calf, Boulder, and Deer Creek watersheds. I arrived in the Boulder area on 19 September and observed high water marks approximately 10 or more feet above the normal flow levels that trickle down the unnamed tributary to Calf Creek that parallels the road from the town of Boulder. The riparian area along this stream was devastated. The riparian area around the Deer Creek Campground appeared to have just experienced a similar sized flood event. On 20 September, 4-5 days after the storm, I walked into Upper Calf Creek Falls area. Calf Creek looked completely different than I was used to. There was flood debris everywhere. The fairly large river birch on the downstream edge of the falls pool was completely gone. It appeared that the Calf Creek drainage had received a larger amount of precipitation and runoff than the Deer Creek.



Plate 1. More than 1 m of hail deposited on or about 14 September 2001 in the upper Calf Creek drainage.

Upstream of Upper Calf Creek Falls to the headwaters the streambanks were lined with more than a meter of deposited hail that had yet to melt (Plate 1). The hail was pea to marble size and was intermixed with a small pieces of debris and soil, but was really quite clean. The hail accumulations had the look of late spring snow pack, but it was



clearly hail. In Plate 1, my backpack is about 1 m tall. The white area next to the pack is where I scraped debris from the hail bank. Again, this was nearly 5 days after the storm. Air temperatures this week were 20-26 C (70-77 F). The Escalante River upstream of Calf Creek did not appear to have seen the same volume of runoff (Figure 3 inset). Unfortunately, the new USGS stream gage on Deer Creek near the Burr Trail Bridge appeared to malfunction during the storm, as there was no data available between 15 and 25 September 2001.

We had collected aquatic invertebrate samples at 5 streams within this area on 2-5 September 2001, prior to the thunderstorm, and I was able to collect samples at these same sites on 20-21 September, after the thunderstorm. We also had data from samples collected during September 2000 at four of these sites. These sites included, Deer Creek near the Burr Trail Bridge, the Gulch upstream of the Burr Trail Bridge, Calf Creek near the mouth, Escalante River downstream from the Highway 12 Bridge, and Boulder Creek at the Highway 12 Bridge.

The impact of this large hydrologic disturbance on aquatic invertebrate assemblages was interesting (Table 3). Taxa richness increased at 4 of the 5 streams and the density of invertebrates decreased at 3 of the 5 streams. The increase in taxonomic richness following the flood was a bit surprising, but may be due to the floods causing a redistribution of taxa within substrates that made them more accessible to sampling or they may have been moved from upstream or lateral habitats into our sampling reach. The number of aquatic invertebrates at each of these sampling locations was considerably less for all sites, except the Escalante River downstream from Calf Creek. This may reflect invertebrates being washed from Calf Creek into the Escalante River.

Table 3. A comparison of aquatic invertebrate taxa richness and abundance between pre- and post thunderstorm samples. Data from September 2000 is also provided for comparison.

Location	Taxa Richness				Abundance (number per m <sup>2</sup> )			
	September 2000	September 2001			September 2000	September 2001		
		Pre-flood	Post-flood	Pre-post flood difference, %		Pre-flood	Post-flood	Pre-post flood Difference, %
Deer Creek	8	16	20	125	304	363	207	57
Gulch Creek	12	11	11	100	136	220	108	49
Calf Creek near mouth	No data	25	31	124	No data	573	641	112
Escalante River at Highway 12 Bridge	17	12	36	300	245	395	2919	739
Boulder Creek at Highway 12 Bridge	26	29	19	66	1379	1263	254	20

**Notable taxa**

Some notable taxa that have been collected including a blind subterranean amphipod (Figure 6) from a spring near Alvey Wash and several species of *Notonecta* from throughout the Monument. The amphipod belongs to the *Stygobromus hubbsi* group, and is likely a new undescribed species. Several interesting fairy shrimp were collected and are currently being identified by Dr. Tim Graham. A list of all taxa collected and identified to date are shown in Table 4.



Figure 6. The blind subterranean amphipod, *Stygobromus*.

**Plans for 2002**

Our plans for 2002 include sampling in the early summer and late fall our long-term sampling sites. We plan to locate and sample more tinajas and we want to do more exploration in the southwestern part of the monument than we have in previous years. We will be maintaining our current number of thermographs.

**Table 4.** Aquatic organisms identified from all samples collected through December 2001. All identifications should be considered provisional until verified.

Annelida	Ostracoda	Berosus
Hirudinea	Candoniidae	Hydrobius
Oligochaeta	Candona	Hydrochara
Haplotaxida	Entognatha	Laccobius
Tubificidae	Collembola	Paracymus
Lumbriculida	Insecta	Tropisternus
Lumbriculidae	Coleoptera	Lampyridae
Arthropoda	Amphizoidae	Scirtidae
Arachnida	Amphizoa	Elodes
Trombidiformes	Curculionidae	Staphylinidae
Crustacea	Dryopidae	Tenebrionidae
Amphipoda	Helichus	Diptera
Crangonyctidae	Dytiscidae	Athericidae
Stygobromus hubbsi group	Agabus	Atherix
Gammaridae	Coptotomus	Ceratopogonidae
Gammarus lacustris	Deronectes	Atrichopogon
Hyaletellidae	Eretes stricticus	Bezzia
Hyaella azteca	Hydroporus	Culicoides
Anostraca	Hygrotus	Dasyhelea
Branchinectidae	Laccophilus	Probezzia
Branchinecta packardi	Neoclypeodytes	Chironomidae
Calanoida	Oreodytes	Chironominae
Diaptomidae	Rhantus	Orthoclaadiinae
Diaptomus	Rhantus gutticollis	Tanypodinae
Temoridae	Stictiotarsus	Culicidae
Epischura nevadensis	Thermonectus marmoratus	Anopheles
Cladocera	Elmidae	Culex
Bosminidae	Cleptelmis	Culiseta
Bosmina longirostris	Heterelmis	Dixidae
Chydoridae	Heterlimnius	Dixa
Daphnidae	Microcylloepus	Dixella
Daphnia	Microcylloepus pusillus	Dolichopodidae
Daphnia pulex	Narpus	Empididae
Daphnia rosea	Optioservus	Chelifera
Daphniidae	Ordobrevia	Clinocera
Ceriodaphnia	Stenelmis	Hemerodromia
Ceriodaphnia laticaudata	Zaitzevia	Ephydridae
Ceriodaphnia quadrangula	Gyrinidae	Muscidae
Copepoda	Dineutus	Limnophora
Cyclopoida	Gyrinus	Psychodidae
Cyclopidae	Haliplidae	Maruina
Decapoda	Haliphus	Pericoma
Cambaridae	Peltodytes	Simuliidae
Orconectes virilis	Helophoridae	Prosimulium
Harpacticoida	Helophorus	Simulium
Isopoda	Hydraenidae	Stratiomyidae
Asellidae	Hydraena	Caloparyphus
Notostraca	Ochthebius	Euparyphus
Triopsidae	Hydrophilidae	Myxosargus
Triops longicaudatus	Amator	Nemotelus

Stratiomys	Gerridae	Libellula saturata
Syrphidae	Aquarius	Paltothemis lineatipes
Tabanidae	Gerris	Pantala flavescens
Chrysops	Naucoridae	Tramea
Tabanus	Ambrysus	Tramea lacerata
Tipulidae	Ambrysus mormon	Plecoptera
Antocha	Notonectidae	Capniidae
Dicranota	Notonecta	Mesocapnia
Erioptera	Notonecta kirbyi	Utacapnia
Hesperoconopa	Notonecta lobata	Chloroperlidae
Hexatoma	Notonecta undulata	Suwallia
Limonia	Veliidae	Sweltsa
Rhabdomastix	Microvelia	Leuctridae
Tipula	Rhagovelia	Nemouridae
Ephemeroptera	Rhagovelia distincta	Amphinemura
Ameletidae	Rhagovelia obesa	Malenka
Ameletus	Lepidoptera	Prostoia
Baetidae	Pyralidae	Zapada
Acentrella	Petrophila	Perlidae
Baetis	Megaloptera	Hesperoperla pacifica
Baetis bicaudatus	Corydalidae	Perlodidae
Baetis tricaudatus	Corydalus cognata	Isogenoides zionensis
Callibaetis	Odonata	Isoperla
Paracloeodes	Aeshnidae	Isoperla longiseta
Caenidae	Aeshna	Megarcys
Caenis	Aeshna umbrosa	Megarcys signata
Ephemerellidae	Anax walsinghami	Skwala
Drunella coloradensis	Calopterygidae	Pteronarcyidae
Drunella doddsi	Hetaerina	Pteronarcella
Drunella grandis	Hetaerina americana	Pteronarcella badia
Drunella spinifera	Coenagrionidae	Taeniopterygidae
Ephemerella	Argia	Taenionema
Ephemerella inermis	Argia plana	Taenionema pacificum
Heptageniidae	Argia vivida	Trichoptera
Cinygmula	Coenagrion	Brachycentridae
Epeorus	Enallagma	Brachycentrus
Heptagenia	Enallagma cyathigerum	Brachycentrus americanus
Nixe	Ischnura	Brachycentrus occidentalis
Rhithrogena	Telebasis salva	Micrasema
Leptohyphidae	Cordulegastridae	Glossosomatidae
Tricorythodes	Cordulegaster diadema	Glossosoma
Leptophlebiidae	Cordulegaster dorsalis	Helicopsychidae
Paraleptophlebia	Gomphidae	Helicopsyche
Siphonuridae	Erpetogomphus	Helicopsyche borealis
Siphonurus	Erpetogomphus compositus	Hydropsychidae
Hemiptera	Gomphus	Arctopsyche
Belostomatidae	Ophiogomphus	Hydropsyche
Lethocerus	Ophiogomphus severus	Parapsyche
Corixidae	Lestidae	Smicridea
Corisella	Archilestes	Hydroptilidae
Graptocorixa	Archilestes grandis	Hydroptila
Neocorixa	Lestes	Leucotrichia
Gelastocoridae	Libellulidae	Neotrichia
Gelastocoris oculatus	Libellula	Ochrotrichia

Lepidostomatidae	Tinodes	Stagnicola
Lepidostoma	Rhyacophilidae	Physidae
Lepidostoma subgenus	Rhyacophila	Physella
neodinarthrum	Sericostomatidae	Planorbidae
Leptoceridae	Gumaga	Gyraulus
Oecetis	Uenoidae	Mesogastropoda
Triaenodes	Neophylax	Hydrobiidae
Ylodes	Neothremma	Nemata
Limnephilidae	Oligophlebodes	Nematomorpha
Amphicosmoecus canax	Mollusca	Platyhelminthes
Dicosmoecus	Bivalvia	Turbellaria
Hesperophylax	Veneroidea	Vertebrata
Limnephilus	Pisidiidae	Amphibia
Onocosmoecus	Pisidium	Anura
Philopotamidae	Gastropoda	Bufonidae
Chimarra	Basommatophora	Bufo
Dolophilodes	Ancylidae	Bufo woodhousii
Wormaldia	Ferrissia	Pelobatidae
Phryganeidae	Lymnaeidae	Spea intermontana
Agrypnia	Fossaria	
Psychomyiidae	Radix	

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Appendix 1A. List of taxa collected in 10 samples taken in alcove pools within and adjacent to the Grand Staircase - Escalante National Monument.

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Annelida	Hydrophilidae	Gerridae
Oligochaeta	Berosus	Aquarius
Haplotaxida	Hydrobius	Notonectidae
Tubificidae	Laccobius	Notonecta
Arthropoda	Paracymus	Notonecta kirbyi
Arachnida	Scirtidae	Notonecta lobata
Trombidiformes	Elodes	Odonata
Crustacea	Diptera	Aeshnidae
Amphipoda	Ceratopogonidae	Aeshna umbrosa
Hyalellidae	Probezzia	Coenagrionidae
Hyalella azteca	Chironomidae	Argia
Cladocera	Chironominae	Argia vivida
Daphnidae	Orthoclaadiinae	Coenagrion
Daphnia	Tanypodinae	Enallagma
Daphnia pulex	Culicidae	Enallagma cyathigerum
Copepoda	Dixidae	Gomphidae
Cyclopoida	Dixella	Lestidae
Cyclopidae	Simuliidae	Archilestes grandis
Decapoda	Simulium	Libellulidae
Ostracoda	Stratiomyidae	Libellula
Candoniidae	Caloparyphus	Libellula saturata
Candona	Tabanidae	Trichoptera
Insecta	Chrysops	Hydroptilidae
Coleoptera	Tipulidae	Ochrotrichia
Dytiscidae	Limonia	Mollusca
Agabus	Tipula	Bivalvia
Deronectes	Ephemeroptera	Veneroidea
Laccophilus	Baetidae	Pisidiidae
Rhantus	Baetis	Pisidium
Thermonectus marmoratus	Baetis tricaudatus	Gastropoda
Gyrinidae	Callibaetis	Basommatophora
Gyrinus	Hemiptera	Physidae
Haliplidae	Belostomatidae	Physella
Haliplus	Lethocerus	Platyhelminthes
Peltodytes	Corixidae	Turbellaria
Hydraenidae	Neocorixa	
Hydraena		

Appendix 1B. List of taxa collected in a single sample taken in a hanging garden adjacent to the Grand Staircase - Escalante National Monument near Lake Powell.

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Arthropoda

Insecta

Coleoptera

Dytiscidae

Agabus

Elmidae

Zaitzevia

Hydraenidae

Hydraena

Hydrophilidae

Scirtidae

Elodes

Staphylinidae

Diptera

Chironomidae

Chironominae

Dixidae

Dixella

Stratiomyidae

Caloparyphus

Ephemeroptera

Baetidae

Baetis

Hemiptera

Gerridae

Aquarius



Appendix 1C. List of benthic taxa and zooplankton collected in Ponds, Posy Lake, Reservoirs, and wetlands within and adjacent to the Grand Staircase - Escalante National Monument.

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Annelida	Helophorus	Coenagrionidae
Oligochaeta	Hydrophilidae	Argia
Arthropoda	Berosus	Enallagma cyathigerum
Arachnida	Paracymus	Telebasis salva
Trombidiformes	Diptera	Lestidae
Crustacea	Ceratopogonidae	Archilestes grandis
Amphipoda	Bezzia	Libellulidae
Gammaridae	Dasyhelea	Libellula
Gammarus lacustris	Probezzia	Tramea lacerata
Hyalellidae	Chironomidae	Trichoptera
Hyalella azteca	Chironominae	Hydropsychidae
Calanoida	Orthoclaadiinae	Hydropsyche
Temoridae	Tanypodinae	Hydroptilidae
Epischura nevadensis	Culicidae	Hydroptila
Cladocera	Anopheles	Limnephilidae
Daphnidae	Dixidae	Limnephilus
Daphnia	Dixella	Phryganeidae
Daphnia rosea	Muscidae	Agrypnia
Daphniidae	Simuliidae	Mollusca
Ceriodaphnia laticaudata	Simulium	Bivalvia
Ceriodaphnia quadrangula	Stratiomyidae	Veneroidea
Cyclopoida	Myxosargus	Pisidiidae
Ostracoda	Tabanidae	Pisidium
Insecta	Ephemeroptera	Gastropoda
Coleoptera	Baetidae	Basommatophora
Amphizoidae	Baetis	Ancyliidae
Amphizoa	Baetis bicaudatus	Ferrissia
Curculionidae	Baetis tricaudatus	Lymnaeidae
Dytiscidae	Callibaetis	Radix
Agabus	Hemiptera	Stagnicola
Coptotomus	Corixidae	Physidae
Deronectes	Corisella	Physella
Hygrotus	Neocorixa	Planorbidae
Laccophilus	Gerridae	Gyraulus
Oreodytes	Notonectidae	Nemata
Rhantus	Notonecta	Vertebrata
Thermonectus marmoratus	Notonecta kirbyi	Amphibia
Gyrinidae	Odonata	Anura
Gyrinus	Aeshnidae	Pelobatidae
Haliplidae	Aeshna	Spea intermontana
Peltodytes	Aeshna umbrosa	
Helophoridae	Anax walsinghami	

Appendix 1D. List of taxa collected in springs and seeps within and adjacent to the Grand Staircase - Escalante National Monument.

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Annelida	Orthoclaadiinae	Notonecta kirbyi
Oligochaeta	Tanypodinae	Veliidae
Arthropoda	Culicidae	Lepidoptera
Arachnida	Culiseta	Pyrilidae
Trombidiformes	Dixidae	Petrophila
Crustacea	Dixella	Odonata
Amphipoda	Empididae	Coenagrionidae
Hyalellidae	Clinocera	Argia
Hyalella azteca	Simuliidae	Argia vivida
Decapoda	Simulium	Lestidae
Ostracoda	Stratiomyidae	Archilestes grandis
Insecta	Stratiomys	Trichoptera
Coleoptera	Tabanidae	Helicopsychidae
Dytiscidae	Tabanus	Helicopsyche
Agabus	Tipulidae	Limnephilidae
Deronectes	Hexatoma	Limnephilus
Laccophilus	Limonia	Philopotamidae
Oreodytes	Tipula	Chimarra
Rhantus	Ephemeroptera	Psychomyiidae
Elmidae	Baetidae	Tinodes
Microcyloopus	Baetis	Sericostomatidae
Hydrophilidae	Baetis tricaudatus	Gumaga
Berosus	Callibaetis	Mollusca
Laccobius	Hemiptera	Gastropoda
Paracymus	Corixidae	Basommatophora
Tropisternus	Gelastocoridae	Lymnaeidae
Diptera	Gelastocoris oculatus	Physidae
Ceratopogonidae	Gerridae	Physella
Probezzia	Aquarius	Nemata
Chironomidae	Gerris	
Chironominae	Notonectidae	

Appendix 1E. List of taxa collected in 257 samples taken in rivers and streams within and adjacent to the Grand Staircase - Escalante National Monument.

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Annelida	Thermonectus marmoratus	Dixella
Hirudinea	Elmidae	Dolichopodidae
Oligochaeta	Cleptelmis	Empididae
Haplotaxida	Heterelmis	Chelifera
Tubificidae	Heterolimnius	Clinocera
Lumbriculida	Microcylloepus	Hemerodromia
Lumbriculidae	Microcylloepus pusillus	Ephydriidae
Arthropoda	Narpus	Muscidae
Arachnida	Optioservus	Limnophora
Trombidiformes	Ordobrevia	Psychodidae
Crustacea	Stenelmis	Maruina
Amphipoda	Zaitzevia	Pericoma
Crangonyctidae	Gyrinidae	Simuliidae
Stygobromus hubbsi group	Gyrinus	Prosimulium
Gammaridae	Haliplidae	Simulium
Gammarus lacustris	Peltodytes	Stratiomyidae
Hyalellidae	Helophoridae	Caloparyphus
Hyalella azteca	Helophorus	Euparyphus
Cladocera	Hydraenidae	Myxosargus
Daphnidae	Ochthebius	Nemotelus
Daphnia	Hydrophilidae	Stratiomys
Daphnia pulex	Ametor	Syrphidae
Copepoda	Berosus	Tabanidae
Cyclopoida	Hydrobius	Tabanus
Cyclopidae	Hydrochara	Tipulidae
Decapoda	Laccobius	Antocha
Cambaridae	Paracymus	Dicranota
Orconectes virilis	Tropisternus	Erioptera
Harpacticoida	Lampyridae	Hesperoconopa
Isopoda	Scirtidae	Hexatoma
Asellidae	Elodes	Limonia
Ostracoda	Staphylinidae	Rhabdomastix
Entognatha	Tenebrionidae	Tipula
Collembola	Diptera	Ephemeroptera
Insecta	Athericidae	Ameletidae
Coleoptera	Atherix	Ameletus
Curculionidae	Ceratopogonidae	Baetidae
Dryopidae	Atrichopogon	Acentrella
Helichus	Culicoides	Baetis
Dytiscidae	Dasyhelea	Baetis bicaudatus
Agabus	Probezzia	Baetis tricaudatus
Deronectes	Chironomidae	Callibaetis
Eretes stricticus	Chironominae	Paracloeodes
Hydroporus	Orthoclaadiinae	Caenidae
Hygrotus	Tanypodinae	Caenis
Laccophilus	Culicidae	Ephemerellidae
Oreodytes	Culex	Drunella coloradensis
Rhantus	Culiseta	Drunella doddsi
Rhantus gutticollis	Dixidae	Drunella grandis
Stictiotarsus	Dixa	Drunella spinifera

Ephemerella	Coenagrion	Brachycentrus
Ephemerella inermis	Enallagma	Brachycentrus americanus
Heptageniidae	Ischnura	Brachycentrus occidentalis
Cinygmula	Cordulegastridae	Micrasema
Epeorus	Cordulegaster diadema	Glossosomatidae
Heptagenia	Cordulegaster dorsalis	Glossosoma
Nixe	Gomphidae	Helicopsychidae
Rhithrogena	Erpetogomphus	Helicopsyche
Leptohyphidae	Erpetogomphus compositus	Helicopsyche borealis
Tricorythodes	Gomphus	Hydropsychidae
Leptophlebiidae	Ophiogomphus	Arctopsyche
Paraleptophlebia	Ophiogomphus severus	Cheumatopsyche
Siphonuridae	Lestidae	Hydropsyche
Siphonurus	Archilestes	Parapsyche
Hemiptera	Archilestes grandis	Smicridea
Belostomatidae	Libellulidae	Hydroptilidae
Lethocerus	Libellula	Hydroptila
Corixidae	Paltothemis lineatipes	Leucotrichia
Neocorixa	Pantala flavescens	Neotrichia
Gerridae	Tramea	Lepidostomatidae
Aquarius	Plecoptera	Lepidostoma
Gerris	Capniidae	Lepidostoma subgenus
Naucoridae	Mesocapnia	neodinarthrum
Ambrysus	Utacapnia	Leptoceridae
Ambrysus mormon	Chloroperlidae	Oecetis
Notonectidae	Suwallia	Trienodes
Notonecta	Sweltsa	Ylodes
Notonecta kirbyi	Leuctridae	Limnephilidae
Notonecta undulata	Nemouridae	Amphicosmoecus canax
Veliidae	Amphinemura	Dicosmoecus
Microvelia	Malenka	Hesperophylax
Rhagovelia	Prostoia	Limnephilus
Rhagovelia distincta	Zapada	Onocosmoecus
Rhagovelia obesa	Perlidae	Philopotamidae
Lepidoptera	Calineuria	Chimarra
Pyalidae	Hesperoperla pacifica	Dolophilodes
Petrophila	Perlodidae	Wormaldia
Megaloptera	Isogenoides	Psychomyiidae
Corydalidae	Isogenoides zionensis	Tinodes
Corydalus cognata	Isoperla	Rhyacophilidae
Sialidae	Isoperla longiseta	Rhyacophila
Sialis	Megarcys	Sericostomatidae
Odonata	Megarcys signata	Gumaga
Aeshnidae	Skwala	Uenoidae
Aeshna	Pteronarcyidae	Neophylax
Aeshna umbrosa	Pteronarcella	Neothremma
Anax walsinghami	Pteronarcella badia	Oligophlebodes
Calopterygidae	Pteronarcys californica	Mollusca
Hetaerina	Taeniopterygidae	Bivalvia
Hetaerina americana	Taenionema	Veneroidea
Coenagrionidae	Taenionema pacificum	Pisidiidae
Argia	Trichoptera	Pisidium
Argia plana	Brachycentridae	Gastropoda
Argia vivida	Amiocentrus	Basommatophora

Ancylidae  
Ferrissia  
Lymnaeidae  
Fossaria  
Radix  
Physidae

Physella  
Planorbidae  
Gyraulus  
Pleuroceridae  
Juga  
Mesogastropoda

Hydrobiidae  
Nemata  
Nematomorpha  
Platyhelminthes  
Turbellaria

Appendix 1F. List of taxa collected in tinajas within and adjacent to the Grand Staircase - Escalante National Monument.

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Annelida	Elmidae	Naucoridae
Hirudinea	Microcyloepus pusillus	Ambrysus mormon
Oligochaeta	Gyrinidae	Notonectidae
Arthropoda	Dineutus	Notonecta
Arachnida	Gyrinus	Notonecta kirbyi
Trombidiformes	Helophoridae	Veliidae
Crustacea	Helophorus	Lepidoptera
Anostraca	Hydraenidae	Odonata
Branchinectidae	Ochthebius	Aeshnidae
Branchinecta packardi	Hydrophilidae	Aeshna umbrosa
Calanoida	Berosus	Anax walsinghami
Diaptomidae	Paracymus	Coenagrionidae
Diaptomus	Tropisternus	Enallagma
Cladocera	Staphylinidae	Lestidae
Bosminidae	Diptera	Archilestes
Bosmina longirostris	Ceratopogonidae	Archilestes grandis
Chydoridae	Bezzia	Lestes
Daphnidae	Culicoides	Libellulidae
Daphnia	Dasyhelea	Libellula saturata
Daphnia pulex	Probezzia	Trichoptera
Daphniidae	Chironomidae	Brachycentridae
Ceriodaphnia	Chironominae	Brachycentrus
Ceriodaphnia	Orthoclaadiinae	Micrasema
quadrangula	Tanypodinae	Helicopsychidae
Copepoda	Culicidae	Helicopsyche borealis
Cyclopoida	Culex	Hydropsychidae
Cyclopidae	Culiseta	Hydropsyche
Notostraca	Ephydriidae	Limnephilidae
Triopsidae	Simuliidae	Limnephilus
Triops longicaudatus	Simulium	Mollusca
Ostracoda	Tabanidae	Gastropoda
Entognatha	Tabanus	Basommatophora
Collembola	Tipulidae	Physidae
Insecta	Dicranota	Physella
Coleoptera	Tipula	Nemata
Dryopidae	Ephemeroptera	Nematomorpha
Helichus	Baetidae	Platyhelminthes
Dytiscidae	Baetis tricaudatus	Turbellaria
Agabus	Callibaetis	Vertebrata
Coptotomus	Heptageniidae	Amphibia
Deronectes	Hemiptera	Anura
Hygrotus	Corixidae	Bufonidae
Laccophilus	Corisella	Bufo woodhousii
Neoclypeodytes	Graptocorixa	Pelobatidae
Oreodytes	Neocorixa	Spea intermontana
Rhantus	Gerridae	
Rhantus gutticollis	Aquarius	
Stictiotarsus	Gerris	

**Appendix 2.** Aquatic invertebrate sampling locations. Station notations with BLM and NPS designations were sites sampled by BLM personnel in Escalante and National Park Service personnel from the Glen Canyon National Recreation Area. These samples were processed by the BugLab, Logan, Utah.

Station	Location	Latitude	Longitude	Elevation (m)
ES-001	Escalante River near Escalante Cemetery trailhead	37.776	111.579	1737
ES-002	Tinaja, down drainage from HWY 12 below overlook	37.754	111.443	1737
ES-003	Vinson Creek, trib to Deer Creek, off Burr Trail	37.848	111.374	1707
ES-004	Deer Creek, downstream from campground	37.855	111.355	1646
ES-005	Steep Creek at mouth	37.864	111.312	1567
ES-006	Gulch Creek upstream from Burr Trail bridge	37.865	111.313	1579
ES-007	Calf Creek, just downstream from upper falls	37.855	111.451	1676
ES-008	Tinaja, near Phipp's pictographs	37.759	111.419	1524
ES-009	Calf Creek, at mouth	37.776	111.419	1439
ES-010	Deer Creek, below tributary ES-003	37.838	111.367	1701
ES-011	Tinaja near Deer Creek	37.838	111.366	1777
ES-012	Tinaja between Hwy 12 and Boulder Creek	37.810	111.400	1679
ES-013	Tinaja between Hwy 12 and Boulder Creek	37.809	111.397	1747
ES-014	Tinaja between Hwy 12 and Boulder Creek	37.809	111.396	1630
ES-015	Boulder Creek, off Hwy 12 near Calf Creek CG	37.812	111.394	
ES-016	Little Death Hollow Creek midway down	37.759	111.215	1765
ES-017	Tinaja near Highway 12, down drainage from ES-002	37.749	111.444	1860
ES-018	Tinaja near Highway 12, down drainage from ES-018	37.750	111.444	1878
ES-019	Alcove pool downstream from upper Calf Creek Falls	37.854	111.451	1420
ES-020	Tenmile Creek	37.680	111.485	
ES-021	Alvey's Wash Creek	37.719	111.629	1675
ES-022	Upper Alvey Wash Creek	37.695	111.631	1933
ES-023	North Creek	37.778	111.708	1910
ES-024	Birch Creek	37.764	111.696	1910
ES-025	Escalante River at Birch Creek and North Creek	37.765	111.684	1882
ES-026	No-name Reservoir off Pine Creek Road	37.805	111.601	1868
ES-027	Pine Creek below lower box trailhead	37.816	111.608	1720
ES-028	Upper Valley Creek, west of Escalante	37.747	111.703	1720
ES-029	Harris Wash Creek near trailhead	37.634	111.341	1720
ES-030	Un-Named Creek between Sand and Mamie Creeks	37.777	111.473	1720
ES-031	Mamie Creek at mouth	37.781	111.505	1720
ES-032	Escalante River upstream from Mamie Creek	37.781	111.523	1720
ES-033	Tinaja near Escalante River, between Mamie & Sand	37.778	111.495	1720
ES-034	Sand Creek at mouth	37.775	111.458	1720
ES-035	Spring near Sand Creek	37.776	111.459	
ES-036	Lake Creek	37.923	111.524	2097
ES-037	Tinaja upstream from upper Calf Creek Falls	37.867	111.462	1853
ES-038	Calf Creek at source	37.866	111.462	1701
ES-039	Calf Creek above upper falls	37.854	111.453	1798
ES-040	Tinaja south of Deer Creek, west of The Gulch	37.821	111.343	1695
ES-041	Tinaja south of Deer Creek, west of The Gulch	37.819	111.342	1707
ES-044	Coyote Gulch downstream from Hamblin Arch	37.420	111.040	1274
ES-045	Seep in Coyote Gulch	37.422	111.003	1158
ES-046	Coyote Gulch at mouth	37.428	111.981	1122

Station	Location	Latitude	Longitude	Elevation (m)
ES-047	Harris Wash, 0.5 near NRA boundary	37.642	111.290	1494
ES-048	Harris Wash - Upper	37.637	111.319	1506
ES-049	The Gulch at mouth	37.725	111.296	1512
ES-050	Escalante River upstream from Harris Wash	37.663	111.215	1390
ES-051	Harris Wash at mouth	37.663	111.215	1390
ES-052	Escalante River at bridge north of Escalante town	37.776	111.593	1768
ES-053	Pleasant Creek at Pleasant Creek campground	38.102	111.336	2670
ES-054	Wetland off Burr Trail, trib to Vinson Creek	37.860	111.381	1807
ES-055	Tinaja West of McGath Point	37.835	111.465	1945
ES-056	Tinaja below Early Weed Bench	37.541	111.186	1433
ES-057	Tinaja East of Haymaker Bench	37.790	111.392	1719
ES-060	Cat Well	37.486	111.253	1524
ES-061	Orins Well	37.456	111.236	1520
ES-062	Tinaja at Dance Hall Rock	37.360	111.097	1537
ES-063	Ampitheater Tinaja at Dance Hall Rock	37.357	111.101	1512
ES-064	Seep to Forty Mile Creek	37.342	111.018	1150
ES-065	Hidden Falls Pool in Forty Mile Creek	37.343	111.014	1124
ES-066	Spring off Forty Mile Creek	37.344	111.014	1176
ES-067	Forty Mile Creek	37.342	111.006	1176
ES-068	Seep at Fifty Mile Creek, 4 mi. from Cave Pt. TH	37.317	110.976	1184
ES-069	Fifty Mile Creek	37.320	110.962	1184
ES-070	North Creek, upstream from reservoir	37.847	111.758	2099
ES-071	Lost Creek, east of Twin Lakes	37.914	111.699	2766
ES-072	Posy Lake	37.936	111.694	2499
ES-073	Hungry Creek, 1 mile SE of Posy Lake	37.930	111.684	2687
ES-074	Deep Creek, 2 miles E of Posy Lake	37.936	111.666	2616
ES-075	Blue Spring Creek at Hell's Backbone Road	37.963	111.656	2422
ES-076	Grimes Creek near Hell's Backbone Road	37.970	111.574	2496
ES-077	Death Hollow Seep, upstream from Mail Trail	37.844	111.521	1977
ES-078	Death Hollow Creek at Boulder Mail Trail	37.844	111.521	1977
ES-079	Tinaja between Sand Creek and Death Hollow	37.860	111.492	1851
ES-080	Sand Creek upstream from Boulder Mail Trail	37.867	111.496	2008
ES-081	Lake Creek at confluence with Sand Creek	37.868	111.495	
ES-082	Sand Creek at Lake Creek confluence	37.867	111.495	1782
ES-083	Tinaja near Sand Creek mouth	37.863	111.490	1875
ES-084	Reservoir off Burr Trail	37.920	111.140	2005
ES-085	Reservoir 2 off Burr Trail Rd.	37.874	111.106	2046
ES-086	Frisky Creek near source	38.013	111.373	2754
ES-087	Upper Steep Creek	37.873	111.323	1743
ES-088	Lower Steep Creek	37.866	111.317	1701
ES-089	Water Canyon Creek	37.915	111.292	1798
ES-090	Water Canyon Creek upstream from The Gulch	37.904	111.285	1777
ES-091	Large pond off Burr trail	37.887	111.398	1859
ES-092	Small pond off Burr trail	37.894	111.406	1875
ES-093	Sheep Creek upstream from spillway	37.496	112.066	1829
ES-094	Yellow Creek upstream from old homestead	37.535	112.063	1719
ES-095	Paria River upstream from Cannonville Bridge	37.569	112.051	1768
ES-096	Pine Creek near upper trailhead	37.963	111.652	2341
ES-097	Pine Creek between upper and lower trailheads	37.934	111.643	2195
ES-098	Hungry Creek upstream from Pine Creek	37.917	111.645	2134
ES-099	Pine Creek at Lower Box Trailhead	37.864	111.635	1731



Station	Location	Latitude	Longitude	Elevation (m)
ES-100	Ribbon Canyon Alcove 1	37.255	110.842	1247
ES-101	Ribbon Canyon Hanging Garden	37.249	110.832	1247
ES-102	Ribbon Canyon Alcove 2	37.259	110.839	1247
ES-103	Bown's Canyon Alcove Pool	37.359	110.875	1170
ES-104	Bown's Canyon lower	37.374	110.878	1209
ES-105	Bown's Canyon upper	37.380	110.886	1228
ES-106	Iceberg Canyon Alcove	37.293	110.734	1140
ES-107	Iceberg Canyon Creek	37.286	110.732	1136
ES-108	Iceberg Canyon Creek, pool at head of left fork	37.295	110.704	1189
ES-109	Cottonwood Canyon Alcove	37.242	110.854	1134
ES-110	Cottonwood Canyon Seep	37.242	110.855	1131
ES-111	Death Hollow Creek, 2 mi upstream Escalante River	37.805	111.511	1707
ES-112	Death Hollow Creek, at mouth	37.782	111.505	1646
ES-113	Calf Creek, downstream from bridge, near HWY 12	37.793	111.413	1631
ES-114	Calf Creek, downstream from Lower Falls	37.829	111.419	1722
ES-115	Alcove pool near Upper Calf Creek Falls	37.815	111.418	1692
ES-116	Tinaja upstream from Upper Calf Creek Falls	37.867	111.462	1853
ES-117	Escalante River at confluence with Coyote Gulch	37.428	111.981	1122
ES-118	Lake Powell, Red Canyon	37.716	110.458	
ES-119	Escalante River above Sand Crk.	37.776	111.459	1619
ES-120	Escalante River at Hwy 12 Bridge	37.776	111.419	1521
ES-121	Boulder Creek at Hwy 12	37.901	111.437	2003
ES-122	Tinaja off trail to Upper Calf Creek Falls	37.855	111.448	1825
ES-123	Calf Creek, big pool upstream Up Calf Creek Falls	37.856	111.453	1638
ES-124	Willis Creek above Skutumpah Road	37.483	112.097	1757
ES-126	Sheep Creek below spillway	37.493	112.064	1798
ES-127	Tinaja A, between HWY 12 and Boulder Creek	37.810	111.399	1793
ES-128	Tinaja B, between HWY 12 and Boulder Creek	37.809	111.396	1762
ES-129	Tinaja C, between HWY 12 and Boulder Creek	37.810	111.396	1719
ES-129B	Tinaja D, between HWY 12 and Boulder Creek	37.810	111.396	1719
ES-130	Boulder Creek, near Calf Creek Campground	37.811	111.395	1756
ES-131	Tinaja E, between HWY 12 and Boulder Creek	37.811	111.394	1734
ES-132	Tinaja off Hwy 12 between miles 71 & 72, west side	37.752	111.445	1625
ES-133	Tinaja, updrainage of HWY 12, near mile 71-72	37.754	111.444	1710
ES-135	Escalante River at Boulder Creek confluence	37.758	111.350	1573
ES-136	Boulder Creek at confluence with Escalante River	37.758	111.350	1573
ES-137	Tinaja above Head of Calf Creek	37.867	111.461	1890
ES-138	Paria River at Highway 89	37.108	111.905	1324
ES-139	Thousand Pockets Area	36.930	111.609	1435
ES-140	Thousand Pockets Area	36.928	111.609	1429
ES-141	Thousand Pockets Area	36.928	111.606	1450
ES-142	Thousand Pockets Area	36.932	111.609	1394
ES-143	Tinaja #1 Above Tinaja A off Hwy 12	37.810	111.399	1768
ES-144	Tinaja #2 Above Tinaja A off Hwy 12	37.810	111.399	1768
ES-145	Tinaja at Upper end of Willow Patch Canyon	37.828	111.451	1750
ES-146	Willow Patch Creek	37.824	111.450	1731
ES-147	Upper Sand Creek	37.863	111.489	1865
ES-148	Tinaja along west side of McGath Bench	37.860	111.477	1932
ES-149	Cottonwood Creek	37.264	111.906	1471
ES-150	Pool at head of Stone Donkey Canyon	37.333	111.922	1609
ES-151	Stone Donkey Creek	37.333	111.922	1609

Station	Location	Latitude	Longitude	Elevation (m)
ES-152	Hackberry Creek	37.322	111.916	1585
ES-153	Hogeye Creek	37.312	111.987	1597
ES-154	Paria River at Old Pariah	37.251	111.958	1457
ES-155	Stocktank at Forty Mile Spring	37.351	111.079	1344
ES-156	Coyote Gulch at Natural Bridge			
ES-157	Last Chance Creek near Smokey Mountain Road	37.347	111.526	1509
ES-158	Stock Pond on Smokey Mountain Road	37.468	111.533	1932
ES-159	Upper Sand Creek	37.863	111.490	1878
ES-160	Sweetwater Creek	37.868	111.494	1892
ES-161	Tinaja off Sand Hollow	37.819	111.443	1825
ES-162	Tinaja West of Upper Calf Creek Falls	37.854	111.452	1873
ES-163	Cattail Tinaja	37.851	111.458	1854
ES-164	Tinaja Below Cattail Tinaja	37.851	111.458	1853
ES-BLM-001	Drip Tank Creek (Collected by Kanab BLM)			1512
ES-BLM-002	Chimney Rock Creek (Collected by Kanab BLM)			
ES-BLM-003	Brown Spring (Collected by Kanab BLM)			1890
ES-BLM-004	Cottonwood Creek (Collected by Kanab BLM)			1585
ES-BLM-005	Three Mile Creek (Collected by Kanab BLM)			2164
ES-NPS-001	Escalante River (Collected by NPS)	37.500	111.042	1262
ES-NPS-002	Escalante River (Collected by NPS)	37.333	110.917	1085
ES-NPS-SJ1	San Juan River (Collected by NPS)	37.197	109.975	1195
ES-NPS-SJ2	San Juan River (Collected by NPS)	37.195	109.982	1195
ES-NPS-SJ3	San Juan River (Collected by NPS)	37.208	109.979	1195
ES-NPS-SJ4	San Juan River (Collected by NPS)	37.212	109.981	1195